

PLANARIANS FROM THE ANDAMANS.

By TOKIO KABURAKI, of the Tokyo Imperial University.

(With I text-figure.)

This is a brief account of two new species of planarians, a freshwater and a terrestrial, from the Andamans, which were placed by the late Dr. N. Annandale in my hands for identification. To him I would like to offer my thanks for the privilege of examining the material; my thanks are also due to Marquis Y. Tokugawa for his help most generously given in his Institute.

***Planaria andamanensis*, sp. nov.**

Based upon five specimens obtained from a small jungle-stream in Ross island. The present species looks externally very much like *Planaria annandalei* described by myself from the Inlé Lake, so far as concerns the shape in the preserved state. The head is of a triangular shape and merges behind into the trunk, from which it is indistinctly marked off by a slight neck-like narrowing. The trunk dorsally convex and ventrally flat, gradually widens backwards to the region in front of the pharynx and then begins to taper slowly, to end in a bluntly pointed posterior extremity. The largest specimen measures 9 mm. long by about 2 mm. across at the pharyngeal region.

The dorsal side of the specimen is of a dark olive-like colour, which acquires a much darker tone in the median zone, leaving a somewhat paler space of an irregular contour in the pharyngeal region. The ventral surface is of a much lighter colour than the dorsal.

The two eyes are each of a crescentic form and situated at the inner border of a small oval space without pigment. Generally they occur slightly in front of a line drawn across the broadest part of the head; the distance between them is about equal to that between either of them and the lateral head margin of the same side.

Auricular sense organs are present on each side as very distinct, elongate-oval, non-pigmented spaces on the cephalic lappets.

The epidermis is, as is usual, somewhat thicker on the dorsal than on the ventral surface, and contains a number of rhabdites, evidently situated between the epidermic cells. As has been mentioned by some authorities, the rhabdites seem to be formed in the cells scattered in sparse numbers in the parenchyma just beneath the dermal musculature, such rhabdites being found there as are still contained in the cells. The dermal musculature consists of outer circular, middle diagonal and inner longitudinal fibres. Dorso-ventral fibres occur, running between gut diverticula.

The mouth lies a little behind the centre of the body, leading into the pharyngeal chamber, in which the pharynx is horizontally disposed from the front. The pharynx is of a cylindrical shape and about one-fourth as long as the body. The unpaired anterior main trunk of the

intestine extends far forwards, sending out some pairs of subdivided lateral branches, while each of the posterior trunks gives off a number of branches, those inwardly directed joining together the two trunks, as is frequently the case.

Quite similar to that of *Pl. gonocephala*, each longitudinal nerve-trunk forms anteriorly a well-developed brain-mass, those of the two sides being connected by a number of strong commissures and sending out a few forwardly directed sensory nerves and numerous lateral ones. Posteriorly the longitudinal trunks proceed, running nearly parallel to each other, to the hind end of the body, and are connected together by fine transverse commissures. Lateral nerves are given off from the main trunks usually at points opposite to the union of the latter with transverse commissures.

The genital aperture occurs near the commencement of the posterior third of the body. It leads directly into the narrow vestibulum and receives the opening of the penis-sheath in front. Both the vestibulum and the penis-sheath are lined with a single layer of epithelium of columnar cells resting upon a fine basement membrane, beneath which comes a moderately thick muscular layer.

The testes are extremely numerous and occupy a dorsal position in the body. They are arranged in two lateral zones beginning from the brain region and extending behind near the posterior end of the body. Each testis is made up, as is usual, of sperm-mother cells and spermatozoa in several stages of development, surrounded by the tunica propria. On its lower side the testis gives rise to a fine testicular canal or vas deferens, which, though not clearly made out in the sections available, may frequently unite with its mates to form a wider duct, and then take a course directed towards the vas deferens on either side, which is distinctly discernible in the pharyngeal region. The vas deferens proceeds backwards just inside the longitudinal nerve-trunk on the ventral side and rises upwards to enter the penis-bulb on the side finally to open separately into the lumen of the seminal vesicle.

The penis consists of the hemispherical bulb and the conical intro-mittent part, which is horizontally disposed in the penis-sheath. The bulbous part contains, as is the case with *Pl. burmaensis*, a relatively narrow and smooth-walled seminal vesicle, which posteriorly narrows gradually into the ejaculatory duct, opening into the penis-sheath near the tip of the penis. In its course the ejaculatory duct exhibits a slight expansion and receives throughout its length the penis-glands, which are profusely present in the body-parenchyma around the penis-bulb.

The ovaries are nearly oval in shape and are present in a pair slightly behind the brain and probably between the first and second pairs of the lateral branches of the anterior gut-trunk.

The oviduct of either side runs just along the outside of the longitudinal nerve-trunk, receiving at numerous points the communication of the vitelline glands, which are very extensively distributed posteriorly from the region of the ovaries and in the interstices between gut diverticula. A little behind the genital aperture it bends mediad rather abruptly, at the same time rising slightly upwards, to unite, unlike *Pl. burmaensis*, with its mate of the opposite side into a short common

duct, which opens into the vestibulum from behind near the outer end of the vaginal canal. The oviduct shows a distinct lumen in its course, its actual wall being formed by a homogeneous and ciliated layer exhibiting no nuclei at all. The nucleus-containing parts are sunk into the surrounding parenchyma, as is the case in *Pl. gonocephala*, *Dendrocoelum lacteum*, etc. The mode of connection of the vitelline glands with the oviduct is quite similar to that found in *Pl. annandalei*, *gonocephala*, *polychroa* and some others, being effected by means of a pyriform or spherical giant cell.

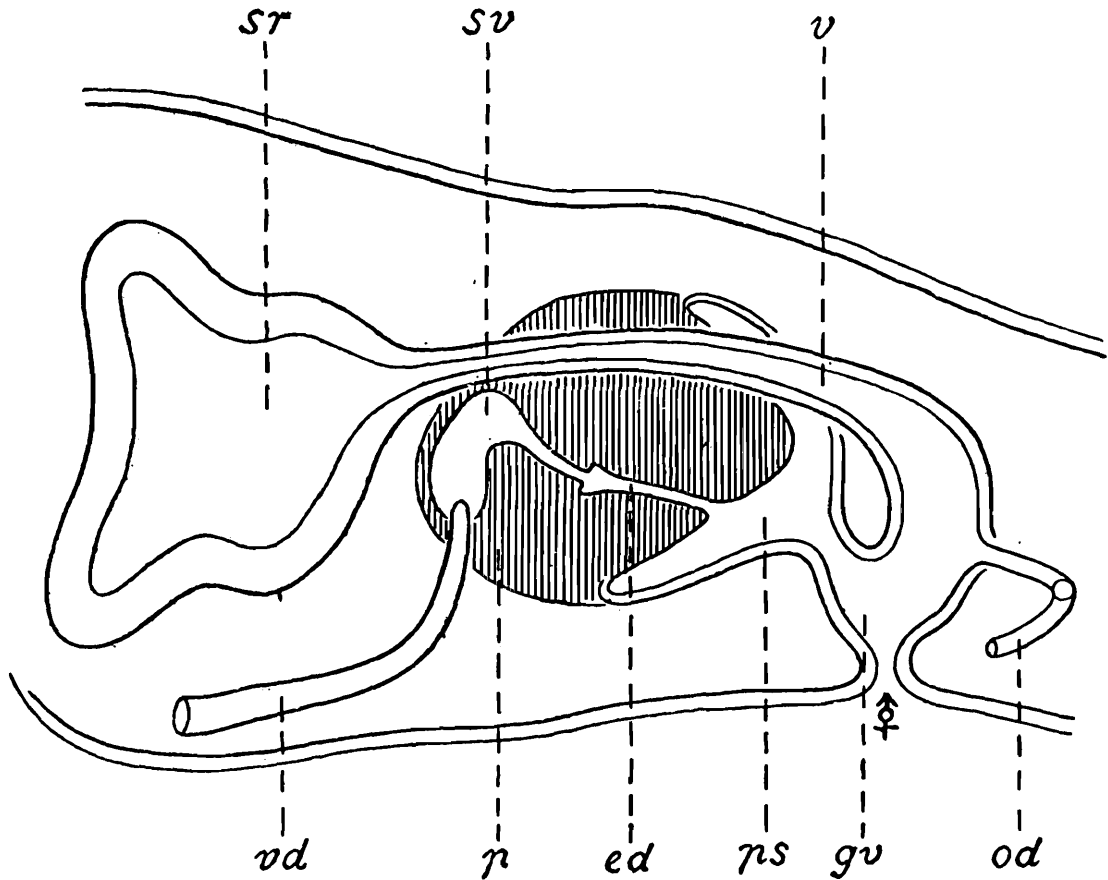


Diagram of genital organs of *Planaria andamanensis* in sagittal section.
 ed. ejaculatory duct, gv. genital vestibulum, od. oviduct, p. penis, ps.
 penis-sheath, sr. seminal receptacle, sv. seminal vesicle, v. vagina, vd.
 vas deferens, ♀. genital pore.

The seminal receptacle is a moderately large sac-like organ lying between the pharyngeal chamber and the penis. Its wall is made up of an epithelium of large columnar cells of a glandular nature, resting upon a delicate basement membrane, beneath which is a very feeble muscular layer. At its postero-superior aspect the receptacle gives rise to the vaginal canal, which runs backwards, passing dorsally to the left of the penis and then dips below to open into the vestibulum. The vagina is internally lined with an epithelium of columnar cells resting on a fine basement membrane. Just external to it is a thin muscular coating.

***Bipalium vinosum*, sp. nov.**

This species is represented by only one specimen which was unfortunately preserved in an imperfect state and presents an aspect closely similar to von Graff's *Bipalium claparèdei* and *simplex*, both from the

islands of Sunda and Java, though differing in some respects from either of them, as will be mentioned below.

Somewhat distinctly marked off from the trunk by a neck-like narrowing is the head, which is, as in *Bip. simplex*, of a small semilunar shape and a little narrower than the broadest part of the body, measuring about 3 mm. Its lobes are a great deal smaller than those of *Bip. claparèdei*. The trunk, which is convex dorsally and flat ventrally, is almost uniformly broad for the greater part of its length, though it gradually tapers for some little distance from the posterior end to a rather pointed extremity. Along the mid-ventral line runs the slender creeping sole, which is scarcely raised above the general surface and a great deal narrower than one-fourth as wide as the trunk, differing from that found in *Bip. simplex*. In this form the sole is about one-third as broad as the trunk and longitudinally divided by a slight median groove. The example before me measures 52 mm. long by 4 mm. across the broadest part of the body. The mouth-opening lies on the sole near the commencement of the middle fifth of the body. The present form, though about twice as large as *Bip. claparèdei* and *simplex*, is still sexually immature.

The posterior half of the body is in spirit of a uniform vinous red colour on the dorsal surface, which gradually fades forwards from the pharyngeal region into a pale buff. No trace of marking is found on the head lobe. The ventral surface is similar but, though much lighter than the dorsal, is pale yellow anteriorly and reddish posteriorly. As is usual, the lower surface is of a much lighter colour.

A number of small eye-spots are arranged in one or two rows along the margin of the head, exclusive of the lobe where they occur in scattered distribution. At the sides of the neck they are much more closely approximated than on the head, extending to the dorsal surface and forming a comparatively large black patch on each side. In this respect the present form is widely different from *Bip. simplex*, in which some eye-spots form ventrally a crowded tract at the sides of the neck. No eye-spots are found extending farther back along the sides of the trunk.

THE FRESHWATER FISH FROM THE ANDAMAN ISLANDS.

By the late N. ANNANDALE, D.Sc., F.A.S.B., C.I.E., AND SUNDER LAL
HORA, D. Sc., Officiating Superintendent, Zoological Survey of India.

(Plate II.)

INTRODUCTION.

Our knowledge of the fishes of the Andamans (apart from deep-sea forms) is derived from three papers published many years ago, two by Blyth¹ and one by Day.² Neither author gave particulars as to the environment in which the different species were found, and neither, so far as can be ascertained, discussed the forms found in rapid-running water in the smaller streams. We have here to record or describe several species from this type of environment, and we take the opportunity also of giving certain particulars about the interesting genus named *Andamia* by Blyth. We have no direct information as to the circumstances in which this peculiar fish lives, and the only specimens we have examined are those originally described by Blyth (1858). From the structure of *Andamia*, however, it is clearly adapted to affix itself to stones or other objects in rapid-running water. In its structural modifications it resembles certain torrential forms very closely, but it is possibly an inhabitant of the surf-line.

Omitting *Andamia*, we have here to consider only five species, specimens of which were recently collected by one of us in streams on the lower slopes or at the base of the jungle-clad hills of South Andaman. The conditions of life in these streams are very similar to those in the smaller streams at the base of the Nilgiris or the Western Ghats in Southern India. At first sight, as seen in their natural environment, the fish seem very similar also. The little gobies of the genus *Sicyopterus*, which abound in the Andaman streams, were actually mistaken when first seen for some small species of the genus *Garra*, while the much larger *Ophiocara ophiocephalus* was thought to be a larger form of the same or an allied genus; but these Andaman fish both belong to the order Gobiodea, whereas *Garra* is in most respects a typical Cyprinoid.

The habits of *Sicyopterus garra* are closely similar to those of such species as *Garra rupiculus* from Assam, though the structures by means of which, directly or indirectly, the two fish obtain their food, are quite different. Both species cling to rocks in rapid-running water by means of a ventral sucker, and both feed by scraping organic matter, mainly minute algae, from the surface of the rocks to which they adhere. In

¹ Blyth, Report of Curator, Zoological Department, for May 1858. *Journ. As. Soc. Bengal* XXVII, pp. 270-272 (1858). Report on some Fishes received chiefly from the Sitang River and its Tributary Streams, Tenasserim Provinces. *Journ. As. Soc. Bengal* XXIX, pp. 145-147 (1860).

² Day, On the Fishes of the Andaman Islands. *Proc. Zool. Soc. London*, pp. 677-705 (1870).

the Andamans the rocky bed of the hill streams examined is covered by a thin film of deposited silt. This *Sicyopterus* clears away, probably by means of its fringed lips, and then, clinging tight by its ventral fins, which are joined together and transformed into a cup-like sucker, it scrapes off the algae with a pair of horny pads on its lower jaw assisted probably by its strong canine teeth. The upper lip is pendant and fringed, it is probably of use in preventing the escape of particles scraped from the rock. The smaller species of *Garra* which live in hill streams behave in exactly the same way, but the sucker by which they adhere to the rocks is a special tegumentary organ and there are no teeth. There is, however, a veil-like structure over the upper jaw—it is not the true upper lip—which prevents the escape of particles which have been removed by the horny ridge on the lower jaw.

Ophiocara ophiocephalus is not so highly modified as *Sicyopterus garra* and might be mistaken if not observed in its natural haunts for a surface fish. The shape of its head, indeed, recalls that of *Panchax panchax*, which is apparently the only fish of wide range in fresh water which occurs in the Andaman streams, and *P. panchax* is essentially a surface form, only descending from the surface when alarmed. The ventral fins of *O. ophiocephalus* are not united and do not form a sucker, but they are used for clinging to rocks almost like a pair of hands, and the fish rarely rises to the surface. It cannot, however, scrape matter from the rocks and must with its up-turned lower jaw be dependent on food which reaches it from above. It is probably predaceous and catches insect larvae, etc., as they sink down to the bottom after rising through the water.

No special observations were made on the habits of *Doryichthys insularis*, the fifth species in our collection. It was found among weeds in little backwaters of the streams, where it was apparently common.

The geographical relations of the freshwater fish of oceanic islands are always interesting. Of the five species from the Andamans discussed here two have a very wide range on the coasts and islands of the Indian ocean, one (*O. ophiocephalus*) being found as far afield as the east coast of Africa. These are both estuarine forms of great physiological adaptability. *Panchax panchax*, on the other hand, the distribution of which extends from the eastern part of Peninsular India to the Sunda Islands and Siam, is mainly a freshwater fish but not uncommonly occurs in brackish or even salt water.

The remaining two species are described as new, one belonging to the family Gobiidae and the genus *Sicyopterus*. This genus is found on the coast and even in the streams of many parts of the Indian Ocean and in the warmer region of the Atlantic and the Pacific. Although it occurs on the mainland in certain places, most of its species are insular. The other new species belongs to the family Syngnathidae and the genus *Doryichthys*, which is also a genus of wide geographical range, with most of its species Indo-Pacific. They are found both in fresh and brackish water in rivers and their estuaries.

Our knowledge of the freshwater fishes of the Andamans is still far from complete, but we have no evidence that any of the Cyprinoidea or of the true fluviatile Siluroidea occur in the small streams of these

islands.¹ The Ophiocephalidae are apparently absent also, as indeed are all the true fluviatile families except the Cyprinodontidae and the Syngnathidae, both of which have exceptional powers of accommodating themselves to peculiar conditions of salinity in water in which they live.

The stream-fauna of the Andamans, therefore, at any rate so far as the fish are concerned, is evidently of very recent origin and is, indeed, not a true freshwater fauna at all, but consists mainly of adaptable marine species. So far as we know, the only genera not strictly marine which have established themselves naturally in freshwater on the island are those which are physiologically adaptable in an exceptional degree. There is nothing in the physical conditions adverse to the Cyprinidae or the Ophiocephalidae, for members of both of these families have been introduced into ponds in the neighbourhood of Port Blair and at other places and are doing well and apparently breeding, though more precise information as to their apparent increase in number would be desirable.

It is clear, therefore, that the fluviatile fish-fauna of the Andamans has been derived from the surrounding sea rather than from any other territory.

SYSTEMATIC ACCOUNT OF THE COLLECTION.

***Sicyopterus garra* Hora, sp. nov.**

(Plate II, figs. 2-5.)

D. 6, 7 | 1/11 ; P. 18 ; V. 1/5 ; A. 1/10 ; C. 15+ ; L. l. 64 ; L. tr. 15.

This is a strongly built subcylindrical species with a characteristic facies resembling very much that of the fishes of the genus *Garra*.² The head is broader than high and its length is contained about 4 times in the length of the fish without the caudal. The height of the body is five-sixths of the length of the head. The eye is situated almost in the middle of the length of the head and its diameter is contained 3·8 times in the length of the head. The interorbital is flat and is 1·6 times the diameter of the eye. The upper margins of the eyes project slightly beyond the dorsal profile of the head. The snout is obtuse and rounded. The mouth is on the under surface slightly behind the tip of the snout and is overhung by a loose, fimbriated, membranous fold of the skin, which is continued with the lower lip at the angle of the mouth. The lower jaw is provided with a sharp horny covering probably for rasping off algal slime from rocks and stones. This horny covering is divided in the middle. The maxilla scarcely reaches to below the middle of the eye. In the upper jaw there is a single moveable row of small teeth embedded in the gum, while in the lower jaw a large

¹ The chief Cyprinid introduced is *Labeo rohita*, but other, smaller species of the same family, and possibly certain Siluroidea have been brought with it from the neighbourhood of Calcutta. The fish were taken to the islands as what are locally called "finger-lings," that is to say a fry about an inch or two in length and in these circumstances little discrimination of species is usually made.

² Hora, *Rec. Ind. Mus.* XXII, pp. 633-687, pls. xxiv-xxvi (1921).

recurved canine is present on either side of the symphysis besides a row of smaller teeth internally. The teeth in the upper jaw are tricuspid, all the cusps lying in one plane which is at right angle to the long axis of the tooth. The three cusps are equal and when the whole of the tooth band is subjected to a great magnification, the teeth appear unicuspid, the other cusps being hidden beneath the outer cusp. The gill-openings are vertical and do not extend to below the base of the pectoral fin.

The spines of the first dorsal are rarely filamentous and extend only slightly beyond the membrane. In one example (figured) the second spine is very long and filamentous and is longer than the depth of the body below it. The first and second branched rays of the second dorsal are the longest, but they are not as high as the depth of the body below them. The pectoral is slightly longer than the head. The ventrals form a complete disc and are separated from the anal by a distance slightly greater than their length. The anal and the second dorsal are almost of equal extent and commence at the same level anteriorly. The anal is not as high as the dorsal. The caudal is somewhat shorter than the head and is rounded or subtruncate posteriorly.

The scales are small and regularly arranged, those behind the first dorsal are all equal and strongly ctenoid. Anteriorly they become smaller and their posterior ciliated margins become less marked. The scales are continued as far forwards as the eyes, those on the sides of the abdomen are also greatly reduced and it appears that in the region just behind the ventrals they are totally absent.

The general colour in spirit is leaden gray and this effect is produced by numerous blackish dots on a yellowish white basis. There are several indistinct pale vertical bars on the body. The ventral surface of the body is dirty white. The fins are grayish with black dots, the dorsal and the anal have the distal part of the membrane infuscated particularly in the posterior region, but the rays are whitish except the elongated ray in the first dorsal, which is also infuscated.

Sicyopterus garra is the third species to be described from within the limits of the Indian Empire. The first two were described by Day,¹ one from Burma and the other from Ceylon. Unfortunately no specimens of the earlier Indian species exist in the collection of the Indian Museum and in separating the new species from these two I had to rely on their published descriptions and figures. *S. garra* is readily distinguished in having a fringed upper lip; from *S. fasciatus* it is further distinguished by the character of its first dorsal and from *S. halei* in having much longer pectorals as compared with the length of the head. The three species in all other respects seem to be closely related to one another.

There are altogether 8 specimens of this species in the collection, two were obtained in a small stream near Birchgunge, S. Andaman, while the remaining were netted in a streamlet flowing out of the reservoir at the base of Mount Harriet. In both the streams water was running rapidly over a rocky or pebbly bed.

¹ Day, *Fish. India*, p. 299, pl. lxiv, fig. 7; Suppl., p. 796 (1876-1888).

Measurements in millimetres.

Total length without caudal	...	...	...	...	24.3
Length of head	...	...	...	...	6.1
Length of snout	...	...	...	...	2.3
Diameter of eye	...	...	...	...	1.6
Interorbital width	...	...	...	...	2.6
Height of body	...	...	...	...	5.1
Length of pectoral	...	...	...	...	6.5
Length of caudal	...	...	...	...	5.6

Ophiocara ophiocephalus (Kuhl. & v. Hass.).

1870. *Eleotris ophiocephalus*, Day, *Proc. Zool. Soc. London*, p. 694.

1878. *Eleotris ophiocephalus*, Day, *Fish. tumifrons India*, p. 312, pl. lxvii, fig. 2.

The synonymy of this species still seems to us doubtful. Day in the Supplement to the Fishes of India (1888, p. 795) called it *Eleotris tumifrons* but in Cuvier and Valenciennes' original description of that species the top of the head is said to be "bombé entre les yeux."¹ This description cannot apply either to our specimens or to those named *ophiocephalus* by Day, for the surface between the eyes is actually concave in some individuals and quite flat in others. The natural colouration is very striking. The whole of the upper surface is suffused with dark blue and the other markings have the same colour. There are two or three radiating lines on the side of the head behind the eye, a conspicuous T-shaped mark at the base of the pectoral fin and an irregular mid-lateral stripe with much narrower and less complete stripe or series of spots below it. The fins are bluish gray.

Six young and half-grown specimens of this species were obtained in a streamlet flowing out of the reservoir at the base of Mount Harriet.

Ophiocara ophiocephalus is found along the eastern coast of Africa, in the Andamans and the Malay Archipelago.

Eleotris fusca (Bl. & Schn.)

1870. *Eleotris fusca*, Day, *op. cit.*, p. 694.

1870. *Electris fusca*, Day, *op. cit.*, p. 313, pl. lxv, fig. 7.

This species is common in small streams in South Andaman, both close to the sea and at some miles from it.

Eleotris fusca is found along the coasts of India and its range extends to the Malay Archipelago.

Panchax panchax (Ham. Buch.)

1870. *Haplachilus panchax*, Day, *op. cit.*, p. 700.

1922. *Panchax panchax*, Weber and Beaufort, *Fish. Indo-Austral. Archipel.* IV, p. 374, figs. 96, 97.

This species is common in the quieter parts of jungle-streams in South Andaman. It does not appear to have been introduced artificially as its occurrence in the Andamans was mentioned by Day in 1870.

The species has a wide distribution in eastern Peninsular India as far south as the Chilka Lake, in Assam, Burma, Siam, the Malay Peninsula and the Sunda Islands.

¹ Cuvier and Valenciennes, *Hist. Nat. Poiss.* XII, p. 241 (1837).

Doryichthys insularis Hora, sp. nov.

(Plate II, fig. 1.)

D. 34-35 ; A. 3 ; P. 18 ; C. 9 ; Rings 18+31 ; subdorsal rings 1+7.

It is a narrow, elongated, slender species, in which the length of the head is contained 8.4 to 9 times in the total length of the fish. The snout is slightly shorter than the remaining part of the head and the eye is situated distinctly nearer to the posterior margin of the operculum than to the tip of the snout ; its diameter is contained about 6.4 times in the length of the head. The greatest body height is equal to half the length of the head excluding the snout.

The shields are finely striated transversely and their edges minutely serrated in half-grown examples. The edges appear to be quite smooth in young individuals. The inferior cristae of trunk and tail are discontinuous, while the median cristae of trunk are continuous with the inferior cristae of tail. The superior cristae of trunk are continued to the end of the dorsal while the superior cristae of the tail are continued as far forwards as the commencement of the dorsal. The operculum is provided with a complete, longitudinal, rectilinear keel, while one or two of shorter length, but of a similar nature, are situated close below it. The snout is also provided with as many as eight longitudinal keels. The nuchal crista runs in the middle of the dorsal surface of the head from behind the eyes to as far backwards as the pectorals. In none of the specimens examined is the brood-pouch formed.

The colour in spirit is very characteristic of the species and shows some variations with age. In young individuals it is grayish white mottled with black on the sides of the tail and body, towards the anterior extremity of the latter the markings become more definite and a dark irregular band appears above the middle line with a series of more or less well-defined white spots below it. The dark band is continued as a more definite streak on the post-orbital part of the head. The snout is mottled. In the adult all these markings become of a more definite nature. The dorsal surface is yellowish white with numerous black dots, and the ventral surface is paler but is also provided with black dots. Sometimes a series of round black spots is present in the middle line of the anterior part of the body. The fins are grayish white.

Six specimens of the new species were obtained from among small patches of *Potamogeton* at the edge of a pool in a small stream running rapidly over a pebbly bed through fairly open country at Birchgunge, S. Andaman.

Doryichthys insularis is closely allied to *D. retzii* (Bleeker)¹ ; but differs from it in not having prolonged rays in the caudal, in the forward extension of the superior cristae of the tail, in colouration and proportions.

¹ Weber and Beaufort, *Fish. Indo-Austral. Archipel.* IV, p. 52 (1922).

Measurements in millimetres.

Total length including caudal	...	...	...	81.4	97.0
Length of head	...	...	...	9.6	10.7
Length of snout	...	...	...	4.4	5.0
Diameter of eye	...	...	...	1.5	1.9
Length of head and trunk	...	...	...	37.0	43.5
Length of tail region	...	...	...	44.4	53.5
Height of body	...	...	...	2.5	2.8
Length of caudal	...	...	...	3.6	4.0

A SHORT NOTE ON *Andamia heteroptera* (BLEEKER).***Andamia heteroptera* (Bleeker).**

(Plate II, fig. 6.)

1857. *Salarias heteropterus*, Bleeker, *Act. Soc. Sci. Indo-Neerl.* II, pp. 65, 66 (Amboina).
 1857. *Salarias heteropterus*, Bleeker, *Nat. Tijdschr. Ned. Ind.* XIII, p. 372.
 1858. *Andamia expansa*, Blyth, *Journ. As. Soc. Bengal*, XXVII, p. 271.
 1861. *Salarias aequipinnis*, Günther, *Cat. Fish. Brit. Mus.* III, p. 253.
 1861. *Andamia expansa*, Günther, *Cat. Fish. Brit. Mus.* III, p. 294.
 1869. *Andamia expansa*, Day, *Proc. Zool. Soc. London*, p. 518.
 1878. *Andamia expansa*, Day, *Fish. India*, p. 336, pl. lxxi, fig. 2.
 1889. *Andamia heteroptera*, Day, *Faun. Brit. Ind. Fish.* II, p. 323, fig. 104.

A paratype of *Andamia expansa* Blyth was sent to Mr. J. R. Norman of the British Museum for comparison with the specimens of Günther's *Salarias aequipinnis* and of Bleeker's *S. heteropterus*. He has very kindly favoured us with the following report :—" I have examined 6 specimens of this species (*Andamia expansa*), and the types of *Salarias aequipinnis*, but unfortunately we have no examples of Bleeker's *S. heteropterus*. The principal measurements, etc., of the different specimens are given below, the depth of the body and length of head being taken into the length (without caudal) as usual. As far as I am able to judge, *Andamia expansa* is certainly synonymous with *Salarias aequipinnis*, and from Bleeker's description I should think it very probable that *S. heteropterus* also pertains to the same species."

The following are the measurements sent to us by Mr. Norman :—

			Port Blair (Day) 3 specimens.	Andamans (Day) 3 specimens.	<i>S. aequi- pinnis</i> , 2 spe- cimens.
Depth of body	...	...	8½—9	8½—8¾	8¾—9
Length of head	...	...	5½—5¾	5¾—6	5¾—5¾
Diameter of eye	...	...	3½—4	4½	4
Length of pectoral (in body)	...	...	5½—5½	5½—5¾	5¾
Dorsal rays	...	...	XVI 18-19	XVI 19	XV-XVI 18-19
Anal rays	...	...	24-26	25	25
Caudal rays	...	...	12-13	13	12-13
Pectoral rays	...	...	15	14-15	15
Total length	...	...	60-77mm.	45-67mm.	60-70mm.

There appears to be a certain amount of confusion regarding the systematic position of Blyth's genus *Andamia*. Jordan¹ in his recent work

¹ Jordan, A Classification of Fishes. *Stanford University Publications. University Series. Biological Sciences* III, No. 2, p. 233 (1923).

on the classification of Fishes places *Andamia* in his family Runulidae, which he defines as "A group of naked blennies with the mouth small, transverse and inferior." He confesses, however, that the members of this family are "perhaps not related one to another." *Andamia*, whatever be the status of the other genera of "Runulidae," does not conform to Jordan's definition for its mouth though transverse and inferior is by no means small. We see no reason for regarding Blyth's genus as anything but an abnormal and highly modified Blennid.

Bleeker's species of the interesting genus *Andamia* is long and slender and is, as has already been pointed out, well adapted for life in rapid-running water. The head and the anterior part of the body are greatly depressed and the under surface in this region is almost flat. The mouth is on the under surface of the head slightly behind the tip of the snout; the lips are fleshy and well developed; they are continuous at the angle of the mouth, being joined together by broad integumentary folds. The upper lip is minutely fringed and pendant, it projects considerably beyond the upper jaw and conceals the teeth within its fold. The lower lip appears to be free from its jaw and is coarsely fringed. Behind the lower lip is an adhesive sucker formed by a modification of the skin and closely resembles the disc on the belly of the tadpoles of the *Ranaeformosae* in general structure. In *Andamia*, the sucker is not operated by the bones of the hyoid apparatus as in *Garra* or attached to the vertebral column as in the tadpoles, but moves in correlation with the mandible with which it is closely connected. Unfortunately the exact nature of the connection is not altogether clear in the material examined. Neither the free marginal portions of the disc nor the lower or the upper lip are apparently provided with papillae, but the histology of the whole structure is difficult to study as the specimens have been preserved for about three-quarters of a century. It may, however, be pointed out that even in young specimens about 26 mm. in total length the disc is as fully formed as in older examples. The teeth in both the jaws are small and pointed and are arranged in a regular linear series on a somewhat raised ridge. So far as can be seen, they appear to be quite efficient in rasping off algal slime from rocks and stones.

Other structures that exhibit modifications are the paired fins. The pectorals are greatly expanded and resemble in certain respects, as has been pointed out by Blyth, those of the fishes of the genus *Balitora*. Their bases are orientated in such a way that the lower portion of the fin can act as an adhesive organ and it appears probable that the under surface of some of the lower rays may have been provided with integumentary pads. The ventral fin consists of 4 rays; the two outer rays are greatly flattened and thickened and are segmented throughout their length except at the base. The two inner rays are very much like long and slender bony spines. They are entire for the greater part of their length but are segmented or jointed towards their extremities. The fin, however, must be dissected before its structure can be made out and our specimens were not sufficiently well preserved to show integumentary details. The structure of the two outer rays recalls that of the outer ray of the pectoral and ventral fins of certain species of the genus *Glyptosternum*

We believe that the ventral fin of *Andamia* is used for adhesive purposes. In most of the members of the family Blennidae the ventrals are very small and, indeed, often vestigial, but in *Andamia* these fins are specially developed, offering a clear instance of convergent evolution when considered with those of many of the fishes of hill streams. In its whole structure, indeed, *Andamia* affords a most interesting example of this phenomenon. It is probably a fish of rocks in the surf-line or of the shores of islands and is evidently modified for resistance to rapid-flowing water of marine waves.

EXPLANATION OF PLATE II.

FRESHWATER FISH FROM THE ANDAMANS.

Doryichthys insularis Hora, sp. nov.

FIG. 1.—Lateral view of type-specimen $\times 1\frac{1}{2}$.

Sicyopterus garra Hora, sp. nov.

FIG. 2.—Lateral view of type-specimen $\times 3$.

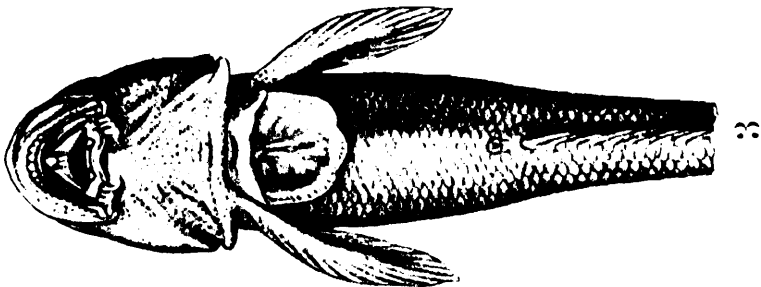
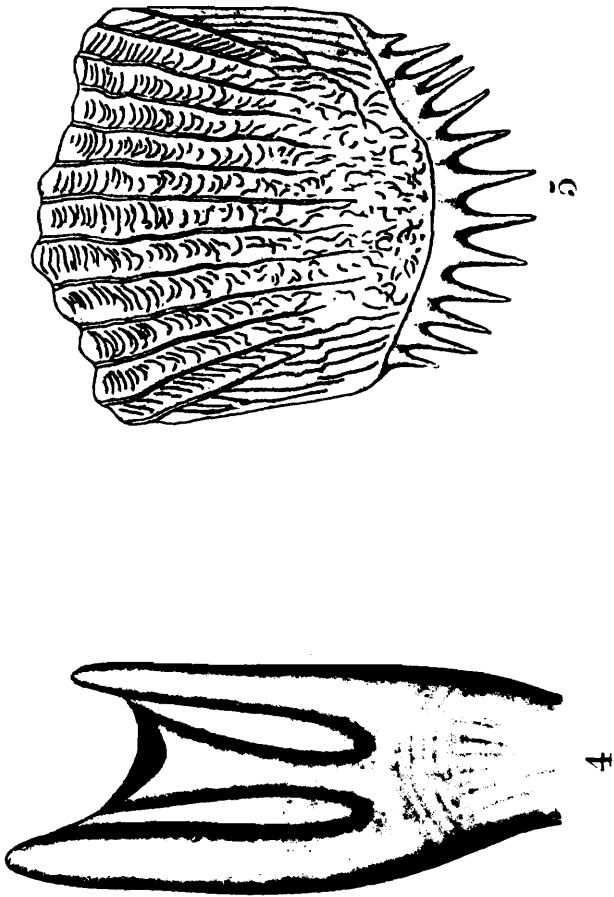
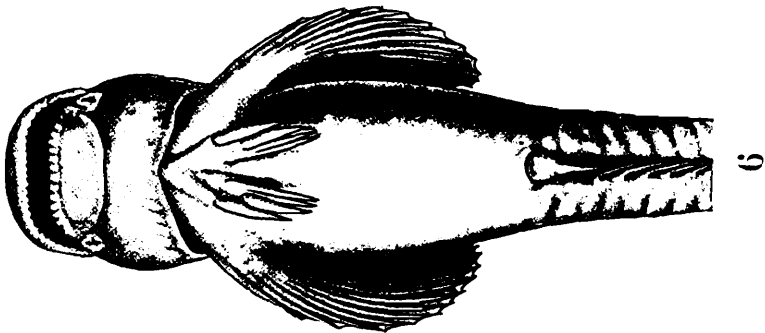
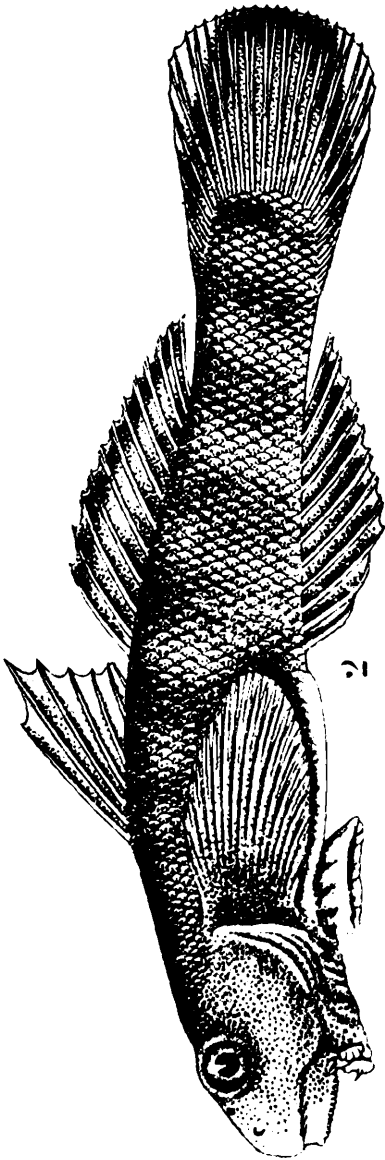
FIG. 3.—Under surface of head, body and anterior portion of tail $\times 3$.

