Onderstepoort Journal of Veterinary Science and Animal Industry, Volume 10, *Number* 1, *January*, 1938.

Printed in the Union of South Africa by the Government Printer, Pretoria.

A Monograph of the Helminth Parasites of the Elephant.*

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INTRODUCTION.

Since the literature on the helminth parasites of the elephant is extremely scattered and contained in various periodicals, the object of this paper was to attempt to compose a synopsis of all the hitherto known helminth parasites of the Indian and African elephant.

The synopsis is not merely a compilation, but includes examination of material representing a large proportion of the parasitic genera. This detailed study showed that it was necessary to augment description of certain structures and also to amend the diagnosis of a few of the genera.

The material placed at my disposal for this investigation, has been contributed by Dr. H. O. Mönnig (Veterinary Research Officer at Onderstepoort), to whom I am also indebted for his suggestion as to the nature of the undertaking.

The specimens were collected from four circus elephants of the Indian species, all of which died as a result of the severity of their nematode infections. I also had the opportunity of examining some species from the African elephant, which Dr. Mönnig was so kind as to send me.

The nematode collection presented a very interesting study, and after it had been sorted out, proved to contain specimens of practically all the species so far described from the Indian elephant, with the addition of two new species belonging to the genera, *Choniangium* and *Grammocephalus*, respectively. The super-family Strongyloidea, is extremely well represented in the elephant. The family Strongylidae is represented by 6 genera including 35 species, of which 25 species are parasitic in the African elephant, and 12 in

* A portion of the nematode section of this paper was sumbitted as a thesis, presented in partial fulfilment of the requirements for the degree of Master of Science of the University of South Africa.

the Indian elephant. The family ANCYLOSTOMIDAE is represented by 3 genera including 7 species, of which 3 are parasitic in the African elephant, and 4 in the Indian. The family SYNGAMIDAE however, is represented by only one genus including one species from the Indian elephant. Of the 10 genera the following are found in the Indian elephant only: *Equinubria*, *Decrusia*, *Bathmostomum* and *Choniangium*.

It is interesting to note that the nematode parasites of the Indian and African elephant show a fairly strict host specificity, in so far that up to the present no one species has been found which is common to both hosts. In connection with this it is important to note that in the collection of nematodes worked through, a species belonging to the genus *Grammocephalus*, was found, which combines more or less the features presented by the two previously described species, one of which parasitises the Indian elephant, and the other the African elephant. This species, however, is fully discussed in this paper.

The STRONGYLIDS of the elephant are all parasitic in the alimentary tract, except the genus *Grammocephalus*, the adults of which inhabit the bile ducts, and in the case of one species of *Grammocephalus*, immature and larval forms were taken from nodules removed from the lining of the large intestine. This suggests that in the development of its life history, the larvae of *Grammocephalus*, which are probably introduced into the host with food, in course of its development penetrate the wall of the intestine from where, in course of time they probably re-enter the lumen of the intestine and then migrate directly up the bile duct. On account of the large size of the larval forms encountered in the intestinal nodules, it is impossible to conclude that these larvae might also reach the liver, and finally the bile duct, via the blood circulation.

A few larvae belonging to the genus *Murshidia*, were also found among the specimens collected from the lumen of the small intestine. *Murshidia*-larvae probably do not migrate, but develop in the intestine which is also the habitat of the adult forms.

A thorough investigation of the species at my disposal revealed certain structural characters which had been overlooked by previous workers.

All species of *Murshidia* encountered among the material, show the presence or the indication of a second coronal leaf-crown; this structure however, is not mentioned by Khalil, Lane, Witenberg, nor by the other investigators who either revised species of *Murshidia* already described, or added more species to the genus. It is however, indicated by Witenberg, 1925, in his figures of *M. murshida*, *M. falcifera*, and *P. neveu-lemairei*, and also by Neveu-Lemaire, 1928, in his figures of *M. brevicauda* and *P. omoensis*. Neveu-Lemaire actually describes a second coronal structure for *P. omoensis* from the African rhinoceros, and although he states that this species is indistinguishable from *P. omoensis* from the African elephant, he does not figure nor describe a second corona for the latter species. This second leafcrown is composed of numerous, very short elements, and has its origin at the anterior margin of the buccal capsule. It

must, however, be admitted that this structure is not equally distinct in all the species, and its presence is sometimes masked by the more pronounced leaflets of the first leafcrown. However, in the species of Murshidia in my possession, the coronal structure is extremely well marked, and in the large number of specimens examined, it is a very constant feature. In my opinion this is sufficient evidence to assume the presence of a second corona in all species of *Murshidia*, and this, I think, future investigations will show to be the case.

Also in the species of *Decrusia*, attention is directed to the presence of a poorly developed but very definite second (internal) coronal leafcrown.

In all members of the MURSHIDIINAE examined, the first (external) corona always has much longer and better defined leaflets. In *S. sipunculiformis* however, the external leafcrown is composed of small, short and stout elements.

Examination of the buccal capsules in many species, under very high powers, also revealed the presence of numerous small teethlike structures or tubercles at the base of the capsule. These structures, although of no great diagnostic significance, were also overlooked by previous workers. These were found present in all species of *Murshidia* examined, and also in *Amira pileata* and *Equinubria sipunculiformis*.

It is also interesting to note that many species, even from the same individual host, are subject to extreme variations. This is particularly the case among species of *Murshidia*, especially in regard to bursal rays in the male and the tail endings in the female.

In preparing this paper, I have so far as is possible relied for my illustrations and descriptions on personal observation, but I have of necessity also copied from the work of others. Their drawings have been acknowledged in the usual manner.

I wish to take this opportunity to acknowledge my thanks to Dr. G. Theiler, under whose supervision the major part of this investigation was carried out, and to whom I am very grateful for her useful criticism.

Also my grateful thanks to Dr. H. O. Mönnig for the use of his literature and of his camera-lucida drawings, as also to Dr. R. J. Ortlepp (Research Officer at Onderstepoort) for his valuable suggestions, and for so kindly placing several very useful references at my disposal.

TECHNIQUE.

The Nematode and Amphistome material was fixed in 70 per cent. alcohol. For study, however, the Nematode specimens were cleared in lactophenol.

The Amphistomes studied were stained with acid alum carmine, and serial sections, both transverse and sagittal, were made of some specimens, and other stained specimens were studied *en toto*.

CLASSIFICATION OF NEMATODES PARASITIC IN THE ELEPHANT.

Super-family.	Family.	Sub-family.	Genus.	Species.	Host.
I. Strongyloidea	1. Strongylidae	A. Murshidiinae	Murshidia	*M. murshida*	Ind. Eleph.
				M. falcifera	,,
				M. indica	,,
				M. neveu-lemairei	,,
				M. linstowi	Afr. Eleph.
				M. hadia	,,
				M. longicaudata	,,
				M. brachyscelis	,,
				M. africana	,,
				M. anisa	,,
				M. dawoodi	,,
				M. omoensis	,,
				M. brevicapsulatus	,,
				M. memphisia	,,
				M. aziza	,,
				M. loxodontae	,,
				M. soudanensis	,,
				M. brevicaudata	,,
				M. lanei	Ind. Eleph.
		B. Trichoneminae	Quilonia	*Q. renniei*	,,
				Q. travancra	,,
				Q. apiensis	Afr. Eleph.
				Q. africana	,,
				Q. uganda	,,
				Q. brevicauda	,,
				Q. ethiopica	,,
				Q. khalili	,,
				Q. loxodontae	,,
				Q. magna	,,
		C. Amirinae	Amira	*A. pileata*	Ind. Eleph.
				A. sumeera	Afr. Eleph.
		D. Strongylinae	Choniangium	*C. epistomum*	Ind. Eleph.
				C. magnostomum	,,
			Equinubria	*E. sipunculiformis*	,,
			Decrusia	*D. additictia*	,,
			Bunostomum	*B. foliatum*	,,
				B. brevispiculum	Afr. Eleph.
				B. hamatum	,,
	2. Ancylostomidae	Necatorinae	Bathmostomum	*B. sangeri*	Ind. Eleph.
			Grammocephalus	*G. clathratus*	Afr. Eleph.
				G. varedatus	Ind. Eleph.
				G. hybridatus	,,
	3. Syngamidae		Syngamus	*S. indicus*	,,
II. Oxyuroidea	Atractidae	Atractinae	Leiperenia	*L. leiperi*	Afr. Eleph.
				L. galebi	Ind. Eleph.
III. Ascaroidea	Ascaridae	Ascarinae	Toxocara	*T. longoptera*	Ind. Eleph.
IV. Spiruroidea	Acuaridae	Acuariinae	Parabronema	*P. indicum*	,,
				P. smithi	,,
				P. africanum	Afr. Eleph.
				P. rhodesiense	,,

CLASS NEMATODA.

SUPERFAMILY STRONGYLOIDEA. Weinland, 1858; Hall, 1916.

FAMILY I, STRONGYLIDAE, Baird, 1853.

Sub-family I, Murshidiinae, Witenberg, 1925.

Diagnosis: Strongylidae, of medium size with a straight head and a mouth opening which is oval in cross-section. The mouth-capsule has the shape of an oval ring, of which the dorso-ventral axis is longer than the transverse. The cuticular layer which paves the mouth-capsule splits (at different levels according to different species) into narrow leaflets which form one row showing elongation of the leaflets laterally and shortening dorsally and ventrally. The base of the mouth-cavity leads to a funnel-shaped throat, which may or may not be provided with toothlike processes. Four submedian head-papillae are generally well developed, the lateral ones are on the contrary, generally very small.

The vulva is situated near the posterior extremity of the body. The female genital ducts show parallel uteri running cephalad, two ovejectors and two vaginal ducts which run together forming a short common portion terminally at the vulva (Fig. 1).

In the male there are two similar spicules and an accessory piece.

Genus Murshidia, Lane, 1914. (Amended.)

Syn. Pteridopharynx, Lane, 1921.

Memphisia, Khalil, 1922.

Henryella, Neveu-Lemaire, 1924.

Pterygopharynx, Witenberg, 1925.

Fairly slender worms tapering towards the head-end. Mouth directed straight forwards; mouth-collar is more prominent laterally giving the appearance of two lateral lips, each of which bears a sessile lateral, and two prominent head-papillae. The oval capsule is roughly cylindrical and oval on cross-section, while the thickness of the wall varies in different parts. Since this is thicker caudad and thinner caphalad, on its dorsal and ventral than on its lateral aspects, its cavity is, at its cephalad end, wider dorso-ventrad than latero-laterad. The external leafcrown, which originates about one-third of the way down the depth of the mouth capsule, is composed of numerous fine elements originating along a curved line which runs closer to the anterior margin of the buccal capsule dorsally and ventrally than laterally. The dorsal and ventral leaflets are also shorter than the lateral thus giving to the mouth the shape of a dorso-ventral slit. The internal leafcrown forms the anterior margin of the buccal capsule and its elements (leaflets) are short. Tubercles or teethlike structures may be present at the base of the buccal capsule. The oesophagus is short and stout, the cuticle lining the anterior portion may or may not exhibit a plumose sculpturing.

Male: Bursa with well-developed dorsal lobe. Ventral and lateral rays arise from a common trunk, the medio-lateral and postero-lateral separated in their distal portions. The externo-dorsal arises from the base of the dorsal. The dorsal ray is bifurcate for about half its length, and from about the point of bifurcation gives off either two lateral branches arising close together, or a single branch which is cleft to a greater or less extent. Various small projections may be present on the postero-lateral or on the externo-dorsal ray. The spicules are equal, with the points bent in one direction. Gubernaculum present.

Female: Posterior extremity is long and tapering. Vulva is near the anus.

Parasites of elephants, rhinoceroses and warthogs.

TYPESPECIES—*M. murshida*, Lane, 1914. Host—Indian elephant.

Other species from elephants:—

	Host.
M. falcifera (Cobbold, 1882)	Indian elephant
M. indica (Ware, 1924)	,, ,,
M. neveu-lemairei (Witenberg, 1925) ...	,, ,,
M. linstowi, Khalil, 1922	African elephant
M. hadia, Khalil, 1922	,, ,,
M. longicaudata, Neveu-Lemaire, 1928 ...	,, ,,
M. brachyscelis, Mönnig, 1932	,, ,,
M. africana (Lane, 1921)	,, ,,
M. anisa (Khalil, 1922)	,, ,,
M. dawoodi (Khalil, 1922)	,, ,,
M. omoensis (Neveu-Lemaire, 1924)	,, ,,
M. brevicapsulatus (Mönnig, 1932)	,, ,,
M. memphisia (Khalil, 1922)	,, ,,
M. aziza (Khalil, 1922)	,, ,,
M. loxodontae (Neveu-Lemaire, 1928) ...	,, ,,
M. soudanensis (Neveu-Lemaire, 1928 ...	,, ,,
M. brevicaudata (Neveu-Lemaire, 1928) ...	,, ,,
M. lanei? Witenberg, 1925	Indian elephant

DISCUSSION ON CLASSIFICATION AND SYNONYMY.

Witenberg, 1925, created the sub-family MURSHIDIINAE, and takes the genus *Murshidia* out of the sub-family TRICHONEMINAE, Railliet, 1916, on the constant features of the oval shape of the oral aperture with the dorso-ventral axis longer than the lateral, and on the elongation of the leaflets laterally. He proposed to group the two sub-families MURSHIDIINAE and TRICHONEMINAE under a new family TRICHONEMIDAE, without, however, defining the latter. Since there seems to be no special reasons for grouping these two together,

and for taking them out of the STRONGYLIDAE, and since Witenberg himself failed to define this new family TRICHONEMIDAE, I have decided to admit the sub-family, but not to accept the family TRICHONEMIDAE, and to group MURSHIDIINAE on a level with TRICHONEMINAE and the other sub-families of the STRONGYLIDAE as given by Yorke and Maplestone, 1926.

In this sub-family Witenberg includes *Pteridopharynx*, Lane, 1921, *Memphisia*, Khalil, 1922, *Henryella*, Neveu-Lemaire, 1924 and *Buissonia*, Neveu-Lemaire, 1924.

According to Yorke and Maplestone, 1926, the features differentiating the genera *Pteridopharynx* and *Memphisia* from *Murshidia*, Lane, 1914, are not marked enough to constitute a generic distinction. They also conclude that since the chief characters of the mouth capsules in all the species of these genera are the same, *Pteridopharynx*, Lane, 1921, and *Memphisia*, Khalil, 1922, are to be considered as synonymous with *Murshidia*, Lane, 1914.

A detailed study of the species included under *Murshidia*, *Pteridopharynx* and *Memphisia*, leads one to conclude that the inclusion of *Memphisia* and *Pteridopharynx* in *Murshidia* is quite justifiable.

There is no doubt that *Pteridopharynx* and *Memphisia* cannot remain separated. The features used in constituting a generic distinction between them are (1) the presence of a cuticular collar round the anterior end of the body in *Memphisia* and (2) the possession of a branched externo-dorsal ray in the bursa of *Memphisia*.

As regards the cephalic collar in Khalil's figure of *M. aziza*, the cuticular collar can hardly be seen. In *Pteridopharynx brevicapsulatus*, Mönnig, 1932, we find the *Memphisia*-character of the externo-dorsal ray bearing a prominent caudally directed branch, associated with the *Pteridopharynx*-character of " no cuticular collar ". Hence considering this species alone, the genera *Pteridopharynx* and *Memphisia* are indistinguishable. The cuticular collar thus appears to be a variable character which cannot be considered as of generic importance.

As regards the branched externo-dorsal ray, this is present in a more or less marked degree in all three genera, and is almost as well pronounced in *Pteridopharynx indica* (Fig. 22) and *Murshidia falcifera* (Fig. 13); as in any species *Memphisia*. So that the value of this as a distinguishing feature between *Murshidia* and *Pteridopharynx* also falls away.

Khalil, 1922, differentiates *Pteridopharynx* from *Murshidia* on the grounds that in the former (1) there is a prominence of the posterior border of the lateral ray and (2) the two external branches are fused almost to their tips.

As regards the prominence of the lateral ray it must be noted that *Murshidia falcifera* as well as *M. murshida*, show a prominence on the posterior border of the postero-lateral ray (Figs. 13 and 8). Although it is never as pronounced as in *P. indica* or *P. brevicapsulatus*, yet it is just as marked as in *P. neveu-lemairei*.

So far as the fusion of the external branches of the dorsal ray is concerned, again it seems to be merely a matter of degree. *M. falcifera* shows them fused for about half their length (Figs. 14 and 16), and this condition is the same in *Pteridopharynx neveu-lemairei* (Fig. 35). In the other species of *Pteridopharynx* and *Memphisia*, this fusion is more complete, leaving only the tips free. So it may be stated that the fusion of the two external branches of the dorsal ray in the three genera shows a gradation from complete separation as in *M. murshida* and *M. brachyscelis*, through a stage of partial fusion as in *M. falcifera*, *M. linstowi* and *P. neveu-lemairei*, to a state of almost complete fusion with only the tips free, as is seen in many of the other species.

Another point raised by Neveu-Lemaire, 1928, against the inclusion of *Pteridopharynx* in the genus *Murshida*, is the width of the body in front of the caudal bursa. In the specimens examined both of *Murshidia* and *Pteridopharynx*, this appears to be a variable character depending on the state of preservation of the material.

The same author also states that the distance between the vulva and anus is considerable in *Murshidia* and practically nil in *Pteridopharynx*. In *P. neveu-lemairei*, however, the anus is well separated from the vulva (Fig. 27). Considering actual distance in millimetres, we find that the vulva and anus in the different species are the following distances apart: —

In *P. omoensis* ... ... = ·075 mm.
,, *P. brevicapsulatus* = ·09 ,,
,, *P. anisa* ... ... = ·12 ,,
,, *M. aziza* ... ... = ·25 ,,
,, *P. loxodontae*... ... = ·34 ,,
,, *P. neveu-lemairei* = ·4 ,,
,, *M. linstowi* ... ... = ·5 ,,
,, *M. hadia* ... ... = ·6 ,,
,, *M. murshida* ... ... = ·72 ,,
,, *M. falcifera* ... ... = ·8 ,,

Here again we find intermediate forms which nullify the difference set up between the two genera.

The possibility whether the presence of a plumose sculpturing on the anterior portion of the oesophagus associated with a general elongate form of the dorsal ray might not be taken as a generic characteristic, shall now be considered.

Were this characteristic to be taken as the chief generic feature of *Pteridopharynx*, *P. africana*, *P. brevicapsulatus* and *M. aziza* would then definitely belong to the genus. The dorsal ray of *P. neveu-lemairei* is much shorter and approaches more or less the condition as found in *M. brachyscelis* the dorsal ray of which is typically that of *Murshidia*, but *M. brachyscelis* also shows the plumose

M. brachyscelis and *P. neveu-lemairei* therefore definitely link up the species of *Pteridopharynx* with the species of *Murshidia* in which a plumose sculpturing of the oesophagus is not present. Thus again it is not possible to separate *Pteridopharynx* from *Murshidia*.

The elongate dorsal ray is also found in *M. anisa*, *M. memphisia* and *P. omoensis*, none of which shows a plumose corrugation of the oesophagus. These species can be linked up with *Murshidia* through *P. neveu-lemaire*, the bursa of which is intermediate between the elongate form of *Pteridopharynx* and the more squat form of *Murshidia*. Hence, it is concluded that *Pteridopharynx* cannot be generically separated from *Murshidia* and that the synonymy of *Pteridopharynx* and *Memphisia* with *Murshidia*, should stand, as proposed by Yorke and Maplestone, 1926.

A Key to the Species of Murshidia.

A. *With anterior portion of oesophagus plumosely sculptured.*

I. *Branch of externo-dorsal ray well pronounced.*

(*a*) Ventral ray cleft for its whole length ... ... **M. indica** ... ... p. 60

(*b*) Ventral ray cleft for half its length ... ... **M. brevicapsulatus** ... p. 68

II. *Branch of externo-dorsal ray rudimentary.*

(*a*) Dorsal ray fairly short and broad, with its external and median branches fused for about half their lengths ... ... **M. neveu-lemairei** ... p. 61

(*b*) Dorsal ray elongate and thin, with its external and median branches completely fused to almost their extreme tips ... ... **M. aziza** ... ... p. 70

III. *With branch on externo-dorsal ray, absent.*

(*a*) Dorsal ray very short, its external branches entirely free, and longer than its median and internal branches ... **M. brachyscelis** ... ... p. 64

(*b*) Dorsal ray very elongate and thin, its external and median branches fused to almost their tips ... ... **M. africana** ... ... p. 65

B. *Plumose sculpturing of the oesophagus, absent.*

I. *Dorsal lobe of bursa short and broad.*

(*a*) *Parasitic in the Indian elephant.*

(i) Oesoph. about 1·0 mm. long, and bases of the external branches of the dorsal ray swollen **M. falcifera** ... ... p. 59

(ii) Oesoph. about 0·6 mm. long, and bases of ext. branches of the dorsal ray not swollen ... ... **M. murshida** ... ... p. 59

(*b*) *Parasitic in the African elephant.*

(i) With a small (±0·1 mm.) curved and more or less S-shaped accessory piece.

(*a*) External leafcrown composed of 40 leaflets ... ... **M. hadia** ... ... p. 63

(*b*) External leafcrown composed of 20-28 leaflets ... ... **M. linstowi** ... ... p. 62

(ii) With a broad (±0·45 mm.) four-sided accessory piece ... ... **M. longicaudata**... ... p. 64

II. *Dorsal lobe of bursa elongate and thin.*

(*a*) *Teeth present at the base of the capsule.*

(i) Dorsal ray cleft till beyond the origin of the accessory branches **M. dawoodi** ... ... p. 67

(ii) Dorsal ray cleft approx. half way to the origin of accessory branches

(*a*) Cuticular collar present ... ... **M. memphisia** ... ... p. 69

(*b*) Cuticular collar absent ... ... **M. anisa** ... ... p. 66

(*b*) *Teeth absent* ... ... **M. omoensis** ... ... p. 68

NOTE. -Since no males have been found for *M. soudanensis*, *M. brevicaudata* and *M. loxodontae*, these species cannot be included in the key (see descriptions and figures for female characteristics).

Murshidia murshida, Lane, 1914.

The specimens examined, and of which measurements were taken, consisted of a large number of males and females. On the whole the worms examined seemed to be much larger than those examined by Lane, 1914, and Khalil, 1922. (For measurements see Table 1.)

The oral aperture is bounded by 60 leaflets arising about half-way down the depth of the mouth-capsule. According to Lane, 1914, the cervical glands reach to a point 4 mm. caudad of the caudal end of the oesophagus.

Male: The most characteristic features of the bursal rays are the general ruggedness of the outline of the externo-dorsal and dorsal rays (Fig. 5), and the swollen basis of the lateral rays, although the latter characteristic is not always too well pronounced. The three subdivisions of the dorsal rays are situated about equidistant from one another (Fig. 5). The spicules are equal and similar; the shaft is straight for its whole length, the extremity is bent almost directly dorsad, and the extreme end is marked by a prominence or " beak " directed caudad (Fig. 6). An irregular S-shaped accessory piece is present (Lane overlooked the presence of an accessory piece).

Female: The vulva is marked by a fairly long low cuticular prominence caudad of it (Fig. 2). Mature ova were absent from the females examined, but according to Witenberg these measure ·072 × ·048 mm.

Habitat: Large intestine and caecum.

Host: Indian elephant.

Murshidia falcifera (Cobbold, 1882).

Syn. Strongylus falcifer, Cobbold, 1882.

Nematode No. 3, Evans and Rennie, 1910.

Strongylus falcifer, Mitter, 1912.

Cylicostomum falciferum, Railliet, Henry and Bauche, 1914.

Murshidia falcifera, Lane, 1914.

The oral aperture is bounded by 80 leaflets. The excretory pore lies a little posterior to the level of the junction of the oesophagus and chyle-intestine and the lateral papillae shortly caudad of this level.

For *M. falcifera* the measurements were also found to be larger on the whole than recorded by Lane, 1914, and Khalil, 1922. (For other measurements, see Table 1.)

Male: The lateral rays of the bursa are not bulbous at the base, and according to Lane, 1914, the dorsal and externo-dorsal rays are not rugged in outline, but an examination of a large number of specimens proved that although the majority have smooth dorsal rays, variations exist, which show a tendency towards ruggedness of the

internal branches of the dorsal rays (Figs. 16 and 17). The externo-dorsal ray has a projection which is a constant feature, but the projection may take in various shapes sometimes having a forked appearance (Fig. 14). Of the three subdivisions of the dorsal ray, the two laterals lie closer together and somewhat separated from the central one (Fig. 16). Some individuals show a tendency towards fusion of the lateral rays of the dorsals, at least on one side.

The shafts of the spicules are curved just cephalad of the terminal bend, giving them a lyrate shape. There is no " beak ". An S-shaped accessory piece is present (Fig. 15) .

Female : Caudal papillae are present between the anus and tip of tail. The cuticle cephalad and caudad of the vulva is but slightly thickened. Ova were not present in the females examined, but according to Lane, 1914, these measure ·05 × ·03 mm. and according to Witenberg, 1925, ·084 × ·041 mm.

Habitat : Large intestine.

Host : Indian elephant.

Murshida indica (Ware, 1924).

Syn. Pteridopharynx indica, Ware 1924.

The material examined consisted of a large number of males and females.

The worms are easily recognised by the featherlike appearance of the anterior portion of the oesophagus (Fig. 21), and the enormous prominence on the ventral side immediately anterior of the vulva in the females (Fig. 26 and 28).

The body is slender, tapering at both ends. The posterior region of the female body is suddenly and markedly constricted to form the tail, which appears to the naked eye as a posteriorly placed spine slightly bent dorsally. Both males and females were perfectly straight; only a few males showed a slight posterior bend; however, none approached the form of a pothook as recorded by Ware, 1924,—this may be due to the different preserving media used.

The head bears two sessile lateral, and four submedian papillae. Two coronal leafcrowns are present. The external leafcrown consisting of 40-42 leaflets, originates near the base of the capsule and its anterior extremity falls just short of the anterior line of the mouth collar. The internal leafcrown (which is not figured by Ware) forms the anterior margin of the mouth capsule—the leaflets are much shorter than those of the external leafcrown.

The mouth collar is separated from the rest of the body. The buccal capsule is typically that of a *Murshidia*, its lateral axis is shorter than its dorso-ventral axis. At the base of the capsule a group of small irregular prominences comparable with teeth, are present (Fig. 24).

Male : The bursa in the male is distinctly divided into a dorsal, median and two lateral lobes. The ventral, lateral and externo-dorsal rays lie close together, while the branches of the dorsal ray are widely

separated from each other (Fig. 22 and 31). The externo-lateral ray is somewhat separated from the other two lateral rays, which lie close together and it is also thicker at the base than the other two (Fig. 23). The postero-lateral ray has an accessory dorsal branch (dorsal boss) which is well marked but stumpy. The externo-dorsal bears an accessory ray, which varies from a pronounced condition in some specimens (Fig. 33) to a mere vestige in others (Fig. 34). The dorsal ray has a very rugged outline in some specimens (Fig. 31), whereas in others it is almost smooth (Fig. 32). The anterior branches of the dorsal ray are slightly bifid at their extremities (Fig. 31), and the posterior branches have pointed extremities and converge slightly; they are subject to variation (Fig. 25). The spicules are slender and equal and provided with fine plumose alae; their posterior extremity is bent dorsally and ends in a fine point (Fig. 36). A saddleshaped accessory piece is present measuring 0·1 mm. × ·05 mm. Ware records well developed prebursal papillae situated slightly in front of the ventral rays, but these could not be identified in the specimens examined. At least no papillae could be found slightly in front of the ventral rays. Three to four anal papillae however, were noticed, situated on the anal cone and surrounding the anal opening laterally and posteriorly.

Female: The openings of the vulva and anus are close together. Immediately anterior to the vulva is an enormous cuticular prominence, which usually covers the vulva (Fig. 26) and posterior to the anus a slight prominence guards the dorsal lip of the anus. The prevulvar prominence was present in most of the females examined, but a number of females was found which showed the post-vulvar (or pre-anal) prominence (Fig. 29) and two other females showed no prominence at all (Fig. 30). All the other features of these latter specimens were similar to those possessing the marked prevulvar prominence, and also their measurements coincided with those of the latter. So that at present these differences may be regarded as variations of the female posterior extremity.

The vaginal measurement varied from 0·56- 0·73 mm. Ova present measured ·056 × ·029 mm. (Ware's measurement for the ova is slightly different.)

(For measurements see Table 1.)

Habitat: Large intestine and stomach.

Host: Indian elephant.

Murshidia nereu-lemairei (Witenberg, 1925).

Syn. Pterygopharynx nereu-lemairei, Witenberg, 1925.

The material examined consisted of three specimens—one male and two females. (For measurements see Table 1.)

The mouth collar is separated by a slight groove in which are situated the four submedian papillae. According to Witenberg each papilla consists of three parts: a large basal portion; a small middle one and a fine terminal one; this however does not appear to be a constant feature. The head-papillae did not show any distinctive parts, but were the same capitate papillae as are seen in *Murshidia* generally (Fig. 38) except for small prominences situated laterally

near the tips. In the females the head-papillae showed a slight median construction thus approaching the condition described by Witenberg (Fig. 38), but neither showed the condition as well pronounced as is shown in Witenberg's drawing.

The lateral papillae do not project from the surface of the mouth collar.

The oral aperture is in the form of an elongated oval. The dorsal and ventral leaflets of the external row are shorter than the laterals, giving a crescentic appearance when viewed laterally. The internal leaflets are shorter and relatively inconspicuous, and are represented in Witenberg's figure as a denticulated line. At the base of the capsule very fine tubercles are present (Fig. 37), which are similar to those of *M. falcifera* and *M. murshida*. (These tubercles have not been mentioned by Witenberg.) A dorsal gutter is also present projecting slightly into the mouth capsule. The oesophagus is bottle-shaped, its anterior part is covered with peculiar plates obliquely striated giving it a plumose appearance (Fig. 37), which reach to the level of the nerve ring. These plates measure 0·15 mm. in the male and 0·18 mm. in the female.

Male: In the bursa the dorsal lobe is somewhat longer than the lateral lobes. According to Witenberg the rays are quite smooth, but in the male specimen examined they presented a rather uneven outline (Fig. 35). The spicules are similar and were found to be 1·4 mm. in length. Witenberg's measurement of 0·28 mm. is apparently incorrect for according to his drawing they are much larger. They taper gradually to their terminations and have a feathery appearance. An accessory piece and telamon is present (Fig. 39).

According to Witenberg the anus in the female is protected by a large lip situated caudad, but no prominent lip was seen in the specimens examined (Fig. 27), nor does Witenberg show such an anal lip in his drawing. My measurement for the vagina (0·86 mm.) also differs from that given by Witenberg (0·21 mm.) Mature ova were not present in the females examined but according to Witenberg these are 0·062 mm. long and 0·038 mm. broad.

Habitat: Large intestine.

Host: Indian elephant.

Murshidia linstowi, Khalil, 1922.

Syn. Sclerostomum rectum, Von Linstow, 1907.

Cylicostomum rectum, Gedoelst, 1916.

Murshidia recta, Railliet, Henry and Bauche, 1915.

Description: The body of the male is straight, the female tail is slightly bent ventrally. The mouth collar is well developed and rounded in outline. It is ·07 mm. long and ·2 mm. in diameter. The external leafcrown arises from the inner surface of the mouth collar, two-thirds the way up the capsule, and consists of 28 leaflets (20 according to Gedoelst 1916); these are longer laterally than ventrally to dorsally. Each leaflet tapers to a point. An internal

leafcrown is also figured by Leiper (Fig. 42). Lateral and submedian papillae do not project beyond the head. The mouth capsule is large and globular in shape when seen from the lateral aspect. From a dorsal or ventral aspect it is pearshaped, with a narrow opening. No teeth at the base of the buccal capsule. A coneshaped oesophageal funnel is present, 0·8 mm. in length.

Female: The wide opening of the vulva is surrounded by a raised cuticular margin. The two uteri end in strong ovejectors. The female tail gradually tapers to a sharp point.

Male: The bursa is very short and indistinctly divided into three lobes. It measures ·27 mm. in length. The ventral ray is bifid throughout its length, and is placed a considerable distance from the ventral edge of the bursa. The lateral rays arise from a common origin. At the site of the bifurcation each ray has a bulblike swelling. The antero-lateral ray lies separate from the other two, and nearer to the ventral rays. The medio-lateral and dorso-lateral rays lie close together. The externo-dorsal has a rugged outline. It arises in common with the dorsal ray. The dorsal ray arises by a very broad stem and bifurcates into two branches, each ending in three distinct rays. The outer two rays arise by a common trunk (Fig. 41). The two spicules are very stout and practically straight except at their tips. The clubshaped tip is bent sharply dorsally. A small curved accessory piece (S-shaped according to Gedoelst) is present, ·13 mm. in length. (For other measurements see Table 1.)

Habitat: Small intestine.

Host: African elephant.

Murshidia hadia, Khalil, 1922.

(Figs. 43-48.)

The body of the male is straight, the female tail is slightly bent ventrally. Mouth collar is well developed and rounded in outline, and is separated from the rest of the body by a distinct groove. The external leafcrown consisting of 40 leaflets arises from the inner surface of the mouth-capsule. These leaflets are longer laterally than ventrally or dorsally. A second leafcrown is not mentioned. The usual 4 submedian head-papillae are present and they project freely above the head, surmounted by a small knob. The wide conical lateral papillae do not project. The cervical papillae are very thin, long and point cephalad. The mouth cavity is large and globular, measuring ·12 mm. in length and ·15 mm. in maximum diameter. The mouth capsule is a massive chitinous structure. The floor of the oral cavity is free of any teeth.

Female: The wide opening of the vulva is surrounded by a raised cuticular margin. The muscular vagina runs straight towards the head end. The tail gradually tapers to a sharp point.

Male: The bursa is very short and indistinctly divided into three lobes of approximately the same length. It measures ·22 mm. in length and ·7 mm. in breadth. The ventral ray is bifid throughout its length. The lateral rays arise from a common origin. At the site of their bifurcation each ray has a bulblike swelling. The

externo-lateral lies separate from the other two, and it ends in a papilla on the external surface, a short distance from the edge of the bursa. The two remaining laterals lie close together. The externo-dorsal has a rugged outline. It arises in common with the dorsal ray. The dorsal ray arises by a very broad origin and bifurcates into two branches, each ending in 3 rays. The outer 2 rays arise by a common trunk and lie close together. The median ray is stouter and longer and ends some distance from the corresponding ray of the opposite side. The dorsal ray is ·25 mm. long.

The two similar spicules are stout and practically straight. The club-shaped point is bent sharply forward. A small curved accessory piece ·1 mm. long is present. (For other measurements see Table 1.)

Habitat: Intestine.

Host: African elephant.

Murshidia longicaudata, Neveu-Lemaire, 1928.

(Figs. 49-52.)

Neveu-Lemaire described this species as follows:

Cylindrical worms, tapering anteriorly in both sexes. The cuticle is only distinctly striated in the anterior portion of the body. The mouth is surrounded by four sub-median head-papillae (lateral papillae are not mentioned). A well developed external corona is present (a second leafcrown is not mentioned). The buccal capsule is cylindrical. Inside the capsule is a distinct prominence. The intestine at its commencement is wider than the oesophagus.

Male: Equally wide anteriorly and posteriorly, giving to the naked eye a truncated appearance posteriorly. Caudal bursa is large, each division of the dorsal ray has three branches. The medio-lateral and postero-lateral rays are irregularly swollen except at their extremity. The spicules are equal, are slightly sinuous and curved and slightly swollen at their extremities. An accessory piece is present.

Female: The tail is not separated off by a notch or constriction. The uterus and vagina contain oval, segmented, thin-shelled eggs. (For measurements see Table 1.)

Habitat: Large intestine.

Host: African elephant.

Murshidia brachyscelis, Monnig, 1932.

(Figs. 53-56.)

Mönnig's description of this species is based on a single male specimen found amongst other nematodes collected from an African elephant. Its main characteristics are as follows:—

A straight worm and much smaller than any of the other species of this genus. The mouth collar is well developed and separated from

the rest of the body by a distinct groove. The external leafcrown consists of 24 leaflets which are shorter dorsally and ventrally than laterally. (A second leafcrown is not mentioned.) The mouth capsule has the shape of an oval ring flattened from side to side and higher laterally than dorsally and ventrally. The " three sharp curved cuticular flanges, one surmounting each of the three muscular oesophageal columns " described by Lane, 1921, in his generic diagnosis of *Pteridopharynx*, are also present here. There is an oesophageal funnel, 0·12 mm. deep, showing the feathered arrangement. The two thin long cervical papillae are directed cephalad.

The bursa is well developed but short. The ventral rays are close together and reach the edge of the bursa. The externo-lateral turns ventrally away from the other laterals and ends in a papilla, which projects slightly beyond the margin of the bursa. The medio- and postero-laterals are parallel. The externo-dorsal is smooth, it arises at the very base of the dorsal stem and runs near to the postero-lateral, not quite reaching the margin of the bursa. The dorsal ray has a broad base which gives off two branches, each again dividing at once into three rays; of these rays the medial one of each side is the shortest. There are two similar alate spicules which are slightly bent, the tips being bent forwards. A small curved accessory piece and telamon is also present.

(For measurements see Table 1.)

Habitat: ?

Host: African elephant.

Murshidia africana (Lane, 1921).

(Figs. 57-60.)

Syn. Pteridopharynx africana, Lane, 1921.

Description: Rather slender worms, widest at about the middle, with a discoidal head. The leaflets of the corona are 16 in number. The mouth capsule is nearly circular, wider than long. There are two prominences projecting into the floor of the mouth capsule, which Khalil, 1922, regards as teeth, and Lane, 1921, as the beginning of an oesophageal funnel. The oesophagus is short and wide, constricted at the site of the nerve ring. The anterior portion of the oesophagus has a plumose appearance, ·15 mm. long.

Male: The bursal rays are long and slender. The outer branches of the dorsal ray are united up to near their tips (Fig. 60). The dorsal ray of the bursa may have an irregular outline. The spicules are similar and equal, each with a central rod, which ends in a curve and terminates in a sharp hook and with two thin alae, plumosely marked.

Female: In the female caudal papillae are present at a distance of ·55 mm. from the tip of the tail.

(For other measurements see Table 1.)

Habitat: Stomach.

Host: African elephant.

Murshidia anisa (Khalil, 1922).

(Figs. 61-64.)

Syn. Pteridopharynx anisa, Khalil, 1922.

