AUSTRALASIAN ANTARCTIC EXPEDITION

1911-14.

UNDER THE LEADERSHIP OF SIR DOUGLAS MAWSON, O.B.E., B.E., D.Sc., F.R.S.

SCIENTIFIC REPORTS.

SERIES C.—ZOOLOGY AND BOTANY.

Edited by Professor T. Harvey Johnston,
University of Adelaide.

VOL. X PART 2.

ACANTHOCEPHALA

BY

PROFESSOR T. HARVEY JOHNSTON

AND

EFFIE W. BEST, M.Sc.,
UNIVERSITY OF ADELAIDE.

WITH THIRTY-NINE FIGURES.

PRICE: TWO SHILLINGS AND SIXPENCE.

Wholly set up and printed in Australia by
DAVID HAROLD PAISLEY, GOVERNMENT PRINTER, SYDNEY, NEW SOUTH WALES.

1937.

ISSUED 16th NOVEMBER, 1937.
*2804

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REPORT ON THE ACANTHOCEPHALA

COLLECTED BY THE

AUSTRALASIAN ANTARCTIC EXPEDITION.

By Professor T. HARVEY JOHNSTON and EFFIE W. BEST, M.Sc., University of Adelaide.

(With thirty-nine figures.)

The collection entrusted to us consisted of material from comparatively few host species, though numerous individuals were present in most cases. It comprised specimens from several Weddell seals, the remainder being from fish, chiefly the Nototheniids, *Notothenia coriiceps* Richardson and *Trematomus bernacchii* Boulenger. The whole of it, with the exception of the specimen of *Echinorhynchus zanclorhynchi* n. sp., was obtained by the late Dr. A. L. McLean, the medical officer of the party which wintered at Commonwealth Bay, King George V Land.

The material has been deposited in the collection of the Australian Museum, Sydney.*

LIST OF HOSTS AND THEIR ACANTHOCEPHALAN PARASITES.

(1) LEPTONYCHOTES WEDDELLI Lesson, Weddell seal.
Corynosoma antarcticum (Rennie).

(2) TREMATOMUS BERNACCHII Boulenger.
Leptorhynchoides campbelli (Leiper and Atkinson).

(3) NOTOTHENIA CORIICEPS Richardson.
Leptorhynchoides campbelli (Leiper and Atkinson).
? *Leptorhynchoides debenhami* (Leiper and Atkinson).

(4) ZANCLORHYNCHUS SPINIFER Günther.
Echinorhynchus zanclorhynchi Johnston and Best, n. sp.

* Since this report was accepted for publication in May, 1929, the following papers relating to subantarctic Acanthocephala have appeared:—Van Cleave, A.M.N.H. (10), 4, 1929, 229–231 describing *Aspersentis austrinus* from fish, South Shetlands; Baylis, Discovery Reports, 1, 1929, 541–560, describing some new and known species from cetaceans and fish (pp. 555–59); Chandler (Parasitology 26, 1934, 352) has assigned *Rhadinorhynchus johni* and *R. wheeleri*, two of Baylis' species (1929), to *Aspersentis*.

RHADINORHYNCHIDAE.

LEPTORHYNCHOIDES CAMPBELLI (*Leiper and Atkinson*).

(Figs. 1–18.)

Syn. *Echinorhynchus campbelli* Leiper and Atkinson, 1914, 223; 1915, 31–32, pl. 2, fig. 13.

Echinorhynchus rennicki Leiper and Atkinson, 1914, 223; 1915, 32–33, text fig. 3, pl. 2, fig. 15.

A number of echinorhynchs were collected on five different occasions during 1912 and 1913 from species of Nototheniid fish at Commonwealth Bay, Adelie Land, by Dr. A. L. McLean. The only two species recorded by Waite (1916) as having been obtained in shallow water at that locality were *Notothenia coriiceps* Richardson and *Trematomus bernacchii* Boulenger, so that these two fish may be considered as the hosts of the parasite. The specimens examined—chiefly immature females—varied greatly in size, but were all approximately cylindrical, tapering a little posteriorly. They were thin-walled so that part of their internal organisation was recognisable without clearing. The females ranged from 4·6 to 10·5 mm. in length and 0·75 to 1·8 mm. in width, the ratio between these two measurements being on an average 5·8 : 1. The range in the case of the males was 3·75 to 7·5 mm. in length and 0·6 to 0·9 mm. in width, and the ratio 6·2 : 1. A large number of individuals were measured in order to determine whether there was a continuous gradation in size, or whether more than one species, a large and a small, might be present. It was found that no female less than 6·5 mm. in length contained eggs possessing the three shell layers, while those about 5 mm long contained only egg balls, and the largest specimens were filled with completely formed eggs. It was, therefore, concluded that only one species was present and that the majority were young individuals.

The proboscis is about 0·55 mm. long and 0·1 mm. wide, and is almost cylindrical, bearing fourteen longitudinal rows of hooks, seven or, in the largest specimens, eight, in each row. Their arrangement is radially symmetrical and they are rather deeply embedded in the transparent cuticle of the proboscis. The protruding portion is long, sharp and strongly recurved. The form of the proboscis is shown in fig. 4 and of the hooks in fig. 8. At the apex of the proboscis there is a peculiar downgrowth of subcuticular tissue containing three or four nuclei (fig. 5).

The lacunar system of the body wall shows two very definite longitudinal lacunæ from which circular channels arise having a fairly regular annular arrangement (fig. 13). At the centre of their length these ring vessels anastomose forming an irregular reticular area (figs. 14, 15).