FIG. 4.—A tricuspid tooth from the upper jaw (highly magnified).

FIG. 5.—A scale from above the lateral line (highly magnified).

Andamia heteroptera (Bleeker).

FIG. 6. —Under surface of head, body and anterior portion of tail $\times 1\frac{1}{2}$.



FISH OF THE ANDAMAN ISLANDS.

S. C. Mondul del.

ON SOME OLIGOCHAETA MAINLY FROM ASSAM, SOUTH INDIA AND THE ANDAMAN ISLANDS.

By J. STEPHENSON, M.B., D.Sc., C.I.E., Lieut.-Col., I.M.S. (ret.),
Lecturer in Zoology, Edinburgh University.

(Plates III, IV.)

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The present paper contains an account of three collections of Oligochaeta, recently received from the following sources in India :—

- (1) From the Director of the Zoological Survey of India, the late Dr. Annandale ; collected mainly in Assam and the Andaman Islands.
- (2) From the Superintendent of the Madras Museum, Dr. F. H. Gravely ; collected in S. India.
- (3) From the Government Entomologist, Coimbatore ; a few specimens collected in S. India.

I am much indebted to the gentlemen mentioned for the opportunity of examining the collections, which contain a number of interesting species.

Not less interesting, perhaps, than the new species described below is the rediscovery of *Diporochaeta pellucida*, the only Indian representative of its genus, briefly described by Bourne, without indication of locality, thirty years ago.

Family NAIDIDAE.

Genus *Nais* Müll., em. Vejd.

Nais communis Piguet var. *caeca* Steph.

Madras ; in mass of *Plumatella (Afrindella) tanganyikae*. H. S. Rao. Several specimens, but none sexual.

The prongs of the anterior ventral setae (segms. ii-v) are longer and relatively thinner than those shown in the figure accompanying

the original description (4). The forking of the dorsal needles was plainly visible only with the oil immersion ; the points diverge moderately. There was a slight stomachal swelling in segm. viii.

Genus **Pristina** Ehrbg.

Pristina synclytes, sp. nov.

(Plate III, fig. 1.)

Bangalore, Mysore ; ca. 3,000 ft. From Polyzoa covering sticks in the effluent of the activated sludge plant at the Indian Institute of Science. Several specimens, none sexual. Bred in Madras, Feb. 1924. (Madras Museum) F. H. Gravely.

The majority of the worms were *Aulophorus furcatus*, but several examples of the present species were amongst them.

These were small white worms, 5-7 mm. in length (preserved) ; in diameter they were 0.25 to 0.3 mm., diminishing to 0.14-0.17 mm. in the posterior half, the posterior portion being much thinner than the anterior. Number of segments in a chain of two, 71 ; in a specimen from which the posterior individual had been separated off, 44 ; in a single individual, 35, or in another case 61 *plus* a fairly long region in which distinct segments are not differentiated. In the last example the hinder half of the body was narrower, of equal diameter throughout, transparent, with the setal bundles at uniform intervals ; the whole 30 or 40 segments in this part seemed to have been rapidly and recently formed ; the second animal of the chain had been broken off, so that the hinder end was truncated.

$N=18, 20$, or 22 ; seven segments of the anterior end of the posterior animal are formed in the budding zone.

The prostomium is prolonged into a short proboscis, frequently broken off in part or altogether ; the proboscis (exclusive of its base, the prostomium proper) is much shorter than the diameter of the body.

There are no eyes.

The ventral setae, of the usual double-pronged type, are four per bundle anteriorly, three further back, and two in the hinder part of the body. Behind the first few segments the length is from 63 to 71μ ; the prongs are equal in length, but the proximal is about twice as thick at its base as the distal ; the nodulus is distal to the middle of the shaft, the proportions being :—distal to nodulus : proximal to nodulus : $2 : 3$ or $7 : 9$. In the first few segments the proportions of the prongs are about the same as further back, but the proximal curve of the shaft is less marked than in the more posterior setae ; the nodulus is at or very slightly proximal to the middle. There is no noticeable difference in thickness in the setae of different regions.

Thus there is only a slight difference in type between the setae of the anterior segments and those of the rest of the body,—not so marked as in many species of *Nais*, for example. The change of type takes place in this species after segment vii ; this is correlated with the fact that the anterior seven segments are formed in the budding zone. In *Nais*, where the anterior five segments are formed in the budding zone, the change in the type of the setae takes place after segm. v.

The dorsal setae begin in segm. ii. The bundles comprise one needle and one hair seta, or two needles and one hair seta, or two setae of each kind. The hair setae of segm. iii are not specially elongated. The length of the hairs increases from segm. ii backwards in the first few segments; in iv-vi they measure 290, 330, or 350 μ ,—i.e., rather more than the diameter of the body; further back they are shorter,—250 μ ,—still, however, longer than the diameter of the body in that region. There is no serration in the hair setae.

The needles are 60-82 μ long, and somewhat bayonet-shaped (fig. 1); they are bifid at the free end, with long prongs,—about 7-8 μ ,—separated by an acute angle; the prong on the inner side of the curve is slightly longer and stouter than the other. There is no perceptible nodulus.

The coelomic corpuscles are spherical, 11-13 μ in diameter, and granular.

Septal glands are present in segms. iv and v. The stomachal swelling occupies viii and part of ix; the dilatation may be slight, but the region is distinguishable by the gut wall being thicker here.

Numerous vascular loops, applied to the inner surface of the body-wall, are seen in the hinder half of the second animal of a chain of two, where they seem to arise as, at first, wide channels, which then become narrower and more definite; I did not see these loops in the anterior animals. In the anterior part of the body the vascular loops are present as far back as segm. vii, but I cannot say exactly how many there are,—I could only see distinctly those in vi and vii.

The specific name signifies “a messmate, a boon companion”; I have applied it to the present specimens since they were found living commensally with a Polyzoan.

Genus **Slavina** Vejd. em. Steph.

Slavina appendiculata (Udek.)

Andaman Is.; on *Spongilla crateriformis* var. *insularis*. N. Annandale. A single specimen, not sexual.

Genus **Aulophorus** Schmarda.

Aulophorus furcatus (Oken).

Bangalore, Mysore; ca. 3,000 ft. From Polyzoa covering sticks in the effluent of the activated sludge plant at the Indian Institute of Science. Numerous specimens, none sexual. F. H. Gravely. Bred in Madras, Feb. 1924. (Madras Museum).

Aulophorus gravelyi, sp. nov.

(Plate III, fig. 2.)

Ennur, Chingleput Dist.; from a pool among felled *Casuarina* trees. 26-28. v. 1922. F. H. Gravely. A number of specimens, none sexual. (Madras Museum).

Small white worms; the flexure of the body usually dorsal, not ventral. Length (preserved) 5-8 mm.; maximum diameter 0.35 mm. Segments 46-73.

The prostomium is short, and very blunt and truncated ; its shape is rather characteristic, resembling that of a dog's snout. There are no eyes.

The ventral setae are three or four in front, and usually three per bundle behind, but occasionally four. They are divided into two groups, an anterior in segms. ii-v, and a posterior, in the rest of the body. Those of the anterior group are 115μ long and 3μ thick ; the prongs are unequal, the outer fully half as long again as the inner, but the two are equal in thickness at the base ; the nodulus is at the middle of the length ; the curvatures of the shaft are a little less than in the setae of the posterior group.

The posterior ventral setae differ considerably among themselves in length,—from 62 to 90μ . The variations follow a regular plan, which I have shown to exist also in a number of other worms of the family Naididae (5) ; the outer seta of a bundle is the shortest, the innermost the longest. Thus in one bundle, from the outer to the inner seta, the lengths were 62, 74, 78, 90μ ; in another, 65, 74, 82, 90μ . In thickness the setae are 3μ ; the prongs are of about equal length, but the inner prong is twice as thick as the outer ; the nodulus is at the middle or slightly distal to the middle.

The dorsal bundles begin in segm. vi, and are composed of hair-setae and needles, in couples of one hair and one needle ; commonly there are two such couples, occasionally three, in each bundle in the anterior part of the body ; and one in the posterior. The hair-setae are a half to two-thirds of the diameter of the body in length, the maximum length being 240μ though ordinarily they are somewhat less, perhaps 190-200 μ .

The needles (fig. 2) are slightly sickle-shaped, 66-80 μ in length, with a small nodulus where the curve begins, slightly distal to the middle of the shaft (distal to nodulus : proximal to nodulus :: 7 : 9). The tip is bifid ; the prongs, nearly 2μ long and visible with the ordinary high power, are about equal in length and thickness, and are separated by an acute angle ; with the oil immersion, the outer prong is seen to be slightly longer and perhaps a little thicker.

The anus opens into the branchial fossa. There is a pair of palps, bent forwards in the preserved specimens, like a hooked finger. The gills are really four pairs, though only three pairs are to be made out by examination of the whole animal ; this region is unfortunately much contracted in all the specimens. In sections however a more anterior pair appears, small, and largely fused with the lip of the fossa ; this pair is not separately distinguishable in the specimens mounted whole. The second and third pairs are finger-like and rather cylindrical ; the posterior pair are broader and more massive.

No coelomic corpuscles are to be seen.

There is no stomachal dilatation ; indeed there is very little differentiation of the alimentary canal, which simply presents a series of segmental swellings throughout the length of the body. Chloragogen cells begin in segment vi.

The dorsal vessel is ventrally situated and on the left side for the greater part of its extent ; it becomes dorsal in segm. vi.

No budding zone was seen in any of the specimens. Some have no branchial fossa, and appear as if broken off at the hinder end, which is widely open, but without gills or palps. Probably, therefore, fragmentation takes place without the previous formation of a budding zone.

Family TUBIFICIDAE.

Genus **Limnodrilus** Clap.

Limnodrilus socialis Steph.

Coonoor Ghat, Nilgiris; ca. 5,500 ft. 6. vi. 1921. F. H. Gravely. Numerous specimens. (Madras Museum.)

Madras. 8. vi. 1922. Numerous specimens. (Madras Museum.)

Family MONILIGASTRIDAE.

Genus **Moniligaster** E. Perr.

Moniligaster deshayesi E. Perr.

Kavalai, Cochin Forest. Sept. 1914. A single specimen. (Madras Museum.)

This species is still somewhat of a rarity. I add a few notes on certain features of the present specimen.

Length 118 mm.; diameter 6 mm. Segments 128. Colour a reddish brown, like other worms in the same tube.

Prostomium small, prolobous, withdrawn under cover of segm. i. The setal distance *aa* is equal to *bc*, or in places seems a trifle less; *dd* is equal to half the circumference. The male pores are between the lines *b* and *c*, but much nearer *b*, the lower end of the lip surrounding the orifice being almost in *b*.

The gizzards are six in number, in segms. xii-xvii, the first the smallest, the last the largest. The testis sacs, suspended by septum 9/10, project about as much forwards into ix as backwards into x. The prostates are extremely large, extending back to the level of the hinder end of segm. xv; this they do by bulging back septum 13/14. The atrial gland, of considerable size, is contained entirely in segm. vii, occupying the whole length of the segment; it is slightly bilobed; the duct is short, moderately stout, slightly curved, and shining.

Septum 4/5, which is slightly strengthened, is directed backwards, so that it is inserted along the same line as 5/6, which is directed forwards. This peculiarity has been noted in some previous examples.

Remarks.—The present specimen differs from the type form of the species in having a larger number of gizzards, which are placed further forwards; in the fact that the testis sacs extend forwards into ix; and in having the atrial glands merely bilobed (and that not very markedly) instead of divided into two separate parts each with its own stalk.

It thus approaches var. *gravelyi*, in which the atrial gland is entirely single and undivided; but is distinguished, in addition to the character of the atrial gland, by the position of the male pores (nearer *b* in the present specimen).

Moniligaster perrieri Mich.

Tirumalai Hills, Chittoor Dist., Madras; under stones near a stream. June 1914. Four specimens, three being sexually mature. (Madras Museum.)

Genus **Drawida** Mich.**Drawida annandalei** Steph.

Kandlamadagu, Chittoor Dist. ; ca. 2,500 ft. 17. ix. 1923. E. Barnes. Three specimens, sexually mature. (Madras Museum).

My former description of this species was written from a single specimen, which was sectioned. I therefore give the following account of the more ample material now available, which I have examined by the usual method of dissection.

External Characters.—Length 50-62 mm. ; diameter in the genital region 2.75 mm., elsewhere 2 mm. Colour bluish green anteriorly and dorsally, paler behind and ventrally. Segments of the longest example 181 ; no secondary annulation.

Prostomium prolobous.

Dorsal pores absent. Nephridiopores in line with *cd*.

Setae closely paired ; *aa* is slightly less than *bc* (about $\frac{5}{8}$ *bc*) ; *dd* is equal to half the circumference.

The clitellum extends over x-xiii (=4) ; the colour is slightly paler and the body thicker here ; the intersegmental furrows are however well-marked.

A transversely oblong area with rounded ends takes up the posterior half of segm. x and the anterior half of segm. xi ; it extends laterally to between the lines of *b* and *c*. Its extent is delimited by grooves at its lateral boundaries, and to a slight extent also along the greater part of its anterior and posterior borders,—though here the difference is rather one of texture and colour. Almost in its centre, rather over the hinder part of segm. x, is an oval, raised and wrinkled, somewhat indefinite papilla, comprised within the limits of the interval *aa* ; but this could only be called well-marked in one of the three specimens.

Near the lateral margins of this modified area are a pair of transverse grooves, differing in extent and depth in the several specimens, with prominent anterior lips, their centres in the line of setae *ab* ; these possibly correspond to the line of groove 10/11, and may contain the male pores, though I could not find any indication of an aperture in them ; from internal dissection the pores should about correspond to these grooves in position.

The female apertures appear to be indicated by a slight whitening of the lip of groove 11/12 in line with *b*.

The spermathecal pores are apparently also in line with *b*, in 7/8 or rather on vii just in front of the groove.

Internal Anatomy.—Septa 5/6-8/9 are somewhat (not much) strengthened.

There are three gizzards, in segms. xiii-xv ; these have the form of three narrow rings, each being small and narrow antero-posteriorly.

The testis sacs are smoothly rounded, slightly longer than broad, suspended but not constricted by septum 9/10 ; a third or a quarter of each sac is contained in segm. ix, the rest in x.

The vas deferens is little coiled, and is situated on the posterior side of the septum ; after reaching the body-wall it runs up on the anterior face of the prostate to enter it on this face near the upper surface.

Each prostate is spherical, covered with papillose soft and closely set projections, and sessile on the body-wall in the line of the setae *ab*.

The septa limiting the ovarian chamber are widely separated above, where they join the dorsal body-wall; the chamber is thus incomplete.

The ovisacs extend a considerable distance backward,—to segm. xviii on one side, to xvi on the other.

The spermathecal ampullae are small and almost spherical. The duct, on the posterior face of septum $7/8$, is convoluted. The atrium is a teat-like projection, of moderate size, which joins the body-wall in the line of setae *b*; the spermathecal duct enters it on its posterior side.

Drawida burchardi Mich.

Andaman Is., Sta. 10, thick jungle below the summit of Mt. Harriet, ca. 900 ft.; immediately under casting of *Pheretima harrie ensis* (v. *post.*). 4. xii. 1923.

N. Annandale. Three specimens, mature but without clitellum.

Amingaon, near Gauhati, Assam; Sta. 4, a cutting in a hill. 14. iii. 1924. S. L. Hora. Several specimens, sexual but without clitellum.

The present species was described by Michaelsen (2) from a single specimen collected in Sumatra; the same author, in a subsequent paper (3), has given a few notes on some examples from the same locality as some of those now under consideration (Mt. Harriet). I subjoin a few observations on the present specimens, since the differences from previous accounts are not altogether inconsiderable.

The length of the specimens from Mt. Harriet was about 50-55 mm., of those from Assam 70-80 mm.,—not greatly different from that previously recorded. The thickness however seems in these examples to be much greater,—3 to 4 mm. as against 1.4 mm. in the original description. The interval *aa* in the present specimens is usually about $\frac{4}{5}$ *bc*, while *dd* may be equal to half the circumference, or slightly more, or slightly less. The gizzards are in segments xiv-xvi. The vas deferens is wholly in segm. x. There is a complete annular ovarian chamber. The testis sacs are wholly contained in segm. x, except in one case where a rounded lobe projects forwards into ix.

Perhaps the most interesting peculiarity however is the presence of a few dorsal pores in one of the examples from Mt. Harriet. The usual position of the pores is indicated by dark dots, but these are not for the most part pervious, and no fluid could be squeezed through,—except for a short region about the junction of the anterior and middle thirds of the body, where a number of pores were quite patent. *D. barwelli* is the only other species of the genus in which patent dorsal pores have been found.

Drawida hodgarti Steph.

Amingaon, with the last species. Six specimens, not all mature.

The previous record of the species is from Rangamati, Chittagong Hill Tracts. The present specimens show a few slight differences from the former description:—*dd* is equal to or slightly less than half the circumference (in the original specimens *dd* is greater than half the circumference); and the position of the male pores is rather further out here,—between *b* and *c*, but nearer to *b* (just outside *b* in the original specimens).

Drawida papillifer Steph.

(Plate III, fig. 3.)

Amingaon ; a small island in Jaulah Lake. 13. iii. 1924. S. L. Hora. A number of specimens, sexually mature, in not very good condition.

As my previous description was written from a single specimen, I subjoin a few notes on the present examples.

External Characters.—Length of well-developed specimens 100 mm., and diameter 3 mm. ; but sexually mature specimens are present of a length of only 70 mm., and diameter 2 mm.

Prostomium small, prolobous.

The setae are very minute, indeed hardly visible over most of the body, and their position can only be made out by noting certain markings in the body-wall, due to separation of muscular bundles or differences of tinting along certain lines. In the anterior part of the body $aa=bc$, and dd is rather less than half the circumference ; further back aa is rather less than bc , and dd is equal to half the circumference.

The male pores are bounded behind by a transverse swelling which forms a prominent posterior lip ; the anterior border may also take the form of a lip, or may be a slight depression. The pores themselves were not actually visible ; what is seen is a transverse fissure with its centre midway between b and c . In the neighbourhood of these fissures are a few tiny papillae, with a slight depression in the centre, not unlike the small papillae of *Pheretima hawayana* ; they have no definite positions.

The female pores were not seen ; possibly they are in line with b .

The spermathecal pores are fairly conspicuous, and have their centre a little below c . In their neighbourhood are a few small papillae of the same kind as those near the male pores.

Internal Anatomy.—Besides the three gizzards, in segments xvi-xviii, there was a rudimentary gizzard in xix, and perhaps also some slight strengthening of the gut wall in xv.

The testis sac on the left side of the specimen dissected was very large, of an elongated ovoid shape, not constricted by the septum, extending in front to the anterior limit of segm. ix and behind to the level of septum 12/13. The sac on the right side is much smaller and does not pass the limits of segm. x ; it is irregular in shape.

The vas deferens is long and thin, and forms a close coil in segm. x ; it enters the prostate not far from the ental end of the latter.

The prostate is elongated and curved, with a "glandular" surface ; the ental end is swollen and rounded, the ectal three-fifths is narrow and cylindrical (fig. 3).

The spermathecal atrium is of an elongated pear-shape ; it is joined by the spermathecal duct near its lower end.

Drawida pellucida (A. G. Bourne) var. **pallida** Mich.

Horsleykonda, Chittoor Dist. ; ca. 3,000-4,100 ft. 11-16. ix. 1923. E. Barnes
A single specimen. (Madras Museum).

Length 48 mm. ; diameter 3 mm. Segms. 163 ; all the segments except those at the anterior end are very short. Colour greyish, only slightly pigmented ; dorsal and ventral surfaces the same,

The setal interval *aa* is three-fourths or four-fifths of *bc*; *dd* is equal to half the circumference.

The gizzards are three in number, in segms. xv-xvii.

The prostates are hemispherical and sessile on the body-wall; they have a smooth, slightly shiny surface, without "glandular" investment.

The spermathecal atrium is a short cylindrical "teat-like" thickening of the end of the duct, mainly or entirely concealed in the lower part of the septum and the body-wall.

***Drawida robusta* (A. G. Bourne) var. *cochinensis*, var. nov.**

(Plate III, fig. 4.)

Chalakudi, Cochin State. Sept. 1914. Two specimens, sexually mature. The anterior end of the largest injured. (Madras Museum.)

Kavalai, Cochin Forest. Sept. 1914. A single specimen, sexually mature. (Madras Museum.)

External Characters.—Length 125-130 mm.; diameter 5-7 mm. Colour a rather pale brown, the same on both surfaces. Segms. 187, the hinder end tapering. The body is slightly depressed; there is a thickened region laterally on each side, mainly above the level of the setae *cd*, in which the intersegmental grooves are strongly marked and deeper than in the rest of their extent.

The prostomium is absent, or perhaps withdrawn into the buccal cavity.

Dorsal pores are absent. The nephridiopores are in *cd*.

The setae begin in segm. ii, and are closely paired; *aa* is sometimes equal to, sometimes a little less than *bc*; *dd* is slightly more than half, perhaps about five-ninths of the circumference.

The clitellum is not distinguishable.

The male pores are in 10/11, between *b* and *c*, slightly nearer *c*; they are slitlike, with rather prominent lips.

The female pores are small, in 11/12, in line with *b*.

The spermathecal pores are inconspicuous, in 7/8, in line with *c*.

Internal Anatomy.—Septum 5/6 is slightly, 6/7, 7/8 and 8/9 much thickened; 9/10 is slightly thickened, the rest thin.

The gizzards in one of the specimens from Chalakudi are five in number, in segms. xvii-xxi, and there is in addition some strengthening of the gut wall for several segments in front of this. In the specimen from Kavalai the gizzards were six in number, in segments xv-xx, increasing in strength from before backwards.

The testis sacs may extend far backwards,—in the specimen from Kavalai to xiii and xiv on the two sides respectively, the necks of the sacs passing underneath the ovarian chamber. In the specimen from Chalakudi which was dissected, the sacs were irregular in shape, of moderately large size, that of the right side contained wholly in x; that of the left side in xii, attached to septum 9/10 by a neck which passed through segm. x and underneath the ovarian chamber.

The vas deferens forms many coils in segm. ix but not in x; it enters the prostate on the anterior face of the latter.

The prostate is subspherical in form, with a "glandular" surface, which has a granular appearance in consequence of being clothed with numerous closely set minute mamillations. Each prostate is attached by a short thick stalk, almost as wide as the gland itself, which penetrates within the body-wall.

The ovarian chamber, the representative of segm. xi, is narrow and completely closed off from the body-wall above.

The ovisacs are small, elongated but very narrow, curled, tapering towards the free end, and confined to segm. xii.

The spermathecal duct is much coiled on the posterior face of septum 7/8; it penetrates the septum close to the body-wall, and then ascends to enter the atrium; its last part is somewhat stouter than the rest and shiny.

The atrium is of moderate size, contained wholly in vii, firm, slightly bilobed, the posterior lobe extending further upwards than the anterior; the duct enters on its inner face, between the two lobes (fig. 4). On the left side of the Kavalai specimen the atrium could not be called even slightly bilobed; it was ovoid in shape, its long axis antero-posterior, with a slight bulging on the upper surface.

Remarks.—The present variety differs from the *forma typica* in the setal relations (which are like those of var. *ophidioides*), in the number and more especially in the position of the gizzards; and particularly in the shape of the atrium, which in the typical form is fully bilobed, one lobe in segm. vii and one in viii. From var. *ophidioides* it differs in size, colour, and number and position of gizzards.

Drawida agricola, sp. nov.

Taliparamba Farm, Malabar District; among ginger roots. 4. x. 1923. Y. R. Rao. (From the Government Entomologist, Coimbatore.) Three specimens and one fragment, one of the specimens being sexual, but not fully mature.

The most advanced specimen was not fully mature, and I describe it with some diffidence; the chief diagnostic characters are however recognizable. It will be seen that the organs are one segment further forwards than normal,—probably an individual peculiarity only.

External Characters.—The largest specimen was 32 mm. long, but was incomplete behind; the fragment included in the tube probably belongs to it; in this case its length would be 43 mm. Diameter 2.5 mm. Segments 120 *plus* 53 in the separate fragment, = 173; the segments are very short. Colour dark brown, slightly darker dorsally.

Prostomium prolobous.

No dorsal pores.

Setae closely paired; *aa* rather less than *bc*; *dd* rather more than half the circumference.

Clitellum not present.

Male pores in 9/10, between *b* and *c*, rather nearer *c*.

Female and spermathecal pores not distinguishable; from internal dissection the spermathecal apertures are in line with *cd*.

Internal Anatomy.—Septa 5/6-8/9 are considerably thickened.

There are four gizzards, in segms. xi-xiv ; that in xi is small and weak, those in xii-xiv large and strong.

The testis sacs are (in the present specimen) small ; they project forwards into segm. viii, but the larger portion is in ix ; there is not however much difference in size of the parts in viii and in ix.

The vas deferens consists of a number of loops in segm. ix ; there are none in viii. It enters the prostate at the anterior and inner margin of the latter.

The prostate is hemispherical, soft, not shiny, and sessile on the body-wall.

There is a complete ovarian chamber.

The ovisacs are small (in the present specimen), cylindrical and projecting into segm. xi.

The atrium is a small rounded sac in segm. vi, discharging in line with the lateral setae ; the spermathecal duct joins it on its upper surface.

Family MEGASCOLECIDÆ.

Sub-family MEGASCOLECINÆ.

Genus **Plutellus** E. Perr.

Plutellus macrochaetus, sp. nov.

(Plate III, figs. 5, 6.)

Korangumudi Estate, Valparai, Anamalai Hills ; 4,500 ft. ; at the base of Cardamum plants. 5. ix. 1923. Two specimens, one rather immature. (From Government Entomologist, Coimbatore.)

External Characters.—The larger and more mature specimen measured 69 mm. in length, and 3 mm. in diameter. Colour greyish, only slightly pigmented, but rather more so in the anterior than in the posterior part ; dorsal and ventral surfaces much the same. Segms. 183.

Prostomium epilobous $\frac{1}{2}$, narrow, open behind, constricted and divided by a transverse groove at the middle of its length.

Dorsal pores from groove 10/11.

The setae are paired ; in the middle of the body $ab = \frac{1}{3}aa = \frac{3}{8}bc = \frac{4}{5}cd$; behind the genital region $ab = \frac{1}{3}aa = \frac{1}{2}bc = \frac{3}{4}cd$; while in the anterior segments $ab = \frac{2}{5}aa = \frac{1}{2}bc = \frac{3}{4}cd$; dd = half the circumference in the middle of the body, rather less than half at the hinder end.

The clitellum includes xiv- $\frac{1}{2}$ xviii ($=4\frac{1}{2}$) ; ventrally however xviii is not modified.

The male pores are on xviii, on minute papillae in line with the setae *ab*.

The female pores are paired, close together near the middle line on the anterior part of xiv.

The spermathecal pores are two pairs, in $\frac{7}{8}$ and $\frac{8}{9}$, apparently between the lines of *a* and *b* ; from internal dissection they seem to be almost in *a*.

Internal Anatomy.—Septa $\frac{4}{5}$ and $\frac{5}{6}$ are very thin ; $\frac{6}{7}$ — $\frac{10}{11}$ are moderately strengthened, $\frac{9}{10}$ most so ; $\frac{11}{12}$ and $\frac{12}{13}$ are slightly thickened.

The gizzard is elongated and cylindrical ; it is contained mainly in vi, septum 5/6 being attached round it about a quarter of its length from its anterior end.

There are no calciferous glands. The intestine begins in xviii.

The last heart is in xiii.

The nephridia in the anterior part of the body are all of the tufted kind. These are large in segms. v and vi, opposite the anterior and posterior ends of the gizzard ; those situated at the sides of the oesophagus diminish in size backwards as far as xiii ; they are large in the clitellar region ; thenceforward they are of moderate size, one on each side, not apparently (though the condition of the specimen leaves much to be desired) split up into independent micronephridia,—all the tubules of a tuft discharge in common by a single duct.

In the hinder fourth of the body there are meganephridia of the usual form,—a long loop stretching out on the body-wall, with a more coiled (or possibly slightly tufted) portion ventrally ; on a number of these a funnel was seen, with the usual relation to the septum (confirmed microscopically).

Testes and funnels are free, and are present in segm. xi only.

The seminal vesicles are in segm. xii ; they are large, meeting each other dorsally ; each resembles a bunch of grapes, being composed of a large number of small round lobules.

The prostates are tubular ; each forms a stout coil. The ducts are very short and thin,—disproportionately small in relation to the size of the glands.

Ovaries and funnels are contained in xiii. There are small ovisacs in xiv.

The spermathecae are two pairs ; the ampulla is an elongated, narrow, irregularly shaped and irregularly twisted sac ; the duct is short and thin. There is a single diverticulum, cylindrical, slightly dilated at its ental end, irregularly curved, as long as or rather longer than the ampulla when both are straightened out ; it joins the side of the duct (fig. 5). The central lumen of the diverticulum is tortuous at its ental end, which glistens owing to the contained spermatozoa ; under the microscope the appearance resembles that of a few incompletely separated seminal chambers.

The penial setae (fig. 6) are enclosed in extremely long sacs, two on each side, mainly composed of muscular strands. The setae are 5.5 mm. long, and 9μ in diameter at the middle ; they are thus extremely long and slender. They are gently curved, mainly in their distal portion, through about a quarter of a circle ; they are slightly recurved terminally, expanded and flattened, with a notch which forms three-quarters of a circle cut out of the tip. The width of the flattened portion is 14μ and the diameter of the notch 5μ . There is no ornamentation.

Remarks.—It will be seen that I have taken the tufted nephridia to be meganephridia, according to the views which I have expressed in my volume on "*Oligochaeta*", in "*The Fauna of British India*" (6), p. 184 ; the tufted nephridia are probably a stage on the path of evolution of micronephridia, but the essential character of micronephridia, the breaking up of one into a number of separate organs, has

not yet been brought about. If the tufted nephridia are considered to be micronephridia, the present species will become a *Megascolides*.

Genus **Megascolex** Templeton.

Megascolex konkanensis Fedarb.

Kavalai, Cochin Forest. Sept. 1914. A single specimen, sexually mature. (Madras Museum).

Megascolex mauritii (Kinb.).

Kandlamadagu, Chittoor Dist., ca. 2,500 ft. 17. ix. 1923. E. Barnes. A single specimen, in bad condition. (Madras Museum).

Megascolex triangularis, sp. nov.

(Plate III, figs. 7, 8.)

Kavalai, Cochin Forest. Sept. 1914. Six specimens, sexually mature. (Madras Museum).

External Characters.—Length 143-150 mm. ; diameter 3 mm. Segms. 218. Colour brownish (like other specimens in the same tube), with a slight reddish or purplish tinge ; no difference between dorsal and ventral surfaces ; clitellum a deeper purple. Anterior end truncated.

Prostomium small, epilobous $\frac{1}{2}$, open behind.

Dorsal pores from furrow 4/5.

The setae are in rings ; the dorsal break in the anterior part of the body is equal to $2yz$, while in the hinder part it is irregular, and may be little more than yz ; the ventral break is variable and irregular,—in front of the genital region 2-3 ab , in the middle of the body 4 or even 5 ab , and towards the hinder end 3-4 ab . The setae are on the whole set more closely ventrally than dorsally ; and setae a and b are throughout most of the body closer together than those outside them, so that they form a pretty definite couple on each side. The following numbers were counted :—42/v, 47/ix, 50/xii, 40/xix, and 33 in the middle of the body.

The clitellum extends over segms. xiv to $\frac{2}{3}$ xvii ($=3\frac{2}{3}$) ; it is purple in colour, dorsal pores are present, and setae and intersegmental furrows are also visible.

In the midventral line of segm. xviii, and on the anterior half of the segment, extending from furrow 17/18 to the setal zone, is a small triangular depression, with its apex directed backwards ; the depression is moderately deep, with clean-cut margins (fig. 7).

The male pores are somewhat elongated slits on the lateral sides of the triangle ; hence they converge posteriorly. The lips of the slits are slightly swollen. The pores are very close together, since the sides of the triangle hardly measure more than 0.5 mm.

The female pores are paired, and situated close together on a whitish transverse oval area in the setal zone of segm. xiv.

The spermathecal pores are two pairs, in furrows 7/8 and 8/9, close together, with rather prominent lips.

Internal Anatomy.—Septa 4/5, 5/6, and 6/7 are all thin; 7/8 is slightly thickened; 8/9-11/12 are somewhat strengthened, and 12/13 and 13/14 slightly thickened.

The gizzard, of moderate size, and shortly cylindrical, is in segm. v; septum 5/6 is very thin, and prolonged far backwards before reaching its attachment to the gut, so that it invests the gizzard closely; but it can be separated with a little care.

There are no calciferous glands. The intestine begins in xvi.

The last heart is in xiii. In xiv there is a large vessel on each side, crossing over the alimentary canal obliquely from the middle line in front, backwards and outwards.

Large tufted nephridia are present at the hinder angles of the pharyngeal mass, by the sides of the gizzard, and backwards as far as segm. ix. Behind the genital region the usual micronephridia form a transverse row in each segment.

Testes and funnels are free in segms. x and xi. Seminal vesicles are present in segms. xi and xii; they are of moderate size, those in xii being somewhat the larger; in form they are racemose, each being composed of a mass of small round lobules.

The prostates are confined to xviii, slightly bulging apart the septa in front and behind; each has the appearance of a compact mass, but is deeply divided into a large number of minute rounded closely adpressed lobules. The duct is relatively long, thin, shining, of the same diameter throughout, passing transversely inwards in a straight line.

There are no penial setae.

Ovaries and funnels are present in xiii. There are small ovisacs in xiv.

The spermathecae (fig. 8) are two pairs; the ampulla is an ovoid sac of moderate size, not sharply marked off from the duct, which is about equal to it in length and half as broad or less. There is a single diverticulum, club-shaped, with an elongated stalk, its length equal to that of the duct or rather more; it is attached at the extreme ectal end of the duct; both the stalk and the dilated terminal portion of the diverticulum shine with the included spermatozoa.

Remarks.—The present species appears to be related to *M. kavalaianus* and *pheretima*.

From *M. kavalaianus* it differs in length, diameter, and number of segments, in having paired female pores, in the form of the spermathecal diverticulum, and especially in the configuration of the male field. The last heart is in xiv in *M. kavalaianus*; it is possible however that what I described as a heart may really be the same vessel as that noted above in segment xiv of the present species,—but which does not seem to be comparable to the hearts in the preceding segments.

From *M. pheretima* the present species differs in the proportions of the body (*M. triangularis* being a long thin worm), and the number of segments; in the shape of the prostomium; and again in the configuration of the male field. There are also a number of slighter differences which it is scarcely necessary to enumerate.