Body of both male and female is practically straight with the greatest diameter about the middle. The body tapers slightly towards the head-end and caudal end. The female tail is suddenly constricted from the body, appearing to the naked eye as a spinous process projecting from the posterior end of the body. The skin is finely striated throughout the whole length of the body. The mouth collar is separated from the rest of the body by a distinct groove. It measures ·125 mm. in diameter and ·02 mm. in length. The external leafcrown consists of 20 leaflets which, when viewed from the ventral aspect forms a crest, being longer in the centre than at either side. Cephalic glands are well marked. Four submedian and two lateral papillae are present. The cervical papillae are long and thin. The mouth capsule is longer than broad. A chitinous plate forms the wall of the posterior half of the mouth capsule, and a funnel-like extension of it forms the wall of the anterior portion. From the posterior end of this chitinous ring projects a series of sharp teethlike processes, overhanging the opening of the oesophagus. The oesophagus is hardly constricted at the site of the nerve collar.

Male: The bursa is long and indistinctly separated into three lobes. The elongation is due to the dorsal lobe. The bifid ventral ray is short and placed close to the cephalic end of the bursa. The lateral rays arise from a common trunk, and in addition to the three ordinary branches has a fourth stumpy-looking ray which is directed caudally. The externo-dorsal is stout and arises close to the lateral rays; it does not reach the edge of the bursa. The dorsal ray is ·7 mm. long. It gives off a branch on either side after ·18 mm. The ending of each of these branches is bifid. (This bifurcation is longer than in *M. africana*). The main stem of the dorsal ray divides into two branches, which end at the posterior limit of the bursa. The bursa is ·82 mm. long and ·47 mm. broad. The spicules are similar, their cephalic ends are thick and surrounded by an everted lip. In their course they entwine each other. Their tips are sharp and curve backwards. An accessory piece, 0·13 mm. long, is present, and is curved dorso-ventrally.

Female: At the level of the vulva the ventral surface curves towards the dorsum forming a conical-shaped tail. On the tail are two caudal papillae, marked on the surface by a depression ·33 mm. from the extremity of the tail.

(For measurements see Table 1.)

Habitat: Intestine.

Host: African elephant.

Murshidia dawoodi (Khalil, 1922).

(Figs. 65-68.)

Syn. Pteridopharynx dawoodi, Khalil, 1922.

The bodies of both males and females are practically straight, tapering slightly towards both ends. In the female the tail becomes suddenly constricted from the body, appearing to the naked eye as a spinous process projecting from the posterior end of the body. The mouth collar has a rounded outline and is separated from the rest of the body by a distinct groove. It is ·015 mm. in diameter and ·30 mm. in length. The coronal leaflets have a conical outline when seen from the lateral aspect. The point of the cone is rounded and projects above the outline of the mouth.

Four capitate submedian, and two lateral papillae are present. The cervical papillae are long and thin. The mouth capsule is pear-shaped. It is longer than broad. A chitinous plate forms the wall of the deep part of the mouth capsule and a thin expansion from it forms the funnel-shaped wall of the outer part. The chitinous plate is ·1 mm. in length. From the posterior end of the chitinous ring projects a series of sharp tooth-like processes overhanging the opening of the oesophagus. The oesophagus is slightly constricted at the site of the nerve collar. There is a conical shallow oesophageal funnel bordered by a thick cuticular edge. The excretory vesicle is a fairly fusiform sac with a short duct.

Male: The bursa is distinctly separated into three lobes. The dorsal lobe is longest. The two branches of the ventral ray lie close together. The lateral rays arise by a common stem. The externo- and medio-lateral lie wide apart. The postero-median has a rounded thickening in its posterior border close to its base. The externo-dorsal ray is stout, and arises close to the lateral rays. It does not reach the edge of the bursa. The dorsal ray is comparatively long (0·45 mm.). It divides into two principal branches, each of which in its turn gives off a thick lateral branch. These lateral branches divide in their distal two-fifths, but their subdivisions lie close to one another. There is a distinct truncated genital cone. The two similar and equal spicules are very long; their cephalic ends are thick and surrounded by an everted tip. The tips are bent backwards but end in a fine point, quite different from the club-shaped tips of the spicules in other species of the genus *Murshidia*. An accessory piece is present—·25 mm. long.

Female: The vulval opening is directed caudally lying on a large protruding papilla. The two muscular ovejectors open into the vagina, connecting it with the corresponding uterus.

(For other measurements see Table 1.)

Habitat: Small intestine.

Host: African elephant.

Murshidia omoensis (Neveu-Lemaire, 1924).

Syn. Pteridopharynx omoensis Neveu-Lemaire, 1924.

The description which follows is as given by Neveu-Lemaire for *M. omoemsis* from the African rhinoceros, which he stated is indistinguishable from *M. omoensis* from the African elephant.

Whitish cylindrical worms with fine cuticular striations. The terminal mouth is surrounded by the usual four sub-median, and two lateral head-papillae, each surmounted by a small prolongation in the form of a button. The external leafcrown is formed of converging leaflets of variable length, commencing at the posterior margin of the capsule, and converging at their free tips. There is also an internal leafcrown, the leaflets (teeth) of which are short and annular and form the margin of the anterior border of the buccal capsule. (Neveu-Lemaire does not figure it in his specimens from the African elephant, but see Fig. 72.)

Cervical glands are well developed. The oesophagus is very short and globular and constricted at the level of the nerve ring. Valves are present at the origin of the intestine.

The anterior extremity of the female is truncate, the posterior extremity is very tapering. The vulva and anus are very close together. (Fig. 71.)

Neveu-Lemaire states that he found male specimens of the above species in both African rhinoceros and elephant, but he does not describe the male. His figure (Fig. 70) of the male bursa, however, shows a dorsal boss attached to the medio-lateral ray. If his figure is correct, this appearance is apparently of rare occurrence, since in *Pteridopharynx* this dorsal boss is usually on the postero-lateral ray, and not on the medio-lateral.

(For measurements see Table I.)

Habitat: Large intestine.

Host: African elephant and African rhinoceros.

Murshidia brevicapsulatus (Mönnig, 1932).

(Figs. 73-77.)

Syn. Pteridopharynx brevicapsulatus, Mönnig, 1932.

The main characteristics as described by Mönnig are as follows:

Practically straight worms not tapering much towards the extremities except in the case of the female tail. The mouth collar is separated from the rest of the body by a groove, and bears four prominent submedien and two broad, short, lateral papillae. The cuticle is striated except on the head where it is smooth. The external leafcrown arises from the lining of the buccal capsule and consists of 40 leaflets which are ·047 mm. long laterally and shorter dorsally and ventrally. (A second leafcrown is not mentioned.) Cuticular flanges are present at the base of the capsule. The oesophageal funnel shows a feathered arrangement and is ·14 mm. deep.

Male: The bursa is well developed showing a relatively long dorsal lobe. The ventral rays have a common stem which is about as long as each branch. The latter are close together and do not quite reach the edge of the bursa. The three lateral rays diverge slightly from one another and the postero-lateral bears a well developed backward projection at its base. The externo-dorsal ray arises at the base of the dorsal stem and runs outwards with a slight backward curve. At its base there is a small backwardly directed knob and slightly more distally it bears a prominent caudally directed branch. The dorsal ray gives off a branch on each side before it bifurcates, these two branches have bifid tips, showing that they are made up of two fused branches each. The terminal dorsal branches bear a number of irregular prominences on the lateral aspect of their bases and end near to the margin of the dorsal lobe. There are two equal alate spicules, more or less triangular with the tips bent sharply ventral-wards. A curved accessory piece and small telamon is present.

Female: The tail is fairly long, bent ventrad and acutely pointed. (For measurements see Table I.)

Habitat: ?.

Host: African elephant.

Murshidia memphisia (Khalil, 1922).

(Figs. 78-82.)

Syn. Memphisia memphisia, Khalil, 1922.

Description: Slender straight worms. The body is slightly attenuated at the anterior end. Just posterior to the mouth is an expansion of cuticle, which encircles the body, and is referred to as the cuticular-collar. The tail of the female is suddenly constricted from the body, appearing to the naked eye as a large posterior placed spine. The cuticle is striated, and towards the anterior end of the body becomes inflated, forming in optical section, two alae, which surround the whole circumference of the body.

The mouth collar is indistinctly separated from the rest of the body. It is ·02 mm. long and ·12 mm. in diameter.

The anterior leafcrown consists of 36 incompletely separated leaflets. The usual six head-papillae are present. Cervical papillae are long and delicate. Seen from the ventral surface, the mouth capsule is practically quadrangular, being slightly broader at the outlet. The chitinous ring surrounding the oral cavity is thick and nearly vertical. There are two teeth projecting into the base of the mouth cavity.

The oesophagus is short and broad and a shallow oesophageal funnel is present. It is slightly constricted at the site of the nerve collar.

Male: The bursa is elongated and distinctly divided into three lobes. The bursa is ·75 mm. long and ·55 mm. broad. The dorsal lobe is about double the length of the lateral lobes. The ventral,

lateral and externo-dorsal rays are crowded together, while the branches of the dorsal ray are wide apart. The bifid ventral ray is placed near the anterior edge of the bursa. The lateral in addition to the usual three branches gives off a 4th stumpy ray, directed caudally. The externo-dorsal ray does not reach the edge of the bursa. Near its origin it gives off a long branch directed caudally and having a rounded extremity. It is ·1 mm. long. The dorsal ray is ·7 mm. long. It gives off a branch on either side before ultimately dividing into two rays. The first two branches have a double papilla at their end. The terminal branches are a long distance apart at the caudal extremity of the bursa.

The spicules are similar and thin with a fine termination, bent dorsally. There is a short accessory piece, ·1 mm. long, curved on itself.

Female: The vulval opening is surrounded by a prominent lip especially on the caudal side, and this latter separates it from the anus.

(For other measurements see Table I.)

Habitat: Intestine.

Host: African elephant.

Murshidia aziza (Khalil, 1922).

(Figs. 83-87.)

Syn. Memphisia aziza, Khalil, 1922.

Description: Slender worms with a narrow head end (·1 mm. in diameter). There is no cuticular expansion. The cuticle is finely striated. The mouth collar is separated from the rest of the body by a shallow groove. It is irregularly rounded when seen laterally, and almost quadrangular when seen ventrally or dorsally. The latter appearance is due to the presence of the lateral head papillae being on the extreme edge of the mouth collar. It is ·02 mm. long and ·1 mm. in diameter. The usual six head-papillae are present. The external leafcrown is composed of 24 leaflets which surround the oval-shape mouth opening. The cervical papillae are thin. The mouth capsule is longer than broad. The chitinous ring surrounding the oral cavity is very thick and almost rectangular in optical section. At the base of the capsule there is a ring of 24 sharp teeth. There are four cephalic glands surrounding the anterior part of the oesophagus from the level of the nerve collar to the mouth capsule.

The oesophagus has a plumose appearance. A shallow oesophageal funnel, surrounded by a thick chitinous wall, is present. The oesophagus is slightly constricted at the site of the nerve ring.

Male: The bursa is distinctly divided into three lobes. The dorsal lobe is much longer than the lateral. The bursa resembles that of *M. memphisia*. It is ·5 mm. in length and ·45 mm. in breadth. The ventral and lateral rays are crowded together. The 4th division (but Khalil does not figure this) of the lateral ray is shorter and knoblike. The externo-dorsal ray does not reach the edge of the bursa. It has a small projection near its origin. The dorsal ray is ·47 mm. long. Each of its first two branches terminate in two

papillae. The terminal two branches terminate close to each other at the caudal end of the bursa. Fairly long pre-bursal papillae are present, ·7 mm. from the caudal end of the bursa. The spicules are similar. Their tips are curved, pointed dorsally. The spicular-sheath is transversely striated in its upper third. The accessory piece is ·1 mm. long enclosing the spicules.

Female: The tail gradually tapers to a point. There are two caudal papillae marked by a slight depression in the lateral line. These are placed ·14 mm. from the tip of the tail. The ova are thin shelled.

(For other measurements see Table I.)

Habitat: Intestine.

Host: African elephant.

Murshidia loxodontae (Neveu-Lemaire, 1928).

(Figs. 88-90.)

Syn. Memphisia loxodontae Neveu-Lemaire, 1928.

Only the females of this species were found and described by Neveu-Lemaire. The body is cylindrical tapering slightly in front, cuticular striations are only slightly marked. A narrow terminal mouth is present. The external corona formed of convergent teeth (leaflets),the internal corona fairly well developed. Four submedian and two lateral papillae are present. The buccal capsule is cylindrical. Cephalic glands are well developed. The oesophagus is but slightly swollen in its posterior third. The body shows a sudden narrowing at the level of the anus. The vagina is fairly long.

(For measurements see Table I.)

Habitat: Large intestine.

Host: African elephant.

Murshidia soudanensis (Neveu-Lemaire, 1928).

(Figs. 91-93.)

Syn. Memphisia soudanensis Neveu-Lemaire, 1928.

Only the female of this species was found by Neveu-Lemaire and described as follows:

Body cylindrical tapering anteriorly, cuticular striations are feebly marked anteriorly, but become more marked posterior to the oesophagus. The mouth is terminal, surrounded by four submedian papillae. The external corona consists of numerous delicate leaflets. The buccal capsule is somewhat coneshaped with the largest diameter anteriorly. Cephalic glands are well developed. The oesophagus is hardly swollen in its posterior third. The posterior extremity is suddenly truncated at the level of the anus and vulva, which are situated at the same level. Behind the anus is a short narrow tail, slightly curved ventrally.

(For measurements see Table 1.)

Habitat: Large intestine.

Host: African elephant.

Murshidia brevicaudata (Neveu-Lemaire, 1928).

(Figs. 94-96.)

Syn. Memphisia brevicaudata, Neveu-Lemaire, 1928.

The description as given, is taken from Neveu-Lemaire:—

The body is cylindrical, tapering anteriorly. The cuticular striations are feebly developed anteriorly, but are more marked posteriorly. The mouth is terminal, surrounded by four submedian papillae. The external corona is narrow; the teeth (leaflets) converging at their free ends. [In Neveu-Lemaire's figure of *M. brevicaudata*, (Fig. 95),the anterior edge of the mouth capsule is serrated—this may be taken as a possible indication of the presence of an internal leafcrown. It is however, not shown for *M. soudanensis*.]

The buccal capsule is roughly coneshaped and widest anteriorly. Cephalic glands are well developed. The oesophagus is swollen in its posterior third. The posterior extremity is broad and suddenly truncated at the level of the anus and vulva, both are situated at the same level, 0·1 mm. apart. Behind the anus is a narrow tail separated from the body by a notch. The ovejectors are well developed, and the vagina is short.

Habitat: ?

Host: African elephant.

M. brevicaudata and M. soudanensis: Neveu-Lemaire distinguishes *M. brevicaudata* from his *M. soudanensis* and from the other species of the same genus, by the shape of the tail. The other characters of the two worms are exactly similar according to his descriptions and as shown by his drawings (compare Figs. 91-96). The measurements also coincide almost exactly except for small differences. (See Table 1.) As regards relative proportions the two worms are almost identical, as the following figures show:—

	M. soudanensis	*M. brevicaudata.*
Tail to body length.....	0·029 : 1	0·026 : 1
Max. diameter to body length.....	0·036 : 1	0·035 : 1
Oesoph. to body length.....	0·028 : 1	0·029 : 1
Diameter of Oesoph. to length of Oesoph..	0·363 : 1	0·450 : 1
Length of nerve-ring from anterior extr. of oesoph., to length of oesoph.....	0·345 : 1	0·300 : 1
Length of vulva from tail-end to body-length.....	0·036 : 1	0·032 : 1
Width of ova to length of ova.....	0·583 : 1	0·581 : 1

Only three specimens of *M. brevicaudata* and four specimens of *M. soudanensis*, and no males were found, and all in the same host. It is doubtful whether the slightest difference between the extremities of the two worms is a constant specific character. It is more likely that both are variations of the same species. In other species of *Murshidia* the posterior extremity of the female was also found to vary among individuals of the same species, collected in the same individual

host. This was particularly the case in the female of *M. indica*. Here a cuticular prevulvar prominence is a characteristic feature; however, individuals were found in which this prominence was absent, and in which a more or less marked post-vulvar prominence then tended to appear, the rest of the female characters being identical. (See Figs. 26, 28, 29, 30.)

We can thus assume that *M. brevicaudata* and *M. soudanensis* are variations of the same species.

Murshidia lanei, Witenberg, 1925.

This species was described on material consisting of *one* specimen (male) only, found by Witenberg 1925 among some *Murshidia*. The main characteristics on which this species is founded are as follows:—

The worm measures 21 mm. in length with maximum diameter of ·6 mm. The oesophagus measures ·50 mm. × ·35 mm. The distance of the excretory pore from the anterior extremity measures 1·0 mm. Each half row of leaflets consists of 24 elements (i.e. 48 in all). The leaflets are acutely pointed, they increase in length gradually from the end of each row to its middle, but the four central leaflets are exceedingly long and project considerably over the line (Fig. 97). The shortest leaflets reach almost to the level of the anterior margin of the body, whilst the highest ones reach the level of the tips of the sub-median papillae.

The spicules are similar without clearly visible alae and taper gradually and bend dorsally; they contain a canal-opening on their tips. There is a small spine behind the opening of this canal on the tip of each spicule. (In its essentials the spicules do not differ radically from those of *M. murshida*.) The accessory piece presents the shape of an irregular S., similar to *M. murshida*. A single small papilla projects in front of the cloacal opening. A telamon is present.

Discussion: The measurements and features of the male bursa, spicules, and of the mouth capsule are seen to coincide with those recorded as characteristics for *M. murshida*. Although Witenberg figures a very short internal leafcrown along the anterior edge of the capsule, he makes no mention of it in his description. The presence of this internal leafcrown makes these mouthparts fall into line with those of *M. murshida*.

As regards the four central leaflets, in a large number of *M. murshida* males and females examined, marked irregularities were found in the relative lengths of the external coronal leaflets, in some cases approaching the condition as described by Witenberg for *M. lanei*. These irregularities in the coronal leaflets were more pronounced in badly preserved specimens and in partly squashed ones.

On the preceeding facts it is therefore doubtful whether the one specimen described by Witenberg presents specific differences from *M. murshida*. Until more convincing information is obtained, it would perhaps be more correct to consider this coronal structural peculiarity as an irregularity in the corona of *M. murshida*. So that at the most, one could consider this condition as a variety of the species *M. murshida*. On these grounds it is proposed to discard the species *M. lanei*.

TABLE I.

Host.	*M. murshida.* Indian Elephant.		*M. falcifera.* Indian Elephant.		*M. indica.* Indian Elephant.		*M. neveu-lemaire* Indian Elephant.	
	♂	♀	♂	♀	♂	♀	♂	♀
Total length	20–23	24–28·2	22–28·8	29–36·6	16·7	21·2	25	25·27·3
Maximum diameter	·75	·9	1·02	1·17	·60	·86		
Diameter of head	·18	·21–·25	·27	·28–·32	·18		·20	·25
Diameter of Capsule x depth	·07–·10		·11–·15		·055	·06	·06	·07
No. of leaflets (Ext.)	60		80		40–42		44 app.	
Length of oesophagus	·5–·6	·5–·7	·9–1·1	·9–1·2	·57	·62	·68	·7
Maximum diameter of oesophagus	·22	·27	·36	·36–·45	·2	·23	·36	·36
Nerve ring from ant. end	·2–·4		·5		·3		·35	·36
Excr. pore from ant. end	1·0		1·41		1·04	1·1	1·09	1·18
Cervical papillae from ant. end	1·10		1·55		1·04–1·31		1·09	1·27
Cuticular striations	·007		·008		·0016		·006	
Length of Spicules	1·1–1·3		1·5–2·1		1·06		1·4	
Length of vagina		1·8		1·81–2·22		·56–·73		1·86
Vulva from anus		·72–·86		·81–1·27		·14		·35–·4
Anus from tail end		1·63		1·71–2·27		·72		1·2
Ova		·072x·048		·084x·041		·056x·029		·062x·038

Host.	*M. linstowi.* African Elephant.		*M. hadia* African Elephant.		*M. longicaudata* African Elephant.		*M. brachyscelis* African Elephant.
	♂	♀	♂	♀	♂	♀	♂
Total length	21–26·5	25·8–29·5	18·5	24	23	28	8·3
Maximum diameter	·8	·85	·67	·82	1·0	1·2	·3
Diameter of head			·2		·19	·23	·16
Diameter of capsule x depth	·13x·07–·08		·15x·07		·13x·05	·15x·17	
No. of leaflets (Ext.)			40				24
Length of oesophagus	·9–1·0		·85	·9	·59	·6–·7	·46
Maximum diameter of oesophagus	·33		·26	·34	·24	·275	
Nerve ring from ant. end	·42–·45		·6		·3 app.		·3 app.
Excr. pore from ant. end	1·23–1·6		·68				·73
Cervical papillae from ant. end	·95–1·41		1·14	1·4			·85
Cuticular striations	·0094		·009				·009
Length of spicules	·96–1·02		1·1		1·65		·75
Length of vagina						·8	
Vulva from anus		·5–·9		·6		1·0	
Anus from tail end		2·3–3·15		2·25		2·55–3·10	
Ova		·05x·038		·04x·023		·07x·05	

(All measurements given in millimetres.)

TABLE I—(*continued*).

HOST	*M. africana* African Elephant.		*M. anisa* African Elephant.		*M. dawoodi* African Elephant.		*M. omoensis* African Elephant.		*M. brevicapsulatus* African Elephant.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Total length	17	18	14–15	16·5–17	23	28	15	18	13	16·8
Maximum diameter	·55	·62	·46	·65	·7	9	·65	·85	·43	·59
Diameter of head							·2–·25			
Diameter of capsule x depth			·065x·093		·1x·135		·1x·04			·17x·02
No. of coronal leaflets (Ext.)			20		24					
Length of oesophagus	·57		·45	·57	·87	·95	·4–·5		·52	·54
Maximum diameter of oesophagus			·14		·24	·3	·21			·23
Nerve collar from ant. end	·3		·25		·42	·45	·23		·25	·27
Excr. pore from ant. end	·97		·87		1·22	1·3			·79	·83
Cervical papillae from ant. end	1·1		·92		1·1				·98	
Cuticular striations	·014		·01		·01–·03				·011	
Length of spicules	·9		·82		1·65		·75		·98	
Length of vagina		·55								
Vulva from anus		·2		·12		·8		·075		·09
Anus from tail end		1·03		·52		1·4		1·025		1·0
Ova		·062x·032		·048x·03		·065x·035		·06x·03		

HOST.	*M. memphisia* African Elephant.		*M. aziza* African Elephant.		*M. loxodontae* African Elephant.		*M. soudanensis* African Elephant.	*M. brevicaudata* African Elephant.
	♂	♀	♂	♀	♂	♀	♀	♀
Total length	13·5–14	14·8–16	12	15	17		19	17
Maximum diameter	·55		·5	·5	·77		·7	·6
Diameter of head			0·1		·15		·21	·20
Diameter of capsule x depth	·09x·05		·072x·045		·075x·06		·11x·07	·10x·07
No. of coronal leaflets (Ext.)	36		24					
Length of oesophagus	·48		·47		·45		·55	·50
Maximum diameter of oesophagus	·18		·14		·16		·2	·20
Nerve ring from ant. end	·25		·2		·26		·28	·24
Excr. pore from ant. end			·72					
Cervical papillae from ant. end	·92		·82					
Cuticular striations	·01		·01					
Length of spicules	·9		·75					
Length of vagina		1·7		·52				
Vulva from anus		·08		·25	·34		·12	·10
Anus from tail end		·58		·66	·64		·57	·45
Ova		·055x·035		·06x·035	·06x·035		·06x·035	·055x·032

(All measurements given in millimetres.)

Subfamily II, Trichoneminae Railliet, 1916.

Syn. Cylistominae Railliet, 1915.

Subfamily Diagnosis: Strongylidae, without a transverse ventral cervical groove, or cephalic vesicle; buccal capsule cylindrical and as a rule short or ringshaped. Dorsal gutter relatively short or absent, never reaching the anterior margin of the buccal capsule.

Parasites of the alimentary tract of Vertebrates.

Genus Quilonia Lane, 1914.

Syn. Evansia, Railliet, Henry and Joyeux, 1913.

Nematevansia, Ihle, 1919.

Quilonia, Ihle, 1919.

Paraquilonia, Neveu-Lemaire, 1924.

Generic Diagnosis: Fairly slender worms. Mouth terminal, surrounded by a mouth collar bearing four prominent sub-median, and two sessile, lateral head-papillae. The leaflets of the anterior (external) leafcrown are few and characteristically curved, and surround the mouth anteriorly. A second leafcrown is present or absent. The mouth cavity is narrower than the buccal capsule—the latter is extremely short. One, two or more teeth may be present at the base of the buccal capsule. The oesophagus is nearly cylindrical in shape.

Male: The bursa is divided into three lobes. The dorsal lobe tends to be longer than the lateral lobes. The dorsal ray is bifurcate, each branch having three subdivisions. The spicules are equal and similar, and each has a sickle-shaped point. The accessory piece is curved from side to side, the concavity being ventrad.

Female: The posterior extremity is straight, long and pointed. The vulva is situated in the caudal third of the body. The ovejectors are divergent, but the posterior uterus immediately turns cephalad. Then the two uteri run cephalad side by side.

Parasites of the elephant and rhinoceros.

Type-species: Quilonia renniei (Raill, Henry and Joyeux 1913) (from Indian Elephant).

Other species from elephants:—

Q. travancra, Lane, 1914	In	Indian	elephant.
Q. apiensis (Gedoelst, 1916)	,,	African	elephant.
Q. africana, Lane, 1921	,,	,,	,,
Q. uganda, Khalil, 1922	,,	,,	,,
Q. brevicauda, Khalil, 1922	,,	,,	,,
Q. ethiopica, Khalil, 1922	,,	,,	,,
Q. khalili, Neveu-Lemaire, 1928 ...	,,	,,	,,
Q. loxodontae, Neveu-Lemaire, 1928	,,	,,	,,
Q. magna, Neveu-Lemaire, 1928 ...	,,	,,	,,

A Key to the Species of Quilonia.*

A. *Coronal leaflets project above the head.*

I. *Buccal teeth present.*

(*a*) Buccal capsule bears a single bulbous tooth ... ... **Q. khalili** ... p. 81

(*b*) Buccal capsule bears two or more teeth.

(1) Internal sub-branch of the dorsal ray longer than the median and external sub-branches ... ... **Q. apiensis** ... p. 79

(2) External sub-branch of the dorsal ray longer than the median and internal sub-branches ... ... **Q. uganda** ... p. 80

(3) Sub-branches of the dorsal ray very short and equal ... **Q. magna** ... p. 82

II. *Buccal teeth absent.*

(*a*) Coronal leaflets 18 in number ... **Q. renniei** ... p. 77

(*b*) Coronal leaflets 26 in number ... **Q. loxodontae** ... p. 82

(*c*) Coronal leaflets ±10 in number **Q. travancra** ... p. 78

B. *Coronal leaflets on a level with, or do not project above the head.*

I. *Buccal teeth present.*

(*a*) Buccal teeth two in number ... ... **Q. africana** ... p. 79

(*b*) Buccal teeth three in number ... **Q. brevicauda** ... p. 80

II. *Buccal teeth absent.*

(*a*) A second corona present, with cleft leaflets ... ... **Q. ethiopica** ... p. 81

Quilonia renniei (Raill; Henry and Joyeux, 1913).

(Figs. 98-101.)

Syn. Nematode No. 2 from Indian elephant, Evans and Rennie 1910.

Evansia renniei Railliet, Henry and Joyeux, 1913.

Quilonia quilona Lane, 1914.

Evansia renniei Lane, 1915.

Nematevansia renniei Ihle, 1919.

Quilonia renniei Ihle, 1919.

Description: The main features of this species are: The leaf-crown projects freely above the head. The coronal leaflets are thin and long. The dorsal ray of the bursa is comparatively short (0·35

* This key is constructed on the descriptions and figures given by the original authors, since, with the exception of a single specimen of the species *Q. travancra*, the material studied by the present writer contained no species belonging to the genus *Quilonia*.

mm. in total length). The dorsal ray bifurcates in its posterior third. There is a rather long common stem before the trifurcation. The lateral sub-branch comes off first, and does not reach the edge of the bursa. The median and internal sub-branches are fused until practically at their tips.

In the female caudal papillae are present, 1·2 mm. from the tip of the sharp pointed tail.

(For other measurements see Table 2.)

Habitat: Caecum.

Host: Indian elephant.

Quilonia travancra Lane, 1914.

(Figs. 102-106.)

Syn. Evansia travancra Railliet, Henry and Bauche, 1915.
Nematevansia travancra Ihle, 1919.

A single male specimen was encountered amongst the material; but although the structure of its caudal bursa no doubt places it into the species *Q. travancra*, it nevertheless does not conform in all respects to the description given for *Q. travancra* by Lane 1914. The latter author describes the worm as follows:—

The mouth is surrounded by 10 rays which do not project beyond the head. The bursal rays are all stouter and the dorsal ray also longer, than those of *Q. renniei*. The dorsal ray is 0·85 mm. long. The dorsal lobe is not marked off from the lateral lobe. The dorsal ray bifurcates in its posterior third. The three sub-branches come off practically at the same level, and are approximately of the same length. The spicules are stouter than those of *Q. renniei*, and wavy in outline. In the female the lateral caudal papillae are 0·9 mm. from the tip of the tail.

(For other measurements recorded by Lane, see Table 2.)

The male specimen studied by the present writer differs from Lane's description of *Q. travancra* on the following points:

The coronal leaflets project freely beyond the head (See Fig. 102).

The spicules are well developed, and are *not wavy* in outline as stated by Lane, 1914.

The cervical papillae are situated anterior to the excretory pore, and Lane, 1914 states that these organs are equidistant from the anterior end.

It also differs slightly in certain measurements, as the following measurements will show (Compare with Lane's measurements in Table 2).

Total length	19·1	mm.
Maximum diameter	0·624	,,
Diameter of head	0·244	,,
Number of coronal rays	±10	

Length of buccal capsule	0·048	mm.
Diameter of buccal capsule	0·128	,,
Length of oesophagus	0·83	,,
Maximum diameter of oesophagus	0·25	,,
Cervical papillae to anterior end	0·81	,,
Excretory pore to anterior end	0·82	,,
Nerve ring to anterior end	0·40	,,
Length of spicules	0·912	,,
Length of accessory piece	0·16	,,

Habitat: Intestine.

Host: Indian elephant.

Quilonia apiensis (Gedoelst, 1916), Lane, 1921.

Syn. Evansia apiensis Gedoelst, 1916.

Description: This species was fully described by Khalil 1922, from material consisting of 25 specimens. Khalil describes the body as tapering towards either end. The mouth collar, irregularly rounded in outline, is distinctly separated from the rest of the body by a groove. There is a curious cuticular prolongation in optical section, in the form of a spine at the site of the groove (Fig. 107). The external leaflets consist of 12 in number, and project above the head (Fig. 107). The internal leafcrown consists of 12 leaflets, which have rounded blunt ends and do not project above the mouth collar. The chitinous buccal capsule is short and ringshaped. The oral cavity is coneshaped, wide laterally and contracted from before backwards. A small oesophageal funnel is present. From the top of the oesophageal columns two spinous processes project into the mouth capsule (Fig. 109).

Male: The posterior lobe (dorsal lobe) is slightly longer than the lateral lobes. The bifid ventral ray lies close to the lateral rays (Fig. 111). The externo-dorsal ray arises from the stem of the dorsal ray (Fig. 112). The dorsal ray is ·7 mm. long, and appears rather broad and short. It bifurcates in its lower third. Each branch trifurcates at the same level, the sub-branches being relatively long with the internal sub-branch the longest.

Female: The tail of the female is rather broad, with a fine tip. As in most species of *Quilonia*, the vulval opening is covered by a brown cement.

(For measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

Quilonia africana Lane, 1921.

Description: In this species the corona is sunken and consists of 10 massive rays. The two sub-ventral teeth are long and sharp (Fig. 114).

The bursal rays are fairly delicate. The cleft between the medio-lateral and dorso-lateral is deeper than that between the medio-lateral and externo-lateral (Fig. 116). The dorsal ray is long and slender and bifurcates in its lower third. Each branch trifurcates after some distance, the lateral sub-branch coming off first, and the median subbranch much later; the three branches diverging from one another (Figs. 115 and 118). In one specimen examined by Khalil, 1922 the externo-dorsal ray was completely missing on one side (Fig. 115). The spicules have fine shafts and delicate striated alae.

The tail of the female is exceptionally long and the point is very fine.

(For measurements see Table 2.)

Habitat: Stomach.

Host: African elephant.

Quilonia uganda Khalil, 1922.
(Figs. 119-123.)

Description: The females are longer and thicker than the males. The mouth collar is rounded in outline and distinctly separated from the body by a groove. The external leafcrown consists of 12 leaflets, fairly broad and characteristically bent at their tips. They project a little distance above the head. The internal leafcrown is composed of 12 short stumpy leaflets, which have a rounded end, and which do not project above the head. From the floor of the capsule project two long chitinous teeth, each surmounted by a delicate sharp spine.

The dorsal lobe of the male bursa is slightly longer than the lateral lobes and has a rounded end (Fig. 123). The dorsal ray is long and thin, being ·5 mm. in length. It bifurcates higher than its posterior third, thus giving each branch (which is long and slender) a longer common stem before the trifurcation. The lateral branch comes off first, all three sub-branches are short and slender, the lateral one being longest. The other rays are all fairly slender. The pre-bursal papillae are placed ·52 mm. from the tip of the bursa. The tips of the spicules are sharp and bent ventrally.

The female tail ends in a fine point. The anal opening is marked off from the surface by a round depression.

(For measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

Quilonia brevicauda Khalil, 1922.
(Figs. 124-127.)

Description: Is based on two specimens. The female is much stouter and longer than the male, with a short tail ending bluntly. The male bursa is much smaller than in the other species. The external leafcrown consists of ten very slender leaflets bent near their termination. They do not project freely above the head. The

internal leafcrown consists of blunt and slightly projecting processes. The mouth capsule is very short and lies closer to the oral cavity than in the other species. The oral cavity is funnel-shaped, narrowing towards the mouth opening. Into the buccal capsule project three long formidable teeth, each is placed on the top of one of the three oesophageal columns. (Figs. 125.) A small oesophageal funnel is present. The male bursa is short and broad. It is ·63 mm. in length and ·52 mm. in breadth. The dorsal ray is short and broad, being 0·5 mm. in length. It divides in its lower third into two branches. Each in turn trifurcates giving three small sub-branches. The lateral sub-branch definitely comes off first. The median sub-branch is markedly short, being approximately half the length of the internal. The spicules are equal and similar having fine terminations ending ventrally.

(For measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

Quilonia ethiopica Khalil, 1922.

(Figs. 128-132.)

The description is based on eight specimens examined by Khalil, 1922. The body is straight, tapering towards either end. The external leafcrown consists of 12 leaflets (Fig. 130). They are broad, leaflike and slightly bent at the tip, and do not protrude above the head. The structure of the leaflets is the main characteristic of this species. The internal leafcrown is also composed of 12 leaflets, each of which is broad at its base and tapers to a point. It has a distinct cleft in the middle, and thus each is really two leaflets side by side (Fig. 130). There is a shallow oesophageal funnel surrounded by a chitinous rim lying on the three oesophageal columns (Fig. 130).

The mouth capsule is extremely shallow. The oral cavity is practically cylindrical and contracted in the middle. Buccal teeth are absent.

Male: The dorsal lobe of the caudal bursa is longer than the lateral lobes. The bursa is 0·8 mm. long and 0·6 mm. broad. The dorsal ray is ·67 mm. long. It bifurcates in its lower third. The terminal sub-branches are long and slender. The lateral sub-branch separates first. The median and lateral sub-branches appear to run more or less parallel. The pre-bursal papillae lie on the lateral lines 0·75 mm. from the end of the bursa. The spicules are equal and similar and each has a fine termination, bent forwards (Fig. 132). The accessory piece has a bulbous cephalic extremity.

Female: The tail tapers gradually. It has a rounded tip.

(For measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

Quilonia khalili, Neveu-Lemaire, 1928.

(Figs. 133-135.)

Only the female is known. The body is cylindrical and has a whitish colour. The corona is feebly marked, composed of only a few

leaflets. The diameter of the corona is ·05 mm. The mouth contains a large voluminous prominent tooth (Fig. 135). The oesophagus shows a slight constriction at the nerve ring. The valves at the end of the oesophagus are hardly visible. The posterior extremity of the female tapers to a fine point. The convolutions of the ovary reach to the anterior quarter of the body. (For measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

Quilonia loxodontae Neveu-Lemaire, 1928.

(Fig. 136-138.)

Description: Is based on two female specimens only. The body is cylindrical and has a whitish colour. The nature of the anterior extremity differentiates this species from all others. The external corona is well developed and possesses a relatively large number of leaflets—about 26. These leaflets are fine and delicate, and each has a small papilla at its extremity (Fig. 138). The diameter of the corona measures 0·15 mm. The buccal capsule is very short. The nerve ring is placed 0·3 mm. from the anterior extremity of the oesophagus. The posterior extremity tapers to a fine point. The convolutions of the ovaries reach to the anterior quarter of the body. (For other measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

Quilonia magna Neveu-Lemaire, 1928.

(Figs. 139-143.)

Description: Relatively large cylindrical worms of a whitish colour. The anterior end has prominent lateral papillae. The external corona is well developed, the leaflets of which project above the head. About 16 leaflets are present, each has a small papilla at its extremity as in *Q. loxodontae*. The buccal capsule is very short. (Neveu-Lemaire figures two teethlike structures at the base of the capsule, but makes no mention of it in his description.) The nerve ring is from 0·2 to 0·25 mm. from the anterior extremity of the oesophagus.

Male: Is slightly pointed anteriorly. The dorsal lobe of the caudal bursa is short and rounded. The dorsal ray is 0·55 mm. long. Its base is thick and it bifurcates at an obtuse angle in its posterior quarter. Each branch has a broad common stem which trifurcates into three equal sub-branches. The spicules are equal, curved and finely striated transversely; they are falciform at the end.

Female: Is larger than the male and pointed anteriorly and its posterior extremity has a long tapering point. The ovaries are convoluted extending into the anterior third of the body.

(For measurements see Table 2.)

Habitat: Intestine.

Host: African elephant.

TABLE 2.