The nuclei of the subcuticula are very variable in form. In both sexes a complete series was obtained from a condition in which they were very numerous, with obvious nucleoli, and possessing the form shown at X, in fig. 14, to that in which they were very complexly branched. In general, the males showed nuclei of a more obviously dendritic form than did the females. The nuclei shown in fig. 15 may be taken as

typical of the usual condition in the male, and fig. 14 as that in the female. A considerable degree of variation, which seemed to be quite haphazard in distribution, was observed in different regions of the same individual.

The proboscis sheath is a double-walled sac inserted at the base of the proboscis. The musculature is radially symmetrical, but the outer layer is comparatively loose and its fibrils show a spiral arrangement (fig. 2). The sheath measures about 0·8 mm. by 0·15 mm. in both sexes.

The brain is situated within the four retractor muscle cells of the proboscis, a little posterior to the insertion of the proboscis-sheath (fig. 5). It shows an obvious differentiation into an outer cellular and an inner supporting and fibrous region (fig. 9). No retinacula were observed.

The lemnisci are of moderate length when fully extended, but their degree of extension varies considerably. This is due to their being enclosed for the greater part of their length each within a hollow column of muscle fibres which arises at their origin, i.e., at the level of the insertion of the proboscis sheath, and passes back to the body wall (figs. 1, 2, 5). Anteriorly the lemnisci are completely cut off from the body cavity, as shown in transverse section in fig. 10, but the posterior extremity may project into it through an opening in the muscle column. The nuclei of the lemnisci are peculiar. They are centrally situated and one extremely long nucleus may traverse almost the entire length of the lemniscus, or three or four shorter ones may be present (fig. 5). The outline of each lemniscus in transverse section is irregular (fig. 10). Its canal system breaks up into a network posteriorly.

Male.

The testes are oval and often unequal, either the anterior or posterior being larger. They are situated somewhat in advance of the mid-region. From the base of the capsule of each a vas deferens passes back to the level of the markbeutel where it enters a large swollen vesicula seminalis, from which a narrow ejaculatory duct opens into the penis. The latter is quite a conspicuous structure, terminating in the centre of the bursa, which is a much folded, thin-walled sac whose lining is continuous through a muscular sphincter with the body wall (fig. 2). When everted the bursa appears as a bell-shaped structure containing a median lobe traversed by the mass of tissue surrounding the ejaculatory duct and the base of the penis. The latter projects for a short distance into the cavity of the bell (fig. 6).

There are eight club-shaped prostate glands, each of which narrows posteriorly to form a prostate duct at the level of the apex of the markbeutel (fig. 11). Of these ducts, six pass backward on the one, and two on the other, side of the vesicula and markbeutel (fig. 12). The members of these two groups fuse and open into the base of the ejaculatory duct.

A small number of nerve cells surrounding the base of the vesicula and the ejaculatory duct constitute the genital ganglion.

Female.

As already mentioned, most of the females were immature, but in these the uterine bell and associated structures appeared to have attained somewhere near their full size, except that the uterus itself was rather shorter than in fully mature specimens. The general form of the complex is shown in fig. 1, and the vagina in detail in fig. 7. The egg balls are spherical masses measuring from 0·06 to 0·09 mm. in diameter. Eggs in three stages of development, representing the three conditions most commonly observed, are shown in figs. 16, 17, 18. In mature eggs the polar extensions of the middle shell are very obvious and bear a small terminal swelling.

A number of young females bore a small brownish cap at the posterior extremity. This structure, which Van Cleave terms the copulatory cap, is represented in fig. 3.

Systematic Position.

Leiper and Atkinson (1914, 1915) briefly described *Echinorhynchus campbelli* and *E. rennicki* from *Trematomus bernacchii* from the Ross Sea, the former having page preference. No difference of systematic value, apart from the number of hooks and the presence of a cuticular swelling at the base of each hook in the latter species, appear in their accounts. The dimensions given by these authors for each species are included in the range of our material. On first examination we thought it likely that two distinct species were present, but the large number of specimens available revealed the presence of intermediate forms and no anatomical differences were observed. The difficulty in observing accurately the number and arrangement of hooks on the proboscis may explain the differences recorded by these authors.

The characters above described indicate that the species belongs to the Rhadinorhynchidae. The radially symmetrical arrangement of the hooks and the absence of body spines distinguish it from typical members of the family and ally it with *Leptorhynchioides* and *Polyacanthorhynchus*. We have not access to a detailed account of the latter genus, but Travassos (1926) quoted as generic characters the presence of an enormous proboscis and long, oval, prostate glands.

The parasite agrees with the generic description given by Kostileff (1924) for *Leptorhynchoides*, except in regard to the disposition of the longitudinal muscles which, he states, are grouped into four cords, and the form of the nuclei which are described as dendritic. In *L. campbelli* the musculature is not so arranged and the nuclei vary in form from dendritic to simple, even in the same individual.

We prefer to extend the generic concept very slightly so as to include this species in the genus, which now possesses three species, viz., the type, *L. plagicephalus* (Westrumb), *L. thecatus* (Linton) and *L. campbelli* (Leiper and Atkinson). In a later part of this paper we suggest the possibility that *Echinorhynchus debenhami* Leiper and Atkinson may also belong to this genus.

? Leptorhynchoides debenhami (*Leiper and Atkinson*).

(Figs. 32–35.)

Syn. *Echinorhynchus debenhami* Leiper and Atkinson 1914; 1915.

A few male and female specimens of this small echinorhynch were obtained from the intestine of *Notothenia coriiceps*. The sexes are indistinguishable in the uncleared material and all the parasites are about 2 mm. in length, greatly curved and had the proboscis completely retracted.