Megascolex tripartitus, sp. nov.

(Plate III, figs. 9, 10.)

Tirumalai Hills, Chittoor Dist., Madras ; under stones near a stream. June, 1914.
A single specimen, sexually mature, in bad condition. (Madras Museum).

External Characters.—Length ca. 300 mm., but the specimen is much softened, and this probably does not represent the normal condition ; diameter towards the anterior end 8 mm., less elsewhere. Colour a fairly light brown. Segms. 293 ; segm. v biannulate, vi triannulate, vii quadriannulate, viii-xiii with five secondary annuli.

Prostomium small, zygalobous.

Dorsal pores from furrow 13/14.

The setae are in rings, small, and closer set ventrally. The dorsal and ventral breaks are in general ca. 4*ab* and 4*yz* ; towards the anterior and posterior ends the intervals may be less,—sometimes 3*ab* or 3*yz* in front ; in the hinder part of the body they are rather irregular. The following numbers were counted :—70/v, 90/ix, 83/xii, 105/xxiv, and 72 in the middle of the body.

The clitellum appeared to extend from xiv to xxi, but this is probably a mistake, as the specimen was in very bad condition in this region.

Over the midventral parts of furrows 17/18 and 18/19 are a couple of much elongated narrow transverse areas, somewhat depressed, flat, each surrounded by a lip (fig. 9). The rest of segm. xviii in the midventral region is thus somewhat ridgelike. The male pores appear to be on small papillae which touch each other in the middle line ; on the outer side of each pore is another small indefinite elevation.

The female pores are not visible.

The spermathecal apertures are close together, in furrows 7/8 and 8/9, each in a rugose fissured area, and apparently on small papillae which are scarcely distinguishable from the rugae of the general surface in this region.

Internal Anatomy.—Septa 4/5 and 5/6 are thin ; 6/7 is somewhat thickened, 7/8 moderately so, and 8/9-11/12 are much strengthened ; 12/13 and 13/14 are slightly thickened.

The gizzard is large and barrel-shaped, in segm. vi. There are no calciferous glands.

The last heart is in segm. xiii.

Tufted nephridia are present by the sides of the alimentary canal as far back as segm. xiii ; thenceforward ordinary micronephridia occur in two transverse rows per segment, one row in front of and one behind each septum.

The testes were not distinguishable. Funnelles are present in segms. x and xi, I think free. Seminal vesicles are found in xii only, racemose, and of moderate size.

The prostates are rather small, in xviii, elongated transversely, and marked out into small lobules. The duct is narrow, straight and shining, passing transversely inwards to end near the midventral line. There are no penial setae.

The female organs were not recognized.

The spermathecae are characteristic ; each consists of three (in one case four) separate ovoid sacs, marked by slight annulations, joined below, with a very short stout common duct. The diverticula were 2, 3, 4 and 5 respectively in the four organs ; they are small ovoid shining sacs on the outer side of the duct, attached to the duct just below where the ampullae join, and are either set closely side by side or actually fused by their contiguous margins (fig. 10). In one case two contiguous ampullae were also inseparably united by their margins.

Megascolex sp.

Coonoor, Nilgiris, ca. 5,700-6,000 ft. 31. v. to 3. vi. 1921. A single specimen.
F. H. Gravely. (Madras Museum).

The specimen was not fully mature, and I therefore do not describe it. I mention it only because of an interesting peculiarity,—the dorsal vessel was double in each of the segments from viii to xxi inclusive ; the two portions were united at each successive septum, where the vessel passed from one segment to another. A similar condition has been described in *Megascolex caeruleus*, as well as in some species of other genera ; indeed the division of the vessel into two may be much more extensive and complete than it is here.

Genus **Pheretima** Kinb.

Pheretima hawayana (Rosa).

Kurseong, E. Himalayas, Sta. 13, 5,000 ft. ; under stones in thicket of trees.
9. iii. 1924. B. N. Chopra. Seven specimens, sexually mature.

Pheretima heterochaeta (Mich.).

Kurseong, E. Himalayas, Sta. 13, 5,000 ft. ; under stones in thicket of trees.
9. iii. 1924. B. N. Chopra. Nine specimens, sexually mature.

Pheretima harrietensis, sp. nov.

(Plate III, fig. 11.)

Mt. Harriet, S. Andaman Island ; ca. 900ft. ; in thick jungle below the summit, under a very large casting on the jungle floor. 4. xii. 1923. N. Annandale.
A single specimen, in two pieces.

External Characters.—Length 200 mm. ; maximum diameter, in pre-clitellar region, 11.5 mm., in posterior half of body 9 mm. Colour (preserved), dorsally a slaty purple, darker in the anterior half of the body, pale ventrally ; according to a note made by Dr. Annandale at the time of capture the colour in life was iridescent blue above, white below ; the pigment stained the spirit blackish. Segments 123 ; viii is biannular, the rest as far as a little way behind the male pores triangular (except the clitellar segms.).

Prostomium small, triangular with the point directed backwards and reaching nearly as far as furrow $1/2$; the apex of the triangle prolonged backwards as a groove to join the furrow.

Dorsal pores from 12/13, the first rudimentary.

Setae in rings, a little closer set ventrally ; no setae specially enlarged. The ventral break is small in the anterior part of the body,— $1\frac{1}{2}$ or $1\frac{1}{4}$ al,

still smaller or imperceptible posteriorly ; the dorsal break is also small, not more than $1\frac{1}{4}yz$, and it too is almost imperceptible in the hinder region. The following numbers were counted :—38/v, 75/ix, 90/xii, 91/xix, and 90 in the middle of the body.

The clitellum embraces xiv-xvi (=3). The intersegmental furrows are well marked, but the secondary annulation is lost (except that xiv is biannular). Dorsal pores are present ; and setae are seen on the ventral surface.

The male pores are on conical papillae on xviii, one-third of the circumference apart ; 28 setae intervene between the two.

The female pore or pores are indicated by a small transversely oval depression in the setal zone of xiv.

The spermathecal pores are three pairs, in furrows 6/7, 7/8, and 8/9, small and inconspicuous, one-third of the circumference apart.

In the region of the male pores two copulatory cushions are seen, flat, not raised above the general level of the surface, but marked by very numerous minute pits ; the cushions are thus of the same kind as those of *P. osmastonii*. The anterior cushion takes up the anterior part of segm. xviii and a narrow strip along the posterior margin of xvii ; the posterior cushion includes the hinder part of xviii and a narrow strip along the anterior margin of xix ; the two cushions are thus separated only by the narrow setal zone of xviii ; both extend outwards on each side to the level of the male pores.

Internal Anatomy.—Septum 4/5 is slightly thickened, 5/6, 6/7, and 7/8 are somewhat strengthened, and so too 10/11 and 13/14 ; 11/12 and 12/13 are fairly strongly thickened, and 8/9 and 9/10 are absent.

There is a large round firm gizzard between septa 7/8 and 10/11. The intestine widens out behind the prostates. The caeca originate in xxvii ; they have a swollen base, and in front of this are narrowly conical, twisted and constricted ; the anterior half may be turned backwards. Lymph glands are present dorsally on the intestine.

The last heart is in xiii.

The excretory system is micronephric.

Testis sacs are present in x and xi ; those of x are connected across the middle line, but I did not ascertain if the sacs were further connected with one another.

Vesiculae seminales are present in xi and xii ; they are of considerable size, and only slightly incised into lobes ; each is furnished with a long cylindrical appendage which arises from its inner surface and, stretching dorsalwards, reaches the middorsal line where it ends in a slight dilatation.

The prostates are each completely divided into two halves, an anterior and a posterior ; the anterior occupies segm. xvii and comes slightly into xviii, the posterior xx and xxi and (on one side) a little of segm. xix ; there is thus a wide interval between the two parts. Each part is deeply cut up into small elongated branching and often finger-like lobes. The ducts of each portion are soft and membranous ; they join in xviii, and receive the vas deferens at their junction ; the common duct is short, somewhat curved, shining, but not very firm, its ectal portion wider than the rest.

There are no accessory prostates of the kind found in *P. osmastoni*.

There are however very numerous accessory glands, corresponding to the pitted areas ; these are closely set, each with a rounded internal portion which is connected with the body-wall by a relatively narrow stalk.

The ovaries and funnels are small, in xiii ; there is a receptaculum ovarum of moderate size in xiv.

The spermathecae (fig. 11) are three pairs ; the ampulla is saclike, shortly ovoid in shape ; the duct is one-third to two-fifths as long as the ampulla, moderately stout, not shining. The diverticulum is attached to the ectal end of the duct ; it is very long and thin, and irregularly twisted,—three or four times as long as the ampulla if the twists are allowed for ; the ental end is slightly dilated. A noticeable feature of the spermathecae is a thin-walled swelling of the base of the duct, somewhat lobed at one part of its extent ; this goes all round the junction of the duct with the body-wall, though it is very small and narrow at one spot on the posterior side.

A large seta at the male pore must, as in *P. osmastoni*, be interpreted as a penial seta ; but it is unfortunate that here also, as in all specimens of *P. osmastoni* up to the present, the points were broken off.

Remarks.—There can be no doubt that the present species is closely related to *P. osmastoni*, described from the Andamans by Michaelsen. The general form of the spermathecae, the penial setae, and the peculiar character of the copulatory cushions sufficiently establish the connection.

The differences are however well marked. Thus the prostomium is triangular in the present species, while in *P. osmastoni* the hinder end is almost as broad as the front, and is open ; the male pores are here further apart ; the position of the copulatory cushions is not the same ; most important of all, perhaps, is the wide division of the prostate, and the absence of accessory prostates in the present species ; the swollen base of the spermathecal duct may also be mentioned.

***Pheretima lignicola* Steph.**

Wimberleyganj, Andamans. 8. xii. 1923. B. Prashad. A single specimen, in poor preservation, sexually mature.

***Pheretima osmastoni* Mich.**

Wimberleyganj, Andamans. 2. xii. 1923. B. Prashad. Two specimens, not quite sexually mature (wanting the clitellum).

Mt. Harriet, Andamans, ca. 900 ft. ; thick jungle below the summit. 4. xii. 1923. N. Annandale. A single specimen, also wanting the clitellum.

This interesting species was described previously from the Andamans by Michaelsen (3). The present specimens differ in a few details from the originals ; the copulatory papillae, present on segm. x, were in two of the specimens paired ; thus the single median papilla of Michaelsen's specimens is to be regarded as produced by the confluence of a pair, a process which is illustrated by the third of the specimens which I examined. As in *P. harrietensis*, I find on the inner side of each seminal vesicle a moderately long hollow cylindrical appendage, directed dorsal-wards and ending blindly.

In segm. xiv, on each side of the alimentary canal, and attached to the anterior septum of the segment by connective tissue, was a large

dark friable mass, looking like coagulated blood. When broken up and examined microscopically these were found to consist of a dark granular matter in which very numerous setae were embedded ; the setae were of all sizes,—very small miniatures as well as others of full size.

I can confirm the presence of penial setae ; but unfortunately, as in Michaelsen's specimens, the points were in every case broken off.

***Pheretima wimberleyana*, sp. nov.**

(Plate III, fig. 12.)

Wimberleyganj, Andamans. 8. xii. 1923. B. Prashad. Several specimens, sexually mature, in bad condition. (In same tube as the specimen of *P. lignicola*.)

External Characters.—Length 185-225 mm. ; diameter 4-5 mm. Colour a slaty purple dorsally, pale ventrally. Segms. 134.

Prostomium apparently epilobous $\frac{1}{3}$, broad, open behind ; but its characters are disguised by the eversion of the buccal cavity.

Dorsal pores begin from furrow 12/13.

The setae are disposed in rings ; those at the anterior end, especially in segms. v-xi, are enlarged, and also those in the hinder segments ; the setae are about the same distance apart dorsally and ventrally. The rings are almost closed ; the dorsal break is equal to $1\frac{1}{2}yz$ anteriorly, and to $1\frac{1}{4}yz$ further back ; the ventral break is about $1\frac{1}{4}ab$, or it may be quite imperceptible. The following numbers were counted :—25/v, 44/ix, 48/xii, 53/xix, and ca. 51 in the middle of the body.

The clitellum includes segms. xiv-xvi (=3).

The male pores, on xviii, are rounded orifices of some size, in the setal zone, without prominent lips ; they are about one-third of the circumference apart, and are situated in line with the 8th-10th seta ; nine setae intervene between the two.

The female pore is single, and is indicated by a small pale circular area just in front of the setal zone of xiv.

The spermathecal apertures are three pairs, in furrows 6/7, 7/8, and 8/9, about $\frac{2}{7}$ of the circumference apart, situated where the dark colour of the dorsum merges into the lighter tint of the ventral surface. On the inner side of the pore are a few tiny papillae (0, 1, 2 or 3) in the furrow, representing the apertures of accessory glands.

Internal Anatomy.—Septum $\frac{3}{4}$ is distinguishable ; it and $\frac{4}{5}$ are thin ; $\frac{5}{6}$, $\frac{6}{7}$ and $\frac{7}{8}$ are somewhat strengthened ; 10/11-13/14 are slightly thickened ; 8/9 and 9/10 are absent.

The blood glands in segms. v and vi are particularly obvious ; they are also present in iv.

The gizzard, rounded, firm and of some size, is between septa $\frac{7}{8}$ and 10/11. The intestine begins about in xvii ; caeca are present, but this region seems to be much decomposed in all the specimens, and I can give no further details.

The last heart is in xiii.

The micronephridia are numerous and small.

Testis sacs are present in segms. x and xi ; those of the same side communicate, and also those of the same segment coalesce beneath the alimentary canal.

The seminal vesicles occupy segms. xi and xii ; they are of moderate size, and are cut up into larger lobes and smaller lobules.

The prostates occupy segms. xvi-xx ; they are deeply incised, many of the lobes being almost finger-shaped. The conspicuous vas deferens joins the prostatic duct outside the gland. The prostatic duct is shining, and moderately stout ; it has a horse-shoe curve ; the first part is narrow, and it narrows a little also towards the ectal end ; there is no copulatory pouch.

Accessory prostates are present as white lobular masses, sessile on the body-wall, one in front of and one behind the termination of each prostatic duct. They extend into the neighbouring segments xvii and xix respectively ; the anterior of each couple is the larger.

The ovaries and their funnels are situated in xiii. Small ovisacs are present in xiv.

The spermathecal ampullae (fig. 12) are somewhat elongated and pear-shaped, or sometimes almost circular in outline. The duct is moderately stout, about two-fifths as long as the ampulla, from which it is well marked off. There is a single diverticulum attached near the ectal end of the duct ; it consists of a dilated and twisted ental portion and an undulating tube, narrow and shining ; the whole length of the diverticulum is equal to about half that of the main pouch (ampulla plus duct). The diverticulum is somewhat reminiscent of that of *P. houlleti* in shape ; in the more ectal portion of the dilated region there was an appearance as of cylindrical spermatophores, but this was not confirmed on microscopical examination ; the blind end contained an opaque mass, presumably of spermatozoa.

There are a number of accessory glands, two to six, in the neighbourhood of each spermatheca ; these are small rounded bodies, with a narrow stalk several times as long as the rounded mass of the gland ; the total length is about equal to that of the spermathecal duct. One or two of each group join the spermathecal duct where it enters the body-wall ; the others are attached separately to the body-wall in the neighbourhood of the duct (fig. 12). The stalks are not patent tubes, and probably consist of prolongations of the gland cells.

Remarks.—The species with which the present seems to have most affinity are *P. houlleti* and *P. andamanensis*. From the first it is distinguished by the numbers of accessory spermathecal glands, and by the presence of accessory prostates ; from the second by the number of spermathecae, the presence of accessory spermathecal glands, and the presence of *two* accessory prostates on each side.

Genus **Diporochaeta** Bedd.

Diporochaeta pellucida (A. G. Bourne).

(Plate III, fig. 13.)

Ootacamund, Nilgiris ; ca. 6,700-8,000 ft. 20-30. v. 1921. F. H. Gravely. Two specimens, sexually mature. (Madras Museum.)

This interesting species, the only Indian representative of the genus, has not been seen since it was first described by Bourne thirty years

ago (1). Since the species is of some theoretical importance, and since the standards of description have altered considerably in the interval, I give a complete account of the present specimens.

External Characters.—Length 180 mm.; diameter 4 mm. Colour pale, no difference between dorsal and ventral surfaces. Segms. 268; secondary annulation in segms. v-xiii, which show 3 or 5 annuli.

Prostomium proepilobous.

Dorsal pores begin in furrow 9/10 or 10/11.

The setae are of moderate size, larger at the ends of the body, and set more closely on the ventral side, especially anteriorly. They are disposed in rings which are very incomplete both dorsally and ventrally. The dorsal break in front of the genital region is about equal to $8yz$, or one-fifth of the circumference; throughout the anterior part of the body behind this it is about equal to $5-6yz$; in the hinder half it becomes less, $3-4yz$, and ultimately $2yz$; the difference is partly due to the fact that the intersetal intervals in the hinder part are wider and irregular. The ventral break is equal to $4ab$ in the anterior part of the body, to $3ab$ and finally $2ab$ in the hinder part; here also the apparent diminution is partly due to the intersetal intervals being wider and irregular towards the posterior end. The following numbers were counted:—35/v, 34/ix, 36/xii, 36/xix, and 28 in the middle of the body.

There is a quite evident coupling of the setae, especially behind the genital region; the above figures for segms. xii and xix, and for the middle of the body, represent 9 and 7 couples on each side; the coupling is well marked in the setae on the lateral and dorsal surfaces, less well marked in those on the ventral side. At the hinder end coupling is visible to some extent, but the disposition is very irregular.

The clitellum perhaps includes segms. xiii-xvii (=5?).

On segm. xviii is a transverse depression, with slightly marked lips, and with a groove along the bottom. The male pores are represented by a deepening of the groove on each side, opposite the third seta, and hence fairly close together.

The female pores are inconspicuous, in front of setae *a* of segm. xiv.

The spermathecal pores are also inconspicuous, in line with *c* or *bc* in furrows 7/8 and 8/9.

Internal Anatomy.—Septum 4/5 is thin, 5/6 slightly thickened, 6/7-9/10 moderately thickened, 10/11 less so, and 11/12 and 12/13 only slightly.

The gizzard, firm and cylindrical, of moderate size or rather small, is in segm. v.

There are large lobed calciferous glands in xiv, xv and xvi; these are dorso-laterally situated on the gut, well set off, kidney-shaped in form, and attached broadly by the hilus. The oesophagus is very vascular in xiii, but there are no glands.

The intestine begins in xviii.

The last heart is in xii.

The excretory system is meganephridial. The first well-marked nephridium is in segm. xiv, but smaller ones are visible in segms. xi, xii and xiii. In some of the anterior segments small coils are seen,—perhaps in all, as far forwards as v; microscopically I could not make

out any funnels on these small coils, but I could not say that they do not exist,—the whole organ is very small.

Testes and funnels are free in x and xi. Vesiculae seminales, of moderate size, racemose, and meeting dorsally, are present in xii; a second pair, also racemose, but smaller, are seen in xi.

The prostates are tubular, each consisting of a stout coil, which occupies xviii and extends into xix also. The duct is short, thinner than the glandular portion, shining; and looped, or with a bend in its course at its beginning.

Ovaries and funnels are present in xiii.

The spermathecal ampulla (fig. 13) is elongated and cylindrical in form; there is no duct, the ampulla joining the body-wall with only a slight narrowing. The single diverticulum, small, short, and cylindrical, is given off from the junction of ampulla and body-wall.

Remarks.—There appears to be a difference between the nephridia in the anterior part of the body of the present specimens and of Bourne's originals. Bourne mentions in segms. vii-xi the presence of complex nephridia consisting each of a nephridial tube with a bush-like group of tubules springing from one part; while in the above examples the nephridia of these segments were very small coils. For the rest the correspondence is such as to leave no doubt as to the specific identity.

On the relation of the present form to the genus *Perionyx* cf. Stephenson, 6, p. 318.

Genus *Perionyx*, E. Perr.

Perionyx crassiseptatus, sp. nov.

(Plate III, fig. 14; plate IV, fig. 15.)

Chalakudi, Cochin State. Sept. 1914. A single specimen, sexual but not fully mature. (Madras Museum).

External Characters.—Length 70 mm.; width 3.5 mm.; body much depressed. Segms. 127. Colour lightish brown, slightly darker dorsally and in the anterior part of the body, otherwise dorsal and ventral surfaces are much the same. A median dorsal groove in the anterior half of the body.

Prostomium epilobous $\frac{1}{2}$, tongue cut off behind.

Dorsal pores begin in furrow $\frac{4}{5}$ (? a small pore in $\frac{3}{4}$).

Setae disposed in rings; the setae are small, and set closer ventrally than dorsally. The dorsal break is very small,—ca. $1\frac{1}{4}yz$; there is no ventral break. The following numbers were counted:—57/v, 55/ix, 54/xii, 56/xix, and 52 in the middle of the body.

The nephridiopores are seen to alternate in position, as in *P. sansibaricus*, in successive segments; one series is one-fifth of the half circumference from the mid-dorsal line, the other two-fifths of the half circumference from the mid-ventral line. The alternation is however not perfectly regular.

The clitellum is not distinguishable; it perhaps includes xiv-xvii, which are slightly lighter in colour.

Midventrally on xviii is a rectangular depression, longer than broad, taking up the whole length of the segment and extending slightly into

xvii and xix. The male pores are very inconspicuous, in the setal zone, on the sides of the depression near its floor. The setae are continued across the floor of the depression between the pores.

The female pore is single, on the anterior part of segm. xiv near furrow 13/14.

The spermathecal pores were not visible externally; from internal examination they must be in 6/7, 7/8 and 8/9, close to the mid-ventral line.

Internal Anatomy.—Septum 5/6 is thin, and perhaps imperfect; 6/7 is somewhat thickened; 7/8 begins to have the peculiar development described below.

All through the anterior part of the body, but more markedly after segm. xv, the septa are replaced by soft, opaque white bodies lying at the sides of the alimentary canal (fig. 14). In antero-posterior extent each is almost the length of a segment, so that successive masses are in contact with each other or nearly so; at their dorsal ends they are somewhat pointed, and approach their fellows, so as almost to meet in the region of the dorsal vessel. The bodies cannot be separated from the sides of the alimentary canal, and there are no visible septa. In the hinder part of the body the masses are somewhat smaller, and do not touch their neighbours in front and behind; but they persist to the hinder end.

Microscopical examination shows that each of these structures represents a septum, increased to an enormous bulk by a great development of elongated pear-shaped peritoneal cells on each face.

The gizzard is cylindrical, moderately firm but very small, in segm. vi.

The oesophagus is very vascular in segms. ix-xii, and shows transverse striation due to the direction of the blood-channels; but there are no calciferous glands.

The last heart is in xii.

The excretory system is meganephridial. The alternation of the position of ending of the nephridia can be confirmed by observation of the end-sacs, which are of some size and elongated transversely. There were only two irregularities in the rule of alternation in the anterior part of the body, so far as opened up,—one on each side.

Testes and funnels are free in segms. x and xi; both are very small (the presence of funnels was concluded from the small iridescent masses of spermatozoa). The seminal vesicles are two pairs, in xi and xii; these were very small, the organs not being fully developed.

The prostates, also probably not fully developed, are small compact blocks, confined to xviii. The duct is very small and short, and leads off from the under surface of the gland.

The female organs were not identified.

The spermathecae are three pairs, and lie at the sides of the ventral nerve cord. They are in the present specimen very small, and perhaps not fully developed; yet the diverticulum of one of the organs is shining, as after copulation. The ampulla is horseshoe-shaped or irregularly lobed; in all, however, the disposition of the two principal lobes has somewhat the appearance of a horseshoe (fig. 15); there is no

distinguishable duct,—or possibly one of the projections on the under surface of the spermatheca illustrated in fig. 15 may be the duct. There is a single spherical diverticulum, given off from the under side of the ampulla.

There are no penial setae.

***Perionyx sansibaricus* Mich.**

Ootacamund, Nilgiris ; ca. 6,700-8,000 ft. 20-30. v. 1921. A number of specimens. F. H. Gravely. (Madras Museum.)

Dhoni Forest, S. Malabar ; ca. 1,500-4,000 ft. E. Barnes. 17-26. v. 1923. A single specimen. (Madras Museum.)

***Perionyx silvicola*, sp. nov.**

(Plate IV, figs. 16, 17.)

Dhoni Forest, S. Malabar ; ca. 1,500-4,000 ft. 17-26. v. 1923. E. Barnes. A single specimen, sexually mature, with the last. (Madras Museum.)

External Characters.—Length 25 mm. ; diameter 2 mm. Colour a light brownish purple dorsally, pale ventrally ; clitellum pale ; the anterior end rather deeper in colour. Segms. 110.

Prostomium epilobous $\frac{1}{2}$, open behind.

Dorsal pores from furrow 4/5.

The setae are disposed in rings ; the dorsal break is equal to about $2yz$, but is irregular ; the ventral is equal to $2-3ab$. The setae are closer set ventrally. The following numbers were counted :—ca. 31/v, ca. 34/ix, ca. 37/xii, 31/xix and 33 in the middle of the body. The setae are difficult to count in the anterior part of the body.

The clitellum includes almost all segm. xiii and succeeding segments as far as xvii (=nearly 5).

The male pores are on segm. xviii, on small papillae, about opposite the third seta on each side.

The female aperture was not visible.

The spermathecal apertures were only doubtfully visible ; from internal dissection they are situated in furrows 7/8 and 8/9, not very close together, about in line with the sixth seta on each side.

Internal Anatomy.—No septa are notably thickened.

There is no gizzard. The intestine begins in segm. xix.

The last heart is in xii.

The excretory system is meganephridial. There is no alteration in the position of the external pores.

Testes and funnels are free in segms. x and xi. Vesiculae seminales are present in xi and xii, those in xii being rather larger than the others ; both pairs are lobulated, and meet their fellows dorsally in the middle line.

The prostates are in segm. xviii ; they are rather small, and are cut up into a number of small lobules. The duct is slightly bent,—almost straight ; it is short, thin, and scarcely shining.

There are large ovaries in xiii.

The spermathecae (fig. 16) are two pairs, situated in segms. viii and ix, and opening in 7/8 and 8/9. The ampulla is a rather irregular sac ; the duct is as long as the ampulla, from which it is demarcated

by a constriction ; it widens below the constriction, and again narrows where it enters the body-wall ; at its widest part it is half as wide as the ampulla. There are two diverticula attached to the widest part of the duct ; each is small, spherical, and is joined to the duct by a very short stalk.

The species shows apparently the first beginnings of the formation of penial setae. I saw no distinct penial setal sacs, but nevertheless obtained from the neighbourhood of the end of the prostatic duct a seta (fig. 17) 0.24 mm. long and 12 μ thick, almost straight, without the curve of an ordinary seta ; the tip tapers, and has a slightly irregular truncated end,—just possibly the extreme end has been broken off. There is no nodulus. The proximal end was not well seen, being embedded in muscular fibres ; it may or may not have the curve which is seen in an ordinary seta. There is no ornamentation.

Sub-family *OCTOCHAETINAE*.

Genus **Octochaetus** Bedd.

Subgenus **Octochaetoides**, Mich.

Octochaetus (Octochaetoides) barnesi, sp. nov.

(Plate IV, figs. 18-20.)

Horsleykonda, Chittoor Dist. ; ca. 3,000-4,100 ft. 11-16. ix. 1923. E. Barnes.
Two specimens, sexually mature. (Madras Museum.)

External Characters.—Length 75 mm. ; diameter 3.5 mm. Colour an indefinite grey ; no difference between dorsal and ventral surfaces. Segms. 201 ; segms. vi-x with slightly marked secondary annulation (two to four annuli).

Prostomium epilobous $\frac{3}{4}$, sides parallel, open behind.

Dorsal pores from furrow 12/13.

Setae of rather large size, paired. In the middle of the body $ab = \frac{3}{7}aa = \frac{1}{2}bc = \frac{4}{5}cd$; behind the genital region $ab = \frac{1}{3}aa = \frac{1}{3}bc =$ just under $\frac{1}{2}cd$, and the ratios are approximately the same in front ; $dd =$ half the circumference in the middle of the body, and four-sevenths more anteriorly.

The clitellum includes xiii-xvii (=5) ; setae are visible but no inter-segmental grooves.

The prostatic pores are two pairs, on xvii and xix, in line with a ; the grooves connecting them are widely bowed outwards, as far as the line of b ; the male pores are presumably at the middle of the length of the grooves, and so will be in line with b . The posterior part of segm. xvii and the anterior part of xix, behind and in front of the level of the pores respectively, are somewhat depressed ; the midventral part of xviii forms a ridge.

The female pores are a pair of minute white spots, immediately in front of the setal zone, and a little internal to a .

The spermathecal pores are two pairs, in $\frac{7}{8}$ and $\frac{8}{9}$, on minute papillae in line with a . On segm. viii, around the setae ab , is an indefinite whitish swelling, which joins its fellow across the middle line.

Internal Anatomy.—Septum 4/5 is moderately thickened ; the next is 8/9,—this and the three following are slightly thickened, 9/10 and 10/11 most so ; 12/13 and 13/14 are also very slightly thickened.

The gizzard is probably morphologically in vii, since there are two pairs of vascular commissures behind it and in front of septum 8/9 ; it consists of a muscular ring, somewhat obliquely placed, so that there is a soft area of gut behind it on its dorsal surface.

The calciferous glands are large, kidney-shaped, and situated in xv ; they take up the whole length of the segment, and surround the alimentary canal completely at each side, being attached by the hilus.

The intestine begins in xvii ; its anterior part shows a large typhlosole, which forms a double fold, beginning abruptly.

The last heart is in xiii.

The micronephridia are numerous, small, and irregularly scattered.

The testes had apparently disappeared ; funnels were seen free in segms. x and xi. Seminal vesicles were present in ix and xii, both pairs rather small ; the two anterior vesicles were each cut up into two almost unconnected portions, the posterior pair were slightly lobed.

There are two pairs of prostates,—coiled tubes of moderate size. The ducts are narrow and shining, of the same thickness throughout, and pass inwards with an almost straight course or with a few gentle undulations.

Ovaries and funnels are present in xiii. There are small ovisacs in xiv.

The spermathecal ampullae are ovoid sacs. There is a single large diverticulum, cylindrical in shape though sometimes with a rather irregular outline ; it is rather longer than the ampulla, half as wide or nearly so, and scarcely narrower at its attachment. There is a short duct,—merely the place just below the ampulla where the diverticulum is attached (fig. 18).

The penial setae (fig. 19) are 1.4 mm. long, and 25μ thick at the middle. The shaft has a gentle curve from end to end, and becomes a little thinner towards the tip. The distal extremity is thinned and flattened, and slightly hollowed as seen from the side ; it is 29 wide. The terminal 0.4 mm. of the seta is ornamented with circles of very fine spines ; these extend distalwards on to the flattened tip ; towards the proximal limit of their extent the circles become irregular.

Copulatory setae are present in segm. viii, apparently two on each side. These are 0.8 mm. long, and 20μ in thickness at their middle. The shaft is slightly curved ; the tip is pointed and slightly bulbous or clawshaped. The distal fourth is ornamented with semicircular depressions, convex backwards, each with a sharp margin (fig. 20).

***Octochaetus (Octochaetoides) excavatus*, sp. nov.**

(Plate IV, figs. 21-24.)

Horsleykonda, Chittoor Dist. ; ca. 3,000-4,100 ft. 11-16. ix. 1923. E. Barnes.
Three specimens, sexually mature. (Madras Museum.)

External Characters.—The size varies ; worms measuring 70 mm. in length and 3 mm. in thickness, and 46 mm. in length and 2 mm. in thickness, were both mature. Colour greyish,—a rather slaty grey,

the anterior end lighter; no difference between dorsal and ventral surfaces. Segms. 150; a slight secondary annulation in vii-x.

Prostomium epilobous $\frac{2}{3}$, open behind.

Dorsal pores from furrow 12/13.

The setae are paired. In the middle of the body $ab = \frac{2}{7}aa = \frac{3}{7}bc = \frac{3}{4}cd$; behind the genital region $ab = \frac{2}{5}aa = \frac{3}{7}bc = \frac{3}{4}cd$; in front of the clitellum $ab = \frac{2}{7}aa = \frac{2}{7}bc = \frac{2}{5}cd$; $dd = \frac{4}{7}$ of the circumference.

The clitellum embraces segms. xiii-xvii (=5); the surface is smooth; dorsal pores are visible.

The male field has the form of a circular or rather hexagonal depression with a well-marked lip; with the lip, it extends over segms. xvii to xix and includes half of xx also (fig. 21). The spermathecal grooves run for most of their extent in line with setae *b*, just within the lip of the depression; but they bend inwards at their ends, so that the prosthetic pores are in line with *a*. The portion of the floor of the depression which is included between the grooves is more deeply excavated than the region in which the grooves lie,—i.e., is at a lower level.

The female and spermathecal pores are as in *O. barnesi*, to which the present form is related. Setae *ab* of segm. viii are displaced, especially *a*, which is shifted backwards, near the spermathecal pore in 8/9.

Internal Anatomy.—Septum 4/5 is moderately thickened; 10/11 and 11/12 are fused at their periphery, and enclose segment xi between them; these and 12/13 are slightly thickened. There is no trace of any septum between 4/5 and 10/11.

There are three hearts between septum 10/11 and the gizzard, which is thus morphologically in viii,—the three hearts corresponding to segments x, ix, and viii. Calciferous glands occupy segms. xv and xvi, meeting dorsally above the oesophagus.

The last heart is in xiii.

The micronephridia are irregularly scattered.

Attached to the anterior face of septum 10/11 is a testis sac on each side, the two being continuous below the oesophagus; the sacs are slightly lobed, and extend upwards, tapering as they do so, by the sides of the alimentary canal. Testis sacs are also present in xi, attached to the posterior surface of septum 10/11; they are smaller than those in x, and rounded in form. When opened, the sacs were found to contain a mass of coagulum, but testes were not distinguishable within this mass; the presence of funnels was concluded from the iridescence of parts of the masses. There were no testes or funnels outside the sacs.

The seminal vesicles are a single pair, in segm. xii; each is elongated transversely, and dorsally it approaches its fellow, tapering upwards towards the dorsal middle line.

The two pairs of prostates are rather short convoluted tubes, of moderate size, confined to segments xvii and xix. The ducts are short, very narrow, shining, of the same diameter throughout, and pass transversely inwards.

Ovaries and funnels are present in xiii; there are small ovisacs in xiv.

The spermathecal ampullae (fig. 22) are rounded sacs. The duct is short, about a quarter the length of the ampulla. There is a single

diverticulum, short, stumpy, slightly curved, its length one-third that of the ampulla, its width equal to that of the duct; it arises from the base of the ampulla; indications of a few seminal chambers are seen as slight bulgings on its surface.

The penial setae (fig. 23) are 1.27 mm. in length and 18μ in diameter at the middle. The shaft is slightly bowed; the tip thin and flat, slightly broadened, and slightly bent back as seen in a side view (*b*). On the distalmost part of the shaft, proximal to the thinned and flattened tip, are about five irregular rings of small spines. The width of the tip is 17.5μ , and that of the shaft in the region of the spines 16μ .

The copulatory setae (fig. 24) are 0.7 mm. in length, and 16μ thick at the middle; the shaft is slightly bowed, and the distal end rather bulbous, with a bluntly pointed tip. The terminal 0.2 mm. of the shaft is ornamented with short irregular rows of teeth forming incomplete circles,—rather an irregularity or fracture of the surface than a row of teeth, yet differing from the semicircular depressions of the previous species; the claw-like termination is also rather more elongated in the present species than in *O. barnesi*.

Remarks.—I had at first ranked this form as a variety of the previous species, with which it is doubtless closely related. But although the relationship cannot be mistaken, the present specimens show so many distinctive features that I think there is no escape from the necessity of erecting a separate species for them. Thus the external configuration of the male field, the absence of so many septa, the testis sacs, and the form of the spermathecae, are important distinguishing characters; while there are minor differences in the penial and copulatory setae, and in the occurrence of only one pair of seminal vesicles.

Octochaetus (Octochaetoides) thurstoni Mich.

(Plate IV, fig. 25.)

Madras. Oct. 1922. F. H. Gravely. Two specimens, sexually mature. (Madras Museum.)