Host.	*Q. renniei.* Indian Elephant.		*Q. travancra.* Indian Elephant.		*Q. apiensis.* African Elephant.		*Q. africana.* African Elephant.		*Q. uganda.* African Elephant.		*Q. brevicauda.* African Elephant.		*Q. ethiopica.* African Elephant.		*Q. khalili.* African Elephant.	*Q. loxodontae.* African Elephant.	*Q. magna.* African Elephant.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀	♀	♂	♀
Total length	15	20	18	20	16	19–21	15–17	21	11·5	16	13	21	13·5	19	22–25	26	20	24
Maximum diameter	·6	·85	·65	·9	62	·78	·52	·64	·55	·64	·45	·87	·55	·7	·56	·85	·67	1·12
Diameter of head	·2		·26		·22	·27	·18		·19		·18	·22	·17					
No. of coronal leaflets	18		10		12		12		12		10		12		10	26	16	16
Length of buccal capsule	·1		·18		·06	·08	·1		·06		·04		·01		0·3	·02	·03	·03
Diameter of buccal capsule	·16		·17		·16		·15		·15		·13	·14	·12		·15	·2	·15	·175
Length of oesophagus	·8		·75		·73	·8	·68	·79	·52	·62	·52	·7	·55	·57	·63	·7	·61	·725
Maximum diameter of oesophagus	·25		·2		·25	·28	·2	·23	·2		·18	·2	·21	·26	·2	·3	·225	·275
Cervical pappillae from ant. end	·85		1·0		·98	1·04	·92	·95	·61	·78	·95	1·1	·7	·86	—	—	—	
Excr. pore from ant. end	·65		1·0		·78	·82	·6	·92	·47		·73	·88	·6		—	—	—	
Nerve ring from ant. end	·4		·45		·34		·43	·52	·25		·29	·39	·25		·30	·4	·3	·35
Length of spicules	·825		·9		·91		·9		·72		·81		·83		—	—	·75	
Length of Acc. piece	·175		·2		·19		·16		·1		·19		·1		—	—	·10	
Length of female tail		2·0		2·3		2·66		3·6		2·43		1·75		2·3	3·0	2·75		3·47
Vulva from tail end		6·0		5·8		6·2		6·85		5·2		5·1		4·97	6·6	6·65		6·72
Cuticular striations	·031		·037		·02		·025		·02		·02		·029		—	—	—	
Ova	·075–·08x037		07x·045		·083x·048		·073x·03		·065x·03		·056x·083		·063x·035		·075x·038	·082x·044	·08x·045	

(All measurements given in millimetres.)

Sub-Family III, Amirinae Neveu-lemaire, 1924.

Diagnosis.—Strongylidae: Ventral rays of male bursa thin and united, preceded by a long and slender prebursal papilla. Lateral rays almost completely united forming a compact mass. Externo-dorsal and dorsal ray arise from a common stem. Each branch of dorsal ray tridigitate. Vulva close to anus, vagina long, uteri parallel.

Present genera: *Amira* Lane, 1914.

Khalilia Neveu-Lemaire, 1924.

Genus Amira Lane, 1914. (Amended—Khalil, 1922.)

Syn. Khalilia Neveu-Lemaire, 1924.

Generic Diagnosis: Fairly small worms with a thick cuticle. Cuticular bosses may be found anterior to the male bursa. The mouth is terminal and is surrounded by an external and internal leafcrown. There are six head-papillae, four sub-median and two sessile laterals, none of which are prominent. The mouth capsule is very short, its dorso-ventral and lateral axi are equal. The oesophagus is hourglass in shape, the nerve collar surrounding the constriction. There is an oesophageal funnel. The oesophagus has a cuticular lining.

Male: The dorsal lobe of the bursa may be enormously elongated. The pre-bursal papillae are very much elongated. The two equal spicules are of enormous length and very fine. A gubernaculum is present.

Female: The vulva lies close cephalad to the anus. The long vagina runs cephalad and divides into two parallel, cephalad running uteri provided with ovejectors. The colourless thinshelled ova are segmented.

Type-Species: A. pileata (Raill., Henry and Bauche, 1914.) (In Indian elephant.)

Other species from elephants:—

A. sameera Khalil, 1922. (In African elephant.)

The generic diagnosis of Lane, 1914, based on his *Amira omra* was slightly amended by Khalil 1922, who added another species—*A. sameera*—to the genus.

Amira pileata Railliet, Henry and Bauche, 1914.

(Figs. 144-149.)

Syn. Cylicostomum pileatum Raill., Henry and Bauche, March, 1914.

Amira omra Lane, 1914.

Five males and six females were found. Five of the females contained mature ova. The bursae of all the males were more or less in a state of disintegration, so that no original camera-lucida drawings of the male extremities could be produced.

The mouth collar is separated from the rest of the cephalic end by a groove. The mouth capsule is circular, its dorso-ventral axis equal to its lateral axis. The capsule has roughly the shape of a flattened barrel so that its anterior and posterior diameter is less than its median diameter. The capsule is shallow and at its base there is a row of tubercles similar in structure to those observed in *M. murshida* and *M. falcifera*. Cephalic glands are fairly well developed (Fig. 145).

The leaflets of the external leafcrown—32 in number—extend slightly beyond the anterior rim of the mouth collar (Fig. 144). The internal leafcrown is also composed of 32 short leaflets forming the anterior margin of the mouth capsule. The specimens also possess cuticular elongate flattened projections at the base of the capsule (Fig. 145). The oesophagus is short and broad and its posterior extremity projects into the beginning of the chile-intestine forming three small lobes. An oesophageal funnel is present extending from the mouth capsule to the level of the nerve ring.

The male bursa is greatly elongated, mainly due to the length of the dorsal lobe. According to Khalil, 1922, the bursa is 1·9 mm. in length and 0·55 mm. in breadth. The cuticle in front of the bursa on the ventral surface is much thickened. The free edges of the lateral lobes of the bursa are folded inwards, obscuring the exact mode of ending of the lateral rays (Fig. 147). The pre-bursal papilla is very long, thin and wavy and measures 0·25 mm. in length. The ventral ray is bifurcated in its terminal half and the two branches lie close together. The anterior branch is thinner than the posterior (Fig. 148). The three lateral rays have a common origin. The postero-lateral ray branches before the other two rays. All three rays lie close to each other throughout their entire course.

The externo-dorsal ray is slender and pursues a curved course. It does not reach the edge of the bursa. The dorsal ray is enormously long. It measures 1·67 mm. and divides high up within 0·15 mm. of its origin. After a short course each primary division gives off a long and a short branch lying close to each other. The longer branch is 0·12 mm. and the shorter 0·05 mm. in length. These branches appear as offshoots from the main stem which continues a straight course parallel and close to the corresponding ray of the other branch. (All bursal measurements recorded here are those given by Khalil, 1922—for own measurements see Table 3).

The caudal end of the female tapers suddenly to a point.

Habitat: Large intestine and caecum.

Host: Indian elephant.

Amira sameera Khalil, 1922.

(Figs. 150-153.)

Syn. Khalilia sameera, Neveu-Lemaire, 1924.

Khalil, 1922, described this species on a single male specimen. In 1932 Mönnig described the female—his measurements are recorded (see Table 3). The two sets of measurements do not quite

coincide, nevertheless there seems to be a close resemblance between the worms described by Khalil, 1922, and those described by Mönnig in 1932.

Khalil's description is as follows: mouth collar is distinctly separated from the rest of the body by a shallow groove. It is regularly rounded in outline and measures 0·048 mm. in length, and 0·25 mm. in breadth. The external leafcrown consists of 36 slender leaflets, 0·065 mm. in length and tapering at their free ends. The internal leafcrown covers the top of the chitinous ring of the mouth capsule. It consists of 36 very short leaflets. The oesophagus is short and thick—bulbous at either end and constricted where the nerve collar is placed. Compared with *A. pileata* the oesophagus of *A. sameera* is longer and thinner. A large oesophageal funnel is present. It ends at the level of the nerve ring where the oesophagus is constricted. There are three chitinous plates lining the funnel as well as the rest of the oesophagus. The cavity of the funnel is 0·21 mm. in length and 0·175 mm. in maximum diameter.

Male: The bursa has a wrinkled appearance. Its edges are curved inwards. The dorsal is distinctly separated from the lateral lobes, and is not as elongated as in *A. pileata*. The bursa is 6·7 mm. long and 0·54 mm. broad. The pre-bursal papilla is thin and wavy and is 0·3 mm. in length. The ventral ray is bifid in its terminal half. The two branches lie close together. The lateral rays lie close together and their terminations are bent inwards similar to *A. pileata*. The externo-dorsal ray is long and ends very near the edge of the bursa. The dorsal ray measures 0.25 mm. It is massive and divided at the level of the origin of the externo-dorsal ray. Each of these primary divisions gives a thick short lateral branch, which almost immediately divides into two (Fig. 153). They are very short and do not reach the edge of the bursa. The main stem is longer and ends near the corresponding ray of the other side. The genital cone is sharply pointed and more massive than that of *A. pileata*. It is not marked with any cuticular thickenings. The cloacal opening is placed practically at the apex of the genital cone. The elongated spicules pursue a wavy course. Their tips are thickened. An accessory piece is present which measures 0·12 mm. in length. It is strongly curved from side to side and less so in longitudinal direction. The concavity of the latter curvature is directed caudally and dorsally. (For other measurements see Table 3.)

Mönnig, 1932, described the female as follows:—

Fairly stout worms tapering only slightly anteriorly, and more posteriorly. The mouth collar is distinctly separated from the rest of the body by a groove, and is a good deal narrower anteriorly than posteriorly. It is 0·31 mm. broad and 0·07 mm. high. The elongate external leafcrown arises from the cuticular lining of the buccal cavity and consists of 42 leaflets, 0·08 mm. long. (This number is bigger than that recorded by Khalil for the male—see Table 3.) An internal leafcrown consisting of short blunt leaflets is also figured (Fig. 150). The oesophageal funnel is typical, 0·24 mm. deep and 0·16 mm. wide. The tail is long, acute and bent dorsad.

Habitat: Stomach.

Host: African elephant.

TABLE 3.

Amira.

HOST.	*A. pileata.*		*A. sameera.*	
	Indian Elephant.		African Elephant. (Khalil.)	African Elephant. (Mönnig.)
	♂	♀	♂	♀
Total length	12·5	13·9–19·9	10·5	11·5–12
Maximum diameter		·59	·45	·65
Diameter of capsule		·13	·165	·22
Length of capsule		·036	·05	
Diameter of head		·19		—
No. of leaflets (Ext.)		32·	36·	42·
No. of leaflets (Int.)		32·	36·	
Length of oesophagus	·52	·58	·6	·75
Maximum diameter of oesophagus	·31	·34	·25	·33
Nerve ring from ant. end	·27	·29	·33	·29
Excretory pore from ant. end		·72	·7	·45
Lateral pappillae from ant. end	·72	·86		—
Length of spicules	3·7		2·9	
Length of dorsal ray	1·34			—
Length of vagina		2·2		—
Vulva from anus		·22		·23
Anus from tail end		·43–·52		·62
Ova		·036x·072		·035x·039
Cuticular striations		—		·006–·008

(Measurements given in millimetres.)

SUBFAMILY IV, STRONGYLINAE Railliet, 1893.

Subfamily Diagnosis: Strongylidae, without a transverse ventral cervical groove; buccal capsule large and globular, subglobular, or infundibular. Duct of the dorsal oesophageal gland almost always prolonged as a ridge on the dorsal wall of the buccal capsule to open near its oral margin. Bursa copulatrix well developed and terminal. Parasites of the alimentary canal of Vertebrates.

Genus EQUINUBRIA Lane, 1914.

Generic Diagnosis: Fairly large and stout bursate nematodes. External leafcrown composed of numerous elements of two lengths. The internal leafcrown is composed of numerous small, short and stout elements. Mouth opening is roughly circular and the mouth capsule is more or less globular with a dorsal oesophageal gland discharging through a dorsal gutter. The buccal capsule bears denticles at its base.

Male: Bursa—ventral ray cleft, and lateral rays arise from a common trunk; externo-dorsal arises separately from the dorsal and almost immediately breaks up into three branches of which the first is the longest. The dorsal ray is split for almost half its length with two lateral branches arising from the common trunk immediately before it bifurcates. The spicules are equal and similar. There is no accessory piece.

Female: The vulva opens on a prominence close to the anus. The two uteri are convergent, running parallel and cephalad, and are furnished with weak ovejectors. Parasites of elephants.

Type-species: E. sipunculiformis (in Indian elephant).

Other species from elephants:—None.

Equinubria sipunculiformis (Baird, 1859), Lane, 1914.

(Figs. 154-161.)

Syn. Sclerostoma sipunculiforme Baird, 1859.

Cylicostomum sipunculiforme (Baird, 1859), Railliet, Henry and Bauche, 1914.

Description: Stout worms, the head separated from the body by a distinct " neck ". The oral aperture is circular and surrounded by an external leafcrown consisting of 168 rays of which 56 are long, while between each pair of these lie two shorter rays (Fig. 156). Internal to the bases of these is a row of bodies, oval when seen from the side and wedge-shaped when the head is cut off and viewed end-on. This is taken to represent an internal leafcrown. The oral aperture points slightly dorsad, and is surrounded by two lateral and four sub-median papillae, none of which are very prominent. The oral cavity and oral capsule are practically identical, they are cup-shaped, the dorsal wall being slightly shorter than the ventral (Fig. 154). Along the mid-dorsal line runs the fine duct of the dorsal oesophageal gland (Fig. 155). At the base of the buccal capsule up to ten teethlike structures (denticles) have been noticed. The anterior end of the oesophagus is enlarged and its posterior bulb ends in the chyle-intestine by the usual three valves.

Male: Is straight for the greater part of its length but turns abruptly dorsal just cephalad of the bursa. The dorsal lobe of the bursa is longer than the laterals. The bursa is supported by a large number of rays. The ventral rays are apposed, the lateral rays have markedly diverging points. The postero-lateral ray has a dorsal boss (Fig. 158). The externo-dorsal trifurcates, the ventral branch is the longest, the other two branches are considerably shorter and are irregular in outline. The dorsal ray shows three sub-divisions on each side marged by irregular prominences. A pair of small pre-bursal papillae is present. The spicules are strong, equal and similar (Fig. 160).

Female: Is straight except for a slight dorsad deviation of the tail. The anus lies at the bottom of a depression between the tail and a marked caudal-projecting conical prominence on which the vulva opens (Fig. 157).

(For measurements see Table 4.)

Habitat: Caecum.

Host: Indian elephant.

Discussion.

The material examined consisted of a large number of males and females. The specimens studied agreed in all characters with Lane's description, except in the length of the male. According to Lane the males average 15 mm., and the shortest male in my collection measured 23·7 mm.; the majority of males were about 27 mm. in length. The males examined by Lane were probably immature forms. The other measurements of this species, although all slightly bigger than Lane's, compare fairly well with his table of measurements (see Table 4).

Furthermore in all specimens examined I noticed denticles at the base of the buccal capsule, these structures are neither mentioned nor figured by Lane. Comparing Lane's figure of the dorsal ray of the bursa with the dorsal rays of males in my collection, I found the stem of the three divisions of the dorsal ray to be considerably longer than that given in Lane's drawing. In all the specimens examined the dorsal ray was much more elongated than that figured by Lane.

(Compare Figs. 159 and 161.)

TABLE 4.

Equinubria sipunculiformis.

HOST.	Author's Measurements. Indian Elephant.		Lane's 1914.	
	♂	♀	♂	♀
Total length	23–27	24–28	15	27·5
Maximum diameter	1·2	1·4		—
Diameter of capsule	·30	·36		—
Depth of capsule	·20	·27		—
Diameter of head	·81	·81–·86		—
Length of oesoph		2·2		2·3
Maximum diameter of oesophagus		·54		—
Nerve ring from ant. end		1·0		1·0
Excretory pore from ant. end	2·7	3·0		—
Length of spicules	1·6		1·5	
Cuticular striations		·004		·004
Length of vagina		1·8		1·7
Anus from tail end		·82		·8
Caudal papillae from tail end		·36		·35
Ova		·063x·036		·060x·035

(Measurements given in millimetres.)

Genus STRONGYLUS Muller, 1820.

Syn. Sclerostoma Rudolphi, 1809.

Generic Diagnosis: Elements of the external leafcrown numerous. Internal leafcrown usually absent. Buccal capsule cupshaped, thick-walled with an external circular ridge immediately behind its anterior border. Teeth may be present towards the base of the capsule.

Dorsal gutter is strongly developed. Bursa of the male is small. Spicules not barbed. Uterine branches opposed. Parasites of Equidae and elephants.

Sub-Genus DECRUSIA Lane, 1914. (Amended.)

Diagnosis: Mouth subterminal facing slightly dorsally. A cup-shaped buccal capsule with two sub-ventral teeth at its base, is present. There is a marked dorsal oesophageal duct running along the mid-dorsal line of the buccal capsule. External and internal leaf-crowns present, each composed of numerous elements. Dorsal ray is undivided except at its extreme tip. Spicules are equal and similar, fine pointed, and without an accessory piece. The female tail is blunt, the vulva is in the caudal third, the uteri are divergent, the caudad-running uterus turning immediately cephalad. Parasites of elephants.

Type-Species: D. additictia—In Indian elephant.

Other species from elephants—None.

Decrusia additictia Raill., Henry and Bauche, 1914.

Syn. Strongylus additictus Railliet, Henry and Bauche, 1914.

Decrusia decrusi Lane, 1914.

Decrusia additicia Raill., Henry and Bauche, 1915, and Lane, 1915.

Strongylus additicius Ihle, 1919.

Fairly stout worms tapering at both ends, and at a first glance looks like *Strongylus vulgaris*. The head is truncated. Dorsal wall of the oral cavity is slightly shorter than the ventral. (Fig. 164.) The oral aperture is surrounded by an internal corona composed of numerous short and blunt leaflets, which are somewhat masked by the more pronounced external leafcrown, the leaflets of which latter are pointed and longer than those of the internal leafcrown. (Fig. 162.) Both leafcrowns arise apparently at the same level. The dorso-oesophageal duct is very pronounced and runs along the dorsal wall of the mouth cavity as a canal bordered by scalloped marking. In the basal region of the capsule are two triangular prominences (teeth) with similar scalloped markings. There are six oesophago-intestinal valves. Cervical papillae are absent.

Male. The ventral rays of the bursa are long and stout. The externo-lateral ray is short. The externo-dorsal is also short, The dorsal ray is undivided except at its extreme tip—but this tip is subject to marked variations. (See figs. 167, a, b, and c.) In all variations the edge of the bursa between the two final branches is prolonged into a prominent point. The spicules have marked cross-striations at the base. They taper to extremely fine points. There is no accessory piece.

Female. The tail is very blunt but often has a short projecting spine. (Fig. 163.) The caudal papillae lie facing caudad 0·05 mm. from the tip. The vulva is situated in the posterior third of the body.

(For other measurements see Table 5.)

Habitat: Caecum and large intestine.

Host: Indian elephant.

Discussion: The material examined consists of 12 females which were in a very damaged state, due to the fact that they had been kept too long in the preserving medium (lacto-phenol). Males were absent. The females examined are definitely *D. additictia* and the measurements taken agree very favourably with those recorded by Lane, 1914, except for the total lengths (see comparative Table 5). Furthermore, the specimens very definitely show a double leafcrown, a feature which does not seem to have been observed either by Lane or by the other workers. The establishment of the presence of the internal leafcrown hence necessitates a slight amendment of the generic diagnosis to include two leafcrowns.

TABLE 5.

Decrusia additictia.

HOST.	Author's Measurements. Indian Elephant.	Lane, 1914.	
	♀	♂	♀
Total length	17, 20–21	14	15
Diameter of capsule	·5	—	
Length of capsule	·4	—	
Cuticular striations	·013	·01	
Length of oesophagus	1·8	1·9	
Maximum diameter of oesophagus	·41	·37	
Nerve ring from ant. end	1·07	1·1	
Excretory pore from ant. end	—	1·0	
Length of spicules	—	2·4	
Vulva from anus	7·5		7·3
Anus from tail end	·29		·3
Ova	·08x·036	·075–·04	

Genus CHONIANGIUM Railliet, Henry and Bauche, 1914 (amended).
Syn. Asifia Lane, 1914.

Generic Diagnosis: Fairly stout, straight worms. The anterior extremity is, or tends to be obliquely truncate, so that the mouth is directed antero-dorsally, with an external leafcrown arising from the rim of the mouth opening. The external leafcrown is composed of a circle of similar leaflets. An internal leafcrown is absent. The mouth capsule is large and deep and may have teeth in its depth. Cuticular prominences may project into the cavity of the buccal capsule about the middle of its length. The bursa has an accessory ray projecting

from the dorsal aspect of the main stem of the lateral ray. The two spicules are equal and similar. The vulva lies close to the anus where the worm suddenly narrows. The vagina divides into two uteri running parallel towards the cephalic end. The tail is bluntly conical.

Parasites of elephants.

Type-species: *C.epistomum*—In Indian elephant.

Other species from elephants:—

C. magnostomum, n.sp.—In Indian elephant.

Choniangium epistomum (Piana and Stazzi, 1900) Raill., Henry and Bauche, 1914.

Syn. Sclerostomum epistomum Piana and Stazzi, 1900.
Asifia vasifa Lane, 1914.

Description: Males are shorter than the females. The oral aperture is surrounded by a corona of about 50 converging leaflets (Fig. 169). The leaflets extend very slightly above the head. Each leaflet is supported by an external cuticular flap. Lane, 1914, does not mention this. A large funnel-shaped buccal capsule follows on the oral cavity (Fig. 168). There are no teeth at the base of the capsule, but four pairs (not 5 pairs as recorded by Lane, 1914) of hemispheroidal cuticular prominences project into the oral cavity. One pair lies just posterior of its equator close to the middorsal duct (Fig. 169-1). Slightly more cephalic of these and on a more ventral plan lies a second pair (Fig. 169-2). A third pair lies just cephalad of the last pair and about the same level (Fig. 169-3). A fourth smaller pair lies anteriorly and ventrally in the anterior third of the buccal capsule (Fig. 169-4). The dorsal gutter shows a thin line (Fig. 168).

The valves of the chyle-intestine are exceptionally large and the anterior extremity of the chyle-intestine is wider than the posterior extremity of the oesophagus (Fig. 168).

Male bursa are longer dorsally than ventrally. The ventral rays are apposed, the points of the three branches of the lateral ray are divergent. An accessory lateral ray is present, which has a granular appearance (Fig. 172). The externo-dorsal ray is long and somewhat sinuous. The dorsal ray divides into three branches, each of which is bifurcate (Fig. 171). The spicules terminate in fine points. The accessory piece is wider caudad than cephalad and forms a trough containing the spicules.

(For measurements see Table 6.)

Habitat: Caecum.

Host: Indian elephant.

Choniangium magnostomum, sp. n. (Figs. 173-178).

Description: The worms belonging to this species are longer than those of the type-species. The oral aperture is surrounded by a corona of about 50 leaflets, which stand up straight and bend inwards at

their extreme tips, giving the appearance of semi-hooks. The corona extends well beyond the anterior extremity. Each leaflet is supported on its external surface by a cuticular flange (Fig. 176) which curves round on to the collar and ends at the level of the posterior fifth of the tooth. The mouth collar is more pronounced than in *C. epistomum*. The buccal capsule is long and deep, its walls remaining more or less equidistant anterior and posterior or in some specimens slightly wider posteriorly than anteriorly (Fig. 173). Cuticular prominences of the nature found in *C. epistomum* are absent. Small teethlike structures are present at the base of the capsule (Fig. 175). The dorsal oesophageal gutter is more pronounced than in *C. epistomum*.

The valves of the chyle-intestine are large and flaplike and the anterior extremity of the former is wider than the posterior end of the oesophagus (Fig. 175).

Male: The male is very similar to that of *C. epistomum*. The dorsal lobe is fairly long. The three branches of the lateral ray are divergent. The externo-lateral ray is slightly longer and sometimes thinner than the other two laterals. An accessory lateral ray is present, but is not granular (Fig. 178). The dorsal divides into three branches each of which bifurcates again. The inner bifurcation of the lateral branches has a characteristic swelling near its tip (Fig. 177). The spicules end in fine points and a saddleshaped accessory piece is present (Fig. 177).

(For measurments see Table 6.)

The characteristic form and shape of the external corona and the characteristic shape of the buccal cavity, as well as the absence of cuticular prominences in the latter, are the distinguishing features of this species.

Habitat: Intestine.

Host: Indian elephant.

Discussion: The material examined consisted of two females of *C. epistomum* and no males, and 12 specimens of *C. magnostomum*, including six males and six females.

On the constant features shown by the 12 specimens, especially in regard to coronal form and shape of buccal capsule, I propose to put these worms in the new species described above.

Ware, 1924, described a nematode taken from nodules removed from the intestinal wall of an elephant. He suggested that this nematode be admitted as an immature form of a member of the genus *Choniangium*, since it agreed very closely with the generic description of *Choniangium*. The dorsal ray of this parasite, figured by Ware, is typical of *Choniangium*, and the lateral lobe shows the fourth accessory ray and the female tail end is also very similar to that of *C. epistomum*. However, his figure of the capsule shows hardly any resemblance to that of either of the two *Choniangium*-species. The measurements also do not agree as will be seen from the table, but this may be accounted for by the fact that the parasite described by Ware, was an immature individual.

(Type-specimens have been deposited at Onderstepoort Laboratories.)

TABLE 6.

Choniangium.

HOST.	*C. epistomum.* Indian Elephant. (Lane, 1914).		*C. magnostomum.* Indian Elephant.		WARE'S *nematode.* Indian Elephant.	
	♂	♀	♂	♀	♂	♀
Total length	14	18·5	19–21·2	21–22·3	9–	9
Diameter of capsule	·35	·36	·31	·36	·16	
Length of capsule	·75	·75	1·0		—	
Cuticular striations	·004		·004		·018	
Length of oesophagus	1·5	1·55	1·8		·75	
Diameter of oesophagus	·32	·34	·4		·13	
Nerve ring from ant. end	1·25	1·30	1·4	1·5	·35	
Excretory pore from ant. end	2·2		2·5	2·6	—	
Cervical papillae from ant. end	2·0	2·3	2·2		·75	
Length of spicules	2·0		2·3		·6	
Caudal papillae from tail end	·12		·13		—	
Vulva from anus	·29		·31–·36			·23
Anus from tail end	·45		·4			·2
Length of vagina	1·2		1·2			·25
Ova	·05x·025		·075x·027		—	

(Measurements given in millimetres.)

FAMILY II ANCYLOSTOMIDAE (LOOSS, 1905) LANE, 1917.

SUB-FAMILY NECATORINAE, Lane, 1917.

Sub-Family Diagnosis: Ancylostomidae: mouth directed antero-dorsally; with a sub-globular buccal capsule, the oral margin of which is provided ventrally with semi-lunar plates.

Genus BUNOSTOMUM Railliet, 1902.

Syn. Monodontus Molin, 1861, in part.

Bustomum Lane, 1917.

Generic Diagnosis: Capsuled bursate nematodes having the mouth guarded by ventral semilunes. The mouth cavity contains a dorsal tooth, being the freely projecting duct of the dorsal oesophageal gland. There is a pair of sub-ventral lancets at its base.

The dorsal and externo-dorsal rays are asymmetrical. The dorsal ray bifurcates to a varying degree, each branch being bidigitate or tridigitate. Spicules are equal. A gubernaculum absent.

The vulva in the female is situated in front of the middle of the body. Parasites of herbivores.

Type-Species: B. trigonocephalum, Rudolphi, 1808.—In sheep and cattle.

Other species from elephants:—

B. foliatum Cobbold, 1882.—In Indian elephant.

B. brevispiculum Mönnig, 1932.—In African elephant.

B. hamatum Mönnig, 1932.—In African elephant.

Bunostomum foliatum (Cobbold, 1882.) Rail., Henry and Bauche, 1914.

(Figs. 179-183.)

Syn. Strongylus foliatus Cobbold, 1882.

Uncinaria sangeri Alessandrini, 1905 (not Railliet, 1896).

Cobbold, 1882, describes this nematode as follows: Body smooth, of nearly uniform thickness, finely striated transversely. Head indistinct, truncated in front, with five small auriculate folds. Mouth slightly oblique, leading to a deep buccal capsule, armed with a few coarse teeth, succeeded by a long muscular oesophagus. Neck marked by two short conical papillae at the upper part, one on either side, and by two larger and longer tapering papillae placed lower down. (The latter are probably the cervical papillae.)

The bursa is bilobed, foliate. Rays few in number, and widely separated. Spicules long, flattened, and twisted at the base, tapering and finely pointed below at the apex. They measure 1·46 mm. The tail of the female is well marked, long and conical, with a wavy contour, directed backwards, and rapidly narrowing to form a subulate point. Anus in front, and immediately above the base of the tail. Length of the male is 13 mm. and of the female 15·2 mm.

Habitat: Stomach. (Tumours.)

Host: Indian elephant.

Bunostomum brevispiculum Mönnig, 1932.

(Figs. 184-187.)

The description is based on a single male specimen. The anterior end is flexed dorsad, and the mouth opening is situated on the dorsal side. Six papillae, four sub-median and two lateral, surround the mouth. The buccal cavity is lined with highly refractive chitin, varying in thickness in different places and thus forming a sinuous line in optical section. The buccal capsule is longer ventrally than dorsally. At the base of the capsule there is a moderately large dorsal tooth, 0·043 mm. long with a bifid tip, and two slightly smaller sub-ventral teeth. The oesophagus is provided with a small funnel lined with chitin; the whole oesophagus is club shaped. The excretory pore opens slightly behind the level of the nerve ring. There are a pair of fairly thick blunt cervical papillae placed at a short distance behind the level of the excretory pore.

The bursa is well developed and the dorsal lobe is asymmetrical. The ventral rays have a common stem which is longer than the two branches; the latter lie close together and do not reach the edge

of the bursa. The lateral rays originate from a thick stem which divides about half-way down the length of the lateral lobe. The externo-lateral ray diverges widely in a ventral direction from the other two; the medio- and postero-laterals are directed somewhat dorsad, run close together, and reach the margin of the bursa. The right externo-dorsal ray comes off very high from the dorsal stem, it is thin and runs a sinuous course into the right lateral lobe. The left externo-dorsal ray is given off just anteriorly to the bifurcation of the dorsal ray and passes into the left lateral lobe. The two branches of the dorsal ray have tridigitate tips which differ in the two rays. The specimen showed one spicule which is alate and twisted irregularly.

(For other measurements see Table 7.)

Habitat: ?.

Host: African elephant.

Bunostomum hamatum Mönnig, 1932.

(Figs. 188, 189.)

The description is also based on a single male specimen. It is smaller than *B. brevispiculum*. Its mouth capsule is similar to that of *B. brevispiculum*, with a slightly longer dorsal tooth (0·055 mm.). The cervical papillae are placed on a level between the nerve ring and excretory pore.

The male bursa has the same appearance as in *B. brevispiculum*, but differs from it in the case of the ventral rays, whose common stem is shorter than the two branches. There are two equal alate spicules, with their distal ends sharply bent dorsalwards and the extreme tips curved back in the form of small hooks.

(For other measurements see Table 7.)

Habitat: ?.

Host: African elephant.

TABLE 7.

Bunostomum.

	B. foliatum.		*B. brevispiculum.*	*B. hamatum.*
	♂	♀	♂	♂
Total length.....	·13	15·2	12·1	8·7
Maximum diameter.....	—		0·073	0·086
Cuticular striations.....	—		0·003	0·003
Vent. length of capsule....	—		0·157	0·161
Dorso-ventral diameter of capsule.....	—		0·118	0·118
Length of oesophagus	—		1·02	1·08
Nerve ring from ant. end..	—		0·52	0·50
Excretory pore from ant. end.....	—		—	0·55
Length of spicules.....	1·46		0·224	0·67

Genus BATHMOSTOMUM Raill. and Henry, 1909 (Amended).

Generic Diagnosis: Anterior extremity bent dorsally. Buccal capsule infundibular with two semilunar ventral cutting plates at its oral margin. The internal surface of the capsule is raised into a series of shelflike ridges. A dorsal gutter is present. Teeth in the depth of the buccal capsule are absent.

Male bursa: Dorsal rays are separate for nearly their whole extent, the externo-dorsal rays springing from the individual dorsal rays. The lateral rays have a ventral direction. Spicules are stout and equal. A gubernaculum present.

The vulva is a little in front of the middle of the body.

Parasites of elephants.

Type-species: B. sangeri—In Indian elephant.

Bathmostomum sangeri (Cobbold, 1882), Raill. and Henry, 1909.

(Figs. 190-198.)

Syn. Dochmius sangeri Cobbold, 1879.

Uncinaria sangeri (Cobbold, 1879), Railliet, 1897.

Uncinaria os-papillatum Piana and Stazzi, 1900.

Description: Fairly small worms with a characteristic dorsally bent anterior extremity. The semilunes are large and massive. Lane, 1921 states that the buccal cavity is wider than long; but in all specimens measured the buccal capsule was never wider than long, the width of the capsule was either equal or slightly shorter than its length. This measurement probably depends on the state of preservation of the specimens. The semilunes are not well pronounced. The shape of the buccal cavity is more or less sub-globular, its internal surface is raised mainly ventrally and laterally upwardly tilted shelf-like ridges. The ridges appear to be complete, and not interrupted as stated by Lane, encircling the cavity of the capsule. These ridges appear to be folds in the cuticular lining of the buccal capsule. The buccal capsule bears no teeth, but each ridge is pleated once on either side of the median ventral line, giving in lateral view the appearance of double supporting teeth, and in dorsal view of three pairs of sub-ventral teeth, as was wrongly interpreted by Lane. The oesophageal gutter opens into the buccal cavity as a conical projection, and it is not associated with a dorsal tooth, as was stated by Lane. The oesophagus is long and simple with a slight posterior swelling. Three intestino-oesophageal valves are present

Male: The bursal rays are fairly stout, the lateral and ventral rays tapering steadily. The divisions of the three lateral rays are about the same depth. The pre-bursal papilla is large. The spicules are stout and similar, ending in sharp truncated points. One male examined had spicules whose median parts were inflated (Fig. 195), but this is probably an abnormal condition or irregularity. A gubernaculum is present, the two halves of which form a semi-circle (Fig. 194).

Female: The vagina is short, the two uteri divergent. The tail has a long tapering point (see Figs. 198 and 191).

(For measurements see Table 8.)

Habitat: Large intestine.

Host: Indian elephant.

Discussion: The material in hand consists of an enormous number of males and females. A large number of specimens was examined and all showed the features characteristic of the above species. Buccal teeth being found to be absent, and a gubernaculum to be present, the specific description and also the generic diagnosis have been amended. The ridges in the internal surface-lining of the capsule being complete, the capsule is not fissured, as stated by Lane.

The measurements taken do not compare very well with Lane's but this difference may be due to the poor state of preservation of Lane's specimens.

TABLE 8.

Bathmostomum sangeri.

HOST.	Indian Elepahnt.			
	Author's Measurements.		Lane's 1921.	
	♂	♀	♂	♀
Total length	15–16·6	18–22·1	15–16*a	20*a
Maximum diameter	·63		—	
Diameter of capsule	·27		—	
Length of capsule	·27		·24	
Cuticular striations	·006		·005	
Length of oesophagus	1·55	1·67	1·5	
Maximum diameter of oesophagus	·27	·29	—	
Nerve ring from ant. end	·63	·73	·5	
Excretory pore from ant. end	·81–·90	·86–1·09	·6	
Cervical papillae from ant. end	—		·66	
Caudal papillae from tail end		·16		·18
Length of spicules	·75		·47	
Vulva fron anus		8·9–11·4		9·0
Anus from tail end		·72		·6
Ova		·063x·033		·045x·030

(All measurements given in millimetres.)

* a. These total length measurements are taken from Yorke & Maplestone, 1926.

Genus GRAMMOCEPHALUS Raill. and Henry, 1910.

Generic Diagnosis: Anterior extremity bent dorsally. Buccal capsule wide, and narrowed posteriorly, the narrowing being more abrupt on the dorsal wall and accompanied by an infolding of the capsule. Oral margin has two semilunar ventro-cutting plates. Towards the base of the capsule a pair of lateral and a pair of subventral teeth are present, also a dorsal cone carrying a dorsal gutter. The intestine has a long anteriorly directed dorsal diverticulum, arising close to its union with the oesophagus.

Male Bursa: Ventral ray cleft to its base. The extreme-lateral and postero-lateral are close together. The externo-dorsal and dorsal arise from a common trunk. The dorsal ray has two limbs, each limb being bidigitate. The spicules are stout and alate. An accessory piece is absent.

Female: Vulva situated near the middle of the body; the uteri are divergent.

Parasites of elephants and rhinoceroses.

Type Species: G. clathratus, Baird, 1868. (In African elephant.)

Other species in elephants:

G. varedatus, Lane, 1921. (In Indian elephant.)

G. hybridatus, n. sp. (In Indian elephant.)

Grammocephalus clathratus (Baird, 1868.), Railliet and Henry, 1910.

(Figs. 200, 201, 203, 204.)

Syn. Sclerostoma clathratum Baird, 1868.

Strongylus clathratus Cobbold, 1882.

The description as given is taken from Lane, 1921.

The semilunes at the anterior extremity are large (Fig. 200), the fold in the dorsal wall of the oral capsule is marked; the medium dorsal tooth not particularly prominent; the apical notches in the sub-ventral teeth large, the anterior edges of these teeth face anteriorly and ventrally. The anterior edges of the lateral piece lie well posterior of the corresponding edges of the sub-ventral teeth (Fig. 200). The oesophagus is long and simple. The intestinal diverticulum measures 2·3 mm. (For other measurements see Table 9.)

Male: The bursal rays (Fig. 201) are relatively long. The dorsal rays are united from their base to the point of origin of the externo-dorsal rays, separate beyond, and their extremities are bifid; the outer branch curving, the inner inclining towards the midline (Fig. 204).

Female: The body narrows abruptly about the anus, and the first part of the tail is nearly cylindrical. (Fig. 203).

Habitat: Bile ducts.

Host: African elephant.

Grammocephalus varedatus Lane, 1921.

(Figs. 199, 202, 205.)

Syn. Strongylus clathratus Cobbold, 1882.

Sclerostomum clathratum Piana and Stazzi, 1900.

Nematode No. 1 Evans and Rennie, 1910.

Grammocephalus clathratus (Baird), *ex parte* Raill. and Henry, 1910.

The following description is taken from Lane, 1921:

The semilunes are somewhat small, the fold in the dorsal wall of the oral capsule is not markedly conspicuous. The ventral projection of the dorsal tooth is considerable, the apical notches of the sub-ventral teeth are small, and the anterior edges of these teeth face anteriorly and dorsally. The anterior edges of the lateral teeth do not lie posterior of the corresponding edges of the sub-ventral teeth (Fig. 199). The intestinal caecum measures 2·2 mm.

(For other measurements see Table 9.)

Male: The bursal rays are relatively short (Fig. 205). The branches of the dorsal ray are exceedingly short. The tail of the female is conical. (Fig. 202).

Habitat: Bile ducts.

Host: Indian elephant.

Grammocephalus hybridatus, sp. n.

(Figs. 206-221.)

The material consists of a large number of male and female specimens, from the bile ducts of the Indian elephant. Also numerous larval forms taken from nodules removed from the large intestine. Among the adult specimens from the bile ducts few larval and immature males and females were also present.

The males and females are more or less of equal length. The head is curved towards the dorsum and the mouth is directed obliquely, dorsally and anteriorly.

