

VIII ON A NEW SPECIES OF BLEPHAROCERID FLY FROM KASHMIR, TOGETHER WITH A DESCRIPTION OF SOME LARVAE FROM THE SAME LOCALITY

By S. P. AGHARKAR, M.A., *Rashbihari Ghosh Professor of Botany, Calcutta University.*

(Plates xvi-xvii.)

While working in the Indian Museum in January and February, 1914 I was asked by Dr. Annandale to examine and report on the collection of Blepharocerid larvae and adults made by Mr. H. B. Bion of the Geological Survey of India at Nagaberan, in Kashmir. The collection has proved very interesting in more ways than one. The adults have proved to be specimens of a new species (*Philorus bionis*) of the genus *Philorus*, which genus has not hitherto been recorded from India. The larvae include specimens of 3 species, none of which appear to agree with the descriptions and figures of any of the previously described species; they either represent new species or belong to species whose larvae are unknown at present. It has to be noted that this is the first time that any Blepharocerid larvae are being described from India. The collection was made at an altitude of 10,000—10,500 ft., which appears to be the greatest height from which any species of the family have been recorded. All the specimens were obtained in rapid-running streams and were captured by means of a hand-net inserted into places where stones had just been overturned. The adult flies were taken in the same way and at the same time as the larvae.

An interesting point is the occurrence of such a large number of species (four) in the same locality. This, however, is a fact which has been previously noticed by Kellogg with reference to his New California larva, which was found to occur along with the larvae of *Bibiocephala comstocki* and *B. doanei* in most streams (cf. Kellogg, *Proc. Cal. Acad. Sci. Zool.*, Vol. iii, No. 6, 1903).

I have to thank Dr. Annandale for giving me the opportunity of examining such an interesting collection. I have also to thank him and Mr. Brunetti for valuable suggestions and help during the course of the work. The illustrations were all drawn by Babu D. N. Bagchi of the Indian Museum staff under my supervision, and he has done the work with his usual skill. All the specimens described are in alcohol.

KEY TO THE SPECIES OF THE GENUS *PHILORUS*, KELLOGG.

Second longitudinal vein simple without branches; a cross-vein present between the 4th and 5th longitudinal veins.

A₁ Eyes contiguous, bisected by a simple groove.

1. *P. ancilla*, Osten-Sacken.

A₂ Eyes separated by a broad front; not bisected by a cross-band or groove.

b₁ Submarginal cell with a long pedicel.

2. *P. yosemite*, Osten-Sacken.

b₂ Submarginal cell sessile.

C₁ Second vein curving *downwards*, nearly parallel to the third vein; forking of 5th and 6th veins at nearly $\frac{1}{4}$ its length from the base.

3. *P. bilobata*, Loew.

C₂ Second vein curving *upwards*, in an opposite direction to that of the third vein; forking of the 5th and 6th veins at nearly $\frac{1}{3}$ its length from the base.

4. *P. bionis*, sp. nov.

***Philorus bionis*, sp. nov.**

(Plate xvi, figs. 1-7.)

♂ ♀ *Head* (figs. 4, 5) transverse, narrower in width than the thorax; nearly black in colour; ocelli conspicuous. Proboscis brownish yellow, somewhat shorter than the vertical height of head in length.

Eyes widely separated; not bisected by any non-faceted cross-band; facets all of the same size, pubescent all over, black in colour.

Antennae (figs. 6, 7) 14-jointed; the scapal and 1st flagellar joints brown in colour, the remaining joints black.

Palpi 5-jointed; the 1st rather a short joint, the 2nd longer with a slightly swollen head, the 3rd pear-shaped with the terminal part coloured dark brown, the 4th a trumpet-shaped joint, the last nearly oblong in shape with a small peduncle by which it is inserted on the side of the 4th.

Mandibles absent in both ♂ and ♀

Thorax strongly arched on the dorsal side, with a distinct transverse suture. Dorsum is black with a trefoil-shaped yellowish-white mark on the posterior region. This is much more conspicuous in the ♀ than in the ♂

Abdomen: ♂ terga clove-brown in colour, sterna and pleura nearly white; hypopygium conspicuous, clove-brown in colour. ♀ terga light cinnamon-brown in colour, much less chitinised than in the ♂. A black line is seen on each side which is really formed by the tracheal vessel with its branches going to the abdominal stigmata.

Genitalia (figs. 1-2) very conspicuous. ♂ The hypopygium is during life bent upwards very much like the forceps of an earwig; there is a small dorsal plate covering only the basal parts of the genitalia. A much larger ventral plate with its sides turned upwards so as to enclose the genitalia from below and the sides is present. Its posterior edge has a wide shallow notch in the middle. From near the sides of this notch arise two leaf-like claspers which are folded in the middle along their length. They bend towards each other and meet nearly in the middle line. From the sides of the ventral plate, a little behind these claspers arise a pair of stiff three-lobed claspers. During life they are apparently turned towards each other so that one of the lobes of one meets the corresponding lobe of the other enclosing an arched surface between. Arising from the anterior part of the ventral plate are two beak-headed claspers, with their beaks turned towards one another and enclosing a space through which the penis is protruded. The penis is not visible in all specimens, but where it is seen it appears to be a cylindrical structure from which eight fine filamentous structures arise.¹ These appear to be the actual intro-mittent organs.

♀ The genitalia of the female are neither so conspicuous nor so complicated as those of the ♂. There is a dorsal and a ventral plate similar to that of the ♂ but much smaller. There is a pair of leaf-like claspers situated similarly to the claspers of the male but much smaller. The only other organs are a pair of small leaf-like claspers arising from near the middle of the anterior edge of the ventral plate. These guard the ♀ genital aperture.

Legs long and slender. The legs of the ♂ are proportionately much larger than those of the female. Colour of legs in ♂ brown, in the ♀ yellowish-white. *Front tibiae* without any spurs, the middle ones with a single terminal spur, the hind ones with a small spur in addition to and by the side of the terminal spur. *Ungues* pointed and hook-like. *Pulvilli* absent, *empodia* rudimentary.

Wings (fig. 3). The venation can be distinguished from that of other species of *Phylorus* by the following characters: (1) the 2nd vein is bent upwards instead of downwards near its termination; (2) the forking of the 5th and 6th veins takes place at about $\frac{1}{3}$ its length from the base.

Halteres well-developed; both stem and club light brown in colour.

Immature stages unknown; it is possible that one of the three species of larvae found occurring with it may belong to it. But nothing can be said on this point until more information is available.

Length ♂ 4 to 5 mm. ♀ 5.5 to 6 mm. Described from 9 ♂ and 5 ♀ specimens, collected by Mr. Bion at Nagaberan, Kashmir.

Types preserved in the Indian Museum.

¹ Fig. 1, 2 does not show the parts in their natural positions; it was drawn from a balsam preparation in which the parts had been pressed out flat.

LARVAE FROM KASHMIR.

Along with the specimens of adult ♂ and ♀ collected at Nageran, Kashmir, were enclosed nearly 275 specimens of larvae of all sizes. I first thought that they were all of one species, presumably *Phylorus bionis*, sp. nov., with the adults of which they were found to occur. It was only when I examined the whole collection carefully that I found them to belong to three distinct species and a form which appears to be only a variety of one of them. As none of the larvae agree with any Blepharocerid larvae previously described and figured,¹ it has become impossible to assign them to any species. I have, therefore, followed the only course open under the circumstances, viz. to describe the larvae and figure them without giving any names.

LARVA A.

(Plate xvii, figs. 8-10.)

The fully-grown larvae are from 7 to 8 mm. in length and moderately broad. In the collection before me there are younger specimens of various sizes from 3 mm. onwards. The general appearance agrees with that of typical Blepharocerid larva, being broadest at the head region with the successive segments slightly narrower than those in front of them. *The colour* of the dorsal surface varies from light cinnamon-brown to deep clove-brown. The difference in shade does not appear to depend on the size of the larva, but to some other cause, such as exposure to light.²

The markings on the head consist of a central rectangular dark area and two triangular ones on its sides, on the most anterior region of the head segment. In the centre of the rectangular patch is a nearly ellipsoidal area separated from the rest by a deep groove which appears as a bright line when viewed by transmitted light. The other markings on the head segment are two transverse bands, a faint one in the middle and a dark one in the posterior part of the segment. On each of the other segments of the body there is a transverse dark band in the middle. The ventral surface of the body is white with the exception of the suckers, which appear to the naked eye as dark circular rings. The lateral processes are light brown in colour.

Antennae: two-jointed, the 2nd joint having 4 or 5 small papillose hairs with globular heads at the end. Proximal half of each joint white, distal half black in colour.

Lateral processes single, with a tuft of long fine hair-like processes at the end of each. *Tracheal gills in groups* of 6.³ There

¹ With the possible (but very improbable) exception of the larva of *P. yosemite*, described by Prof. Kellogg in *Psyche*, Vol. X, p. 186, I could not get a copy of this paper in any of the libraries in Calcutta.

² Mr. Bion informs us that all the larvae were much paler in life than they are in spirit.

³ I have found the number of gills in a tuft vary from 5 to 7, but 6 is the most common number.

are 5 pairs of gill-tufts, one in front of each lateral process, excepting those of the head-segment. Behind the last sucker there are 4 gills much larger than the others. These probably represent another type of tracheal gills. This is the most common larva, over 260 specimens out of a total of over 275 larvae belonging to it.

Among specimens belonging to this species are some forms (Larva A') which are very much broader in proportion to their length than the typical individuals. I have not been able to find any other characters, in which they differ from the type and am not in a position to say whether they really represent the same species. The outline figure (fig. 11) will give a good idea of the appearance. The larvae appear to be very much like those of the genus *Blepharocera* as figured by Kellogg and others and it is to be hoped that they represent the larvae of *Blepharocera indica*, Brun., which has been described from the Western Himalayas (*Rec. Ind. Mus.* IV, p. 316 (1911) and *Fauna Brit. India*, Nematocera, p. 156).

Types preserved in the Indian Museum.

LARVA B.

(Plate xvii, figs. 12-13.)

Length 6-7 mm. The markings in the dorsum of the head and thoracic segment consist of a single dark patch with an ellipsoidal groove in the middle. In some there is a tendency to have this patch divided into three areas like those of the larva A. Behind there are some darkish markings. The abdominal segments have each a single dark transverse bar. There is a row of 6 spines on each side of the body, one spine being placed a little above the base of anterior lateral process; each of the abdominal segments except the last has 4 spines, a pair in front and a pair behind the transverse dark bar. The head and thoracic segment as well as the last segment have two spines only.

Lateral processes not very conspicuous, double; the anterior member of each pair longer and bearing at tip a long spiny hair; lateral processes pale fuscous in colour; tracheal tufts in groups of 4 each, rather short, 3 of them directed anteriorly and 1 posteriorly; antennae rather short, three-jointed.

Described from 15 specimens from among those collected by Mr. Bion at Nagaberan in Kashmir.

Types preserved in the Indian Museum.

LARVA C.

(Plate xvii, figs. 14-15.)

Long and broad; length 8-6 mm. The markings on the head and thoracic segment consist of a central rhomboidal area in two sides of which are two nearly triangular patches; the central

part is very pale in colour. Each segment has two spines, one above the other, on each side a little above the base of the lateral processes; besides this there are 2 spines in the mid-dorsal line of the head and thoracic and the last abdominal segment, and 4 on each of the other segments; lateral processes very conspicuous, double, the anterior member of each pair longer, pointed and bearing a number of fine hairs on its side and a single long spiny hair at its tip; the posterior member of each pair blunt and stout and bearing a number of fine hairs on its side; these lateral processes yellow in colour; tracheal tufts in groups of 4, moderately long, 3 directed forwards and 1 backwards. The suckers are proportionately broader than in larvae **A** and **B**; antennae longer than in larvae **A** and **B**, three-jointed, black in colour.

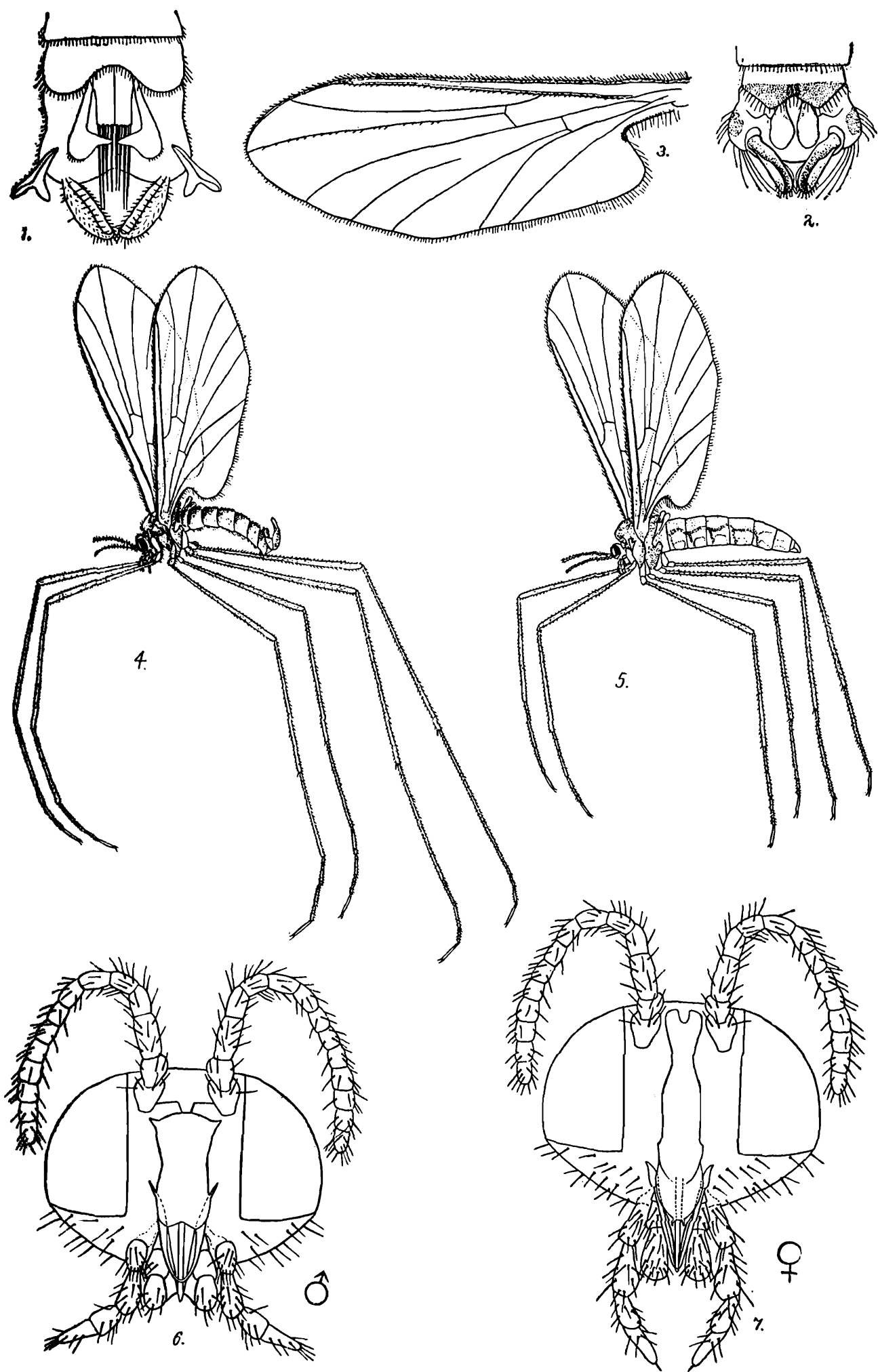
Described from a single specimen from among those collected by Mr. Bion at Nagaberan.

Types preserved in the Indian Museum.

EXPLANATION OF PLATE XVI.

FIG. 1.--*Philorus bionis*, sp. nov., ♂ genitalia, × 30.

„ 2.—	„ „	♀ „ „	
„ 3.—	„ „	wing, × 8	
„ 4.—	„ „	adult ♂ ,	} enlarged.
„ 5 —	„ „	♀ ,	
„ 6 —	„ „	head of ♂ ,	
„ 7.—	„ „	„ ♀ ,	



EXPLANATION OF PLATE XVII.

BLEPHAROCERID LARVA A.

FIG. 8.—Dorsal view, $\times 8$.

„ 9.—Ventral view, $\times 8$.

„ 10.—Sucker, highly magnified.

BLEPHAROCERID LARVA A .

„ 11.—Dorsal view, $\times 8$.

BLEPHAROCERID LARVA B.

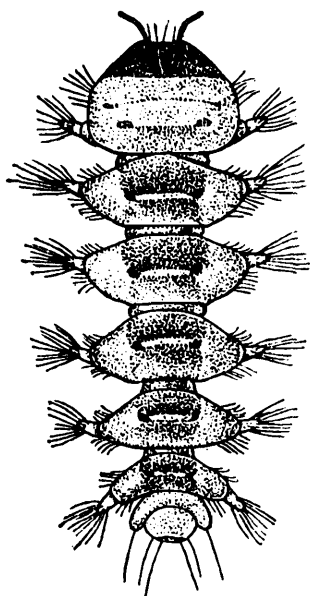
„ 12.—Dorsal view, $\times 8$.

„ 13.—Ventral view, $\times 8$.

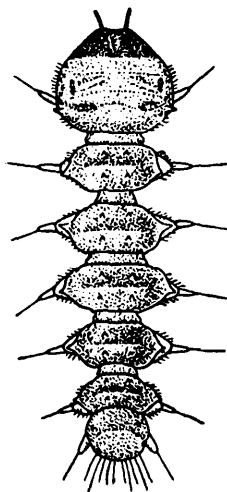
BLEPHAROCERID LARVA C.

„ 14.—Dorsal view, $\times 8$.

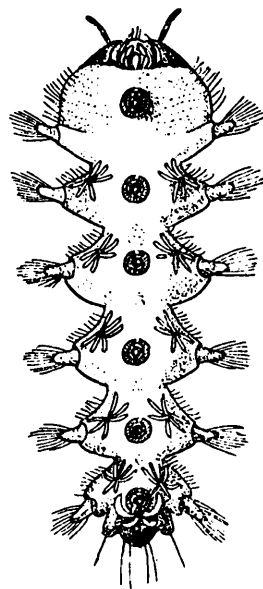
„ 15.—Ventral view, $\times 8$.



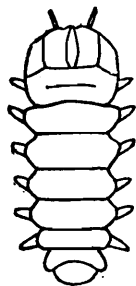
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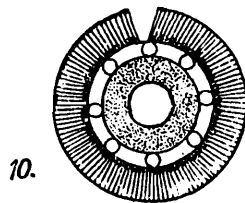
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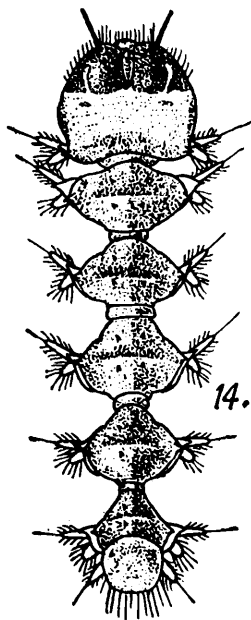
9.



11.



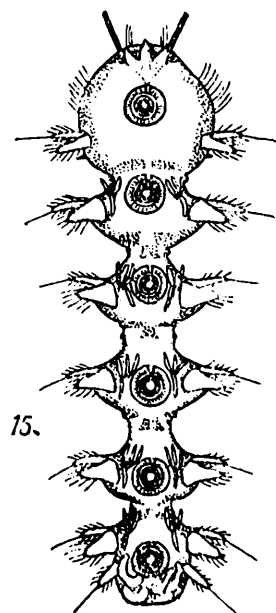
10.



14.



13.



15.

IX STUDIES IN INDIAN HELMINTHOLOGY,
No I

By F. H. STEWART, M.A., D.Sc., M.B., Capt., I.M.S.
Hon. Asst., Indian Museum.

(Plates xviii-xxiii).

In the present report the following species are recorded,
viz. :—

1. *Oxysoma macintoshii*, n. sp.
2. *Oxysoma kachugae*, n. sp.
3. *Heterakis macronis*, n. sp.
4. *Dacnitis callichroi*, n. sp.
5. *Spiroptera denticulata*, R. var. *minor*, n. var.
6. *Atractis kachugae*, n. sp.
7. *Physaloptera*, sp. larva.
8. *Ascaris*, sp., larva (L. 33, 36).
9. " " " (L. 15).
10. Larva undiagnosed (L. 30).
11. " " " (L. 14).
12. *Oncholaimus indicus*, v. I. inst.

1. *Oxysoma macintoshii*, n. sp.

(Pl. xviii, figs. 1-12).

From rectum of *Rana tigrina*, Daud., and *Bufo*
stomaticus, Lütken Lucknow.

Plump little worms, the body cavity being more developed and less closely packed with viscera than in many nematodes; greater variations in shape and consequently in the measurements occur—(*vide* tables I and Ia pp. 184, 185). The head can be invaginated into the anterior part of the body, a fact which also contributes to variations in the measurements.

Females (fig. 1) 1·9-2·78 mm. long. Head (fig. 3). The mouth is surrounded by three lips, one dorsal, two subventral. Each lip is low, semicircular and membranous, the edge thickened. The lips curve in toward the mouth forming a diaphragm over the shallow oral cavity. The base of this cavity is formed by the anterior end of the oesophagus from which three powerful chitin-covered teeth, one dorsal, two subventral, project into it.

A curved chitinous flagellum can be observed in some specimens, springing apparently from the apex of the dorsal tooth.

The head can be retracted into the neck until the mouth is at the level of the collar.

The cuticle of the head is not ringed, that of the body shows annulation, but this is probably artificial as the rings are completely irregular in breadth.

Lateral membranes extend from the head to the base of the tail, but it has not been found possible to measure them.

A large ventral pore (fig. 1, v. p.) lies in the midline opposite the oesophageal bulb, .323 mm. from head and opens into a wide sac.

The vulva is transverse, midventral, without prominent lips and lies somewhat nearer the head than the tail (fig. 1, v.).

The anus also has no prominent lips and lies in the midventral line.

Behind the anus, the tail (fig. 2) narrows rapidly and then again more gradually, forming a sharp spine.

The body wall is of the meromyarian type. The lateral lines measure .039 mm. in breadth shortly behind the oesophageal bulb.

Internal organisation.—Oesophagus. The anterior extremity is slightly thickened, but the greater length of the organ is cylindrical and of uniform calibre. It moves and bends with the retraction or protraction of the head.

The anterior portion of the oesophagus, .0187 mm. in length, is marked off by a transverse diaphragm of closely set muscle fibres, corresponding to the pharynx described by Dujardin in *Heterakis brevicaudata*.

The lumen of the oesophagus is of the usual triradiate form with a tubular dilatation at the outer end of each radius such as also occurs in *Oxysoma kachugae*, mihi, and which is described by Schneider (9) in *Asc. ferox*, Ehrbg. At its posterior extremity it expands to form the chestnut-shaped bulb, which possesses a triradiate lumen, the inwardly projecting angles of which are armed with chitin.

The bulb is succeeded by a pear-shaped dilatation of the intestine, but behind this the intestine is compressed by the reproductive organs.

Males (fig. 4) are relatively infrequent. Only three specimens were found among a large number of females. They measure .99–1.07 mm. in length; relatively more stout than the females.

The head probably has the same structure as in the female, but the three membranous lips have not been observed by the present writer. The three teeth arising from the anterior end of the oesophagus are distinct. The head can be withdrawn. The anterior portion of the oesophagus is marked off by a diaphragm. Lateral lines extend from head to anus. Ventral pore as in female.

The cuticle of the body is transversely striated. The striae measuring .0017 mm. in breadth. The head and tail are unstriated.

The anogenital aperture (figs. 7 and 8) is enclosed in front and at the sides by a fine bursal membrane, which is supported on each side by three papillae shaped like delicate nine pins. A row of three additional papillae lies in front of the bursa on either side.

Thus the characteristic three preanal $\oplus$ and three perianal papillae of the genus *Oxysoma* are found.

The tail is sharp pointed but relatively stouter than in the female. Postanal papillae (fig. 6) occur, seven pairs on the ventral half of the tail and six pairs on the dorsal half.

The spicules (figs. 8, 9, 11, 12) two in number, are long, measuring each $\frac{1}{5}$ of the body length. They are stout hollow cylindrical structures, .013 mm. in thickness. In one specimen the wall of the cylinder is so thick that vacuoles can be observed in it. Two muscular bands are attached to the anterior end of each spicule.

The gonads appear to consist of a single tube divided into an upper testicular region, a large seminal vesicle and a short vas deferens.

The species is named in honour of my teacher and friend Professor MacIntosh of St. Andrews.

Comparison of this species with species described by Dujardin (3).

(A.) *Heterakis acuminata*, Schrank. The Lucknow specimens differ from *Heterakis acuminata*, Schrank, as described by Dujardin, in that the males possess long spicules ($\frac{\text{Sp. length}}{\text{T.L.}} = \frac{1}{5}$), not short spicules.