The present species has only been subjected to examination once before, by Michaelsen. I therefore give a few particulars of the specimens now before me.

External Characters.—Length 235-242 mm.; diameter 5-6 mm. Segms. 214. Colour yellowish grey, somewhat darker dorsally, especially at the anterior end, where the dorsal surface is slaty; a narrow dark stripe mid-dorsally.

Prostomium almost (in one) or quite (in the other) tanylobous; the tongue crossed by a transverse furrow nearer its anterior than its posterior end.

Dorsal pores beginning in furrow 12/13.

The setal intervals vary; in one specimen, in front of the genital region $ab = \frac{1}{3}aa = \frac{1}{3}bc = \frac{2}{3}cd$; behind the genital region $ab = \frac{1}{4} - \frac{2}{7}aa = \frac{1}{3}bc = cd$ or less than cd ; in the middle of the body $ab = \frac{2}{6} - \frac{1}{2}aa = \frac{4}{7}bc = cd$ or rather less; in another specimen, in the middle of the body the ratios were:— $ab = \frac{1}{3}aa = \frac{1}{2}bc = \frac{3}{4}cd$. The interval dd is $\frac{5}{9}$ of the circumference in the middle of the body, rather more towards the anterior end.

The number of copulatory cushions was rather greater than in Michaelsen's specimens. In one of mine they were present on xxi-xxiv, and in addition there was a smaller one on xx, and one on xvi; in the other they were on xxiii-xxv, on the left side only in xxii, over furrow 16/17, on the hinder part of xvii and on the middle of xviii; the latter two were small and in the middle line, and rather indefinite.

Internal Anatomy.—Testes and funnels were found free in segms. x and xi. The seminal vesicles in xi were small, those in xii of moderate size, with slightly lobed margins.

The prostatic duct was slightly narrower than the glandular part, shiny, of considerable length, with a general transverse direction but with many undulations.

The spermathecal ampullae were irregular sacs, with irregularly lobed margins. The duct was merely a narrowing of the sac, short and thin, not distinctly demarcated. There was a single diverticulum, small, somewhat flattened, with a number of small lobules, the seminal chambers; the whole rather cauliflower-like, and attached by a short stalk to the ectal end of the duct.

Michaelsen did not find any penial setae. They are however present in the specimens before me (fig. 25). They are 1 mm. in length, and 10 μ thick at the middle; the shaft has a slight curve, more marked distally; the point tapers simply, and is fairly sharp; there is an ornamentation of irregular rings, twelve to sixteen in number, of very small spines, which occupy the distal part of the shaft but not the region of the tip.

Genus **Eutyphoeus** Mich.

Eutyphoeus gammiei (Bedd.).

(Plate IV, fig. 26.)

Jaulah Lake, Amingaon, Assam; in damp earth on an island in the lake 13. iii. 1924. S. L. Hora. A single specimen, sexually mature.

A small village near Jaulah Lake, Amingaon, Assam. 14. iii. 1924. S. L. Hora. A number of specimens, sexually mature.

The species is a variable one; cf. my discussion in the "Fauna of British India" volume (6), pp. 426-428.

The copulatory areas presented themselves here rather as elevations than as depressions. In addition to those usually described, there were a number of small circular papillae, quite irregularly distributed over segms. xi and xii, some even dorsal, with two ventrally in furrow 10/11 and a very few on segms. ix and x.

I now think that the female pores are each, when visible, situated in a whitish not specially defined area just in front of seta *a*. The areas which are shown in the fig. in the "Fauna of British India" are probably the depressions which frequently occur in the course of furrow 13/14.

The young penial setae (fig. 26) have in some cases a double series of oblique markings near the tip, arranged in chevron fashion; the tip is, as often, softened and variously bent.

Subfamily *DIPLOCARDINAE*.Genus **Dichogaster** Bedd.**Dichogaster bolau** (Mich).

Bangalore, Mysore ; ca. 3,000 ft. 6. xii. 1921. F. H. Gravely. A single specimen, sexually mature. (Madras Museum).

Family LUMBRICIDAE.

Subfamily *GLOSSOSCOLECINAE*.Genus **Pontoscolex** Schmarda.**Pontoscolex corethrurus** (Fr. Müll.).

Kankanaddy, Mangalore, S. India. 30. vii. 1923. J. A. M. A single specimen. (From the Government Entomologist, Coimbatore.)
Aberdeen, S. Andamans ; under stones with cocoons. N. Annandale. Two specimens, sexually mature.

Subfamily *LUMBRICINAE*.Genus **Allolobophora** Eisen.Subgenus **Eisenia** Malm.**Allolobophora (Eisenia) foetida** (Sav.).

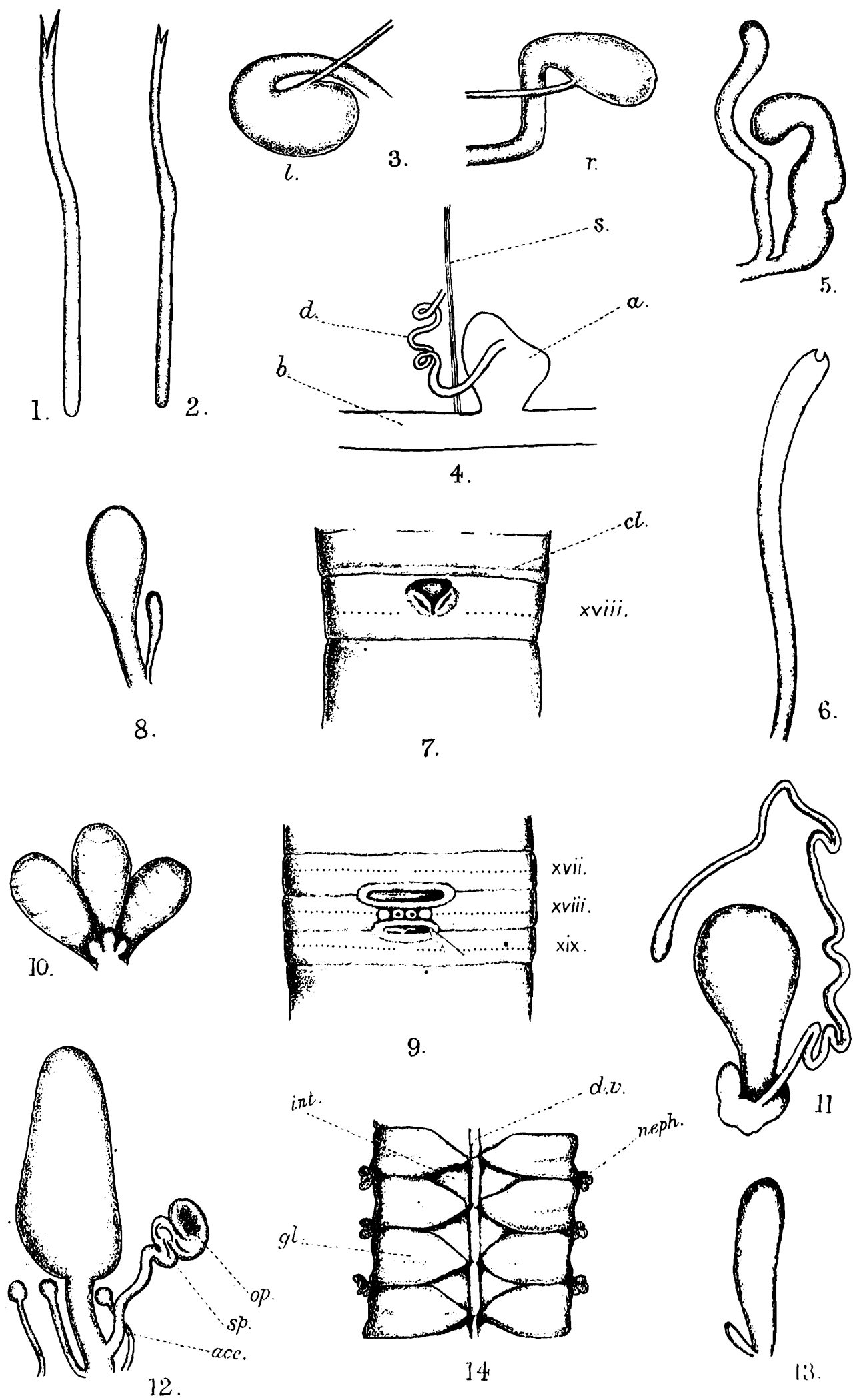
Kurseong, E. Himalayas ; 5,000 ft. ; under stones near edge of water, Sta. 11. 7. iii. 1924. B. N. Chopra. A single specimen, sexually mature.

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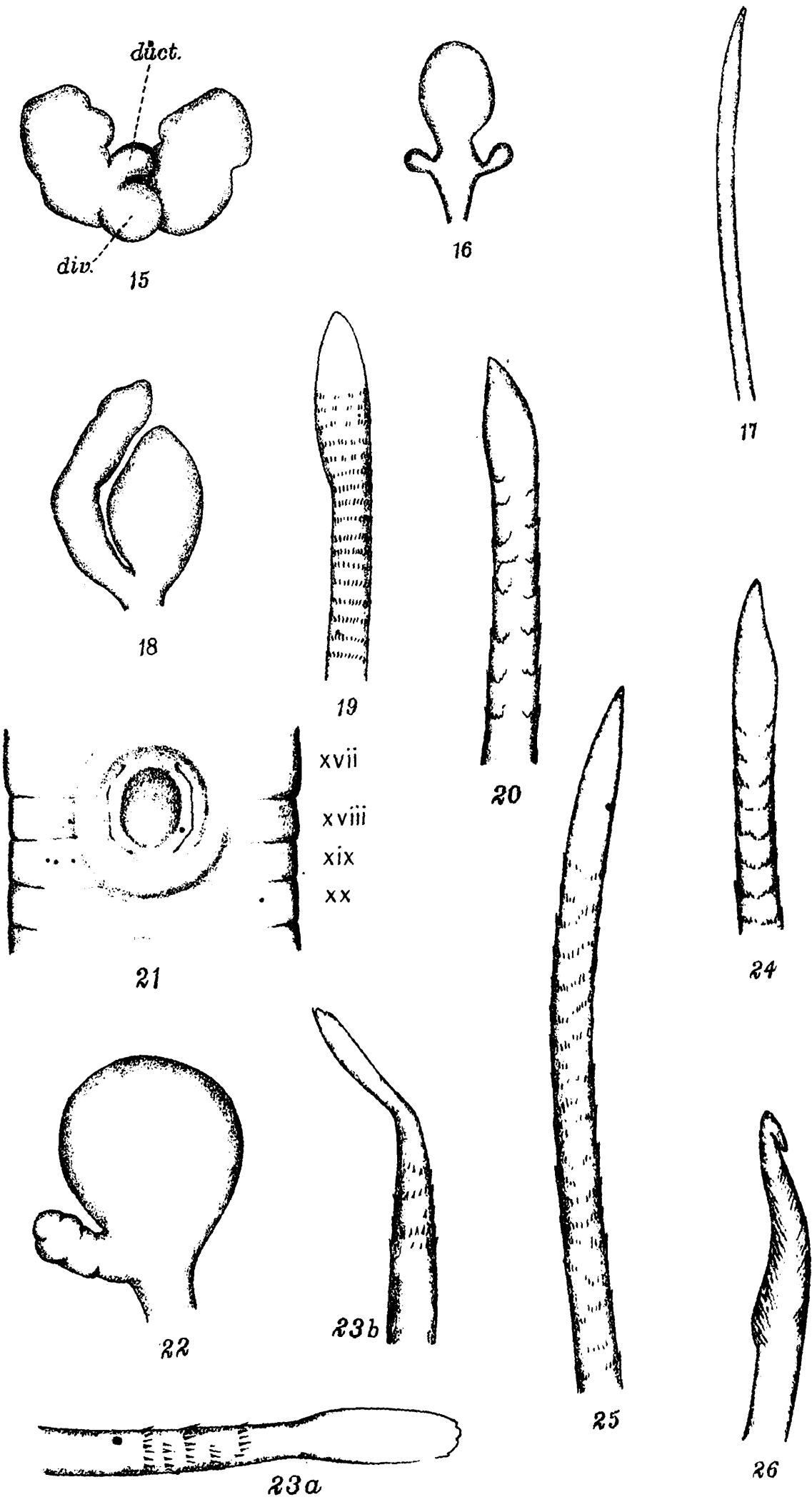
EXPLANATION OF PLATE III.

- FIG. 1.—*Pristina synclites* ; a dorsal needle ; $\times 1,000$.
- FIG. 2.—*Aulophorus gravelyi* ; a dorsal needle ; $\times 850$.
- FIG. 3.—*Drawida papillifer* ; prostates ; *l.*, that of the left side ; *r.*, that of the right.
- FIG. 4.—*Drawida robusta* var. *cochinensis* ; spermathecal atrium, diagrammatic, from the side. *a.*, atrium ; *b.*, body-wall ; *d.*, spermathecal duct ; *s.*, septum 7/8.
- FIG. 5.—*Plutellus macrochaetus* ; spermatheca.
- FIG. 6.—The same ; distal end of penial seta ; $\times 325$.
- FIG. 7.—*Megascolex triangularis* ; male genital area ; *cl.*, hinder limit of clitellum.
- FIG. 8.—The same ; spermatheca.
- FIG. 9.—*Megascolex tripartitus* ; male genital area.
- FIG. 10.—The same ; spermatheca.
- FIG. 11.—*Pheretima harrietensis* ; spermatheca.
- FIG. 12.—*Pheretima wimberleyana* ; spermatheca. *acc.*, an accessory gland ; *op.*, opaque mass in ental end of diverticulum ; *sp.*, spermatophore-like appearances in first part of duct of diverticulum.
- FIG. 13.—*Diporochaeta pellucida* ; spermatheca.
- FIG. 14.—*Perionyx crassiseptatus* ; a portion of the intestine with the glandular thickened septa adhering to it. *d.v.*, dorsal vessel ; *gl.*, the glandular masses ; *int.*, the dorsal surface of the intestine seen between the dorsal ends of the glandular masses ; *neph.*, nephridia appearing at the sides.



EXPLANATION OF PLATE IV

- FIG. 15.—*Perionyx crassispetatus* ; spermatheca, from the under side ;
div., the diverticulum ; *duct.*, probably the duct.
- FIG. 16.—*Perionyx silvicola* ; spermatheca.
- FIG. 17.—The same ; distal end of penial seta ; $\times 210$.
- FIG. 18.—*Octochaetus barnesi* ; spermatheca.
- FIG. 19.—The same ; distal end of penial seta ; $\times 260$.
- FIG. 20.—The same ; distal end of copulatory seta ; $\times 475$.
- FIG. 21.—*Octochaetus excavatus* ; male genital field.
- FIG. 22.—The same ; spermatheca.
- FIG. 23.—The same ; distal end of penial seta ; *a*, seen on the flat ; *b*,
from the side. $\times 450$.
- FIG. 24.—The same ; distal end of copulatory seta ; $\times 375$.
- FIG. 25.—*Octochaetus thurstoni* ; distal end of penial seta ; $\times 575$.
- FIG. 26.—*Eutyphoeus gammiei* ; distal end of a young penial seta.



SOME NOTES ON INDIAN SYRPHIDAE, CONOPIDAE AND OESTRIDAE.

By E. BRUNETTI.

Having received a most kind invitation in the summer of 1923 from Monsieur Hervé-Bazin, with whom I had corresponded slightly some years ago whilst I was in India and he in China, I was afforded the privilege of studying, at his charming old French chateau, his splendid and extensive collection of Syrphidae; and we were enabled to examine the greater part of the species of this family recorded by me in the "Fauna of British India" volume.

This led to the discovery of numerous errors in generic location, and to the relegation to synonymy of several of my species. Monsieur Hervé-Bazin has included all these corrections in a short paper,¹ but since then additional errors and omissions have come to my notice and these are dealt with in the present summary.

It was with exceeding regret that I discovered that no acknowledgment had been made in my volume to Colonel Yerbury for the very valuable assistance he has rendered me on many occasions in consultation on doubtful points and synonymy, in which his extended acquaintance with this family was of the utmost service. My indebtedness to him is great and my thanks are sincerely tendered, also for permission to draw on the very copious notes on Ceylon Syrphidae compiled by him during his residence on that island.

SYRPHIDAE.

Pipizella rufocincta Brun. Mr. Hervé-Bazin has shewn that *P. rufiventris* Brun. is really a *Syrphus*, and I now think that *P. rufocincta* can hardly be a true *Pipizella*, though the specimens referred to are not at present available for comparison. As the name *Syrphus rufiventris* is pre-occupied by Macquart in 1849 for an Australian species, I propose *S. bazini* in consideration for the assistance Mr. Hervé-Bazin has generously rendered me in this family.

Dideoides kempî Brun. The description of the legs should read: "coxae, nearly all the basal half of anterior femora and more than basal half of hind pair; more than apical half of hind tibiae; and all tarsi, wholly black; remainder of legs orange." The only black in the tibiae is the apical half of the hind pair, but all three pairs of tarsi are entirely black.

¹ *Ann. Soc. Ent. Fran.* XCII, 289 [March 26, 1924]. Other short papers by this author touching on Oriental Syrphidae are as follows: *Bull. Soc. Ent. Fran.* 1922, p. 213 (*Korinchia*); *Id.* 1923, p. 25 (new species from Laos, some of which are synonymous with my own); *Id.* 1923, p. 29 (notes on a paper by Becker); *Bull. Mus. Paris* XXIX, p. 252 (*Megaspis*, *Volucella*); *Id.* p. 173 (*Lathyrrophthalmus*); *Ann. Sci. Nat. (Zool.)*, (10) VI, p. 125 (*Lathyrrophthalmus*).

Syrphus cinctellus Zett. I have taken this species on more than one occasion at Darjiling and its identity occurred to me from the first capture, although subsequently doubts arose. On comparison with European specimens the identity was fully confirmed by both Mr. Hervé-Bazin and myself.

Ischiodon scutellaris Fab. My statement (*Fauna*, p. 97) that the stick-like processes are present on the trochanters in both sexes is incorrect, they being present in the ♂ only, as stated by Sack. I have a note of the species being bred from larvae preying on Aphidae on roses at Dehra Dun, 29-XI-18 [*Chatterjee*].

Sphaerophoria bengalensis Macq. My reference to this species (*Fauna*, p. 100) is not clear. The commonest Indian species of the genus is what I have regarded as *indiana* Big. and which may be a form of the equally common European *scripta* L. The other Indian species may be Macquart's *bengalensis*, which may be synonymous with, or a variety of the common European *menthrastris* L. (*taeniatus* Mg.). Macquart's brief description runs as follows :—

“Similar to *S. taeniata*, differing only by the shorter abdomen, of which the bands are wider; the first placed at the middle of the 2nd segment; the 4th segment is tawny with a dorsal black stripe. Bengal (M. Duvaucel), Paris Museum.”

Eristalis (Lathyruphthalmus) connectens Bazin. This species, is recorded from Trichinopoly, Ceylon, one ♂ in Mr. Hervé-Bazin's collection. It also occurs in Java. It was described in the *Ann. Sci. Nat. (Zool.)*, (10) VI, 148, fig. 24, ♂ (p. 149). It was omitted in error from the *Fauna* volume.

Eristalis (Lathyruphthalmus) lugens Wied. (*tarsalis* Macq.). A ♂ recorded by Mr. Hervé-Bazin from Kodaikanal, South India, May 1913. This gentleman has it also from Nankin and other localities, and makes some interesting notes on it in a recent short paper.¹

Eristalis quadristriatus Macq. This species, described from India, was inadvertently omitted; Macquart's description is therefore appended. It must be rather closely allied to *arvorum* but differences in the frons, abdominal markings and the colour of the femora may make it distinct.

“♀. Allied to *E. arvorum* F. Face and frons black, with whitish tomentum; facial bump yellowish. First two antennal joints yellow (3rd missing). Eyes bare, with small black spots. Thorax brassy, with four stripes and a longitudinal one of yellowish white tomentum; scutellum yellowish, black at base. Abdomen dull black, 1st segment yellow, 2nd with a shining yellow band in front, excised in middle and with a transverse yellow spot at each end of anterior margin; 3rd with a small, oblique yellow spot at each end of anterior margin; hind margins of 2nd, 3rd and 4th segments steel coloured, shining; 5th segment entirely of this colour. Belly yellow, tip black. Femora simple, black, tips yellow; tibiae yellow, tips brown; tarsi yellow. Wings hyaline, venation normal, no appendix at inner corner of discal cell.” Macquart

¹ *Ann. Sci. Nat. (Zool.)*, (10) VI, 137.

also referred a ♂ to this species differing only in the tawny scutellum with yellow margin, and in the black and steel parts in the ♀ abdomen being replaced by tawny. Described from India ; in Bigot's collection. Length 8 mm.

Eristalis arvorum F. The reference to the synonym "*Syrphus quadrilineatus* Fab." should read "Mant. Ins." and not "op. cit."

Eristalis simulatus Brun. This cannot be identical with *cerealis* F. as suggested by me (*Fauna*, 414) as it is nothing like *solitus* Walk. which latter species is synonymous with *cerealis*.

Eristalis multifarius Walk. The description of the antennae was omitted. First joint very short, 1st and 2nd joints black, 3rd dark brown, a little greyish dusted, arista bare, orange brown.

Megaspis aesygnus Walk. This species must be deleted from the Indian list, it having been included in my *Fauna* volume inadvertently, possibly through Van der Wulp having given it as coming from East India. In several cases he has altered Walker's quotation "East Indies" to "East India," which of course is not at all the same thing. It is probable that in the early days of zoology the terms "East Indies" and "West Indies" were applied loosely to any part of the Orient and to any of the lands bordering on the Gulf of Mexico respectively.

Merodon interveniens Walk. A closer study of the possible synonyms of this species, except the two which I have had actually before me (*pictipes* Big. and *orientalis* Brun.), impels me to reject all of them. *Eristalis vilis* Wied. must be a true *Eristalis* (sensu lato), as the genus *Merodon* was well known to Wiedemann. Macquart in his *Helophilus curvigaster* neither mentions nor figures any tooth on the hind femora, though his descriptions are often found to be inadequate. *Simoides crassipes* F., an African species, has a closed marginal cell, and is an *Eristalis* (sensu lato), yet *M. interveniens* does appear at first sight like a small form of *crassipes*. The structure of the hind femora in the two species is, however, totally different from one another.

Dissoptera pollinosa Edw. This genus and species were inadvertently omitted. Both were described in the *Proc. Zool. Soc. Lond.* XXX, p. 410, ♂ ♀, pl. xxxviii, fig. 6 (1915), the type coming from Papua, the other specimens, all of which are in the British Museum, from Dong Hanon, Mishmi Country, 2,000 ft., N. E. India, on the Thibetan Frontier, 27, VII, XI, [*F. M. B. viley*]; the Malay States, the New Hebrides and Queensland. *Eristalis flavohirta* Klocker (*Mem. Queens. Mus.* VIII, pt. 1, p. 57 (1924), from Dunk Island, Queensland is synonymous, as Mr. Edwards has informed me.

Milesia sexmaculata Brun. Of this species, described from the ♂ alone, a ♀ has come before me from Coimbatore, South India, sent by Mr. Bainbrigge Fletcher. It agrees very well with the ♂ except that the abdominal spots are rather smaller and narrower. The frons and face are chrome yellow and widen regularly and rather rapidly from the vertex to the lower part of the eyes, the frons being distinctly less than one-third the width of the head at the base of the antennal prominence, the small vertical triangle being black, triangular, with three small dull yellow ocelli. The legs are shortly and softly pubescent. Length about 18 mm., which is considerably less than that of the ♂.

Microdon auricinctus Brun. In the table of species this should be included in couplet 12 (not 13). Also in line 2 from bottom of page 309 after the words "considerable part red" add, in brackets, ("or brown with gold pubescence in *flavipes*").

Microdon apiformis Brun. This name is pre-occupied by Degeer in 1766 for a European species, the name being synonymous with *mutabilis* L., and it was used again in 1824 by Curtis, in which instance it is a synonym of *devius* L. I have proposed *apiformis* nom. nov. in *Rec. Ind. Mus.* XXVI, 152 (March, 1924).

CONOPIDAE.

Owing to the war a paper on Oriental Conopidae published in 1915 by Prof. Krober was not seen by me until after the issue of my volume. In it he has established a number of new species, none of which appear to be synonymous with any of mine. These are as follows:—

<i>Conops indicus</i> Krob.	<i>Arch. Naturg.</i> LXXXI, Heft 7, p. 45.	♂ Sikkim.
<i>C. nigrofasciatus</i> .	<i>loc. cit.</i> p. 46.	♀ Rangoon.
<i>C. maculiventris</i> .	„ p. 50.	♂♀ Sikkim; Burma.
<i>C. tenthrediniformis</i> .	„ p. 51.	♂ Burma.
<i>C. punctifrons</i> .	„ p. 52.	♀ Sikkim.
<i>C. brevirostris</i> .	„ p. 53.	♀ Burma.
<i>C. pseudogigas</i> .	„ p. 55.	♂ Burma.
<i>C. frontosus</i> .	„ p. 57.	♂ Sikkim.

Dr. de Meijere described *C. celebensis* from Celebes [*Tijd. v. Ent.* LIII 165 (1910), as a *Physocephala*], and Krober records it (*Arch. Naturg.* LXXXI, Heft 7, p. 52) from Sikkim.

Conops ornatus Big. 1892. This name was used during the same year for a species by Williston (*Kans. Univ. Quart.* I, No. 1, p. 46, 1892). As this latter was described on page 46 of the above work, whereas Bigot's species was described on page 211 (*Bull. Soc. Zool. France*, XVII) it must certainly have been published first, so that *ornatus* Big. must be renamed, and I have therefore pleasure in proposing *bigoti*, nom. nov.

Conops sepulchralis Brun. This is near *pseudogigas* Krob., but distinct. The latter species has different antennae, a dark spot on each side of the face, a shorter and thicker proboscis, and pale brown wings with an intense violet tinge.

Conops rufofasciatus Brun. This is near *maculiventris* Krob. The latter has a black transverse band above the antennae. The 3rd and 4th abdominal segments are reddish yellow, with nearly triangular black dorsal spots and black side margins. Length 15 mm. Sikkim and Burma.

In *Physocephala* Dr. Becker has described recently the following species:—

<i>P. furax</i> .	<i>Ann. St. Petersb.</i> XVII, p. 612	♂♀ (1913).	Perso-Baluchistân.
<i>P. laeta</i> .	<i>loc. cit.</i>	p. 613	♂♀ <i>id.</i>
<i>P. detecta</i> .	„	p. 615	♂ <i>id.</i>

Prof. Krober redescribes these three species with additional new ones as follows :—

<i>P. detecta</i> Beck.	<i>Arch. Naturg.</i> LXXX, Heft. 10, p. 58 (1914).	Perso-Baluchistan.
<i>P. furax</i> Beck.	<i>loc. cit.</i> p. 58	<i>id.</i>
<i>P. zarudnyi</i> Beck.	„ p. 65 ♂	<i>id.</i>
<i>P. laeta</i> Beck.	„ p. 69	<i>id.</i>
<i>P. persica</i> Krob.	„ p. 59 ♂♀	<i>id.</i>
<i>P. pugioniformis</i> <i>id.</i>	„ p. 64	<i>id.</i>
<i>P. punctithorax</i> <i>id.</i>	„ p. 69	<i>id.</i>
<i>P. scutellata</i> <i>id.</i>	„ LXXXI, Heft. 4, p. 118 ♂ (1915)	Burma.
<i>P. assamensis</i> <i>id.</i>	„ p. 121 ♀	Assam.
<i>P. aterrima</i> <i>id.</i>	„ p. 122 ♂♀	Sikkim.
<i>P. ammophiliformis</i> <i>id.</i>	<i>loc. cit.</i> p. 122 ♂	Burma.
<i>P. aureopygia</i> <i>id.</i>	„ p. 123 ♂♀, p. 131.	Sikkim and Australia.

The Perso-Baluchistan species should be included in any list like the present one as they are all liable to occur in Western and North Western India.

Physocephala bicolor Brun. This name being pre-occupied by Krober (1915) for a species from Matto Grosso, Brazil, I propose *bicolorata* as a nomen novum.

Physocephala diffusa Brun. This comes near *P. limbipennis* Macq., but the latter has a broad blackish brown band before the tip of the hind femora, which is absent in my species.

Physocephala testacea Macq. (*Conops id.*). I examined the type ♀ with another female in the Paris Museum. A reddish brown species; 1st and 2nd abdominal segments wholly red brown, 3rd similarly coloured, bearing a broad hind marginal gold dusted band, 4th segment black with a similar gold margin, remainder more or less gold dusted. Wings clear, a brown costal band ending in clear cut truncate form opposite middle of discal cell; 1st basal cell wholly clear. Legs reddish brown, hind femora a little blackish above. Length about 11 mm.

Sicus vaginalis Krob. *Arch. Naturg.* LXXXI, Heft 1, p. 88, ♀. From East India ("Ostindien").

Occemyia atra. One specimen from Shillong, viii-x-1919 [Fletcher], is probably a large variety of this common European species.

OESTRIDAE.

Therobia abdominalis Wied., *Auss. Zweifl.* II, 200. This species of Oestridae was omitted from the "Fauna" volume on account of Braner himself having removed it to the Tachinidae. I claim no excuse for overlooking the fact that some authors place in the Tachinidae certain genera which have till recently been considered to be Oestrids.

It is described from Bengal. Type in Vienna Museum.

A REVISION OF THE SUB-FAMILY RHINIINAE IN THE ORIENTAL REGION.

By RONALD SENIOR-WHITE, *F.E.S., F.R.S.T.M. & H.,*
Malariologist, The Kepitiigalla Rubber Estates, Ltd.

(Plates V, VI.)

The present paper forms part III of a general revision of the old family Muscidae in the Oriental Region by Major W. S. Patton and the present writer. The two parts which have already appeared (Senior-White, 1924*a*, and Patton & Senior-White, 1924) have covered groups of great economic interest and medical importance, and whilst the same claim can be made for the major portion of the remaining sub-families, that which forms the subject of the present paper, though of much biological interest, has apparently little or no economic status. None the less, a systematic revision, even, as in the present case, with an ultimate medical object, cannot omit the study of any part of a group. In its course it is necessary to cover the present sub-family, just as any revision of the Culicidae must include the Chaoborinae.

The Rhiniinae form a rather homogeneous group, very distinct in general facies from the remainder of the Muscoid Tachinids by reason of the strongly projecting face, whilst in adult habit they are essentially flower flies, and, with few exceptions, are never found in houses or frequenting food or offal. Taxonomically, they are well distinguished as a group by the presence on the upper side of the wing of a row of bristles on the radial sector, by the vibrissae always high above the epistomal margin, the apically clavate palpi, the sterno-pleural bristles arranged 1 : 1, and in the male sex, by the sternites, after the apparent first, being covered by the over-lapping margins of the tergites. This narrowing of the sternites is characteristic of many true Tachinids, none the less, the sub-family probably leads on from the Calliphorines by way of *Anastellorhina* and *Pollenia*, but such questions of phylogeny are outside the scope of the present paper.

The history of the systematics of the Oriental species follows very closely that of the Sarcophaginae of the same area, as described by the writer in his paper 1924*a*. There is a 'first period' commencing with Fabricius in 1794 and ending with Bigot in 1887, during which the tale of the species mounted steadily, but, owing to the much more distinctive external characters the Rhiniinae possess, without leading to such ultimate confusion. Then, just as in Sarcophaginae, there came a pause, in this case of thirty years, only broken by one or two odd fresh descriptions, at the end of which the 'second period' starts with the first revision of the sub-family by Townsend (1917), on whose paper all modern knowledge of the sub-family is based.

The material with which Townsend worked was sent him from the Zoological Survey, and he carried out his researches in America, far from the resting places of the types of the 'first period.' He, therefore, described as new all such species as he could not recognize from

the published descriptions, which, of course, at once ruled out the whole of Walker's numerous descriptions, but thanks to the varying facies of the species, he was able to recognize with certainty many of the older species. Townsend's paper was followed by two by the present writer (Senior-White 1922 and 1923), in which the collections of the Agricultural Research Institute at Pusa and several smaller collections were worked out, and a good many new species described. None the less, in the second of these papers the writer sounded the warning that when type examination became possible many of the new species of the 'second period' would fall to old names. The results of such type examination, with a few additional new species of certain validity, are recorded in Senior-White 1924*b*. As a result of that paper it is hoped that the nomenclature and enumeration of the species in the Region have reached approximate finality, but, since the results of the work of the second period are scattered through four papers, it is necessary that there should be a final revision to collate them and render the determination of species convenient for the general worker. On the other hand, as these papers are all easily accessible and in one language, it is not considered necessary that descriptions appearing in them should be re-quoted in full in the present revision. Only species of which the description is inaccessible or poor are re-described here. The reference or references given under the remaining species are to good descriptions or figures. But, in the majority of cases, most of the noticeable specific characters have been made use of in preparing the specific keys.

The location of a species in the present sub-family can be accomplished with the aid of the composite table on page 219 of my paper 1924*a*. The sub-joined key, which is based on Townsend's of 1917, should enable any species to be correctly located generically. It will be noticed that it commences with the opposite end of the sub-family to Townsend; the reason for this is phylogenetic only.

Comparison of the two keys shows that many of the Townsendian genera have disappeared. My reasons for sinking these in older genera will be found in each case under the genera affected.

KEY TO THE ORIENTAL GENERA OF RHINIINAE.

1. Epistome projected downward rather than forward	2
Epistome projected strongly forward	10
2. Arista plumose or long pubescent, ciliate above and below	3
Arista bare or at most microscopically pubescent	8
3. Anal segment with discals, at least laterally	4
No discals on anal segment	7
4. Arista plumose practically to tip	5
Arista pubescent about two-thirds length only	<i>Metalliopsis</i> Tnsd.
5. Species non-metallic, grey or brown in colour	6
Species metallic, green or blue	<i>Strongyloneura</i> Big.
6. Palpi not apically widened	<i>Idiopsis</i> B. & B.
Palpi apically widened	<i>Pollenia</i> R.-D.
7. Epistome very narrow, hypopygium of moderate size	<i>Thoracites</i> B. & B.
Epistome normal, hypopygium enlarged in both sexes	<i>Chloroidia</i> Tnsd.

8. Facial carina quite absent	9
Facial carina weak but distinct	<i>Metallea</i> Wulp.
9. Apical cell closed or very narrowly open	<i>Rhynchomyia</i> R.-D.
Apical cell widely open	<i>Trichometallea</i> Tnsd.
10. Arista plumose, ciliate above and below	11
Arista ciliate on upper edge only ¹	13
11. Disc of mesoscutum with macrochaetae	12
Disc of mesoscutum without macrochaetae	<i>Borbororhinia</i> Tnsd.
12. Anal segment with median discals ..	<i>Cosmina</i> R.-D.
Anal segment without median discals	<i>Synamphoneura</i> Big.
13. Male genitalia prominent, enlarged .	14
Male genitalia normally small and inconspicuous.	15
14. Apical cell petiolate	<i>Chlororhinia</i> Tnsd.
Apical cell open	<i>Idiella</i> B. & B.
15. Apical cell open or closed, in line with final course of vein IV	<i>Stomorphina</i> Rond.
Apical cell closed, almost in final course of vein III ..	<i>Rhinia</i> R.-D.

Idiopsis Brauer & von Bergenstamm.

Epistome moderately forward produced. Facial carina wanting. Arista biplumose. Palpi narrow throughout, not apically widened. Apical cell open. Male sub-holoptic. Anal segment with irregular discals.

Owing to the shape of the palpi this genus is doubtfully included in the present sub-family—unless the only Oriental species, from which this character is drawn, is wrongly located generically. Townsend is doubtful as to the shape of the palpi in the genotype.

Idiopsis argenticincta Senior-White.

A small dark species, at once recognizable by the transverse band of silvery pollen across the middle of the thorax, starting from the sternopleuron on each side. For detailed description see Senior-White 1923, page 48.

Simla ; Muktesar (Kumaon Himalaya).

Pollenia Robineau-Desvoidy.

Epistome produced forwards,—narrowed. Facial carina present or absent. Arista biplumose. Apical cell open or closed. Male sub-holoptic. Anal segment with irregular discals.

In this genus I would sink *Nitellia* R.-D., as has been done by many previous authors as summarized in Kertész (1907), and also the two Townsend genera *Dexopollenia* and *Polleniopsis*, which differ from *Pollenia* as restricted by Townsend only in the shape of the facial carina, and between themselves only in some chaetotactic characters of very minor value.