The number and arrangement of the hooks on the proboscis could not be observed, but a hookless region is present at the base and measures about half the length of the introverted portion. The proboscis sheath is double-walled and inserted at the base of the organ. When the latter is completely withdrawn, a large amount of the body wall is also invaginated by the contraction of a retractor muscle (figs. 32, 34). The sheath measures 0·4 mm. by 0·15 mm. The lemnisci are long, tubular and considerably coiled. They appear to be enclosed in a cylindrical column of muscle (figs. 32, 34). Both are situated on the concave surface of the animal. The lacunar system is not obvious but resembles that of *L. campbelli* in its general arrangement.

Male System.

The testes are large, measuring 0·4 mm. by 0·35 mm., and are situated in the anterior half of the body. The second overlaps the first for about half its length and is in contact with the proboscis sheath anteriorly and the prostate glands posteriorly. The prostate glands are arranged in two groups, each of which opens into a lateral prostate duct on the corresponding side of the markbeutel. At the base of the latter these two ducts unite with each other before joining the ejaculatory duct which terminates at the bursa. It was not found possible to state definitely whether there were six or eight prostate glands. The bursa was found retracted in each case and did not exhibit any outstanding characteristics.

Female System.

The very short uterus is indicated in fig. 34, and in more detail in fig. 33. The arrangement of the three pair of gland cells surrounding the vagina is essentially similar to that described for *L. campbelli* (fig. 7). One of the females contained eggs, which are shown in fig. 35.

Systematic Position.

We have no hesitation in identifying the present material with the species described by Leiper and Atkinson as *Echinorhynchus debenhami* from *Trematomus bernacchii*, in spite of certain discrepancies in the accounts. The figures in the two cases agree much more closely in regard to relative sizes and internal organisation.

It is possible that the species is identical with that collected from *Notothenia coriiceps* at South Georgia by the Hamburg Magellan Expedition and described by Linstow as *Echinorhynchus megarhynchus*. The account of this form is confined mainly to a description of the hooks. Unfortunately Leiper and Atkinson make little reference to them, though they give a smaller number of longitudinal rows, while we have not been able to count them satisfactorily in our material.

We have assigned the species tentatively to *Leptorhynchoides*, mainly on the characters of the lemnisci and the lacunar system, which, together with the general arrangement of the male organs, resemble those described above for *L. campbelli*. If there are only six prostate glands as Leiper and Atkinson's figure seems to indicate, then the species must be assigned to some other genus.

ECHINORHYNCHIDAE CORYNOSOMINAE.

CORYNOSOMA ANTARCTICUM (*Rennie*).

(Figs. 19–31.)

Syn. *Echinorhynchus antarcticus* Rennie 1907.
Corynosoma sipho Ralliet and Henry 1907.
Corynosoma hamanni Leiper and Atkinson 1915.

A number of specimens of this acanthocephalan were obtained from the small intestine of Weddell's seals, *Leptonychotes weddelli*, on three occasions.

The parasite is of a peculiar shape, being pyriform with a narrow proboscis eccentrically placed at the broad end (figs. 21, 22, 24).

The males range in length, exclusive of the proboscis, from 4·25 mm. to 6·0 mm.; the average being 5·3 mm., and have an average width of 2·75 mm. across the swollen anterior end. The almost cylindrical posterior region occupies about half the total length and is about a millimetre in its smallest diameter. The females are shorter and broader and range from 4·0 mm. to 4·75 mm. in length, the average being 4·4 mm. The anterior region averages 3·25 mm. in diameter, while the posterior, which is more conical and less sharply marked off from the anterior than in the male, is only about one-third the total length.

The whole of the anterior swollen part of the body is armed with minute spines which arise in the subcuticula and pierce the cuticle. These spines are absent from the so-called dorsal side of the posterior portion of the parasite but are present on the ventral surface and surround the genital opening in both sexes (fig. 24).

The nearly cylindrical proboscis is slightly swollen at the base and separated from the body by a short bulbous neck, devoid of spines (fig. 24). The organ is armed with eighteen longitudinal rows of alternately fourteen and fifteen hooks, making a total of about 260. The arrangement of the hooks and form of the proboscis are shown in figs. 19, 30.

The proboscis sheath is double-walled, curved ventrally and inserted at the base of the proboscis. The spindle-shaped ganglion is situated a short distance from the posterior end, and the retinacula arise from the side walls at the same level (figs. 21, 22).

The lemnisci are of an unusual shape (figs. 20, 31). Each appears to consist of two laminæ enclosing a space which is in communication with the body cavity through an opening at the anterior end. Apart from this peculiarity, they possess a canal system and a histological structure similar to those usually met with amongst Acanthocephala.

The muscle cells of the body wall show a closer resemblance to those of the Nematoda than do those of most Acanthocephala. They have been figured for this genus by Linstow and by Rennie. The body cavity is, however, traversed by sheets of muscle whose fibres are of the more usual form.

Male System.

The two oval testes, which are situated side by side in the swollen part of the body (fig. 25), measure about 0·8 mm. by 0·6 mm. From each a wide vas efferens passes back for a short distance, the two uniting to form a vas deferens, which expands in the region of the markbeutel to form the vesicula seminalis (fig. 28). This opens by a short ejaculatory duct into the bursa (fig. 21).