(B.) *Heterakis brevicaudata*, Duj. They agree with the *Heterakis brevicaudata* of Dujardin in characters of generic value, namely: (i) as regards the head, "tête obtuse, à trois lobes peu distincts, non mucronés, séparés à l'intérieur par des pièces cornees" "Pharynx long de .05. mm. à trois angles—et séparé de l'oesophage par une sorte de diaphragme armée de trois pointes horizontales" may be the same structure as the anterior portion of the oesophagus described above. A specimen of *Oxysoma* sp. ? from the rectum of an English specimen of *Rana temporaria* (kindly given to me by my friend Dr. Dobell) exhibits the structure of the head identical with that of the Lucknow specimens. Dujardin's specimens were obtained in Paris and Rennes; (ii) as regards the tail of the male—"Mâle à queue..munie de deux membranes trèsétroites et de deux rangées de..papilles..; deux spicules très-longs.

They however differ from this species in many characters. (i) Size—females not longer than 2.78 mm., whereas *H. brevicaudata*, Duj., measures 4.5–6 mm. The relation $\frac{\text{Mx. Br.}}{\text{T.L.}}$ equals $\frac{1}{13}$ as contrasted with $\frac{1}{25}$ in *H. brevicaudata*. (ii) The vulva is in front of the middle, in *H. brevicaudata* it is behind the middle. (iii) $\frac{\text{Postanal length}}{\text{T.L.}}$ in ♀ equals $\frac{1}{6}$: in ♂ equals $\frac{1}{5}$, contrasted with $\frac{1}{20}$ in both sexes in *H. brevicaudata*. (iv) Papillae of tail in ♂ 6 pairs contrasted with 13 in *H. brevicaudata*. (v) Spicules strong, stout,

hollow cylinders, not "très-minces très-flexibles..terminés en pointe falciforme très-aiguë." (vi) Viviparous not oviparous.

Comparison with Oxysoma brevicaudatum, Zeder as described by Schneider (19).

Schneider's specimens were "immature" and engaged in moulting. He nevertheless identifies them with *H. brevicaudata*, Dujardin, and on the results of his examination of these dubious specimens criticises adversely and corrects Dujardin's definition.

The Lucknow *Oxysoma* is smaller, since Schneider's measurements are given as ♀ 5.5 mm. ♂ 3 mm. In Schneider's species the $\frac{\text{Hd.} - \text{Vulva}}{\text{V.} - \text{Tail}}$ is $\frac{1}{.84}$ and the male does not bear a bursa.

Comparison with Oxysoma contortum, v. Linstow (7) from the large intestine of Bufo vulgaris, Korfu. This species measures

♂ 5.4 long by .3 mm. in Br.

♀ 5.9 ,, ,, .35 m. in Br.

the males are therefore more than five times as long as those of *Oxysoma macintoshii*, the females about three times as long; the species does not exhibit the marked difference in size between males and females. The relation of $\frac{\text{Br.}}{\text{Length}}$ in the male is very different, $\frac{1}{18}$, contrasted with $\frac{1}{8} - \frac{1}{10}$ in *O. macintoshii*. The spicules are relatively much longer $\frac{\text{Length of spicule}}{\text{T.L.}}$ in *O. contortum* = $\frac{1}{2.8}$ in *O. macintoshii* = $\frac{1}{5.8}$. Caudal papillae of ♂ in *O. contortum* preanal 12, postanal 6 pairs, in *O. macintoshii* preanal 6, postanal 13 pairs.

In the female, the vulva is behind the middle of the body in *O. contortum*, in front of it in *O. macintoshii*. $\frac{\text{Postanal L.}}{\text{T.L.}}$ in *O. contortum* $\frac{1}{37}$ in *O. macintoshii* $\frac{1}{5} - \frac{1}{6}$.

The following two species of *Oxysoma* have been described in recent years from batrachians:

Oxysoma tuberculatum, v. Linst., from *Megalophrys montana* (10) differ from *O. macintoshii* in possessing six lips each bearing a thorn-like spine: the immature female measures 4.5 mm.

O. terdentatum, v. Linst. (9) from the gut of *Triton cristatus*. Head with three lips, each lip with two papillae. The oesophagus projects between the lips forming three rounded projections each of which is armed with a tooth (So far agrees with *O. macintoshii*). The oesophagus has no enlargement (Herein differing from *O. macintoshii*) ♀ — 15 mm.—br. .46 mm.

v. Linstow gives a poor figure of the head of *O. brevicaudatum*. Zed. in (8). The figure does not show any teeth.

2. *Oxysoma kachugae*, sp. nov.

Pl. xxix, figs. 13-16.

From intestine of *Kachuga lineata*, Gray: Lucknow.

A single female specimen was found. For measurements see table II, page 186.

The head (figs. 13, 14) is expanded like the head of a nine-pin. Body diminished in breadth uniformly from the middle toward either extremity. The tail (fig. 16) is moderately sharp pointed and curved on itself at the tip.

The head bears three flattened lips, one dorsal, two sub-ventral, which are entirely composed of cuticle. Each lip is however supplied with two forked papillae of corium. As can be seen in fig. 13 the outer branch of the papilla is flask-shaped and parallel with the length of the body, the inner is thinner and inclined inward. The corium from which these papillae spring surrounds the commencement of the oesophagus.

The cuticle is transversely striated, the striae being very uniform in breadth.

There are narrow lateral membranes.

The vulva is a narrow slit in the ventral line without prominent lips.

The anus has slightly prominent lips.

The oesophagus (fig. 15) is divided into three sections: (1) .074 mm. long, represents the 'pharynx' of Dujardin. Its anterior extremity is dome-shaped—the dome rising into the space between the lips. Three fine tubular structures—one ventral, two sub-dorsal—are found in this portion, and are doubtless tubular dilations of the outer ends of the radii of the oesophageal lumen. The body of this part of the oesophagus shows the same muscular structure as the remainder of the organ. Part 1 is separated from part 2, by a transverse diaphragm. (2) 1.416 mm. long, shows three fine cuticular tubes corresponding with those of part 1. The tubes, however, do not appear to be continuous with those of part 1, but are separated from them by the diaphragm. Their anterior extremities are dilated (fig. 15), and it is the cuticle lining these dilations, which produces the appearance of teeth referred to by Dujardin. With the exception of a short portion at its anterior end, this part of the oesophagus is of a dark brown colour. The colour ceases abruptly at the commencement of the bulb. Special aggregations of this pigment occur on the surface of the organ in the median and lateral lines .272 mm. from the head. (3) The bulb is pear-shaped .425 mm. long.

The intestine is dilated at its commencement where it embraces the bulb, but further back is compressed by the gonads. It is coloured in the same manner as the oesophagus.

Impregnation with this colouring matter renders the reproductive organs difficult to decipher. The vagina is apparently non-

muscular and runs forward. There appear to be two uteri and ovarian tubes.

The ventral pore is small, 1.275 mm. from the head. Lateral lines were not distinguished. A nerve ring was also not seen.

This specimen agrees with *Oxysoma falcatum*, v. Linst. (14a) from the intestine of *Geoemyda (Nicoria) trijuga*, Schweigg. in size, general shape, structure of head, proportion $\frac{\text{Oes. L.}}{\text{T.L.}}$, and proportion $\frac{\text{Hd.—Vulva}}{\text{V.—Tail}}$. It differs from it in possessing a striated cuticle and in the proportion $\frac{\text{Postanal length}}{\text{T.L.}}$ which is $\frac{1}{8.6}$ instead of $\frac{1}{14}$ as in *O. falcatum*.

3. *Heterakis macronis*, n. sp.

(Pl. xix, figs. 17–24. Pl. xx, figs. 25–34.)

Seven specimens, four males and three females, were found in the intestine of *Macrones aor*, Ham. Buch., obtained from the market, Lucknow. They are delicate hair-like animals. Their absolute and relative measurements are given in table III, page 186. The greatest diameter of the body is situated at the posterior end of the oesophagus, and the breadth of the body diminishes rapidly toward the head, gradually toward the tail. In the majority of fixed specimens, the anterior end of the body is curved toward the dorsum. The tail of the male curves toward the ventral surface.

The head (figs. 17, 18 and 19) is rounded and very slightly greater in diameter than that part of the body which immediately succeeds it. There are no lips (figs. 18 and 19). The mouth is formed by a shallow funnel-shaped depression in the anterior end of the oesophagus, and is surrounded by a ring of slightly thickened cuticle. This ring is somewhat thicker in the ventral than in the dorsal segment; the anterior end of the oesophagus is also slightly more prominent in the ventral than in the dorsal segment, consequently the transverse plane of the mouth is tilted very slightly toward the dorsum. Viewed in the sagittal plane (fig. 17), the same cuticular ring is visible, and it can be seen that it is carried outward in the two midlateral lines to form ribs, which support the commencement of the lateral membranes. Cephalic papillae, if present, are very small and do not raise the cuticle.

The lateral membranes (figs. 17 and 24–34) extend from the head to a level shortly in front of the anus. At the head they are supported by sickle-shaped thickenings of their outer and anterior margins. They increase rapidly in breadth to a maximum of .048 mm. at the level of the end of the oesophagus. At this level the breadth of each membrane is equal approximately to half the diameter of the body. At a distance of .56 mm. from the head a thread-like process of protoplasm passes outward from the lateral line in the substance of the lateral membrane to the outer margin of the latter structure (fig. 24). This is doubtless a sense organ.

In cross section the lateral membrane has the form of an equilateral triangle.

The cuticle is entirely plain and unringed.

The lateral lines measure 0.238 mm. in breadth in the oesophageal region. Lateral canals are not visible.

Female.—The tail of the female (fig. 20) is sharply conical, the anus is situated .25 mm. from the tip. The body cavity of the tail is occupied by a glandular mass. The vulva is situated at the junction of the middle and posterior thirds of the body. It is a transverse slit extending through one-third of the circumference of the body. The internal reproductive organs of the female will be described in a later paper.

Male.—The tail of the male when viewed in profile is seen to be arched on the dorsum and flattened on the ventral surface by the formation of the bursa (figs. 21 and 22, 33 and 34). It is terminated by a sharp narrow caudal appendage .073 mm. in length. The region of the tail which carries the bursa measures .44 mm. in length, both the transverse and sagittal diameters are enlarged compared with that portion of the body which immediately precedes it. The bursa is formed by two flatly semicylindrical cushions applied lengthwise to the body between the mid-ventral and lateral lines (figs. 33, 34). The anterior boundary is marked by the sucker (fig. 22), the posterior by the base of the caudal appendage (fig. 21).

Five rows of papillae occur on the surface of the bursa—two sublateral and two subventral on the cushions, and one median ventral in the space between the cushions. The sublateral series consists of three papillae with finger-like pulpa: (i) (numbered from behind forward) situated dorsal to the posterior end of number 1 subventral papilla; (ii) dorsal to the anterior end of number 2 subventral; (iii) dorsal to the interval between numbers 2 and 3 subventral.

The subventral series consists of eight papillae—numbered again from behind forward they are situated and shaped as follows: (1) at the posterior end of the bursa, large and capsule-like showing a tendency to division into two compartments; (2) immediately in front of 1, capsule-like but somewhat smaller; (3) shortly behind the anus; (4) shortly in front of the anus; (5) opposite the junction of the vas deferens and intestine with the cloaca; (6) midway between the anus and the sucker; (7) opposite the sucker; (8) .14 mm. in front of the sucker.

The median series consists of two papillae which are slightly raised above the surface—1m. shortly in front of the anogenital aperture; 2m.—shortly in front of the termination of the vas deferens.

The space between the two cushions is flat and contains the anogenital aperture and sucker. The former is surrounded by a ring-like thickening of cuticle. The latter is slightly raised above the surface and resembles a flattened volcano. It does not possess a cuticular cup. It is situated .45 mm. from the tip of the tail.

The spicules (fig. 23) are two in number and are so delicate that they are invisible when not extended. Each spicule measures .0765 mm. in length; is hollow at its base (figs. 33 and 34), where it measures .0068 mm. in breadth. Toward the point it becomes flattened and bears five longitudinal ribs on its outer and posterior surface. It has a reversed S-shaped curve, curving outward and backward at the tip. An accessory piece has not been observed.

The testis is a single tube which is sharply bent upon itself. The fundus (fig. 31) lies 1 mm. in front of the tip of the tail. From the fundus the testicular tube runs forward to the mid-point of the body where it comes in contact with the body of the ventral gland. It here bends abruptly and runs backward (fig. 26). After the bend the sperm mother cells are arranged in a definite cylinder, the nuclei around the periphery. The testis is succeeded by a dilated thin-walled seminal vesicle (fig. 31), and this in turn by a thick-walled ductus ejaculatorius (figs. 32-35). The junction of the rectum and ductus is surrounded by unicellular glands the cells belonging to the lateral and midventral lines (fig. 34). The glands have well-developed tubular ducts.

Ventral gland. At the middle of the body a large unicellular gland occupies the ventral half of the body cavity (fig. 25). The protoplasm of this cell stains only with difficulty, is granular and contains two canaliculi in its substance. Shortly behind the middle of the body this cell divides into two finger-like processes (fig. 26), which as they run backward come into more and more close relationship with the two lateral lines (fig. 27), ultimately running in the substance of the lateral lines (fig. 28). The processes can be traced to the three-quarter point of the body length. The canaliculi are visible throughout the entire length of the processes and acquire thickened walls as they run backward. Behind the level at which the processes can be recognized, fine ducts are to be seen in the lateral lines which doubtless open into the canaliculi. These ducts can be recognized as far back as the level of the anus.¹

Alimentary canal. The oesophagus (fig. 17) is simple and club-shaped. Its walls are darkly pigmented behind the nerve ring. There is no short anterior segment divided off by a transverse diaphragm (pharynx of Dujardin) as in *Heterakis vesicularis*. There is no oesophageal bulb.

This species is placed temporarily in the 'genus' *Heterakis* pending a thorough revision and division of the group. It does not belong to the genus as defined by Dujardin, since (1) it is devoid of lips and of a 'pharynx,' (2) it has no oesophageal bulb, (3) the spicules are equal, (4) the caudal papillae of the male are

¹ The form of this gland is of interest in connection with the evolution of the excretory organs of Nematodes. See Jägerskiöld, Zool. Jahrb. Anat., Bd. vii, p. 449, and the present writer, Q. J. M. S., vol. L, p. 141.

arranged in three series. On the other hand it resembles Dujardin's *Heterakis* in the following points; (1) the two uterine branches are opposed; (2) lateral membranes are present, (3) the tail of the male bears a sucker and papillae. It cannot be included in Dujardin's genus *Dacnitis* on account of the absence of the characteristic anterior enlargement of the oesophagus.

Schneider's '*Heterakis*' includes many genera. *H. macronis* should be included in the same group as *H. distans*, R., a parasite of *Simia sabaea*, which it resembles in the absence of lips and of a chitinous ring in the sucker. This group is identical with *Heterakis*, *Acheilostomi* of Railliet (18, p. 409) characterized by 'bouche sans lèvres, deux spicules égaux assez courts, ventouse sans anneau chitineux.' Railliet identifies *Heterakis*, *Acheilostomi* with *Stelmus* of Dujardin and *Subulura* of Molin. The species at present under consideration differs from *Stelmus* in the fact that the vulva lies in the middle of the body length and not shortly in front of the anus.

4. *Dacnitis callichroi*, n. sp.

(Pl. xxi, figs. 35-38.)

Two females were found in the intestine of *Callichrous macrophthalmus*, Blyth, from Lucknow. Owing to contraction in the preservative (Looss' fluid) the body wall has been thrown into wrinkles to a considerable extent, which diminishes the value of the measurements.

They are moderately plump worms; for measurements see table IV, page 187. The region corresponding to the anterior two-thirds of the oesophagus is narrower than the remainder of the body (fig. 35). The head (figs. 36 and 37) is rounded. The mouth is of the usual *Dacnitis* type, of elongated lozenge-shape, the long axis lying in the sagittal plane, with its aperture directed forward and to the dorsum. It is surrounded by the usual membranous collar springing from a cuticular thickening resembling a wire frame. Each side of the collar bears 32-36 longitudinal striae. There are four cephalic papillae—two subdorsal, two subventral. The head does not curve toward the dorsum.

No lateral membranes.

The cuticle is not striated in the anterior oesophageal region, but is transversely striated from the posterior oesophageal region backward. The striae are caused by fibrillae lying in the deeper layer of the cuticle and encircling the body. Intervals between the striae .002 mm. in the anterior half, .0012 mm. in the posterior half of the body.

The vulva is narrow and oval, not prominent, in the mid-ventral line, $\frac{H-V}{V-T} = \frac{1.4}{1}$

The tail (fig. 38) is conical and pointed, and bears a prominent papilla on either side, slightly behind the mid point between the anus and tip of the tail.

The anus (A—T=.2 mm.) is broad transversely and has a prominent anterior lip.

The oesophagus (fig. 35) has the form usual in the genus. Circumoesophageal nerve ring not seen. A large unicellular gland lies on one side of the oesophagus.

Female gonads. The vagina runs forward from the vulva for a distance of .55 mm. and is furnished with thick walls. The uteri (two, anterior and posterior) are distended with eggs which possess thin shells. The usual coiled ovarian tubes are visible in front of and behind the uteri.

Discussion of the systematic position. Comparison with :—

1. *D. foveolata*, R. (*vide* Dujardin (3) p. 270. Schneider (19) p. 74) = *D. esuriens*, Duj.

D. callichroi is a much more stout animal $\frac{\text{Br.}}{\text{T.L.}} = \frac{1}{17}$ contrasted with $\frac{1}{43}$ in *D. foveolata*.

In figures 39 and 40, representations are given of the head and oesophageal region of *D. foveolata*, R., from *Pleuronectes platessa* (collected at Plymouth) for comparison with figs. 36 and 35, respectively. Some measurements from *D. foveolata* are also included in table IV (see page 187). The difference in the relation $\frac{\text{Oes. Br.}}{\text{Oes. L.}}$ is very marked.

2. *D. abbreviata* R. (Dujardin, p. 269), in *Perca cirrosa*. The description of this species is insufficient for recognition.

3. *D. globosa*, Duj. (Dujardin, p. 269) from *Salmo fario*—is a larger animal than *D. callichroi* ♀ = 16 mm., is thinner $\frac{\text{Mx. Br.}}{\text{T.L.}} = \frac{1}{55}$ $\frac{\text{Post an. L.}}{\text{T.L.}} = \frac{1}{50}$ ($\frac{1}{39}$ in *D. callichroi*). The head bears a tubercle on its dorsal aspect which is absent in *D. callichroi*.

4. *D. hians*, Duj. in *Muraena conger*. A larger animal than *D. callichroi*, length 20.7 mm. contrasted with 6–7.5 $\frac{\text{Br.}}{\text{T.L.}} = \frac{1}{39}$ contrasted with $\frac{1}{17}$.

5. *D. sphaerocephala*, Rud. fr. *Acipenser microcephalus*, a larger animal, ♀ length 15.6 mm.; and thinner $\frac{\text{M. Br.}}{\text{T.L.}} = \frac{1}{26}$ not $\frac{1}{17}$. $\frac{\text{Post anal}}{\text{T.L.}} = \frac{1}{56}$ not $\frac{1}{39}$. Ova smaller — .052 × .027 contrasted with .085 × .055.

6. *D. squali*, Duj., a larger animal, ♀ length 18.5 mm., and thinner $\frac{1}{37}$ (contrast $\frac{1}{17}$). $\frac{\text{Post Anal L.}}{\text{T.L.}} = \frac{1}{56}$ (contrast $\frac{1}{39}$). $\frac{\text{Hd. V.}}{\text{V.T.}} = \frac{1}{6}$.

7. *D. rotundata*, Mol. (Molin (16) from *Cantharus vulgaris*, Padua, description of ♀ insufficient for recognition.

5. *Spiroptera denticulata*, Rud., var. *minor*, nov.

(Not *Spir. denticulata*, Molin—from *Merops apiaster* and *Falco palumbarius*).

(Pl. xxi, figs. 41-43.)

Two male worms from the stomach of *Wallago attoo*, Bl. Schn., from Lucknow.

For measurements see table V (page 188).

Elongated cylindrical animals expanding in club-like manner at the anterior extremity. The body divided into a series of rings, each of which in the anterior $\frac{1}{3}$ of the body bears a circle of cuticular hooks. Fig. 41 represents the head of one specimen, and shows the cone at the apex of which the mouth opens, and the expanded 1st, 2nd, 3rd and 4th rings.

The hooks are strong outgrowths of cuticle .0238 mm. in length on the 2nd ring. There are 26 on the 1st ring, 22 on the 2nd, and 20 on the 3rd ring.

The tail (fig. 42) is flattened on its ventral surface, .277 mm. from the tail end, to form spear-head-shaped adhesive surfaces, the margins of which are sharpened and supported by papillae.

The number of these papillae is as follows:—

Spec. 1.	Right side—Preanal	6.	Postanal	6.
	Left side	,, 4.	,, 5.	
Spec. 2.	Right side	,, 4.	,, 5.	
	Left side	,, 4.	,, 6.	

The preanal group is separated from the postanal by a distinct gap.

The two spicules are unequal, the right is short and pointed, the left (fig. 43) long ($\frac{1}{4}$ of the body length) and has a curious foot-shaped termination.

It measures .015 mm. in length. The spicules can be moved independently of one another; in both specimens the right spicule is extended, but the left is withdrawn in the one and extended in the other.

The lateral lines are relatively narrow, $\frac{1}{8}$ th of the breadth of the body and show a line in their centre which may represent the longitudinal canal. The animal therefore belongs to the family Secernentes of v. Linstow.

The mouth is devoid of lips, narrow and circular, situated at the end of the oral cone. A tubular pharynx leads from the mouth to the anterior end of the oesophagus; it is slightly curved, and has a very fine cuticular lining. The oesophagus is broadest at its anterior extremity where it expands like the capital of a pillar, and decreases steadily in its first third. The second two-thirds are uniformly cylindrical. Before joining the intestine it forms one complete loop by curling upon itself. There is no bulb.

A nerve ring or ventral pore have not been observed.

The single testis commences .7 mm. from the anterior extremity and measures .5 mm. in length. It is followed by the seminal vesicle .185 mm. long which ends at the base of the left spicule and by a ductus ejaculatorius measuring .481 mm.

Systematic Position.—The two specimens agree with *Spiroptera denticulata*, R., as described by Schneider (19) except (1) in size—(being only $\frac{1}{5}$ th of the length of *S. denticulata*), (2) in the number of spines on each ring—*S. denticulata* bears 56 per ring on the head, (3) the bursal edges are shown as cushion-like in *S. denticulata* by Schneider, whereas they appear sharp in the variety. Schneider does not refer to the remarkable left spiculum.

6. *Atractis kachugae*, n. sp.

(Pl. xxi, figs. 44-47. Pl. xxii, figs. 48-49.)

A large number of small organisms found in the intestine of *Kachuga lineata*, Gray: Lucknow. They were so abundant that the water used for washing the intestine appeared to swarm like a magnified bacterial culture.

The specimens vary in degree of maturity, some possessing merely the rudiments of sexual organs, such as specimen 41/1/1, others, such as 41/1/3, possessing fully developed sexual organs, others, such as 41/4/-, containing larvae in utero.

For measurements see table VI, page 189). It will be observed that they are fine and delicate organisms, the maximum breadth not exceeding 2.4% of T.L. The head is truncated, the maximal breadth lies at the end of the oesophagus at 20% of T.L. (except when the body is distended by larvæ). The tail is long and fine.

The head bears a circle of six lips—two lateral with simple peg-like pulpa and four submedian which possess a pulpa of a curious cross-like figure springing from a thick pedestal. The form of these lips is best appreciated by referring to fig. 44.

Lateral membranes (fig. 45) measuring .0085 mm. in depth run from the level of the 2nd bulb to behind the anus. A fine cuticular transverse ringing is visible on some specimens only and is probably artificial. The vulva is a transverse slit with slightly prominent lips .102 mm. in front of the anus.

The anus is not prominent.

Genital papillae in the male. Two pairs of simple papillae preanal and one postanal (fig. 47). The tail of the male is curved to a right angle with the rest of the body at the anus (fig. 49).

Internal organisation.—Alimentary canal. The anterior end of the oesophagus is square and lies at the level of the bases of the lips. The anterior portion of the body of this organ, .005 mm. in length, is marked off by a ring of vacuoles between the muscle fibres. The remainder is again divided into two portions, each portion terminated by a bulb. The anterior portion shows definite muscular striation, the posterior is granular in appearance. The anterior bulb is fusiform, the posterior pear-shaped, and the

latter contains three semi-circular thickenings of the cuticular lining constituting a grinding apparatus.

The intestine presents no features of note.

No oesophageal nerve ring or ventral pore have been observed.

Reproductive organs of male.—Three pairs of simple papillae referred to above, in the anogenital region, two preanal, one post-anal. Spicules two unequal (fig. 48). Right, short, .0925 mm. measured in a straight line from head to tip and .0042 mm. in maximum breadth, nail-shaped with a distinct closed head. Left, long, .187 mm. in length, .005 mm. in breadth, simple tubular, narrowing toward the tip, with head slightly expanded, open and receiving insertion of a retractor muscle.