The semilunes are not large, somewhat intermediate between that of *G. varedatus* and *G. clathratus*. The fold in the dorsal wall of the buccal capsule is not well marked at all. In most specimens it is not visible. A pair of sub-ventral teeth are present, the apical notches of which are relatively small, and the anterior edges of these teeth face anteriorly and dorsally. The position and shape of this lancet is very similar to that of *G. varedatus* except that its ventral anterior edge is usually produced into an acute point, and is never rounded like that of *G. varedatus*. In one particular specimen the sub-ventral lancets had only one instead of two apical notches (Fig. 209) and their dorsal anterior edges approach the condition as figured for *G. varedatus* (Fig. 207). A pair of lateral teeth is also present. These, although subject to variation (Figs. 208, a, b, c,) are also very similar in shape and position, to those of *G. varedatus*, i.e. they have the anterior surface concave, so that the free apex forms an acute angle. The anterior edges of the lateral lancets also lie anterior of the corresponding edges of the sub-ventral teeth. (Compare Figs.)

The single dorsal tooth is not so conspicuous and receives the duct of the dorsal oesophageal gland. The oesophagus is long and simple. The intestinal diverticulum averages 2·09 mm.

Male: The bursa is elongate, particularly so in the larval males (see Fig. 215), and the externo-dorsal rays of the adult male are longer than those of *G. varedatus* and *G. clathratus* (Fig. 219). The general appearance of the bursa is very similar to that of *G. clathratus*. The structure of the larval male spicule is very different to that of the adult male spicule (compare Figs. 217 and 218).

Female: Is thickest at the vulva and tapers towards both ends. The tail ends in a long conical point, which is more acute in the larval females than in adult females. Also the tail ending points slightly dorsad in all adult females, but is straighter in larval females (compare Figs. 210, 212, 213). Rectal glands were observed in a number of females.

(For measurements see Table 9.)

Habitat: Adults in bile ducts and larvae in nodules on large intestine.

Host: Indian elephant.

Discussion: From the above description and figures presented it will be noted that the cephalic end of this nematode from the Indian elephant bears a remarkable resemblance to the cephalic end of *G. varedatus*, (from Indian elephant) whereas the male bursa closely resembles that of *G. clathratus* (from African elephant). However, the features of the cephalic extremity and the male bursa respectively, are not absolutely identical. For example, the lateral and sub-ventral lancets of the species described above are not quite identical with those of *G. varedatus*. *G. hybridatus* also differs in the almost complete absence of the fold in the dorsal wall of the capsule, and in structure and position of the oral plates. In the male bursa, the individual rays of this species are also somewhat more elongate than those of *G. clathratus*, as figured by Lane, 1921. Also the female tail end, although very similar to that of *G. varedatus*, is not identical with it as regards shape. Furthermore, the principal measurements of this worm differ widely from those recorded for the other two species (see table). Hence, according to the peculiar combination of characters shown by the anterior and the posterior end, as well as the different measurements of this worm, it is not possible to consider it as a variation of either *G. clathratus* or *G. varedatus*. Also, since the nematode parasites of the Indian and African elephant have so far been found to be quite specific to their host, the worm in question cannot be regarded as a variation of *G. clathratus* from the African elephant.

Neveu-Lemaire, 1924, described a *Grammocephalus*—species (*G. intermedius*) from the large intestine of the African rhinoceros, but according to his description (based on a few badly damaged specimens) and his figures, this species is more closely related to *G. clathratus* of the African elephant, than to the species described above; which is what one would expect, since both African elephant and rhinoceros inhabit more or less the same locality.

Since the characters of the buccal capsule and bursa, and the measurements as given above for the bile-duct-nematode under discussion, were found to be very constant in the large number of

specimens examined, including immature and larval forms, it is in my opinion justifiable to consider it as a new species, for which the name *G. hybridatus* is being proposed.

(Type-specimens have been deposited at Onderstepoort.)

TABLE 9.

Grammocephalus.

HOST.	*G. clathratus.* African Elephant.		*G. hybridatus.* Indian Elephant.		*G. varedatus.* Indian Elephant.	
	♂	♀	♂	♀	♂	♀
Total length	45·5	36	37	37	55	47
Maximum diameter	1·15	1·03	1·4	1·0	1·35	1·1
Length of buccal capsule	·46		·50	·46	·55	
Cuticular striations	·014		·012		·014	
Length of oesophagus	3·6		3·64	3·7	3·6	
Nerve ring from ant. end.	1·2		1·09	1·0	1·16	
Excretory pore from ant. end	1·7		1·29	1·07	1·5	
Cervical papillae from ant. end	1·7		1·15		1·7	
Length of spicules	1·2		1·54		1·35	
Vulva from anus		17		16·7		22
Anus from tail end		·67		·80		·8
Ova	·05x·035		·058–·063x·029–·036		·068x·037	

(Measurements given in millimetres.)

FAMILY III SYNGAMIDAE LEIPER, 1912.

Family Diagnosis: Strongyloidea, with a well developed chitinous subglobular buccal capsule, the oral margin of which is not supplied with leafcrowns or other cutting organs, but is thickened to form a prominent chitinous rim, and bears teeth at its base.

Parasites of the respiratory system.

Genus SYNGAMUS, v. Siebold, 1836.

Syn. Cyathostoma Blanchard, 1849.

Generic Diagnosis: Nematodes with a well developed buccal capsule provided at its surface with a large chitinous ring, and in its depth with a variable number of small triangular teeth. Two lateral and four sub-median head papillae. The males are much smaller than the females to which they are permanently coupled.

Male: Bursa short; with the following formula: ventral ray cleft, postero-lateral arising separately from the other laterals, but lying close to them; medio-lateral and antero-lateral lying close together and parallel; externo-dorsal arises separately from the dorsal; dorsal bifurcated for about half its length or more, each branch usually bi- or tri-digitate; spicules small and equal, highly chitinised, usually fairly stout, and short; gubernaculum absent.

Female: Posterior extremity conical; vulva in the anterior part of the body; uteri parallel. Oviparous, ova of very characteristic shape, slightly flattened on one side.

Parasites of the respiratory tract of birds and mammals.

Syngamus indicus Mönnig, 1932.

(Figs. 222-225.)

Description: The worms are blood-red in colour when fresh, and are often found *in copula*. The body of the male gradually increases in thickness backwards, and is constricted immediately anterior to the bursa. The body of the female also grows thicker up to a short distance behind the vulva, then gradually attenuates and is again thicker in the anal region. There is practically no mouth collar. The mouth opening is surrounded by two lateral and four sub-median papillae, and opens into a strong buccal capsule more or less subglobular in appearance which is 0·4 mm. deep and 0·44 mm. broad, including the walls in both sexes. The wall bears internally six longitudinal ridges, two lateral and four submedian, like in *S. laryngeus* Raill., 1899, and *S. hippopotami* Gedoelst, 1914. In the base of the buccal capsule there are eight teeth, 0·14 mm. high, all except the dorsal and the ventral standing against the longitudinal ridges. The cervical papillae are short and thick being at the same level as the nerve ring, or slightly posterior to it. The excretory pore is either slightly anterior to the nerve ring or level with it.

The oesophagus is clubshaped, its anterior half is narrow, and posterior it becomes thicker and reaches double the width of the anterior portion.

Bursa: The bursa in the male is very short, but otherwise well developed. The ventral rays are thick, close together and each ends with a narrow point (Fig. 224). The antero- and medio-lateral rays arise from a common stem and lie close together, while the postero-lateral arises separately, beginning sometimes with a narrow base and diverges from the other laterals. The externo-dorsal rays arise quite independently (Fig. 223); they are relatively thin rays, rather short and may end either bluntly or in narrow points like the ventrals. The two branches of the dorsal ray arise separately and their bases are quite a distance apart; they both end as if broken off with irregular, fringed extremities.

The spicules are like small nails in appearance.

Female: The female has a short tail which narrows down abruptly behind the anus. The terminal portion of the tail is bent towards the ventral side. The vagina is short and soon bifurcates and forms the two uteri. In younger specimens the uteri pass directly towards the portion of the body posterior to the vulva, while in gravid specimens the uteri describe a short loop anterior to the vulva before turning posteriorly. In gravid females the genitalia occupy a little less than three-quarters of the postvulval body portion, but in younger females they occupy nearly a half of the postvulval region of the

body. The ovarian coils are confined to the post-uterine region. Between the dense coils of the ovary and the uteri the winding oviduct can be distinguished.

The shell of the egg is thickened at the poles.

The measurements recorded by Mönnig, 1932, and Bhalerao, 1935, for this species are not quite identical. (See Tables 10 and 11.)

Habitat: Pharynx.

Host: Indian elephant.

TABLE 10.

S. indicus. Mönnig 1932.

Host.	Indian Elephant.	
	♂	♀
Total length	8·5	30
Maximum diameter	·59	·91
Cuticular striations	·026–·045	
Cervical papillae—Ant. end	1·3	1·83
Excretory pore—Ant. end	1·08	1·61
Length of oesophagus	1·34	1·92
Maximum diameter of oesophagus	·2	·44
Nerve ring—Ant. end	1·0	1·28
Length of tail	—	·338
Vulva—Ant. end	—	9·0
Ova	—	·094–·105x·049–·056

TABLE 11.

S. indicus. Bhalerao 1935.

Host.	Indian Elephant.	
	♂	♀
Total length	3·75–6·5	8·6–18·5
Maximum diameter	0·31–0·44	·335–·64
Cuticular striations	0·014	·008–·022
Cervical papillae—Ant. end	·675–1·11	·87
Excretory pore—Ant. end	·575–1·07	·77– ·95
Length of oesophagus	·9 –1·2	1·07–1·78
Maximum diameter of oesophagus	·181–·265	·22– ·33
Buccal capsule	·235–·32x·25–·32	·31–·4x·25–·35
Nerve ring—Ant. end	·66 –·76	·68 –·8
Length of tail	—	·168–·22
Vulva—Ant. end	—	4·4 –5·8
Ova	—	·088–·092x·046–·047
Length of bursa	·28–·43x·125–·18	—
Length of spicules	·067–·075	—

SUPERFAMILY OXYUROIDEA, Railliet, 1916.

FAMILY ATRACTIDAE, Travassos, 1919.

Sub-family Atractinae, Railliet, 1917.

Subfamily Diagnosis: Small worms, mouth variable, intestine simple without diverticula. Male without preanal suckers; two unequal spicules, and a gubernaculum. Female tail pointed: genitalia single, vulva situated posteriorly. Viviparous.

Genus Leiperenia, Khalil, 1922.

Generic Diagnosis: Small nematodes just visible to the naked eye. The males are slightly smaller than the females. Mouth is surrounded by more than six lips; cervical alae present; vestibule absent; anterior portion of the oesophagus is shorter than the posterior, which is slightly swollen posteriorly.

Male: Tail is incurved, long and pointed; caudal alae are absent; four postanal papille; spicules unequal; gubernaculum present.

Female: Tail long and pointed; vulva near anus. Viviparous. Parasites of elephants.

Type-species: L. leiperi, Khalil, 1922. Host: African elephant.

Other species from elephants: *L. galebi*, Khalil, 1922. Host: Indian Elephant.

Leiperenia leiperi, Khalil, 1922.

(Figs. 226-229.)

This species was described by Khalil from material which consisted of two males and three females.

Very small nematodes, females slightly longer than the males. The body narrows slightly towards the head end which is truncated in appearance. Posterior to the head cuticular expansions or cervical alae about 0·3 mm. long and 0·037 mm. in maximum breadth, are present. The mouth collar is very short and has a rounded shape. It is 0·012 mm. long and 0·06 mm. in diameter. The mouth opening is practically circular and is surrounded by ten small lips. The lip in the mid-ventral line and that in the mid-dorsal line are the largest and broadest. The lips placed on either side of these lines are smaller and rounded. There is no mouth capsule. The pharynx is a short muscular canal, demarcated from the oesophagus by a deep groove. It is 0·083 mm. long and 0·06 mm. in maximum diameter. From its cephalic end project about eight conical processes (Fig. 227) which are muscular processes from the pharynx. The oesophagus is long and thin sometimes pursuing a wavy course. Its posterior end is a little swollen, but it has the pronounced bulbar swelling which is characteristic of most Oxyuroidea. The chyle intestine is simple; near its commencement its wall is surrounded by a clear refractile band, the nature of which is unknown. A large excretory vesicle is present, situated on a raised papilla, and situated radially round the pore.

Male: The caudal end of the male is bent towards the ventral surface; its end being more rounded than in the female. About 0·16 mm. from the tip of the tail there are four papillae, two near the mid-ventral line and two on either side of the tail. The papillae are simple and project very little above the surface. The irregularly convoluted testis reaches within 0·8 mm. from the head. There are two unequal spicules, and an accessory piece.

Female: Practically straight, its tail is long and gradually attenuated to a fine point. There are four papillae on either side of the anus. There is only one ovary and one uterus, placed in the axis of the body. The vagina is short and opens in the posterior part of the body. The females are viviparous, the embryos reaching an advanced stage of development while still in the uterus.

(For other measurements see Table 12.)

Habitat: Intestine.

Host: African Elephant.

Leiperenia galebi Khalil, 1922.

(Figs. 230-232.)

Khalil describes this species as follows: Very small nematodes. The head end is truncated, while the caudal is attenuated to a fine end, more delicate in the female than in the male.

The cervical alae are 0·023 mm. broad and 0·6 mm. long. The cuticle is striated throughout its length, except for a short distance at the cephalic extremity. The mouth collar is distinct and measures 0·18 mm. in length and 0·08 mm. in diameter. The oral opening is circular and surrounded by ten rounded lips. The one in the mid-ventral line and also that in the mid-dorsal line are broader and divided into two by a superficial depression. There is no buccal capsule. The pharynx is much broader and longer than in the type-species. At its cephalic end it gives rise to eight cone-shaped processes that surround the mouth opening. The chyle intestine is simple and pursues an almost straight course. The excretory pore is placed on a large raised papilla.

Male: The spicules are unequal and an accessory piece is present which has a characteristic thick bulbous end. The tail is gracefully curved and carries a group of four papillae, 0·17 mm. from the tail end, and similar to those in *L. leiperi*.

Female: Tail short and conical unlike that of *L. leiperi*. Its tip is pointed. The anal opening is not surrounded by prominent lips, and carries four papillae on either side.

The female is viviparous. The convolutions of the single ovary reach within 0·52 mm. of the head end.

(For other measurements see Table 12.)

Habitat: Intestine.

Host: Indian Elephant.

The two species of *Leiperenia* differ mainly in the length of the spicules and accessory piece, and particularly in the shape of the female tail, which is very long and narrow in *L. leiperi*, and stumpy and broad in *L. galebi*.

TABLE 12.

Leiperenia.

Species.	*L. leiperi.*		*L. galebi.*	
Host.	African Elephant.		Indian Elephant.	
	♂	♀	♂	♀
Total length	3·8	3·9	3·25	3·8
Maximum diameter of body	·2	·21	·17	·18
Cuticular striations	·007		·008	
Length of pharynx	·083		·14	
Length of oesophagus	·38		0·39	·40
Maximum diameter of oesophagus	·073		·06	·07
Excretory pore—Ant. end	·92		1·2	
Nerve ring—Ant. end	·22		·25	
Vulva—Anus	—	0·1	—	·06
Length of tail	·38	·7	·43	·53
Longer spicule	·3	—	·25	—
Shorter spicule	·19	—	·13	—
Length of gubern	·09	—	·13	—
Embryos	—	·52x·06	—	·48x ?

SUPERFAMILY ASCAROIDEA (Raill. and Henry, 1912),

FAMILY ASCARIDAE, BAIRD, 1853.

SUB-FAMILY ASCARINAE, RAILLIET AND HENRY, 1912.

Genus TOXOCARA, Stiles, 1905, Travassos, 1913.

Syn. Belascaris Leiper, 1907.

Toxocara lonchoptera (Dies; 1851) (Leiper, 1911), Yorke and Maplestone, 1926.

Syn. Strongylus elephanti Rudolph, 1819.

Ascaris lonchoptera Diesing, 1851.

Belascaris lonchoptera Leiper, 1911, Khalil, 1922.

No description can be given of this species since no material was available, and it was described by Leiper, 1907, in unpublished notes to which no access could be had.

T. lonchoptera was the first Helminth parasite recorded from the elephant, and so far the male of this species remains undescribed.

Habitat: Bileducts.

Host: Indian elephant.

SUPERFAMILY SPIRUROIDEA, Railliet and Bauche, 1915.

FAMILY ACUARIDAE, Seurat, 1913.

Sub-family Acuariinae, Raill., Henry and Sisoff, 1912.

Diagnosis: Acuaridae, usually with two large simple lateral lips. The anterior part of the body is provided with cutaneous cordons. A long cylindrical vestibule is present; the oesophagus is cylindrical, divided into two parts; the cervical papillae are usually behind the nerve collar. Lateral cuticular flanges are usually absent.

Male: Caudal alae present, with four pairs of long, pedunculated preanal papillae; spicules unequal and quite dissimilar.

Female: Usually with a short muscular ovejector and a short vagina.

Genus *Parabronema* Baylis, 1921.

Generic Diagnosis: Polymyarian worms, having the mouth bordered by paired lateral lips, each with three papillae. The cephalic extremity is provided with dorsal and ventral cuticular shields and is ornamented with six horseshoe-shaped cordons or auricular appendages of which two are lateral, two subventral and two subdorsal. Lateral flanges are absent. The cervical papillae are a short distance behind the nerve ring. The oral aperture is of greatest diameter dorsoventrally; and passes into a long cylindrical vestibule with thick walls. The oesophagus consists of two portions, both muscular, the anterior part is short and narrow and the posterior part longer and broad.

Male: Posterior extremity spirally coiled ventrally with interrupted longitudinal ridges on the ventral surface posteriorly; small caudal alae present; four pairs of preanal, and two pairs of postanal papillae arranged somewhat asymmetrically, and in addition an extra double papilla immediately in front of the cloaca; spicules very dissimilar. A somewhat triangular accessory piece is present.

Female: The female is considerably larger than the male. The posterior extremity is curved dorsally, and the tail is short. The vulva is in the region of the termination of the oesophagus. The female is viviparous. Parasites of the stomach wall of elephants and camels.

Type-species: P. indicum, Baylis, 1921. Host—Indian elephant.

Other species from elephants:—

P. smithii Cobbold, 1882. Host—Indian elephant.

P. africanum Baylis, 1921. Host—African elephant.

P. rhodesiense Yorke and Maplestone, 1926. Host—African elephant.

Parabronema indicum Baylis, 1921.

(Figs. 233-236.)

The material examined consisted of three females and one male. Rather small worms. The female is much larger than the male. The head is conical and distinctly narrower in front than behind the auricular appendages which are horseshoe-shaped and bear a narrow groove on their free edges. These horseshoe-shaped cordons vary in shape and size (compare Figs. 233 and 235) but usually have a more or less rounded posterior margin. The oral aperture passes into a long cuticular tube which leads into the oesophagus. A thick nerve collar surrounds the cephalic portion of the oesophagus. The excretory pore is anterior to the cervical papillae more or less in the region of the nerve collar.

Female: The position of the vulva varies from 0·24-0·56 mm. caudad to the posterior end of the oesophagus. The vagina is about 0·2 mm. in length and forms a characteristic U-shaped bend before it divides into the two uterine branches which run posteriorly. The one branch runs posterior to a point about 0·32 mm. from the anus where it turns anterior again. The other branch turns anterior a short distance from its origin, and runs up to about the posterior end of the oesophagus where it forms a loop and runs once more posterior. The tail is inclined dorsally and carries a small pair of caudal papillae close to the tip. These papillae were not observed in all the specimens.

Male:The anterior pair of postanal papillae in the male overlap in such a way that the termination of the right papilla is well to the left of the midventral line (Fig. 236). The posterior pair of postanal papillae are symmetrically placed opposite each other. The spicules are very unequal; the left spicule is very slender and about two and a half times as long as the right. An accessory piece of irregular shape is present.

(For other measurements see Table 13.)

Habitat: Stomach.

Host: Indian elephant.

Parabronema smithii (Cobbold, 1882), Baylis, 1921.

(Figs. 237-243.)

Syn. Spiroptera smithii Raill., Henry and Bauche, 1914.

Filaria smithii Cobbold, 1882.

The material examined consisted of four males and about fifty females. Very small nematodes, the female is considerably larger than the male. The female is inclined to be curved, the tail directed dorsally. The tail of the male is spirally coiled ventrally. The auricular appendages are open towards the head end like in *P. indicum*. Their posterior margins are somewhat flat in some specimens but in others are round like in *P. indicum*. The cervical papillae are irregularly placed in the regions of the nerve collar. The excretory pore could only be made out in the female.

Female: The position of the vulva varies from about 0·06 mm. anterior to about 0·45 mm. caudad to the posterior end of the oesophagus. (Compare Figs. 241 and 242.) The vagina forms a curious U-shaped bend at a variable distance from the vulva. The posterior turn of the one uterus is from 0·40-0·48 mm. from the anus. A small pair of papillae are also present on the female tail, about 0·04 mm. from its tip. The uteri are packed with embryos, and no ova are present.

Male: The testis runs anterior to a point about 0·35 mm. from the posterior end of the oesophagus, and then turns posterior. The spicules are very unequal, and a more or less triangular accessory piece is present (Fig. 243).

(For other measurements see Table 13.)

Habitat: Coats of stomach and intestine.

Host: Indian elephant.

There are no essential differences in structure between the two *Parabronema* species described above. The two species are differentiated by differences in their respective sizes and the measurements of their various organs.

Parabronema africanum Baylis, 1921.

(Figs. 244-246.)

Syn. Sclerostomum clathratum Baird, 1868.

This species is described by Baylis as follows: A much larger worm than either *P. indicum* or *P. smithii*, and the unequality in the size between the sexes are less marked, the male attaining about two-thirds of the length of the female.

The cuticle especially near the head shows minute longitudinal striations, in addition to the usual transverse striations. The head is almost invariably bent towards the dorsal side and may be roughly described as bullet shaped. It is nearly as wide at the level of the outer papillae as behind the auricular appendages. The latter are somewhat elongate with the edges curled inwards so as to form a nearly V-shaped appendage (Fig. 244), and their " grooves " are wide and are carried on the inner surface. The tail of the female is conical with a rounded tip. Caudal papillae have not been observed. The vulva is situated either just behind or just in front of the posterior end of the oesophagus. The U-shaped bend of the vagina occurs at about 1·0-1·2 mm. from the vulva. The course of the uterine branches is very similar to that described for *P. indicum* and *P. smithii*.

Male: The caudal papillae of the male are distinctly asymmetrical, the group of four preanal papillae on the left side being much more widely separated than those on the right, so that the most posterior of the group lies at the level of the cloaca. The two terminations of the median preanal papilla appear to be situated close

TABLE 13.

Parabronema.

Species.	*P. indicum.*		*P. smithii.*		*P. africanum.*		*P. rhodesiense.*	
Host.	Indian Elephant.		Indian Elephant.		African Elephant.		African Elephant.	
	♂	♀	♂	♀	♂	♀	♂	♀
Total length	9·0	13·0	6·5	6·6–9·3	40·0	57·0	7–8	9–10
Maximum diameter	·24	0·30	·22	·24	·8	1·0	—	—
Posterior diameter of head	0·12	0·14		·09	·27	·32	—	—
Length of buccal tube	·13	·16	—	0·10	·35	·4	·15	·175
Posterior oesophagus to anterior excretory	2·5	2·8	1·5	1·5–1·9	6·5	7·2	—	—
Nerve ring—Anterior excretory	·32	·32	·22–·24	·25	·7	·83	—	—
Cervical papillae—Anterior end	·38	·38–·43	·24–·27	·27	?	?	—	—
Excretory pore—Anterior end	—	·34	?	·32	?	0·9	—	—
Vulva—Posterior oesophagus	—	·24–·56 post	—	·06 ant. to ·45 post.	—	0·1 ant. to 0·2 post.	—	·86–·9 post
Anus—Tip of tail	·20	·33	·20	·28–·35	·85	·52	—	·20
Caudal papillae—Tip of tail	—	·042	—	0·04	—	—	—	—
Cuticular striations	·006	·004	·004	·003	·01	—	—	—
Long spicule	·95	—	·63	—	3·15	—	6·12	—
Short spicule	·40	—	·23	—	·68	—	3·3	—
Maximum length of Accessory piece	·05	—	·03	—	·08	—	—	—

together near the middle line (Fig. 246). The left spicule is more than four times as long as the right. A triangular gubernaculum is present.

(For other measurements see Table 13.)

Habitat: Stomach.

Host: African elephant.

Parabronema rhodesiense, Yorke and Maplestone, 1926.

(Figs. 247-249.)

Description: The difference in total length between male and female is less marked than in the other *Parabronema* species. The distance of the posterior end of the cordons from the anterior extremity varies from 0·11 mm. in the male to 0·13-0·14 mm. in the female; the cordons are longer than in the other species. The length of the oesophagus is 1·03 mm. in the male and 1·23 mm. in the female.

No material of this species was available for investigation.

(For other measurements see Table 13.)

Habitat: ?.

Host: African elephant.

Discussion: Khalil, 1922, erroneously places the genus *Parabronema* in the family Spiruridae, Oerley, 1885, some of the diagnostic features of which are the following:—

Mouth usually with trilobed lateral lips. The cervical papillae, usually at least one, in front of the nerve collar. The caudal alae in the male are well developed. The vulva in the female is usually situated near the middle of the body. Oviparous.

None of the above-mentioned features, however, are applicable to the genus *Parabronema*.

CLASS TREMATODA.

GROUP AMPHISTOMATA Rudolphi, 1801, e.p., Nitsch, 1919.

Definition:—Digenea: Two suckers, the anterior surrounding the month and the posterior terminal or ventro-terminal behind the genitalia; gut forked; excretory pore opening dorsally towards the hinder end; testes generally in front of the ovary; almost always thick worms more or less circular in section.

FAMILY PARAMPHISTOMIDAE, Fischoeder, 1901.

Definition:—Amphistomata: Body not divided into two portions. Ventral pouch absent.

Subfamily I, Cladorchinae, Fischoeder, 1901.

Definition.—Paramphistomidae: Oral sucker with a pair of oral diverticula.

Genus Pseudodiscus, Sonsino, 1895.

Syn. *Watsonius*, Stiles and Goldberger, 1910.

Diagnosis: Body sub-ellipsoidal, acetabulum strong and subterminal. Oral sucker with diverticula well developed and muscular. Caeca sinous, extending to the acetabular zone. Genital pore without sucker; bifurcal. Cirrus sac absent. Vesicula seminis well developed and convoluted. Testes lobate, post equatorial, in the same zone but in separate fields. Laurers canal present. Ovary posterior to the testes. Uterus pre-ovarian and dorsal. Vitelline glands lateral, extending from oesophageal zone to acetabular zone. Parasites of mammals.

Type-species: P. collinsi (Cobbold, 1875).

Host: Indian elephant.

Other species in elephant:—

P. hawkesii. Host Indian elephant.

Pseudodiscus collinsi (Cobbold, 1875).

Syn. *Amphistoma collinsi*, Sonsino, 1895.
Amphistomum collinsii, Cobbold, 1875.
Amphistomum collinsii, Fischoeder, 1903.
Pseudodiscus stanleyii, Stiles and Goldberger, 1910.
Pseudodiscus collinsi, Stiles and Goldberger, 1910.

Description: The material studied consists of numerous specimens. Dorso-ventral (sagittal) and transverse serial sections were studied, as also the en toto specimens.

The measurements obtained confirm those recorded by Bhalerao, 1933.

The body is oval in shape, convex dorsally and flattened on the ventral surface. In larger specimens the ventral surface is concave. The anterior extremity is bluntly pointed and may bear small conical papillae. The posterior extremity is round, almost semi-circular and the lateral margins are convex.

The mouth is situated anterior, and is surrounded by an oral sucker constricted in the middle to form a globular oral portion and a bulbous posterior portion. The latter is bilobed and each lobe communicates posteriorly with a diverticulum measuring 0·1—1·5 mm. × 0·7—1·25 mm. The oesophagus starts from the base, between the two bulbs of the oral sucker, and continues posteriorly in a straight course. It bifurcates into two intestinal caeca which run posteriorly and end somewhat posterior to the middle of the posterior sucker. Each caecum makes an inward bend at the level of the testes.

The excretory bladder lies on the dorsal surface of the posterior sucker and the excretory pore opens in the central line behind the posterior sucker.

The testes are two large deeply lobed bodies, situated slightly posterior to the centre of the body, but their position is subject to variation and may sometimes be slightly anterior. The vasa efferentia

arise from the centre of the testis and run anteriorly for a short distance and then unite centrally to form the vesicula seminalis, a thin-walled moderately dilated, but much coiled duct. The seminal vesicle passes into a less coiled, but, relatively thicker muscular duct called the pars musculosa. The latter passes into a short narrow duct, the pars prostatica. From its ventral aspect leads a short muscular duct ventrally, called the ductus ejaculatorius which unites with the terminal portion of the uterus, the metraterm, to form a ductus hermaphroditicus. The latter is a short duct and opens into the genital atrium which communicates ventrally with the genital pore. The ductus hermaphroditicus, the ductus ejaculatorius, metraterm and the genital atrium are enclosed in a mass of muscle fibres.

The position of the ovary is slightly variable, being sometimes situated on the left and sometimes on the right side of the median line, between the testes and posterior sucker. Sometimes the ovary appears to lie in the centre of the body, which is probably its normal position, it being deflected either to the right or the left side according to the state of contraction of the worm. The oviduct arises from the anterior aspect of the ovary and runs dorsally through the shell gland.

Laurer's canal arises from the oviduct and runs postero-dorsally. Its opening is approximately 3·0 mm. from the posterior end, and approximately 2·0 mm. anterior to the opening of the excretory duct. The vitelline glands consist of sparsely scattered follicles lying on the outer side of the intestinal caeca. The follicles usually extend posterior as far as the ends of the intestinal caeca. Anteriorly their extent varies from the level of the intestinal fork to as far as the hind ends of the diverticula, or the middle of the oesophagus. The uterus is much coiled and runs anteriorly along the dorsal surface and then coils into the metraterm.

(For measurments see Table 14.)

(Figs. 250 251.)

Habitat: Large intestine.

Host: Indian elephant.

Pseudodiscus hawkesii (Cobbold, 1875), Stiles and Goldberger, 1910.

Syn. Amphistoma hawkesi, Cobbold, 1875.
Pseudodiscus hawkesi, Sonsino, 1895.
Watsonius ornatus (Cobbold, 1882).
Amphistoma ornatum, Cobbold, 1882.
Pseudodiscus ornatus, Sonsino, 1895.
Hawkesius hawkesii, Stiles and Goldberger, 1910.
Pseudodiscus watsoni, Conyngham, 1904.
Cladorchis watsoni, Shipley, 1905.
Gastrodiscus watsoni, Verdun, 1907.
Paramphistomum watsoni, Manson, 1908.
Watsonius watsoni, Stiles and Goldberger, 1910.
Watsonius macaci, Kobayashi, 1915.

Description: The material studied consists of half a dozen specimens.

The worms are conical with the anterior end tapering and the posterior end hemispherical. The dorsal surface is convex, while the ventral is slightly concave or may tend to be flat. The genital pore lies more or less in a pit on the ventral surface, and opens on a genital papilla.

In external appearance the worms appear to be more elongate than *P. collinsi* and also the oral pole is relatively more acutely pointed.

The mouth is somewhat elliptical and directed dorso-ventrally. The oral sucker appears to be divided into an oral portion which is globular in form, and a short posterior or oesophageal portion. From the latter originate lateral suctorial pouches (diverticula) which project caudad and laterad of the point of origin of the oesophagus. The oesophagus passes into a muscular pharynx before bifurcating into the lateral intestinal caeca. The intestinal caeca pursue a wavy course posteriorly and usually end in the equatorial zone of the posterior sucker.

The testes are one behind the other and in some cases their zones are slightly overlapping. The testes are deeply lobate, almost branched. The vas efferens emerges from the dorsal aspect of each testis and unites to form the vas deferens which is much coiled in the first part of its course and passes into a coiled well-developed musculosa which in some cases much resembles a cirrus sac. The musculosa passes into a short prostatica. The terminal portion of the vas deferens is a short narrow duct, the ductus ejaculatorius, which, at the base of the genital papilla unites with the terminal portion of the uterus to form the ductus hermaphroditicus.

The ovary lies post-testicular, a little to the left of the median sagittal plane, and close to the acetabulum. The vitelline glands are composed of small follicles, which longitudinally, extend the whole length of the caeca in the extracaecal area. Their caudal portions however, may extend slightly into the intercaecal area.

Laurer's canal and an excretory vesicle are both present.

(For measurements see Table 14.)

(Figs. 252-253.)

Habitat: Colon.

Host: Indian elephant.

Sub-family II. Pfenderinae (Fukui, 1929), as amended Bhalerao, 1935.

Definition: Paramphistomidae, with conical body. Posterior sucker papillated or not papillated. Oral sucker with paired diverticula. Oesophagus with bulb. Intestinal caeca simple, diverticulated or heteromorphic. Testes lobed, symmetrical. Cirrus sac spindle-shaped and muscular. Inside cirrus sac male genital duct differentiated into vesicula seminalis, pars prostatica and cirrus. Genital

sucker absent. Vitellaria lateral. Excretory system coiled. Lymphatic system consisting of 3 pairs of canals. Parasitic in Indian elephant.

TABLE 14.

Host.	*P. collinsi.*	*P. hawkesi.*
	Ind. elep.	Ind. elep.
Total length	5–12 mm.	3·5–6 mm.
Width	3– 7	2–3
Thickness	2–3·5	2–3
Gen. pore—Anterior end	2·5–4·5	2·1
Length of oesophagus	·9–1·5	±1·0
Excretory pore—Posterior end	·4– ·84	± ·3
Testes	1–2·5x·75–2·25	·4x·36–·39
Ovary	·40–·87x·25–·75	·5x ·8
Shell gland	·16x·18	·06
Diameter of Acetabulum	1·2–2·1	1·1–1·60
Ova	·135x·086	·135x·07

(In millimetres.)

Genus PFENDERIUS, Stiles and Goldberger, 1910.

Diagnosis: Body conical, convex dorsally, slightly convex ventrally. Ventral pouch absent. Acetabulum terminal with projecting margins. Genital pore without sucker. Excretory pore in vesicular zone, caudad of Laurer's canal. Oral sucker with one (anterior) sphincter and a pair of well developed diverticula. Testes two, lobed, fields separate, zones coincide. Cirrus sac present. Genital sucker absent. Ovary and shell gland post-testicular. Eggs operculate. Parasites of mammals.

Type-species: *P. papillatus* (Cobbold, 1882), in Indian elephant.

Other species in elephant:

P. birmanicus, Indian elephant.

P. heterocaeca, Indian elephant.

Pfenderius papillatus (Cobbold, 1882), Stiles and Goldberger, 1910.

(Figs. 254-255.)

Description: Conical worms, 4·5-5·5 mm. in length, 2·5-2·75 mm. broad and 1·7 mm. thick, slightly bent ventrad; greatest diameter posterior, attenuating gradually and considerably cephalad. The genital pore is in the oesophageal zone, about 1·0-1·5 mm. from the oral end. The posterior sucker measures 1·7 mm. transversely and 1·4 mm. in dorso-ventral diameter. Its opening is directed slightly ventrally and its surface bears prominent papillae. The oral sucker has two caudal lateral diverticula, and has a well defined sphincter about 0·12-0·14 mm. from the oral end. The intestinal caeca pursue a wavy course and extend to the acetabular zone, and then curve slightly cephalad before they terminate.

The excretory vessel is well developed, dorsal of the cephalic half of the acetabulum.

The testes are situated in the equatorial zone, their fields are separate and their zones nearly coincide. They are lobate, and measure 0·4 mm. in diameter. The seminal vesicle is a coiled duct. A pyriform cirrus sac is present, and is 0·44 mm. long, and 0·33 mm. in greatest diameter.

The ovary is post-testicular, intercaecal, pre-acetabular and nearly or quite median. The vitellaria consist of sparsely scattered small follicles extending the length of the intestinal caeca. Laurer's canal open in the zone of the shellgland. The ova are elliptical and measure $0{\cdot}15 \times 0{\cdot}07$ mm.

Habitat: Colon.

Host: Indian elephant.

Pfenderius birmanicus, Bhalerao, 1935.

(Figs. 256-257.)

Description: The worms are oval, with the anterior end attenuated and the posterior hemispherical. The dorsal surface is convex and the ventral aspect is almost flat with a little concavity. The worms measure 2·3 mm. in length, and 2·12 mm. in breadth. The mouth is subterminal and surrounded by papillae. The acetabulum is situated at the posterior end of the body, and is subterminal, 0·92-1·02 mm. in diameter. The genital pore is situated 0·48 mm. from the anterior extremity.

The oral sucker measures $0{\cdot}39 \times 0{\cdot}46$ mm., and has two well developed diverticula. The oesophagus enlarges posteriorly into a large oesophageal bulb composed of circular muscle fibres and which is surrounded by thick glands. The intestinal caeca run laterally and terminate lateral to the acetabulum. The caeca are diverticulated internally, the diverticula being either simple or divided. The excretory bladder is pearshaped, and opens posteriorly on the dorsal side.

The testes are situated antero-lateral to the posterior sucker. They are lobed and measure 0·28-0·33 mm. $\times$ 0·31-4·46 mm. The coiled vas deferens enters a muscular, spindleshaped cirrus sac measuring $0{\cdot}5 \times 0{\cdot}3$ mm.

The ovary is situated immediately in front of the posterior sucker, and measures $0{\cdot}25 \times 0{\cdot}2$ mm. The shellgland is situated to the left of the ovary almost at the same level. Laurer's canal opens on the dorsal side slightly lateral to the central line. The uterus is coiled, and its course is similar to that of the other species of *Pfenderius*. The vitelline follicles extend laterally to the intestinal caeca and the posterior sucker. The eggs are elliptical, and measure $0{\cdot}16 \times 0{\cdot}09$ mm.

Habitat: Large intestine.

Host: Indian elephant.

Discussion: Bhalerao, 1935, classes this species under the subfamily PFENDERINAE of the family PARAMPHISTOMIDAE, on account of the elongate, spindle-shaped and muscular cirrus sac, and the oral sucker with lateral diverticula.

Pfenderius heterocaeca (Fukui, 1926), Bhalerao, 1935.

(Figs. 258-259.)

Syn. Tagumaea heterocaeca, Fukui, 1926.

Description: The worms measure 3·13-4·8 mm. in length, 2·5-3 mm. in breadth, and 1·8-2·4 mm. in thickness. The body is oval in shape and somewhat flattened dorso-ventrally. The dorsal side is convex and the ventral is either quite flat or slightly concave. The anterior end is attenuated while the posterior is hemispherical. The genital pore is ventral, situated 0·7-1·09 mm. from the anterior extremity. The posterior sucker measures 0·97-1·27 mm. in diameter, and is situated on the ventral surface of the body.