There are six club-shaped prostate glands, each of which narrows posteriorly to form a prostate duct. They are arranged in pairs, one of each pair lying on either side of the midline (fig. 26). The ducts of each group of three glands belonging to the one side unite at the level of the markbeutel (fig. 27) to form a pair of prostate reservoirs, also one on each side (fig. 28). These reservoirs open separately by very short canals into the ejaculatory duct, at the base of the vesicula seminalis. The genital ganglion is situated in this region (fig. 29). The bursa, in the retracted condition, shows a very marked pocket on each side (fig. 29), lined by a thickened layer of the subcuticula. When the organ is everted this thickening forms a very firm rim to its bell (fig. 21).

Female System.

The general form of the female system is shown in fig. 22. The vaginal aperture is terminal and usually lies on the summit of a slight papilla devoid of spines. The uterus is comparatively thick with a very marked swelling just below its junction with the uterine bell. A mature egg (fig. 23) from the cavity of the uterus measures 0·095 mm. by 0·025 mm.

Systematic Position.

The above account differs in many points from those given by other investigators who have examined Antarctic material. Rennie states that there are, in *Ech. antarcticus*, twenty-eight rows of hooks with ten in a row; from his context he apparently means

transverse rows. An examination of his figure of the proboscis shows the presence of about nine longitudinal rows on the one surface—i.e., about eighteen surrounding the organ. Each of these is shown to contain fifteen or sixteen hooks, so that the arrangement figured by him approximates that described by us. Railliet and Henry mention twenty-one to twenty-two longitudinal rows with eleven hooks in each, but as this is the only significant difference between our accounts, we do not hesitate to retain their *C. sipho* under the synonomy of *C. antarcticum*. The dimensions of the parasite, its proboscis and hooks, as recorded by the authors named, agree sufficiently closely with what we have observed.

Leiper and Atkinson reported the presence of 150 to 170 hooks but did not say how they were arranged. They re-examined the type material of *Ech. antarcticus* and stated that the male system possessed the normal arrangement, which suggests that Rennie must have misinterpreted certain anatomical details.

The host species is given as Weddell's seal by Rennie, by Railliet and Henry, and by Leiper and Atkinson. The last-named give, in addition, the crab-eating seal, *Lobodon carcinophaga*, and the sea leopard, *Hydrurga leptonyx*, and mention that the larval stage occurs in *Trematomus bernacchii*.

The parasite has been identified by various workers as being identical with that described by Linstow from *Stenorhynchus* (i.e., *Hydrurga*), *leptonyx*, as *Ech. hamanni*. There are, however, certain discrepancies which suggest that the two may be distinct, though very closely related. The hooks in *Ech. hamanni* are stated to be arranged in fifteen longitudinal rows, each containing eighteen. The dimensions of the parasite are smaller, but as eggs were not observed in the females, such material was obviously immature. The position of the genital opening in both sexes is different from that recorded above. Linstow also reported the presence of spines on the bursa. The leminisci are stated to consist each of two separate laminæ. If the two forms are specifically identical, then the correct name is *C. hamanni*. If distinct, then it is possible that Leiper and Atkinson's specimens from the sea leopard belong to Linstow's species.

ECHINORHYNCHINAE.

ECHINORHYNCHUS ZANCLORHYNCHI n. sp.

(Figs. 36–38.)

A single specimen of an echinorhynch, a female, was obtained from the stomach of a Scorpænid fish, *Zanclorhynchus spinifer*, from Macquarie Island. It measures 10 mm. in length and has a practically uniform width of 0·8 mm. when compressed. The proboscis is not completely everted but is long, cylindrical and armed with fourteen longitudinal rows of very long sharp hooks. From the insertion of the proboscis sheath to the tip of the everted part measures 0·65 mm. and the introverted portion 0·25 mm., so that the proboscis, when fully everted, would be about 1 mm. in length. The posterior

transverse row of hooks is considerably anterior to the insertion of the proboscis sheath, so that of the armed portion, about one-third is introverted. In each longitudinal row the number of hooks exposed is seven, so that the total number of hooks in a row may be estimated at ten or eleven, making the probable total of 140–154.

The proboscis sheath, whose dimensions were 0·9 mm. in length by 0·35 mm. in maximum width, is double walled and inserted at the base of the proboscis.

The lemnisci are short and irregular, reaching about one-third the length of the proboscis sheath. Their peculiar form, as well as the brittleness of the specimen and the condition of the eggs, made it appear likely that the material had been allowed to dry before it came to our hands.

Further details of the anatomy of the parasite were obscured by the masses of eggs which it was not found possible to remove in the usual way by pressure.

An egg from the body cavity is shown in fig. 38. The general form of the body and the details observed at the anterior end are also figured (fig. 36).

It is to be regretted that the material available for study was so scanty and unsatisfactory, but in view of the fact that no endo-parasites have been recorded from this fish and that this is the first acanthocephalan to be collected from Macquarie Island, a specific name is being attached to it. The characters of the proboscis and its sheath, as figured and described above, should permit of its identification if more material should become available.

The characters described are such as would not prevent one from allotting it to the genus *Echinorhynchus*, though an examination of a male specimen may necessitate its transfer to some other genus of the Echinorhynchidae.