Testis single tubular. Fundus lying dorsal to alimentary canal .68 mm. from head. Cells at fundus spherical. As it passes backward the tube curves round the left side of the intestine to assume a ventral position, the cellular contents are large square cells with large round distinct nuclei. At a distance of about .25 mm. from the fundus the cells change abruptly in appearance, the protoplasm becomes filled with small granules. A long simple vas deferens, lying in front of intestine and spicules, leads into the cloaca.

Female reproductive organs (fig. 46).—In immature specimens (measuring .217 mm. in length) the female gonads are represented by a flattened and elongated group of cells lying ventral to the intestine. The cells are large and angular and contain large spherical nuclei. In the adult (.263–.306 mm.) only a single functional ovary is to be found, which is conical in shape, the apex of the cone (the fundus) directed backward. The cellular contents are of the usual type, ova broad and disc-shaped at the junction of ovary and caecum. The caecum contains two large ova and also a considerable number of other smaller cells which appear to arise from proliferation of the wall cells. Attached to the anterior end of the caecum is a cellular appendix possibly representing a second ovary. The opening of the caecum into the uterus lies close to the ovarian opening. The uterus is an elongated spindle-shaped sac. At its anterior extremity its walls are thickened to form a sphincter. In young adults it contains spermatozoa—sometimes in large numbers. A cellular gland surrounds the junction of the uterus and the caecum. In older specimen (.306 mm.) the uterus contains from 6–8 larvæ, some doubled on themselves, others fully extended but never coiled or enclosed in a shell. The larvæ distend the uterus from the sphincter to the vulva.

The following species of *Atractis* have been described up to the present :—

(1) *Atractis dactylura* Duj., from *Testudo graeca*. (Dujardin —(3) p. 654. Diesing (2) ii, p. 151. Schneider (19), p. 124. V. Linst. (11), p. 516.

This species has a two-horned uterus and only one oesophageal bulb—Schneider. The porus excretorius is very prominent and surrounded by a ring of chitinous rods—v. Linst.

(2) *Atractis opeatura*, Leidy. (Leidy (5), p. 410), from the intestine of the iguana *Cyclura baeolopha*, Cope, Australia. The head is tripapillate, ♀ and ♂ both 5 mm. long.

(3) *A. hystrix*, Dies. (Diesing (2) p. 188) from *Podocnemis erythrocephala*, America.

(4) *A. perarmata* v. Linstow (v. Linstow (11), p. 516, from *Cinixys belliana*, German East Africa, ♂ 5.6 mm. ♀ 6.2 mm. Spicules of ♂ almost equal.

(5) *A. cruciata*, v. Linstow (v. Linstow (12), p. 29) from *Metapoceros cornutus*, Daud. Haiti, ♀ 6.2 mm.

(6) *A. fasciolata*, Gendre. (Gendre. (4), p. 30). I have not been able to obtain a copy of this article.

7. *Physaloptera*, sp. Larva.

(Pl. xxii, figs. 50-51.)

Two specimens were found encysted in the wall of the urinary bladder of *Bufo stomaticus*, Lütken (= *B. andersoni*, Blgr.¹) at Lucknow. The cyst wall consisted of an outer capsule of loose connective tissue and an inner membranous capsule. The embryo was coiled up within the cyst.

The measurements of one specimen are given in table VII, p. 190.

The body (fig. 50) tapers slightly and gradually toward the head, abruptly at the conical tail.

The head (fig. 51) is surmounted by two lateral lips, each of which bears a nipple-shaped tooth at its apex. Each lip is shaped roughly as the half of a hemisphere, the two lips together forming a hemisphere. On the inner aspect of each lip a flat triangular area (1) projects slightly inwards, the apex of which forms the tooth referred to. The outer aspect of each lip bears two papillae, one subdorsal, one subventral. The third, lateral, pair of papillae, which occur in *Physaloptera* have not been distinguished in this larva. Even in the adults of the genus they are however flat in contrast with the raised submedian papillae. The two circular spots marked 2 and 3 are situated on the internal face of the left lip, (2) in the base of a flagellum.

The anus is a narrow slit.

The rudimentary vulva (?) a transverse slit-like depression in the cuticle, is situated somewhat behind the midpoint of the body.

The rings of the cuticle are highly irregular.

The oesophagus is divided into two sections: (1) Anterior shorter section—muscular and with lumen lined with cuticle; the anterior end somewhat broader than the remainder and forming the floor of the interlabial space. The nerve ring surrounds this portion. (2) Posterior longer section somewhat narrowed anteriorly, but uniform in diameter for the greater part of its length. Histological structure shows a parenchymatous appearance. The lumen is not lined by cuticle.

¹ See Annandale, *Rec. Ind. Mus.* III, p. 283.

The intestine is dilated where it receives the oesophagus.

The rudimentary gonads extend from the junction of the oesophagus and intestine to the anal canal, and lie ventral and to the side of the intestine.

Systematic position.—After considering the structure of the head and of the oesophagus little doubt remains that we are dealing with a *Physaloptera*. The two lateral lips with their teeth and papillae are characteristic. The division of the oesophagus into an anterior muscular and a posterior glandular section also occurs in this genus,—compare *Physaloptera cluusa*, Rud. (Dujardin, p. 85).

The adult doubtless inhabits a snake or bird.

The only adult *Physaloptera* recorded from an amphibian is *Physaloptera amphibia*, v Lin., which inhabits the oesophagus and stomach of *Rana macodon*, Kuhl., in the island of Luzon (v. Linstow (13), p. 15).

8. *Ascaris*, sp. Larvae (L. 33, 36).

(Pl. xxii, figs. 52, 53, 54.)

Larvae (L. 33 and 36)¹ from the peritoneal cavity of *Wallago attoo*, Bl. Schn. and *Callichrous pabda*, Ham. Buch.: Lucknow and Calcutta. numerous specimens encysted. For details of measurements refer to table VIII, columns 36 and 33 (page 191).

The head (figs 52, 53), bears three lips of which the dorsal and right subventral are less prominent than the left subventral. The latter is apparently used as a boring organ and carries a thickened cap of cuticle which is either sharply conical or more rounded and surmounted by a nipple-like projection. The surface between the lips is formed by the body wall and not by the anterior extremity of the oesophagus as in L. 15. No cephalic papillae observed. The head is separated from the body by a slight constriction, .033 mm. from the anterior extremity, and behind this constriction the cuticle shows a succession of rings for a distance varying from .18 to .646 from the head.

The tail is represented in fig. 54. There is no definite caudal appendage.

Oesophagus:—The anterior end is sharpened by portions cut out opposite the three lips. Oesophageal and intestinal diverticula are present, the former .731 mm. long, the latter .935 mm.

9. *Ascaris*, sp. Larvae (L. 15).

(Pl. xxii, figs. 55, 56.)

Two specimens from the peritoneal cavity of *Wallago attoo*, Bl. Schn. They were free, moveable and extended, not encysted and coiled up.

¹ Numbers preceded by an L. are serial numbers of the specimens.

The measurements are given in table VIII, col. 15 (see page 191).

T.L. 25 and 30 mm. One sp. (i. 30 mm.) showed rudiments of ♀ organs, the second gave no indication of sex. They taper very slowly and uniformly from the middle to the head, which is truncated; the posterior half is of fairly uniform diameter and the posterior end tapers more abruptly than the anterior.

The head bears two short conical horns—dorsal and ventral, composed partly of thickened cuticle, but also resting on a raised pulpa. From each horn two fillets of thickened cuticle curve, one on either side, to meet in the midlateral lines. These fillets form the anterior margin, a ring of thickened cuticle which surrounds the head. On this ring are situated four submedian papillae, two submedian dorsal, two submedian ventral. Between the horns the anterior end of the body of the oesophagus projects in front of the fillets.

Intestinal and oesophageal diverticula are present, the latter long and narrow. Both the oesophagus and its diverticulum are of a black-grey colour.

One specimen contains developing sexual organs, vulva and single gonad tube, which latter lies on the left side of the intestine.

The tail is conical, but its shape varies according to the state of contraction or relaxation of a circular band of muscle which surrounds the body at the level of the anus.

Probably the larva of an *Ascaris* belonging to Schneider's group C. or D.

10. Larva undiagnosed. (L. 30).

(Pl. xxii, figs. 57–60. Pl. xxiii, figs. 61, 62.)

A single specimen obtained from the intestine of *Wallago attoo*, Bl. Schn. Lucknow. It exhibits only the rudiments of sexual organs. Length 4.67 mm. For measurements see table VIII, column 30 (page 191). It narrows fairly abruptly toward the head (fig. 57), more gradually toward the tail. The head is of a flattened dome-shape with a rounded funnel-shaped mouth (fig. 58) and two conical horn-like processes—one dorsal, one ventral.

The lateral lines (figs. 61, 62) are broad and divided into two sections longitudinally, each occupies about $\frac{1}{8}$ th of the circumference of the body; musculature is meromyarian. Transverse rings appear to be artificial.

The postanal region (fig. 60) is short and conical, and bears a small caudal appendage. The anterior lip of the anus is very prominent and broad, and measures half the length of the tail.

The oesophagus (fig. 51) occupies the region measuring .56 mm. from the head. It is contorted and without a bulb.

The intestine presents nothing of note. Neither oesophageal nor intestinal diverticula are present.

In the posterior oesophageal region a peculiar spine lies embedded in the right side of the body wall, extending from the

dorsal line to the right lateral line, the sharp point lying in the latter, the base in the former (fig. 57).

The pore of the ventral gland is situated .27 mm. from the head in the ventral line, and the gland extends from this point backward to about 2 mm. from the head (figs. 57, 59, 61, 62). It consists of a bulky hyaline body, somewhat of a yellow colour in unstained preparations. It is closely applied to the ventral surface of the intestine and oesophagus, and the anterior portion is divided into several lobes. A thread-like duct traverses the entire organ, but in the portion which was cut in sections this 'duct' did not exhibit a patent lumen.

Two narrow cellular cords applied to the posterior end of the ventral gland probably represent the rudiment of the gonads.

It is not possible to diagnose this larva more exactly than as belonging to the meromyaria.

11. Larva undiagnosed. (L. 14):

(Pl. xxiii, figs. 63-65.)

Two immature worms from the stomach of *Wallago attoo*, which cannot be referred with certainty to any genus, from the same locality.

The measurements are given in table IX (page 192).

There are no lips (fig. 63). The mouth is circular and leads into a barrel-shaped buccal cavity. The walls of this cavity are cuticularised, brown in colour, thinnest in front, thickening to the equator (*a*), then again becoming somewhat thinner with a thickened ring at the posterior extremity (*b*).

The cuticle of the body covering shows annular markings on its outer surface, of irregular breadth (.0017-.0034 mm.) on the anterior half of the body, more regular (.0017 mm.) on the posterior half.

The anus (figs. 64, 65) opens in a broad transverse cleft .0374 mm. from the base of the caudal spurs, and .0544 mm. from the tip of the tail.

The caudal spurs (figs. 64, 65) are two in number, subventral, conical in shape, and equal in size to the tail.

Internal structure—The oesophagus (fig. 63) is simple and without a bulb. At its commencement it is twisted. It possesses the usual triradiate lumen, its substance is hyaline in appearance and devoid of distinct muscular fibres.

The intestine is divided into two sections, the first with finely granular walls and a straight lumen, the second and longer section with curved transverse markings.

These larvae cannot be referred with certainty to any genus. The oesophagus is the organ which shows the greatest constancy in the transition from larval to adult life, and in this respect the larvae which we are considering resemble the *Filariæ*. The two prominent characters which these organisms possess, namely the

barrel-shaped buccal capsule and the caudal spurs, are not of great systematic importance since the former may well be lost during one of the moultings and the latter are doubtless converted into caudal papillae such as occur in widely separated genera, *e.g.* *Filaria* (*F. papillosa*, Rud.) and *Dacnitis* (*D. callichroi*, mihi), *Cucullanus* (*C. elegans*, Zed.).

The mouth capsule might point to genera :

(1) **Angiostoma**, Duj. No species of this genus have been recorded from fishes, the larvae might however belong to a species parasitic in limax, *e.g.*, *A. limacis*, Duj. The shape of the oesophagus however renders this identification unjustifiable (compare larvae of *A. macrostomum*, V Linstow (6) p. 325, see also Neuhaus (17), p. 653).

(2) **Cucullanus**. There is however no longitudinal striation as in the larva of *C. elegans* figured in Schneider (19) Pl. xxvi, fig. 10. The oesophagus of *Cucullanus* is also characteristically divided into two sections.

(3) **Leptodera**, Schneider (= *Leptodera*, Duj. *Angiostoma*, Duj. and *Rhabditis*, Duj, ex parte). The oesophagus is furnished with one or two dilatations (Schneider (19) p. 156).

(4) **Dacnitis**. The buccal capsule might alter to form the cuticular collar of this genus, but the oesophagus is again quite different in form.

12. *Oncholaimus indicus*, v. Linstow.

(Pl. xxiii, figs. 66-70.)

This species was described for the first time by v. Linstow in 1907 (*Rec. Ind. Mus.*, Vol. I, p. 45). The specimens at the disposal of this distinguished observer do not appear to have shown clearly certain important characters of the head. Consequently a redescription will not be out of place.

The species occurs among filamentous algae and sponges in pools of brackish water at Port Canning in Lower Bengal and also in a canal of brackish water on the outskirts of Calcutta.

Measurements	♀ (1)	♀ (2)	♂
Total length	2.07	2.55	2.43
Max. breadth	.059	.068	.05
Buccal cavity, length	.034	.037	—
Oesophagus ,,	.357	.374	.357
Head-Vulva	1.035	1.326	—
Vulva-tail	1.035	1.224	—
Anus-tip of tail	.129	.125	—
Tail appendage, length	.085	.076	.085
Uterine egg, length	.272	—	—

General shape (fig. 66). Tapers very gradually to both ends. The head is truncated. Shortly behind the anus the body

narrows (figs. 69, 70) in a club-shaped manner to form the tail which bears a thin appendix-like termination. This thin portion of the tail is of almost uniform diameter, and is somewhat crooked toward the ventral surface.

Head (figs. 67, 68). Mouth wide, surrounded by six leaf-like semicircular lips, each bearing a sharp flat spine-like process. The lips are situated two in the lateral lines, two subdorsally, two subventrally. They can be folded in over the mouth, closing it, or extended to lie parallel with the length of the body. No setae on head in either sex.

Buccal cavity. Cylindrical, lined with stout chitinous membrane. It contains three teeth—one large right subventral and two smaller, one dorsal, one left lateral, the smaller teeth lie somewhat posterior to the large one, all three in front of the middle of the length of the buccal cavity.

The oesophagus (fig. 66) is muscular and club-shaped with a small segment, also muscular, at its posterior extremity, distinctly separated from the main mass. This small segment projects into the lumen of the intestine.

Nerve ring not very distinct, .0017 from anterior extremity. The circumoesophageal ganglionic collar is well marked. Pore of ventral gland (?) opposite nerve ring even in adult female. The tail bears a few setae at its tip.

Female.—Vulva at the mid point of the body-length. Gonad tubes two—anterior and posterior, each bent on itself and divided into ovary and uterus.

Male.—There are a few hairs on the oesophageal region of the body, and a row of 9-10 setae on either side of the anogenital aperture (fig. 69). Two sabre-shaped spicules with a hollow conical accessory piece are present.

This species is closely allied to *Oncholaimus fuscus*, Bast. (1) from the English Channel and North Sea. It possesses in common with the latter species (1) the head bearing six mobile lips, and (2) the peculiar appendix-like termination of the tail. It differs from *O. fuscus* in size: ♂ 2.4 mm. contrasted with 6.5 mm. in *O. fuscus*, ♀ 2.5 mm. contrasted with 7 mm. (De Man. 15). The writer has not observed the tubular organ described by De Man in *O. fuscus*.

Tables of Measurements.

TABLE I.

Oxysoma macintoshii, n. sp., from *Rana tigrina*.

Cobb's Formula.

	9/1/♀	10/1/♀	9/2/2		10/1/♂	10/2/♂
T.L. ...	2.414	2.55	2.261	...	*1.48	.999
Br. Hd.	1.07	1.16	1.14	...	—	2.6
Hd.—Hd.	0	0	0	...	—	0
Br. at N.R.	3.2	2.61	3.1	...	—	6.5
Hd.—N.R.	6.6	6.2	6.5	...	—	8.6
Br. at end oesoph.	5.36	3.62	4.4	...	—	28.8
Hd.—end oesoph.	17.5	18.3	19.6	...	—	9.3
Br. at vulva or middle	7.7	4.4	5.72	...	—	50
Hd.—V. or middle	49.6	49.6	48.8	...	—	3.3
Br. at Anus.	4	2.8	2.7	...	—	84.5
Hd.—Anus.	80.7	83	88	...	—	—
	L9/1/♀	L10/1/♀	9/2/2	...	L10/1/♂	10/2/♂
T.L.	2.414	2.55	2.261	...	*1.48	.999
Mx. Br.	.185	.111	.1295	...	.0851	.0925
Mx. Br.	1	1	1	...	*1	1
T.L.	13.05	23	18.2	...	17.4	10.8
Br. at Hd. Ant.	.0259	.0296	.0259	...	*.037	.0259
Br. Body Ant.	—	.0555	—	...	—	.0518
Length of Hd.	—	.0444	—	...	—	—
Br. at N.R.	.0777	.0666	.0703	...	—	.0646
Hd.—N.R.	.1591	.1591	.148	...	—	—
B. at end Bulb.	.1295	.0925	.0999	...	.0777	.0851
Hd.—end Bulb.	.4218	.4588	.444	...	.37	.2857
Br. at Vulva or middle	.185	.111	.1295	...	.0925	.0925
Hd.—Vulva	1.19	1.241	1.105	...	—	—
Br. at Anus.	.0962	.0703	.0629	...	.0333	.0333
Hd.—Anus.	1.938	2.074	1.989	...	1.276	.8366
Anus—Tail	.476	.476	—	...	.2035	.1924
Post anal L.	1	1	—	...	*1	1
T.L.	5.07	5.35	—	...	7.3	5.19
Oes. T.L.	.425	.4421	.425	...	.2479	.2627
Oes. T.L.	1	1	—	...	*1	1
T.L.	5.6	5.8	—	...	5.3	3.8
Oes. Bulb. L.	.085	.0851	.085	...	.0555	.0518
Oes. Ant. Br.	.0296	.0333	.0333	...	.0257	.0259
Oes. Mid. Br.	.037	.0333	.037	...	—	.0259
Oes. Post. Br.	.0259	.0259	.0185	...	—	—
Oes. Bulb. Br.	.0999	.0814	.0814	...	.0518	.0518
Oes. Bulb. Br.	1	1	1	...	1	1
Oes. T.L.	4.25	5.43	5.22	...	5.4	5.07

* Corrected by addition for invagination.

Vulv.—Tail	...	1'224	1'309	1'156	...	...	—	—
Hd.—Vulv.	...	1	1	1	...	...	—	—
Vulv.—Tail	...	1'029	1'05	1'04	...	...	—	—
L. Memb. Br.	...	—	—	—	Br. Spicule Ant.	0'119	—	—
Body Br.	...	—	—	—	...	...	—	—
Uterine Egg. L.	...	0'814	0'962	0'925	" "	Md.	0'136	—
" " Br.	...	0'407	0'407	0'518	" "	Post.	0'102	—
Spicule L.	...	—	—	—	...	...	0'2295	0'1785
Hd.—Ventr. Pore.	...	—	0'3145	—	...	...	—	—

TABLE Ia.

Oxysoma macintoshii, n. sp., from *Bufo stomaticus*.

Cobb's Formula.

	♀	♀ 2/1/2	2/1/3	2/1/1	...	...	♂ 1/1
T.L.	...	2'48	2'78	1'901	...	...	1'017
Br.—Hd	...	1'79	1'59	1'36	...	...	1'85
Hd.—Hd.	...	0	0	0	...	...	0
Br. at N.R.	...	4'4	5'4	5	...	...	5'92
Hd.—N.R.	...	5'66	7'6	6'8	...	...	9'52
Br. at end oesoph.	...	6'7	6'9	7'4	...	...	11'1
Hd.—end oesoph.	...	16	13'5	18	...	...	20'35
Br. at Vulva or middle	...	7'62	8'5	8'17	...	...	12'58
Hd.—Vulva or middle	...	46'6	46'4	43'6	...	...	50'
Br. at Anus.	...	5'1	4'9	5	...	...	6'4
Hd.—Anus.	...	83'6	82'8	77	...	...	80'61
	♀	2/1/2	2/1/3	2/1/1	2/3/1	2/3/3	♂ 1/1/
T.L.	...	2'32	2'48	2'78	1'901*	2'445*	2'658
Mx. Br.	...	—	1'87	2'38	1'554	2'221	2'255
Mx. Br.	...	—	1	1	1	1	1
T.L.	...	—	13'2	11'6	12'2	11'06	10'4
Br. at Head Ant. end	...	—	0'444	0'444	0'259	0'222	0'481
" Body Ant. end	...	—	0'777	0'777	0'518	0'555	0'851
Length head	...	0'34	0'444	0'444	0'37	0'333	0'481
Br. at N. R.	...	—	1'11	1'517	0'962	—	—
Hd—N. R.	...	—	1'406	2'035	1'295	—	—
Br. at end oesoph.	...	—	1'665	1'924	1'406	1'48	1'961
Hd—end oesoph.	...	—	3'996	3'774	3'441	3'7	4'25
Br. at V. or middle	...	2'04	1'924	2'38	1'554	2'035	2'255
Hd—V.	...	1'07	1'156	1'291	8'28	1'17	1'128
Br. at Anus.	...	—	1'295	1'369	0'962	1'036	1'295
Hd—Anus.	...	—	2'073	2'302	1'476	2'061	2'182
Anus.—Tail	...	4'08	4'07	5'44	4'25	3'848	4'76
Post anal L.	...	1	1	1	1	1	1
T.L.	...	5'7	6	51	4'47	6'36	5'59
Oes. T.L. †	...	34	—	442	362	3145	—
Oes. T.L.	...	1	—	1	1	1	—
T.L.	...	7	—	6'2	5'2	7'5	—
Oes. Bulb. L.	...	—	—	0'999	0'74	0'814	—
Oes. Ant. Br.	...	—	0'555	0'592	0'333	0'333	0'481

* Corrected by addition for invagination.

† Including bulb.

Oes. middle Br.	...	—	·0444	·0444	·0333	·037	·0444	...	·0259
„ bulb. „	...	—	·1184	·1221	·0962	·0851	·1295	...	·0518
Oes. Mx. Br. bulb.	...	—	—	1	1	1	—	...	1
Oes. T.L.	...	—	—	3·6	3·7	3·7	—	...	4·6
Vulva—Tail	...	1·258	1·326	1·495	1·073	1·275	1·53	...	—
Hd—Vulv.	...	1	1	1	1	1	1	...	—
V.—Tail	...	1·17	1·16	1·16	1·29	1·09	1·3	...	—
Uterine Egg. L.	...	—	·0925	·0925	—	·0814	—	...	—
„ „ Br.	...	—	·0625	·0666	—	—	—	...	—
Spicule L. ...	...	—	—	—	—	—	—	...	·2035

TABLE II.

<i>Oxysoma kachugae</i> , n. sp.			Cobb's Formula.	
T. L.	... 13·68	Post anal	1	Br. at comm. oes. 1·5
Mx. Br.	... ·612	T. L.	8·6	Hd.—comm. oes. ·54
Mx. B.	... 1	Br. at Anus	·306	Br. at end oes. 3·1
T. L.	... 22·3	Oes. Pt. 1, L.	·074	Hd.—end oes. 14·6
Head L.	... ·102	Oes. pigmented		Br. at Vulva 4
Hd. Mx. Br.	... ·204	part L.	1·416	Hd.—Vulva ... 62·4
Hd.—Oes. Comm.	·074	Bulb L.	·425	Br. at Anus 2·2
Hd.—Bulb end...	1·989	Oes. T. L.	1·915	Hd.—Anus ... 88·9
Body Br. behind		Oes. T. L.	1	
Hd.	... ·17	T. L.	7·1	
Body Br. at end		Oes. Br. Ant.	·119	
Bulb	... ·425	Oes. pigmented		
Hd.—V.	... 8·49	part Br.	·153	
V.—T.	... 5·19	Bulb Br.	·255	
Hd.—V.	... 1	Br. Bulb	1	
V.—T.	... ·64	Oes. T. L.	7·5	
Br. at V.	... ·544	Hd.—Vent. pore	1·275	
Hd.—Anus	... 12·09	Cuticular striae		
Anus—Tail	... ·59	ant.	·0037	
		Cuticular striae		
		post.	·0037	

TABLE III.

Heterakis macronis, n. sp.

Cobb's Formulae.