The mouth-opening lies at the bottom of the papillated anterior portion, and is directed towards the ventral aspect. The mouth is surrounded by the oral sucker which measures 0·61-0·78 × 0·50 mm. Posteriorly the oral sucker has two simple diverticula. The oral sucker has a sphincter near its anterior end. The oesophagus measures 1·53 mm. in length. At its posterior end the oesophagus has a muscular bulb which is composed of alternate layers of circular and longitudinal muscles. The intestinal caeca terminate on either side of the posterior sucker. They are short and stout and are divided into two parts; a much swollen anterior portion, and a slender posterior portion.

The testes are two large bodies lying connubially slightly in front of the acetabulum, and measuring 0·425-0·51 × 0·33-0·425 mm. They may be either bi- or tri-lobed. The vas deferens is coiled, and enters the thick, muscular, clubshaped cirrus sac, measuring 0·62-0·82 × 0·7-0·33 mm. In the cirrus sac the vas deferens forms a long clubshaped vesicula seminalis which is again followed by a short thin pars prostatica surrounded by non-cellular prostatic glands. At the terminal end of the male genital duct is the cirrus which is conical and muscular, and almost as long as the vesicula seminalis. The last portion of the genital duct enters the hermaphroditic bulb and opens on a genital papilla which is not very prominent.

The ovary is oval in shape, and measures 0·23-0·33 × 0·2-0·3 mm., and lies on the antero-lateral border of the posterior sucker, close behind the left testis. The shellgland is larger than the ovary and measures 0·33-0·42 × 0·19-0·323 mm. It is situated posterior to the ovary. Laurer's canal opens dorsally, slightly lateral to the central line. The oviduct opens together with the male genital duct on the genital papilla. The vitelline glands consist of follicles lying external to the intestinal caeca and the posterior sucker. The follicles extend the whole length of the intestinal caeca up to almost the centre of the posterior sucker. The excretory vesicle is pearshaped, and opens almost at the posterior end on the dorsal surface of the body.

The lymphatic system consists of three pairs of main canals, which communicate with one another in the region of the oral and posterior sucker.

The ova measure $0{\cdot}135 \times 0{\cdot}08$ mm.

Habitat: Intestine.

Host: Indian elephant.

Discussion: Fukui, 1926, distinguishes the genus *Tagumaea* from the genus *Pfenderius*, on the following characters:—

1. The acetabulum, which is not papillated in the former, but papillated in the latter.

2. The oesophageal bulb, which is composed of alternate bundles of circular and longitudinal muscles in the former, but of thick bundles of circular muscle only, in the latter.

3. The caeca, which is divided into an anterior broad, and posterior short and slender portion in the former, but which is undivided in the latter.

The species described above resembles *Tagumaea* in having the musculature of the oesophageal bulb composed of alternate layers of circular and longitudinal muscle fibres. It differs from both the genera however, in that the caeca are diverticulated internally. Since the species in question has also some characters in common with *Pfenderius papillatus* and *Tagumaea heterocaeca*, Bhalerao, 1935, proposes to drop the genus *Tagumaea*, and to include the species *heterocaeca* under *Pfenderius*, so that the genus *Tagumaea* then lapses into synonymy with the genus *Pfenderius*.

Although specimens of *P. heterocaeca* were not available for study, the present writer agrees with the abovementioned author that relatively insignificant characters such as the papillated or non-papillated condition of the acetabulum, the texture of the musculature of the oesophageal bulb, and the simple branched or heteromorphic nature of the intestinal caeca, do not form a valid basis for the creation of a new genus.

Sub-Family III Brumptinae, Stunkard, 1925.

Diagnosis: Paramphistomidae: Body sub-pyriform, with two posterior prolongations containing most of the vitellaria. The acetabulum is small, situated at the point of insertion of the auricular appendages. Ventral pouch absent. Oral sucker with diverticula. Pharynx absent. Genital sucker present. Testes lobate, their fields adjacent and zones coinciding. Ovary post-testicular. Vitellaria lateral, in the auricular prolongations of the body. Cirrus pouch present. Intestinal caeca large and sinuous. Lymphatic system complex.

Genus Brumptia, Travassos, 1921.

Syn. Cladorchis, MacCallum, 1917.

Diagnosis: Body sub-pyriform with two posterior appendages in the form of an ear, and which face ventrally. Acetabulum small, situated between the two auricular formations. Oral sucker with well developed diverticula. Pharynx absent. Genital pore with a genital sucker, median, post-bifurcal. A large cirrus pouch present. Testes lobate, with zones coinciding and fields adjacent, intra-caecal, and partially in the caecal zone. Uterus dorsal. Ovary post-testicular. Vitellaria are branched, situated in the auricular appendages. The lymphatic system is complex.

Type-species: B. bicaudata, from the African elephant.

Brumptia bicaudata (Poirier, 1908), Travassos, 1934.

Syn. Amphistoma bicaudata, Poirier, 1908.
Cladorchis gigas, MacCallum, 1917.
Brumptia gigas, Travassos, 1921.
Brumptia gigas, Maplestone, 1923.
Brumptia gigas, Joyeux and Mathias, 1926.
Brumptia gigas, Fukui, 1929.

Description: The worms are 12-15 mm. in length, and 7-9 mm. in breadth. The body consists of two portions; an anterior conical portion, and a posterior part consisting of two crescentic appendages. The ventral surface is almost flat from side to side, while the dorsal surface is convex.

The acetabulum is slightly in front of the posterior extremity of the body of the worm and is situated entirely on the ventral surface, and directed ventrally. The genital pore is situated about midway between the two suckers in the midline of the ventral surface.

The most characteristic feature of the worm is the presence of two large crescentic caudal appendages which arise from the postero-lateral borders, and measure about 5 mm. in length when fully extended. As a rule their borders are incurved towards the ventral surface, so that they appear somewhat shorter and tend to overlap the posterior sucker.

The oral sucker surrounds the mouth and bears two large muscular diverticula which run in a dorsal and slightly posterior direction.

The oesophagus is simple and passes into the intestinal caeca which pursue a wavy course laterally and end in the dorsal part of the caudal appendages.

The testes are large oval organs lying side by side in the lateral fields in front of the acetabulum, and the posterior part of the cirrus pouch lies between their anterior ends. The testes are lobed and measure about 3·5 mm. in diameter. The vas deferens forms a dilated thin-walled sac, the seminal vesicle which runs into the cirrus pouch (4 mm. in diameter), and then passes into the pars prostatica which eventually unites with the uterus near the centre of the cirrus pouch. The genital duct opens on a genital papilla.

The genital pore is provided with a small sucker surrounding its opening (see Fig. 261), and the genital papilla lies within the genital sucker and is surrounded by a small atrium which would obviously disappear if the papilla were extruded. The ovary lies towards the dorsal surface between the testes and slightly to one side of the midline. The shellgland lies on the medial aspect of the ovary. Laurer's canal runs dorsally from the shellgland, and curving posteriorly over the anterior end of the excretory bladder, it opens in the midline above the middle of the bladder far in front of the excretory pore.

The vitellaria consist of numerous collections of follicles which almost entirely fill the two caudal appendages. In some cases a few follicles may lie in front of the acetabulum. The eggs are oval and operculated and measure 0·112 - 0·116 × 0·076 mm. (Figs. 260 and 261).

Habitat: Large intestine.

Host: African elephant.

Sub-Family IV Gastrodiscidae, Stiles and Goldberger, 1910.

Definition: Paramphistomidae; with flattened leaflike bodies, divided into anterior and posterior portions. Oral sucker with paired diverticula. Cirrus pouch and genital sucker absent.

Genus Gastrodiscus, Leuckert, 1877.

Diagnosis: Body divided by a constriction into a small, nearly cylindrical, anterior portion and a large, discoidal, ventrally concave, posterior portion. The latter is covered with regular rows of large papillae and contains the genital glands. A ventral pouch and genital sucker are absent. The posterior sucker is small and sub-terminal. The oral sucker bears a pair of diverticula. The intestinal caeca extend posterior behind the testes. The ovary is post-testicular. The vitelline glands are mainly lateral to the intestinal caeca.

Parasites of mammals.

Type-species: G. aegypticus (Cobbold, 1876).

Host: Equidae.

Gastrodiscus secundus, Looss, 1907.

(Fig. 262.)

This worm, very common in equines in India, was first recorded from elephants by Bhalerao, 1933. He describes it as follows:—

The body constructed into a cylindrical or slightly depressed cephalic portion, and a broad, oval, or disclike posterior portion. The body measures 7-8 mm. in length, and 5-8 mm. in maximum breadth. The thickness is 1·75- 2 mm. The cephalic portion is 1·87-2·6 mm. broad and 1·09-1·17 mm. long. The disc is 6·3-6·5 mm. long, and 5·8 mm. broad.

The mouth is situated at the anterior extremity on the ventral side. Tactile papillae open at a distance of 0·4 mm. from the oral aperture.

The sides of the abdominal disc tend to roll down ventrally. The ventral surface of the cephalic portion behind the mouth is slightly excavated. The ventral surface of the disc is covered with papillae or pseudo-suckers, bearing on their summits small slitlike openings.

The genital opening is situated 1·12-1·48 mm. from the anterior extremity of the disc. The genital ducts open close together separately on a genital papilla.

The posterior sucker is situated centrally at the posterior end of the body, and measures 1·2-1·7 × 0·98-1·08 mm.

The mouth is surrounded by an oral sucker measuring 0·32-0·4 × 0·46-0·65 mm. It is followed by a portion into which open the two diverticula measuring 0·54-0·63 × 0·35-0·4 mm. The oesophagus is a long straight tube measuring 1·3-1·7 × 0·23-0·25 mm. Its walls are glandular. At a distance of about 0·7 mm. from the anterior end of the disc the oesophagus bifurcates into two intestinal caeca. The latter are straight and pass along the sides of the body and end at a distance of about 1·49-1·52 mm. from the posterior end. In some cases the caeca pursue a somewhat wavy course.

The testes are situated diagonal to each other in the centre of the body. They measure 0·98-1·2 × 0·88-0·98 mm. The anterior testis is on the left side. The coiled vas deferens lies anterior to the left testis and opens on the genital papilla. The ovary also lies on the left side and measures 0·4-0·48 × 0·38-0·43 mm. The uterus takes a sinuous course between the testes and passes on the right side of the vas deferens.

The shellgland lies to the right side of the ovary and measures 0·62 × 0·36 mm. The vitelline glands extend from the level of the genital pore to the middle of the posterior sucker. The follicles lie mostly in the extra-caecal area although a few may overlap the intestinal caeca as well.

The ova measure 0·125-0·16 × 0·09-0·1 mm.

Habitat: Large intestine.

Host: Indian elephant.

GROUP DISTOMATA.

Definition: Digenea; with two suckers, the posterior of which is ventral, separated from the hind end by at least a part of the genitalia.

FAMILY FASCIOLIDAE.

Definition: Large flat worms with the genital pore in front of the ventral sucker, and with much branched testes and intestinal caeca.

Genus FASCIOLA, Linnaeus, 1758.

Diagnosis: The anterior end frequently forms a conical portion marked off by distinct " shoulders " from the rest of the body. The intestinal caeca are much branched. The ventral sucker is situated in the anterior region of the body. The ovary and testes are much branched.

A cosmopolitan parasite.

Type-species: F. hepatica, Linnaeus, 1758.

Species in elephant: F. jacksoni, Cobbold, 1869.

Fasciola jacksoni, Cobbold, 1869.

(Fig. 263.)

Syn. Cladocoelium elephantis, Diesing, 1858.
Distomum elephantis, Diesing, 1858.
Distomum jacksoni, Braun, 1892.
Fasciolopsis jacksoni, Looss, 1899.

Description according to Bhalerao, 1935: The worm is more or less pear shaped in appearance. The anterior and posterior ends have a tendency to curl down ventrally. In some cases the cephalic end is distinctly set off the rest of the body, and in such cases the " shoulders " are very well defined. In other specimens the cephalic end cannot be so well distinguished from the rest of the body.

The worms measure 12-14 mm. in length, and 9-12·5 mm. in breadth, and 1·5-2 mm. in thickness. The whole body is covered with a thick cuticle beset with close-set alternately transverse rows of spines which measure ·042-·055 mm. in length. The spines on the dorsal and ventral sides of the body are equally stout. The mouth is surrounded by an oral sucker which is elliptical in shape and measures 0·52-0·64 mm. × 0·44-0·43 mm. The pharynx is large. The oesophagus is very short. The intestine is branched both internally and externally, but the branches on the outer side are more profuse than those on the inner side.

The ventral sucker measures 1·18-1·41 × 0·97-1·017 mm. Its cavity is somewhat triangular, and in some cases a notch is seen posteriorly. The genital pore is situated about 2·5 mm. from the anterior end.

The testes lie centrally in the body, one behind the other. They occupy nearly half the area of the body. The cirrus sac is pyriform and is situated anterior to the ventral sucker. It measures 0·73 × 0·56 mm. The cirrus is a very long structure and may be coiled in the cirrus sac or may protrude considerably out of it.

The ovary is a branched structure lying on the right side of the central line, immediately anterior to the testis. It measures 1·37 × 1·28 mm. The shellgland lies centrally, anterior to the testes, and measures 1 × 0·74 mm. The receptaculum seminis is absent. Laurer's canal commences from the oviduct and opens to the

exterior on the dorsal side of the shellgland. The vitellaria are very extensive and occupy nearly two-thirds of the body. The vitelline follicles are small and are situated in the meshes of the intestinal branches. The vitelline receptacle or yolksac is situated in the centre and measures 0·14 × 0·1 mm. The uterine coils lie between the shellgland and the ventral sucker. The eggs are operculated and measure 0·110-0·120 × 0·05-0·062 mm.

Habitat: Bileducts and duodenum.

Host: Indian elephant.

CLASS CESTODA.

ORDER CYCLOPHYLLIDEA, Carus.

Definition: Vitelline gland compact and unpaired, in neighbourhood of ovary.

FAMILY ANOPLOCEPHALIDAE, Furhmann, 1907.

Definition: Rostellum unarmed, mature proglottides usually broader than long, testes mostly anterior or lateral to female organs.

Subfamily Anoplocephalinae, Blanchard, 1891.

Diagnosis: Anoplocephalidae: Genital ducts usually pass dorsally to longitudinal excretory vessels. Uterus persistent and tubular, sac-like, branched or reticular. Adults in mammals and birds.

Genus Anoplocephala, Blanchard, 1848.

Diagnosis: A single set of reproductive organs in each proglottis. Genital canals pass dorsally to longitudinal excretory vessels. Genital pores unilateral (or occasionally alternating). Vaginal pore ventral to cirrus-sac. Testes aporal, or scattered uniformly throughout the proglottis. Female glands poral, but in the parasite from the elephant the female glands median in position. Uterus a transversely elongated sac with pocket-like appendages anteriorly and posteriorly. Eggs with well developed pyriform apparatus. Adults in mammals and birds.

Type-species: Anoplocephala perfoliata (Goeze, 1782).

Species in Elephant: A. manubriata, Raill., Henry and Bauche, 1914.

Anoplocephala manubriata Raill., Henry and Bauche, 1914.

(Figs. 264-266.)

Description: Railliet, Henry and Bauche, 1914, describe the worm as follows:—

Only two specimens and a number of gravid proglottides were encountered in an Indian elephant.

The two specimens presented the following measurements:—

The first 2·6 cm. long and 1·6 cm. wide, the second 1·5 cm. long and 1·2 cm. wide, but some of the isolated gravid proglottides, however, measured up to 4 cm. in width.

The scolex forms a voluminous mass, tetragonal in shape, and depressed from before backwards. It measures 6 mm. to 7 mm. transversely and from 5·5-6 mm. dorso-ventrally. The scolex carries no hooks, but it is provided with four large suckers which are separated from one another by two cross-shaped grooves of which the dorso-ventral groove is more pronounced. In the one specimen this groove was even continued onto the dorsal and ventral faces of the strobilus. There is no neck; a simple fold separates the scolex from the strobilus. The strobilus attains its maximum width about 1·5 cm. from the scolex. At the point of maximum width the strobilus forms a lateral bulge which is more marked on the left side. From this point backwards the strobilus becomes narrower but the individual segments become longer and less thick. The average thickness of the segments are from 2·5-3 mm. The anterior segments of the strobilus are very short (1·0 mm. long), but they increase in length towards the middle and again shorten towards the posterior end.

There are two longitudinal and ventral, excretory canals which are united by a transverse canal in the posterior region of each segment. The transverse canals of successive segments are also in communication by means of a well developed longitudinal anastomosis.

There are two simple lateral nerve strands. These lie external but very close to the lateral excretory canals.

The genital organs are fully developed at a distance of two cm. from the scolex, but at this point the uterus contains no eggs yet.

The testes are small and numerous; distributed in the dorsal region of the segment. The testicular zone stops 1·5 mm. from the lateral margin of each segment. The vas deferens runs the entire width of the testicular zone in the segment. In reality there are two vasa efferentia, very unequal in length, which unite after a short distance to form a much convoluted seminal vesicle. The cirrus pouch is fusiform and measures 1·5-1·8 mm. in length by 0·25-0·28 mm. in width. The ejaculatory duct forms one or two coils before leading to the exterior.

The genital pore is situated anteriorly on the left side of each segment, forming a small atrium which is directed anteriorly.

The penis was not seen in the evaginated condition, but appears to be ciliated.

The ovary almost surrounds the vitellarium and measures 1·5 mm. It occupies a considerable central portion in the posterior region of the segment.

The vagina after a short distance forms a large receptaculum seminis, situated 0·3 mm. from the genital pore. The uterus is conspicuous in the posterior segments of the strobilus and consists

of a large transverse canal with anterior and posterior pocket-like appendages, but in the gravid proglottides the uterus is no more than a transverse band consisting of small pockets containing the eggs.

The eggs are irregular in outline, circular or slightly pentagonal or hexagonal in shape, with a diameter of 0·07-0·08 mm. The eggs have a pyriform apparatus measuring 0·05 -0·055 mm. in length, and contain embryos measuring from 0·017-0·022 mm.

Habitat: Intestine.

Host: Indian elephant.

BIBLIOGRAPHY.

BAYLIS, H A. 1921. "A New Genus of Nematodes parasitic in Elephants." *Indian Jl. of Vet. Sc. and Husb.*, Vol. 13,, p. 57.

BAYLIS, H. A. 1929. "A Manual of Helminthology, Medical and Veterinary." Bailière, Tindall & Cox, London.

BHALERAO, G. D. 1933. "The trematode parasites of the Indian Elephant." *Indian Journal of Vet. Sc. and Animal Husbandry*, Vol. 3, Part I, March, 1933.

BHALERAO, G. D. 1934. "Helminth Parasites of the Indian Elephant from the Andamans and Burma." *Indian Journal of Vet. Sc. and Animal Husbandry*, Vol. 5, Part I, March, 1935.

BHALERAO, G D. 1935. "Helminth Parasites of the Indian Elephant from the Andamans and Burma." *Indian Journal of Vet. Sc. and Animal Husbandry*, Vol. 5, Part I, March, 1935.

COBBOLD, T S. 1882. "The Parasites of Elephants." *Trans. Linn. Soc., London, 2nd. Ser., Zoology*, Vol. 2, pt. 4, pp. 223-258, pl. XXIII-XXIV.

GEDOELST, L. 1922. "Quelques nematodes parasites de l'Elephant africain." *Bull. Soc. Path. Exot.*, tome XV., Seance, 8 Fevr., 1922, No. 2, pp. 122-127.

KHALIL, M. 1922. "A preliminary Note on some new Nematode Parasites from the Elephant." *Ann. and Mag. Nat. Hist.*, Ser. 9, Vol. 9, pp. 212-216, Feb., 1922.

KHALIL, M. 1922. "A Revision of the Nematode Parasites of Elephants, with a description of four new Species." *Proceedings of the Zoological Society of London*, June, 1922, pp. 1-75.

KHALIL, M. 1922. "Parasites from Liberia and French Guiana, Part 1, Nematodes." *Zeitschrift fur Parasitenkunde*, Band 4, p. 431.

LANE, C. 1914. "Bursate Nematodes from the Indian Elephant." *Indian Journal of Med. Research*, Vol. 3, No. 1, p. 380.

LANE, C. 1915. "A further Note on Bursate Nematodes of the Indian Elephant." *Indian Journ. of Med. Research*, Vol. 3, No. 1, p. 105.

LANE, C. 1917. "Bunostomum Kashinathi and the Ancylostomidae. *Indian Journ. of Med. Research*, Vol. 4, No. 3, pp. 419-439, Jan., 1917.

LANE, C. 1921. "Some Bursate Nematodes from the Indian and African Elephant." *Indian Journ. of Med. Research*, Vol. 9, No. 1, pp. 163-172.

MAPLESTONE, P. A. 1923. "A Revision of the Amphistomata of Mammals." *Annals of Tropical Medicine and Parasitology*, Vol. 17, No. 2.

MEGGIT, F. J. 1924. The Cestodes of Mammals.

MÖNNIG, H. O. 1932. "On some strongylid Nematodes of the African Elephant." *Trans. of the Royal Soc. of S.A.*, Vol. 13, Part 4, pp. 313-321.

MÖNNIG, H. O. 1932. "Syngamus indicus: A new Nematode from the Indian Elephant." *18th Report of the Director of Veterinary Services and Animal Industry*, Union of S.A., August, 1932.

NEVEU-LEMAIRE, M. "Les strongylides du Rhinoceros africain." *Ann. de Par. Hum. et Comp.*, tome II, No. 2, pp .121-154, 11 pls. Avril, 1924.

NEVEU-LEMAIRE, M. "Strongylides nouveaux du genre Quilonia chez l' Elephant d' afrique." *Ann. de Par. Hum. et Comp.*, t. VI., No. 2, pp. 187-192, Avril, 1928.

NEVEU-LEMAIRE, M. "Strongylides nouveaux des genres Murshidia et Memphisia chez l' Elephant d' afrique." *Ann. de par. Hum. et Comp.*, t. VI., No. 3, pp. 291-302, Juillet, 1928.

RAILLIET, A. ET HENRY, A. 1910. "Quelques Helminthes nouveaux ou peu connus du groupe des Bunostomiens." *Bull. de la Soc. Path. Exot.*, t. III., No. 5, pp. 311-315, Mai, 1910.

RAILLIET, A., HENRY, A., BAUCHE, A. 1914. "Sur les Helminthes de l' Elephant d' Asie. I. Trematodes et Cestodes." *Bull. Soc. de Path. Exot.*, t. VII, 1914, p. 78.

STILES, Ch. W., AND GOLDBERGER, J. 1910. "A Study of the Anatomy of Watsonius (n.g.) Watsoni of Man." *Hygienic Laboratory-Bulletin, No.* 60, April, 1910.

TRAVASSOS, L. 1934. "Synopse dos. Paramphistomoidea." *Reimpresso des Memorias di Instituto Oswaldo Cruz.*, t. 29—Fasc. I, Novembro, 1934.

WARE, F. 1924. "Two Bursate Nematodes from the Indian Elephant." *Jl. Comp. Path. Therap.*, Vol. 37, pp. 278-286.

WITENBERG, G. 1925. "Notes on Strongylidae of Elephants." *Parasitology*, Vol. 17, No. 3, pp. 284-294.

YORKE, M., AND MAPLESTONE, P A. 1926. "The Nematode Parasites of Vertebrates." Churchill, London.

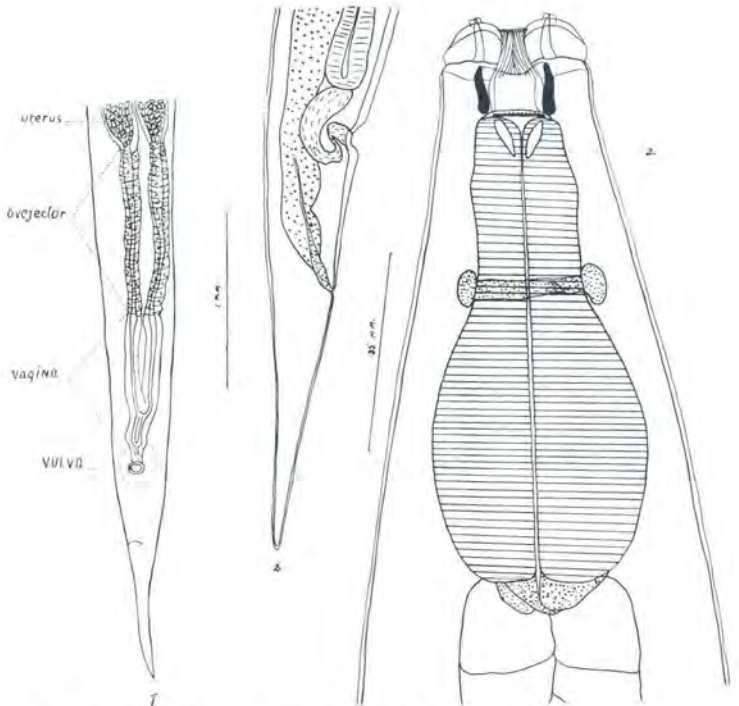


Fig. 1.—*Murshidia*—female genital ducts. (Orig.)
Fig. 2.—*Murshidia murshida*—female tail. (Orig.)
Fig. 3.—*Murshidia murshida*—anterior end, dorsal view. (Orig.)

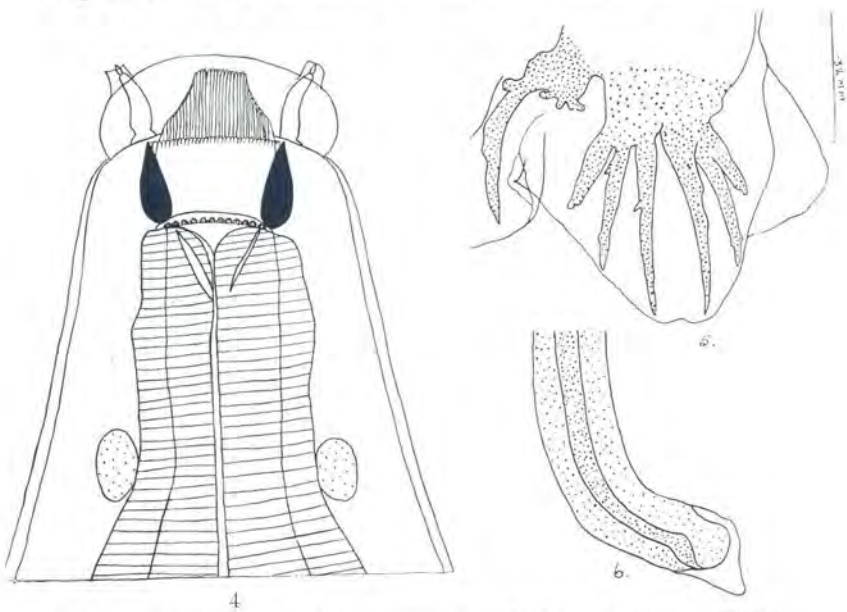
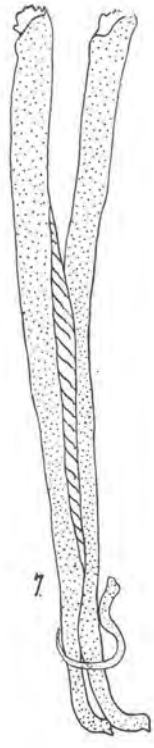


Fig. 4.—*Murshidia murshida*—anterior end, lateral view. (Orig.)
Fig. 5.—*Murshidia murshida*—male bursa, dorsal ray. (Orig.)
Fig. 6.—*Murshidia murshida*—" beaked " tip of male spicule. (Orig.)



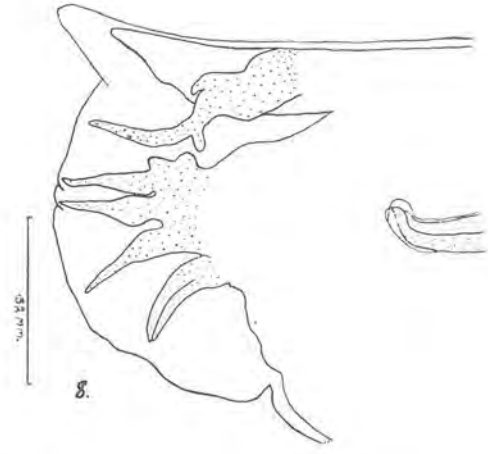


Fig. 7.—*Murshidia murshida*—spicules of male. (Orig.)

Fig. 8.—*Murshidia murshida*—male bursa, lateral view. (Orig.)

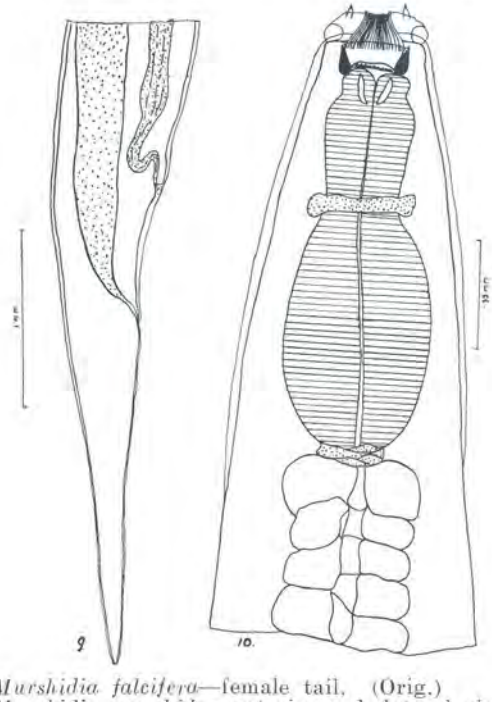


Fig. 9.—*Murshidia falcifera*—female tail. (Orig.)

Fig. 10.—*Murshidia murshida*—anterior end, lateral view. (Orig.)

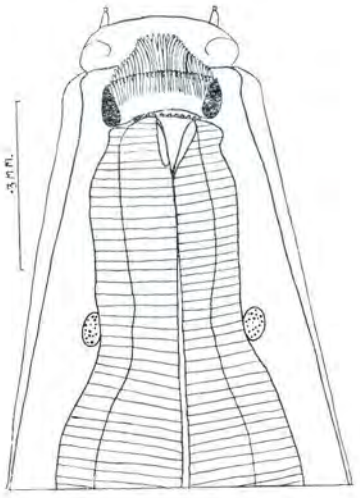


Fig. 11.—*Murshidia falcifera*—head, lateral view. (Orig.)

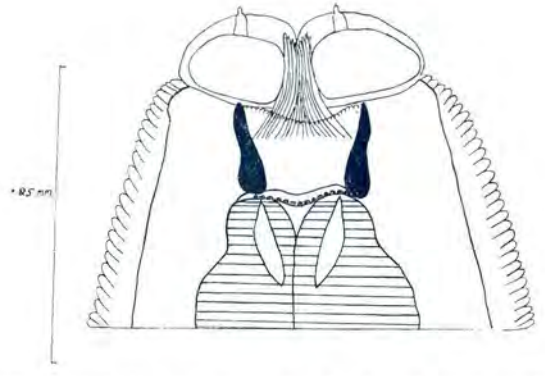


Fig.12.—*Murshidia falcifera*—head, dorsal view. (Orig.)

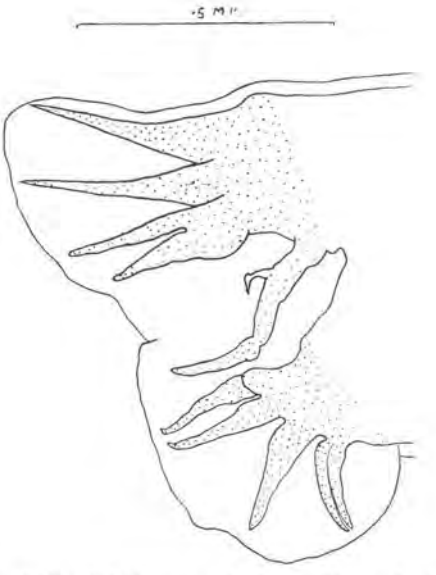


Fig. 13.—*Murshidia falcifera*—male bursa, lateral view. (Orig.)

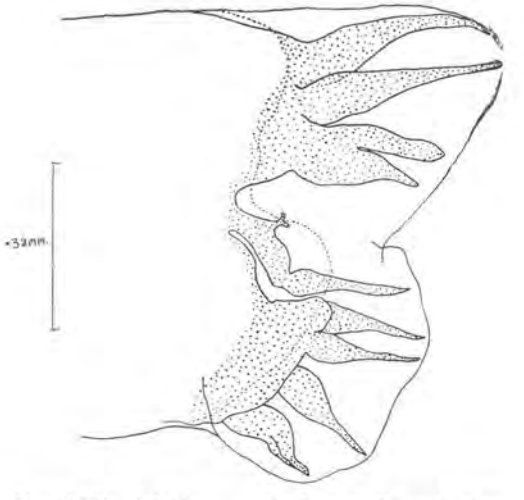


Fig. 14.—*Murshidia falcifera*—male bursa, lateral view. (Orig.)

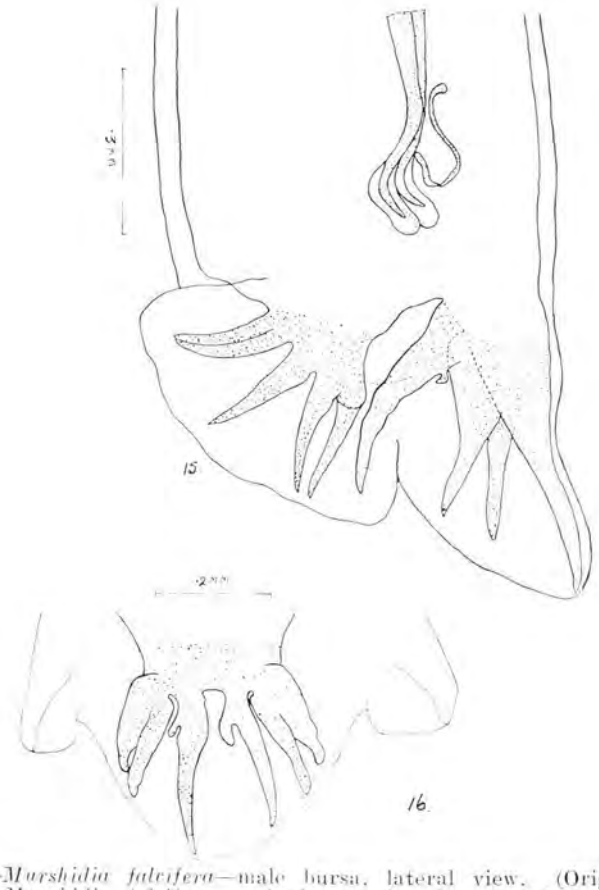


Fig. 15.—*Marshidia falcifera*—male bursa, lateral view. (Orig.)
Fig. 16.—*Marshidia falcifera*—male bursa, dorsal ray variation. (Orig.)

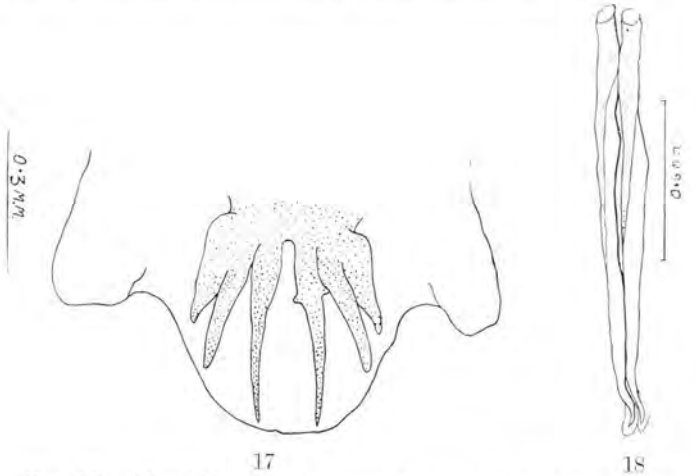
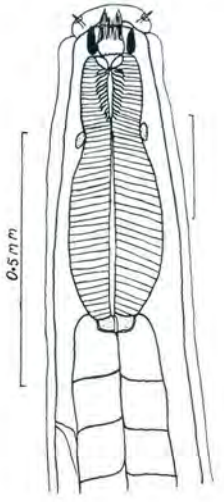


Fig. 17.—*Marshidia falcifera*—male bursa, dorsal ray. (Orig.)
Fig. 18.—*Marshidia falcifera*—spicules of male. (Orig.)



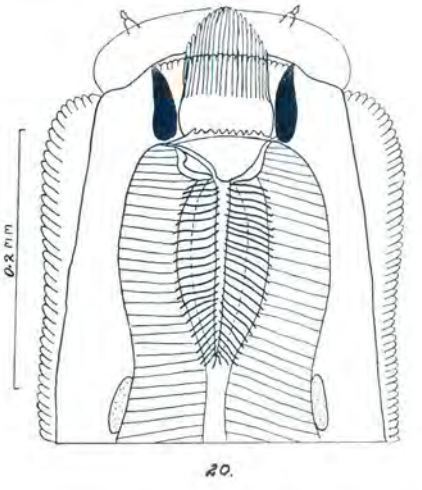
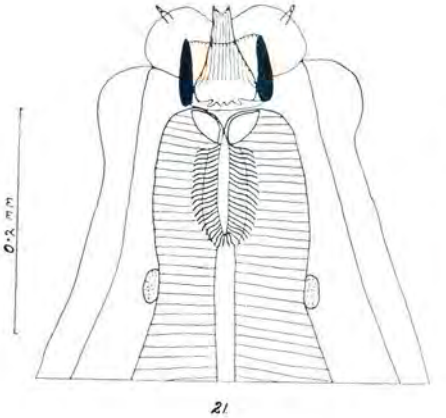
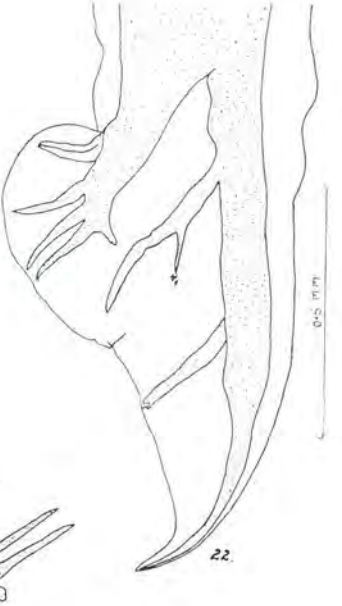


Fig. 19.—*Murshidia indica*—anterior end, dorsal view. (Orig.)
Fig. 20.—*Murshidia indica*—head, lateral view. (Orig.)





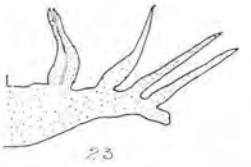


Fig. 21.—*Murshidia indica*—head, dorsal view. (Orig.)
Fig. 22.—*Murshidia indica*—male bursa, lateral view. (Orig.)
Fig. 23.—*Murshidia indica*—male bursa, lateral lobe. (Orig.)