EXPLANATION OF LETTERING.

aa, anterior aperture of uterine bell; avs, anterior vaginal sphincter; b, bursa; br, brain; bw, body wall; c, cuticle; cc, copulatory cap; cl, central lacuna; clb, central lobe of bursa; ed, ejaculatory duct; fa, female aperture; gc 1, gc 2, gc 3, gland cells of vagina; gl, genital ligament; gs, genital sphincter; ip, introverted proboscis; ips, inner proboscis sheath; l, lemniscus; la, lacuna; lab, lateral aperture of uterine bell; lpr, lateral prostate reservoir; mc, muscle column surrounding lemniscus; mb, markbeutel; n, nucleus; nc, nucleolus; nf, nerve fibre; ops, outer proboscis sheath; p, penis; pb, pocket of bursa; pd, prostate duct; pr, proboscis; ps, proboscis sheath; pvs, posterior vaginal sphincter; rb, rim of bursa; rm, retractor muscle of the proboscis; rmb, retractor muscle of body wall; s, prostate secretion; sc, subcuticula; scp, subcuticular organ of the proboscis; sn, spineless neck; u, uterus; ub, uterine bell; v, vagina; vd, vas deferens; ve, vas efferens; vs, vesicula seminalis.

Leptorhynchoides campbelli.

Fig. 1. Female.
2. Male, drawn to same scale as fig. 1.
3. Female, posterior end.
4. Proboscis.
5. Male, anterior end.
6. Male, posterior end, bursa everted.
7. Female, detail of vagina.

Leptorhynchoides campbelli.

Fig. 8. Longitudinal row of hooks, in profile.
9. T.S. of ganglion.
10. T.S. anterior end of body.
11. T.S. region of prostate.
12. T.S. region of markbeutel. Figs. 9, 11 and 12 drawn to same scale.
13. Longitudinal lacuna.
14. Lacunar system of female showing different forms of nuclei.
15. Lacunar system of male showing more usual form of nuclei.
16, 17, 18. Eggs in different stages of maturity, drawn to same scale.

Corynosoma antarcticum.

Fig. 19. Hooks from anterior region, mid region, and base of proboscis.
20. Anterior end showing form of lemnisci, etc.
21. Male.
22. Female, drawn to same scale as fig. 21.
23. Mature egg.
24. Female, showing distribution of spines.

Corynosoma antarcticum.

Figs. 25–29. Series of transverse sections of male complex drawn to same magnification.
25. T.S. through region of testes.
26. T.S. through region of prostate glands.
27. T.S. through region of markbeutel.
28. T.S. through region of vesicula seminalis.
29. T.S. through region of ejaculatory duct.
30. Proboscis.
31. Oblique section of anterior part of worm.

? Leptorhynchoides debenhami; Echinorhynchus Zanclorhynchi.