KEY TO THE ORIENTAL SPECIES OF *POLLANIA*.

- | | |
|--|---|
| 1. Larger species, fourth vein angled and concave beyond, much as in <i>Sarcophaga</i> | 2 |
| Smaller species, fourth vein practically straight beyond the bend | 4 |

¹ Except in *Stomorphina biplumosa* S.-W.

2. No yellow at wing base	3
Base of wing strongly yellow infuscated ..	<i>pilosa</i> Tnsd.
3. Anterior end-piece of aedoeagus forked, posterior long, thin spine ..	<i>rudis</i> Fab.
Anterior end-piece of aedoeagus unbranched, posterior short, broader, half its length ..	<i>indica</i> S.-W.
4. Lateral discals present on all abdominal segments ..	5
Lateral discals on apical segment only ..	6
5. Brown species, thorax with yellow pile ..	<i>testacea</i> Tnsd.
Grey species, thorax with thick golden woolly pile ..	<i>hazarar</i> S.-W.
6. Antennae barely one-third height of eye, short	<i>khasiensis</i> S.-W.
Antennae half height of eye, long	<i>pilisquama</i> sp. nov.

***Pollenia pilisquama*, sp. nov.**

Female. *Head*: frontal stripe black, parafrontals ashy, with dull black patches around bases of bristles. Two proclinate fronto-orbitals. Face and cheeks ashy grey, a dark patch at junction of two latter. Epistome not very strongly produced, but vibrissae well above mouth border. Facial carina low but very sharp. Antennae black, half the height of an eye, the third joint 4-5 times the length of the second and arising higher on head than in *khasiensis*. Palpi yellow-brown apically, and lightly clavate. *Thorax* dark grey with indefinite black stripes. Pleurae similar but rather darker. Acrostichals and dorso-centrals both 2:3, sternopleurals 2:1. Abdomen black and grey tessellate, very like a *Musca*. Marginals on apparent third and fourth segments very strong, lateral discals on fourth weak. *Legs* black, tarsi very spinulose. *Wings* with costal and sub-costal cells yellowish, otherwise clear. Costal spine double and very strong. Fourth vein straight beyond the bend, and closing first posterior cell in margin. Squamae with small patch of hairs as in *M. inferior*. Long $4\frac{1}{2}$ mm.

The whole appearance is very like a *Musca*, but the species is undoubtedly closely allied, though well distinct from *Pollenia khasiensis*. Described from a unique female, taken on window, Suduganga, Matale Dist., Ceylon; 15. viii. 24. In my own collection.

***Pollenia khasiensis* Senior-White.**

A small dark grey species not possessing any noticeable characters for recognition. The sternopleurals are formed 2:1, but I think the species is correctly located here. For detailed description see Senior-White 1923, page 49. Only known from Shillong.

***Pollenia rudis* Fabricius.**

Musca obscura Fab. *Musca depressa* Meig. *Musca varia* Meig.

Male, female. *Head*: epistome forward produced, the opening narrowed, its margin yellowish. Arista biplumose. Palpi black or yellow. Genae grey, brownish anteriorly. A black fleck at junction of parafrons and parafacials, and another, large and greyish, on latter below. ♂ Sub-holoptic, ♀ frons exceeding an eye-width, with one reclinate and two proclinate exterior frontals. *Thorax* dark greyish, with sparse hair of silvery-gold, the macrochaetae black. Sternopleu-

rals normally 1 : 1, but a weak extra one is sometimes developed anteriorly. *Abdomen* grey and black tessellate. Strong median discals on apparent fourth segment. *Legs* black. *Wings* slightly smoky. Long 8-9 mm.

This Palearctic species only enters the Oriental Region in Kashmir. It is the only species of which the life-history is known, being parasitic on earthworms, as discovered by Keilin.

***Pollenia indica* Senior-White.**

Very closely allied to *rudis*, but more elongate. For description see Senior-White 1923, page 51, and plate iv, figs. 7 & 8 of the same paper, where the genitalia are figured compared with those of the preceding species. Only known from the Kumaon Himalaya.

***Pollenia pilosa* Townsend.**

A large grey species, noticeable for the orange coloration about the base of the wing. For detailed description see Townsend 1917, page 202. An Eastern Himalayan species, recorded by myself with some doubt from the Khasia Hills.

***Pollenia hazarae* Senior-White.**

At once noticeable by the thick dull golden wooly pile enveloping the thorax. For detailed description see Senior-White, 1923, page 51. Only known from the Western Himalaya (Abbottabad).

***Pollenia testacea* Townsend.**

A reddish brown species, with some yellow pile on the thorax. For detailed description see Townsend 1917, page 201.

Only known from the foothills of the Eastern Himalaya.

This genus in the Oriental Region is obviously an intruder from the Palearctic,—being confined to the Himalaya, except for two species on the Khasia Hills in Assam, and one species in Ceylon, where the fauna is well known to have Himalayan affinities.

***Strongyloneura* Bigot.**

Epistome produced forward. Arista oiplumose. Palpi apically spatulate. Facial carina present or absent, the latter in *Strongyloneura sens. strict.*, but there are traces of one in *S. coeruleana*, leading on to its strong development in species formerly placed in *Thelychaeta*, but as there is an intermediate condition for the feature, the latter genus is hereby sunk. The course of the fourth vein may be evenly rounded or sharply angled,—and is not quite constant, even within the species, but the apical (first posterior) cell always ends more or less bottle-necked, as in *Pyrellia*. The character of the course of the fourth vein being quite illusory, I also sink here *Synamphoneuropsis* Tnsd. The male is sub-holoptic. Anal segment with discals.

KEY TO THE ORIENTAL SPECIES OF *STRONGYLONEURA*.

1. Facial carina weak or absent	2
Facial carina strong, widely separating antennae	8
2. Wings unmarked, species more or less green	3
Wings apically infuscated, blue species	<i>apicipennis</i> S.-W.
3. Antennae yellow to brown	4
Antennae black	<i>nigricornis</i> S.-W.
4. Facialia unmarked	5
Facialia with brown fleck near middle	<i>viridis</i> Tnsd.
5. Parafacialia golden to brown	6
Parafacialia grey	<i>coerulana</i> Tnsd.
6. Green species	7
Purplish, or with much white pile	<i>nebulosa</i> Tnsd.
7. Facial hairs yellow ..	<i>nepalana</i> Tnsd.
Facial hairs black	<i>viridana</i> Tnsd.
8. Wings unmarked, or nearly so	9
Wings with apical half infuscated	<i>dotata</i> Wlk.
9. Parafacialia yellowish	<i>viridaurea</i> Wd.
Parafacialia dark grey	<i>chalybea</i> B. & B.

***Strongyloneura apicipennis* Senior-White.**

A dark blue species, with apical half of wings infuscated. For detailed description see Senior-White 1924*b*, page 116.

Only known from the Philippine Islands.

***Strongyloneura coerulana* Townsend.**

For detailed description see Townsend 1917, page 198. The genitalia are figured in Senior-White 1923, plate iv, fig. 2.

Known from South India, Ceylon, Andaman Islands and Malaya.

***Strongyloneura nebulosa* Townsend.**

For detailed description see Townsend 1917, page 197. The genitalia are figured in Senior-White 1923, plate ii, fig. 3.

Widely distributed in India.

***Strongyloneura nepalana* Townsend.**

For detailed description see Townsend 1917, page 196. The genitalia are figured in Senior-White 1923, plate ii, fig. 1.

Widely distributed in India.

***Strongyloneura nigricornis* Senior-White.**

A smaller species, at once distinguished from the other green species of the genus by the black antennae. For detailed description see Senior-White 1924*b*, page 115.

Only known from Cherat, N.-W.F.P., India, and Buru Island, Dutch East Indies. The first locality is on the Palearctic boundary of the region, the second beyond it, in the Austro-Malayan.

***Strongyloneura viridana* Townsend.**

For detailed description see Townsend 1917, page 197. The genitalia are figured in Senior-White 1923, plate ii, fig. 2.

Widely distributed in India.

***Strongyloneura viridis* Townsend.**

For detailed description see Townsend 1917, page 199.

Not recorded south of the Indo-Gangetic Plain.

***Strongyloneura chalybea* Brauer & von Bergenstamm.**

? *Somomyia infumata* Big.

Very much as in *viridaurea* Wied., but with parafacials dark grey. Pleural hairs are black, and there is no bunch of small black bristles in upper anterior angle of mesopleuron. The ground colour of the body is a more sombre green, with segments one to three more broadly black banded, the median stripe fine and obscure. No tessellate pattern. Femora and tarsi black. Tibiae dark brown. Wings very lightly darkened along the costal margin. Long 16 mm.

Recorded from Borneo, Burma and South India.

***Strongyloneura viridaurea* Wiedemann.**

Somomyia caeruleocincta Big. *Musca munda* Wd. *Pyrellia sivah* Big. *Somomyia versicolor* Big.

Male, female. *Head*: ♂ frons reduced to a line, parafrons narrowly present. ♀ frons three-fifths an eye-width, the parafrons dull ashy yellow. Antennae dark brownish yellow, third joint grey pollinose, widely separated by the short, tubercular carina. The parafrontal bristles run down to the parafacials, in two rows, black. Face dull yellowish brown. Genae as facials. Palpi yellow, apically spatulate. *Chaetotaxy*: Acrostichals 1:2; dorso-centrals 2:4. Pleurae with long soft sparse golden hairs. Upper angle of mesopleuron with a bunch of small black bristles. *Thorax* golden green, with very little white pile. *Abdomen* with some tessellation of white pile. Segments I to III black banded posteriorly. A median stripe on II to IV, broad only on II. *Legs*: femora metallic, tibiae brown with broad black tips, tarsi black. *Wings*: costal margin a little yellowish, there may be some infuscation preapically. Vein III bristly on the node and a little beyond on both sides. Long 11-15 mm.

Recorded from Ceylon, the Eastern side of India, the Himalaya, Burma, Malaya, Java and the Philippines.

***Strongyloneura dotata* Walker.**

I am indebted to Major Austen for the following re description of the type.

"Type ♂.—Length 8.4 mm., width of head just over 3 mm., length of wing 8.2 mm.

Dorsum of body metallic bronze-green; first abdominal segment bronze-black, its hind margin, except in middle, narrowly bronze-green; second and two following abdominal tergites with a not very narrow continuous, median, black longitudinal stripe, second and third tergites also each with a bronze-black transverse band, in contact with anterior margin in middle but tapering off towards hind border at each lateral extremity, so that anterior angles of each tergite are broadly metallic bronze-green, second tergite also with its extreme hind margin bronze-

green; bronze-green lateral extremities of second and two following tergites thinly clothed with pale neutral grey pollen; fifth tergite bronze-green, its extreme tip black-bronze.

Head: eyes narrowly separated in middle of frons by olive-buff frontal margins; occiput black or olivaceous black, posterior orbits pale smoke-grey pollinose; jowls light neutral grey, facial angles orange-cinnamon, clypeus greyish cinnamon-buff; facial carina present but not very conspicuous, descending to level of middle of third antennal segment, then spreading out. Palpi cinnamon buff slightly spatulate at tips; antennae cinnamon-coloured, terminal segment somewhat brownish, arista dark brown, long and slender and feathered with long hairs above and below.

Abdomen: fourth and fifth tergites with median as well as lateral discal macrochaetae.

Wings: rather more than distal halves, from just beyond anterior transverse vein to tips, infuscated, darkest portion of this area resting on costa, from a little beyond end of first longitudinal to end of second longitudinal vein, and terminating in tip of discal cell, in which it occupies rather more than one-third of total area."

Not seen since its original description from Singapore.

Chloroidia Townsend.

Epistome forward directed. Facial carina absent. Arista biplumose. Male sub-holoptic. Macrochaetae bristle-like, on margins of last two segments. Intermediate abdominal segments of male extremely shortened, the two genital segments greatly enlarged and almost as long as the four preceding segments. Fifth sternite of male with a spine brush, sixth sternite excessively broadened and with spine-brushes on each side. Female hypopygium large and broad. Apical cell of wing very narrowly open, almost closed.

Chloroidia prolata Walker.

Chloroidia flavifrons Tnsd.

Plate V, figs. 1—4, 14.

The most beautiful of the Indian Muscids. At once recognizable by the yellow head, bright, non-shining green thorax, and shining purple abdomen. For full description see Townsend 1917, page 196. The minute aedoeagus, in comparison with the enormous ixth tergite, is very notable. The structure of the proboscis shows that the species is predaceous.

Occurs in South India, Ceylon, Assam, Burma and Celebes.

Thoracites Brauer and von Bergenstamm.

Epistome forward produced, very narrow. No facial carina. Arista biplumose to tip. Male eyes as far apart as length of second antennal joint. Macrochaetae marginal on sides of first abdominal segment, discal and marginal on sides of second and third, strong on margins of last segment. Female frons narrower than usual, with one reclinate and two proclinate frontals. Strong marginal spines in female. Apical cell narrowly open.

Thoracites abdominalis Fabricius.*Rhynchomyia plumata* Schin. *Cosmina varia* Wlk.

Head : ♂ frons rather wide, ♀ frons one-third of head width, the eyes sharply diverging from the vertex. Frontal stripe dark yellow, parafrons and face pale yellow, parafacialia not distinguished. Genae and occiput concolorous. Antennae and palpi slightly darker yellow. *Thorax* pale metallic green, with a varying amount of pale yellowish pile, sometimes appearing greyish bronze. No pilose pleural stripe. *Abdomen* brownish-yellow, darkened apically. *Legs* : front femora metallic green, posterior pairs black. Tibiae brown and tarsi black. *Wings* brownish-infuscated along costa. Long 7-8 mm.

Apparently a coastal species, known from the East Coast of India and from Ceylon at sea-level.

Trichometallea Townsend.

Epistome forward produced. No facial carina. Male sub-holoptic. Arista bare. Mesoscutum, scutellum and abdomen pilose in male, but not in female. Anal segment with discals. Apical cell widely open. The male sternites in this genus are uncovered, but I think it is correctly located here.

Trichometallea pollinosa Townsend.

For description see Townsend 1917, page 194. India, Ceylon and China.

Rhynchomyia Robineau-Desvoidy.

Epistome forward produced. No facial carina. Arista microscopically pubescent. Apical cell narrowly open. Male sub-holoptic. No differentiated proclinate fronto-orbitals in female.

I have no hesitation in sinking Townsend's *Rhynchomyiopsis* here. The separatory characters are very weak.

Rhynchomyia indica Townsend.

For description see Townsend 1917, page 195.

Only known from Karachi, the species probably belongs to the Ethiopian fauna, and may prove to be synonymous with some African species.

Metalliopsis Townsend.

Epistome forward produced. Facial carina weak, flattened. Arista short plumose on basal two-thirds. Male sub-holoptic. Female frons rapidly widening from vertex, parafrontalia thickly bristled outside of frontal row. Parafacialia hairy above. Irregular discals on anal segment. Apical cell widely open.

Metalliopsis setosa Townsend.

For description see Townsend 1917, page 198.

Known from the Eastern Himalaya and Malaya.

Metallea van der Wulp.

Epistome forward produced, but only slightly. Facial carina flat and weak. Arista finely pubescent. Male sub-holoptic. A marginal row of macrochaetae on last three abdominal segments. Apical cell well open. As the structure of the ♂ genitalia shows (Plate i, figs. 6, 9, 10), the genus is apparently related to *Cosmina*.

KEY TO THE ORIENTAL SPECIES OF *METALLEA*.

- | | |
|---|------------------------|
| 1. Femora all black | 2 |
| Femora with basal half yellow-brown | <i>flavibasis</i> S.-W |
| 2. Abdomen towards apex with metallic green lateral patches | <i>notata</i> Wulp. |
| No such patches | <i>divisa</i> Wlk. |

Metallea flavibasis Senior-White.

For description see Senior-White 1922, page 168.
Known from the Gangetic Plain and Ceylon.

Metallea divisa Walker.

Metallea nigrofemorata S.W. *Rhynchomyia palliceps* Big.

Plate V, figs. 6, 9, 10.

For description see Senior-White 1923, page 46 (as *nigrofemorata*).
Recorded from the Himalaya, the Gangetic Plain, and Australia.

Metallea notata van der Wulp.

The following is a translation of Wulp's very full description.

Head pale yellow ochre, frontal band orange, very narrow, terminating in a shining spot above the antennae, the middle of the face and the mouth edge very shining. Antennae and palpi orange, the latter pale but brown at the extreme tip. Epistomal hairs whitish yellow. *Thorax* and scutellum a beautiful metallic green, yellowish grey dusted, laterally ashy, but not entirely obscuring the ground colour, the chaetae arising from small black papules. *Abdomen* a transparent yellow on the first three segments, the third ring with a posterior band of metallic green covering almost half its length. Further, on the second and third, and, more or less, on the last segment, dark brown dorsal patches fleck-like, and on the second segment a pair of similar side patches placed bar-wise, the whole more or less visible on the ventral side. Fourth segment is altogether opaque, partly metallic green, with a sprinkling of yellow dust and black hair-papules. *Legs*: femora black, the fore pair with metallic green reflections; tibiae brownish yellow with black tips; tarsi dark brown, lighter basally. *Wings* almost clear, with a somewhat yellow tint basally. Long 7 mm.

India, general but rare. Java. China. ? South Africa.

Borbororhinia Townsend.

Epistome produced downward, facial carina weak. Arista thinly biplumose. Male eyes widely separated. Thorax and abdomen finely

pubescent, the former without macrochaetae, the latter with fine hair-like marginals. Male genitalia somewhat prominent. Apical cell narrowly open.

Borbororhinia bivittata Walker.

Borbororhinia pubescens Tnsd.

Plate V, figs. 5, 7, 8.

For description see Townsend 1917, page 188 (as *pubescens*).

Known from Borneo, Buru Island, Assam, South India and Ceylon.

Cosmina Robineau-Desvoidy.

Epistome produced downwards, not very strongly. Facial carina weak. Arista biplumose, tip more or less bare. Male eyes nearly contiguous. Male hypopygium large. Macrochaetae on anal segment weak, practically only marginal. Apical cell open.

I do not think that there is more than one Oriental species in this genus, of which the oldest name is that of Walker.

Cosmina aenea Walker.

Cosmina micans Big. *Phumosa fulvicornis* Big. *Cosmina indica* S.-W. *Idia basifera* Walk. ms.

For description see Senior-White 1923, page 42 (as *indica*).

Recorded from West Africa, India, Java and Borneo.

Synamphoneura Bigot.

Epistome produced forward, broad. Facial carina absent. Arista biplumose. Male eyes nearly contiguous, frontalia pinched out. Male hypopygium rather large. Strong marginal macrochaetae on anal segment. Apical cell varying from narrowly open to closed and petiolate.

Synamphoneura bicolor Walker.

Synamphoneura cuprina Big. *Cosmina pinangiana* Big.

Head: ♂ sub-holoptic, ♀ frons nearly one-third of head width. Frontal stripe pinched out in ♂, in ♀ chestnut brown. Parafrontalia ashy with shining black spots. Parafacialia silvery white, with two shining black patches. Face shining black, separated from the similar genae by a yellowish stripe which seems silvery in certain lights. Antennae yellow-brown. Palpi apically spatulate black, paler at extreme tips. *Thorax* shining coppery green, with whitish pollen and black spots, with four darker, non-pollinose stripes. *Abdomen* concolorous, with a dark median stripe. *Legs*: femora metallic green, tibiae brownish, tarsi brown on the basal, black on the apical segments. *Wings*: costa deeply infuscated up to second vein, and broadly but less deeply over apex to bend of fourth vein. Apical cell open or closed petiolate in varying degrees, not always constant in opposite wings of same specimen. Long 6-8 mm.

Idiella Brauer & von Bergenstamm.

Epistome produced forwards. Facial carina well developed, sharp. Arista long ciliate above only. Male eyes well separated, the frontalia broadly present throughout. Apical cell closed or narrowly open. Male hypopygium usually prominent.

KEY TO THE ORIENTAL SPECIES OF *IDIELLA*.

- | | |
|---|----------------------------|
| Large species (8 mm.), base of abdomen usually bright yellow. Costa yellowish | <i>mandarina</i> Wd. |
| Small species (5 mm.), base of abdomen dark brown. Costa dark brownish | <i>euidielloides</i> S.-W. |

Idiella mandarina Wiedemann.

Idia bengalensis R.-D. *Stomorphina bivittata* Big. *Idia nigricauda* Big.

Plate VI, figs. 1—3.

Head: ♂ broadly sub-holoptic, ♀ frons one-fifth of head width. Frontal stripe dark brown to black, parafrontalia white with shining black spots. Face shining black, parafacialia white with shining black spots, a very large one just before lower margin. Genae shining black, separated from face by a brownish spot above, but not so from epistome. Antennae brown. Palpi black. Occiput on lower half thickly golden haired. *Thorax* green, thickly greyish-white dusted, so as to nearly obscure the ground colour, with black spots. In certain lights three obscure darker stripes are visible. Pleurae throughout thickly golden haired. *Abdomen*, two basal segments normally orange, sometimes darkened. Apical segments blackened, the tip of abdomen shining blackish-green. *Legs*: femora black, tibiae and first tarsal joint brownish, rest of tarsi black. *Wings* yellow basally, a small apical infuscation. Long 8 mm

The widely spread superior claspers are quite unlike a Rhiniine, and amply justify the separation of the genus from *Stomorphina* and the allied genera erected by Townsend.

Widely distributed in the Oriental Region.

Idiella euidielloides Senior-White.

For description see Senior-White 1922, page 166.

Known from Assam, and the Philippines. I have also taken a specimen in Ceylon, Nalanda, 17-1-23.

Stomorphina Rondani.

♂ Holoptic or nearly so. Facial carina present. Arista ciliate above only; in one aberrant species biplumose. Abdominal macrochaetae from none to marginal on last two segments. Apical cell varying from fairly widely open to closed petiolate. In this genus I would sink *Euidiella* and *Idielliopsis* Townsend. The figures of genitalia in the various Townsend groups show an essential similarity of construction.

KEY TO THE ORIENTAL SPECIES OF *Stomorphina*.

1. Apical cell open	2
Apical cell closed, in line with final course of vein IV	<i>xanthogaster</i> Wd.
2. Antennae ciliate only above	3
Antennae with arista biplumose	<i>biplumosa</i> S.-W.
3. Apical cell quite widely open	4
Apical cell narrowly open	5
4. Abdomen yellow, black banded	<i>lunata</i> Fab
Abdomen green	<i>unicolor</i> Macq
5. Femora always black (base of hind pair sometimes paler)	6
Femora pale brownish-yellow	<i>luteigaster</i> Meij.
6. Front tibiae pale, at least basally	7
Front tibiae all black	10
7. Abdomen all dark, without traces of yellow markings	8
Abdomen with some yellow markings	9
8. Large species, thorax green, abdomen purple	<i>melanostoma</i> Wd
Small species, abdomen dark green	<i>simplex</i> Wlk
9. Abdomen luteous, with dark median stripe of varying extent	<i>discolor</i> Fab.
Abdomen black, with brown spots on second and third segments	<i>quadrinotata</i> Big.
10. Genae and pleural stripe yellow	<i>discolor</i> Fab. ab. <i>nigripes</i> S.-W.
Genae and pleural stripe grey	<i>nila</i> S.-W.

***Stomorphina lunata* Fabricius.**

Idia cinerea R.-D. *Idia fasciata* Meig. ? *Idia rostrata* Wd. *Stomorphina maculata* Rond.

Plate VI, figs. 7—9.

Head: ♂ holoptic, parafacialia silvery, with a large shining black spot. Face shining black, epistome brown. Occiput and genae pale ashy, with long concolorous hairs. *Thorax* pale bluish-grey, with three dark greenish-grey stripes. In the ♂ covered with thick short upright black pile, not so in ♀. Pleurae thickly pale whitish-yellow haired. *Abdomen*: first segment all black, second and third bright yellow with a broad median stripe and narrower hind margins black, fourth black with patches of grey shimmer as in a *Musca*. *Legs*: femora and tibiae brown, appearing greyish in certain lights, tarsi darkened. *Wings* clear. Vein IV very obtusely angled at bend leaving apical cell fairly widely open. Long 7 mm.

Occurs throughout the Palearctic and Ethiopian Regions. In the Oriental Region only found in Baluchistan and the Himalaya, which of course have strong Palearctic affinities. Townsend (1917) records it from the Nilgiris, but this record has not since been confirmed.

***Stomorphina discolor* Fabricius.**

Idia cincta Big. *Stomorphina muscina* Rond. *Idia metallica* Macq.

Plate V, figs. 11—13.

Head: ♂ sub-holoptic, ♀ frons nearly one-third of head width. Frontal stripe dark brown, parafrontalia whitish, with shining black

spots. Parafacialia similar. Face, epistome and anterior half of genae shining black. Posterior half of genae and occiput yellowish white with concolorous hairs. Antennae brown, thickly grey dusted. Palpi brown. *Thorax* ground colour green, thickly grey dusted, covered with small black spots. Pleurae with golden (or whitish) yellow pile forming a stripe. *Abdomen* luteous, the segments with black hind margins, and with a median black stripe of varying width and extent, which sometimes is so extensive as to quite alter the superficial appearance of the specimen. *Legs*: front coxae yellow, posterior pairs black. Anterior femora all black, hind pair with basal third brownish-yellow. Tibiae brownish-yellow, front and hind pairs darkened apically. Tarsi brownish-yellow, apical segments black. *Wings* with apical cell narrowly open. Apex more or less infuscated, never extensively. Long 6-7 mm.

ab. *nigripes* S.-W I described this (Senior-White 1922), as a variety, but as I have never come across another specimen, I think that it is little more than an individual aberration.

Perhaps the commonest Oriental species of the sub-family. Known from India to Hong Kong, Fiji, New Caledonia and North Australia.

***Stomorhina quadrinotata* Bigot.**

Head: ♂ sub-holoptic, ♀ frons nearly one-third of head width. Frontal stripe black, parafrontals dark grey with black spots, parafacials similar. Face grey beneath antennae. Genae and epistome shining black. Occiput ashy grey. Antennae and palpi black. *Thorax* very dark green, with greyish white pile and numerous small black spots. A median and two sub-dorsal black stripes are visible. Pleurae with ashy-grey, not thickly piled, stripe. *Abdomen* dark brownish-black, with a pair of light ochraceous side spots on dorsum always present on second, sometimes on first, and sometimes on third segment. In the ♂ from the Philippines, referred to in Senior-White 1924b, the whole of the first segment is yellow, except for a narrow apical band, as is also the second segment, except for the apical and a narrow median stripe, and the spots on the third are also large. *Legs*: femora black, tibiae and first two tarsal segments brown, apical tarsal segments black. *Wings* clear, apparently never with an apical infuscation. Apical cell narrowly open. Long $5\frac{1}{2}$ mm.

The distribution of this species extends from the Darjiling Himalaya, through Assam, to Borneo, the Philippines and China. I have previously recorded it from Buru Island (Dutch East Indies), which is in the Austro-Malayan Sub-Region.

***Stomorhina simplex* Walker.**

Idiella cyanea Stein. *Euidiella unicolor* Tnsd. (nec Macq.).

For description see Townsend 1917, page 193 (as *unicolor*). As I have pointed out (Senior-White 1923), there may be an apical infuscation of the wing of which Townsend omits to make mention,

Recorded from India, Sumatra, Borneo and the Seychelles.

Stomorphina melanostoma Wiedemann.*Euidiella purpurea* Tnsd.

Plate V, figs. 15, 16.

For description see Townsend 1917, page 193 (as *purpurea*)

Recorded from India, Java, Malaya and Buru Island.

Stomorphina nila Senior-White.

For description see Senior-White 1922, page 168. There may be brownish dorso-lateral abdominal patches, much as in *quadrinotata*, but darker. Apparently confined to the various Hill ranges of Peninsular India.

Stomorphina unicolor Macquart.

Head: frons black, parafrontals grey. Face dark shining green. Antennae and palpi black. Genae ashy. *Thorax* green, without a distinct lateral stripe across pleurae. *Abdomen* dark green. *Legs* dark brownish. *Wings*, the apical cell more widely open, as in *lunata*.

Described from Java; the species does not seem to have come to hand since, and fresh specimens are required for an adequate description.

Stomorphina luteigaster de Meijère.*Euigiella termitophila* S.-W.For description see Senior-White 1923, page 45 (as *termitophila*).

Recorded from Java and Upper Burma.

Stomorphina xanthogaster Wiedemann.*Idia australis* Wlk. *Idiellipsis similis* Tnsd.

Plate VI, figs. 4—6.

For description see Townsend 1917, page 190 (as *similis*).

From India through Malaysia to Australia. Kertész (1907) records it from Arabia.

Stomorphina biplumosa Senior-White.For description see Senior-White 1924*b*, page 110.

Recorded from Siam and Malaya.

Chlororhinia Townsend.

Male sub-holoptic. Facial carina present but weak. Arista merely pubescent, on upper side only. Male hypopygium large. Apical cell petiolate, in line with third vein.

Chlororhinia viridis Townsend.

For description see Townsend 1917, page 191. The fact that the pilose stripe from the genae across the pleurae, which is usual in this section of the Rhiniinae, is wanting in this species is noted in the generic and not in the specific description. Should another species be

found, corresponding with the generic definition except in this particular, the presence of the pilose stripe would not invalidate its inclusion in this genus. The present species is only known from the Assam Hills.

Rhinia Robineau-Desvoidy.

Beccarimyia Rondani.

Male sub-holoptic. Facial carina broad. Arista ciliate above only. No abdominal macrochaetae. Apical cell petiolate, in line with third vein.

Rhinia testacea Robineau-Desvoidy.

Idia flavipennis Macq. *Rhinia fulvipes* Big. *Idia tripartita* Big. *Beccarimyia glossina* Rond.

Head: ♂ sub-holoptic, ♀ frons one-fifth of head width. Frontal stripe black, parafrontalia white with closely set shining black spots. Parafacials similar. Face, epistome and genae shining black. Occiput black above, covered with bright golden pile below. Antennae and palpi brown. *Thorax* dark green, so thickly covered with black spots as to appear, with the thin white pile with which it is covered, dark grey. Traces of a median and two sub-dorsal black stripes sometimes apparent. Pleurae with stripe of thick golden pile. Abdomen orange, sometimes infuscated at tip. *Legs*, except tips of tarsi, blackened, all brownish-yellow. *Wings* clear, with or without a small apical infuscation. Long 6 mm.

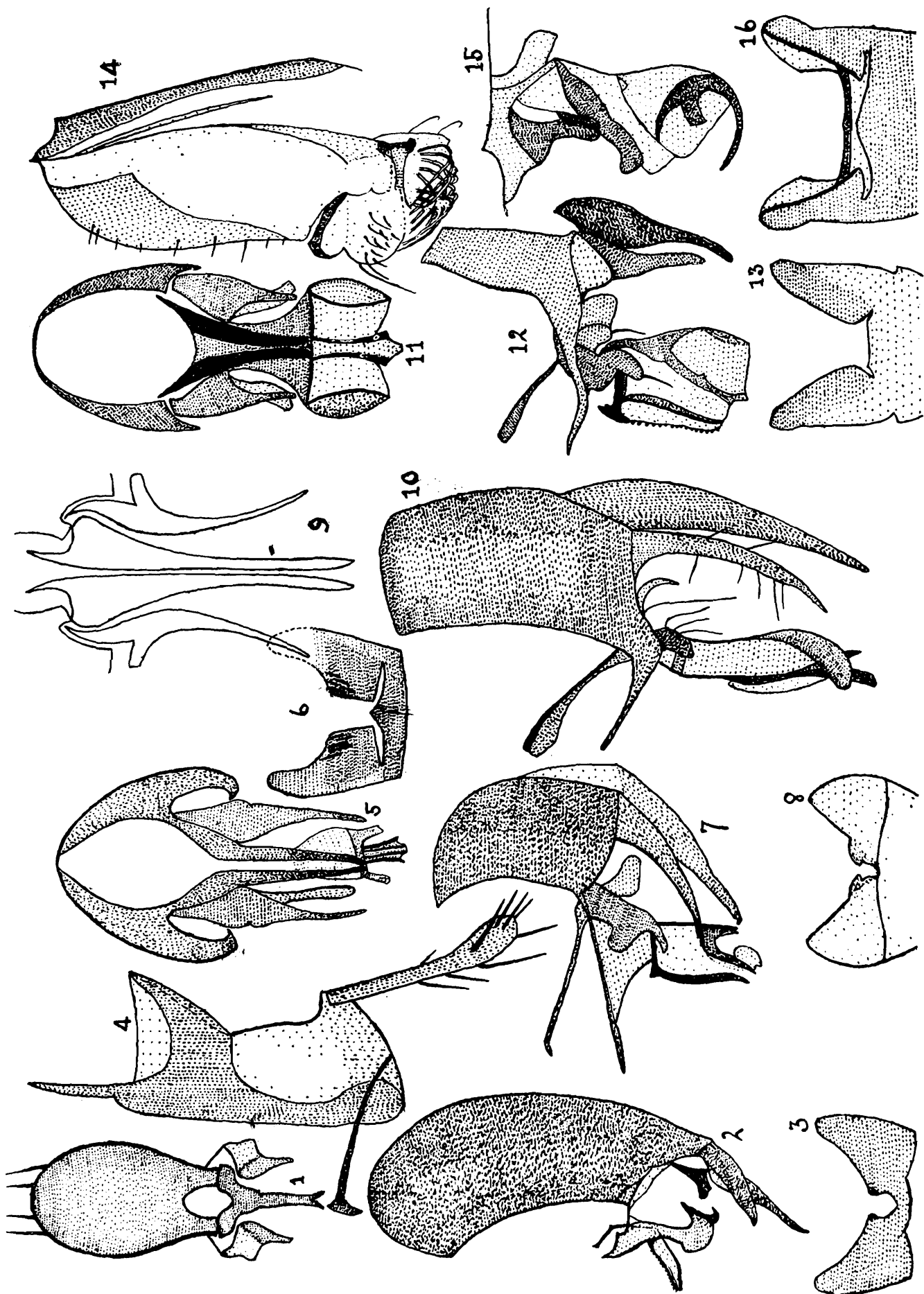
Throughout the Oriental Region, and extending to the Pacific Islands. If the Ethiopian *R. apicalis* Wd. is conspecific, as Villeneuve (1921) believes, then the species also occurs throughout a large part of Africa. I have seen specimens from the Chagos Islands, but whether these belong to the Oriental or the Ethiopian Region has never been declared.