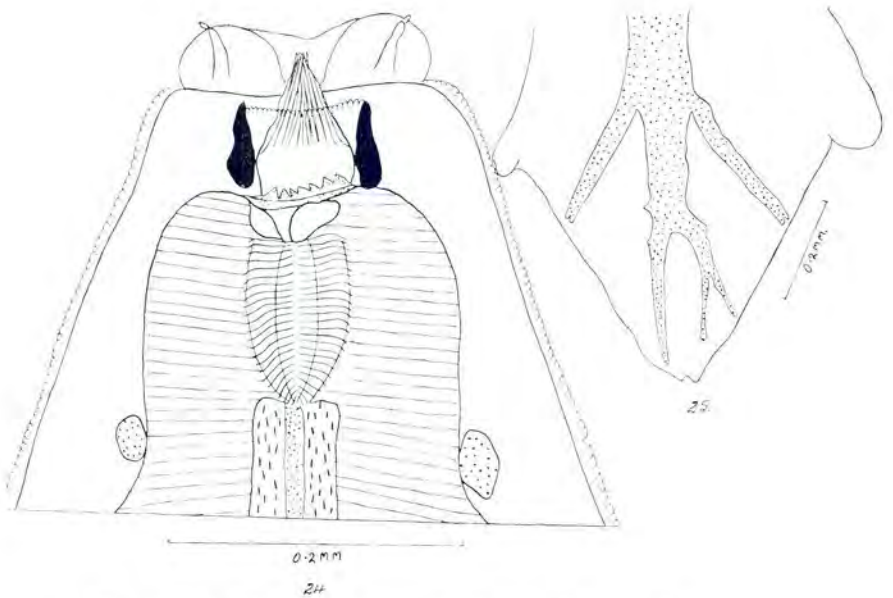


Fig. 24.—*Murshidia indica*—head, dorsal view. (Orig.)
Fig. 25.—*Murshidia indica*—male bursa, dorsal ray. Orig.)

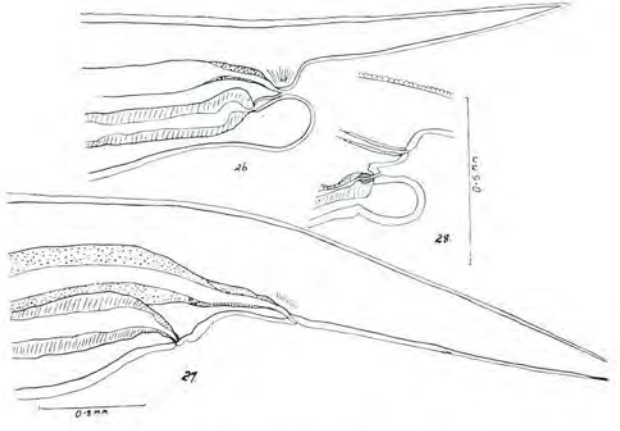
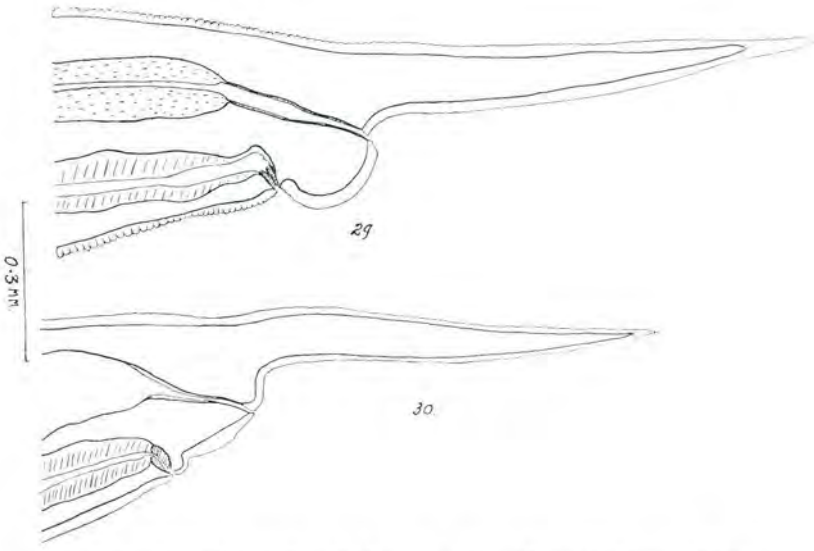
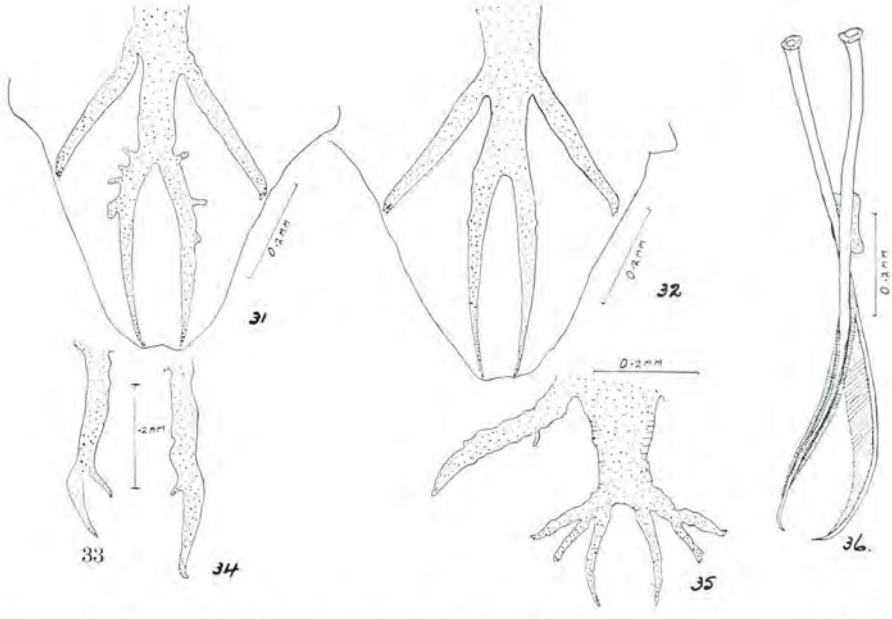


Fig. 26.—*Murshidia indica*—female tail. (Orig.)
Fig. 27.—*Murshidia neveu-lemairei*—female tail. (Orig.)
Fig. 28.—*Murshidia indica*—female, vulvar region. (Orig.)



Figs. 29, 30.—*Murshidia indica*—female tail variations. (Orig.)



Figs. 31, 32.—*Murshidia indica*—male bursa, dorsal ray variations. (Orig.)
Figs. 33, 34.—*Murshidia indica*—male bursa, externo-dorsal ray variations. (Orig.)
Fig. 35.—*Murshidia neveu-lemairei*—male, bursa, dorsal lobe. (Orig.)
Fig. 36.—*Murshidia indica*—spicules of male. (Orig.)

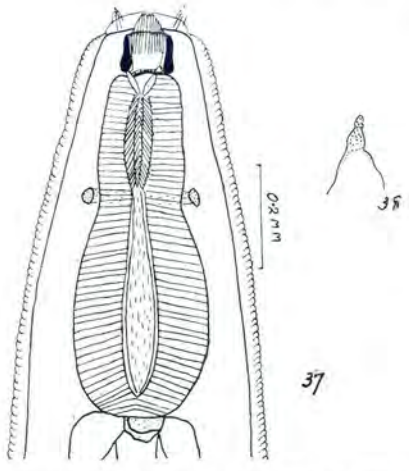


Fig. 37.—*Murshidia neveu-lemairei* anterior end, lateral view. (Orig.)
Fig. 38.—*Murshidia neveu-lemairei*—a sub-median papilla. (Orig.)

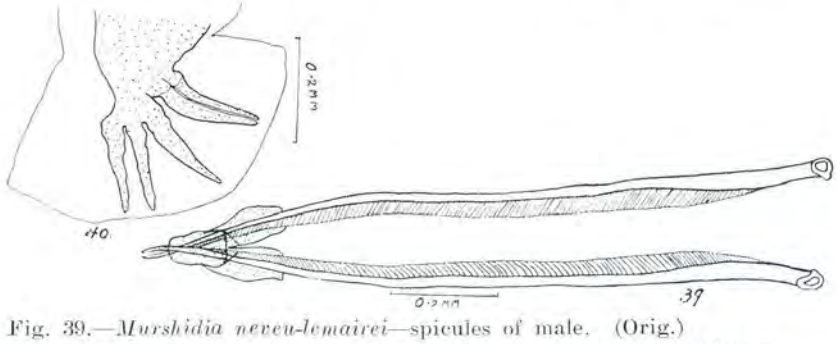


Fig. 39.—*Murshidia neveu-lemairei*—spicules of male. (Orig.)
Fig. 40.—*Murshidia neveu-lemairei*—male bursa, lateral lobe. (Orig.)

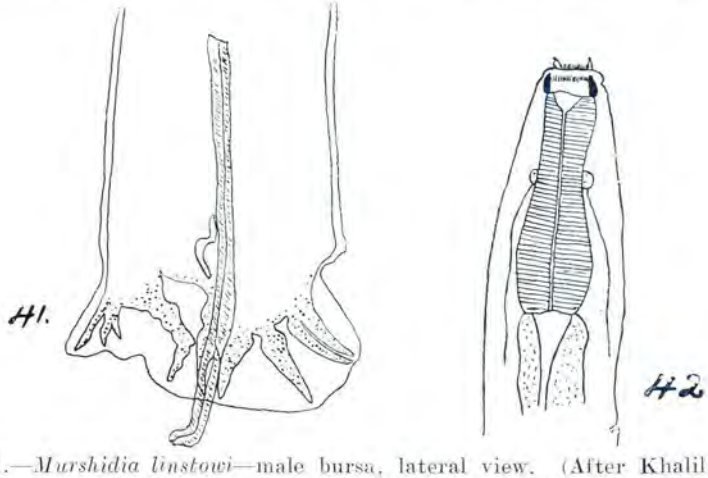
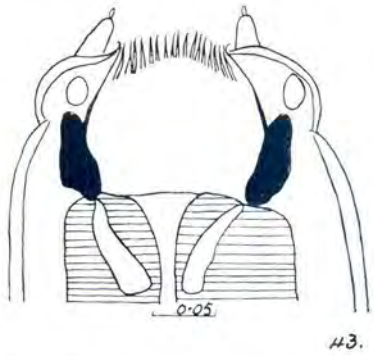


Fig. 41.—*Murshidia linstowi*—male bursa, lateral view. (After Khalil, 1922.)
Fig. 42.—*Murshidia linstowi*—anterior end. (From Khalil, 1922, after Leiper.)



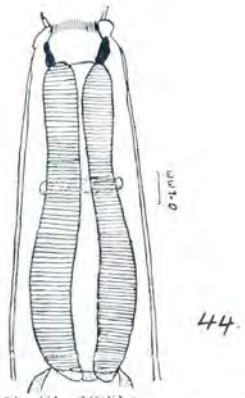


Fig. 43.—*Murshidia hadia*—head. (After Khalil, 1922.)
Fig. 44.—*Murshidia hadia*—anterior end. (After Khalil, 1922.)

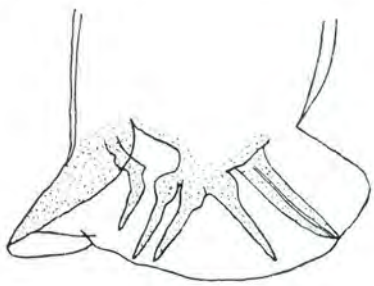


Fig. 45.—*Murshidia hadia*—male bursa, lateral view. (After Khalil, 1922.)
Fig. 46.—*Murshidia hadia*—male bursa, dorsal ray. (After Khalil, 1922.)
Fig. 47.—*Murshidia hadia*—spicules of male. (After Khalil, 1922.)
Fig. 48.—*Murshidia hadia*—female tail. (After Khalil, 1922.)

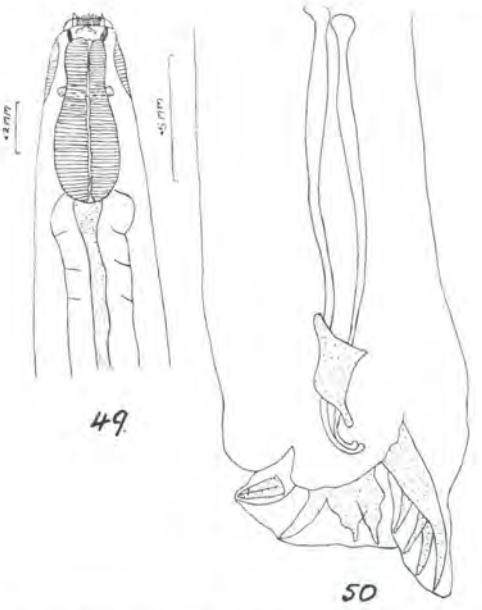


Fig. 49.—*Murshidia longicaudata*—anterior end. (After Neveu-Lemaire, 1928.)
Fig. 50.—*Murshidia longicaudata*—male bursa, lateral view. (After Neveu-Lemaire, 1928.)

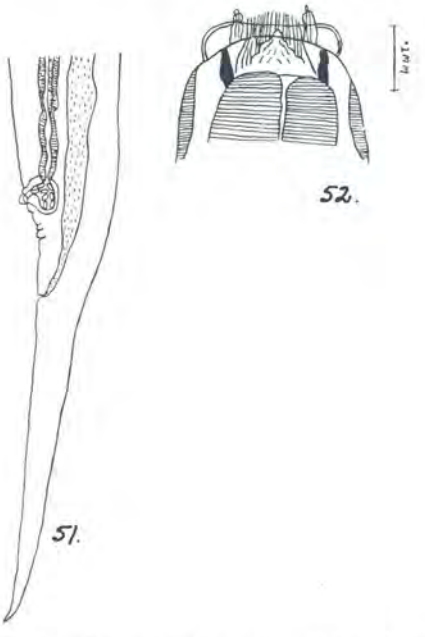


Fig. 51.—*Murshidia longicaudata*—female tail. (After Neveu-Lemaire, 1928.)
Fig. 52.—*Murshidia longicaudata*—head, lateral view. (After Neveu-Lemaire, 1928.)

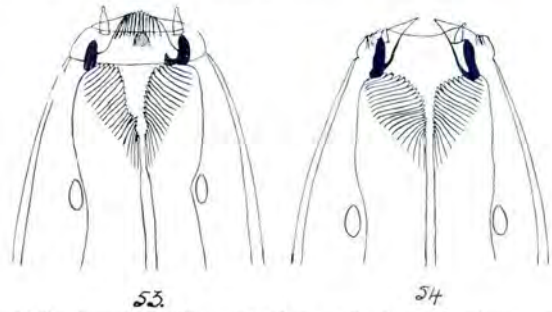


Fig. 53.—*Murshidia brachyscelis*—anterior end, lateral view. (After Mönnig, 1932.)
Fig. 54.—*Murshidia brachyscelis*—anterior end, ventral view. (After Mönnig, 1932.)

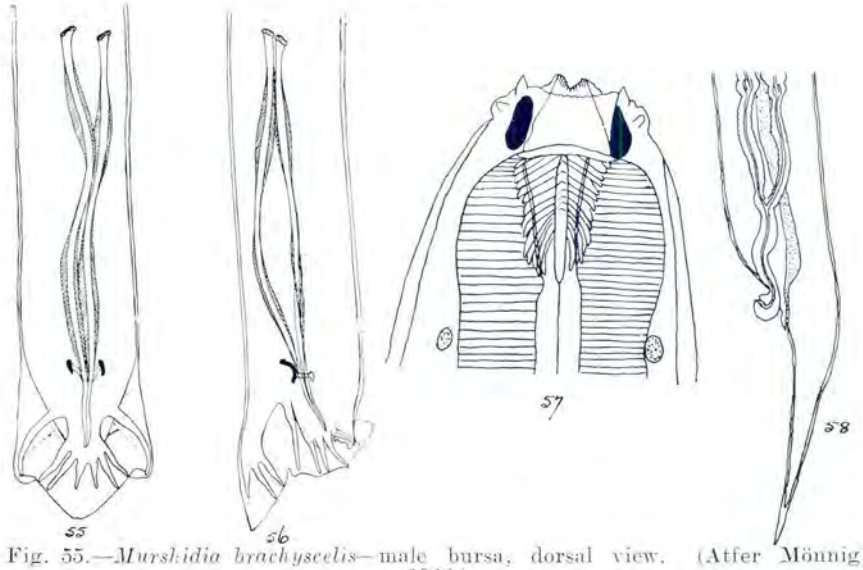


Fig. 55.—*Murshidia brachyscelis*—male bursa, dorsal view. (After Mönnig, 1932.)
Fig. 56.—*Murshidia brachyscelis*—male bursa, lateral view. (After Mönnig, 1932.)
Fig. 57.—*Murshidia africana*—head, dorsal view. (After Lane, 1921.)
Fig. 58.—*Murshidia africana*—female tail. (After Lane, 1921.)

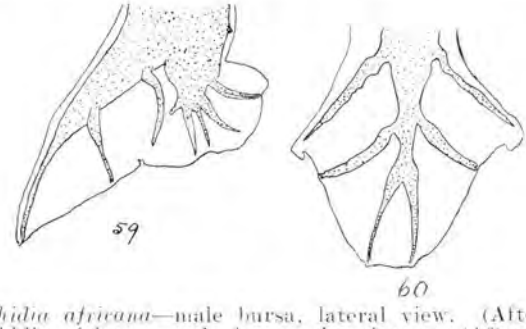
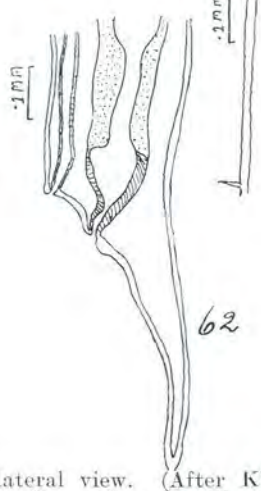


Fig. 59.—*Murshidia africana*—male bursa, lateral view. (After Lane, 1921.)
Fig. 60.—*Murshidia africana*—male bursa, dorsal ray. (After Lane, 1921.)



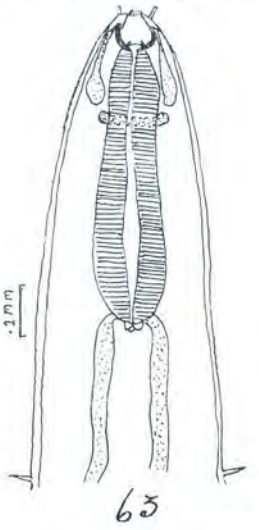


Fig. 61.—*Murshidia anisa*—head, lateral view. (After Khalil, 1922.)
Fig. 62.—*Murshidia anisa*—female tail. (After Khalil, 1922.)
Fig. 63.—*Murshidia anisa*—anterior end. (After Khalil, 1922.

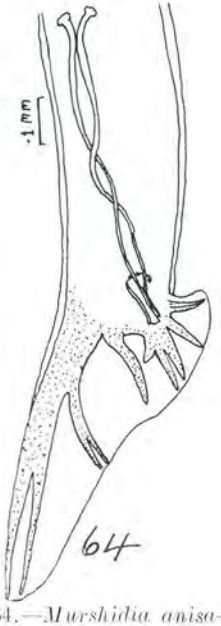
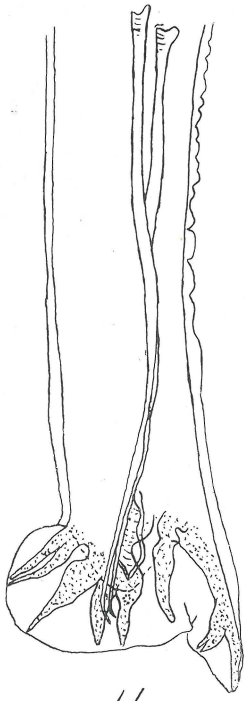
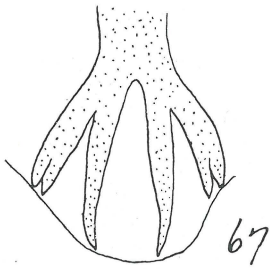


Fig. 64.—*Murshidia anisa*—male bursa, lateral view. (After Khalil, 1922.)
Fig. 65.—*Murshidia dawoodi*—head, lateral view. (After Khalil, 1922.)





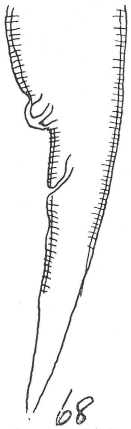


Fig. 66.—*Murshidia dawoodi*—male bursa, lateral view. (After Khalil, 1922.)
Fig. 67.—*Murshidia dawoodi*—male bursa, dorsal ray. (After Khalil, 1922.)
Fig. 68.—*Murshidia dawoodi*—female tail. (After Khalil, 1922.)

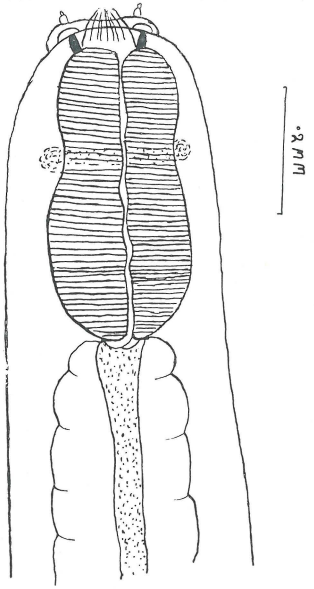


Fig. 69.—*Murshidia omoensis*—anterior end, lateral view. (After Neveu-Lemaire, 1928.)

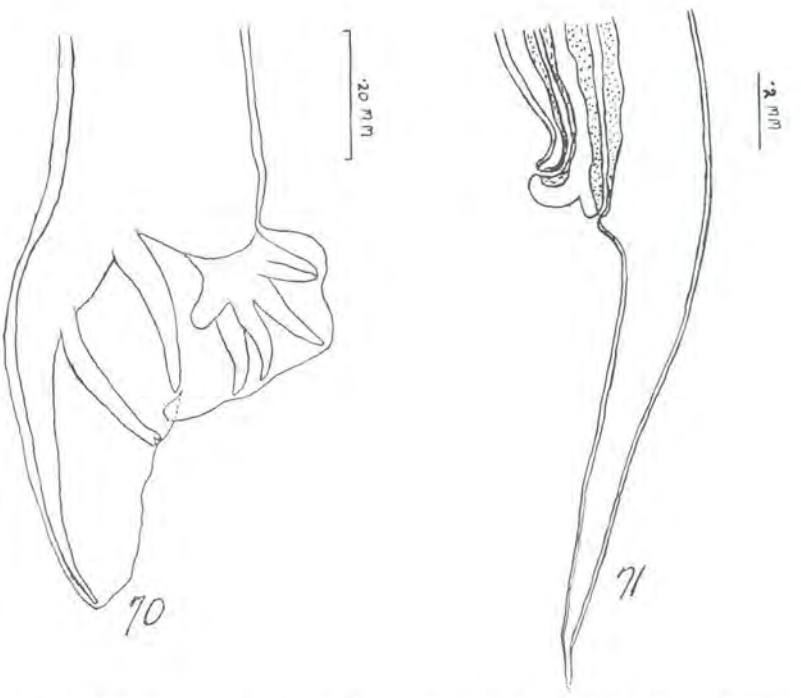


Fig. 70.—*Murshidia omoensis*—male bursa, lateral view. (After Neveu-Lemaire, 1928.)

Fig. 71.—*Murshidia omoensis*—female tail. (After Neveu-Lemaire, 1928.)

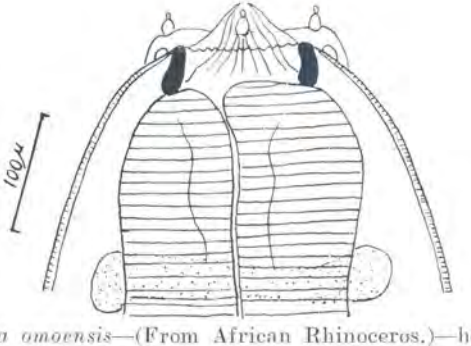


Fig. 72.—*Murshidia omoensis*—(From African Rhinoceros.)—head, dorsal view. (After Neveu-Lemaire, 1924.)

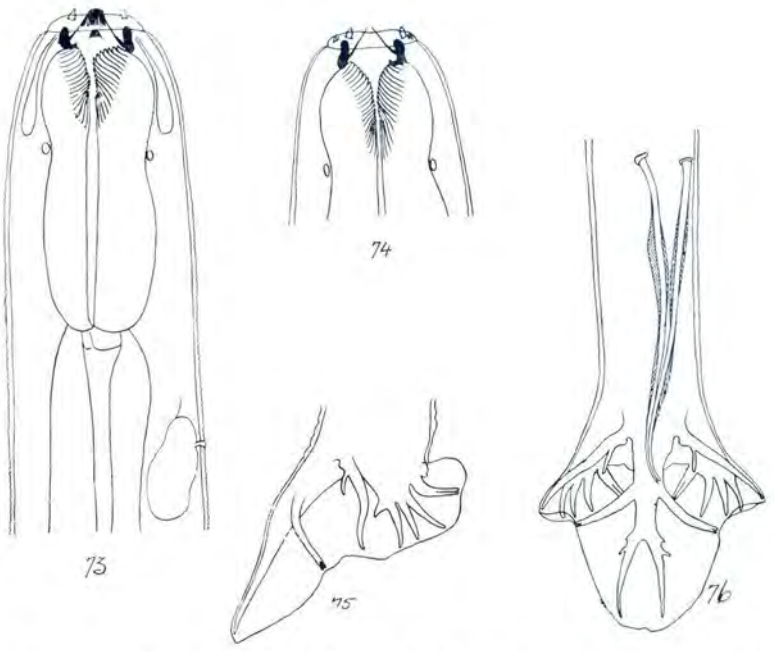


Fig. 73.—*Murshidia brevicapsulatus*—anterior end, lateral view. (After Mönnig, 1932.)
Fig. 74.—*Murshidia brevicapsulatus*—head, dorsal view. (After Mönnig, 1932.)
Fig. 75.—*Murshidia brevicapsulatus*—male bursa, lateral view. (After Mönnig, 1932.)
Fig. 76.—*Murshidia brevicapsulatus*—male bursa, dorsal view. (After Mönnig, 1932.)

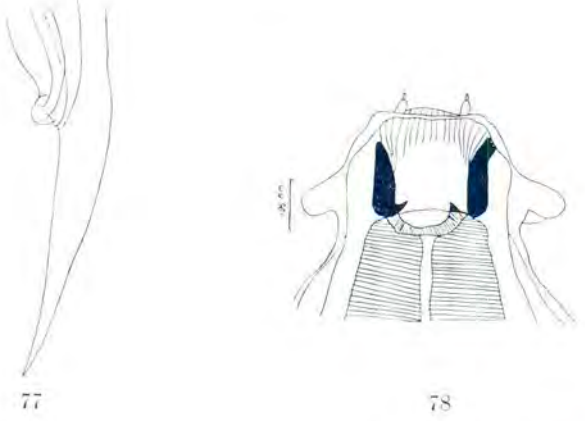


Fig. 77.—*Murshidia brevicapsulatus*—female tail. (After Mönnig, 1932.)
Fig. 78.—*Murshidia memphisia*—head, lateral view. (After Khalil, 1922.)

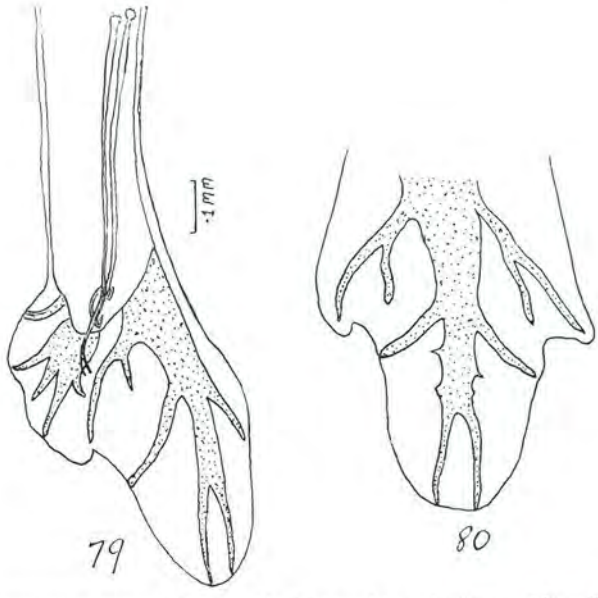


Fig. 79.—*Murshidia memphisia*—male bursa, lateral view. After Khalil, 1922.)
Fig. 80.—*Murshidia memphisia*—male bursa, dorsal ray. (After Khalil, 1922.)

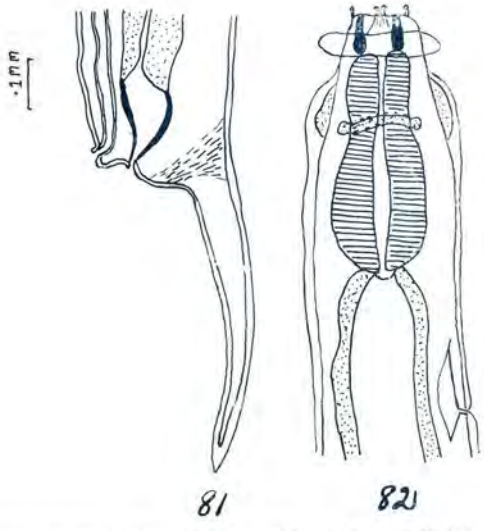


Fig. 81.—*Murshidia memphisia*—female tail. (After Khalil, 1922.)
Fig. 82.—*Murshidia memphisia*—anterior end, lateral view. (After Khalil, 1922.)

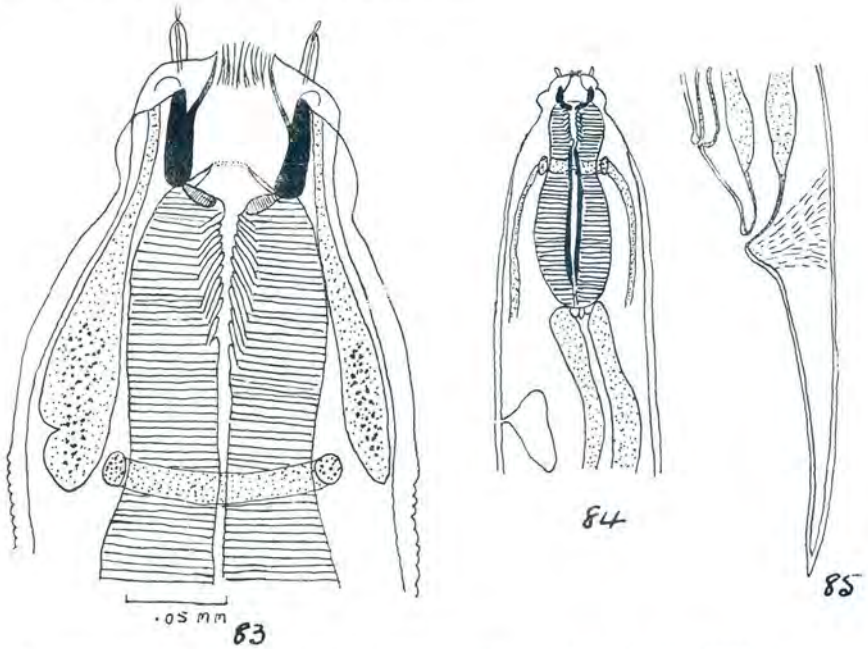


Fig. 83.—*Murshidia aziza*—head, lateral view. (After Khalil, 1922.)
Fig. 84.—*Murshidia aziza*—anterior end, lateral view. (After Kalil, 1922.)
Fig. 85.—*Murshidia aziza*—female tail. (After Khalil, 1922.)

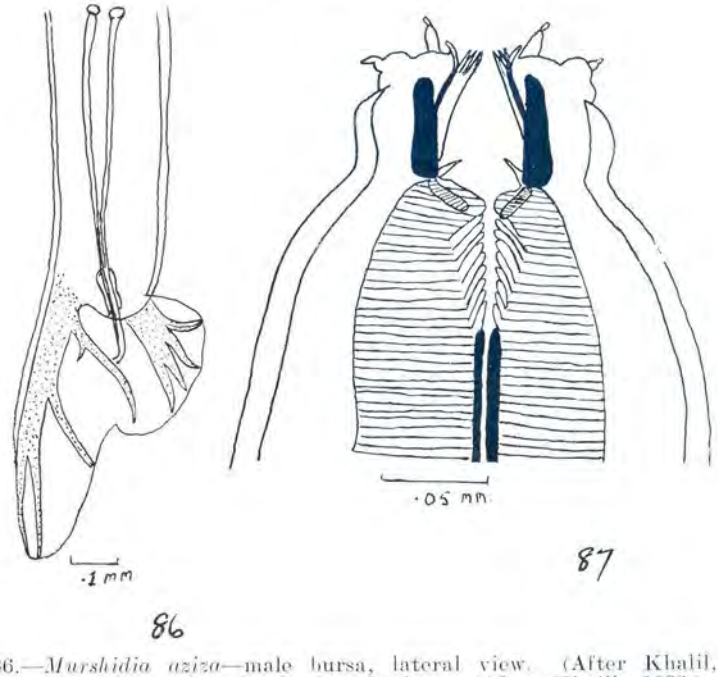


Fig. 86.—*Murshidia aziza*—male bursa, lateral view. (After Khalil, 1922.)
Fig. 87.—*Murshidia aziza*—head, dorsal view. (After Khalil, 1922.)

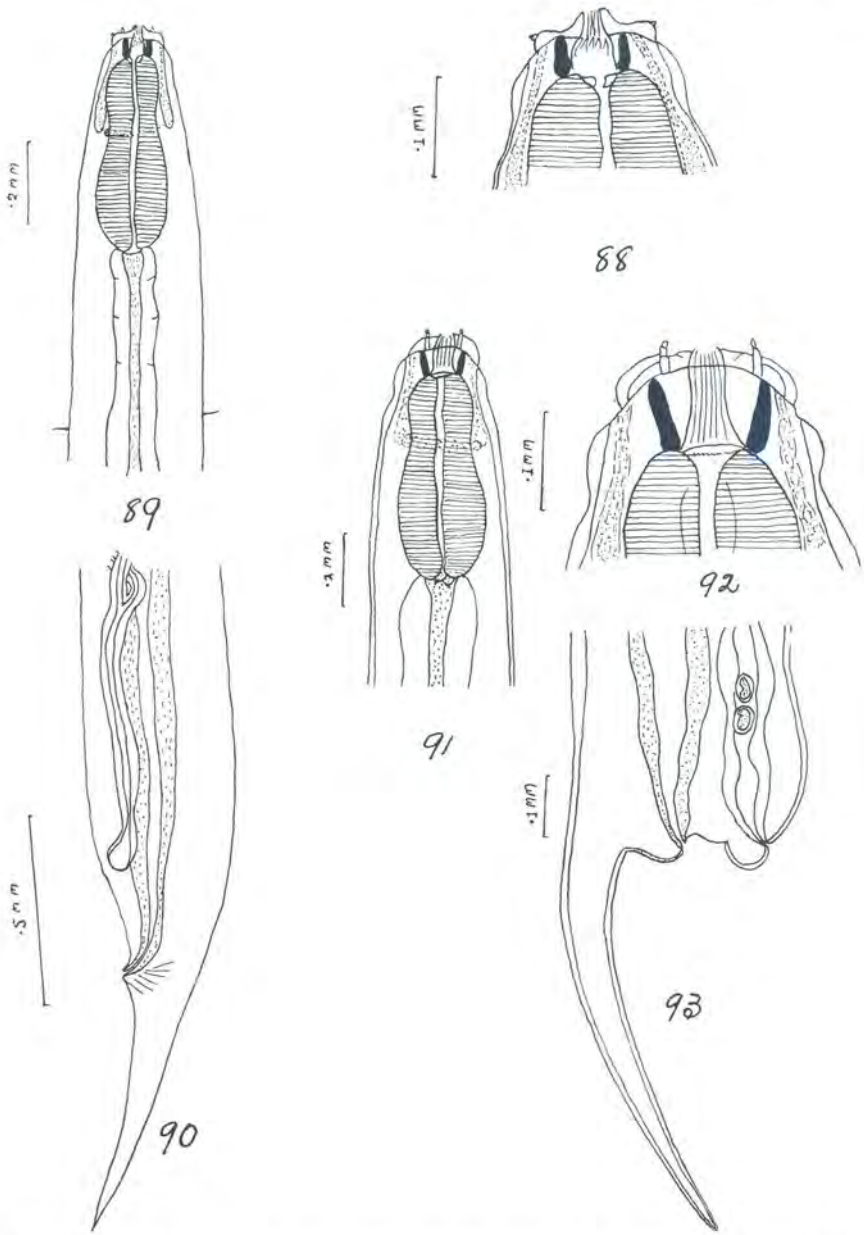


Fig. 88.—*Murshidia loxodontae*—head, dorsal view. (After Neveu-Lemaire, 1928.)
Fig. 89.—*Murshidia loxodontae*—anterior end, dorsal view. (After Neveu-Lemaire, 1928.)
Fig. 90.—*Murshidia loxodontae*—female tail. (After Neveu-Lemaire, 1928.)
Fig. 91.—*Murshidia soudanensis*—anterior end. (After Neveu-Lemaire, 1928.)
Fig. 92.—*Murshidia soudanensis*—head, lateral view. (After Neveu-Lemaire, 1928.)
Fig. 93.—*Murshidia soudanensis*—female tail. (After Neveu-Lemaire, 1928.)

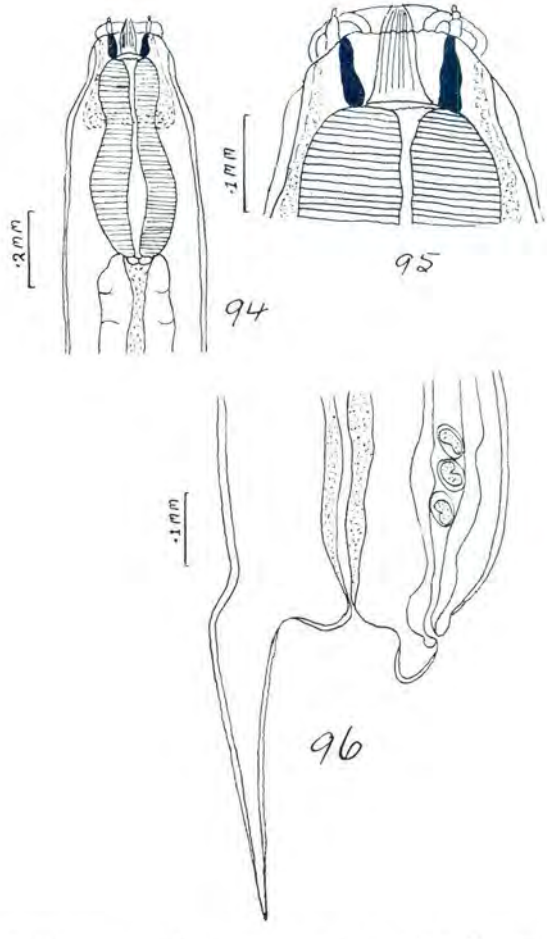


Fig. 94.—*Murshidia brevicauda*—anterior end. (After Neveu-Lemaire, 1928.)
Fig. 95.—*Murshidia brevicauda*—head, dorsal view. (After Neveu-Lemaire, 1928.)
Fig. 96.—*Murshidia brevicauda*—female tail. (After Neveu-Lemaire, 1928.)