Figs. 32–35. *? Leptorhynchoides debenhami.*

32. Male.
33. Female, posterior end.
34. Female, drawn to same scale as fig. 32.
35. Egg (immature).

36–38. *Echinorhynchus zanclorhynchi.*

36. Anterior end.
37. Sketch to show general form.
38. Egg.
39. Hook.

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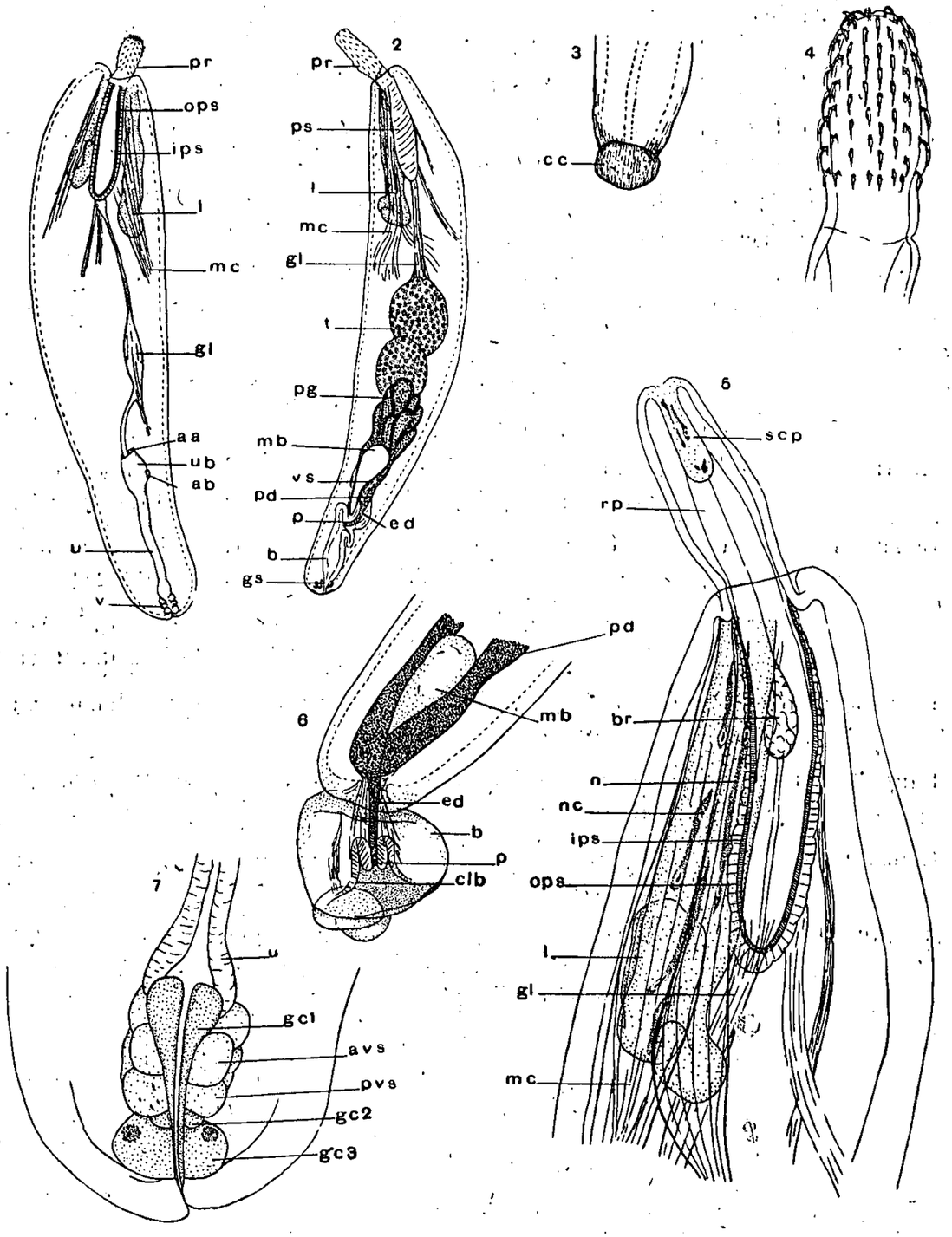
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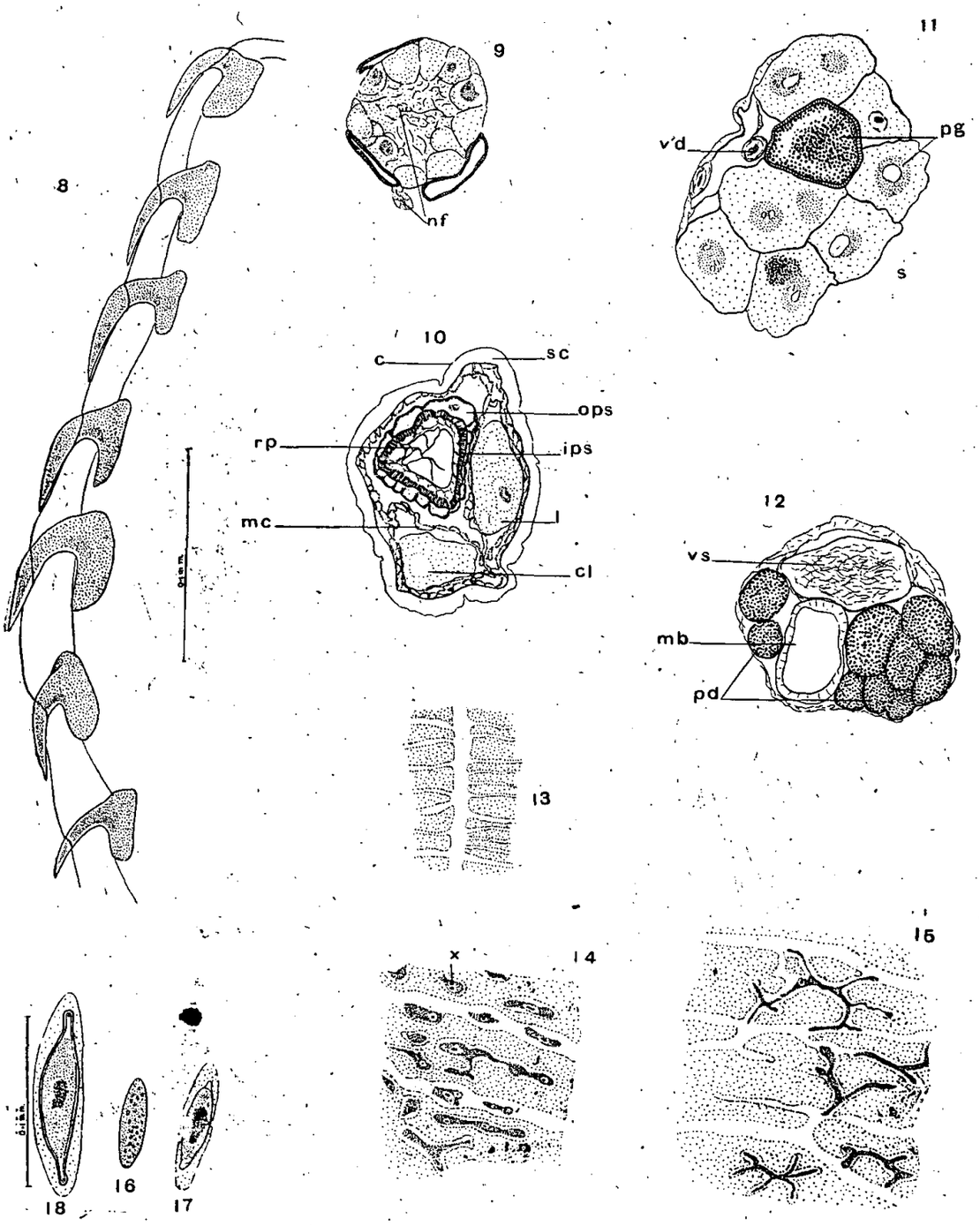
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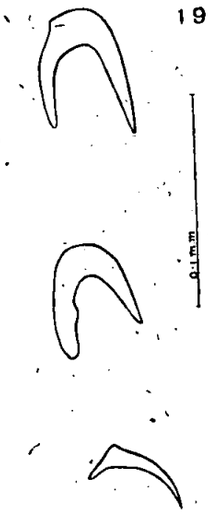

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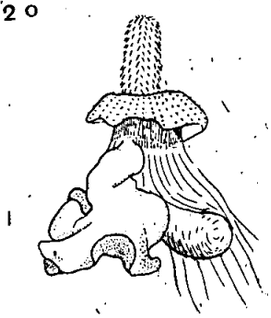