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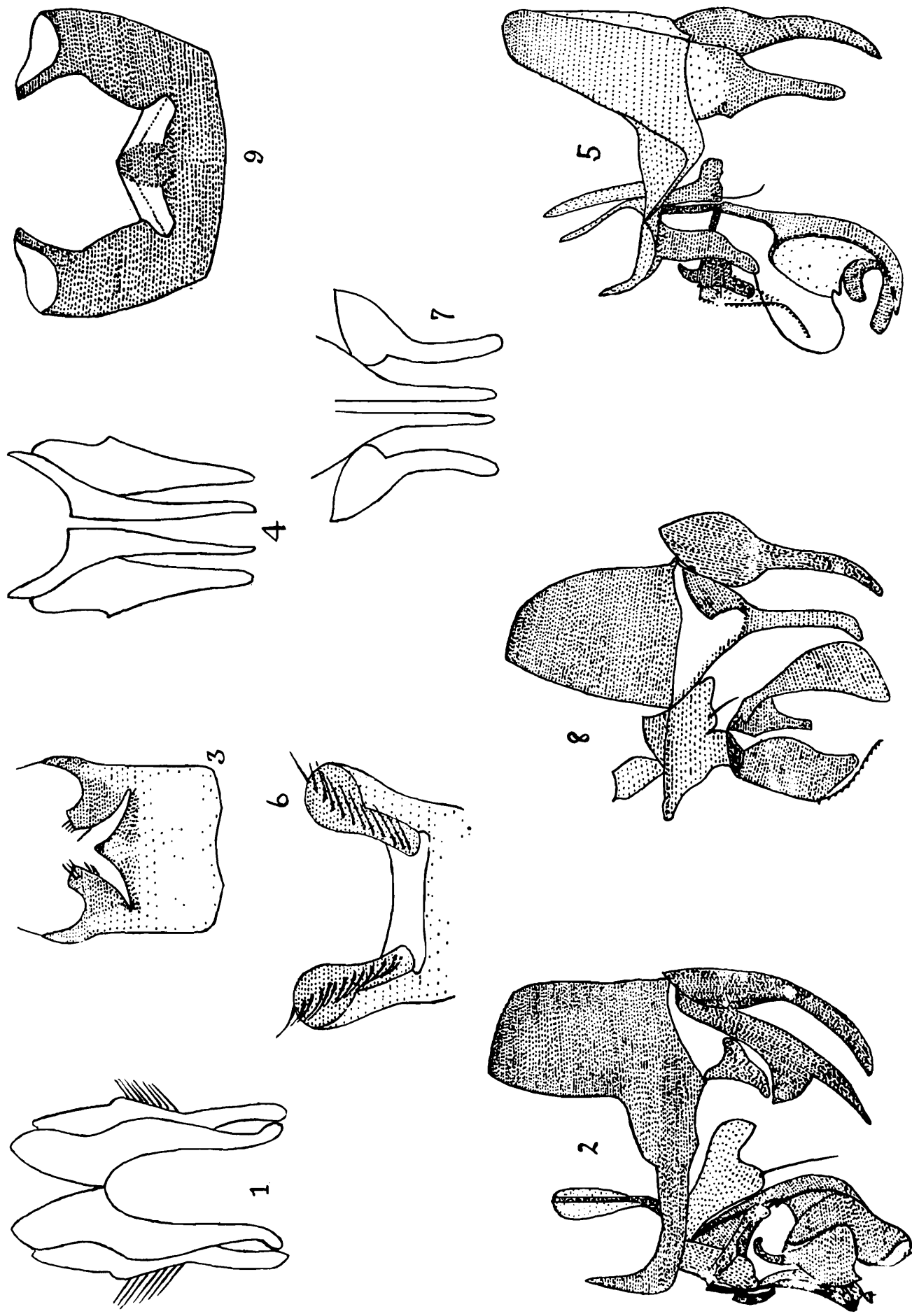
EXPLANATION OF PLATE V.

FIG. 1.—	<i>Chloridia prolata</i> Wlk.	IXth tergite, posterior view.
FIG. 2.—	” ”	IXth tergite and aedoeagus, lateral view.
FIG. 3.—	” ”	Accessory forceps.
FIG. 4.—	” ”	Rostrum of proboscis.
FIG. 5.—	<i>Borbororhinia bivittata</i> Wlk.	IXth tergite, posterior view.
FIG. 6.—	<i>Metallea divisa</i> Wlk.	Accessory forceps.
FIG. 7.—	<i>Borbororhinia bivittata</i> Wlk.	IXth tergite and aedoeagus, lateral view.
FIG. 8.—	” ”	Accessory forceps.
FIG. 9.—	<i>Metallea divisa</i> Wlk.	Superior claspers, posterior view.
FIG. 10.—	” ”	IXth tergite and aedoeagus, lateral view.
FIG. 11.—	<i>Stomorphina discolor</i> Fb.	IXth tergite, posterior view.
FIG. 12.—	” ”	IXth tergite and aedoeagus, lateral view.
FIG. 13.—	” ”	Accessory forceps.
FIG. 14.—	<i>Chloroidia prolata</i> Wlk.	Haustellum of proboscis.
FIG. 15.—	<i>Stomorphina melanostoma</i> Wd.	Aedoeagus, lateral view.
FIG. 16.—	” ”	Accessory forceps.



EXPLANATION OF PLATE VI.

FIG. 1.—	<i>Idiella mandarina</i> Wd.	Superior claspers, posterior view.
FIG. 2.—	” ”	IXth tergite and aedoeagus, lateral view.
FIG. 3.—	” ”	Accessory forceps.
FIG. 4.—	<i>Stomorhina xanthogaster</i> Wd.	Superior claspers, posterior view.
FIG. 5.—	” ”	IXth tergite and aedoeagus, lateral view.
FIG. 6.—	” ”	Accessory forceps.
FIG. 7.—	<i>Stomorhina lunata</i> Fb.	Superior claspers, posterior view.
FIG. 8.—	” ”	IXth tergite and aedoeagus, lateral view.
FIG. 9.—	” ”	Accessory forceps.



ORIENTAL RHININAE.

R. S. W. del.

Measurements in millimeters.

	Height of shell.	Height of aperture.	Maximum breadth of shell.	Maximum breadth of aperture.	Number of whorls in the spire.
Type speci- men.	24.0	14.0	17.5	9.0	3
1.	22.0	13.7	16.0	8.5	4
2.	21.5	16.0	15.6	8.0	2½
3.	26.2	16.2	20.0	10.5	

Measurements of No. 3 refer to a large specimen taken by Captain F. W. Walker in Meiktila Lake, Upper Burma.

Type-specimen.—M $\frac{12485}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Three shells were collected by Dr. Hora from the edge of a stream near Thazi railway station, Lower Burma. A number of shells collected by Captain F. W. Walker, of the Geological Survey of India, at Halin, Burma, in April 1922, belongs to the race *peguensis* of *P. andersoniana*. The deep colour of the shells and the incised spiral lines serve to distinguish them from those of the new species at a glance. The shells from Kin-U in the Chindwin valley, Upper Burma, which were described by Annandale as *Temnotaia incisa*¹ really belong to *Paludomus*.

The species is closely allied to *P. andersoniana* Nevill, especially to the race *peguensis*, but differs in having a relatively short spire and a characteristic sculpture and colour.

***Acrostoma reevei* f. *olivacea*, nov.**

Shells of this form approach those of *A. reevei* var. *lanceolata* Nevill but differ in having less tumid whorls, in the less strongly impressed

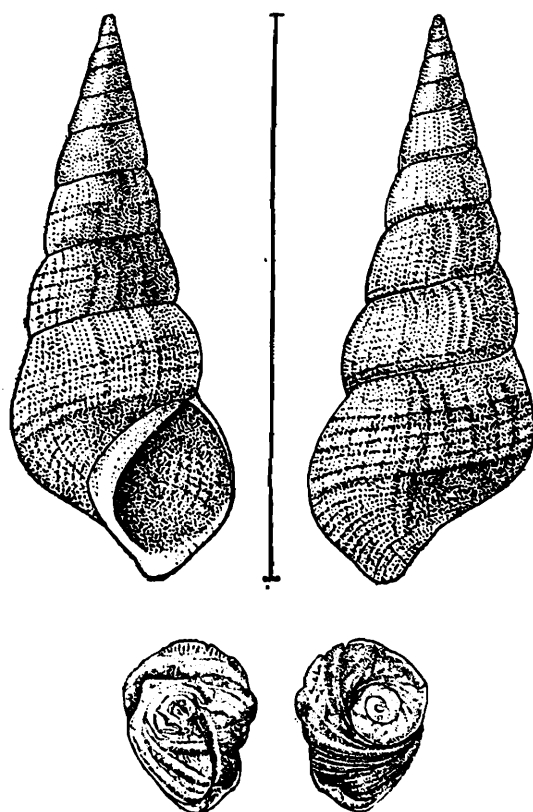


FIG. 2.—Shell and operculum of *Acrostoma reevei* f. *olivacea*.

suture, in the spiral sculpture consisting of fine parallel ridges (instead of impressed striae), which become more prominent on the last three

¹ Annandale, *Rec. Ind. Mus.*, XIX, p. 115 (1920).

whorls, in having fine close-set vertical striae which often give rise to minute varices on the last whorl, in the aperture being a little more compressed, its columellar side being less arched, in the less strongly developed columella, and in their dull olivaceous colour. The upper whorls are often dark while the rest of the shell is olivaceous.

In some shells the columellar fold is reflected outwards as a more or less broad flap leaving a narrow channel running down the umbilicus.

The operculum is strongly chitinous, ovate-conical in outline, and paucispiral. In the specimens examined the operculum was split up along the lines of the spire.

The radular teeth approach those of *A. variabilis* but have distinct features, especially in the central, which has 3 cusps on each side of the median and in the marginal which has a broad rectangular chitinous flap from the outer side of the middle region of the tooth.

The young shell is very similar to that of var. *lanceolata* but differs in having a more prominent sculpture.

In two shells examined remains of the animal were detected and carefully removed by treatment with caustic potash. They were then

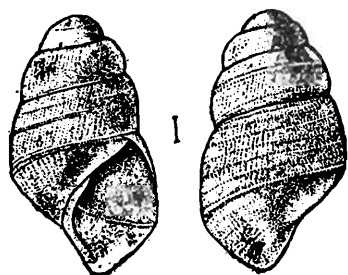


FIG. 3.—Embryonic shell of *Acrostoma reevei* f. *olivacea*.

washed in water and left in a mixture of glycerine and 70 per cent alcohol. On dissection it was found that several embryos, not exceeding 3 mm. in height and 2 mm. in breadth, were closely packed in what was apparently a brood-chamber immediately behind the head of the animal. As the specimens were very much crumpled owing to bad preservation the exact relationship of the brood-chamber to the genitalia could not

be made out by dissection. Our knowledge of the anatomy of Indian Melaniids is very meagre, and so far as I am aware there is no

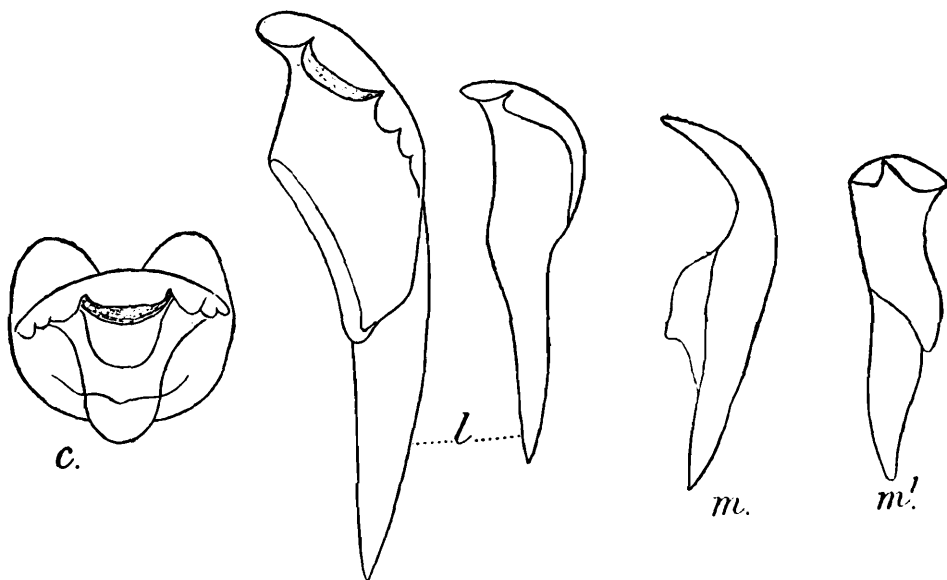


FIG. 4.—Radular teeth of *Acrostoma reevei* f. *olivacea*.

c. central; l. laterals; m and m¹. side and front views of marginal.

record of viviparity in the Indian species of the family, though in Europe viviparous species are known among the Melaniidae.¹

¹Pelseneer in Lankester's *Treatise on Zoology*, Part V, p. 131 (1906).

In one of the two specimens dissected the edge of the mantle and a portion of the rectum were in a good condition. The former bore no processes and had a regular and sharp outline. In the latter were found bundles of elongated rod-like faecal pellets consisting of fine mud. The pellets were bound together by some sticky secretion of the rectum.

The embryonic shells are somewhat transparent and have about four complete whorls, the apical being broad and blunt. The whorls of the spire appear to be telescoped and are separated by a fairly deep suture. The spiral sculpture, consisting of fine ridges, is well developed especially on the last whorl and in the middle region of the remaining whorls. The operculum is very thin and transparent and exactly fits the mouth of the shell. It is slightly depressed in the middle.

Dr. Hora obtained a few specimens of this form from the Thazi stream. The shells collected by Captain F W Walker in Meiktila Lake, Upper Burma, also belong to this form. The largest specimen in our collection has the following measurements (in millimeters) :

Height of shell.	Height of aperture.	Maximum breadth of shell.	Maximum breadth of aperture.
56.5	17.5	21.0	11.0

VIVIPARIDAE.

Vivipara bengalensis race **doliaris** (Gould).

1921. *Vivipara bengalensis* race *doliaris*, Annandale, *Rec. Ind. Mus*, XXII, p. 273, pl. i, fig. 9.

Two shells of this race were obtained by Dr. Hora near the Thazi stream. They are apparently young specimens of this race. The biangulate outline of the body-whorl is not at all conspicuous. One of the shells is partly worn and somewhat thicker than the other.

Vivipara dissimilis var. **decussatula** Blanford.

1884. *Paludina dissimilis* subvar. *decussatula*, Nevill, *Hand List Moll.*, II, p. 30.

Dr. Hora found two shells of this form on the banks of the Thazi stream. One of them is fairly fresh, while the other is more or less worn and slightly decollate. They agree closely with the Burmese specimens of this form in the collection of the Indian Museum but have their spire relatively short. This form apparently forms a link between *V dissimilis* and the smooth-shelled species of *Lissotaia*, a new subgenus of the Burmese *Taia* proposed recently by the late Dr. Annandale and myself.¹

¹Annandale and Rao, *Rec. Ind. Mus.*, XXVII, p. 120 (1925).

FURTHER OBSERVATIONS ON THE AQUATIC GASTROPODS OF THE INLE WATERSHED.

*By the late N. ANNANDALE, D.Sc., C.I.E., Director, and H. SRINIVASA
RAO, M.A., Assistant Superintendent, Zoological Survey of India.*

[Nearly six years ago I published an account of the aquatic molluscs of the Inlé Lake and connected waters. My paper was based on collections made early in 1917 by Dr. F. H. Gravely and myself. The results were so interesting, and cast so much light on general problems of mollusc-ecology and evolution, that I arranged to pay a second visit to the same country in March, 1922. I was accompanied by Dr. Sunder Lal Hora, Assistant Superintendent, Mr. H. Srinivasa Rao, Research Assistant, and Babu D. N. Bagchi, Artist, in the Zoological Survey of India. To these gentlemen, and especially to Dr. Hora, my best thanks are due. Dr. Hora remained in the Southern Shan States after the rest of the party returned and made valuable additional collections. Babu D. N. Bagchi's sketches of living molluscs have proved of great value.

The main object of our expedition was to obtain further information about the remarkable genus *Taia* and especially about its extraordinary variability and plasticity. This investigation was part of one of wider scope on shell-sculpture in the Viviparidae,¹ but the genus will be discussed merely from a taxonomic point of view in this paper. In the course of our work on special lines we obtained much additional information about the molluscs, recent and extinct, of the district, and I was so fortunate as to be accompanied for some time by Mr. F. W. Walker of the Geological Survey of India, to whose assistance I owed much in studying the various deposits of the He-Ho plain and the Hsin Dawng caves.

I have to thank Dr. L. L. Fermor, who was acting as Director, Geological Survey of India, at the time, for permitting Mr. Walker to accompany our party. More frequent co-operation of the kind between the scientific departments of the Government of India seems to me highly desirable. *N.A.*]

No less than 34 species and 10 subspecies of true aquatic molluscs and 2 species of semi-aquatic habits were taken on the two visits to the Inlé watershed. Of these, 7 species and 2 subspecies appear to be extinct and were found in a fossil or subfossil condition. No less than 23 species and 7 subspecies appear to be endemic in the watershed. Of these, 7 species and 2 subspecies were only found subfossil. In this paper we describe 6 species and 3 subspecies as new, several of these were obtained on the former visit but for various reasons were not given names.

The recent specimens collected on the second visit are from all parts of the Inlé watershed except the river which flows out from the south end of the lake. The area they represent extends from Kalaw and Loi-an near the head-waters of the Kalaw River, which enters the lake on the western side, to Taunggyi on the hills above its north-eastern extremity, and from the valley north of the lake to Nanpan close to the point at which the southern river emerges.

The fossil and subfossil specimens are from four different deposits, three of which lie in the He-Ho plain west of the lake, while the third is on the slopes of a little valley to the north-east of Yawngghwe. These four deposits have already been described elsewhere,² but the much richer collection made in 1922 renders it possible to discuss the shells

¹ Annandale, *Proc. Roy. Soc. London* XCVI, pp. 60-76 (1924).

² Annandale, *Rec. Geol. Surv. Ind.*, L, p. 215 (1919)

found in them more fully than heretofore. Those from the peaty superficial deposit on the He-Ho plain prove on more detailed comparison to be identical with the living molluscs of the valley. The deposit is in places almost incredibly rich in shells of *Taia naticoides* race *intermedia*, and the little streams that traverse it have their beds covered with shells washed out from it in a profusion rarely seen except on the sea-shore.

This is also true of the deeper lacustrine deposit of clay at the east end of the valley just above the gorge. The race of *Taia* represented in it is, however, slightly different though specifically the same. We call it *T. naticoides* race *lacustris*. The race *distoma* of *Hydrobioides nassa* is also different from that found living on the plain, and this is probably true of that of *Limnaea shanensis*, which is the typical form of the species, differing in minor characters from the race *superstes* which survives in the Inlé Lake. There are, however, two races or phases of this species in the deposit next to be discussed and their geological relations are not quite clear, though both are distinct from the living form. On the other hand *Acrostoma elongatum* from all deposits is identical with the living form.

The curious bank of calcareous particles at the head of the He-Ho gorge, exactly resembling a sand-bank in appearance, is remarkable for the large number of minute and fragile shells which it contains in a perfect condition. Among those found in it in 1922 were several hitherto not recorded from the Shan States, namely *Ferrissia baconi* (a widely distributed form), *Limnaea laticallosa* (a new species discovered living at Kalaw), *Segmentina taia*, sp. nov., and *Intha capitis* both of which survive in the Inlé valley, a new species of *Camptoceras*, *Succinea godivariana*, a probably amphibious species hitherto recorded only from Peninsular India, *Tricula horae*, sp. nov. and *Hydrobioides diperistoma*, sp. nov., which was formerly confused with *H. turrita*, the type-species of the genus. Both *Limnaea shanensis typica* and another form we call *L. shanensis* f. *hehoensis* occur in this deposit, the shells in which are evidently of mixed origin, some washed out of the superficial peaty deposit of the plain, others from the old lacustrine deposit and yet others of recent origin.

The cave-deposits in the two little limestone caves at Hsin-Dawng were also revisited and the same species found in them, with the addition of imperfect shells evidently representing forms of *Acrostoma elongatum* and the remains of a freshwater crab. The three species of *Taia* already recorded (*viz.*, *T. obesa*, *T. conica* and *T. cylindrica*) were also rediscovered, *T. obesa* was much scarcer than the other two. The shells had evidently been washed into the caves mainly through holes in the roof. They occur in one cave in a fan-shaped slope of earth leading down from the former and in the other in the floor just inside the mouth.

Both in living and in comparatively recent fossil freshwater molluscs the Inlé watershed is extraordinarily rich. In spite of its small area it actually contains more species of living aquatic Gastropods than the whole of the plains of Peninsular India between Peshawar and Cape Comorin and between the Indus and the Brahmaputra, and some of the species are very abundant. No less than 27 species and forms are known

to us and it may be doubted whether we have yet, in two short visits, completely exhausted the fauna. In the following list those species and races only known in a fossil or subfossil condition are marked with an asterisk : forms only known from the Inlé watershed by a dagger :-

PULMONATA.

- | | |
|--|---|
| <i>Succinea indica</i> Pfeiffer. | <i>Indoplanorbis e-vistus</i> (Deshayes). |
| <i>S. godivariana</i> Gude. | <i>Gyraulus euphraticus</i> , Mousson. |
| * † <i>Limnaea shanensis</i> Annandale. | <i>G. labiatus</i> (Benson). |
| † <i>L. shanensis</i> f. <i>superstes</i> , nov. | † <i>G. velifer</i> (Annandale). |
| * † <i>L. shanensis</i> f. <i>hehoensis</i> , nov. | † <i>Intha capitis</i> Annandale. |
| † <i>L. mimetica</i> Annandale. | <i>Segmentina caenosus</i> (Benson). |
| <i>L. luteola</i> f. <i>siamensis</i> Sowerby. | † <i>S. taia</i> , sp. nov. |
| † <i>L. laticallosa</i> , sp. nov. | * † <i>Camptoceras</i> , sp. nov. |
| <i>L. andersoniana</i> Nevill. | <i>Ferrissia baconi</i> (Bourg.). |
| † <i>L. physcus</i> , sp. nov. | |

PROSOBRANCHIA.

- | | |
|---|---|
| * † <i>Tricula horae</i> , sp. nov. | <i>Lecythoconcha lecythis</i> (Benson). |
| * † <i>Hydrobioides diperistoma</i> , sp. nov. | † <i>Taia theobaldi</i> (Kobelt). |
| <i>H. nassa</i> (Theob.). | † <i>Taia naticoides</i> race <i>intermedia</i> |
| <i>H. nassa</i> f. <i>avarix</i> Annandale. | Annandale. |
| † <i>H. nassa</i> f. <i>rivulicola</i> Annandale. | * † <i>T. naticoides</i> race <i>lacustris</i> Annan- |
| † <i>H. nassa</i> f. <i>lacustris</i> Annandale. | dale. |
| † <i>H. nana</i> Annandale. | † <i>T. shanensis</i> (Kobelt). |
| † <i>Paranerita physcus</i> (Annandale). | * † <i>T. obesa</i> Annandale. |
| † <i>Amnicola alticola</i> Annandale. | † <i>T. crassicallosa</i> , sp. nov. |
| <i>Melanoides tuberculatus</i> (Müller). | * † <i>T. conica</i> Annandale. |
| <i>M. scabra</i> (Müller). | * † <i>T. cylindrica</i> Annandale. |
| † <i>Acrostoma elongatum</i> (Annandale). | † <i>T. elitoralis</i> Annandale. |
| † <i>A. elongatum</i> f. <i>planicostata</i> , nov. | † <i>T. intha</i> Annandale. |
| <i>A. variabile</i> (Benson). | <i>Pachylabra conica</i> var. <i>compacta</i> |
| † <i>Vivipara heliciformis</i> (Frauenfeld). | (Reeve). |

Genus *Limnaea* (*auctorum*).

The genus is remarkably well represented in the He-Ho plain and the Inlé watershed, for no less than six living species have been found in this area, whereas only three are known from the whole of Peninsular India ; if we exclude the Punjab Salt Range into which certain Palearctic forms intrude. These six species, however, are quite distinct and most of them are not at all closely related the one to the other.

The *Limnaea*-fauna of this district exhibits affinities both with that of Peninsular India and with that of Indo-China. Of the six species one, represented by a Burmese and Siamese race, is conspecific with a common Indian mollusc. This is *L. luteola* f. *siamensis*. The race occurs both in Upper and in Lower Burma and also in Tenasserim. Four species are known only from the district under discussion, viz., *L. physcus* and *L. laticallosa*, both described here for the first time, *L. mimetica*, a true lacustrine form from the lake, and *L. shanensis*, the typical form of which is apparently extinct but is represented in the living fauna by the race *superstes*. Finally, *L. andersoniana* has a range that extends from Western China through the hill country of Burma to Manipur in Assam on the one hand and the Nepal Himalayas and Kashgar in Central Asia on the other. This species is closely allied to the Palearctic *L. truncatula*,

Key to the species of Limnaea known from the Shan Plateau.

1. Columellar fold exceptionally broad and coarse, occluding the umbilicus on the ventral surface of the shell. Umbilicus often visible from the dorsal surface.
 - A. Shell not exceeding 16 mm. in length, with 5 whorls, very variable in shape .. *L. andersoniana*.
 - B. Shell over 16 mm. long, with 6 whorls, of a regular narrowly ovate form .. *L. laticallosa*.
2. Columellar fold normally developed. Umbilicus never visible on the dorsal surface.
 - A. Spire not depressed, almost or quite as high as broad. Body-whorl much narrower, but not tapering in front .. *L. physcus*.
 - B. Spire not depressed at the base, more than twice as broad. Body-whorl much narrower, but not tapering in front.
 - (i) Columellar callus narrow. Spire situated asymmetrically towards the left side of the body-whorl, which is oblique.
 - (a) Spire much reduced, blunt at the apex, shell not more than 7 mm. long, colourless, very fragile .. *L. mimetica*.
 - (b) Spire sharply pointed, short but well developed. Shell at least 9 mm. long, coloured, less fragile .. *L. shanensis*.
 - (ii) Columellar callus broad. Spire situated symmetrically on the middle of the body-whorl, which is not at all very oblique. Whole shell of a narrowly oval form .. *L. luteola f. siamensis*.

***Limnaea physcus*, sp. nov.**

1918. *Limnaea* ? prox. *ovalis*, Annandale, *Rec. Ind. Mus. XIV*, p. 111, pl. x, fig. 3.

Two living specimens, one adult and one young, of a species, apparently identical with the fossil or subfossil form cited above, were discovered by Dr. Sunder Lal Hora in a railway reservoir near He-Ho. They are more globose than that form, but otherwise agree with it, so far as can be seen in the imperfect condition of the fossil shells. The species seems to be quite distinct and may be defined as follows :—

Shell small, cordiform, with a very small, sharp spire, delicate, transparent, horn-coloured, decorated with fine longitudinal striae, without spiral sculpture, with an oily lustre. Spire consisting of $2\frac{1}{2}$ short transverse whorls, minutely and obliquely truncate at the apex; the whorls not at all swollen, with their outlines almost straight but sloping outwards, the second at least three times as long as the apical complete whorl, much narrower than the upper extremity of the body-whorl and situated towards its inner margin; the suture moderately impressed. The body-whorl relatively very large, oblique, tapering in front to a blunt point, with the outer margin as seen in dorsal view forming a regular curve of less than a semicircle and the inner margin strongly sinuate; the dorsal surface highly convex. The aperture very large but not expanded, auriculate, pointed and introverted above, narrowly rounded below. The columella twisted and curved; its callus delicate

but rather broad, completely occluding the umbilicus, meeting the outer lip above. The outer lip curved, very delicate. The ventral surface of the whorl highly convex in its upper half.

Owing to an accident the soft parts of the only adult recent specimen were destroyed. The shell occurs very rarely in the lacustrine deposit of clay on the banks of the He-Ho river and was not found in the sandy mud at the head of the gorge, probably on account of its fragility which would render its transport in the river difficult and improbable.

Measurements (in millimeters) of type-specimen.

Height of shell.	Height of aperture.	Maximum breadth of shell.	Maximum breadth of aperture.
8.4	7.2	6.5	4.2

Type-specimen.—M $\frac{12045}{2}$ Z. S. I. (*Ind. Mus.*).

The species seems to be allied to some of the Palearctic forms of the *peregra* group, but is very distinct from any Indian form hitherto described.

The species is only known at present from the He-Ho plain (alt. 3,800 ft.) in the Southern Shan States.

***Limnaea laticallosa*, sp. nov.**

This is a species resembling the stream form of *L. andersoniana* ¹ but with a larger shell, more numerous whorls, a still better developed columellar fold, a distinct flattening of the whorls outside the suture and less numerous radular teeth. It also appears to be related to *L. crosseana* ² from Cambodia and Tonquin and resembles some specimens of that species more closely than it does the original figure, but has the shell thicker, the columellar fold and callus much better developed, the mouth of the shell more expanded on the outer side, the umbilicus open on the dorsal surface (though occluded on the ventral) and the sculpture much better developed.

The shell is of moderate size, somewhat elongate and rather narrow, sharply acuminate to the naked eye, moderately thin, translucent, of a horny brown colour and sculptured with irregular longitudinal striae interrupted at intervals by spiral decussate lines, with an oily lustre on the surface.

The shape is narrowly ovate with the spire well exerted, comparatively long, placed vertically on the middle of the body-whorl and occupying from about $\frac{1}{3}$ to nearly $\frac{1}{2}$ of the length of the shell. There are six complete whorls; they increase gradually and evenly in size. The suture is impressed and a little oblique, especially on the dorsal surface. The upper extremities of the whorls are narrowly and slightly obliquely flattened outside it much as in the shell of *L. truncatula*. The body-whorl is distinctly spiral and the umbilicus or rather a channel leading

¹ Annandale and Prashad, *Rec. Ind. Mus.* XXII, p. 576, pl. viii, figs. 4, 5 (1921).

² Mabille and le Mesle, *Journ. Conchyli.* (3) XIV, p. 130, pl. vii, fig. 5 (1866).

to it is visible on the dorsal surface in the form of a pin-hole. The callus and the columellar fold cover a considerable part of the ventral surface of the body-whorl and are coarse, longitudinally striate and lustrous. The columella is strongly twisted and almost vertical. The outer lip is thin and has a somewhat flattened curve. It is not at all introverted above. The aperture as a whole has a distinctly auriculate form and is somewhat dilated outwards below; above it is sharply pointed. The peristome is complete.

Measurements (in millimeters) of type-specimen.

Height of shell.	Height of aperture.	Maximum breadth of shell.	Maximum breadth of aperture.
15.7	9.7	8.4	4.9

The jaw is very characteristic. The maxilla is narrowly biconvex with a transverse ridge in the middle, and the lateral pieces are long and tapering and distinctly fimbriate on the inner surface.

The radula is also very characteristic. The cusps of all the teeth are remarkably long and narrow, especially as regards the mesocone. Some of the laterals are bicuspid, but the first is always tricuspid. The approximate dental formula is 19. 8. 1. 8. 19.

The genitalia offer no very striking peculiarity. In two specimens examined the spermatheca is remarkably large and of subtriangular outline. Its duct is long and somewhat swollen just before entering the sac. In these specimens the penis is very slender and the prostate small and heart-shaped.

The animal (in spirit) is of a leaden grey colour, with the tentacles broadly triangular and the anal funnel exceptionally prominent.

Type-specimen.—M $\frac{12055}{2}$ Z. S. I. (*Ind. Mus.*).

A large series of shells and specimens in spirit was obtained by Dr. Hora from a small reservoir used for horticulture above Kalaw¹ at an altitude of about 4,500 ft. The water was clear, the bottom muddy; there were no water plants.

***Limnaea luteola* Lamarck.**

This is one of the commonest and most widely distributed of the Indian species, but several forms can be distinguished. The common Burmese race, for the study of which abundant material is before us from Tenasserim, Pegu, Upper Burma and the Southern Shan States, is evidently identical with Sowerby's *L. siamensis*. In India and Ceylon at least four forms may be distinguished if sufficient material be examined, but only two of these can be regarded as well established races, namely the *forma typica* (with its phases or varieties *succinea* Deshayes and *impura* Troschel) in India and the subspecies *australis*, nov. in Ceylon and parts of Peninsular India. Specimens from Kulu in the Western Himalayas are quite typical. Nevill recognized the

¹ Kalaw is situated some little distance west of the He-Ho plain on a small stream that ultimately flows into the Inlé Lake after proceeding some miles underground.

Burmese form as a distinct variety but did not give it a name. The five forms may be distinguished as follows :—

- I. Length of shell usually more than 20 mm., shell somewhat elongate with the body-whorl sub-cylindrical and a little compressed—
 - A. Shell with pale longitudinal stripes, moderately thin *forma typica*.
 - B. Shell pale, without longitudinal stripes, thin .. *succinea*.
- II. Shell less than 20 mm., in length : body-whorl not subcylindrical.
 - A. Shell rather short, ovate *impura*.
 - B. Shell more elongate—
 - (i) Body-whorl bilaterally asymmetrical in ventral view *australis*.¹
 - (ii) Body-whorl almost bilaterally symmetrical *siamensis*.

race **siamensis** Sowerby.

1873. *Limnaea siamensis*, Sowerby in Reeve, *con. Icon*. sp. 63, pl. x.

1878. *Limnaeus luteolus* var., Nevill, *Hand List Moll. Ind. Mus.* I, p. 233.

The most characteristic feature of this race is noted in the key. The shell never exceeds 16 mm. in length and is usually about $1\frac{1}{2}$ times as high as broad. It differs greatly in colour and thickness in different localities and types of environment. Specimens from the Royal Lakes in Rangoon are small, with thin, pale lutescent shells ; but Dr. Marshall has sent from the same city a much brighter, rather larger and thicker specimen. Those obtained from a muddy pool used for domestic purposes at He-Ho are thicker and have a solid appearance. The natural colour is dull lutescent, but there is a thin black deposit on the surface and the spire is eroded.

The animal is always rather dark. The tentacles are large and triangular ; the lips normal, the anal funnel is exceptionally well developed. It will be better to defer any description of the anatomy until a comparative account of the soft parts of the different races can be prepared. The radular formula is approximately 16. 7. 1. 7. 16.

This form provides a link (both geographical and structural) with the Malayan *L. javanica*. The shell, however, differs in that the body-whorl is always narrow, with the aperture less dilated, and the spire relatively broader and not so tapering.

Family PLANORBIDAE.

Subfamily PLANORBINAE.

1922. *Planorbinae*, Annandale, *Rec. Ind. Mus.*, XXIV, p. 358.

Like the Limnaeidae this subfamily is also represented by several species in our recent collection. All but one of these were also taken on the first visit to the Shan States, but the identifications were not all correct. Unlike the Limnaeidae, the Planorbidae offer good generic characters of an anatomical nature, and the seven species can be distributed into four genera which are well defined both on such

¹ *Australis* is the name we propose for *pinguis*, Dohrn, preoccupied.

characters and also conchologically. These four genera are *Indoplanorbis* Annandale and Prashad, *Gyraulus* Agassiz, *Segmentina* Flemming and *Intha* Annandale, the last being a genus recently described from our Shan collection.

Genus **Indoplanorbis** Annandale and Prashad.

1922. *Indoplanorbis*, Annandale, *Rec. Ind. Mus.*, XXIV, p. 360.

Indoplanorbis exustus (Deshayes).

1918. *Planorbis exustus*, Annandale, *Rec. Ind. Mus.*, XIV, p. 111, pl. xi, figs. 1, 1a.
 1921. *Planorbis* (*Planorbis*) *exustus*, Germain, *Rec. Ind. Mus.*, XXI, p. 26, figs. 1—11 and 13—16.
 1923. *Indoplanorbis exustus*,—Rao, *Rec. Ind. Mus.*, XXV, pp. 199—219, text-figs. 1—3a, 4—7 and 9—14.

Common in the marginal zone of the Inlé Lake and also on the He-Ho plain. Shells from this district are usually of moderate size and regular form, with fine and regular sculpture and of a chestnut-brown colour.

Genus **Gyraulus** Agassiz.

1922. *Gyraulus*, Annandale, *op. cit.*, p. 361.

Gyraulus convexiusculus (Hutton).

1918. *Planorbis saigonensis* (?), Annandale, *op. cit.*, p. 112, pl. xi, fig. 12.

It is to this species and not to *G. euphraticus* Mousson that shells from the sand-like deposit on the He-Ho gorge belong. A few living specimens were also taken in the marginal zone of the Inlé Lake.

Gyraulus velifer (Annandale).

1918. *Planorbis velifer*, Annandale, *op. cit.*, p. 112, pl. xi, figs. 7—11.

The species is closely allied to *G. convexiusculus* and *G. euphraticus*, but differs from both in its more delicate shell, in the different shape of the mouth of the shell, which is much more expanded, in possessing a thin but distinct callous deposit on both lips and in the very pale colour of its blood.¹ It is by no means confined to the Inlé Lake as was formerly thought, but is also found in ponds and canals in other parts of the valley and subfossil in the sand-like deposit of the He-Ho gorge. The opaque subfossil shells can be recognized by their expanded mouths and by the deposit on their lips, which is particularly distinct in them owing to its polished surface. We figure the living animal from drawings made by Babu D. N. Bagchi in the Southern Shan States. Individuals from the lake are often quite colourless. Sometimes they have a black line running along each tentacle and occasionally the whole of the surface of the body is suffused with black pigment. The shell is

¹ See Annandale, *Rec. Ind. Mus.*, XXIV, p. 358 (1922).

always hyaline and colourless. Specimens from the canal at Yawngwe are darker and their shell is usually tinted of a pale yellowish colour.