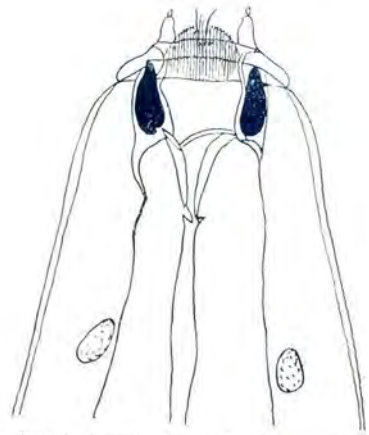


Fig. 97.—*Murshidia lanei*—head, lateral view. (After Witenberg, 1925.)

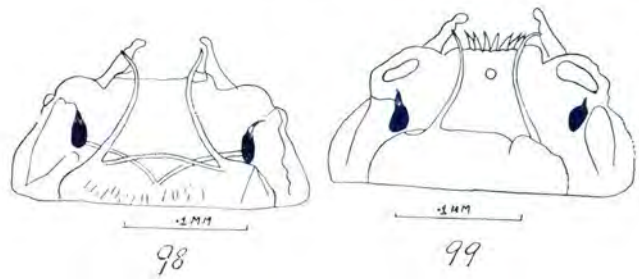


Fig. 98.—*Quilonia rennici*—head, dorsal view. (After Lane, 1914.)
Fig. 99.—*Quilonia rennici*—head, lateral view. (After Lane, 1914.)

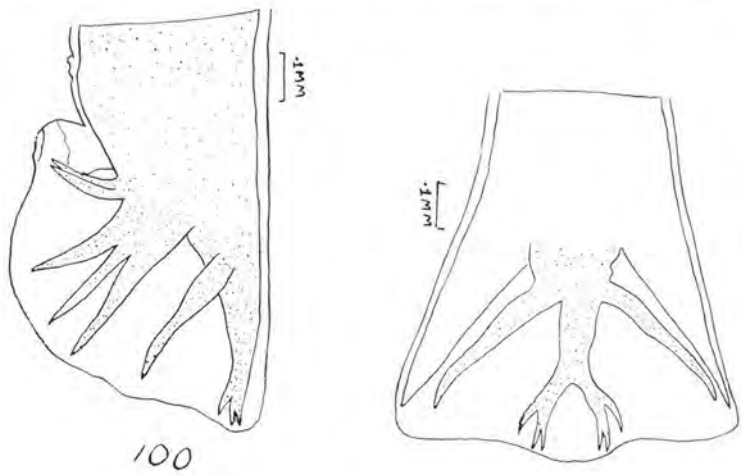
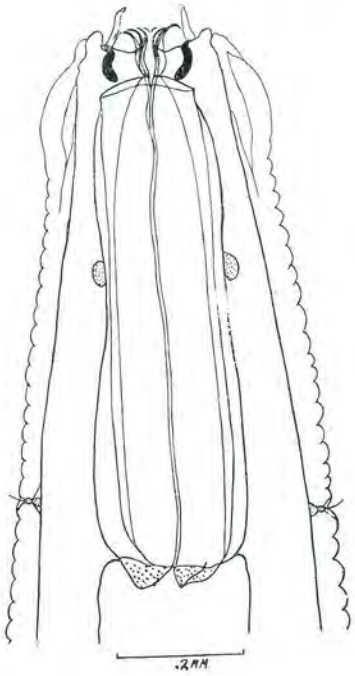


Fig. 100.—*Quilonia rennici*—male bursa, lateral view. (After Lane, 1914.)
Fig. 101.—*Quilonia rennici*—male bursa, dorsal ray. (After Lane, 1914.)



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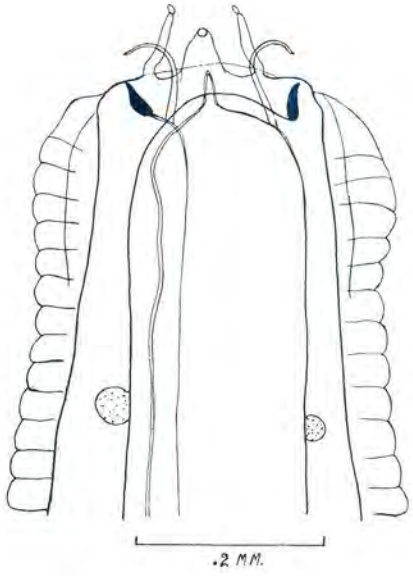

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Fig. 102.—*Quilonia travancra*—anterior end, dorsal view. (Orig.)
Fig. 103.—*Quilonia travancra*—head, lateral view. (Orig.)

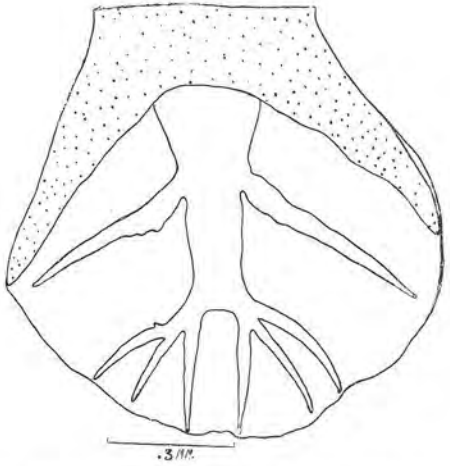

Fig. 104.—*Quilonia travancra*—male bursa, dorsal ray, ventral view. (Orig.)

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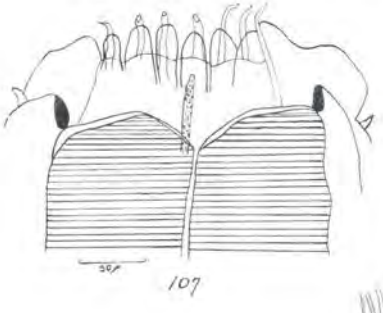
Fig. 105.—*Quilonia travancra*—male bursa, lateral ray. (Orig.)
Fig. 106.—*Quilonia travancra*—spicules of male bursa. (Orig.)



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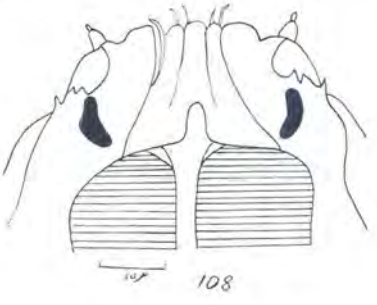

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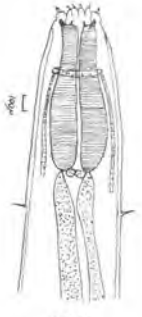

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112.

Fig. 107.—*Quilonia apiensis*—head, lateral view. (After Khalil, 1922.)
Fig. 108.—*Quilonia apiensis*—head, dorsal view. (After Khalil, 1922.)
Fig. 109.—*Quilonia apiensis*—anterior end, ventral view. (After Khalil, 1922.)
Fig. 110.—*Quilonia apiensis*—female tail. (After Khalil, 1922.)
Fig. 111.—*Quilonia apiensis*—male bursa, lateral view. After Khalil, 1922.)
Fig. 112.—*Quilonia apiensis*—male bursa, dorsal ray. (After Khalil, 1922.)

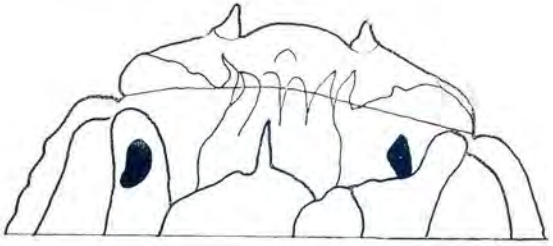

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Fig. 113.—*Quilonia africana*—head, lateral view. (After Lane, 1921.)

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Fig. 114.—*Quilonia africana*—head, ventral view. (After Lane, 1921.)

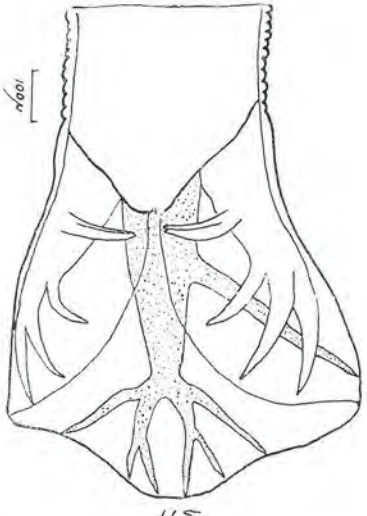

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Fig. 115.—*Quilonia africana*—male bursa, ventral view. (After Khalil, 1922.)

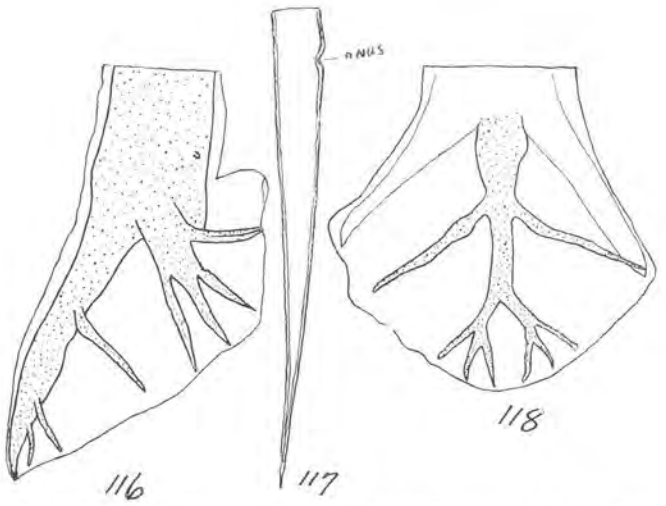


Fig. 116.—*Quilonia africana*—male bursa, lateral view. (After Lane, 1921.)
Fig. 117.—*Quilonia africana*—female tail. (After Lane, 1921.)
Fig. 118.—*Quilonia africana*—male bursa, dorsal ray, dorsal view. (After Lane, 1921.)

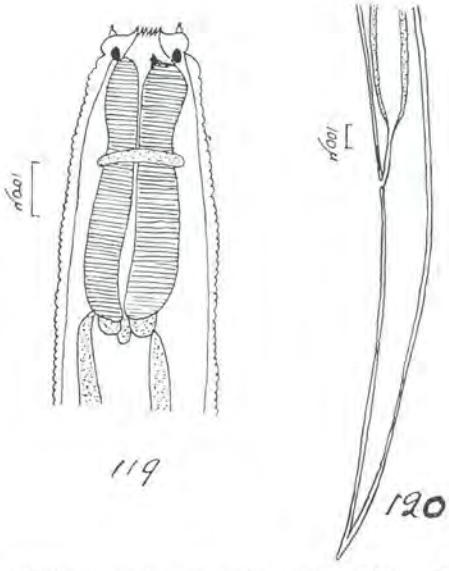


Fig. 119.—*Quilonia uganda*—anterior end. (After Khalil, 1922.)
Fig. 120.—*Quilonia uganda*—female tail. (After Khalil, 1922.)

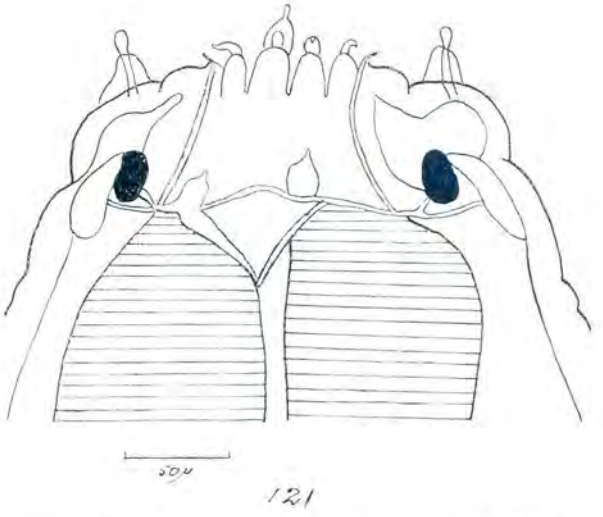


Fig. 121.—*Quilonia uganda*—head. (After Khalil, 1922.)

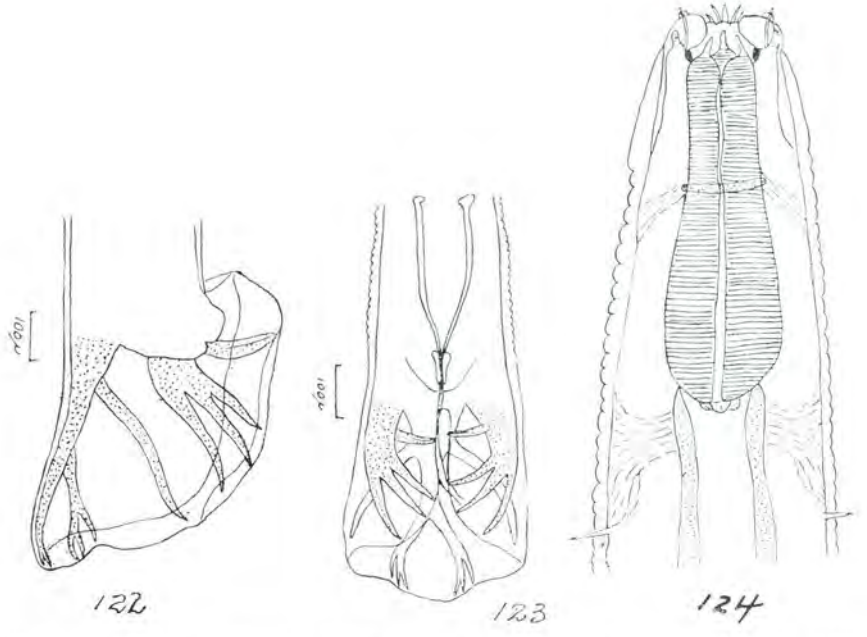


Fig. 122.—*Quilonia uganda*—male bursa, lateral view. (After Khalil, 1922.)
Fig. 123.—*Quilonia uganda*—male bursa, ventral view. (After Khalil, 1922.)
Fig. 124.—*Quilonia brevicauda*—anterior end, dorsal view. (After Khalil, 1922.)

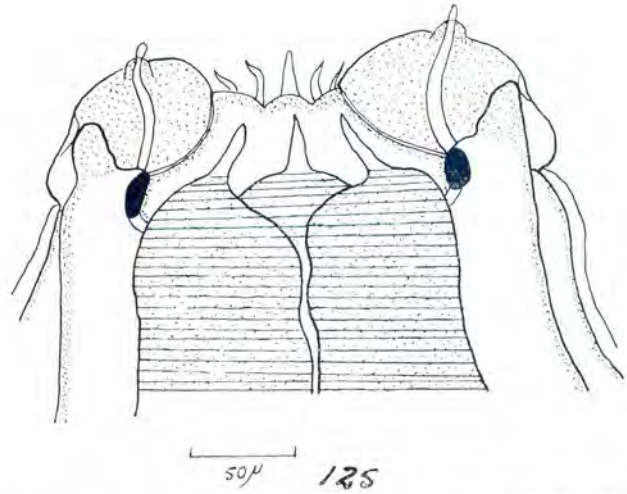


Fig. 125.—*Quilonia brevicauda*—head. (After Khalil, 1922.)

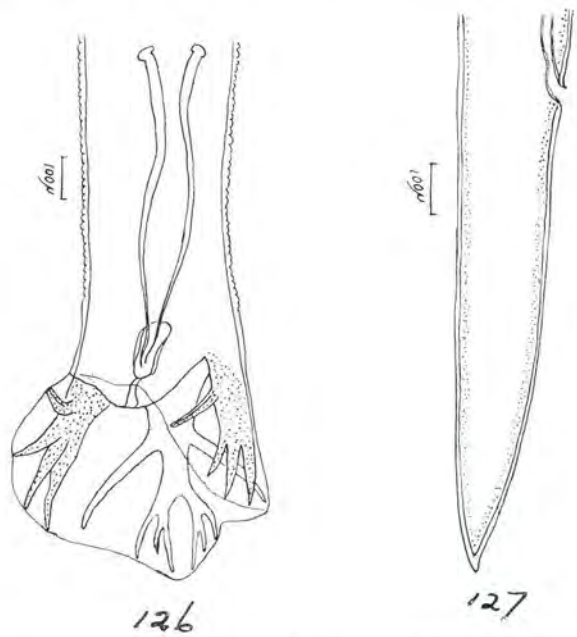


Fig. 126.—*Quilonia brevicauda*—male bursa, ventral view. (After Khalil, 1922.)
Fig. 127.—*Quilonia brevicauda*—female tail. (After Khalil, 1922.)

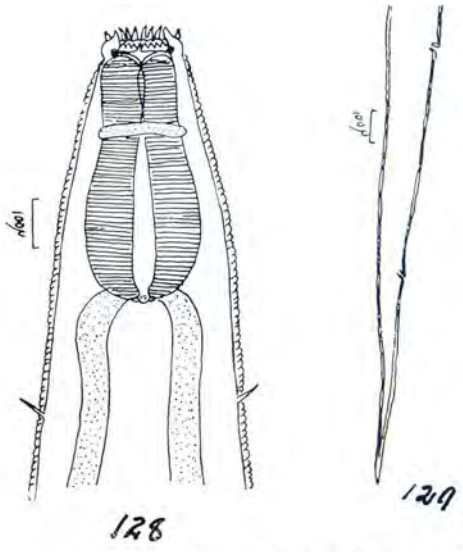


Fig. 128.—*Quilonia ethiopica*—anterior end, dorsal view. (After Khalil, 1922.)
Fig. 129.—*Quilonia ethiopica*—female tail. (After Khalil, 1922.)

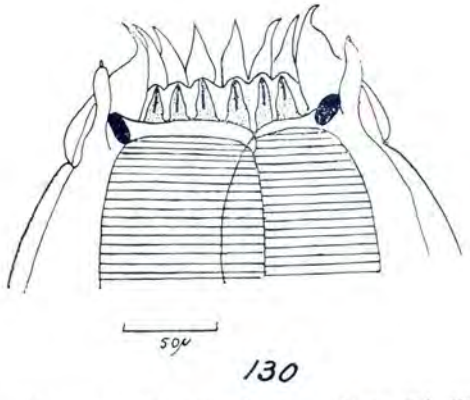


Fig. 130.—*Quilonia ethiopica*—head. (After Khalil, 1922.)

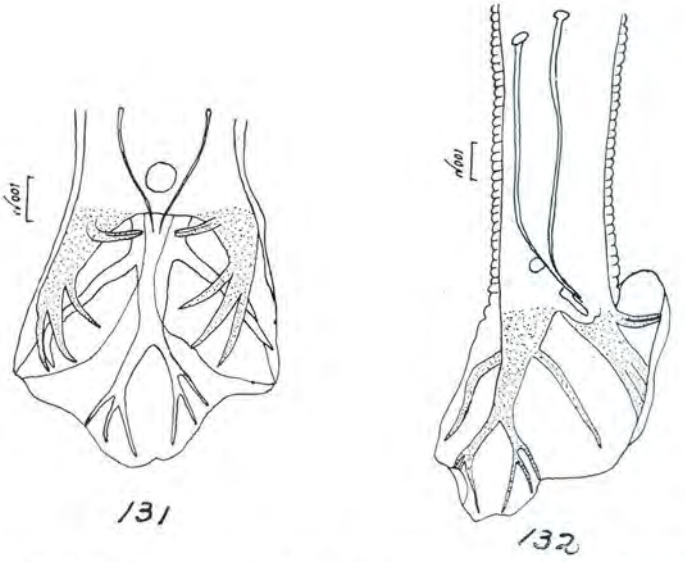


Fig. 131.—*Quilonia ethiopica*—male bursa, ventral view. (After Khalil, 1922.)
Fig. 132.—*Quilonia ethiopica*—male bursa, lateral view. (After Khalil, 1922.)

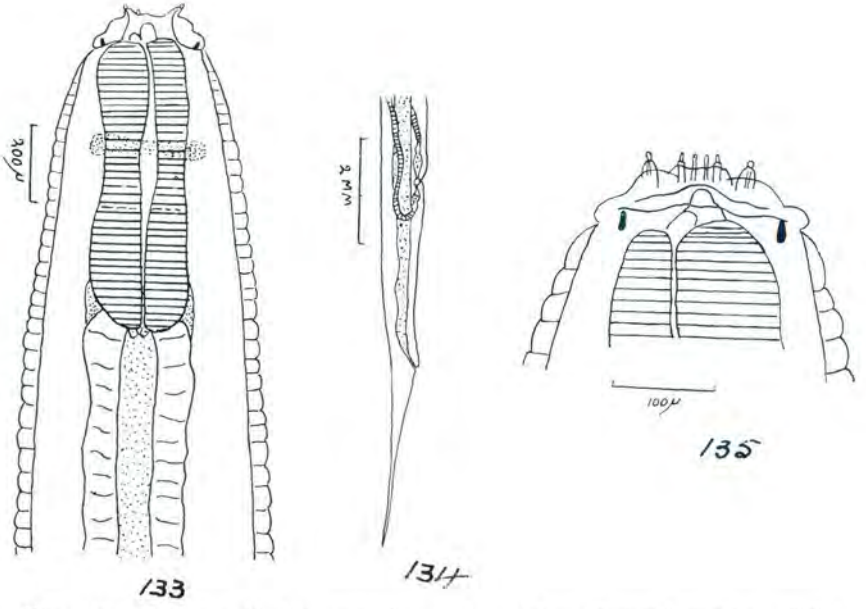
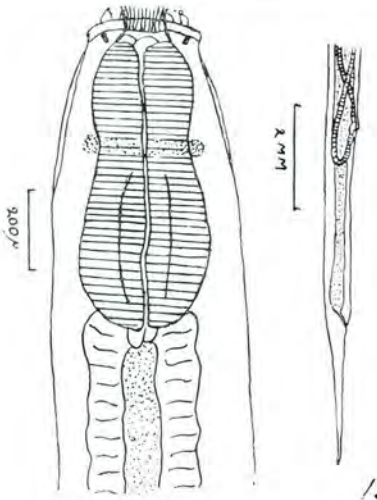


Fig. 133.—*Quilonia khalili*—anterior end. (After Neveu-Lemaire, 1928.)
Fig. 134.—*Quilonia khalili*—female tail. (After Neveu-Lemaire, 1928.)
Fig. 135.—*Quilonia khalili*—head. (After Neveu-Lemaire, 1928.)



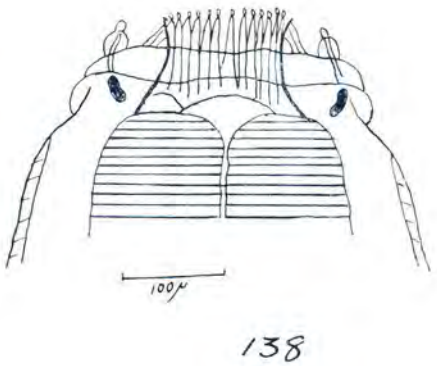
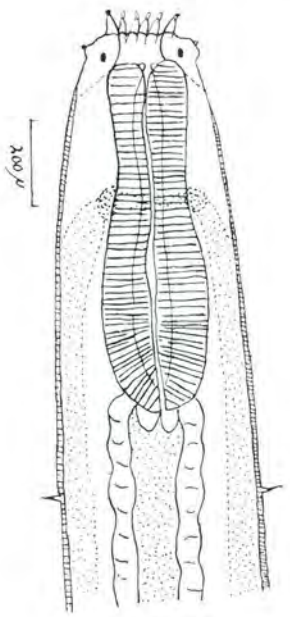


Fig. 136.—*Quilonia loxodontae*—anterior end. (After Neveu-Lemaire, 1928.)
Fig. 137.—*Quilonia loxodontae*—female tail. (After Neveu-Lemaire, 1928.)
Fig. 138.—*Quilonia loxodontae*—head. (After Neveu-Lemaire, 1928.)



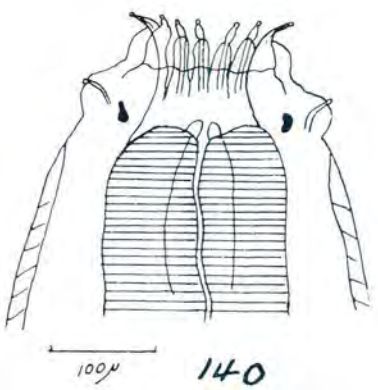


Fig. 139.—*Quilonia magna*—anterior end, ventral view. (After Neveu-Lemaire, 1928.)
Fig. 140.—*Quilonia magna*—head. (After Neveu-Lemaire, 1928.)

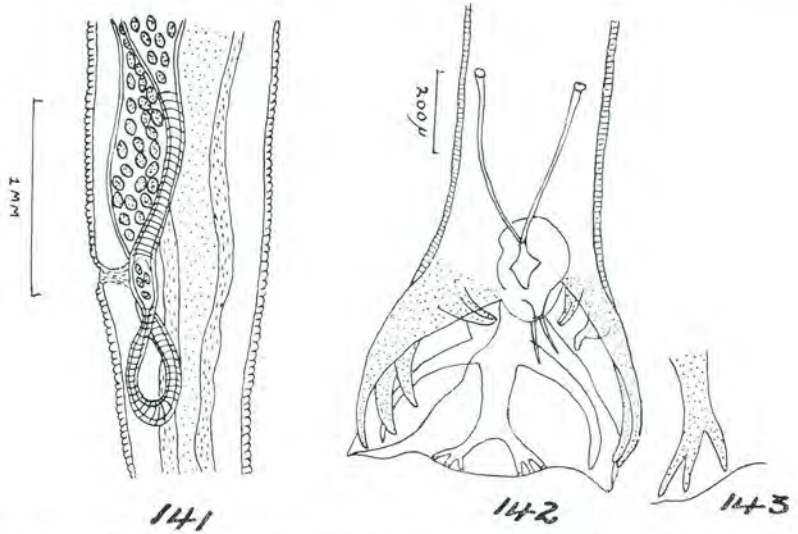


Fig. 141.—*Quilonia magna*—female uteri. (After Neveu-Lemaire, 1928.)
Fig. 142.—*Quilonia magna*—male bursa, ventral view. (After Neveu-Lemaire, 1928.)
Fig. 143.—*Quilonia magna*—male bursa, dorsal ray digitation. (After Neveu-Lemaire, 1928.)

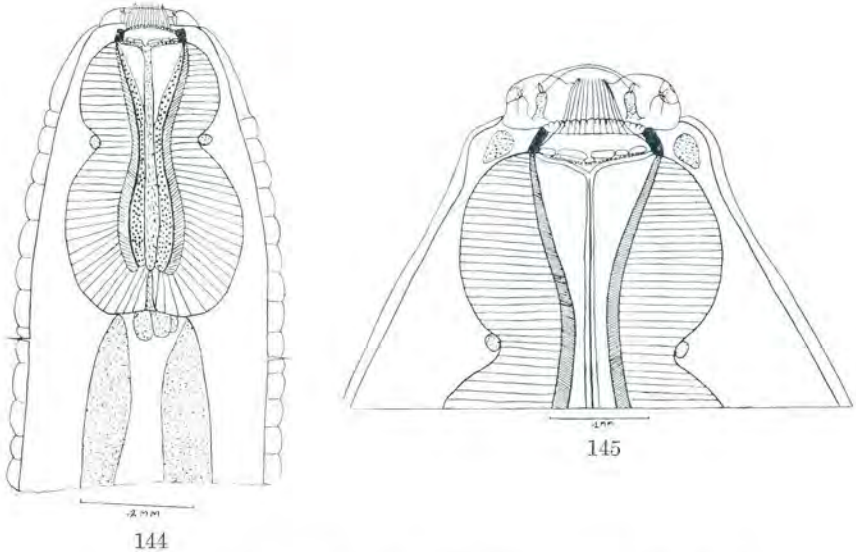


Fig. 144.—*Amira pileata*—anterior end, dorsal view. (Orig.)
Fig. 145.—*Amira pileata*—head, dorsal view. (Orig.)

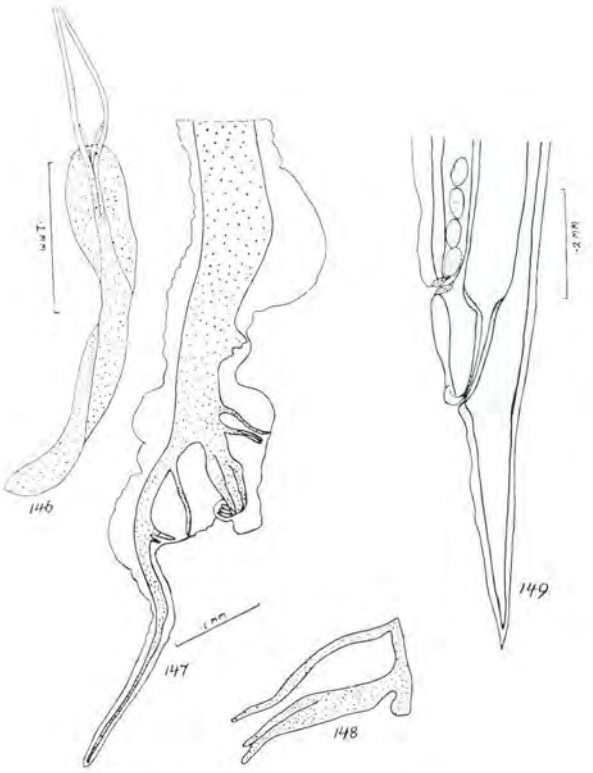


Fig. 146.—*Amira pileata*—accessory piece. (Orig.)

Fig. 147.—*Amira pileata*—male bursa, lateral view. (After Khalil, 1922, and Lane, 1914.)

Fig. 148.—*Amira pileata*—male bursa, ventral ray. (After Lane, 1914.)

Fig. 149.—*Amira pileata*—female tail. (Orig.)

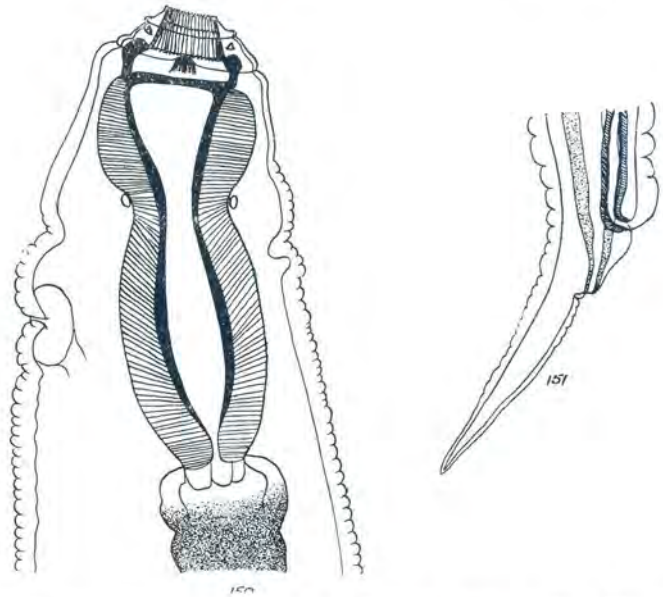


Fig. 150.—*Amira sameera*—anterior end, lateral view. (After Mönnig, 1932.)
Fig. 151.—*Amira sameera*—female tail. (After Mönnig, 1932.)

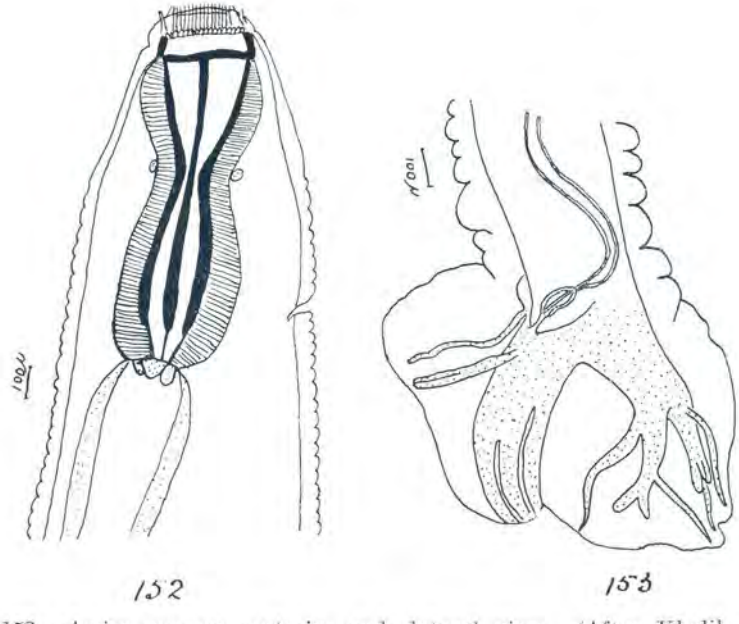
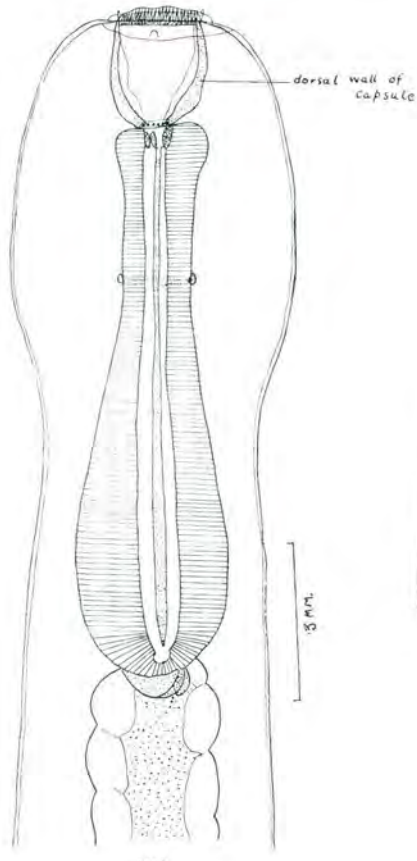


Fig. 152.—*Amira sameera*—anterior end, lateral view. (After Khalil, 1922.)
Fig. 153.—*Amira sameera*—male bursa, lateral view. (After Khalil, 1922.)



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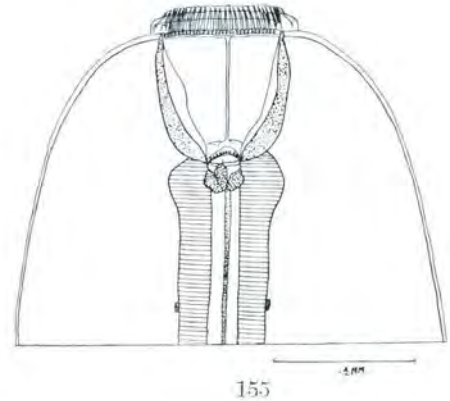

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Fig. 154.—*Equinubria sipunculiformis*—anterior end, lateral view. (Orig.)
Fig. 155.—*Equinubria sipunculiformis*—head, dorsal view. (Orig.)

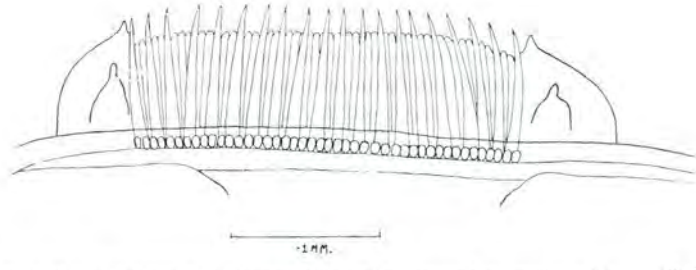


Fig. 156.—*Equinubria sipunculiformis*—anterior extremity. (Orig.)

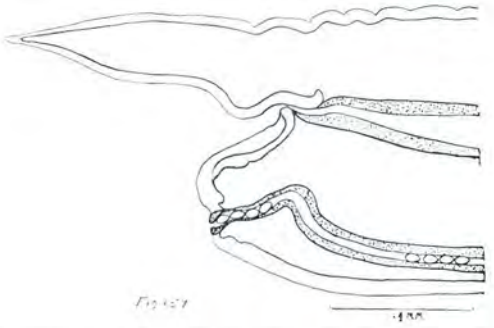


Fig. 157.—*Equinubria sipunculiformis*—female tail. (Orig.)

Fig. 158.—*Equinubria sipunculiformis*—male bursa, lateral view. (Orig.)

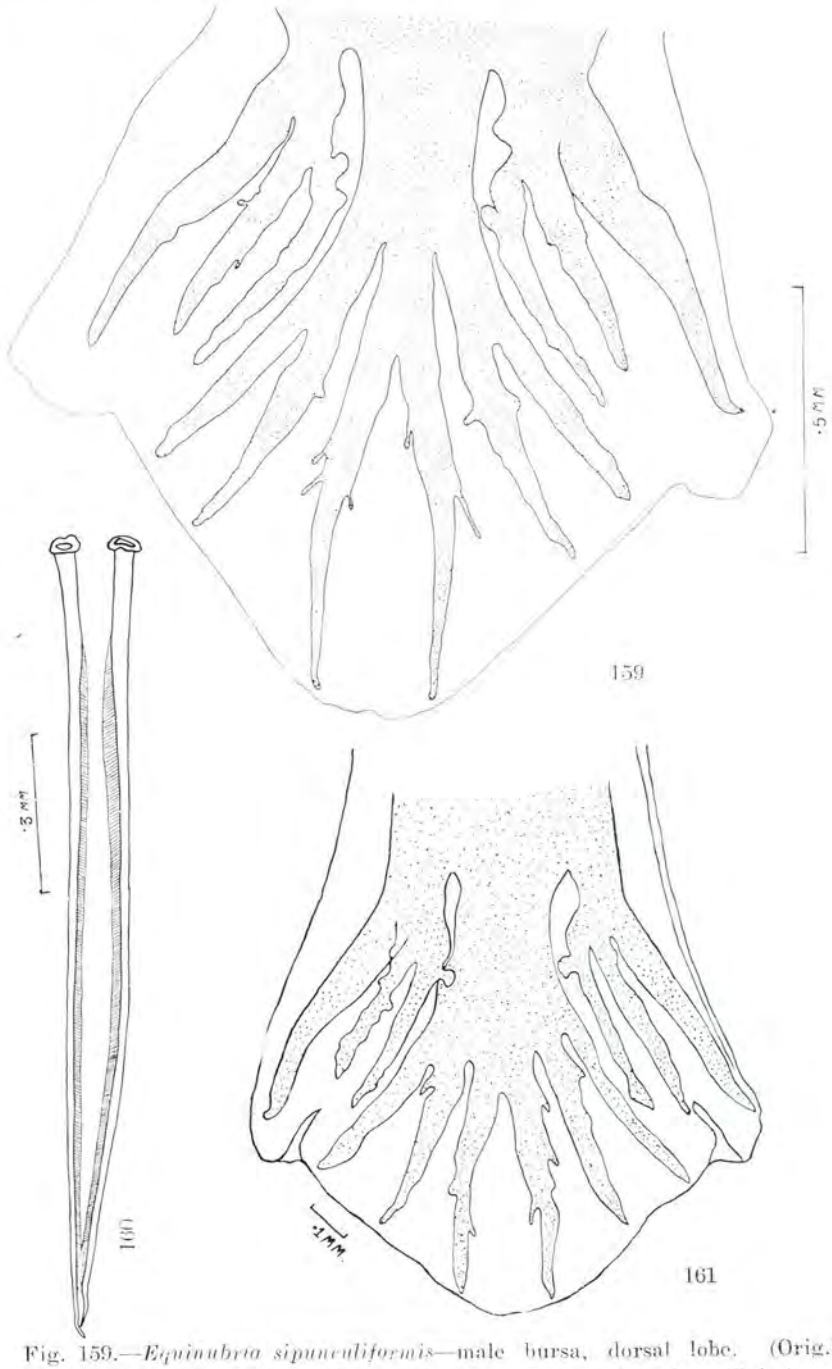


Fig. 159.—*Equinubria sipunculiformis*—male bursa, dorsal lobe. (Orig.)
Fig. 160.—*Equinubria sipunculiformis*—spicules of male. (Orig.)
Fig. 161.—*Equinubria sipunculiformis*—male bursa, dorsal lobe. (After Lane, 1914.)