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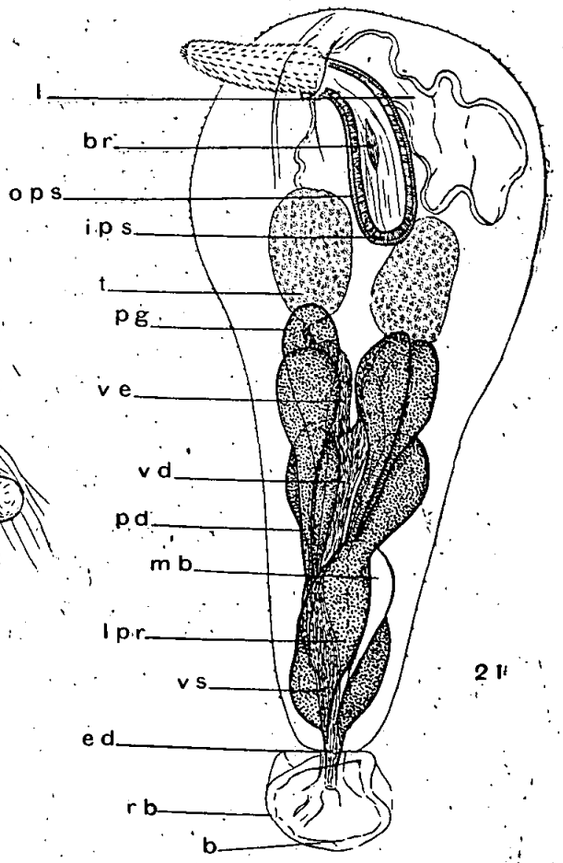

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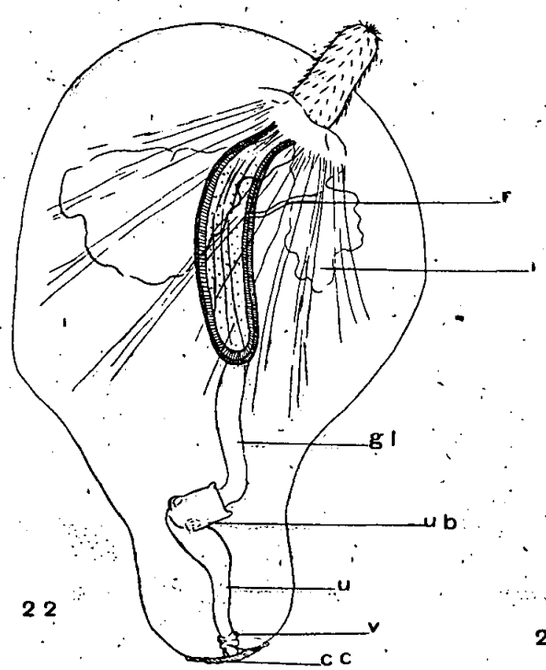

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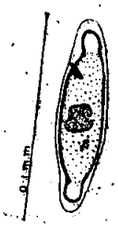

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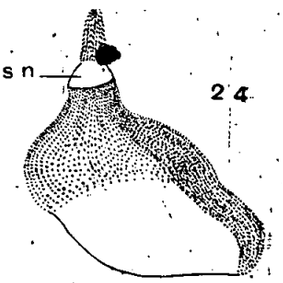

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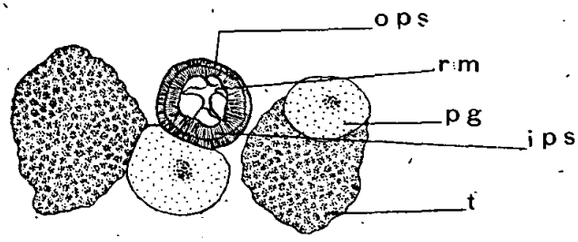

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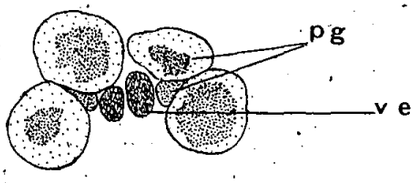

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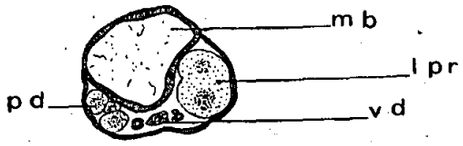

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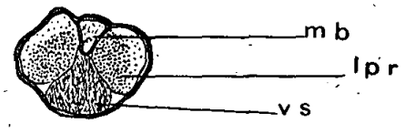

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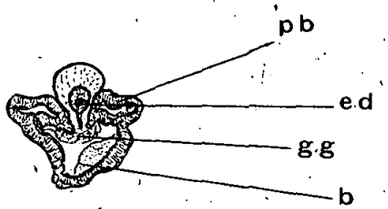

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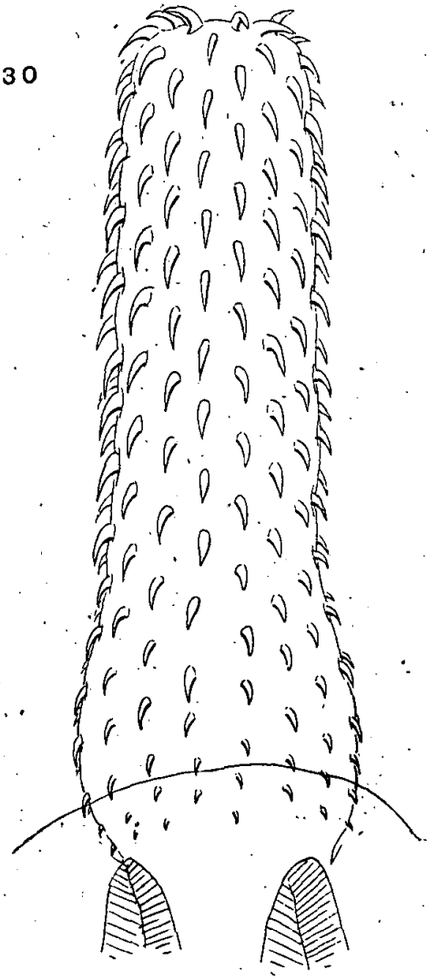