Measurements expressed in units = $\frac{1}{100}$ T. L.

	i ♀	ii ♂	iii ♂
T. L.	... mm. 8·5	7·31	7·5
Br. of Hd.	... 0·6	0·55	0·54
Hd.—Hd.	... 0	0	0
Br. at Nerve Ring	... 1·4	1·4	1·3
Hd.—Nerve Ring	... 5	4·4	4·3
Br. at end oesoph.	... 1·8	2	2
Hd.—end oesoph.	... 9	10·7	11·3
Br. at Vulva or middle of body	... 1·3	1·3	1·43
Hd.—Vulva or middle of body	... 63	50	50·
Br. at Anus	... 0·65	0·86	0·8
Hd.—Anus	... 97	97·6	98·

	♀ ♀ i	iv	viii	♂ ♂ ii	iii	v	vi
T. L.	... 8.5	7.82	6.596	7.31	7.5	7.412	3.65
Mx. Br.	153	.1406	.129	.148	.148	—	—
Mx. Br.	... $\frac{1}{55}$	$\frac{1}{56}$	$\frac{1}{51.1}$	$\frac{1}{50}$	$\frac{1}{51}$	—	—
T. L.	... 55	56	51.1	50	51	—	—
Br. at Head	0518	.0518	.055	.0407	.0407	—	—
Br. at Nerve Ring	1184	.1036	.0962	—	.0962	—	—
Dist. N. R. to Hd.	425	—	.314	.323	.323	—	—
Br. at end oes.	153	.1406	.155	.148	.148	—	—
End Oes.—Hd.	765	.765	.748	.782	.85	—	—
Br. at Vulva or middle ♂	11	.1073	.1147	.0962	.1073	—	—
Hd.—Vulva	... 5.44	5.1	4.428	3.65	3.7	—	—
Lateral Membr. Mx. Br.	...	.0666	.0555	—	—	.0481	—
L. M. Mx. Br.	...	$\frac{1}{2.1}$	$\frac{1}{2.6}$	—	—	$\frac{1}{2.3}$	—
Br. body same plane	...	2.1	2.6	—	—	2.3	—
Br. at Anus	055	.044	.059	.059	.059	—	—
Hd.—Anus	... 8.245	7.561	6.37	7.125	7.33	—	—
Anus—Tail	255	.259	.221	.185	.17	—	—
Post anal L.	... $\frac{1}{33}$	$\frac{1}{30.2}$	$\frac{1}{29}$	$\frac{1}{39}$	$\frac{1}{44}$	—	—
T. L.	... 33	30.2	29	39	44	—	—
Oes. L.	765	.765	.731	.782	.85	—	—
Oes. L.	... $\frac{1}{11}$	$\frac{1}{10}$	$\frac{1}{9}$	$\frac{1}{4.3}$	$\frac{1}{9}$	—	—
T. L.	... 11	10	9	4.3	9	—	—
Oes. Mx. Br.	055	.074	.074	.077	.0703	—	—
Oes. Min. Br.	037	.037	.0326	.029	.0296	—	—
Mx. Br. Oes.	... $\frac{1}{1.5}$	$\frac{1}{2}$	—	$\frac{1}{2.6}$	$\frac{1}{2.4}$	—	—
Oes. Min. Br.	... 1.5	2	—	2.6	2.4	—	—
Hd.—Vulva	... 5.44	5.1	4.428	—	—	—	—
Vulva—Tail	... 2.89	2.29	2.167	—	—	—	—
Hd.—Vulva	... $\frac{2}{1}$	$\frac{2.2}{1}$	—	—	—	—	—
Vulva—Tail	... 1	1	—	—	—	—	—
Uterine Egg. L.	051	.0629	.0518	—	—	—	—
" " Br.	037	.037	.037	—	—	—	—
Bursa L.	... —	—	—	.444	.435	—	—
" Mx. Br.	... —	—	—	—	.0952	—	—
Sucker—Tail	... —	—	—	.462	.41	—	—
Spicules L.	... —	—	—	—	—	—	.0765
Hd.—Ant. end ♂ gonad	... —	—	—	—	2.72	—	1.105

TABLE IV.

Cobb's Formula.

Dacnitis callichroi.

	♀ i	♀ ii
T. L.	... 6.63	7.225
Br. at mouth	... $\frac{15}{0}$	—
Br. at end of oesoph.	... $\frac{5.13}{11.5}$	$\frac{4}{10.1}$
Hd.—end of oesoph.	...	...
Br. at Vulva or middle	... $\frac{5.4}{60}$	$\frac{5.9}{56.6}$
Hd.—Vulva or middle	...	...
Br. at Anus	... $\frac{1.54}{95.9}$	$\frac{1.8}{97}$
Hd.—Anus	...	...

	i	ii	<i>D. foveolata.</i> R. Plymouth.
T. L. ...	6.63	7.22	6.12
Mx. Br. ...	.391	.425	
Mx. Br.	I	I	
T. L. ...	17	17	
Br. at Term. oes. ...	.34	.289	
Hd.—Term. oes. ...	.765	.731	
Br. at Vulva or middle ...	.357	.425	
Hd.—Vulva... ...	3.96	4.08	
Lat. Membr. ...	0	0	
Br. at Anus ...	.102	.129	
Hd.—Anus ...	6.46	7.02	
Anus—Tail ...	.17	.203	
Post anal L.	I	I	
T. L. ...	39	35.5	
Oes. L. ...	.748	.765	.935
Oes. L.	I	I	I
T. L. ...	9	9.4	6.5
Oes. Ant. Mx. Br. ...	.187	.17	.1887
Oes. Min. Br. ...	.102	.085	.0814
Oes. Post. Mx. Br. ...	.17	.17	.1332
Oes. Post. Mx. Br.	I	I	I
Oes. L. ...	4.4	4.5	7
Hd.—Vulva ...	3.96	4.08	
Vulva—Tail ...	2.72	3.14	
Hd.—Vulva	1.4	1.3	
Vulva—Tail ...	I	I	
Uterine Egg. L. ...	.0851	.555	{
without shell		.048	
Br. ...	.0555	.029	
Cuticular Striae Ant. ...	.002	.037	{
Post. ...	.0012	.002	

TABLE V.

Spiroptera denticulata, R.

Var. *minor*, var. nov.

	i	ii		i	ii
T. L. ...	1.87	1.88	Length of Spine of 2nd circle ...	.023	—
Mx. B. (at 2nd ring) ...	0.68	0.68	Lateral line Br. at Head ...	.0068	.0068
Mx. B.	I	I	Lateral line Br. middle of Body ...	.0085	—
T. L. ...	27	27			
Oral cone L. ...	.0136	—			
Br. Ant. margin oral cone	—	.0204	Oes. max. diam. ...	.0204	—
Hd.—end Pharynx. ...	.0306	.0476	Oes. mim. diam. ...	.034	—
Br. Body at end Ph. ...	.068	.068	Hd.—Ant. end gonad ...	.703	—
Hd.—end oesoph. ...	.1275	.204	Testicular Region L. ...	.555	—
Br. Body at end oesoph. ...	.0544	.0612	Vesicul Semin. L. ...	.185	—
Br. at middle... ...	.0561	.068	Duct. Ejaculat L. ...	.481	—
Br. at Anus ...	.034	.034	Spicule R. Length ...	.0799	.0935
Hd.—Anus ...	1.81	1.81	Do. Br. ...	.0038	.0034
Anus—Tail ...	.059	.068	Sp. Left length ...	.442	.4441

Post anal L.	...	$\frac{1}{31.7}$	$\frac{1}{27}$	Sp. Left Br. ...	...	.0038	.0068
T. L.	...	.017	—	Sp. Left Terminal joint L....	—	.0153	
1st Ring L.	...	.0136	—				
2nd " "	...	.0102	—				
3rd " "	...	.007	—				
Middle Rings L.	...						
Br. Hd.	...			i	ii		
Hd.—Hd.	...			—	$\frac{1.1}{0}$		
Br. at end Ph.	...			$\frac{3.8}{1.7}$	$\frac{3.8}{2.6}$		
Hd.—end Ph.	...			$\frac{3}{7}$	$\frac{3.4}{11.3}$		
Br. at end oes.	...			$\frac{3}{7}$	$\frac{3.8}{3.8}$		
Hd.—end oes.	...			$\frac{50}{1.88}$	$\frac{50}{1.88}$		
Br. at middle	...			$\frac{97}{97}$	$\frac{97}{97}$		
Hd.—middle.	...						
Br. at Anus	...						
Hd.—Anus	...						

Cobb's Formula.

TABLE VI.

Atractis kachugae, n. sp.

	Immat.	Mature.	Mature.
	♀	♀	♂
	41/1/1	41/1/3	41/4
T. L.	... 2.17	2.63	3.06
Mx. Br.	044	.055	.077
Mx. Br.	...	—	—
T. L.	...	—	—
Hd.—Br.	...	—	.0333
Hd. Comm. Oes.	...	.011	.011
Hd.—end oes. 2.	349	.391	.459
Br. body at end oes. 2	044	.0555	.0629
Br. at middle	04	.0518	.077
Hd.—V.	...	1.95	2.23
V.—T.	...	.68	.833
Hd.—V.	...	1	1
V.—T.	...	.34	.37
Br. at middle at V.	...	.0407	.059
Hd.—Anus	... 1.67	2.07	2.329
Br. at Anus	029	.033	.044
An.—T.	493	.56	.731
Post anal	...	1	1
T. L.	... 4.4	4.7	4.2
Oes. 1 L.	15	.16	.185
Oes. 1 Br.	018	.022	.029
Bulb. 1 Br.	029	.033	.04
Oes. 2 L.	199	.22	.255
Oes. 2 Br.	018	.025	.029
Bulb. 2 Br.	037	.048	.055
Oes. T. L.	...	1	1
T. L.	... 6.2	6.9	6.8
Hd.—begin. of gonad	... 1.21	—	.969
Spicule R. length	...	—	—
" breadth	...	—	—
" left length	...	—	—
" " Br.	...	—	—

Br. at begin. oes.	...	...	$\frac{1}{0}$	—	} Cobb's Formula.
Hd.—begin. oes.	...	...	$\frac{2}{15}$	$\frac{2}{17.1}$	
Br. at end oes.	...	...	$\frac{2.4}{50}$	$\frac{1.8}{50}$	
Hd.—end oes.	...	...	$\frac{2}{74}$	—	
Br. at middle	...	...	$\frac{1.33}{77.3}$	$\frac{1.3}{84.5}$	
Hd.—middle	...	...			
Br. at V.	...	...			
Hd.—V.	...	...			
Br. at. anus	...	...			
Hd.—anus	...	...			

TABLE VII.

Encysted Embryo from bladder of *Bufo stomaticus*.

T. L.	...	1.739	Hd.—Br.	...	$\frac{4.7}{0}$	} Cobb's Formula.
Mx. Br.	...	.1184	Hd.—Hd.	...	$\frac{6.9}{8.7}$	
Mx. Br.	...	1	Br. at end oes. 1	...	$\frac{6.9}{6.9}$	
T. L.	...	14.7	Hd.—oes. 1 end	...	$\frac{43.5}{6.9}$	
Br. at Hd.	...	.0814	Br. at end oes. 2	...	$\frac{52}{3.2}$	
Lips length	...	.0185	Hd.—end oes. 2	...	$\frac{98}{98}$	
Br. at end oes. 1	...	.1184	Br. at Vulva	...		
Tip of lip—end of	...		Hd.—Vulva	...		
oes. 1	...	.148	Br. at Anus	...		
Br. at end oes. 2	...	.1184	Hd.—Anus	...		
Tip lip—end of oes. 2	...	.74				
Br. at Anus	...	.0555				
Tip of lip—Anus	...	1.665				
Anus—Tail	...	.074				
Post anal L.	...	1				
T. L.	...	23.5				
Oes. 1 length	...	.1295				
Oes. 1 Mx. Br.	...	.0407				
Oes. 1 Min. Br.	...	.0274				
Oes. 1 Mx. Br.	...	1				
Oes. 1 L.	...	3				
Tip of lip—N. R.	...	.103				
Oes. 2 length	...	.592				
Oes. 2 Mx. Br.	...	.0777				
Oes. 2 Min. Br.	...	1				
Oes. 2 L.	...	7.5				
Anal canal L.	...	.0629				
Lat. Line Min. Br.	...	.0085				
Lat. Line Mx. Br.	...	.0153				
Tip lip—Rud. V.	...	.888				
V.—T.	...	.851				
Hd.—V.	...	1				
V.—T.	...	.96				

TABLE IX.

Larvae from Stomach of *Wallago attoo*. (L. 14).

T. L. ...	14/1 ... '578	Postanal L. ...	1	Br. Head	2	Cobb's Formula.
Mx. Br. ...	'034	T. L. ...	9/7	Hd.—Hd.	0	
Mx. Br.	1/7	Body Br. at Anus	'6238	Br. at end capsule	5.2	
T. L.	...	Spurs L. ...	'017	Hd.—end capsule	6.5	
Mouth Br.	... '0068	Cuticular Rings		Br. at end of oeso.	6.2	
Head Br.	... '0119	Ant. Br. ...	'0034	Hd.—end of oeso.	34	
Buccal Caps. L.	... '0374	" " Post Br.	'0017	Br. at middle	6	
" Mx. Br.	... '017			Hd.—middle	50	
" Br. Post	... '0102			Br. at Anus	4.1	
Body Br. at end of				Hd.—Anus	91.9	
Bucc. capsule	... '0298					
Hd.—end Oesph.	... '1955					
Oes. Mx. Br.	... '0136					
Body Br. at end						
Oesoph.	... '0357					
Body Br. at middle	'034					
Hd.—Anus	... '524					
Anus—Tail	... '0544					

LITERATURE REFERRED TO IN THE TEXT.

- (1) Bastian—Monograph of the Anguillulidae. Trans. Linn. Soc. xxv, 1866.
- (2) Diesing—Syst. Helminth. *At. dactylura* and *hystrix*, R. II, pp. 151 and 188.
- (3) Dujardin—Hist. Nat. des Helminthes.
- (4) Gendre—Proc. verb. Soc. Linn. 63. *Atractis fasciolata*, p. 30.
- (5) Leidy—Proc. Acad. Philadelphia, 1890, *Atractis opeatura*, n. sp.
- (6) v. Linstow—Arch. mikroskop. Anat., 39, p. 325, *larvae of Angiostomum*.
- (7) v. Linstow—Arch. f. Naturgeschichte, 72, p. 256, 1906. *Oxysoma contortum*, n. sp.
- (8) v. Linstow—Arch. f. Naturgesch, 52, p. 113. *O. brevicaudatum*.
- (9) v. Linstow—Arch. f. Naturgesch, 1890, p. 171. *Oxysoma terdentatum*.
- (10) v. Linstow—Arch. f. Mikr. Anat. 62, p. 114, *O. tuberculatum* fr. *Megalophrys montana*.
- (11) v. Linstow—Centralbl. f. Bakter. Orig. v. 53. *At. perarmata*.
- (12) v. Linstow—Centralbl. f. Bakter. Orig. v. 31. *At. cruciata*, p. 29.
- (13) v. Linstow—Mitth. Mus. Berlin v. I. *Physaloptera amphibia*, p. 15.
- (14) v. Linstow—Recds. Ind. Mus. Vol. I, p. 45. *Onch. indicus*.
- (14A) v. Linstow—Spolia Zeylanica, Vol. III.
- (15) De Man.—Freilebende Nordsee Nematoden.

- (16) Molin—Sitz. K. Akad. Wien. v. 38, p. 27. *Dacnitis rotundata*.
 (16A) Sitz. K. Akad. Wien. v. 38, p. 25. *Spiroptera papillata* fr. *Leuciscus cavedanus* and *Spir. acuminata*.
 (17) Neuhaus—Jena. Zeitschr. Vol. 37, 1903, p. 653. *Post-embryonal dev. of Rhabditis nigrovenosa*.
 (18) Railliet—Traite de Zoologie Médicale et Agricole.
 (19) Schneider, A.—Monographie der Nematoden.

Reference Letters in Tables.

Br.—Breadth.
 Comm.—Commencement.
 Diam.—Diameter.
 Hd.—Head.
 L.—Length.
 Mx. Br.—Maximum breadth.
 N. R.—Nerve ring.
 Pt.—Part.
 T.—Tail.
 T L.—Total length.
 V.—Vulva.

The numbers at the head of the vertical columns refer to the serial numbers of the specimens.

Reference Letters in Plates.

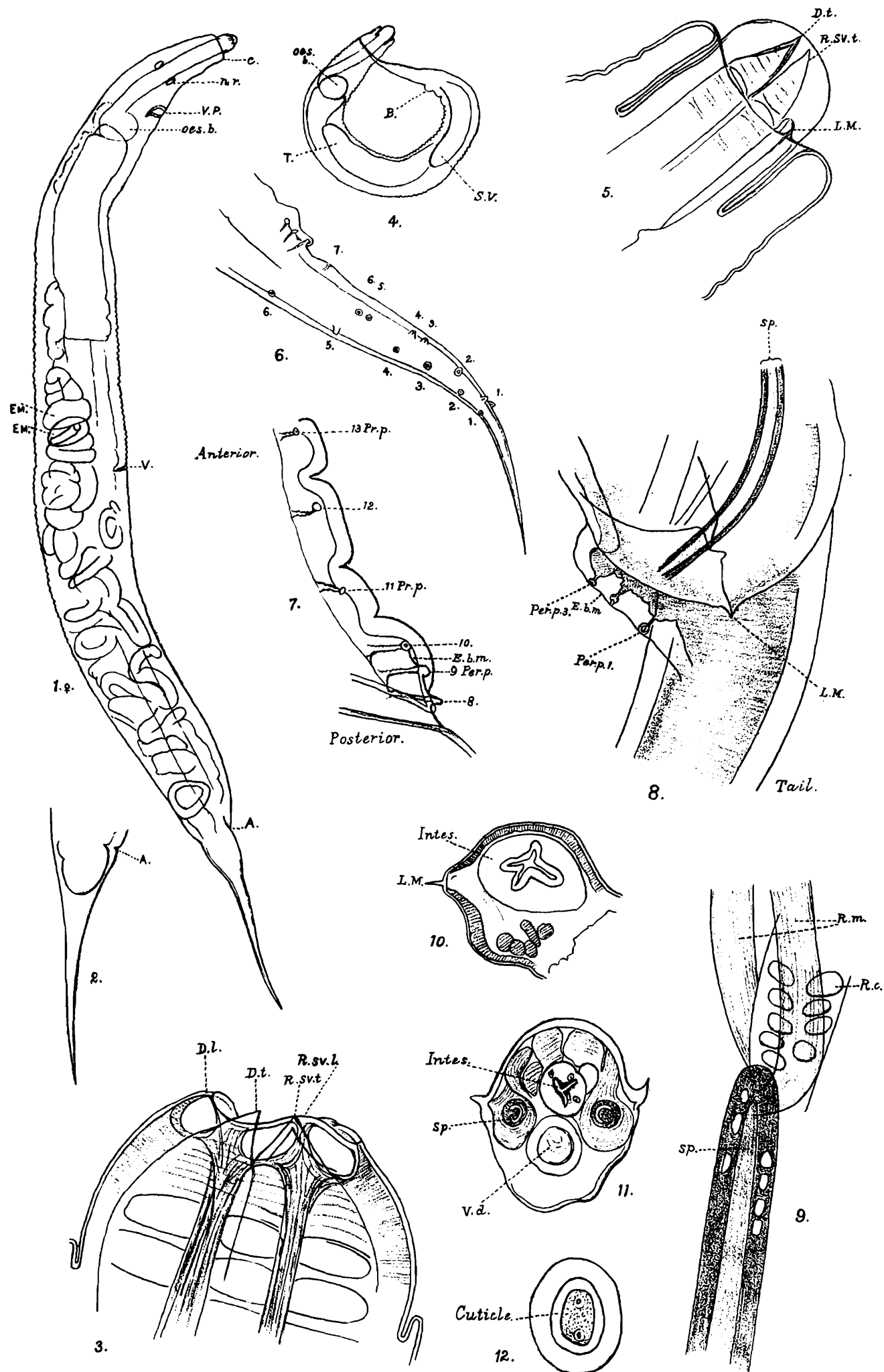
A.—Anus. a.g.g.—anogenital gland. B.—bursa. b.c.—buccal cavity. C.—collar. can.—canaliculus. c.g.c.—cavity of gonocoel. c.m.—circular muscle. cl.—cloaca. cu. i.—inner margin of cushion. D.—dorsal. D. ej.—ductus ejaculatorius. D.l.—dorsal lip. D.t.—dorsal tooth. du.—duct of gland. E.b.m.—edge of bursal membrane. Em—embryo in utero. f.m.—free margin. Intes.—intestine. L.—larva. L.l.—lateral line. L. lp.—lateral line lip. n.r.—nerve ring. oes.—oesophagus. oes. b.—oesophageal bulb. ov.—ovary. P.—papilla. Per. p.—perianal papilla. Post.—posterior. Pr. p.—preanal papilla. R.c.—root column. Re.—rectum. R.m.—retractor muscle. R.s.v.l.—right subventral lip. R.s.v.t.—right subventral tooth. sd.t.—subdorsal tooth. sd.l.—subdorsal lip. sm.l.—submedian lip. sp.—spicule. sph.—sphincter. su.—sucker. s.v.—seminal vesicle. T.—testis. To.—tooth. ut.—uterus. v.—ventral. v.g.—ventral gland. v.p.—ventral pore.

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## EXPLANATION OF PLATE XVIII.

*Oxysoma macintoshii*, sp. nov.

- FIG. 1.—♀ × 75.  
,, 2.—♀ outline of tail. × 75 (2/1/3).  
,, 3.—Head of ♀ in profile. × 750 (2/1/2).  
,, 4.—♂ × 75 (10/2/).  
,, 5.—Head of ♂ × 750 (12/2/).  
,, 6.—Tail of ♂ showing postanal papillae, papillae numbered from behind forward. × 310 (10/2/).  
,, 7.—Anogenital aperture of ♂ showing bursa, peri- and preanal papillae. × 750. (10/2/). The papillae are numbered from behind forward in continuity with the postanal series.  
,, 8.—Posterior end of body and anterior end of tail of ♂, showing bursa and left spicule. × 750. (1/1/).  
,, 9.—Head of right spicule. × 750. (10/1/).  
,, 10.—♂ Transverse section at a level shortly behind oesophageal bulb. × 325.  
,, 11.—♂ Transverse section at a level shortly in front of the anus. Showing vas deferens and spicules (the spicules at this level are incomplete cylinders). × 325.  
,, 12.—♂ Transverse section through spicule at a more posterior level than fig. 11. × 1500.



F.H. Stewart, del.

A. Chowdhary, lith.

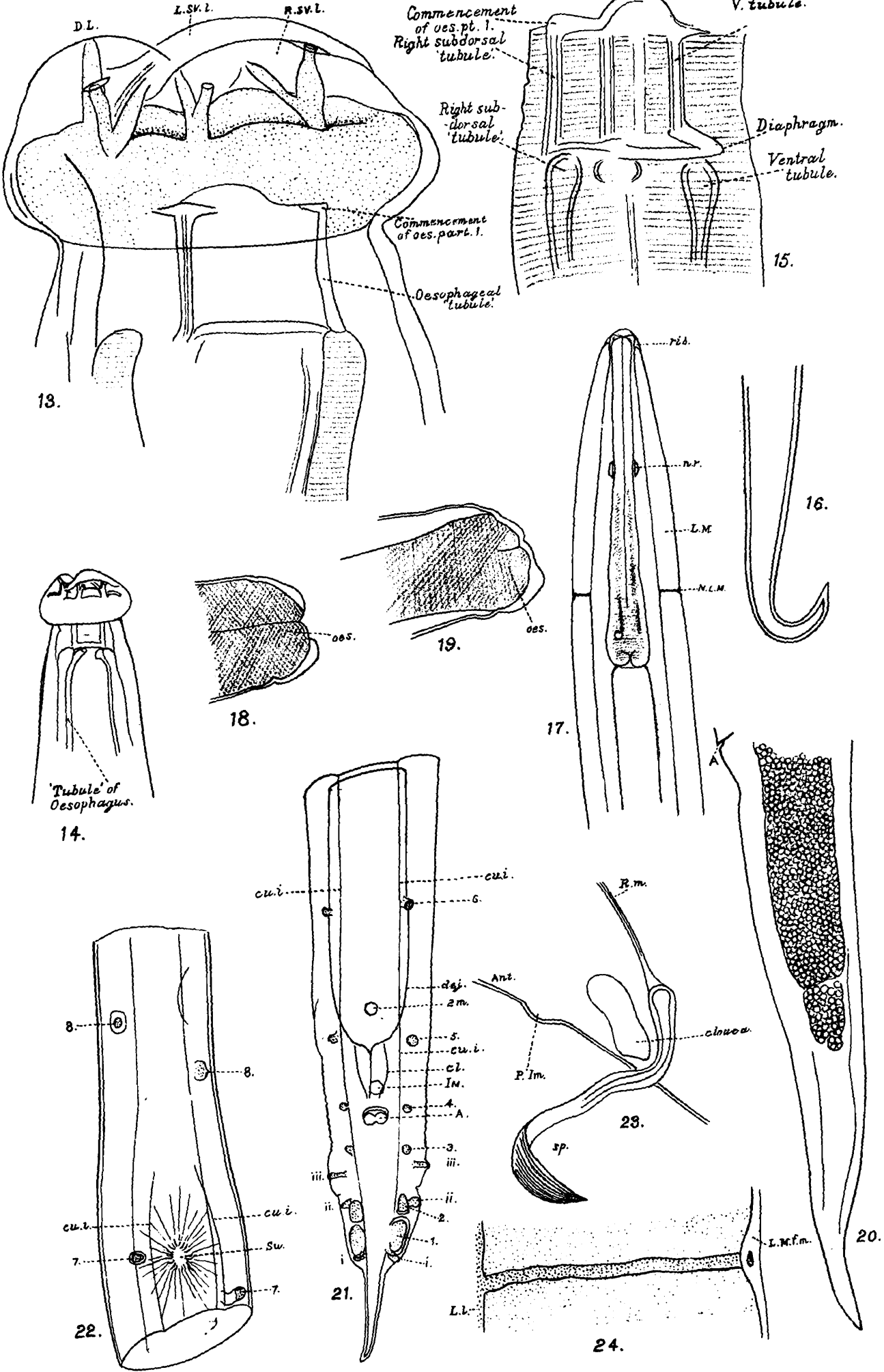
## EXPLANATION OF PLATE XIX.