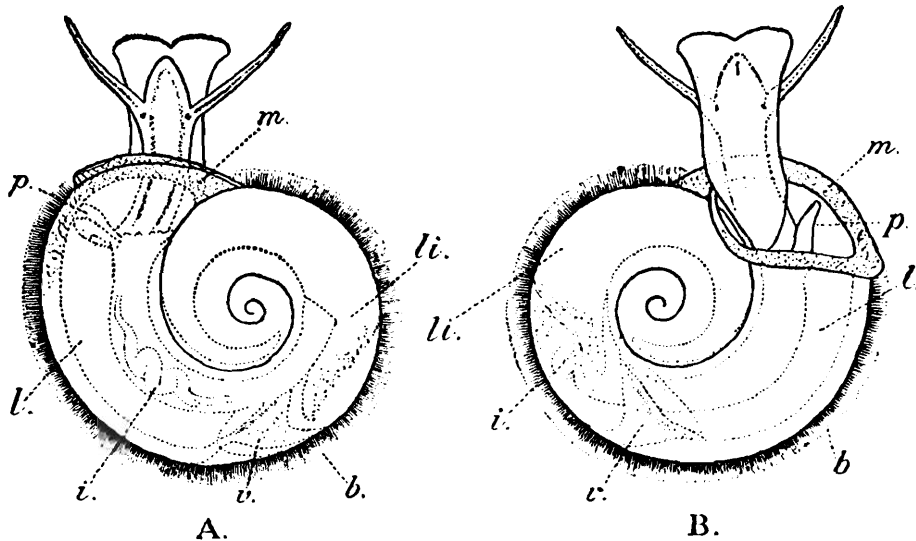


FIG. 1.—*Gyraulus velifer* (Annandale) from Inlé Lake.

A. Dorsal view of living animal in an expanded state.

B. Ventral view of same.

b. bacterial velum; i. intestine; l. pulmonary chamber; li. liver;
m. edge of mantle; p. pseudobranch; v. ventricle.

As Annandale has pointed out elsewhere (*op. cit.*, 1922), the blood is slightly pinker in such individuals than in those from the lake.

***Gyraulus labiatus* (Benson).**

1915. *Planorbis* (*Gyraulus*) *labiatus*, Preston, *Faun. Brit. Ind. Freshw. Moll.*, p. 119, fig. 5.

Several shells from the sand-like deposit at the He-Ho gorge belong to this species. They agree exactly with the figures of Benson's types in the work cited. The whitish ridge on the inner surface of the lip is very well developed in them,¹ but the departure of the last whorl from its axis is less marked than in specimens from Calcutta, Mettupalayam (S. India) and the Central Provinces. The Shan specimens are also smaller.

Genus *Segmentina* Flemming.

1922. *Segmentina*, Annandale, *op. cit.*, p. 362.

The two species Annandale identified in 1918 were, as we now believe, both identified incorrectly. One of them appears to be the true *caenosus* of Benson, the other new.

***Segmentina caenosus* (Benson).**

1876. *Planorbis caenosus*, Hanley and Theobald, *Conch. Ind.*, pl. 39, figs. 7, 8.

1918. *Planorbis calathus*, Annandale (*nec* Benson), *op. cit.*, p. 113.

The specimens examined by Annandale in 1918 were young. The adult shell, which is not uncommon in the Inlé valley and occurs sub-

¹ The ridge appears to be well formed in adult shells in which the growth of the lip is complete, while it varies in prominence in younger specimens.

fossil at the He-Ho gorge, is much less transparent than that of *S. calathus* and the internal ridges are not so well developed. In some specimens, indeed, they are difficult to detect. The size of the umbilicus is also a good character. The blood is of a much deeper red than it ever is in *Gyraulus velifer*.

***Segmentina taia*, sp. nov.**

1918. *Planorbis caenosus*, Annandale (*nec* Benson), *op. cit.*, p. 113.

The shell is conoidal, flattened below, and concave at the apex above. The last whorl slopes abruptly towards the ventral surface. Four and a half gradually increasing whorls are seen from above. The ventral surface of the shell when seen from below, though flat in appearance, is slightly convex along the middle of the last whorl. The

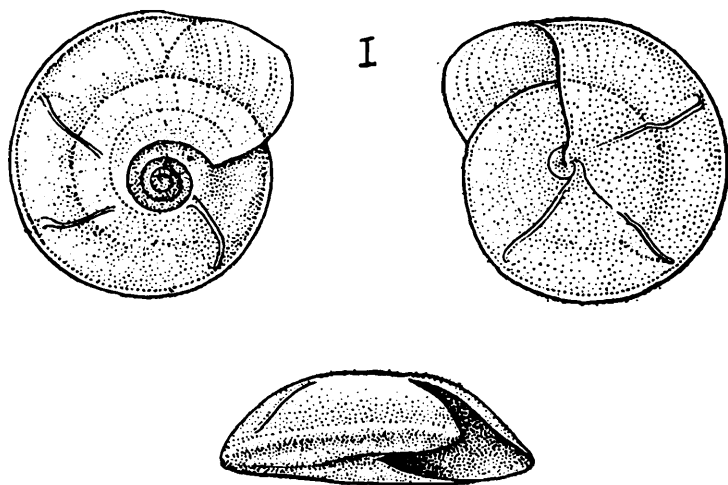


FIG. 2.—Type-specimen of *Segmentina taia*, sp. nov. from Inlé Lake.

umbilicus is minute and occluded and is in the form of a shallow pit. The internal ridges of the shell are visible from below in adult shells, while in young shells they are seen from both surfaces. A faint fourth ridge is often visible on the side nearest to the aperture. In ventral view the aperture has a quadrate appearance while from the sides it is obliquely hastate in outline. The narrow end of the mouth never extends much beyond the level of the opposite extremity of the last whorl. The ventral margin of the peristome is almost straight and joins the strongly arched and convex dorsal margin at its outer extremity. The dorsal margin of the mouth overhangs the ventral considerably in front. The sculpture consists of fine longitudinal oblique striae. The adult shell is of a yellowish brown colour, while young shells are paler.

Measurements of type-specimen in millimeters.

Greatest diameter of shell.	Height of shell.	Greatest height of aperture.	Greatest breadth of aperture.
3.0	1.5	0.7	1.5

*Anatomy.*¹ The jaw consists of a single narrow chitinous strip bent in the form of an inverted U and is distinctly segmented. The radula

¹ Rao, *Rec. Ind. Mus.*, XXV, pp. 203, 205, 210, 216 and 217 (1923).

is a narrow ribbon with minute teeth. The intestine is long and surrounds the liver more or less completely. The pseudobranch is absent. The genitalia agree with those of *Gyraulus* in general structure and arrangement but differ in the absence of a bulbous swelling to the penis-sheath, and of a penial stylet.

Living specimens of this species were found in the marginal zone of the western shore of the Inlé Lake and in the canal at Yawnghwe, S. Shan States. Specimens from the latter locality are smaller and paler.

This species is closely allied to *S. calathus* (Benson), from which it can be distinguished by its more pronounced conoidal form, by the gradually increasing size of the whorls, by the sides of the keel forming a small angle (due to extreme flattening), by the straight lower margin of the peristome (which in *S. calathus* is concave), by its greatly arched upper margin, and by the occluded umbilicus.

Type-specimen.—M. $\frac{12461}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Genus *Intha* Annandale.

1922. *Intha*, Annandale, *op. cit.*, p. 361.

Intha capitis Annandale.

1918. *Planorbis trochoideus*, Annandale (*nec* Benson), *op. cit.*, p. 113.

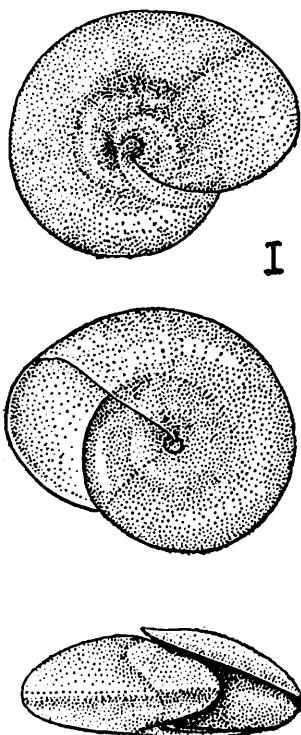


FIG. 3.—Type-specimen of *Intha capitis* Annandale from Inlé Lake.

Living individuals of this species occur commonly in the central and marginal zones of the Inlé Lake, and subfossil shells in the sand-like deposit on the He-Ho gorge.

A further examination of the genitalia of this minute species shows that they do not belong to type I, as stated in the original description of the genus (*op. cit.*, p. 359, 1922), but agree rather with those of *Segmentina*. There are, however, no ear-like processes above the penial sheath. There is no penial stylet. Details are difficult to distinguish on account of the minute size of the structures and the highly contracted state of the material examined.

This species was named after Mr. W. R. Head, Assistant Superintendent, Yawnghwe in 1922 to whom we were greatly indebted for much assistance during our tour in the Yawnghwe State.

Genus *Camptoceras* Benson.

1922. *Camptoceras*, Annandale, *op. cit.*, p. 363.

Camptoceras sp.

*Several specimens of a new species allied to *C. terebra* were found in the granular calcareous deposit on the He-Ho gorge. They have been submitted to Dr. Germain for description.

Family ANCYLIDAE.

Genus **Ferrissia** Walker.

In their recent revision of the Indian Ancyliidae¹ Annandale and Prashad treated *Ferrissia* as a subgenus of *Ancylus*, and we still believe that they were right in doing so on theoretical grounds; but a practical objection arises owing to the difficulty of deciding what will finally be accepted as the type species of *Ancylus*. We are in full agreement with those who claim that two distinct genera are represented by the two British species of the family (*lacustris* and *fluvialis*), but which should be regarded as the genotype of *Ancylus* is another matter, which we leave to the experts on nomenclature to discuss. We therefore accept *Ferrissia* as a genus pending final agreement on this point, merely claiming its very close relationship to "*Ancylus*."

Ferrissia baconi (Bourg).

1921. *Ancylus* (*Ferrissia*) *baconi*, Annandale and Prashad, *Rec. Ind. Mus.*, XXII, p. 592.

Several shells were found in the sand-like deposit at the head of the He-Ho gorge. The range of the species is believed to extend from Bengal to Japan.

Family RISSOIDAE.

Genus **Hydrobioides** Nevill.

1884. *Hydrobioides* (subgenus of *Bithynia*), Nevill, *Hand-List Moll. Ind. Mus.*, II, p. 42.

1918. *Hydrobioides*, Annandale, *op. cit.*, p. 117.

1924. *Hydrobioides*, Annandale, *Proc. Malacol. Soc. London*, XVI, p. 28.

As former descriptions of the genus have proved inadequate for its recognition, a more detailed diagnosis is necessary.

The shells of the genus are always rather thick and of a narrowly ovate or turritid form. They are of small or moderate size. The umbilicus is closed or almost so and there is no channel leading downwards from it towards the lip. The lip itself is thickened near the margin, but the actual margin is usually somewhat attenuate, the thickening, which is often visible externally and always well developed internally, is really a kind of varix, but must not be confused with the much more prominent varix that often occurs above it. In addition to being attenuate the lip is more or less expanded outwards in its lower part. The outer thickening forms a ridge inside the shell against which the operculum rests when withdrawn. It is only in growing shells, therefore, that the operculum can be pulled far into the aperture. The col-

² Annandale and Prashad, *Rec. Ind. Mus.*, XXII, p. 588 (1921).

umellar callus forms a narrowly flattened and expanded fold which usually occludes the narrow umbilicus.

The operculum is thick and shelly, with a thin outer horny covering. In the very young shell its structure is distinctly paucispiral and the nucleus is situated towards the inner margin near the middle point ; but in the adult the spiral figure becomes obsolete and the external sculpture is concentric, while the internal surface is smooth.

The anatomy is very similar to that of *Bithynia*.

Hydrobioides differs from *Amnicola* in the structure of the lip, the operculum (*vide* pl. xiv, *Rec. Ind. Mus.*, XIV, 1918) and of the male organ ¹ ; from *Digoniostoma*, to which it is closely allied, the chief difference lies in the structure of the mouth of the shell. In the former genus the lip is not so much thickened, the umbilicus is usually more open and is always connected with a channel that runs on the surface of the shell obliquely downwards towards the lip, while the callus is narrow and more ridge-like.

Annandale ² has recently proposed a division of *Hydrobioides* into two subgenera, *viz.*, *Hydrobioides* s.s. and *Parafossarulus*. The latter, which has its headquarters in China but also occurs in Burma, has no varix on the lip and is sometimes ornamented with spiral shell-sculpture.

Subgenus **Hydrobioides** Nevill.

Hydrobioides diperistoma, sp. nov.

1918. *Hydrobioides turrita*, Annandale (*nec* Blandford), *op. cit.*, p. 117.

The shell is small and thick with the spire conoidal, slightly longer than the inner margin of the body-whorl but much shorter than the outer margin. The body-whorl is markedly sinuate in outline and the anterior lobe as seen in dorsal view is remarkably well developed and distinct. The whorl is sub-carinate with a blunt ridge running round the periphery. This ridge marks the termination of the inner margin of the body-whorl in dorsal view. In ventral view the true spire is half as long as the body-whorl, to the lower part of which the aperture is appended as a kind of projection. The structure of the peristome is

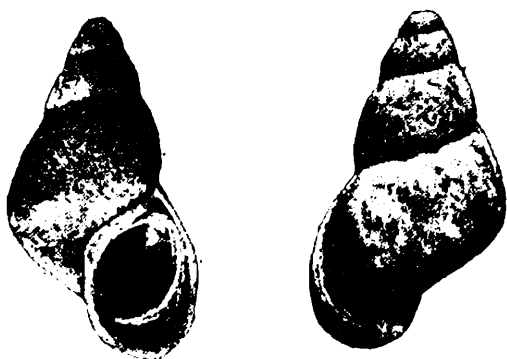


FIG. 4.—Type-specimen of *Hydrobioides diperistoma*, sp. nov.

highly peculiar, but may be taken to represent that typical of the genus in its highest development. There are indeed two peristomes. The inner of these is comparatively small, ovate and oblique. It is defined by a narrow but prominent ridge which is particularly conspicuous on the internal surface of the outer lip. This peristome, which forms the true mouth of the shell, is situated within

another of much larger size, less oblique and of different shape. The

¹ Annandale and Prashad, *Rec. Ind. Mus.*, XVIII, p. 26, fig. 2 (1919).

² Annandale, *Proc. Mal. Soc. London*, XVI, p. 28 (1924).

outer peristome is continued above the inner and is sharply pointed at the apex, leaving a distinct triangular area between the two. The lip is broadly expanded beyond the inner peristome, especially in the anterior region and is somewhat thickened. Its outer margin is a little sinuous but almost parallel to the columellar callus which is quite straight. The callus is rather broad and well developed especially above the rimate umbilicus which is completely closed. Above it meets the outer lip without becoming narrower.

Measurements (in millimeters) of type-specimen.

Height of shell.	Height of aperture.	Maximum breadth of shell.	Maximum breadth of aperture.
5.20	2.35	3.00	1.70

Type-specimen.—M. $\frac{12159}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

The double peristome of this form is much more distinct than in the true *H. turrita* (Blanford), which is figured by Nevill in *Journ. As. Soc. Bengal*, L (2), pl. vi, fig. 15.

The shells were found in large numbers in a subfossil condition in the deposit at the head of the He-Ho gorge. No living specimens were found.

Hydrobioides nassa (Theobald).

1918. *Hydrobioides nassa* (with subsp.) and *H. avarix*, Annandale, *op. cit.*, pp. 118, 120, pl. xiii, figs. 1—7; pl. xiv, figs. 3, 4.

Key to the phases of Hydrobioides nassa (Theobald).

1. Varix on lip of shell poorly developed .. *avarix*.
2. Varix well developed.
 - A. Varix almost confluent with thickened edge of lip, separated merely by a narrow groove .. *distoma*.
 - B. Varix separated from edge of lip by a flattened area.
 - (i) Edge of lip only slightly thickened; shell comparatively thin .. *rivulicola*.
 - (ii) Edge of lip distinctly thickened; shell thick.
 - (a) Flattened area between edge of lip and varix at least $\frac{1}{2}$ as broad as diameter of the shell .. *lacustris*.
 - (b) Flattened area much narrower .. *typica*.

In specimens of the form *avarix* traces of a varix close to the edge of the lip can be distinguished in a good light and in some it is fairly well developed. We found this form abundant in a warm spring the temperature of which was, at 7 o'clock in the morning, 27° C, while that of the air was 17.6° C.

Shells of the *forma typica* have recently been presented to the Indian Museum by Mr. J. R. le B. Tomlin labelled as *Pachydrobia paradoxa* Crosse and Fisher. They are from the Mekong. The two species resemble one another so far as the shell is concerned, but the operculum, radula and male organ are very different.

Subgenus **Parafossarulus** Annandale.1924. *Parafossarulus*, Annandale, *op. cit.*, p. 28.

Hydrobioides nana Annandale (*op. cit.*, p. 121, pl. xiv, fig. 3, 1918) belongs to this subgenus. Shells are not uncommon in the deposit above the He-Ho gorge.

In form and colouration the animal differs somewhat from that of *H. nassa*. The foot is very narrow and tapers behind to a fine point. In front it is truncate with the lateral angles evenly rounded and

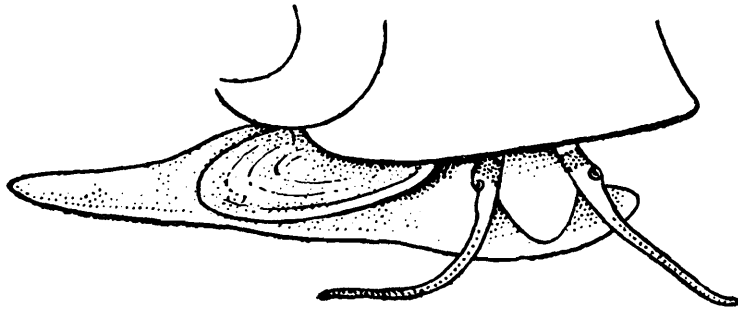


FIG. 5.—Living animal of *Hydrobioides nana* Annandale from Yawngnwe, S. Shan States.

not at all prominent. The snout is short and rather narrow and appears either bilobed or pointed in accordance with the position from which it is seen. The tentacles are very long and narrow and sharply pointed, with the minute eyes situated on them at some distance from their point of origin. The colour of the exposed parts is white or grey with a conspicuous yellow or red blotch behind each eye. The tentacles are spotted with black and the snout is sometimes infuscate.

Genus **Amnicola** Gould and Haldeman.Subgenus **Alocinma** Annandale and Prashad.1919. *Alocinma*, Annandale and Prashad, *Rec. Ind. Mus.*, XVIII, p. 23.**Amnicola alticola** (Annandale).1918. *Amnicola alticola*, Annandale, *op. cit.*, p. 122, pl. xiv, figs. 6, 6a.1919. *Amnicola (Alocinma) alticola*, Annandale and Prashad, *op. cit.*, p. 24, fig. 1-B.Genus **Paranerita** Annandale.1920. *Paranerita*, Annandale, *Rec. Ind. Mus.*, XIX, p. 45.1921. *Paranerita*, Annandale and Prashad, *Rec. Ind. Mus.*, XXII, p. 4.**Paranerita physcus** (Annandale).1918. *Hydrobioides physcus*, Annandale, *op. cit.*, p. 121, pl. xiii, figs. 8, 8a, 9; pl. xiv, figs. 5, 5a.Genus **Tricula** Benson.1921. *Tricula* (in part), Prashad, *Rec. Ind. Mus.*, XXII, p. 67.1924. *Tricula*, Annandale, *Amer. Journ. Hygiene*, Monographic Series, No. 3, p. 278.

***Tricula horae*, sp. nov.**

Shell narrowly ovate, sub-turrit with $5\frac{1}{2}$ to 6 whorls. Spire occupying in dorsal view a little more than half the total length. Apex blunt, mamillate. Outline of shell regular and very little broken by the suture, which is slightly impressed and transverse, whorls of the

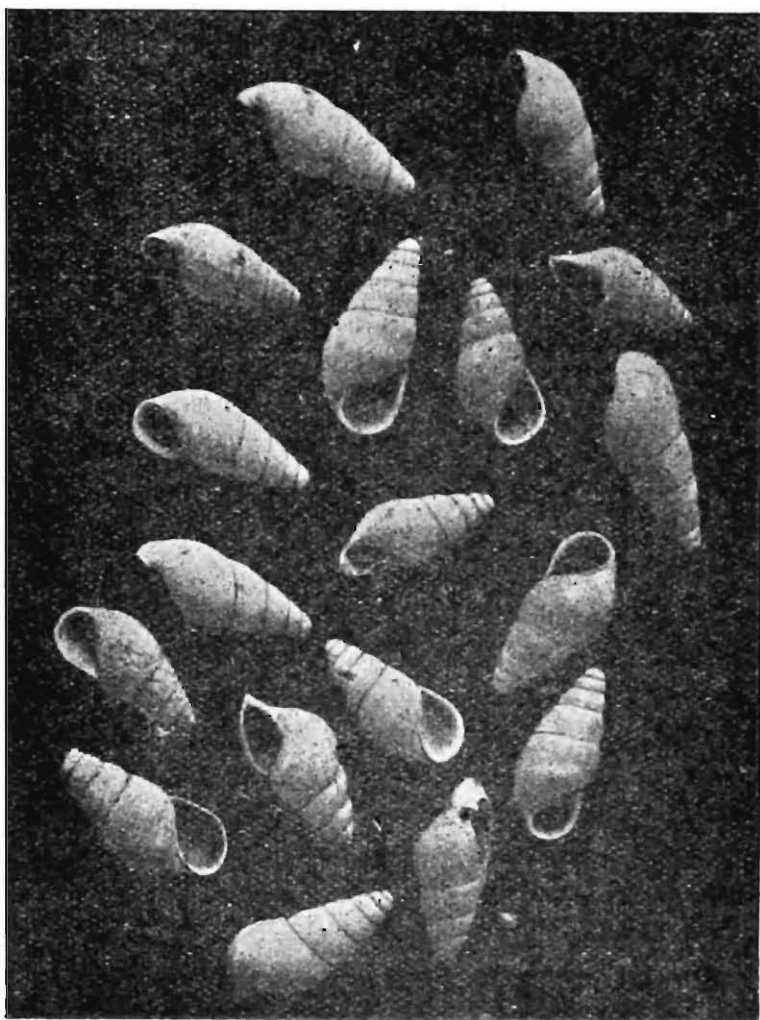


FIG. 6.—Shells of *Tricula horae*, sp. nov.

spire increasing gradually and evenly, the lateral outlines straight and not very oblique. Body-whorl occupying nearly half the length of the shell as seen in dorsal view with the outer margin much longer than the inner, which is evenly rounded. The anterior lobe of the shell in this view not greatly accentuated. On the ventral surface the whorl is slightly convex in its upper part with a slight indication of a peripheral keel, below which it recedes rapidly. The aperture is sub-utriangular and oblique, sharply pointed above and a little expanded below. The outer lip is thin but slightly callous, highly convex downwards and generally having a sinuate outline. The peristome is complete and the callus is well developed in the form of a narrowly flattened ridge continuous at the lip and completely closing the umbilicus. The interior of the mouth is finely polished. The external structure consists of faint longitudinal striae. In a subfossil state the shells have a porcellaneous appearance and sometimes retain faint traces of an olivaceous colour. The operculum has disappeared.

Measurements (in millimeters) of type-specimen.

Height of shell.	Height of aperture.	Maximum breadth of shell.	Maximum breadth of aperture.
2.78	1.05	1.40	0.69

Type-specimen.—M $\frac{1:46}{2}$ Zool. Surv. Ind. (*Ind. Mus.*).

Shells are common in the deposit at the head of the He-Ho gorge, but we did not find the species alive.

From the shells of *Tricula montana*, the type-species of the genus, those of *Tricula horae* are distinguished by the larger body-whorl and by the structure of the lip.

Family MELANIIDAE.

Genus **Acrostoma** Brot.

1921. *Acrostoma*, Annandale, *Rec. Ind. Mus.*, XXV, p. 509.

Acrostoma elongatum (Annandale).

1918. *Melania baccata* subsp. *elongata*, Annandale, *op. cit.*, p. 115, pl. xii, figs. 3—7.

1922. *Melania persculpta*, Ehrmann, *Sitzungsber. Naturf.-Ges. Leipzig*, IX, p. 18, pl. fig. 8.

Several shells with a thick calcareous deposit were obtained in the stream at Tai-O, Yawnghwe State. The species is commonly found living in swamps on the He-Ho plain. We also obtained several shells from a clay-pit one mile above the He-Ho gorge.

The radular teeth are not unlike those of *Acrostoma variabilis* (Benson), but the large middle cusp of the laterals is much better developed than in the latter species, and the median cusp on the central is somewhat blunt.

Acrostoma elongatum f. planicostata, nov.

This form, of which we have a recent specimen from He-Ho and a fossil shell from the Hsin-Dawng Caves, is distinguished by the fact that it has well developed vertical ribs on its whorls and that the two rows of tubercles and the spiral ridges surrounding them are obsolete. Traces of the tubercles can, however, be seen in a good light. The two shells we have examined are small, that from the Hsin-Dawng Cave is incomplete at the apex of the spire, while the living specimen from He-Ho is, unfortunately, broken.

The latter is paler in colour than most specimens of the species and has a well-marked spiral band of a dark brown colour running round the whorls.

We have a fossil specimen with two rows of tubercles from the Hsin-Dawng Cave.

We have been able to extract the radula from the specimen obtained at He-Ho. The radular teeth do not differ from those of *Acrostoma elongatum f. typica*.

The species is so variable in details of sculpture (although less so in its general character than many others) that it seems unnecessary to regard *Acrostoma elongatum* f. *persculpta* Ehrmann as distinct.

The range of the species extends from the head-waters of the Kalaw stream at Loi-an through the He-Ho plain down to its entrance into the Inlé Lake on its western shore.

Melanoides tuberculatus (Müller).

1918. *Melania tuberculata*, Annandale, *op. cit.*, p. 114 and pp. 155—156, pl. xii, figs. 1, 2.

Eight large shells of this species were obtained in a clay-pit one mile above the He-Ho gorge along with shells of *Acrostoma elongatum*. They are of the same size as the specimens obtained in our previous visit in a ridge of recent tufa on the He-Ho plain, and agree with the Shan species figured as *Melania pyramis* var. *adspersa* by Hanley and Theobald¹ except that the mouth is relatively small and not expanded.

Melania terebra Benson.

1918. *Melania terebra*, Annandale, *op. cit.*, p. 115, pl. xii, fig. 9.

We obtained no individuals of this species unless an incomplete smooth shell from the Hsin-Dawng Cave deposit, that we took along with *A. elongatum*, represents it.

Family VIVIPARIDAE.

Genus **Vivipara** Montfort.

The only specimen of this genus we have from the S. Shan States is a shell of *V. heliciformis*² Frauenfeld collected by Dr. S. L. Hora at Kalaw near the head-waters of the stream which enters the Inlé Lake on the west side. This shell and the single specimen of *Lecythoconcha lecythis* collected in the Inlé Lake on the first visit are the only Viviparidae other than *Taia* we have seen from the Inlé system.

Genus **Taia** Annandale.

1918. *Taia*, Annandale, *op. cit.*, pp. 123, 160.

1924. *Taia*, Annandale, *Proc. Roy. Soc. London*, B, XCVI, p. 60.

One of the main objects of our visit to the Shan States in 1922 was to obtain further information about this interesting genus, and a large additional collection of shells and preserved material was made.

The characteristic anatomical features of the genus are:—(a) the head of the animal is relatively larger than in *Vivipara* and has the eyes almost completely sessile; (b) the edge of the mantle is more muscular, though there is no greatly enlarged sphincter, and the margin is frequently produced into broad, highly contractile lobes correlated

¹ Hanley and Theobald, *Conchologia Indica* p. 45, pl. cx, fig. 4 (1876).

² Kobelt perpetuates the erroneous belief that this is an African species in his monograph on "Paludina" in the *Conch. Cab.* (1909), p. 172. Cf. Hanley and Theobald, *Conch. Ind.*, p. 33 (1876).

with the shell-sculpture¹; there is also a broad lobe corresponding to the thickened columellar callus; (c) the marginal teeth of the radula are relatively narrow; (d) the inner wall of the stomach is thrown into transverse folds which are frequently chitinized: (e) the central ner-

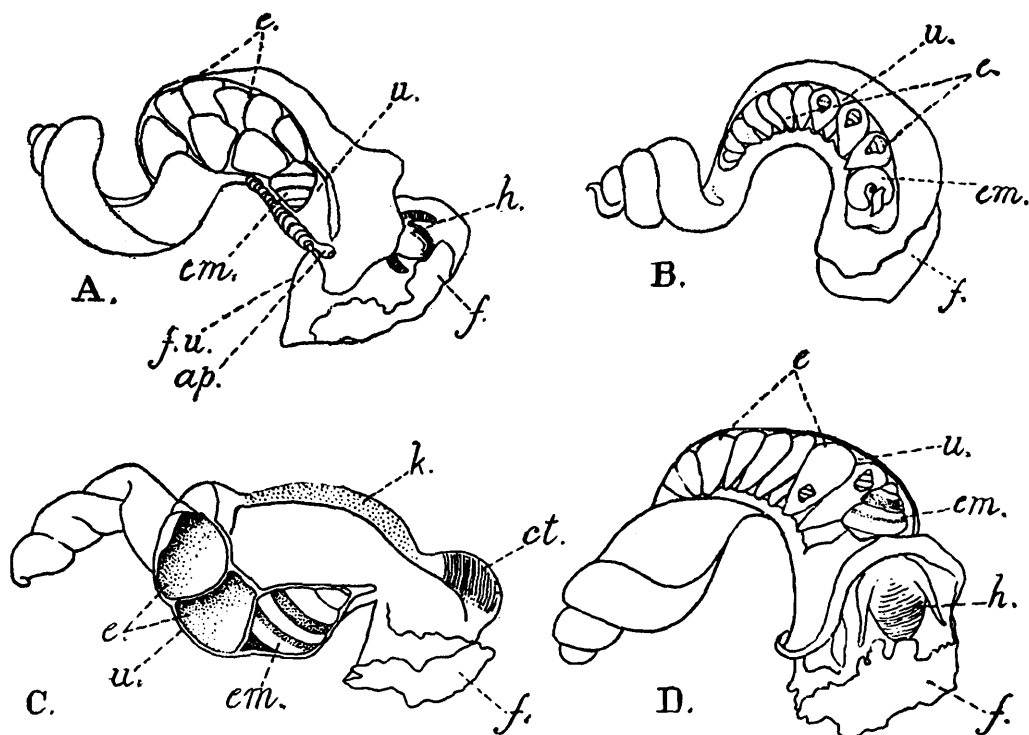


FIG. 7.—Uterus of species of *Taia* cut open to show the form and disposition of embryos and ova.

A. *T. crassicallosa*.

C. *T. intha*.

B. *T. shanensis*.

D. *T. naticoides* f. *intermedia*.

ap. anal papilla; ct. ctenidium; e. ova; em. embryos; f. foot; f.u. folds of uterus (the arrow should reach the folded area behind the anal papilla ap.); h. head; k. kidney; u. uterus.

vous system is relatively very large, with broad ganglia and greatly thickened commissures: (f) the uterus contains only a small number of embryos, which are more fully developed at birth than in *Vivipara*; (g) the gill-filaments are high and narrow with a short base of attachment.

The question of the relative fertility of the different species has been considered by Annandale (*Proc. Roy. Soc. London*, XCVI, p. 70, 1924) in reference to their evolution. An interesting point in this connection is the proportionate numbers of the sexes, for we have to consider the number of developed embryos and not merely that of unfertilized ova. In *T. naticoides* f. *intermedia* only four males were found among 25 individuals; in *T. crassicallosa* there were 4 males to 6 females; in *T. intha* 22 males to 27 females; in *T. shanensis* 18 males to 14 females; in *T. eltoralis* 10 males to 4 females. The numbers of individuals are small, but it would appear that while in the two species which live in streams or in paludine conditions the number of females predominates over that of males, the opposite is the condition in lacustrine and

¹ Annandale, *Proc. Roy. Soc. London*, XCVI, p. 67, fig. 5 (1924).

even paludine forms. There is thus further evidence for the reduction of fertility in the latter.

The examination of much further material renders it necessary to combine several of the forms hitherto regarded as distinct species, but on the other hand reveals the existence of yet another new species in the Inlé valley. We have thus the following living forms in the Inlé watershed :—

<i>Taia naticoides</i> race <i>intermedia</i> Annandale	<i>Taia shanensis</i> (Kobelt).
<i>Taia theobaldi</i> (Kobelt)	<i>Taia elitoral</i> Annandale.
<i>Taia crassicallosa</i> , sp. nov.	<i>Taia intha</i> Annandale.

With the exception of *T. theobaldi*, which we have not examined anatomically, these five forms are distinguished by apparently constant characters in the soft parts as well as the shells.

Four fossil or subfossil species also occur in the same area, namely :

<i>Taia naticoides</i> race <i>lacustris</i> , Annandale	<i>Taia conica</i> , Annandale.
<i>Taia obesa</i> , Annandale	<i>Taia cylindrica</i> , Annandale.

The first of these is known to us from the lacustrine deposit above the He-Ho gorge, while the other three were found in two small limestone caves at Hsin-Dawng, a few miles from the town of Yawngnaw.

We have recently received from Mr. F. W. Walker of the Geological Survey of India a number of shells of the species described by one of us as *Taia incisa*¹ and later made the type of the subgenus or genus *Temnotaia*.² In some of Mr. Walker's specimens the operculum remains. It proves that the species is really a Melaniid and not a Viviparid. *Temnotaia*, therefore, if it is to be retained, is no more than a section of *Paludomus* and a new name must be found for the smooth and thick-shelled forms of *Taia*. The name *Lissotaia* is here proposed. The species are *fulva* (Reeve), *concolor* (Nevill) and *bhamoensis* (Nevill). It is perhaps best, until their anatomy is known, to regard them as representing merely a subgenus of *Taia*.

***Taia naticoides* (Theobald).**

As Annandale pointed out in his original description of the Inlé species of the genus, the form that occurs commonly in swamps and backwaters in the Inlé valley is specifically identical with Theobald's species, but shells from the valley are not precisely identical with those from the Upper Salween, whence *T. naticoides* was originally described. Further, they differ slightly on an average from those from the He-Ho plain on the same watershed but 800 feet higher. Living specimens from the latter locality were thought to differ from subfossil shells from the superficial peaty deposits on the same plain, and these subfossil shells

¹ Annandale, *Rec. Ind. Mus.*, XIV, p. 213 (1918).

² Annandale, *Rec. Geol. Surv. Ind.*, L, p. 231 (1919) and *Rec. Ind. Mus.*, XXII, p. 293 (1921).

were separated into two species. The differences between living Inlé and He-Ho individuals are, however, so slight that it does not seem advisable to recognize them by the use of different names, while the living He-Ho form is found to grade absolutely into the common sub-fossil form originally called *intermedia*, of which the form *analoga* proves to be a mere monstrosity or aberration. We think it best, therefore, to combine all the living and fossil forms of this species from the two connected valleys under the name :

race ***intermedia*** Annandale.

1918. *Taia naticoides* (in part), *T. intermedia* and *T. analoga*, Annandale, *op. cit.*, pp. 126, 128, 132, pl. xv, figs. 6, 7, 12, 13, 16, 17 ; pl. xvi, figs. 3-6, 7-9 ; pl. xvii, figs. 3, 4 ; pl. xviii, figs. 1-3.

The shell of this race is rather more elongate and frequently much larger than that of the *forma typica* from the Upper Salween. It is, moreover, never wholly devoid of coarse spiral ridges, though they vary greatly in development.

The stomach of this form has a distinct chitinous lining and a pair of parallel chitinous ridges of a pinkish colour are usually to be found

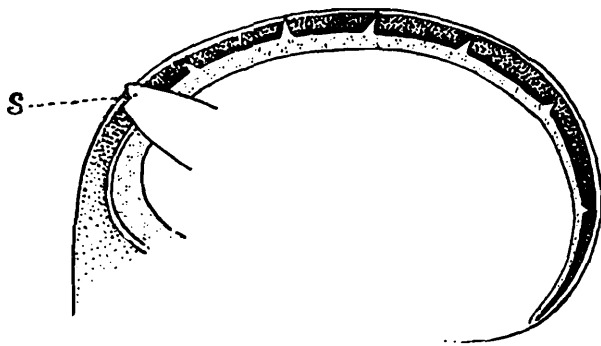


FIG. 8.—Mantle edge of young specimen of *Taia naticoides* f. *intermedia* as seen from below. S. siphon.

a little below the junction of the stomach and oesophagus. They are not always to be detected, however, and it is possible that they are worn out or cast off and replaced periodically.