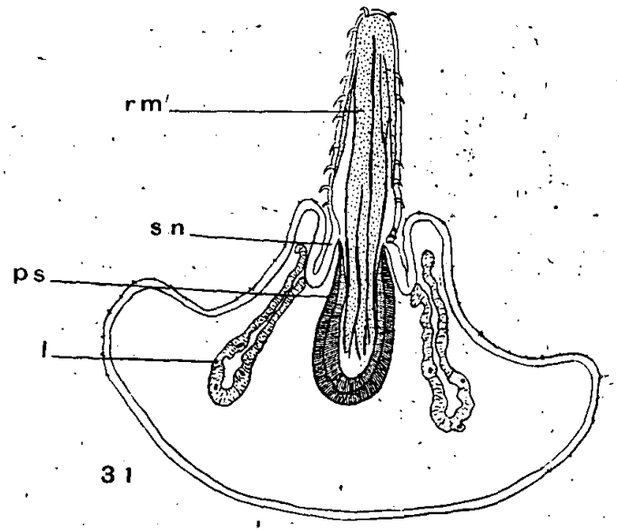

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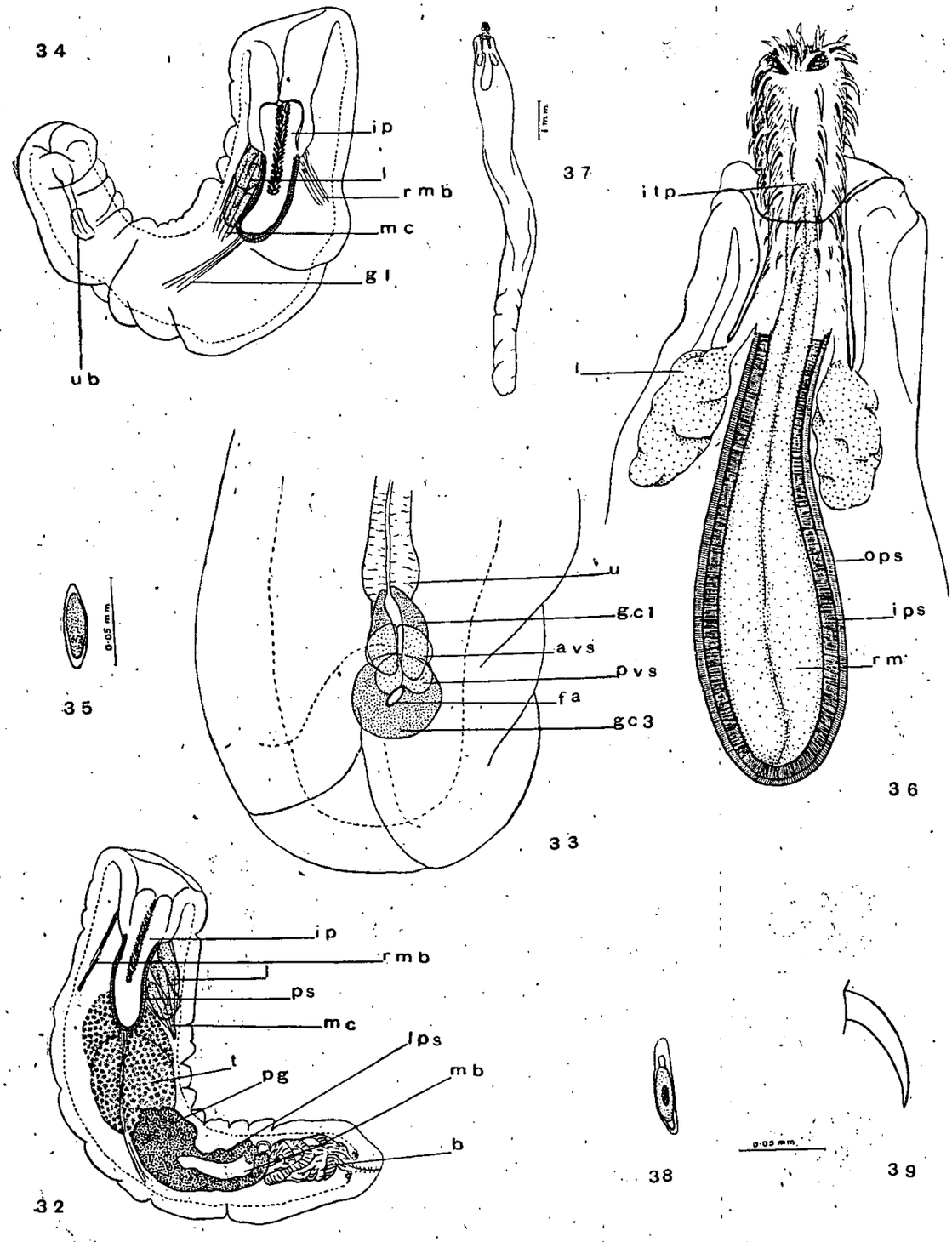

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