### *Oxysoma kachugae*, sp. nov.

- FIG. 13.—♀ Head in profile seen from the right side. × 325.  
 „ 14.—♀ Head in profile seen from right side. × 75.  
 „ 15.—♀ Junction of first and second part of the oesophagus  
 showing tubules of oesophageal lumen.  
 „ 16.—♀ Outline of end of tail. × 75.

### *Heterakis macronis*, sp. nov.

- FIG. 17.—♀ Anterior extremity seen in the sagittal plane.  
 × 75 (26-viii).  
 „ 18.—♀ Head in profile seen in focal plane of the mouth.  
 × 325.  
 „ 19.—♀ Head in profile seen in focal plane to the right of  
 the mouth. × 325.  
 „ 20.—♀ Tail seen from the left. × 325 (26-i).  
 „ 21.—♂ Tail seen from the ventral surface. × 216 $\frac{2}{3}$ .  
 (26-iii). The upper end of this figure should  
 be continuous with the lower end of figure 22.  
 i-iii—the sublateral papillae, 1-8, the sub-  
 ventral papillae, 1m. and 2m. the median ven-  
 tral papillae.  
 „ 22.—♂ Tail continuation of fig. 21.  
 „ 23.—♂ Anogenital aperture seen from the left side, with  
 left spicule extended. × 750 (26-vi).  
 „ 24.—The nerve of the lateral membrane. × 750 (26-viii).  
 The attachment of the lateral membrane to the  
 lateral line is on the left of the figure.



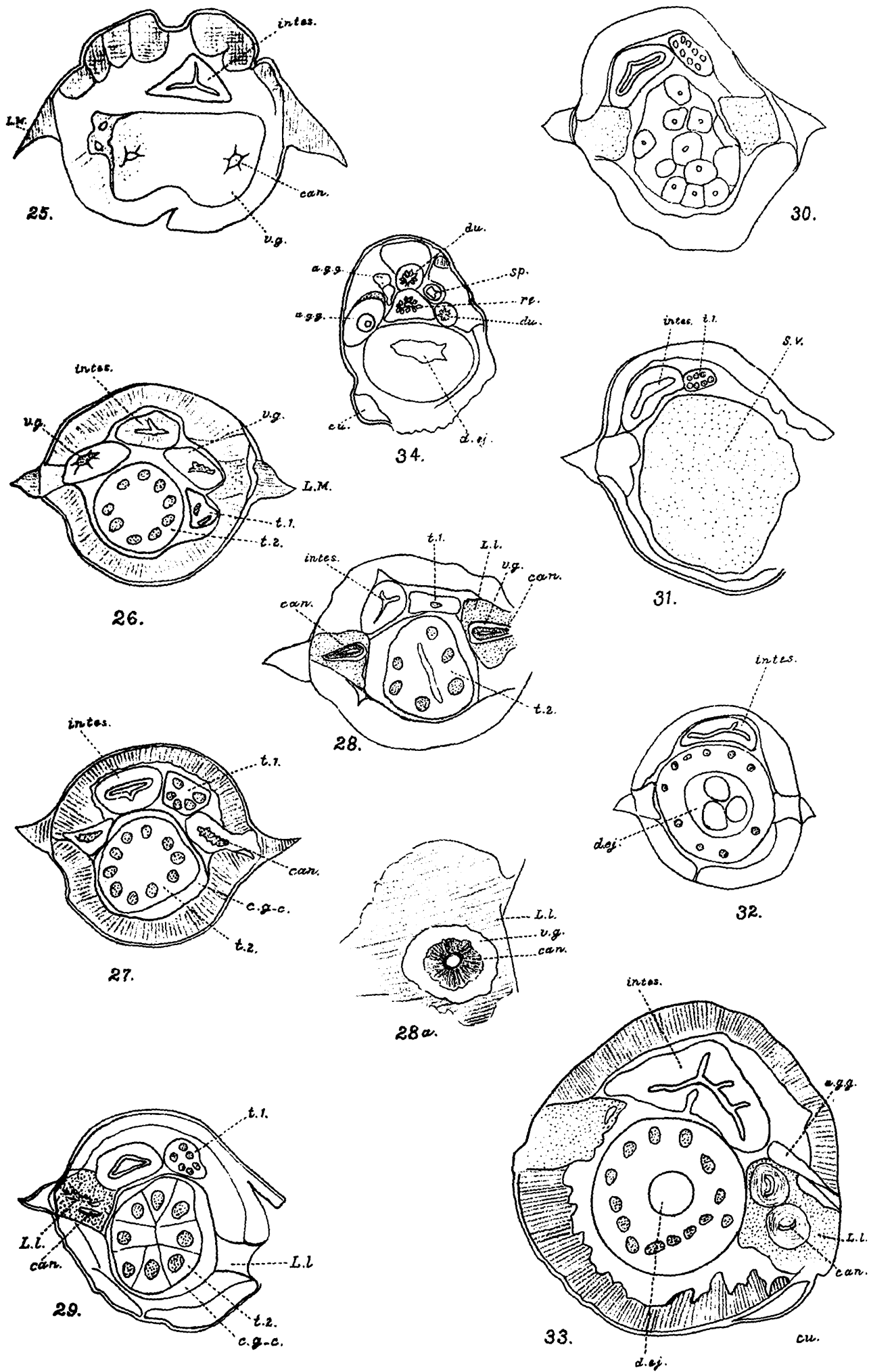
F.H. Stewart, del.

A. Chowdhary, lith.

## EXPLANATION OF PLATE XX.

*Heterakis macronis*, sp. nov.

- FIG. 25.—♂ Transverse section middle of body.  $\times 433\frac{1}{3}$  (Series 1, slide 1). Shows the body of the ventral gland.
- „ 26.—♂ Transverse section behind fig. 25.  $\times 433\frac{1}{3}$ . (Series 1, slide 2/4/). Shows the processes of the ventral gland and the ascending (t. 1.) and descending (t. 2) limbs of the testis.
- „ 27.—♂ Transverse section behind fig. 26.  $\times 433\frac{1}{3}$ . (Series 1, slide 2, end). Shows the processes of the ventral gland coming into close relationship with the lateral lines.
- „ 28.—♂ Transverse section behind fig. 27.  $\times 433\frac{1}{3}$ . (Series 1, slide 3/2/). Shows the processes of the ventral gland near their termination, in the substance of the lateral lines.
- „ 28a.—♂ Transverse section through the lateral line behind fig. 28.  $\times 1500$ . (Series 1, slide 2/3/ end). Shows the end of a ventral gland process, with its canaliculus which possesses a well-marked wall.
- „ 29.—♂ Transverse section behind fig. 28.  $\times 433\frac{1}{3}$ . (Series 1, slide 3/4/ mid). Shows a canaliculus in the lateral line.
- „ 30.—♂ Transverse section behind fig. 29.  $\times 433\frac{1}{3}$ . (Series 1, slide 4/2/). At the transition from testis to seminal vesicle.
- „ 31.—♂ Transverse section behind fig. 30.  $\times 433\frac{1}{3}$ . (Series 1, slide 4/4/). Through the seminal vesicle.
- „ 32.—♂ Transverse section behind fig. 31.  $\times 433\frac{1}{3}$ . (Series 1, slide 5/2/2/3). Through the ductus ejaculatorius.
- „ 33.—♂ Transverse section behind fig. 32.  $\times 1000$ . (Series 1, slide 5/3/). Shows canaliculi in the lateral line and the anogenital glands.
- „ 34.—♂ Transverse section through tail behind fig. 33, and slightly in front of the anogenital aperture.  $\times 433\frac{1}{3}$ . Shows the base of one spicule, the anogenital glands with their ducts, the cushion of the bursa. (Series 1, slide 6).



F.H. Stewart, del.

A. Chowdhary, lith.

## EXPLANATION OF PLATE XXI.

### *Dacnitis callichroi*, sp. nov.

- FIG. 35.—♀ Anterior extremity.  $\times 75$  (L. 19, ii).  
,, 36.—♀ Head.  $\times 325$ . Seen from nearly sagittal plane.  
(L. 19, i).  
,, 37.—♀ Head.  $\times 216\frac{2}{3}$ . From the right side.  
,, 38.—♀ Tail from ventral surface.  $\times 216\frac{2}{3}$  (L. 19, ii).

### *Dacnitis foveolata*, R.

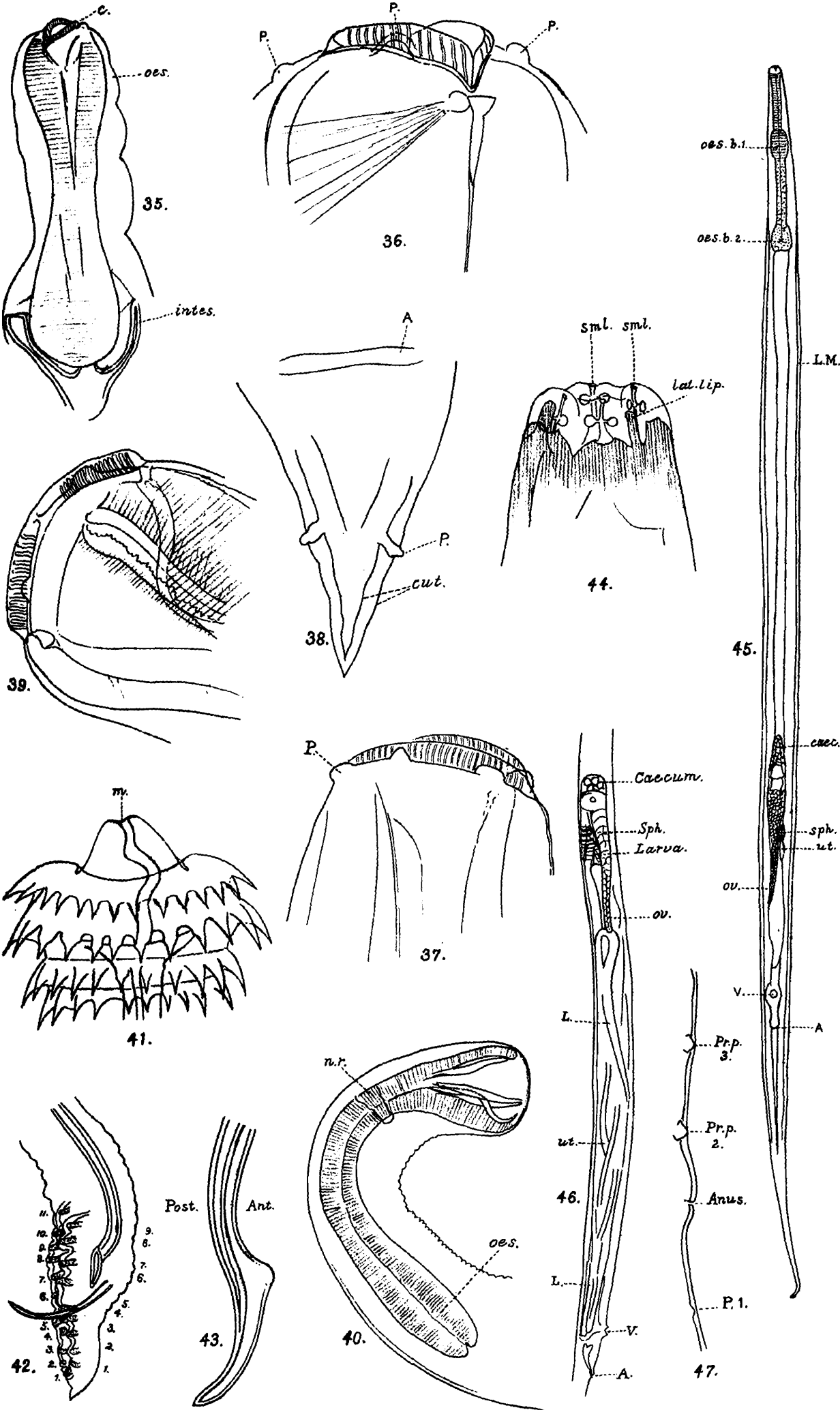
- FIG. 39.—Adult ♀ Head. From the left side.  $\times 216\frac{2}{3}$ . (Plymouth: fr. *Pleuronectes platessae*).  
,, 40.—Adult ♀ Anterior extremity.  $\times 325$ . (Plymouth: fr. *P. platessae*).

### *Spiroptera denticulata*, R. var. *minor*, n. var.

- FIG. 41.—♂ Anterior extremity.  $\times 500$ .  
,, 42.—♂ Tail.  $\times 216\frac{2}{3}$ .  
,, 43.—♂ End of left spicule seen from right side.  $\times 750$ .

### *Atractis kachugae*, sp. nov.

- FIG. 44.—♀ Head.  $\times 1000$ . (41/2/).  
,, 45.—♀  $\times 75$  (41/2/  $\times$ ) from ventral surface.  
,, 46.—♀ Reproductive organs.  $\times 75$ .  
,, 47.—♂ Outline of anogenital region showing papillae.  
 $\times 750$ . (41/1/) from right side.



F.H.Stewart, del.

A. Chowdhary, lith.

## EXPLANATION OF PLATE XXII.

### *Atractis kachugae*, sp. nov.

FIG. 48.—♂. Anogenital region and spicules from the right side  
× 750. (41/1/).

„ 49.—♂. Outline of tail from right side. × 150. (41/1).

### *Physaloptera*, sp.

Larva from *Bufo stomaticus*.

FIG. 50.—× 75.

„ 51.—Head. × 750, seen from the left side.

### *Ascaris*, sp.

Larva (L. 33 and 36).

Encysted in the peritoneum of *Wallago attoo*, Bl. Schn

FIG. 52.—Head. × 216 $\frac{2}{3}$ .

„ 53.—Head seen from the right side. × 216 $\frac{2}{3}$ . (33. ii.).

„ 54.—Outline of tail from the right side. × 216 $\frac{2}{3}$ .

### *Ascaris*, sp.

Larva (L. 15).

Free in the peritoneum of *Wallago attoo*.

FIG. 55.—Outline of head. × 216 $\frac{2}{3}$ . Seen from the right side  
obliquely slightly from D.

„ 56.—Outline of tail seen from the right side. × 216 $\frac{2}{3}$ .

Larva (L. 30).

From intestine of *Wallago attoo*, Bl. Schn.

FIG. 57.—Anterior portion of body. × 75.

„ 58.—Head. × 1500.

„ 59.—Opening of ventral gland. × 325.

„ 60.—Tail. × 325.



### EXPLANATION OF PLATE XXIII.

Larva (L. 30) from intestine of *Wallago attoo*, Bl. Schn.

FIG. 61.—Transverse section, 1 mm. from head.

„ 62.—Transverse section, 2 mm. from head.

Larva (L. 14), from stomach of *Wallago attoo*, Bl. Schn.

„ 63.—Head.  $\times 1500$ .

„ 64.—Tail from ventral surface.  $\times 1500$ .

„ 65.—Tail from left side.  $\times 1000$ .

*Oncholaimus indicus*, v. Linstow.

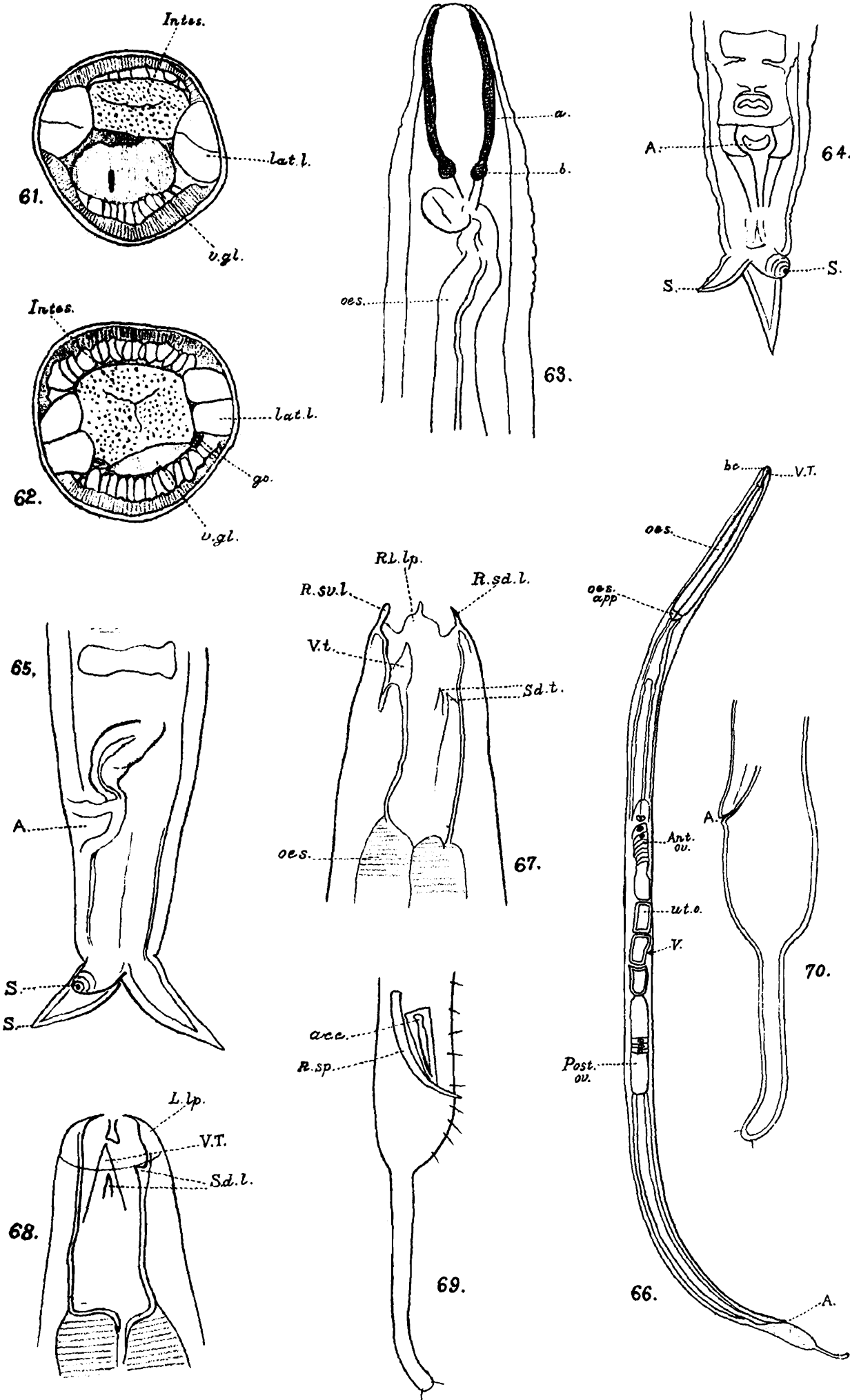
FIG. 66.—♀ from right dorsolateral aspect.  $\times 150$ .

„ 67.—♀ Head from the left side.  $\times 1000$ . The lips are protruded.

„ 68.—♂ Head seen from ventral aspect.  $\times 1000$ . The lips are folded in.

„ 69.—♂ Tail from right side.  $\times 433\frac{1}{3}$ .

„ 70.—♀ Tail from left side.  $\times 216\frac{2}{3}$ .



X STUDIES IN INDIAN HELMINTHO-  
LOGY, No II

By F. H. STEWART, M.A., D.Sc., M.B., Capt., I.M.S.,  
Hon. Assistant, Indian Museum.

THE ANATOMY OF *POLYSTOMUM KACHUGAE*, SP. NOV.,  
WITH NOTES ON THE GENUS *POLYSTOMUM*.

***Polystomum kachugae*, sp. n.**

(Plates xxvi—xxix.)

Two specimens were found in the urinary bladder of a water tortoise (*Kachuga lineata*, Gray) at Lucknow. They were fixed in boiling alcohol, 70%: one specimen was stained with borax-carmin and mounted entire, the other after being stained with the same stain and sketched in oil of cloves was cut into serial sections. I am indebted to my friend Major Walton, I.M.S., for the opportunity of obtaining the specimens at the Medical College, Lucknow, and to Dr. Annandale for the identification of the tortoise.

The body of this new Polystome measures 6.5 mm. in length and 2 mm. in breadth at the level of greatest breadth. It is bluntly pointed at the head, becoming broader in the first 2 mm; the second 2 mm. of length correspond with the greatest breadth. There is a slight but sudden narrowing 1.8 mm. from the posterior extremity. The cotylophore is 1.33 mm. in breadth, the part of the body immediately preceding it is 1.3 mm.

The mouth is subterminal and flattened, of crescent shape when looked at from the ventral surface. The dorsal lip projects downward into the mouth (Pl. xxvii, fig. 2). Eye spots are not present. Four longitudinal lines of nuclei occur on the ventral surface, outlining the sheaths of the ventral nerve cords. The aperture of the genital atrium is situated 1.15 mm. from the anterior extremity.

The cotylophore bears six cup-shaped suckers (Pl. xxvi, fig. 1) the largest of which measures .4 mm. in diameter. Each sucker projects freely from the surface. The wall of the organ is seen in sections (Pl. xxix, fig. 18) to consist of an outer layer of ectoderm (o.e.), a loose fibrous layer (f.l.), an outer cuticular layer (o.c.l.), a muscular layer (m.l.), an inner cuticular layer (i.c.l.), and an inner ectodermal layer (i.e.l.). The cup formed by the outer cuticular, muscular, and inner cuticular layers is perforated at the base, retractor muscles being attached to the margins of the perforations.

The inner and outer cuticular layers completely enclose the muscular layer, becoming continuous with one another at the mouth of the cup and at the perforation at the base. The fibres of the muscular layer radiate from the centre of the sucker cup, in such a manner that when they contract (acting from the outer cuticular layer as a fixed surface) they enlarge the cavity of the cup and thereby produce a vacuum. This action is aided by the retractor muscles attached to the perforation.

The cotylophore bears two pairs of hooks situated between the posterior pair of suckers (Pl. xxvi, fig. 1). One pair is large and sabre-shaped, 0.9 mm. in length, the points curved boldly forward (h.1.). Plate xxix, fig. 18 exhibits the base of such a hook in transverse section. The hooks of the second pair are short, 0.166 mm. in length, fine and simply curved (Pl. xxvi, fig. 1, h.2.).

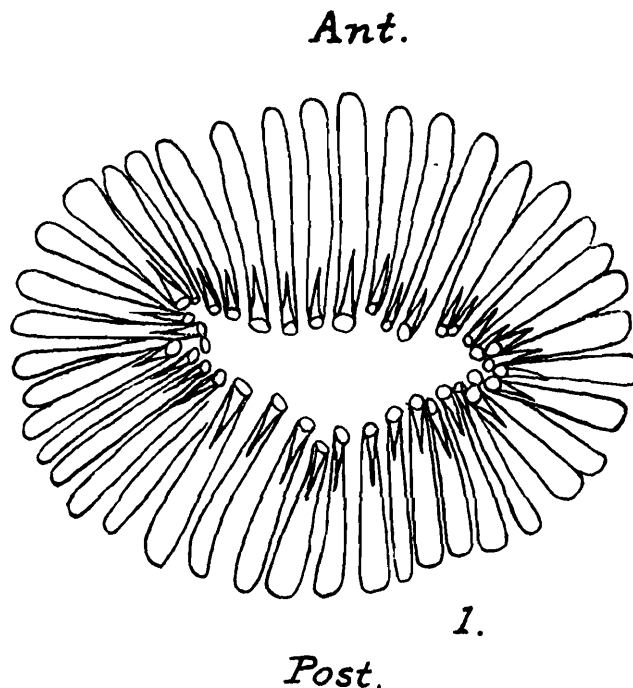


FIG. 1.—The circlet of atrial hooks as seen from the ventral surface,  $\times 650$ .