The gill-filaments are very narrow ; their base is somewhat produced backwards.

The auricle of the heart is a lobed structure, larger than the spongy, thick-walled ventricle.

The uterus as a rule contains several embryos with well-developed shells, but two of these are usually larger and better developed than the others. About nine polygonal, compressed eggs are also present ; altogether there may be as many as thirty eggs and embryos. The embryonic shells are always banded.

Of 25 individuals examined at the Inlé Lake only 4 were males.

race ***lacustris*** Annandale.

1918. *Taia lacustris*, Annandale, *op. cit.*, p. 131, pl. xv fig. 10 (not 11) ; pl. xvii, fig. 1 ; pl. xviii, figs. 7, 8 (not 9).

The shell of this fossil form only differs from that of the race *intermedia* in being a little longer, narrower and less conical. It never

reaches a large size and is fairly constant in shape and sculpture. It occurs only in the clay banks of the He-Ho river above its gorge.

***Taia shanensis* (Kobelt).**

1918. *Taia shanensis*, Annandale, *op. cit.*, pl. xv, figs. 14, 15; pl. xvi, fig. 10; pl. xviii, figs. 4, 6.

This species appears to be somewhat modified structurally in correlation with its environment, especially in three systems, namely the shell,

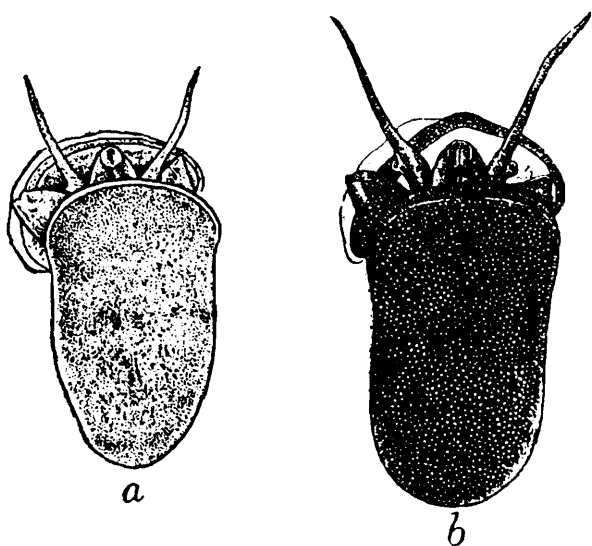


FIG. 9.—a. Ventral view of living animal of *Taia shanensis*.
b. Ventral view of living animal of *Taia intha*.

the respiratory system and the alimentary system, the environmental peculiarities being the very foul water in which it lives and the existence of an abundant supply of an alga containing hard calcareous particles on which it feeds. The shell is relatively thin and brittle. The chitinous lining of the stomach is particularly well-developed and the ridges and folds into which it is thrown unusually prominent, while the radular teeth are stronger than in other species. In the other direction, the gill-filaments are relatively broad, while the supra-intestinal fold of the mantle running close to and parallel to the ctenidium is strongly developed and perhaps acts as an accessory organ of respiration.

The colour of the exposed parts of the living animal, including the edge of the mantle, is nearly black with the usual yellow specks.

Other anatomical peculiarities noted are that both the auricle and the ventricle of the heart are globular and that the testis is of a peculiar shape, being elongate and curved with its anterior extremity extending to the base of the right tentacle. The ejaculatory duct has a tortuous course in the tentacle.

There are usually three to five embryos with distinct shells in the uterus, one or two being further advanced than the others. About eighteen undeveloped eggs are also present as a rule. The embryonic shells are not banded.

***Taia theobaldi* (Kobelt).**

1918. *Taia theobaldi*, Annandale, *op. cit.*, p. 126, pl. xv, fig. 18; pl. xvi, fig. 1; pl. xviii, figs. 15-17.

The spire of the shell is shorter than in any from of *T. naticoides* and the body-whorl is usually more swollen, but the most distinctive feature is in the callus, which in young shells is often ridge-like and even when

fully developed has a sharp outer edge, which leaves a chink leading to the umbilicus open.¹

Taia elitoralis Annandale.

1918. *Taia elitoralis*, Annandale, *op. cit.*, p. 134, pl. xv, figs. 4, 5; pl. xvii, figs. 5, 6; pl. xviii, figs. 13, 14. *Taia intha*, pl. xv, fig. 3.

Much additional material of this species, which was scantily represented in the former collection, was obtained and it becomes evident that the distinction between it and *T. intha* was not quite correctly set forth. The shells from towards the edge of the lake referred to *T. intha* really belong, as is proved by an anatomical examination, to *T. elitoralis*. This fact, while it still further limits the apparent variability of *T. intha*, which was always regarded as a peculiarly stable form, renders that of *T. elitoralis* somewhat wider. The figures cited, however, should render the matter clear.

In anatomy *T. elitoralis* stands somewhat apart from the other two species from the Inlé Lake. It differs from *T. shanensis* both in the structure of the stomach and in that of the respiratory system. The folds of the inner wall of the stomach are much less developed and there are no chitinous ridges, while the heart is better developed and the base of the gill-filaments relatively broader.

The large size of the heart may be correlated with the fact that the auricle is often filled with ova, apparently of an Echinostome trematode. No adult or larval parasites were found, probably because the time of year (March) at which the specimens were examined was unfavourable.

The number of embryos present in the uterus with shells is sometimes larger than in *T. shanensis*, but in specimens dissected at the Inlé Lake it was found that there were as a rule three such embryos, of which two were larger than the third. There are also about eight undeveloped spherical eggs, which are remarkable for their extraordinarily tough and fairly thick outer layer, which has a glistening surface. Inside this layer there is a mass of yolk with a cavity at one end in which the embryo is apparently developed. The eggs are attached to the wall of the uterus as in *Vivipara*.

Of 31 individuals examined at the lake 22 were males.

Taia intha Annandale.

1918. *Taia intha*, Annandale, *op. cit.*, p. 135, pl. xv, figs. 1, 2; pl. xvii, fig. 7; pl. xviii, figs. 10-12.

This is much the most constant species known to us as well as a species with the most highly developed shell-sculpture. Its anatomy resembles that of *T. shanensis* but the following differences have been observed. The testis has as a rule a sharp bend at its posterior end.

¹ Examination of a few specimens of this species from the N. Shan States recently sent by the Director of Public Health, Burma, has enabled me to add a short note on the anatomy. The mantle-edge has a wavy margin in some but has no definite processes. The stomach is relatively small in size and has a few raised folds on the internal wall. The gill-filaments resemble those of *T. raticoides* f. *intermedia* but are shorter and broader with their extremities rounded. Of seven specimens examined only two were females of which one was immature. The uterus was large and contained three embryos of which the anterior was the largest, and eight much compressed eggs. The embryos were faintly banded. Several very minute spiral ridges were present on the shell, the central ones being more prominent on the last whorl. (H. S. P.)

The structure of the rectum appears to be peculiar. The inner wall is provided with transverse folds and a median ventral double ridge running longitudinally.

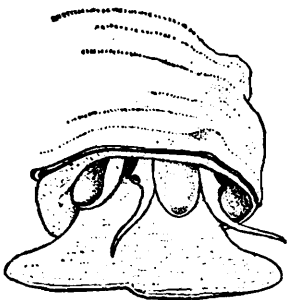


FIG. 10.—Front view of living animal of *Taia intha*.

The gill-filament is broad at the base but tapers to a fine and almost thread-like extremity.

The colour of the exposed parts of the living animal is pale olivaceous with yellow specks which appear to be universal in the family.

The fertility of the species is much reduced. There is often only a single very large embryo in the uterus; this occurred in six females examined consecutively at the Inlé Lake. A second and even a third smaller embryo is sometimes present. Undeveloped eggs are often absent and the single embryo present is often so large that it fills practically the whole cavity. It is thus not improbable that other ova are suppressed by its growth. The embryonic shell is banded.

Taia crassicallosa, sp. nov.

This species stands in much the same relation to *Taia naticoides* (Theobald) as *Taia intermedia* Annandale (here recognized as a form of *T. naticoides*), so far at

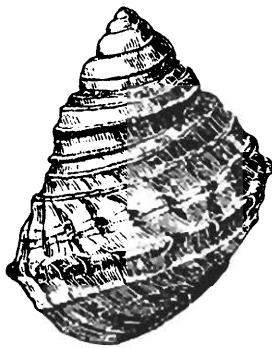
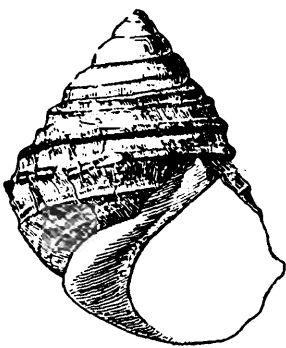


FIG. 11.—Type-specimen of *Taia crassicallosa*, sp. nov. from S. Shan States.

any rate as the external features of the shell are concerned; but differs from both in the relatively short, broad spire, which never exceeds the height of the last whorl, and especially in the extremely broad, very prominent and greatly thickened columellar callus.

The last is smooth and polished, but less so than in *T. naticoides*. The base of the aperture is slightly more oblique than that of *T. naticoides* f. *intermedia*.

Some of the smaller shells of the species seem to approach *T. obesa* Annandale in general form, but the great breadth and thickness of the columellar callus and its smooth and polished surface are sufficient to separate the species.

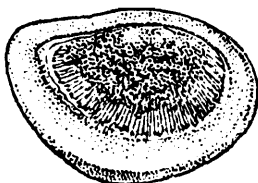
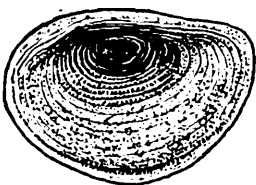


FIG. 12.—Operculum of *Taia crassicallosa*.

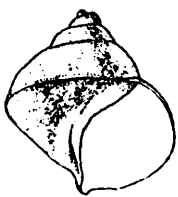


FIG. 13.—Embryonic shell of *Taia crassicallosa*.

The degree of variability in the sculpture and ornamentation of the shell is much the same as in *T. naticoides* f. *intermedia*, but the tendency to form tubercular ridges on the whorls is less marked. Squamous projections are rarely formed in a regular series on the last whorl.

Measurements of type-specimen in millimeters.

Height of shell.	Height of aperture.	Greatest breadth of shell.	Greatest breadth of aperture.
31.5	20.0	26.0	13.0

In actual bulk this species is the largest of all living species of *Taia*. Anatomically the species is well differentiated : it seems to be intermediate in some features between *T. naticoides* f. *intermedia* and

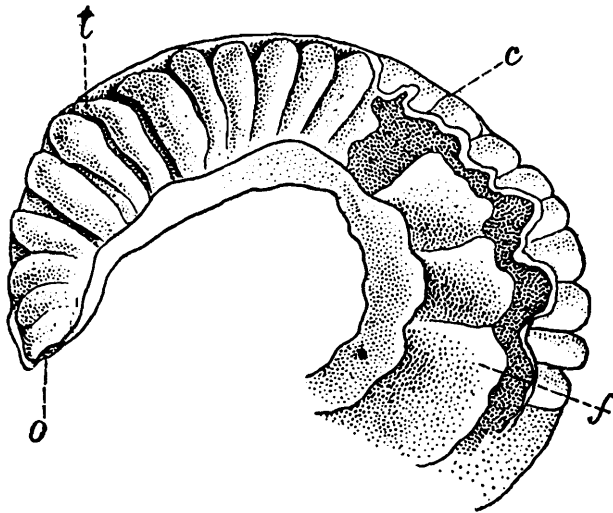


FIG. 14.—Uterus of *Taia crassicallosa* with its posterior half cut open.

o. external opening of uterus ; t. transverse folds of the dorsal wall of uterus ; c. cavity of uterus ; f. longitudinal fold in the floor of the uterine cavity.

only a few specimens before us, however, we are unable to judge whether this difference is merely an individual variation or due to sex. The uterus is transversely folded in such a way that its external surface has the appearance of a series of lamellae. The roof alone is involved in this folding process, while the floor has a thick, wavy longitudinal fold. There are only two full grown embryos (without bands on the shell) and six eggs with undeveloped embryos in them.

Anatomically the characteristic feature of this species is the peculiar structure of the uterus.

Type-specimen.—M. $\frac{12462}{2}$ Zool. Surv. Ind. (*Ind. Mus.*)

Living and dead shells were taken by us on the edge of the Yawnghwe river near Tai-O, Yawnghwe State, S. Shan States in March, 1922. Well-preserved specimens of the species were also brought back by Dr. S. L. Hora who visited the stream in April of the same year.

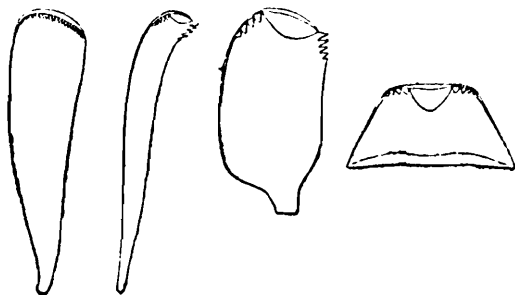


FIG. 15.—Radular teeth of *Taia crassicallosa*.

Several of the dead shells were covered by a thick calcareous deposit¹ which completely obscured their form and sculpture. Some

¹ We have to thank Mr. K. C. Biswas for examining the deposit. Cf.—Paul Ehrmann "Land-und Susswasserschnecken aus den Südl. Shan-Staaten" in *Sitzungsber. Naturf. Ges.* IX, pp. 24–25, pl. i, fig. 9 (Leipzig, 1922).

of the bivalves obtained in the same locality had a similar deposit on them, which, however, is due to a deposit of diatoms.

Taia obesa Annandale.

1918. *Taia obesa*, Annandale, *op. cit.*, p. 128, pl. xv, fig. 19; pl. xvi, fig. 2.

Two fully grown shells, larger than the type-specimen, and several young shells were obtained in the Hsin-Dawng caves. Of the former, one is broken at the lip and has its spire relatively long, its total height being 46.2 mm. The other is complete and relatively broad. It has the following measurements in millimeters:—

Height of shell.	Height of aperture.	Greatest breadth of shell.	Greatest breadth of aperture.
41.5	22.5	34.0	17.0

The tubercles on the spiral ridges of the shells are relatively feebly developed, especially in young individuals.

Taia cylindrica Annandale.

1918. *Taia cylindrica*, Annandale, *op. cit.*, p. 130, pl. xv, fig. 9, pl. xvii, fig. 2.

A large number of shells, some of them broader and higher than the type-specimen, was collected in the Hsin-Dawng caves on a mud slope leading from a hole in the roof of one of the caves to the interior, but many of them are incomplete. In one of the shells we found an exceptionally large embryo, but, unfortunately, in a bad condition.

Taia conica Annandale.

1918. *Taia conica*, Annandale, *op. cit.*, p. 133, pl. xv, fig. 8; pl. xvi, fig. 8.

This is much the most abundant of the fossil species found in the Hsin-Dawng valley. Our recent collection includes several shells smaller than any in the type-series.

Family AMPULLARIDAE.

Genus **Pachylabra** Swainson.

1920. *Pachylabra*, Annandale, *Journ. Nat. Hist. Soc. Siam*, p. 4, pls. i and ii.

Pachylabra conica var. **compacta** (Reeve)

1918. *Ampullaria winkleyi*, Annandale, *op. cit.*, p. 138, pl. xii, fig. 10.

1921. *Pachylabra conica* var. *contracta*, Annandale, *Journ. Fed. Malay St. Mus.*, X, p. 193.

We have consulted Dr. Baini Prashad, who has recently examined the type-specimens of *Pachylabra* in various European museums, as to our specimen. He is convinced of the identity of all from the Southern

Shan States¹ and regards them as falling within the limits of the form *compacta*. As a result of Dr. Prashad's investigations considerable changes become necessary in the nomenclature of the Indian species of the genus.²

The variety is widely distributed in Burma and occurs also in the Malay Peninsula. We obtained specimens at Loi-an near Kalaw as well as in the Inlé valley.

¹ I take this opportunity to invite attention to an unfortunate printer's error in my paper on Malay apple-snails. A whole paragraph has been omitted after the first paragraph on p. 195, *Journ. Fed. Malay St. Mus.*, X, including the name *Pachylabra conica* var. *compacta* in black type. The second and third paragraphs, as they stand, refer not to *P. stoliczkan*a, but to this form. There are several other misprints in the paper, of which I did not see a proof, but I think the others explain themselves. (N. A.)

² Prashad, *Journ. Asiat. Soc. Bengal* (N. S.), XVIII, pp. 585-591 (1923).

ON THE COMPARATIVE ANATOMY OF ORIENTAL VIVIPARIDAE.

By H. SRINIVASA RAO, M.A., Assistant Superintendent, Zoological Survey of India.

The members of the family Viviparidae were until recent years known chiefly by their shells, though a few observations on the soft parts had also been made. There are at present no sufficient data on which could be based a comparative study of the anatomy of the various species described. In the last half century various fragmentary accounts of the anatomy of *Vivipara bengalensis* (Lamarck) had been published, but, so far as I know, there was no single Palearctic or Oriental species of Viviparid in which the anatomy in all its details had been completely studied. This gap in our knowledge was first filled in India by the publication in 1921 of a monograph on *Vivipara bengalensis* by Dr. Annandale and Major Sewell.¹ Their observations on certain structures in the mantle edge of this and other species and genera of the family led Dr. Annandale to important and far-reaching conclusions in respect of the sculpture and ornamentation of the shell.

These authors stated in the summary of their account that the anatomy of the Viviparidae, so far as it had been studied, is strikingly uniform in most respects. Their detailed observations were, however, apart from *V. bengalensis*, restricted to the structure of the mantle, the brain, and the radula of various species. With a view to examine their statement I undertook, at the suggestion of Dr. Annandale, to make a comparative study of other systems of organs. The material placed at my disposal was all preserved, but I have had opportunities of studying fresh and living specimens of the Burmese genus *Taia* and of *V. bengalensis*. A few species from China and Japan were available for comparison in preserved material. A part of the Indian and Chinese material was in a bad state of preservation. Disadvantageous as preserved specimens are for a satisfactory study of the anatomy, I have not hesitated to place together my notes, in the hope that a small attempt in this direction may, at least, be an incentive to an extended and more exhaustive study of the family.

For purposes of comparison structures in which there is appreciable variation have been examined in all the species.

I take this opportunity of expressing my great indebtedness to the late Dr. Annandale for the help received in the preparation of this paper.

The comparative anatomy of the following five genera of Viviparidae was studied in greater or less detail :

Vivipara Montfort.

Taia Annandale.

Dactylochlamys, gen. nov.

Lecythoconcha Annandale.

Margarya Nevill.

¹ Annandale & Sewell, *Rec. Ind. Mus.*, XXII, pp. 215-292, pls. i-iii (1921).

Vivipara Montfort.

I have examined three species of this genus, viz., *Vivipara bengalensis* (Lamarck), *Vivipara dissimilis* (Müller) and *Vivipara quadrata* (Benson). The two former are from India and the last from China. The three species belong to different sections of the genus, namely the *Viviparae bengalenses*, the *Viviparae dissimiles*, and the *Viviparae angulares*. The alimentary organs, the kidney, and the central nervous system are quite uniform and do not show any appreciable variation. Specific differences are found only in the gill-lamellae, in the central nervous system,¹ the male genitalia,² and in the number of embryos present in the uterus. The differences in the form of the gill-lamella in the three species are best appreciated by a reference to the figures. In *V bengalensis* the uterus is cramped with numerous fully developed embryos and eggs enclosing small embryos in various stages of development. In *V dissimilis* there are only four to five embryos and about thirty small polygonal eggs in the uterus. The embryonic shells have no bands on them, but bear three rows of chaetae with a few prominent ridges. Some of the secondary ridges on the bodywhorl also bear chaetae. In *V quadrata* the uterus contains two or three relatively large embryos without bands on their shell, and about sixteen eggs. These differences in the three species seem to be constant.

The type-genus *Vivipara*, therefore, has the following anatomical characters :

The margin of the mantle in the adult is moderately thick and bears three short processes corresponding in position with the three rows of chaetae on the embryonic shell. These chaetae usually disappear on the adult shell. The adult shell may or may not bear coloured bands and is usually without ridges or spines of any kind, but a few species are highly sculptured. The head of the animal is small in relation to its size. The gill-lamella is usually broad and has a well-developed blood-vessel on its superior margin. In the central nervous system the cerebral ganglia are better developed than the pleural or the pedal, the pleural ganglia being usually insignificant and placed near the cerebral. The commissures and connectives are relatively short and thin. The uterus usually contains a large number of embryos in various stages of development.

Taia Annandale.

The following five species of the genus were examined :

Taia naticoides f. *intermedia* Annandale.

Taia shanensis (Kobelt).

Taia elitoralis Annandale.

Taia intha Annandale.

Taia crassicallosa Annandale and Rao.

All the five species are from the Shan plateau in Burma.³

The genus *Taia* is distinct from *Vivipara* not only in the shell but also in the soft parts. It differs from the latter in the head of the animal

¹ Annandale & Sewell, *op. cit.*, p. 269.

² *Id.*, *ibid.*, pp. 232-233.

³ Annandale, *Rec. Ind. Mus.*, XIV, pp. 123-137, pl. xv-xviii (1918).

being larger, in the relatively narrow marginals of the radula, in the lining of the stomach being transversely folded and often chitinized as two ridges at the junction of the oesophagus and the stomach, in the relatively narrow and tapering gill-lamella, in the greater development

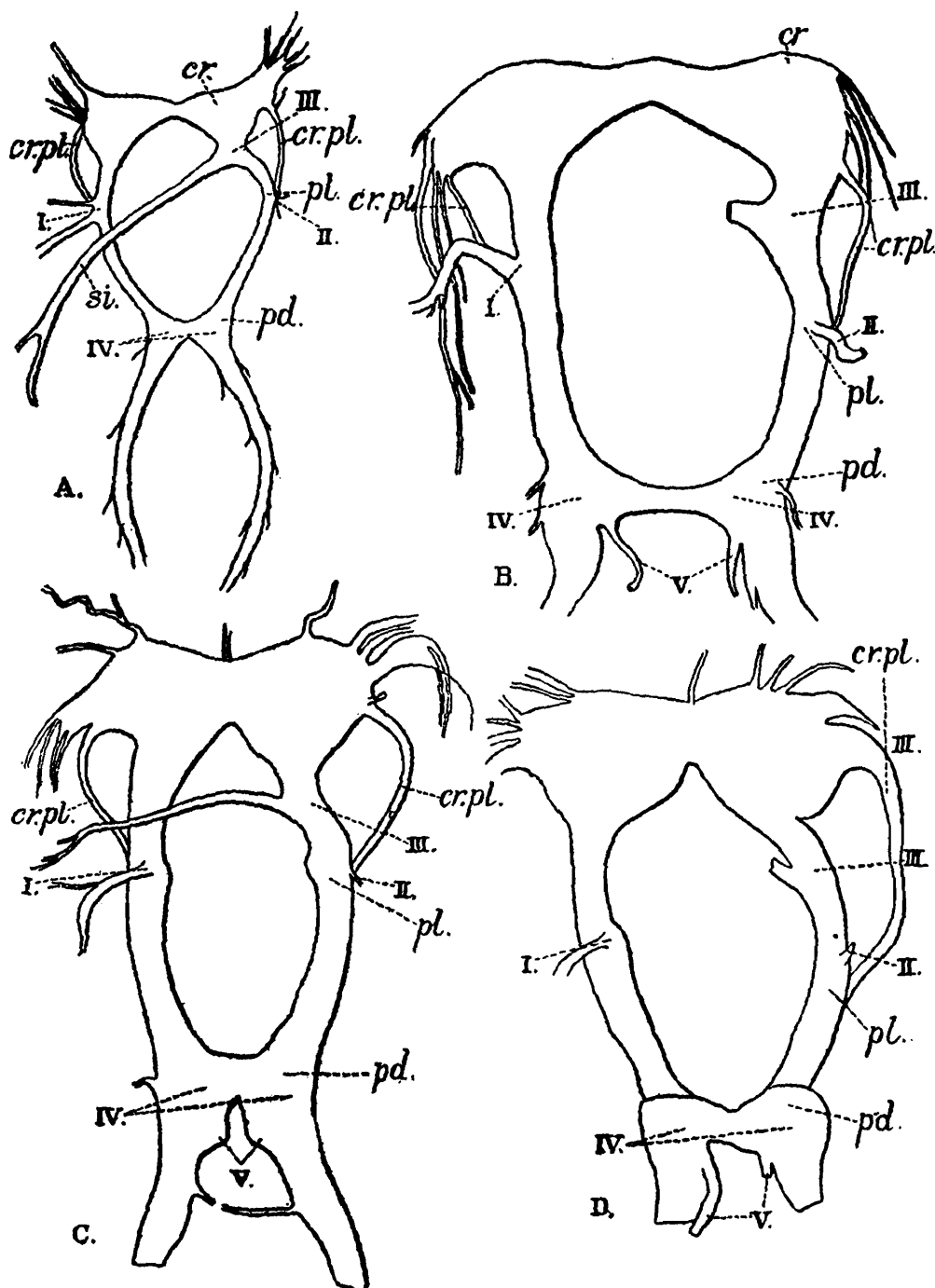


FIG. 1.—Central nervous system of Viviparidae.

A. *Vivipara bengalensis*.

B. *Taia naticoides f. intermedia*.

C. *Taia shanensis*.

D. *Taia intha*.

Cr., cerebral ganglion; cr. pl., cerebro-pleural commissure; pl., right pleural ganglion; pd., pedal ganglion; si., supra-intestinal nerve; I. left pleural ganglion; II., nerve from the right pleural ganglion; III., ganglion from which the supra-intestinal nerve arises; IV., portion of pedal ganglion from which the pedal commissure takes its origin; V., nerve from the posterior side of the pedal ganglion.

of the ganglia and commissures of the brain, and in the much fewer full-grown embryos in the uterus.

Specific differences are found in the gill-lamellae, the stomach and the genitalia. Of these the most reliable are those of the gill-lamella. Other structures such as the radula, the kidney, the heart, and the brain are subject to considerable variability in the individuals of a species. Specific differences have been discussed by Dr. Annandale and myself in a paper on the aquatic Gastropods of the Inlé watershed published immediately before this paper.

Dactyloclamys, gen. nov.

This genus is here proposed for the Assamese and Burmese species *Paludina oxytropis* Benson. It may be defined thus :

The shell is of large size, conical, thin but ornamented with prominent smooth spiral ridges which are concave on the internal surface. The base is somewhat flattened. The umbilicus is broadly rimate with a broad channel descending downwards from it.¹

The radula and operculum are as in *Vivipara*. The mantle has enlarged and highly vascular finger-shaped processes on the margin.

Type-species.—*Paludina oxytropis* Benson.

Dactyloclamys oxytropis² (Benson).

Specimens of this species in the collection are in such a bad state of preservation that the alimentary organs, the kidney, and the genitalia

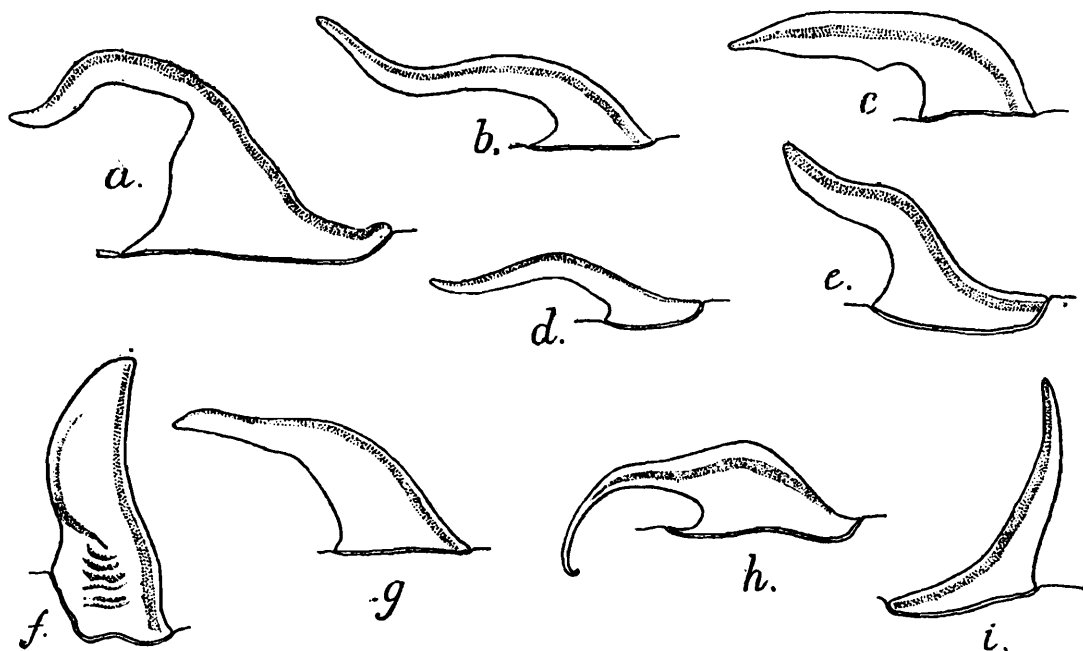


FIG. 2.—Gill-lamellae from the middle region of the ctenidium of Viviparidae.

a. *Dactyloclamys oxytropis*.

b. *Taia crassicallosa*.

c. *T. shanensis*.

d. *T. naticoides* f. *intermedia*.

i. *Vivipara quadrata*.

e. *T. elitoralis*.

f. *Vivipara bengalensis*.

g. *V. dissimilis*.

h. *Taia intha*.

could not be made out.³ Fresh specimens were, however, dissected by Dr. Annandale who states that there is no material difference in the gross

¹ See Annandale, *Rec. Ind. Mus.*, XXII, pp. 548-550, fig. 3B, pl. iv, figs. 2-5 (1921).

² *Paludina oxytropoides* Heude is probably a synonym of this species, at any rate it may be no more than a Chinese race of it. See Heude, *Mem. Hist. Nat. Emp. Chir.*, p. 176, pl. xl, figs. 3, 3a. (Chang-Hai, 1890).

³ The specimens were hardened in formalin, which, as experience has taught us, should be avoided in the preservation of freshwater molluscs.

internal anatomy of *V. bengalensis* and *D. oxytropis*. I have been able to examine the gill-lamellae, the central nervous system, and the uterus of the present species. The gill-lamella approaches that of *V. dissimilis* but is distinct in having a broad basal portion, and a long finger-shaped apical half. The brain is very similar to that of the species of *Taia* in the well-developed ganglia and the stout commissures. In the uterus there are about ten relatively small full-grown embryos and an equal or a slightly larger number of eggs with a tough external covering of albuminous material. The embryonic shells bear three rows of chaetae but no bands.¹

In respect of the gill-lamella and the number of embryos in the uterus the present species may be said to be distinct from those of *Vivipara* or *Taia*.

Lecythoconcha Annandale.

This genus closely resembles *Vivipara* in some features, but has distinctive characters in the mantle, in the gill-lamellae, and in the brain of the animal.

The free-edge of the mantle is greatly thickened, with a strong and conspicuous sphincter muscle along it. The gill-lamella is relatively long and has its superior margin thickened and often thrown into folds. The ganglia and commissures of the brain are strongly developed, much more so than in species of the genera discussed above. There are usually about thirty embryos in the uterus.

I have examined the following three species of the genus, all from outside Indian limits :

Lecythoconcha lecythis (Benson), rice-field phase, from China and Japan.

Lecythoconcha chinensis f. *catayensis* (Heude) from China.

Lecythoconcha sclateri (Frauenfeld) from Japan.

These three species are closely similar in respect of the soft-parts but differ in the form of the gill-lamella and in the number of embryos present.

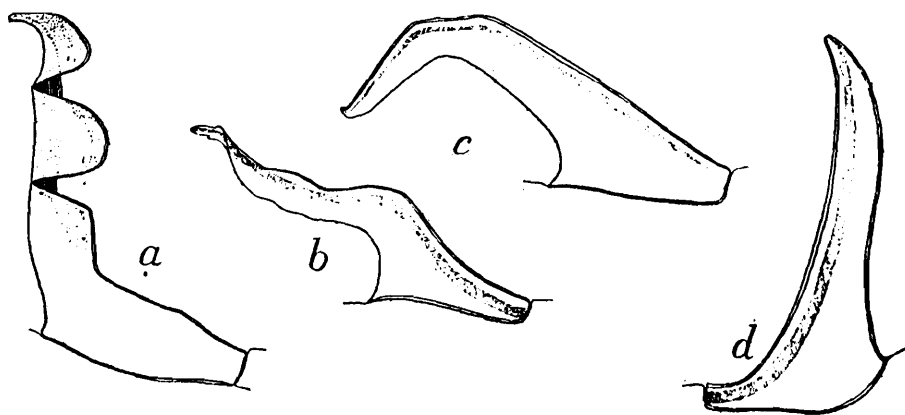


FIG. 3.—Gill-lamellae from the middle region of the ctenidium of Viviparidae.

a. *Lecythoconcha lecythis*. b. *Lecythoconcha lecythis*, a relatively narrow and less folded type.

c. *Lecythoconcha chinensis* f. *catayensis*. d. *Margarya melanoides*.

With regard to the latter feature *L. lecythis* and *L. chinensis* f. *catayensis* come very close. They have about thirty more or less equal-sized em-

¹ Dr. Annandale has observed that males of this species are considerably less abundant than females in the Loktak Lake, Manipur valley.

bryos without bands on the shells. In *L. sclateri*, however, there are only five full-grown embryos, which have three rows of chaetae on the shell but no bands. Eggs with undeveloped or partially developed embryos in the uterus are very few and the uterus is often without them.

Margarya Nevill.

The collection contains only one specimen of *Margarya melanoides* Nevill in spirit, which is badly damaged and consequently no observations on the soft parts except the gill-lamella and the brain could be made.¹

The relationship of the genus to other genera of Viviparidae with regard to the structure of the mantle-edge has been discussed by Annandale in his and Sewell's monograph on *Vivipara bengalensis*.

The head of the animal is small in proportion to its size. The gill-lamella is more or less straight, vertical and narrow, and tapers gradually from the base towards the apex. The superior margin is thickened but never thrown into folds as in *Lecythoconcha*. Heude's figure of the gill-lamella agrees more or less closely in outline with the one figured here, but the natural position of the lamella could not be made out in the specimen examined by me. The ganglia and commissures of the brain are much larger and stouter than in species of *Lecythoconcha*. The form and sculpture of the embryonic shell is quite distinct from those of other genera of Viviparids. The number of embryos found in the uterus is unknown.

Reviewing the family as a whole it is clear that while it stands distinct from the closely allied freshwater families in its viviparity and in the structure of the male organ, the genera are distinguished chiefly by the sculpture of the shell, the variety in which is due to very slight differences in the structure of the mantle-edge. The statement made by Annandale and Sewell as to its anatomical homogeneity is fully justified. There are, however, certain generic characters in the soft parts, though shell-sculpture is the main generic character.

The specific differences are subtle and exist both in the general form of the shell and in the soft parts.

The following synopsis gives the main generic differences in the soft parts of the genera examined.

- | | |
|---|-----------------------|
| a. Edge of mantle greatly thickened with a conspicuous sphincter muscle along it. Superior margin of gill-lamella usually thrown into folds | <i>Lecythoconcha.</i> |
| b. Edge of mantle not so thickened and without a conspicuous sphincter. Superior margin of gill-lamella never thrown into folds. | |
| a. Free part of gill-lamella very long with its superior margin conspicuously thickened | <i>Margarya.</i> |
| b. Free part of gill-lamella relatively short with superior margin never so conspicuously thickened. | |
| 1. Margin of mantle with enlarged and highly vascular finger-shaped processes. | <i>Dactyloclamys.</i> |

¹ Heude, *op. cit.*, pl. xliii, figs. 1 & 2.

2. Margin of mantle with only minute triangular prominences.
 1. Full-grown embryos in the uterus never more than four in number. Central nervous system strongly developed. Lining of stomach thrown into folds which are often chitinised and with ridge-like chitinous thickenings at the entrance to the stomach *Taia.*
 2. Full-grown embryos in the uterus, as a rule, more than four. Central nervous system less developed. Lining of stomach without folds or chitinous thickenings *Vivipara.*