*Alimentary System.*—The flattened mouth leads into the first pharynx—a spherical muscular bulb (Pl. xxvi, fig. 1. Pl. xxvii, 2, 3, and 4, ph.1) which possesses walls of great thickness and a comparatively narrow lumen. The second pharynx (Pl. xxvi, fig. 1. Pl. xxvii, 5 and 6, ph.2) is identical in shape with the first, and lies dorsal and posterior to it. From the second pharynx a narrow, short and muscular oesophagus leads into the intestine (Pl. xxvi, fig. 1. xxviii, 7, 8. xxix, 14, 17. int.) an organ of the customary two-limbed type. The limbs are unbranched and devoid of anastomoses. They extend backward into the region of the cotylophore.

*The Skin.*—The ectoderm exhibits structure only in a few sections (Pl. xxvii, fig. 5). In these it appears to consist of a high palisade like epithelium. Nuclei are not visible except in the

covering of the outer wall of the suckers (Pl. xxix, fig. 18) where minute point-like nuclei occur. The ectoderm rests on a fibrillar basement membrane, beneath which lies the loose connective tissue in which the organs of the body are embedded.

*Nervous System.*—The central nervous system is composed of a ring surrounding the second pharynx. The dorsal portion of this ring lies at the junction of the first with the second pharynx (Pl. xxvii, fig. 4) and contains six to eight large ganglion cells. The ventral portion of the ring lies somewhat further back (Pl. xxvii, fig. 6). The lateral portions (Pl. xxvii, fig. 5) give off stout nerves to the margins of the body. Two dorsal, two lateral, and two ventral longitudinal nerve cords are present. (Pl. xxix, fig. 14. d.n.c., l.n.c., v.n.c., and Pl. xxvi, fig. 1 v.n.c.)

*Reproductive System.*—In regard to the reproductive system, the two specimens at the disposal of the present writer are as

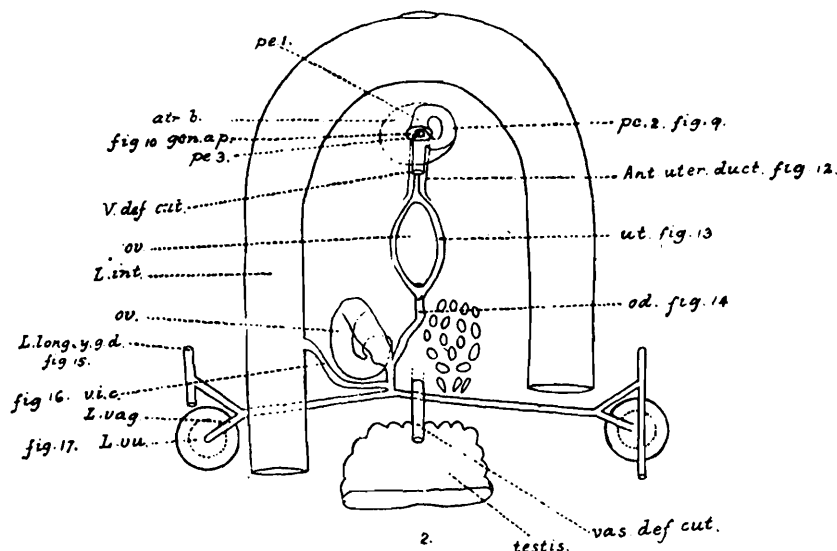
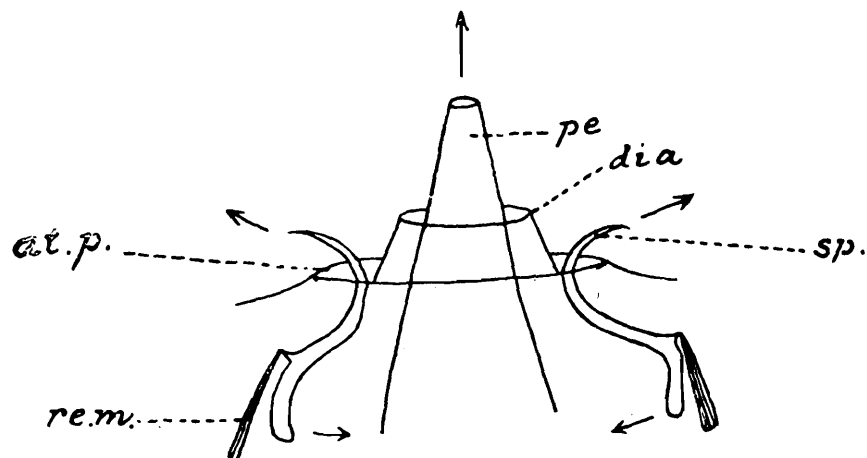


FIG. 2.—Diagram of the reproductive organs as seen from the dorsal surface in specimen No. 2. A portion of the vas deferens is assumed to have been removed to show the underlying female organs. Portions only of the longitudinal yolk ducts are figured.

mirror images the one of the other. The ovary is situated on the right side in specimen No. 1 which is represented in figure 1 of Plate xxvi and on the left side in the second specimen from which the drawings of sections have been made. In the following description the condition of the second specimen is taken as the model.

*The male organs.*—The testis is a broad, flat and lobulated organ (Pl. xxvi, fig. 1 te.) 2.2 mm. in length and 1 mm. in breadth, lying in the median third of the body directly under the ventral epithelium. The vas deferens (Pl. xxviii, fig. 13. Pl. xxix, figs. 14-16 v.d. and text-fig. 2) after gaining the dorsal segment of the body runs forward in the midline. When it approaches within a short distance of the genital atrium it expands somewhat to form a seminal vesicle (Pl. xxviii, figs. 8, 9, 10, 12 s.v.)

which ends in the centre of the surface of the atrial bulb. In this situation it joins the penis, a short, protrusible and muscular tube which curves outward and to the right, and then inward and backward to open into the cavity of the genital atrium (Text-fig. 3 pe. and Pl. xxviii, figs. 9 and 10 pe.). This cavity is enclosed in a muscular bulb (Pl. xxvi, fig. 1. Pl. xxviii, 9, 10 and 12. Text fig. 3 at. b.) and is divided by a diaphragm into a dorsal male atrium and a flattened ventral female atrium. The male atrium opens into the female atrium, and this in turn opens to the exterior through the atrial pore. The penis projects freely into the cavity of the male atrium (Pl. xxviii, fig. 9 pe. 1). The diaphragm is armed with a circle of forty spines which when viewed from the ventral surface appear to be straight truncated rods with recurved fine points (text-fig. 2) but when looked at from the side are seen to be S-shaped hooks (Pl. xxviii, fig. 11) sharp-pointed at the projecting extremity, and having a raised



3.

FIG. 3.—Diagram to explain the action of the atrial spines and the valvular action of the diaphragm on protrusion of the penis. See text.

point on the outer aspect at the junction of the basal and median thirds for the attachment of muscle fibres. The penis can doubtless be extruded through the atrial pore and would carry the diaphragm along with it. This protrusion would separate the points of the hooks and the circlet would embed itself firmly in any tissues with which it came into contact (text-fig. 3). Self-impregnation would be prevented by the impaction of the cone formed by the protruded diaphragm in the atrial pore, the female atrium being closed completely during the protrusion of the penis.

*The female organs.*—(Text-figure 2). The ovary (Pl. xxvi, fig. 1 and Pl. xxix, figs. 14-16 ov.) is situated 1.7 mm. from the anterior extremity. It is a curved sausage-shaped organ, the curve forming all but a complete circle. The fundus is somewhat bulbous. The ovary leads into the oviduct, a narrow canal which runs forward to the uterus (Pl. xxix, figs. 14 and 15 od.). The latter organ

(Pl. xxviii, fig. 13) is of oval form, 0.3 mm. in length and contains a single ovum encased in an eggshell of golden colour. From the uterus the anterior uterine duct leads into the female atrium, on the ventral aspect, as has been explained above, of the atrial circlet of hooks. The two vaginae (text-fig. 3 and Pl. xxix, figs. 16 and 17 vag.) lead out of the oviduct, and pass outward and slightly backward to the vulvae. Each vulva is an open cup situated close to one of the lateral margins, on the ventral surface, and 2 mm. from the anterior extremity. The mouth of the cup is only slightly contracted and has a diameter which measures 0.045 mm. The greatest breadth of the interior of the cup measures 0.068 mm. The wall of the vulva is devoid of cell-outlines and of nuclei and thus resembles the ectoderm with which it is continuous. It is traversed by fine branching fissures which contain a darkly staining material. The vulva opens into the vagina through fissures of this nature. The darkly staining material is neither sperm nor yolk. The vulval capsule is surrounded by pear-shaped cells which possess finely granular protoplasm and large nuclei, but do not contain any obvious secretion.

The main longitudinal ducts of the yolk glands open into the vaginae close to the vulvae (Pl. xxix, fig. 17, text-fig. 3. y.g.d.). The glands extend from the level of the posterior border of the second pharynx as far backward as the anterior margin of the cotylophore. They are found immediately beneath the basement membrane on the dorsal and lateral aspects of the body, and on those portions of the ventral aspect which are not occupied by the reproductive organs. The cells of the yolk glands contain (1) granules which stain pink with carmine, and (2) golden yellow globules. The latter are more numerous than the former. The colour of the globules is identical with that of the eggshell. The granules may be of yolk, but the present writer has not been able to compare them with the contents of the uterine egg, owing to the imperviousness of the eggshell to stains and paraffin. As these glands are morphologically the same as the glands described as yolk glands in other species of *Polystomum*, the name is retained, although they appear also to function as shell glands.

Another group of glandular cells is found at the same transverse level as the ovary, but on the opposite side of the midline. They appear to be connected with the corresponding vagina, but their function is obscure. The protoplasm of these cells is filled with irregular granules.

The vitello-intestinal canal (text-fig. 2. Pl. xxix, fig. 15 v.i.c) leads from the oviduct to the left intestinal branch. The present writer did not find spermatozoa in any part of the female ducts. Yolk cells bearing granules and globules were found in the oviduct and in the left ramus of the gut near to the opening of the vitello-intestinal canal.

*The Excretory System.* A main longitudinal duct is present on either side of the body, situated 0.187 mm. from the lateral margin. It measures 0.238 mm. in diameter and possesses a fibrous wall.

Each duct opens into an excretory vesicle (Pl. xxvi, fig. 1. and Pl. xxviii, 7 ex. ves.), a large spherical space situated amongst the yolk glands, 1 to 1.2 mm. distant from the anterior extremity. The wall of the vesicle is composed of fine fibrous tissue and the vesicle opens on the dorsal surface by a fine pore (Pl. xxviii, fig. 7 ex.p.).

*Summary of the Literature concerning the Genus Polystomum.*

Seven species of Polystoma are known at the present day, viz:—

(1) *Polystomum integerrimum*, Rud. in *Rana temporaria*, urinary bladder.

(2) *Polystomum ocellatum*, Rud. in *Emys lutraria*, Bp., fauces.

(3) *Polystomum oblongum*, Wright, 1888, in *Sternothaerus odoratus*, Gray, urinary bladder.

(4) *Polystomum coronatum*, Leidy, 1888, in *Cistudo carolina*, Gray, nares, pharynx.

(5) *Polystomum hassalli*, Goto, 1900, in *Kinosternon pennsylvanicum*, urinary bladder.

(6) *Polystomum* sp. (= *P. oblongum*, Leidy 1888, not *P. oblongum*, Wright, 1884) Goto 1900, in *Pseudemys rugosa*, urinary bladder.

(7) *Polystomum kachugae*, sp. nov., in *Kachuga lineata* (Gray), urinary bladder.

*Comparison of species.*

(1) **Polystomum integerrimum**, Rud. (Literature Nos. 1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28).

This species is distinguished from the other members of the genus by the branched character of the intestinal rami, the branches anastomosing across the midline; in the remaining species the two rami do not give off branches.

(2) **Polystomum ocellatum**, Rud. (Literature Nos. 5, 7, 16, 20, 22, 24).

Summary of No. 24 Lit. v Willemoes Suhm.—Zeitsch. f. Wissensch. Zool., vol. 22, pp. 29—39, that portion which deals with the anatomy of *Polystomum ocellatum*. The author's description is based on the work of von Siebold (20a). ‘Der Schildkrotenschmarotzer ist im ausgedehnten Zustande 1½ Linien lang, ½ Linie breit. In seiner Körperform ähnelt er durchaus dem Polystoma der Frosche. Am vorderen Leibesende zwischen Pharynx und Geschlechtsöffnung bemerkt man jederseits eine warzenförmige Hervorragung. Ich beobachtete sie jedesmal, sowie dass das Thier sie willkürlich aus—und einziehen könne.

Was die Napfe der Haftscheibe betrifft, so weichen sie von denen des *P. integerrimum* dadurch ab, dass sie von einem festen Ringe, wahrscheinlich chitiner Substanz umgeben sind, der in felder abgetheilt ist, deren jedes 2-3 Löcher zeigt. Zwischen den beiden untersten (Saugnapfen) finden sich zwei grössere, mit den spitzen nach unten stehende, von einander

abgewandte Haken. Von Siebold found small hooklets between the large hooks "noch am erwachsenen thier in wechselnder Zahl

Augenflecke Est ist anzunehmen dass sie das Thier in der Jugend besitze, im Alter aber verliere. Auf eimen Mundnapf mit quergestellter öffnung folgt ein muskulöser, birnförmiger Schlundkopf, ein kurzer Oesophagus und ein Darm der in zwei Schenkel ausläuft und keine weitere Verzweigungen abgiebt."

The genital pore lies "an der bauchfläche, unterhalb der stelle, wo die Darmschenkel sich spalten. Er bildet hier förmlich einen Napf. Im Cirrus liegen kleine Häkchen deren Zahl sich auf 40 beläuft. Von den weiblichen Genitalien ist der am meisten in die Augen fallende Keimstock unregelmässig viereckig. Er liegt im vorderen Theile des Körpers. Die beide Dotterstöcke, grosse, gelappte Organe, welche am Rücken liegen, füllen den ganzen Raum vom Mundsaugnapf bis an die Saugscheibe aus. Ihre Ausführungsgänge vereinigen sich zum Dottergang, der, nachdem er mit dem Keimgang zusammengeflossen ist sich in den Vaginalcanal fortsetzt, wo er eine Anzahl einzelliger Drüsen (deren Summe die Schalendrüse ausmacht) aufnimmt. An der Stelle wo diese einmünden, ist eine kleine Höhle (Ootype, van Beneden), die sich in den Eileiter oder Vaginalcanal fortsetzt. Dieser verläuft in einigen Windungen zum Porus genitalis und mündet hinter der männlichen Öffnung in die Geschlechtskloake aus."

We gather from the foregoing description that the most noteworthy point of distinction between the species *ocellatum* and *kachugae* lies in the position of the vulvae and possibly in the form of these organs. In *P. ocellatum* they lie between the pharynx and the genital aperture, in *P. kachugae* at a considerable distance behind the genital aperture. It is possible that the pit-like form of the organs in *P. kachugae* is due to the retraction of a pair of pad-like vulvae as described by Willemoes Suhm.

The shell gland described by von Siebold is clearly the same morphologically as the innominate gland of *P. kachugae*. It is not clear on what grounds the function of shell-formation has been attributed to the gland and it may be that the function has been taken for granted without sufficient proof, not only in the case of this gland but of the "yolk-gland" also.

(3) **Polystomum oblongum**, Wright, 1884. (Lit. Nos. 13, 25). The succeeding notes are extracted from No. 25. "Body oblong, mouth on the ventral surface of the rounded anterior end. Pharynx bowl-shaped. Intestinal caeca without anastomoses or branches. Generative outlets in front of the line of the lateral vaginae. Cirrus coronet of sixteen alternately small and large sabre-shaped pieces. Viviparous. Length up to 2.5 mm., breadth 1.5 mm. Egg greenish 0.235 mm. by 0.195. Larvae ocellate 0.5 mm. in length. The caudal lamina is somewhat narrower than the greatest width of the body and is shorter than it is broad." Six small hooks, 0.15 mm. in length, situated between the two anterior suckers, in pairs. Four small and two large hooks

between the posterior suckers, the small hooks between the large hooks. The large hooks measure 0.15 mm. "and have a proportionately deeper notch than those of *P. integerrimum*."

Comparing the foregoing description with our species from *Kachuga lineata*, it will be seen that the two species differ in that *P. kachugae* possesses a cirrus coronet of forty equal, instead of sixteen unequal pieces, and in that it measures more than twice the length of *P. oblongum*, whereas the egg measures only half the length of that of *P. oblongum*. The number of the cotylophore hooks also is different.

Professor Wright continues—"The mouth is transversely oval, and is surrounded by a well-marked sucker. . . It leads immediately into a bowl-shaped pharynx, the walls of which possess merely weak circular fibres, and from this the simple intestinal caeca arch backwards directly."

This oral sucker appears to correspond with the first pharynx of *P. kachugae*, the weak bowl-shaped pharynx with the strong globular second pharynx of *P. kachugae*.

The testis of *P. oblongum* is a small solid sausage-shaped gland differing greatly from the flat lobulated testis of *P. kachugae*.

In *P. oblongum* two lateral cushions are present situated each in a depression, as in *P. kachugae*, which communicate with vaginae leading to the centre of the body. "A third canal originating from an oval body with brown contents (shell gland?) situated on the left side of the middle line, likewise was observed to take the same direction. The ovary is situated on the front of the testis on the right side of the body." The shell gland may correspond with the innominate gland of *P. kachugae*.

(4) **Polystomum coronatum**, Leidy, 1888. (Lit. No. 13). A parasite of *Cistudo carolina*, Gray. Three specimens were found in the throat, one in the nose. "These pertain to a different species from" *P. oblongum*, Leidy, 1888 (not the true *P. oblongum*, Wright, 1884) "and may prove to be the *P. ocellatum* found in a similar position in the European turtle, *Emys europea*."

Body when elongated lanceolate. Caudal disk wider than the body, cordiform with three pairs of bothria and with the body attached between the anterior two pairs; changeable in form to oblong, circular, or quadrate; with three pairs of minute hooks between the anterior pairs of the bothria and with a larger pair and two smaller pairs between the last pair of bothria. Genital aperture with a circular or a transverse oval coronet of thirty-two hooks of equal length. No eyes visible. Length elongated from 4.6 mm., contracting to about half the length and widening proportionately."

*Polystomum kachugae* accordingly differs from this species in the following points of anatomy,—the caudal disk is narrower, not wider than the body, does not bear hooks between the anterior pair of suckers, bears one pair of large and one of small hooks between the posterior pair of suckers. The genital aperture is furnished with forty hooks, not thirty-two.

(5) *Polystomum hassalli*, Goto 1898 (Lit. No. 10). From the urinary bladder of *Kinosternon pennsylvanicum*, in Bowie, Prince George county, Md.

"Total length of the body 1.5 mm. Body proper ovate. Adhesive disk hexagonal, the hemispherical suckers occupying the angles of the hexagon and each with a minute hook in the centre, with three pairs of hooks between the most anterior pair of suckers and two pairs between the most posterior; these hooks and those in the suckers being all of the same form and measuring 0.033 mm. in length. The larger hooks between the most posterior suckers bifurcated towards the base, without any lateral process, measuring 0.125 mm. in length."

*Polystomum hassalli* is therefore four times as long as *P. kachugae*, possesses five pairs of small cotylophore hooks in place of one, and a hooklet in each sucker which does not exist in *P. kachugae*.

Goto describes the alimentary system of his species as follows:—"Anterior sucker large, oesophagus wanting, intestine bifurcated, tubular, without lateral branches, the two legs ending independently at the front end of the adhesive disk." The mouth of *P. kachugae* is not surrounded by a sucker: it is possible that Goto refers to a structure of the same nature as the first pharynx of *P. kachugae*.

"Common genital pore" (in *P. hassalli*) "lying midway between the front end of the body and the front end of the adhesive disk. I counted fifteen penis spines which are straight and bear a wing-like process at the middle and are 0.028 mm. long, but as their number in other species is always even, I think that there are sixteen in the present species." The distance of the atrial pore from the anterior extremity of the body in *P. kachugae* is about one-fifth of the distance of the anterior end of the cotylophore from the same point.

The ovary of *P. hassalli* lies as in *P. kachugae* sometimes in the right half of the body, sometimes in the left half. The vaginal openings are lateral, without papillae, midway between the front and hind extremities of the body proper; the two vaginal canals are directed almost straight across the body and meet in the median line. In *P. kachugae* on the contrary the vaginal openings are situated at the junction of the anterior and middle thirds of the body proper. The genito-intestinal canals of *P. hassalli* lie slightly behind the vaginae, in *P. kachugae* slightly in front of them.

(6) *Polystomum* sp. (*P. oblongum*, Leidy, 1888, not the true *P. oblongum*, Wright, 1884) (Lit. Nos. 13 and 10). From the urinary bladder of *Pseudemys rugosa*.

This species is partially described from an imperfect specimen by Goto, but it is not named on account of the inadequacy of the description.

It possesses sixteen equal penis spines measuring 0.66 mm. in length (in contrast to the unequal spines in Wright's species)

and one hook in each sucker. The remaining hooks of the cotylophore had been lost.

LIST OF THE LITERATURE OF THE GENUS  
*POLYSTOMUM*, RUD.

- (1) Baer, Nov. Acta. Akad. C.C.L. tom. 13.2., pl. 32.—*P. integerrimum*.
- (2) Beneden v. und Hesse, Rech., pp. 84-87.—*P. integerrimum*.
- (3) Braun, Schrift der Berliner Ges. Naturforsch. Fr. tom. 10, p. 58, pl. 3.—*P. integerrimum*.
- (4) Bremser, Icon. Helminth., pl. 10, figs. 25 and 26.—*P. integerrimum*.
- (5) Diesing, Syst. Helminth. tom. 1, p. 413.—*P. ocellatum*.
- (6) Diesing, Syst. Helminth. tom. 1, p. 412.—*P. integerrimum*.
- (7) Dujardin, Hist. Nat. des Helminthes, p. 320.—*P. integerrimum*, p. 319.—*P. ocellatum*.
- (8) Fröhlich, Naturforsch., 25, p. 103.—*P. integerrimum*.
- (9) Gmelin, Syst. Nat., p. 3056.—*P. integerrimum*.
- (10) Goto, Journ. Col. Japan, 12, 1900, p. 276.—*P. hassalli* Goto, and *P. sp. ?*(=*P. oblongum* Leidy, 1888, not *P. oblongum* Wright, 1884.)
- (11) Ijima, Zool. Anz. hft. 7. 1884, pp. 635—639.—*P. integerrimum*.
- (12) Leuckart, Parasit. des Mensch. 2 Aufl. 1. 2, pp. 1, 9, and 70.—*P. integerrimum*.
- (13) Leidy, Proc. Acad. Nat. Sci. Philad. 1888, p. 127.—*P. coronatum* Leidy and *P. oblongum* Wright.
- (14) Linstow, v. Compend. der Helm., pp. 177 and 198, Litt.
- (15) Linstow, v. Nachtrag, pp. 61 and 69, Litt.
- (16) Lühe, Süßwasser Fauna Deutschlands, 17, p. 8.—*P. ocellatum* and *integerrimum*.
- (17) Pagenstecher, Trematoden, etc., p. 47, tab. 6.—*P. integerrimum*.
- (18) Roesel, Hist. Ranarum, p. 24.—*P. integerrimum*.
- (19) Rudolphi Entozoor. Hist. tom. 2. 1, p. 451, pl. 6.—*P. integerrimum*.
- (20) Rudolphi, Synopsis, p. 125.—*P. integerrimum*, and p. 436.—*P. ocellatum*.
- (20a) Siebold, v., Zeitschr. f. Wiss. Zool. bd. 1, p. 362.—*P. ocellatum*.
- (21) Stieda, Reichert und du Bois Reymond's Arch. f. Anat. 1870, p. 660.—*P. integerrimum*.
- (22) Willemoes Suhm, v., Arch. des Sci. Phys. et Nat. 1872, p. 99.—*P. integerrimum*, p. 106.—*P. ocellatum*.
- (23) Willemoes Suhm, v., Nach. v. d. k. Med. Ges. d. Wiss. Gottingen, 1871, No. 7.—*P. integerrimum*.
- (24) Willemoes Suhm, v., Zeitschr. f. Wiss. Zool. Bd. 22, pp. 29-39. taf. 1 and 2.—*P. integerrimum* and *P. ocellatum*.

(25) Wright, Contributions to American Helm., pp. 12-15, pl. 1. (Procs. of the Canadian Inst. Toronto, n.s., vol. 1, 1884, pp. 63-66.)—*P. oblongum*.

(26) Zeder, Nachtr, p. 203, pl. 4.—*P. integerrimum*.

(27) Zeller, Zeitschr. f. Wiss. Zool. bd. 22, pp. 1-21, pl. 1 and 2.—*P. integerrimum*.

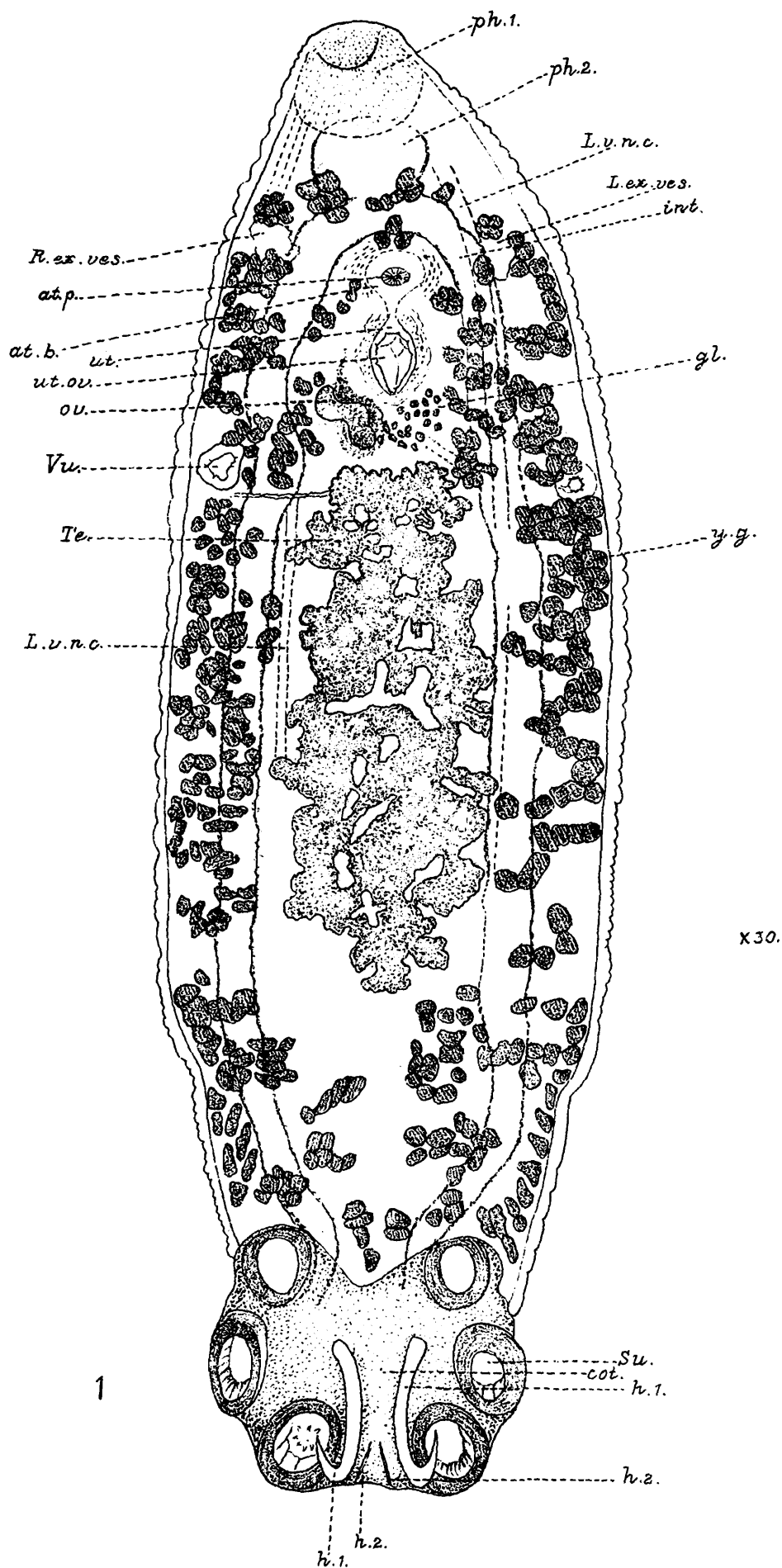
(28) Zeller, Zeitschr. f. Wiss. Zool. bd. 27, pp. 238-275, pl. 17 and 18.—*P. integerrimum*.

### List of Reference Letters in Text-Figures and Plates.

Ant.—anterior; Ant.ut.d.—anterior uterine duct; ♂ at.—male atrium; ♀ at.—female atrium; at.b.—atrial bulb; at.p.—atrial pore; b.m.—basement membrane; cav.—cavity; c.t.n.—connective tissue nucleus; cot.—cotylophore; d.—dorsal; d.g.—dorsal ganglion; dia.—diaphragm; d. lp.—dorsal lip; d.n.c.—dorsal nerve cord; ep. col.—columnar epithelium; ex. d.—excretory duct; ex. p.—excretory pore; ex. ves.—excretory vesicle; f.l.—fibrous layer; g.c.—ganglion cell; gen. em.—genital eminence; gl.—gland innominate; h.—hook; i.c.l. inner cuticular layer; i.e.—inner ectoderm of the sucker; int.—intestine; int. tr.—transverse portion of the intestine; L.—left; l.n.—lateral nerve; l.n.c.—lateral nerve cord; l.y.g.d.—longitudinal yolk gland duct; m.l.—muscular layer; mus.—muscle; o.c.—oral cavity; o.c.l.—outer cuticular layer; od.—oviduct; o.e.—outer ectoderm of the sucker; ov.—ovary; ov. fund.—ovarian fundus; par. n.—parenchyme nucleus; pe.—penis; ph.—pharynx; R.—right; sp.—spicule; su.—sucker; s.v.—seminal vesicle; te.—testis; ut.—uterus; ut. ov.—uterine ovum; v.—ventral; vac.—vacuole; vag.—vagina; v.d.—vas deferens; v.i.c.—vitello-intestinal canal; v.n.c.—ventral nerve cord; v.n. co.—ventral nerve commissure; vu.—vulva; vu. c.—vulvar cells; y. d.—yolk duct; y.g.—yolk gland.

EXPLANATION OF PLATE XXVI.

FIG 1.—*Polystomum kachugae* sp. n. Specimen No. 1 from the ventral surface. × 30.



#### EXPLANATION OF PLATE XXVII.

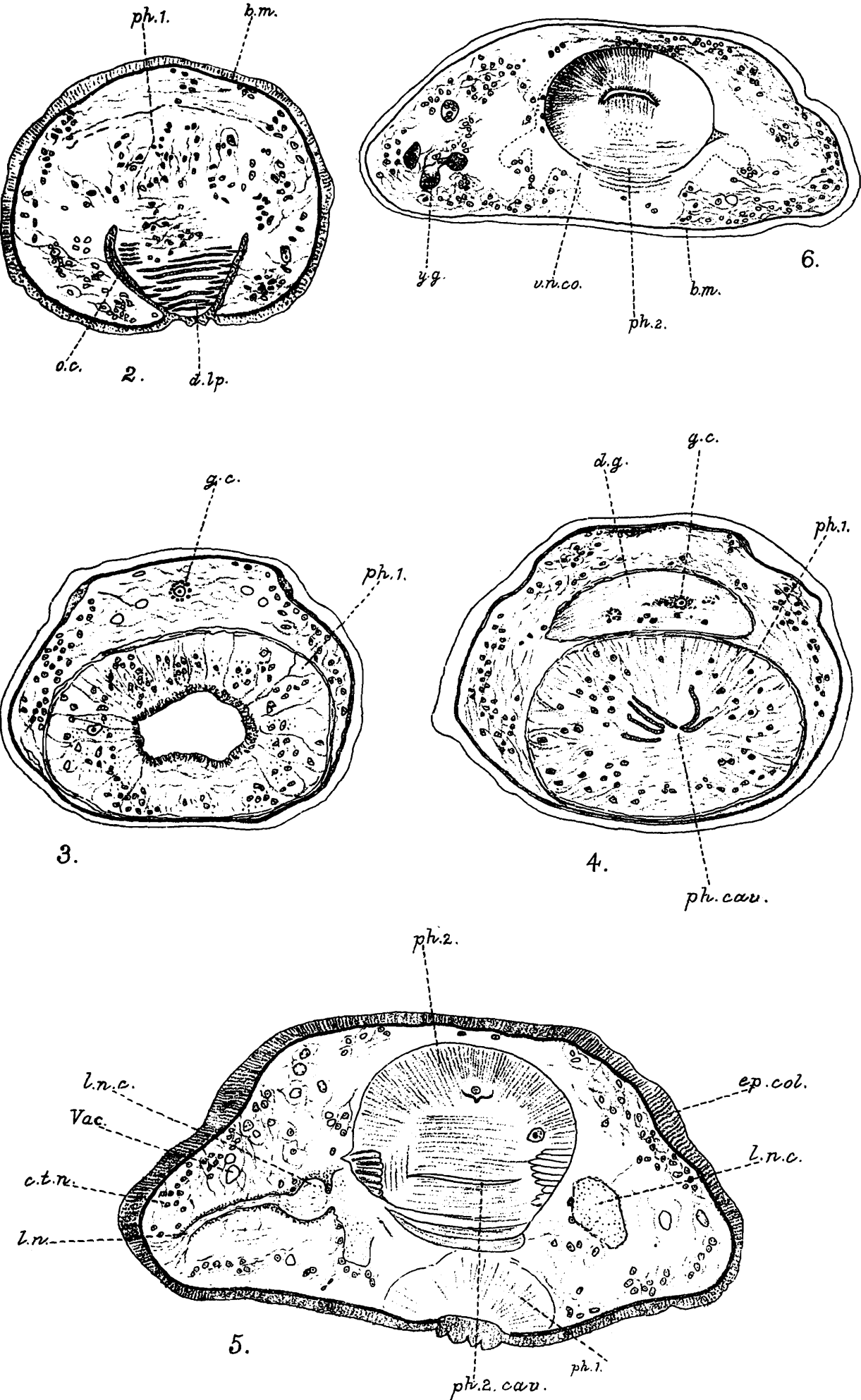
FIG. 2.—Specimen No. 2. Transverse section through the mouth.  $\times 100$ .

FIG. 3.—Transverse section through the first pharynx  $\times 100$ . ( $1/2/1/3$ .)

FIG. 4.—Transverse section through the first pharynx and dorsal ganglion.  $\times 100$ . ( $1/2/2/3$ .)

FIG. 5.—Transverse section through the second pharynx and lateral nerve commissure.  $\times 100$ . ( $1/3/1/2$  )

FIG. 6.—Transverse section through the posterior portion of the second pharynx and ventral nerve commissure.  $\times 68\frac{2}{3}$ . ( $1/3/3/4$  )



F.H. Stewart, del.

A.C. Chowdhary, lith.

POLYSTOMUM KACHUGAE sp nov.

### EXPLANATION OF PLATE XXVIII.

FIG. 7.—Transverse section through the transverse intestine and excretory vesicles.  $\times 68\frac{2}{3}$ . (1/5/8.)

FIG. 8.—Left half of a transverse section in front of the atrium showing the excretory duct and left branch of the intestine.  $\times 100$ . (1/5/ end.)

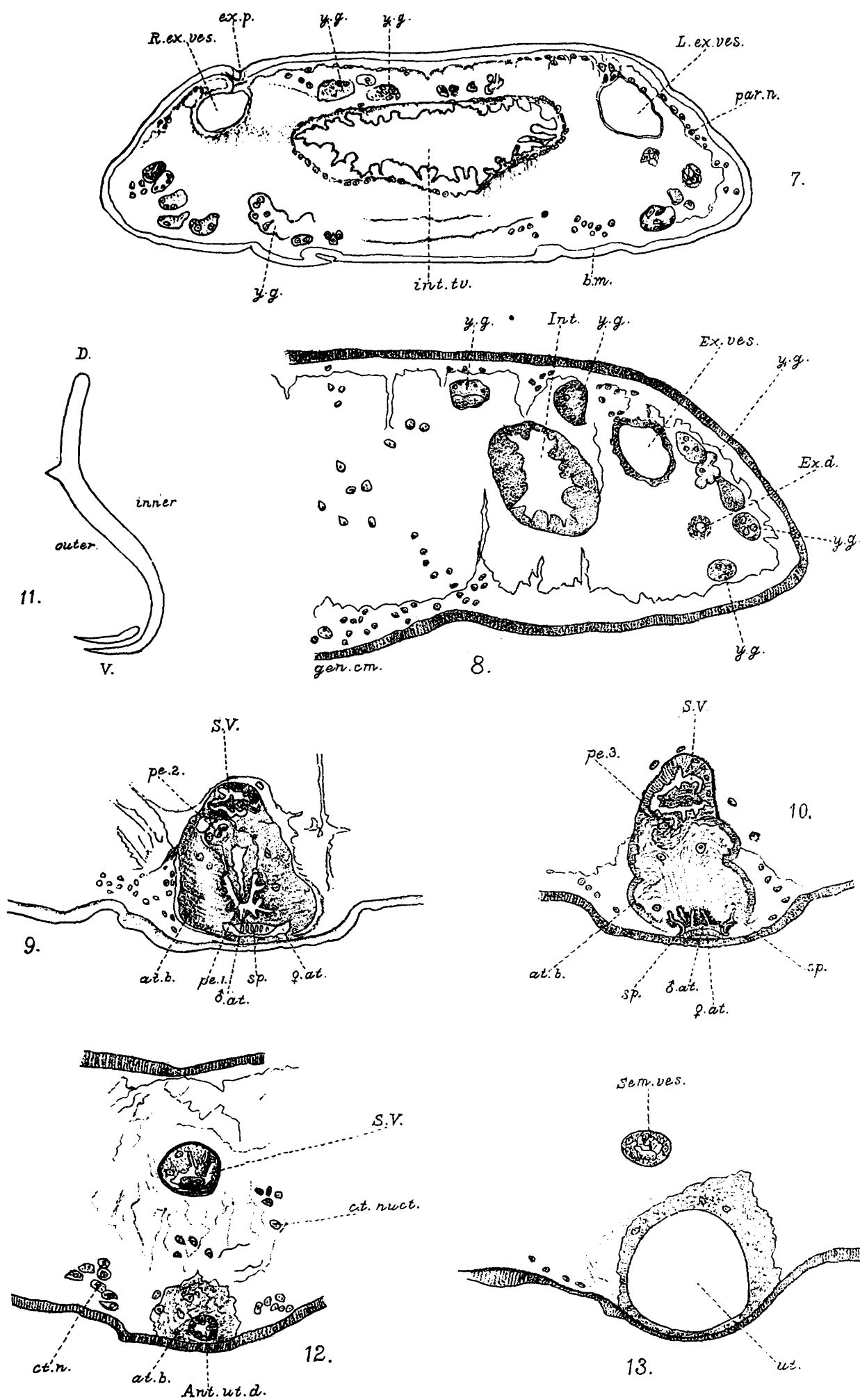
FIG. 9.—Portion of a transverse section through the atrial bulb in front of the atrial pore, showing the terminal portion of the penis in longitudinal section, and the male and female atria.

FIG. 10.—Portion of a transverse section at the level of the centre of the circlet of atrial spines. Shows the atrial bulb with the male and female atria, and the opening of the seminal vesicle into the canal of the penis.  $\times 100$ . (2/1/ end.)

FIG. 11.—A spine of the atrial circlet, with the point of a second spine, from the same section as fig. 10.  $\times 1000$ .

FIG. 12.—Portion of a transverse section immediately in front of the uterus, showing the seminal vesicle and anterior uterine duct.  $\times 100$ .

FIG. 13.—Portion of a transverse section at the level of the uterus showing uterus and the seminal vesicle.  $\times 100$ . (2/3/1/2.)



F. H. Stewart, del.

A.C.Chowdhary,lith.

POLYSTOMUM KACHUGAE sp. nov.

### EXPLANATION OF PLATE XXIX.

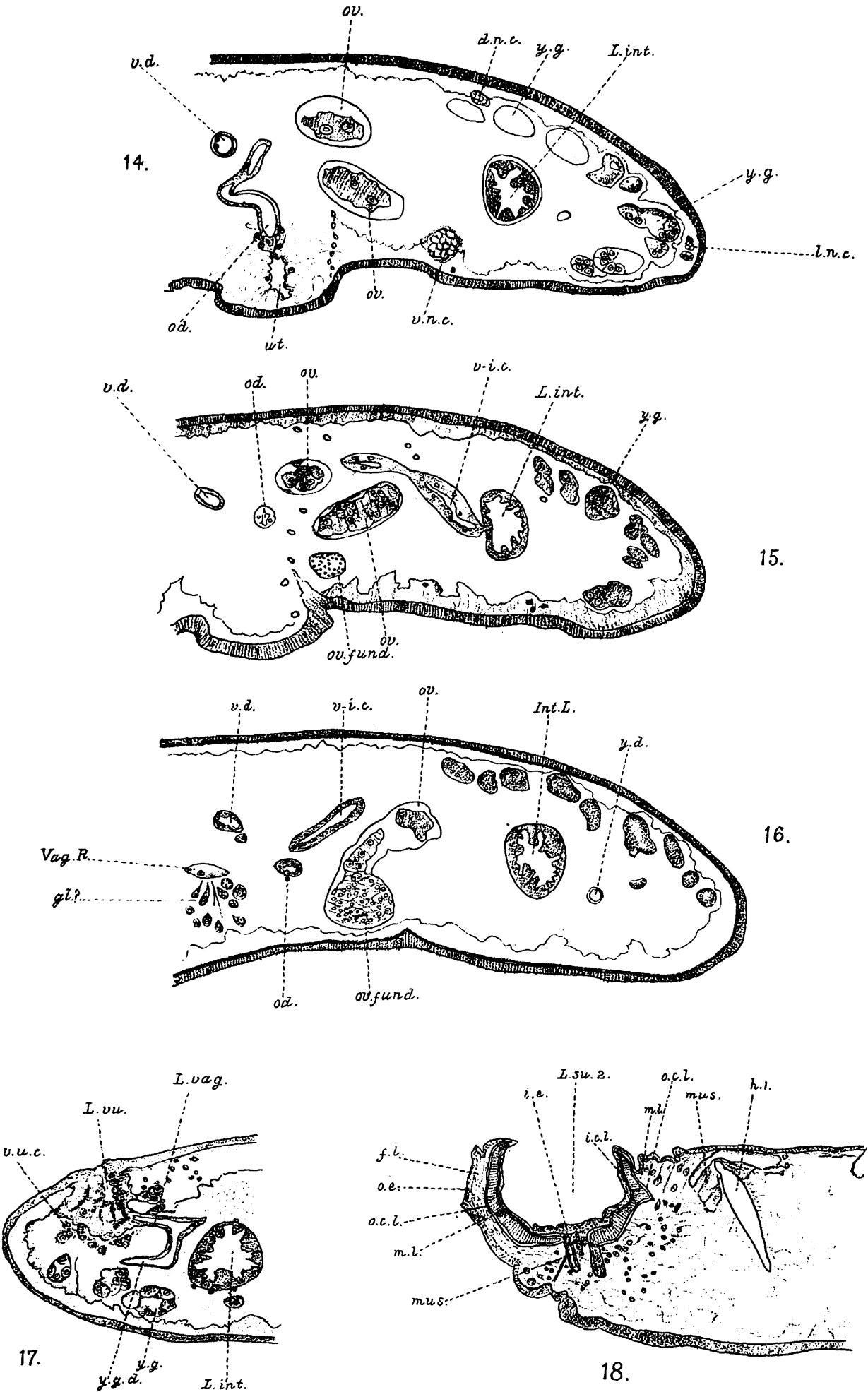
FIG. 14.—Left half of a transverse section at the posterior end of the uterus, showing oviduct, ovary, vas deferens, and three nerve cords.  $\times 68\frac{2}{3}$ . (2/4/1/2.)

FIG. 15.—Left half of a transverse section showing the junction of the vitello-intestinal canal with the left branch of the intestine.  $\times 68\frac{2}{3}$ . (2/5/2.)

FIG. 16.—Left half of a transverse section showing the junction of the vitello-intestinal canal with the oviduct. Also shows the innominate gland lying opposite to the ovary.  $\times 68\frac{2}{3}$ . (2/5/1/2.)

FIG. 17.—Left third of a transverse section at the level of the vulva, showing the junction of the vagina with the vulva and with the lateral yolk duct.  $\times 68\frac{2}{3}$ . (3/1/1/3.)

FIG. 18. Left half of a transverse section through the cotylophore at the level of the second sucker.  $\times 68\frac{2}{3}$ .



F.H.Stewart, del.

A.C.Chowdhary, lith.

POLYSTOMUM KACHUGAE sp nov.

XI    ON SOME NEW TERRESTRIAL  
     ISOPODS FROM THE ANDAMAN  
     ISLANDS AND SOUTHERN  
     INDIA

By WALTER E. COLLINGE, *M.Sc.*, *F.L.S.*, *F.E.S.*

(Plates xxiv and xxv.)

Amongst a collection of Asiatic Terrestrial Isopoda placed in my hands by Dr. Annandale for identification, there are two tubes, containing twenty-one specimens, collected in the Andaman Islands and S. India. They include three species, *viz.*, a new species of *Philoscia*, Latr., of which there are only two imperfect examples, a new species of *Paraperiscyphis*, Stebbing, and a new species of *Cubaris*, Brandt.

Gen. *Philoscia*, Latr.

*Philoscia*, sp.

The two examples from roots of ferns from Port Blair, 28-viii-08, No. 8571/10 (*H. Weskin*) are too imperfect to describe. I have received the same species from various parts of India and Burma.

Gen. *Paraperiscyphis*, Stebbing.

1911. *Paraperiscyphis*, Stebbing, Rec. Ind. Mus., vol. vi, p. 184.

*Paraperiscyphis stebbingi*, n. sp.

(Pl. xxiv, figs. 1-10.)

Body (fig. 1) oblong oval, dorsal face strongly convex, with numerous rounded tubercles. Cephalon small, flanked laterally by the lateral plates of the 1st segment of the mesosome. Ventrally carinate. Eyes sub-dorsal and well-developed. Antennulae small, 3-jointed, situated between the ventral carination of the cephalon and the base of antennae. Antennae (figs. 1, 2) moderately stout with 2-jointed flagellum, the first joint longer than the second. Mandibles (fig. 3), the outer cutting edge has three stout teeth and a blunt process on the inner side. 1st maxillae (figs. 4 and 5) have the outer lobe oblong and somewhat triangular in shape, distally terminating in seven incurved spines, on the outer margin there are a number of long, simple, hair-like setae. Inner

lobe small and narrow, situated basally. 2nd maxillae (fig. 6) slender, terminating distally in two setose plumes. The segments of the mesosome are strongly convex, lateral plates of 1st segment angularly produced backward, those of the 2nd, 3rd, and 4th less so, all tuberculated. Pronotum of 1st, 2nd and 3rd segments strongly pronounced. Maxillipedes (fig. 7) broad, the inner plate with numerous short simple setae, the outer palp terminates in three teeth consisting of a series of minute spinous processes (fig. 8); basally there is a raised portion minutely studded with small setae. Thoracic appendages fringed with numerous spines, 2nd appendages having on the apical border of the fifth joint two with obtuse plumose apices (fig. 9). Uropods (fig. 10), basal plate large, extending beyond telson, expanded and plate-like laterally; outer margin subcrenate, fringed with hair-like setae and tuberculated; exopodite on the inner margin, endopodite longer than exopodite and situated at the top of the inner margin of the basal plate, both covered with fine setae and extending slightly beyond the basal plate. Telson obtusely triangular, tuberculated.

Colour (in alcohol) a uniform dark brown. Length 17.5 mm.

*Habitat*.—Anamalai hills, Madras Pres., S. India, 4,000 feet, 22-1-1912, No. 8612/10 (*T. B. Fletcher*).

I have pleasure in associating the name of the Rev. T. R. R. Stebbing, F.R.S., with this interesting species.

The genus *Paraperiscyphis* was founded by Stebbing (6) for another S. Indian species *P. travancorensis*, Stebbing, which is separated from *Periscyphis*, Gerstaecker, by the following characters: "In the second antennae the first joint of the flagellum is not longer than the second; the telsonic segment is very obtusely triangular, not narrowly produced at the apex; the inner branch of the uropods is attached not to a projection of the peduncle's base, but to a notch far down the inner margin, while still further down is attached the outer branch, not especially small, both branches extending beyond the peduncle, and the peduncle itself extending beyond the telsonic segment."

All the above characters hold good in the species I am here about to describe, excepting the first, viz., the first joint of the flagellum in the antennae is longer than the second, otherwise there can be no question but that the present species finds its proper place in this genus.

The foundation of the genus *Paraperiscyphis* makes it necessary to re-consider the diagnostic characters of the genus *Periscyphis*, Gerstaecker, who described it in 1873 (5). The diagnosis is as follows:—

"*Periscyphis*, nov. gen."

(Trib. Armadillini.)

"Antennae 7 articulatae, articulis duobus apicalibus elongatis, gracilibus, ultimo setifero. Caput margine frontali nullo, supra oculos utrinque leviter carinatum. Annulus corporis primus mar-

gine laterali antice tantum reflexo. Annulus postabdominalis sextus subito angustatus et triquetro acuminatus. Pedes spurii ultimi paris articulo terminali parvo styliformi in apice articuli basalis lati, extus rotundati inserto."

In 1901 (4) Budde-Lund gave a further description as he restricted it, but in my opinion, he had not true species of *Periscyphis* before him, but those of an allied though totally different genus. Unfortunately this author does not seem at all clear regarding the limits of the genus, for although it was known to him in 1885, in his *Crustacea Isopoda Terrestria* (1, p. 293) he describes two Isopods from Egypt, which he placed in a new genus *Cercocytonus* (*convexus* and *albescens*), but later he referred these to *Periscyphis*, *em.* Budde-Lund (4). In the same paper he expresses the opinion that the species he had previously brought into the genus *Periscyphis*, Gerst. (4, p. 10) are not all rightly placed, some seeming to be more akin to the genus *Synarmadillo*, Dollfus. It is quite certain that many of the species described by Budde-Lund cannot remain in the genus *Periscyphis* as defined by Gerstaecker. The two *P. convexus* and *P. albescens* are probably not true *Periscyphis*, Gerst. s. str., and as the genus *Periscyphis*, Budde-Lund, is simply an emended description of *Cercocytonus*, Budde-Lund, they must be referred to that genus. The mouth-parts, on which this author placed such great reliance, are so totally different from those in *Periscyphis*, that they almost alone would be sufficient to separate them.

There are numerous other species which have been referred by Budde-Lund (3) and other authors to this genus which seem to me wrongly placed.

Gen. *Cubaris*, Brandt.

*Cubaris fragilis*, n. sp.

(Pl. xxv, figs. 1-10.)

Body oblong oval with the lateral margins of all the segments angulate and overlapping one another; finely punctated and with rows of longitudinal tubercles at each side of mid-dorsal line. Cephalon (fig. 2) narrow, almost straight in front with small triangular lateral lobes; median lobe absent. Eyes subdorsal, fairly large. Antennae (fig. 3) short, first four joints tuberculated, flagellum two-jointed, distal joint two and a half times longer than proximal joint. Mandibles (fig. 4), outer cutting edge with trifold blunt tooth, with flattened one on the inner side. 1st maxillae (figs. 5, 6). Outer lobe oblong, pointed proximally, terminating distally in nine incurved spines; short, simple, hair-like setae on the outer margin; inner lobe distally terminating in a rounded lobe with two setaceous tufts on the inner side. 2nd maxillae small and plate-like. The segments of the mesosome strongly convex, with three to seven raised longitudinal tubercles on each side of the mid-dorsal line, finely punctated, the lateral plates of 1-5 well separated and slightly revolute. Maxillipeds

(fig. 7), outer palp with two teeth, inner plate with single spine. Thoracic appendages (fig. 8) robust and provided with short blunt spines on the inner border. Uropods (fig. 9), basal plate somewhat triangular in shape, not extending beyond the telson; exopodite small and on the inner margin, endopodite large and situated at the top of the inner margin of the basal plate and not extending beyond the basal plate. Telson (fig. 10) contracted laterally, posterior margin almost straight.

*Habitat*.—From roots of ferns from Port Blair, Andamans, 28-viii-08, No. 8571/10 (*H. Weskin*).

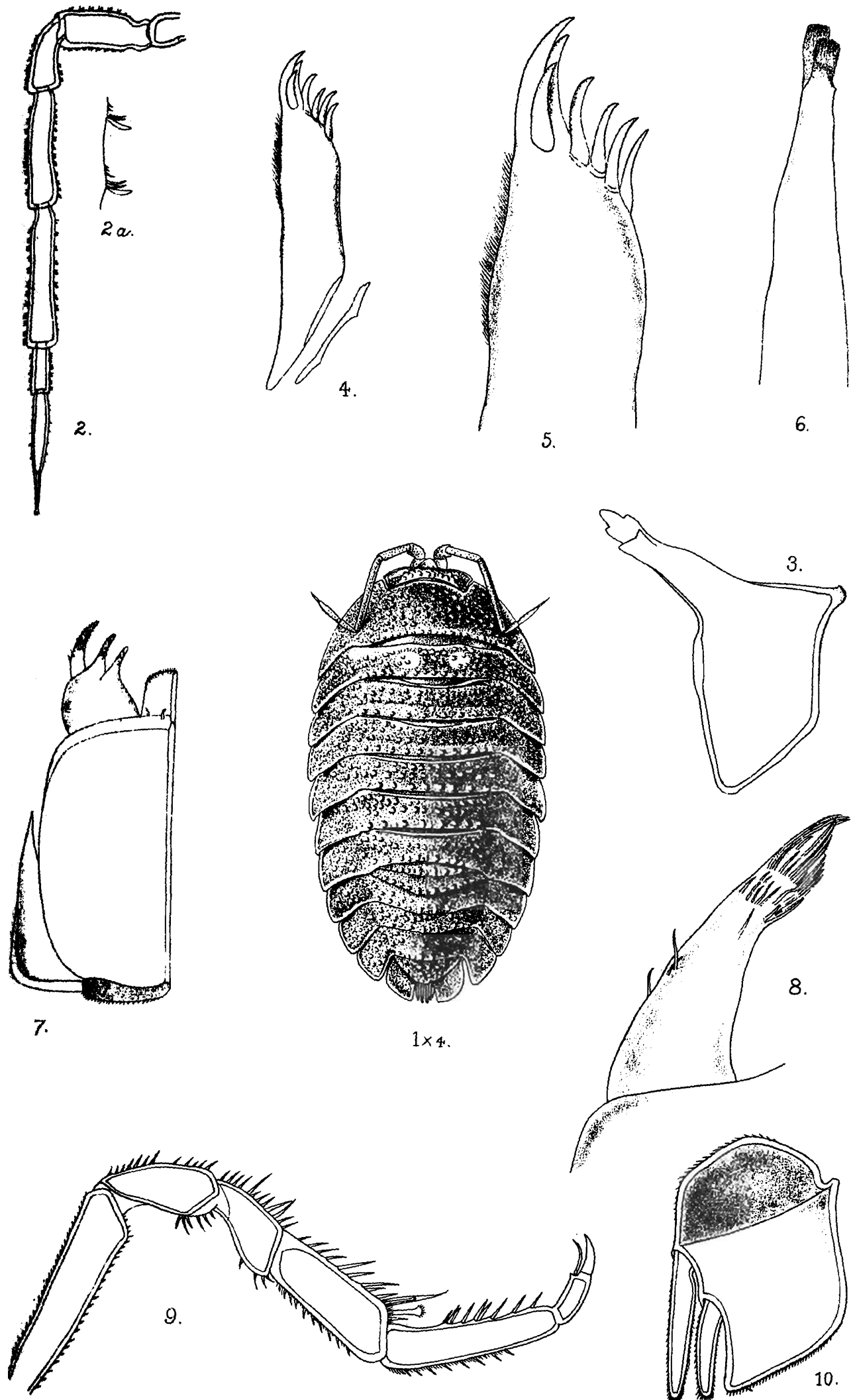
#### REFERENCES.

1. Budde-Lund, G.—Crustacea Isopoda Terrestria. Hauniae, 1885, pp. 1-320.
2. „ A Revision of Crustacea Isopoda Terrestria. Pts. i-iii, 1899-1904, pp. 1-144, T. i-x.
3. „ Die Land-Isopoden Ost-Afrikas. Deutsch Ost-Afrika, 1898, Bd. iv, pp. 3-10, T. i.
4. „ Terrestrial Isopoda from Egypt. Results of the Swedish Zoology Exped. to Egypt and the White Nile, 1901, pp. 1-12, T. i.
5. Gerstaecker, A.—Gliederthieri in Baron Carl Claus von der Decken's Reisen in Ost-Afrika. Leipzig, 1873, Bd. iii, Ab. ii, pp. 525-528.
6. Stebbing, T.R.R.—Indian Isopods. Rec. Ind. Mus., 1911, vol. vi, pp. 179-191, pls. x-xii.

EXPLANATION OF PLATE XXIV.

*Paraperiscyphis stebbingi*, n. sp.

- FIG. 1. Dorsal view,  $\times 4$ .  
,, 2. Antenna. 2a Hair-like setae enlarged.  
,, 3. Mandibles.  
,, 4. First maxilla.  
,, 5. Distal portion of same enlarged.  
,, 6. Second maxilla.  
,, 7. Maxillipede from right side.  
,, 8. Enlargement of distal spine.  
,, 9. Second thoracic appendage.  
,, 10. Uropod.



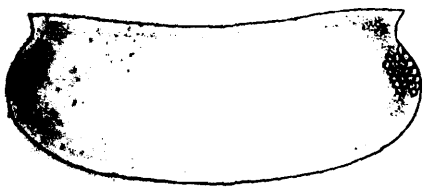
PARAPERISCYPHIS STEBBINGI, n. sp.

A.C.Chowdhary, lith.

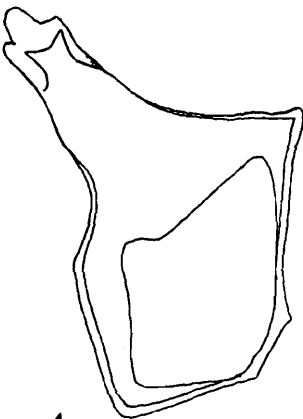
## EXPLANATION OF PLATE XXV

*Cubaris fragilis*, n. sp.

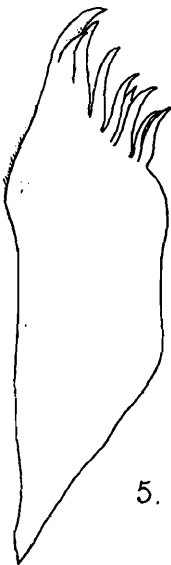
- FIG. 1. Dorsal view,  $\times 8$ .  
,, 2. Cephalon seen from above.  
,, 3. Antenna.  
,, 3a. Portion of meropodite enlarged.  
,, 4. Mandibles.  
,, 5. First maxilla, outer lobe.  
,, 6. First maxilla, inner lobe.  
,, 7. Maxillipede.  
,, 8. Second thoracic appendage.  
,, 9. Uropod.  
,, 10. Telson.



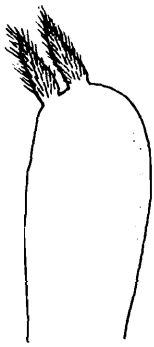
2.



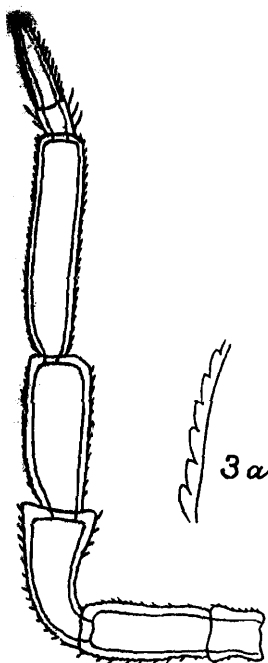
4.



5.



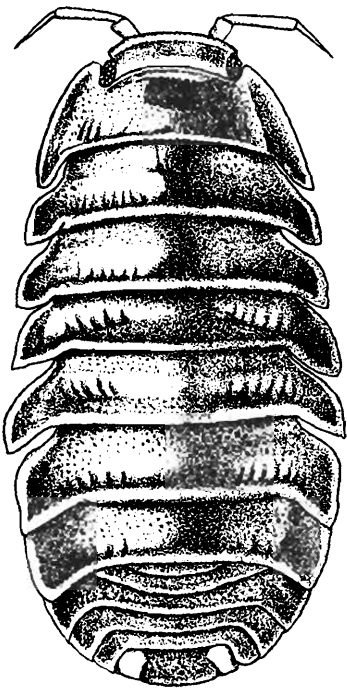
6.



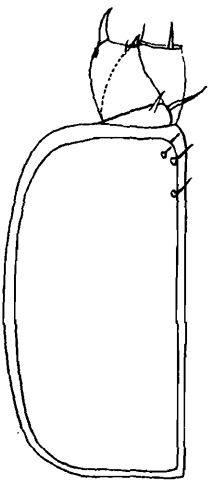
3.



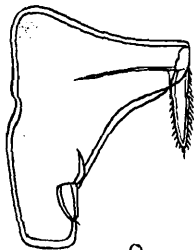
3a.



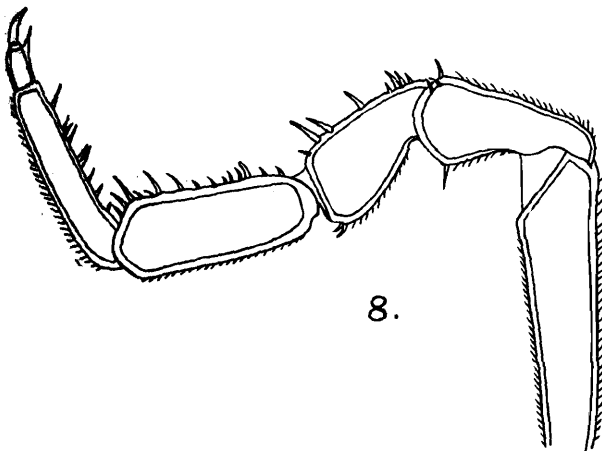
1x8.



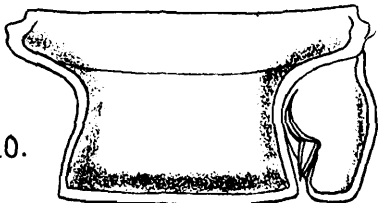
7.



9.



8.



10.

CUBARIS FRAGILIS , n. sp.

A.C.Chowdhary, lith.

## M I S C E L L A N E A

### COELENTERATES.

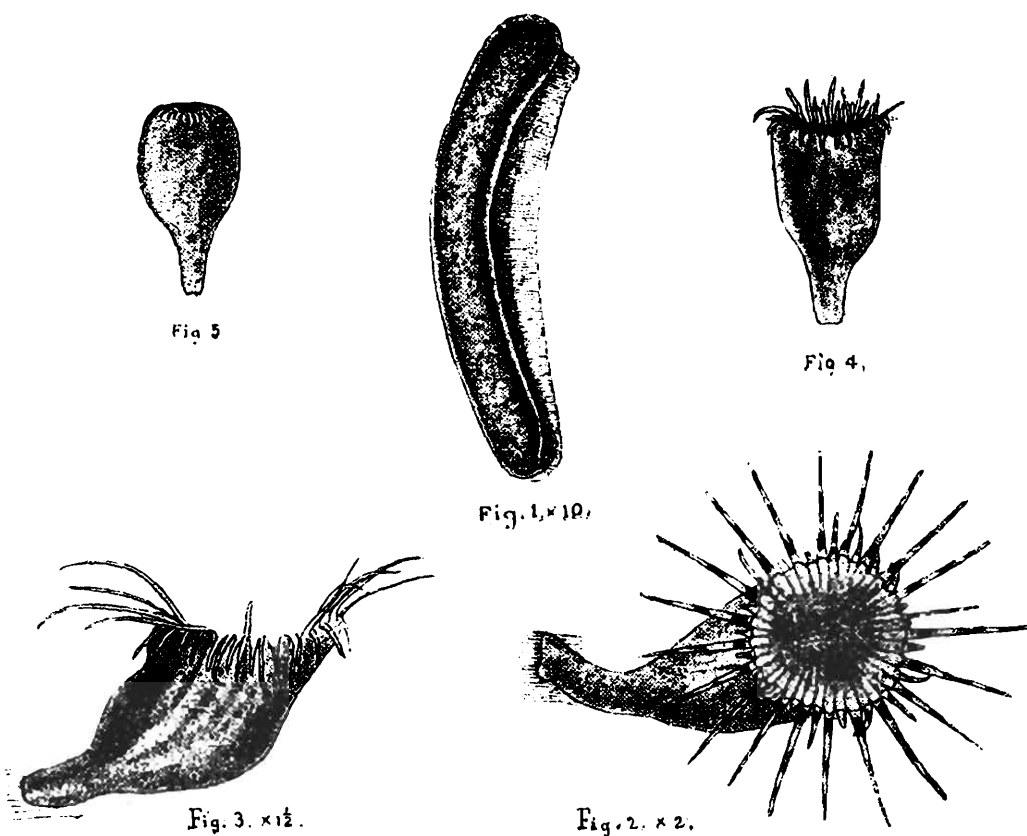
NOTE ON THE GENUS *Anactinia*.—In 1909, there appeared in this Journal, Vol. III, pages 157-162, a paper by Dr. Annandale, under the heading "A pelagic sea-anemone without tentacles." The paper concluded by establishing a new genus and new species *Anactinia pelagica*, for the reception of the animal described therein. Dr. Pax in his reference to the paper in the *Zoologisches Zentralblatt*, Vol. XVII, 1910, pp. 299-300, regarded the animal as identical with a pelagic larva which he had previously described in 1908, and had no doubt as to the larval nature of *Anactinia*. The specimens described by Dr. Annandale were obtained by him at Puri on the Orissa coast of the Bay of Bengal in February 1909. Similar specimens had been obtained by me in previous years at Madras, in February and March in the tow-net and had attracted my attention, among other features, by their large size; but I took them to be pelagic Cerianthid larvae and did not subject them to any special examination. Since reading Dr. Annandale's paper, however, I began to attach some importance and fresh interest to them; and I have been hoping to subject them to observation especially with the view to determine whether they are really larvae or adults. A couple of specimens obtained last year were kept in sea-water; while one of them gradually dwindled and died, the other after some days metamorphosed into a form with tentacles. This lived for about a month or so and then was unfortunately lost sight of. This year I have obtained several specimens, and am keeping them alive. Already five of them have gone through their metamorphosis and the tentacled forms now rest, on the bottom of the glass. I have also got living a specimen which I got in the tow-net some time in September of last year. This specimen has now got thirty-nine marginal tentacles and is a *Cerianthus* (*sensu lato*). When fully stretched at feeding time, it measures five inches in length without the tentacles, and has a cross-diameter of half an inch; ordinarily when it is not so extended, it measures about three and a half inches in length. A comparison of the external features of this and the other specimens recently obtained from the larvae points to their identity. There can in any case be no doubt that the specimens obtained by Dr. Annandale and myself are larvae, and that the most important character on which the genus is based, *viz.* the absence of tentacles, is a purely larval feature.

I have not yet dissected any of the specimens; but when the necessary literature is received I hope to determine the

identity of the animal and to publish a further note along with figures.

K. RAMUNNI MENON.

PRELIMINARY NOTE ON THE METAMORPHOSIS OF *Zoanthella*.—Two species of larvae of *Zoanthella* and one of *Zoanthina* occur at Madras. During February-April of last year, I obtained several specimens of one of the *Zoanthellas* and kept them in sea-water. They fixed themselves to the bottoms of glass vessels and sprouted tentacles and it has been possible to rear them successfully. I have nine of last year's lot living at present, and some of them at the time of writing are more than thirteen months old. The largest specimen measures, when moderately extended, one inch



in length and about half an inch across the peristome from edge to edge. It has now fifty tentacles. The same specimen had thirty tentacles at the end of July, 1913. The tentacles are in two cycles of alternately long and short and in the extended condition are held alternately raised and depressed. In the larger of the remaining specimens, the numbers of tentacles are 42, 44, 46, and 48. The accompanying figures show the animal in various changes of form. The animal is attached by a short peduncle the area of attachment at the end of which is very small; some of the specimens which have accidentally become detached do not fix themselves again. The column is opaque white with a tinge of yellowish brown, the peristome is clearer and translucent with light brown radiating lines and the tentacles are grey to light

brown with white tips and have distinct transverse zones of dark brown near the base and a little below the tip and sometimes a similar but fainter and less defined zone in the middle.

The specimens of the other species of *Zoanthella* and of the species of *Zoanthina*, of which I obtained a fair number last February, have also gone through their metamorphosis and have become fixed and sprouted tentacles.

As the preparation of my paper on these larvae and their adults will, I fear, take some time, it was thought desirable to publish this very brief preliminary note at once. Quite recently, I came across a reference to the rearing of *Zoanthella* by Cary in 1911. Till then I was not aware that anybody else had attempted the rearing of these larvae. As far as I am able to gather from Cary's Report, however, (vide *Carnegie Institution of Washington Year Book*, No. 10) no stage with tentacles was obtained by him.

Fig. 1 represents the *Zoanthella* larva which metamorphosed last year. Fig. 2 shows a tentacled stage with 42 tentacles as seen from the oral side, fully expanded. Fig. 3 represents another specimen fairly expanded, seen from the side. Fig. 4 shows another specimen just opening out. Fig. 5 shows the same specimen with the tentacles retracted and the peristome closed.

PRESIDENCY COLLEGE, MADRAS,      K. RAMUNNI MENON.  
April, 1914.

## ECHINODERMA.

CHANGE OF NAME IN AN INDIAN GENUS OF ECHINOIDEA.—[The following is a translation of a note that appeared in the *Zoologischer Anzeiger* XLIV, No. 4, p. 191 (April, 1914)].

In a memoir which has just appeared (*Echinoderma* of the Indian Museum, part viii, *Echinoidea* [I], Calcutta, March, 1914) I have given the name *Eurypneustes* to a new genus of Spatangidae. This name, having already been applied to a fossil form, cannot be maintained: I propose to give the name *Elipneustes* to the new genus.

D. R. KOEHLER,  
Professor in the University of Lyons.

## CRUSTACEA.

NOTES ON SOME AMPHIPODS COLLECTED ON THE PAMIRS AT AN ALTITUDE OF 15,600 FEET.—In February of the present year, I received from the Indian Museum a tube of Amphipoda for identification, bearing the following label:—

“Reg. No.  $\frac{8693}{103}$ . From stagnant pool on summit of Killik Pass between Northern Hunza Range and the Tagh-

dumkash Pamir. Altitude, 15,600 feet. Collected by Captain R. W. G. Hingston, I.M.S., 27th July, 1913. These Crustacea were numerous in pools near banks of Killik River.'

On examination, the specimens proved to belong to the variable and widely distributed species, *Gammarus pulex*, Linn. The record is interesting, however, in that it marks the highest altitude from which this species has ever been collected, and 5000 feet higher than the previous highest record of 3200 mètres (10,500 feet), from which altitude Chevreux ("Études sur la faune du Turkestan. II. Crustacés Amphipodes." *Travaux de la Soc. Imp. d. Nat. St. Pétersbourg*, t. XXXVII, 2, pp. 91-100, 1908) has recorded this species from Lake Tchatyr-Koule in Turkestan.

In the paper quoted, Chevreux records *G. pulex* from the following localities:—

Lake Issyk-Koule (1615 mét. altitude), Gorge de Karakol (2000 mét. altitude), and Lake Tchatyr-Koule (3200 mét. altitude), all in Turkestan; so that its occurrence on the banks of the Killik River, only some 130 miles south of the Gorge de Karakol is not surprising. Chevreux points out that this species is variable in certain of its characters, so that it might be useful to indicate the nature of this variation in the present specimens.

The posterior angle of the epimeral plate of the third segment of the metasome is considerably more produced and pointed than figured in Sars', Crustacea of Norway, Vol. I. Amphipoda. The number of spines on the segments of the urosome shows considerable individual variation. The maximum number observed is two median dorsal and a pair of lateral spines on each side on each of the three segments, but the dorsal pair are absent from the last segment in some of the specimens, and the lateral spines sometimes only number one on one or other of the segments.

The accessory flagellum of the first antennae is only as long as the first two joints of the main flagellum and is composed of two well-developed joints of equal size followed by a third rudimentary joint. In this particular, the present specimens agree with those from Lake Tchatyr-Koule mentioned by Chevreux.

The telson has two or three spines and, in most cases, a single seta at the apex of each lobe. The lateral spine of the telson is placed much more distally and at the same time further in from the margin than shown in Sars' figure of the type form.

In all other characters, the present specimens agree very completely with the descriptions and figures given by Sars for the typical form and there is no reason to create a new species for the trivial differences noted above. It seems, however, worth while to place on record the capture of this species at the unusual altitude of 15,600 feet.

W. M. TATTERSALL.

[In addition to the examples mentioned above, there are in the Indian Museum collection specimens of *Gammarus pulex*, kindly

determined for us by the Rev. T. R. R. Stebbing, which were obtained by Mr. Coggin Brown at the northern end of Lake Tali Fu (Erh Hai, Shan-kuan) Yunnan, China, at an altitude of about 7000 ft.

We also have the specimens from the Pamirs mentioned by Alcock in his *Report on the Natural History of the Pamir Boundary Commission*, p. 17, 1898].

### INSECTS.

“*Xenopsylla nesiotes*”. A CORRECTION.—In a previous number of this Journal (*Rec. Ind. Mus.*, Vol. VI, p. 43, 1911) I published a small paper on fleas sent to me for identification by the Indian Museum, and among them I mentioned *Xenopsylla nesiotes*. I regret to mention that this identification was incorrect; the specimens I called *Xenopsylla nesiotes* are really *Xenopsylla astia* (see *Novitates Zoologicae*, Vol. XVIII, p. 117, 1911).

N. CHARLES ROTHSCHILD.