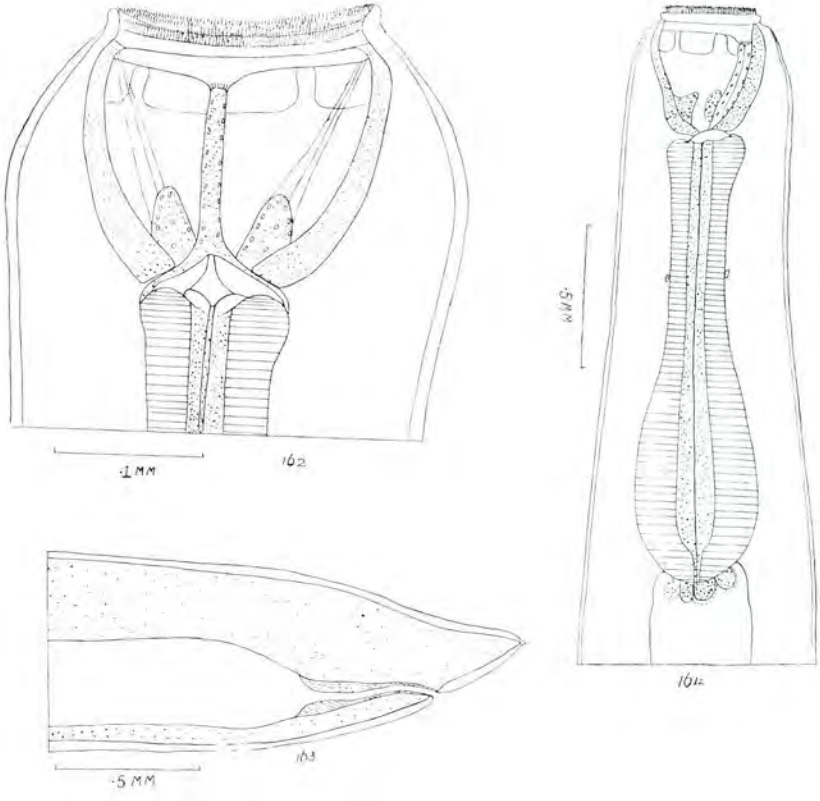


Fig. 162.—*Decrusia additicta*—head, dorsal view. (Orig.)
Fig. 163.—*Decrusia additicta*—female tail. (Orig.)
Fig. 164.—*Decrusia additicta*—anterior end, lateral view. (Orig.)

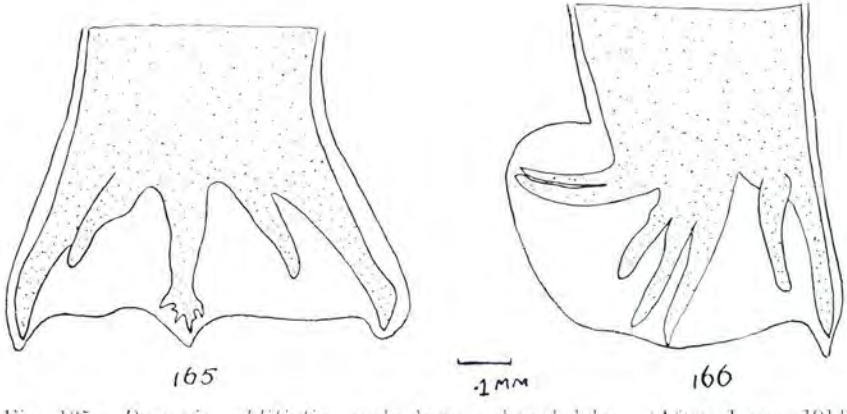


Fig. 165.—*Decrusia additicta*—male bursa, dorsal lobe. (After Lane, 1914.)
Fig. 166.—*Decrusia additicta*—male bursa, lateral view. (After Lane, 1914.)

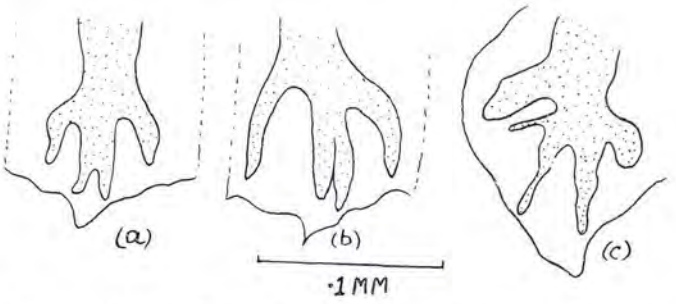
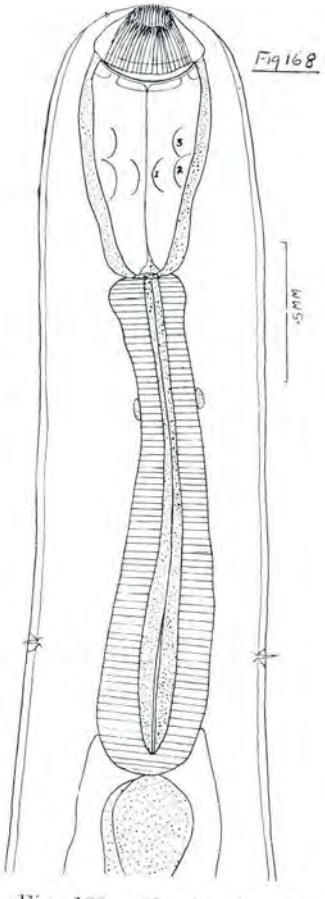


Fig. 167. (*a*), (*b*), (*c*).—*Decrusia additicia*—variations of dorsal ray tip. (After Lane, 1914.)



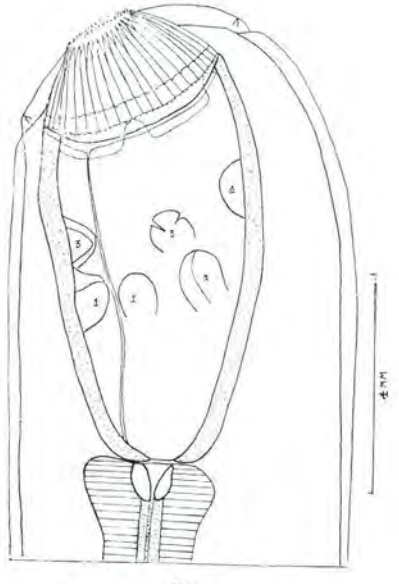


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Fig. 168.—*Choniangium epistomum*—anterior end, dorsal view. (Orig.)
Fig. 169.—*Choniangium epistomum*—head, dorso-lateral view. (Orig.)

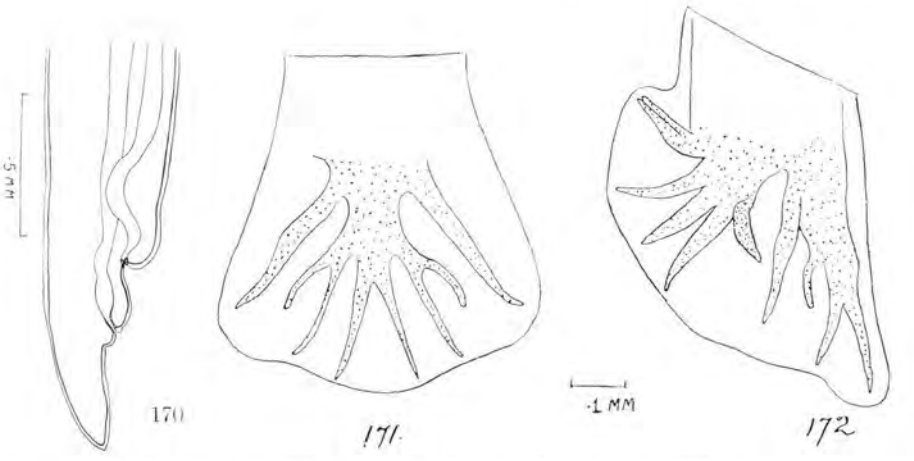


Fig. 170.—*Choniangium epistomum*—female tail. (Orig.)
Fig. 171.—*Choniangium epistomum*—male bursa, dorsal ray. (After Lane, 1914.)
Fig. 172.—*Choniangium epistomum*—male bursa, lateral view. (After Lane, 1914.)

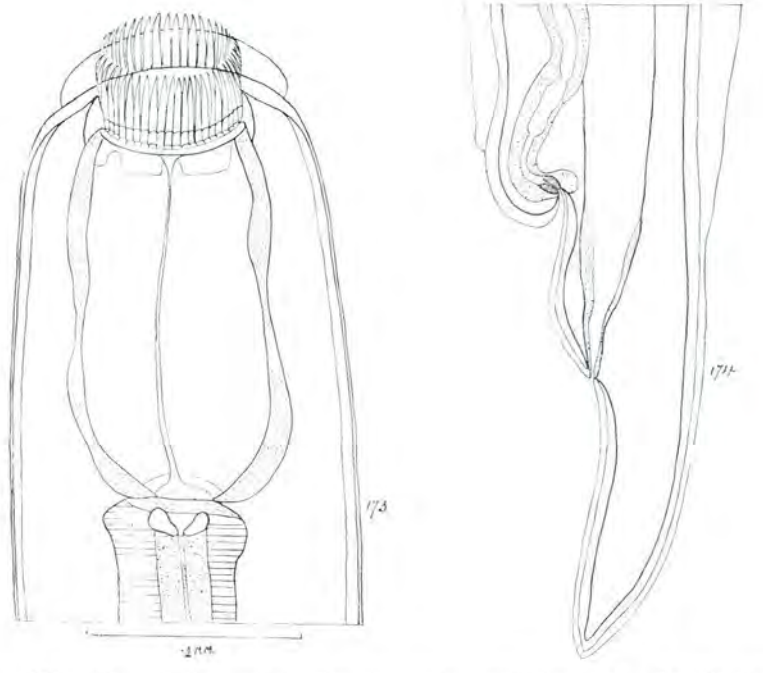
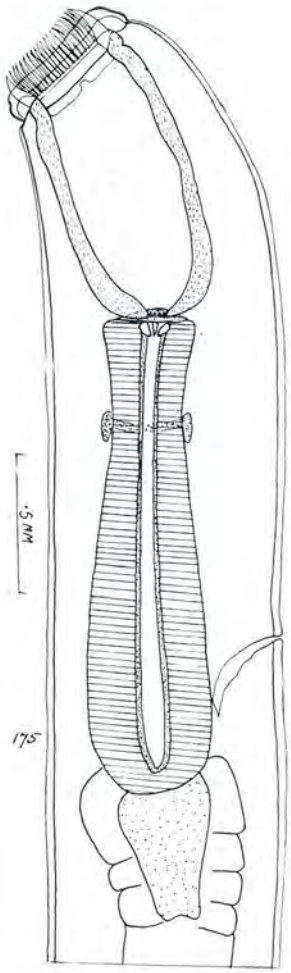


Fig. 173.—*Choniangium magnostomum*—n.sp.—anterior end, dorsal view. (Orig.)
Fig. 174.—*Choniangium magnostomum*—n.sp.—female tail. (Orig.)



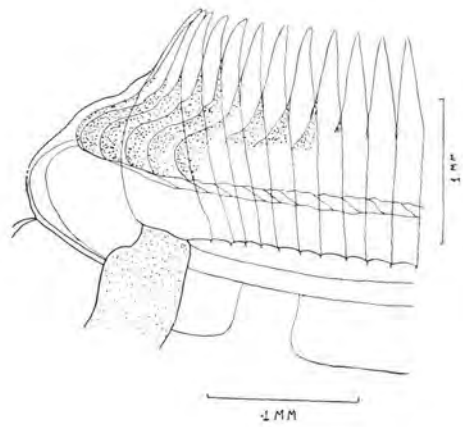


Fig. 175.—*Choniangium magnostomum*—n.sp.—anterior end, lateral view. (Orig.)

Fig. 176.—*Choniangium magnostomum*—n.sp.—portion of leafcrown. (Orig.)

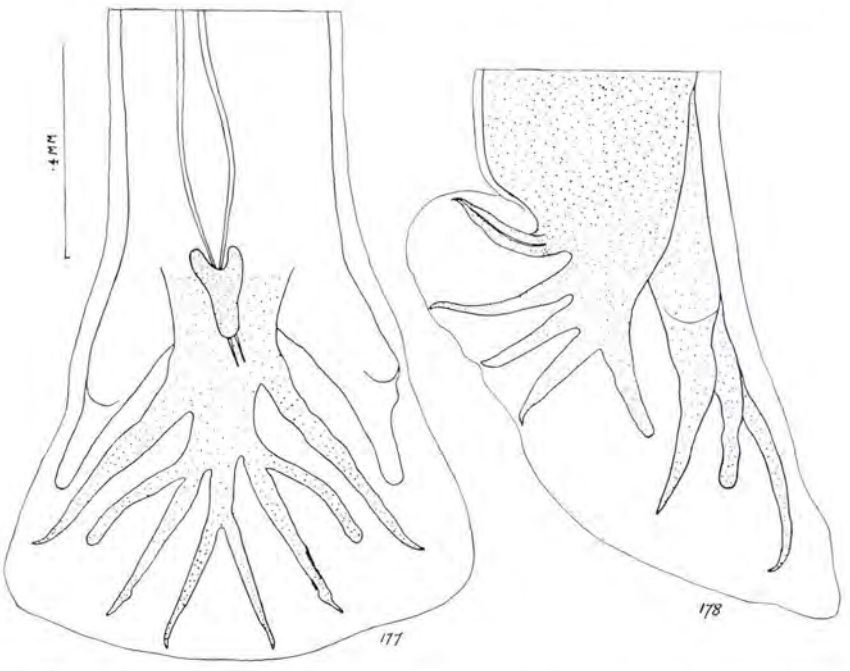


Fig. 177.—*Choniangium magnostomum*—n.sp.—male bursa, dorsal view. (Orig.)
Fig. 178.—*Choniangium magnostomum*—n.sp.—male bursa, lateral view. (Orig.)

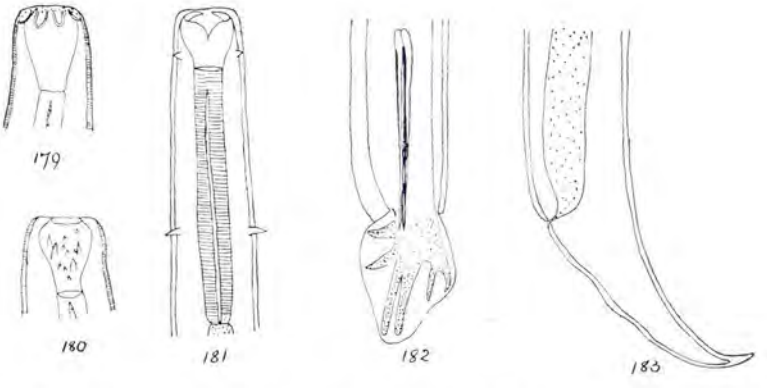
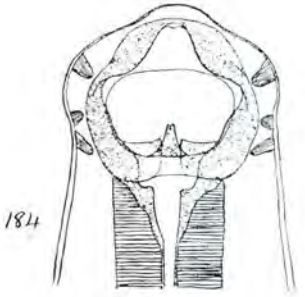


Fig. 179.—*Bunostomum foliatum*—head, showing lateral auricular folds. (After Cobbold, 1882.)
Fig. 180.—*Bunostomum foliatum*—head, lateral view, showing buccal teeth. (After Cobbold, 1882.)
Fig. 181.—*Bunostomum foliatum*—anterior end, ventral view. (After Cobbold, 1882.)
Fig. 182.—*Bunostomum foliatum*—male bursa, lateral view. (After Cobbold, 1882.)
Fig. 183.—*Bunostomum foliatum*—female tail. (After Cobbold, 1882.)



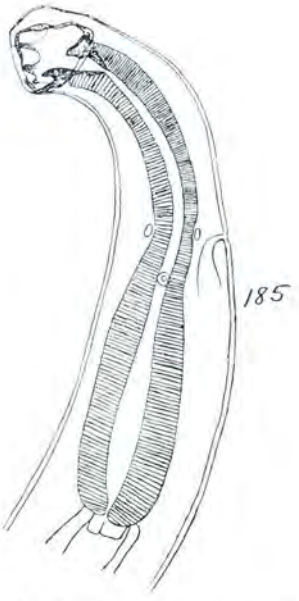
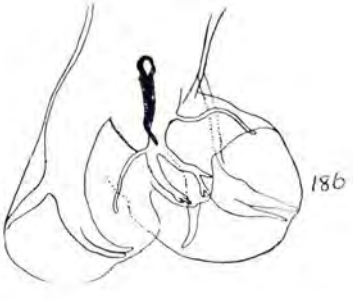


Fig. 184.—*Bunostomum brevispiculum*—head, dorsal view. (After Mönnig, 1932.)

Fig. 185.—*Bunostomum brevispiculum*—anterior end, lateral view. (After Mönnig, 1932.)



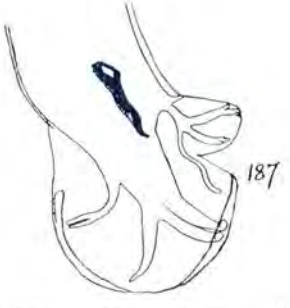
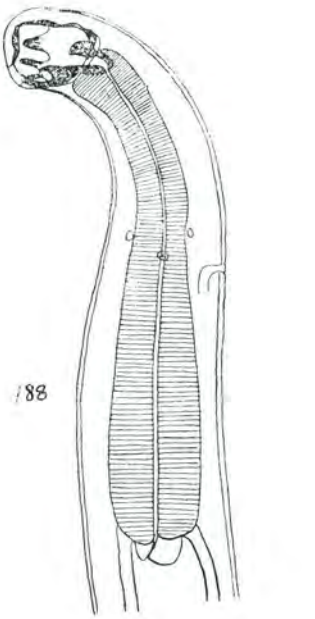
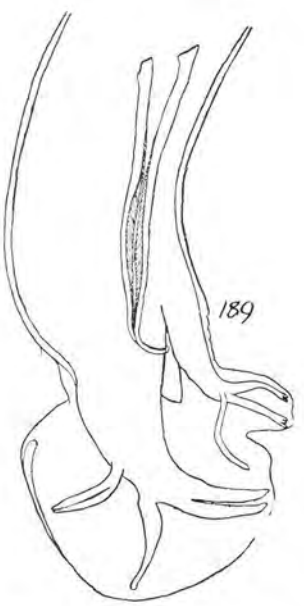


Fig. 186.—*Bunostomum brevispiculum*—male bursa, dorsal view. (After Mönnig, 1932.)

Fig. 187.—*Bunostomum brevispiculum*—male bursa, lateral view. (After Mönnig, 1932.)





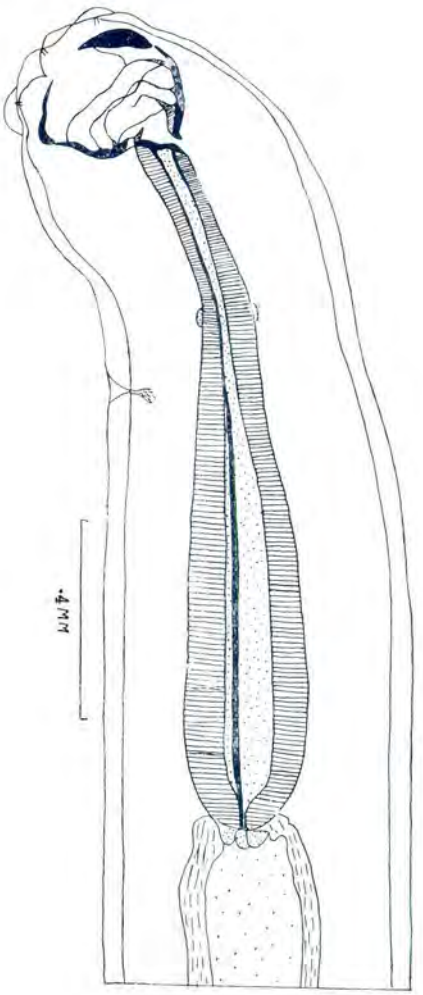


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Fig. 188.—*Bunostomum hamatum*—anterior end, lateral view. (After Mönnig, 1932.)

Fig. 189.—*Bunostomum hamatum*—hind end of male, lateral view. (After Mönnig, 1932.)

Fig. 190.—*Bathmostomum sangeri*—anterior end, lateral view. (Orig.)

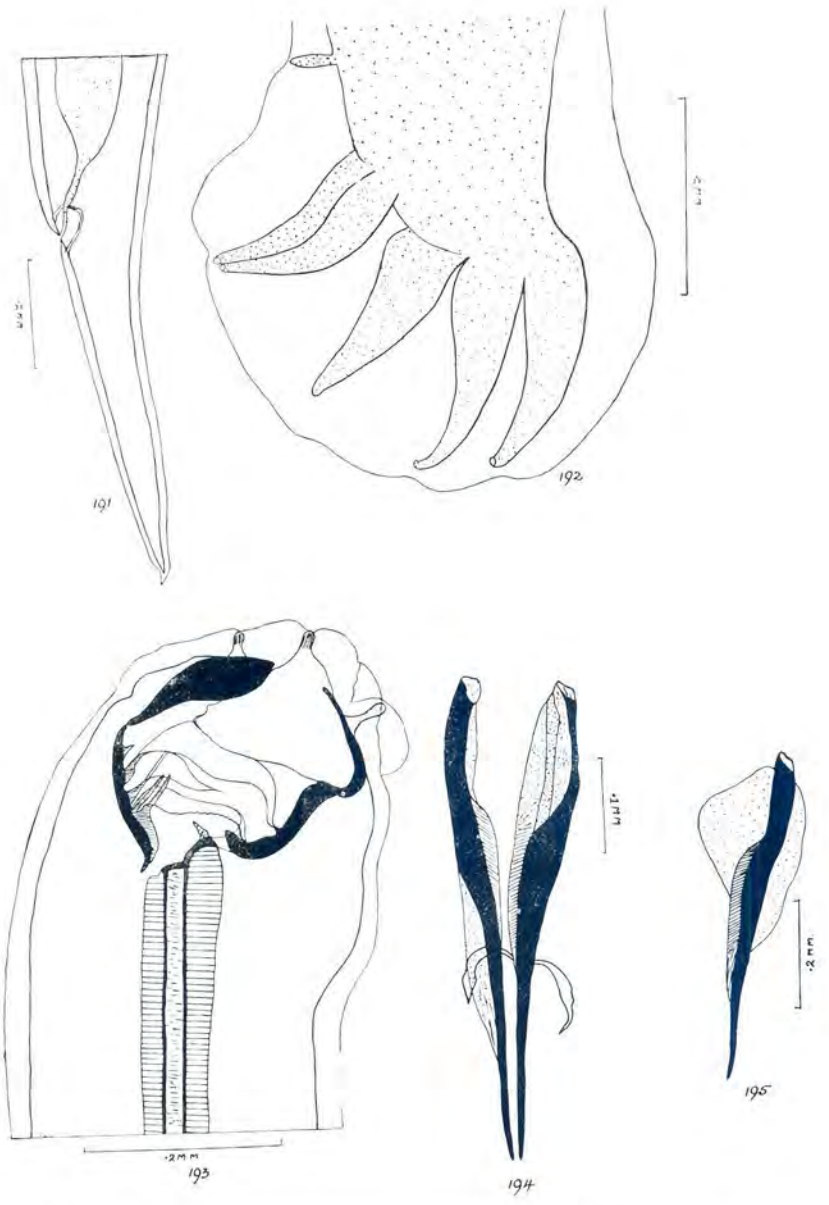


Fig. 191.—*Bathmostomum sangeri*—female tail. (Orig.)
Fig. 192.—*Bathmostomum sangeri*—male bursa, lateral lobe. (Orig.)
Fig. 193.—*Bathmostomum sangeri*—head, lateral view. (Orig.)
Fig. 194.—*Bathmostomum sangeri*—spicules of male. (Orig.)
Fig. 195.—*Bathmostomum sangeri*—spicules of male. (Orig.)

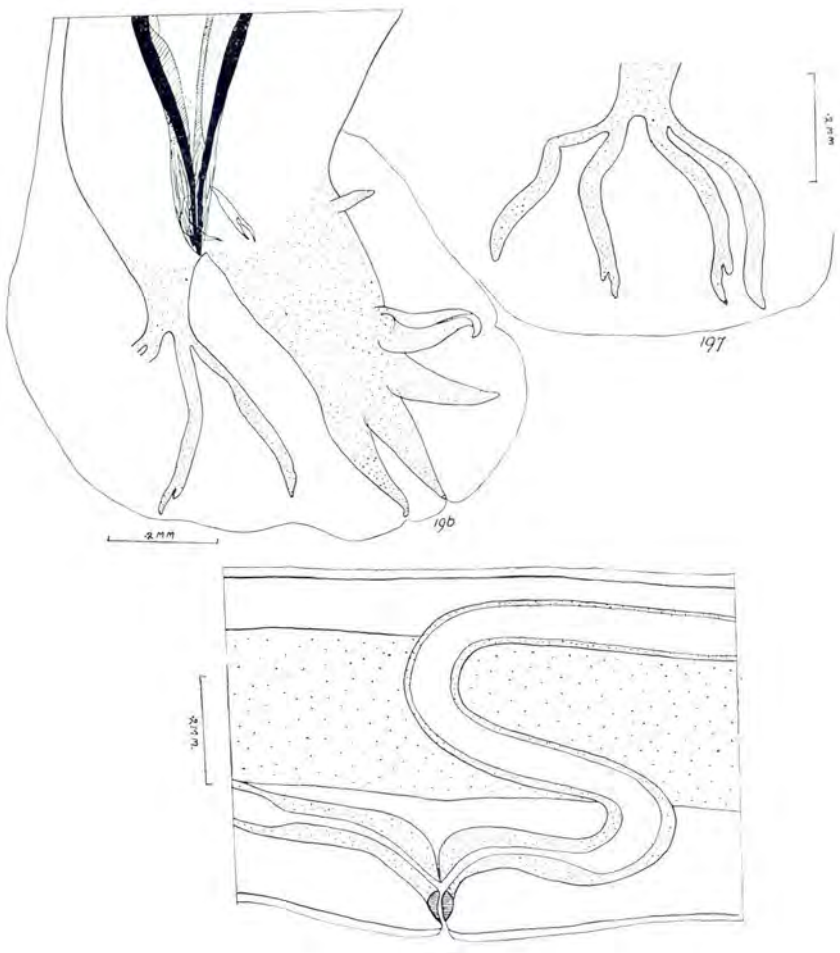


Fig. 196.—*Bathmostomum sangeri*—male bursa, lateral view. (Orig.)

Fig. 197.—*Bathmostomum sangeri*—male bursa, dorsal ray. (Orig.)

Fig. 198.—*Bathmostomum sangeri*—vulvar region. (Orig.)

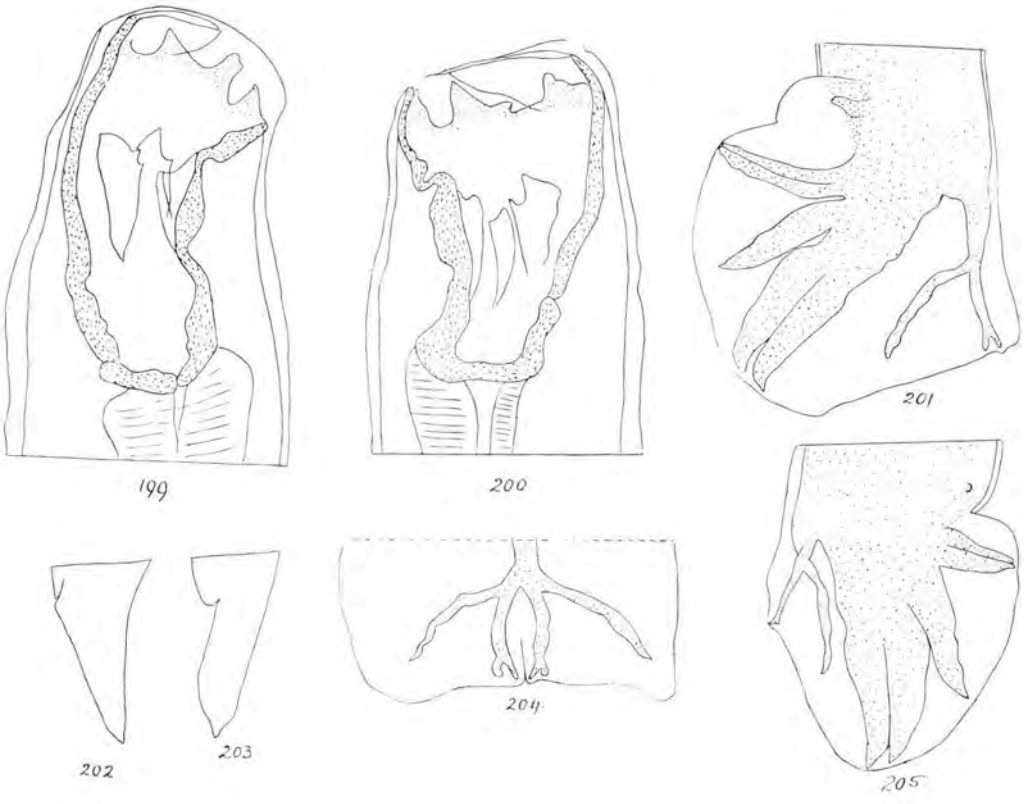


Fig. 199.—*Grammocephalus caredatus*—head, lateral view. (After Lane, 1921.)

Fig. 200.—*Grammocephalus clathratus*—head, lateral view. (After Lane, 1921.)

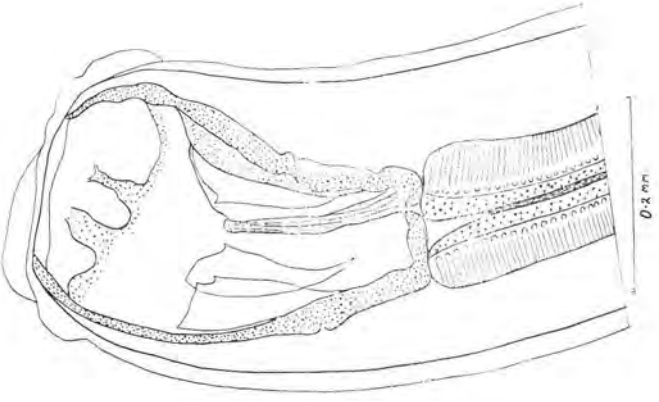
Fig. 201.—*Grammocephalus clathratus*—male bursa, lateral view. (After Lane, 1921.)

Fig. 202.—*Grammocephalus caredatus*—female tail. (After Lane, 1921.)

Fig. 203.—*Grammocephalus clathratus*—female tail. (After Lane, 1921.)

Fig. 204.—*Grammocephalus clathratus*—dorsal ray of bursa. (After Lane, 1921.)

Fig. 205.—*Grammocephalus caredatus*—male bursa, lateral view. (After Lane, 1921.)



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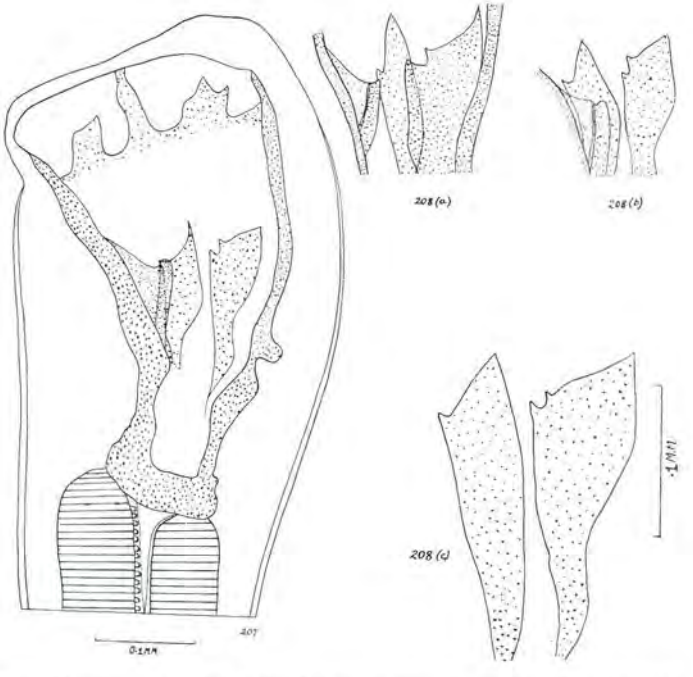


Fig. 206.—*Grammocephalus hybridatus*—n.sp.—anterior end, lateral view. (Orig.)

Fig. 207.—*Grammocephalus hybridatus*—n.sp —head, lateral view. (Orig.)

Fig. 208 (*a*), (*b*), (*c*),—*Grammocephalus hybridatus*—n.sp.—buccal teeth variations. (Orig.)

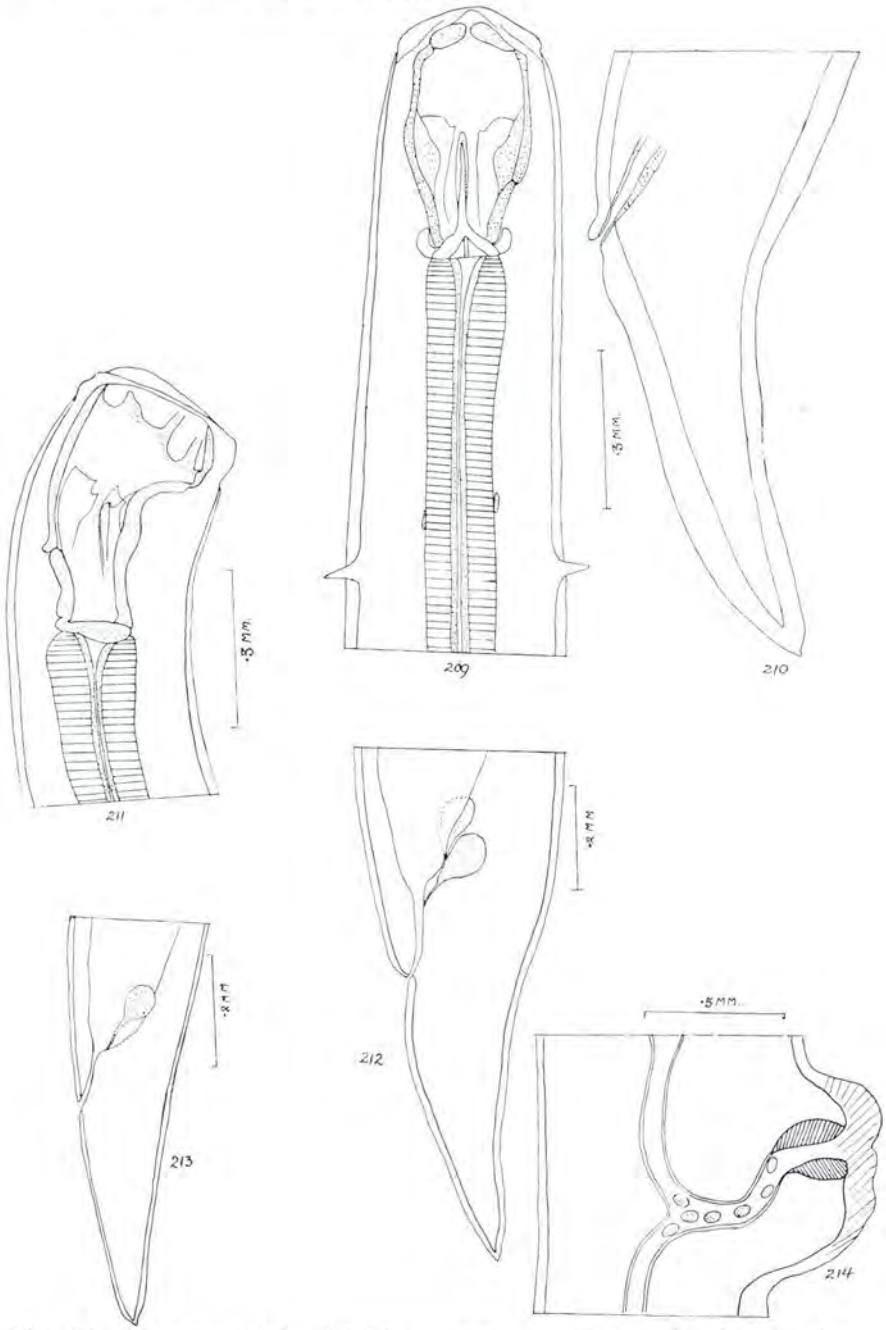


Fig. 209.—*Grammocephalus hybridatus*—n.sp.—anterior end. dorsal view. (Orig.)
Fig. 210.—*Grammocephalus hybridatus*—n.sp.—female tail. (Orig.)
Fig. 211.—*Grammocephalus hybridatus*—n.sp.—anterior end of larval form. lateral view. (Orig.)
Fig. 212.—*Grammocephalus hybridatus*—n.sp.—larval female tail. (Orig.)
Fig. 213.—*Grammocephalus hybridatus*—n.sp.—larval female tail. (Orig.)
Fig. 214.—*Grammocephalus hybridatus*—n.sp.—vulvar region of adult. (Orig.)

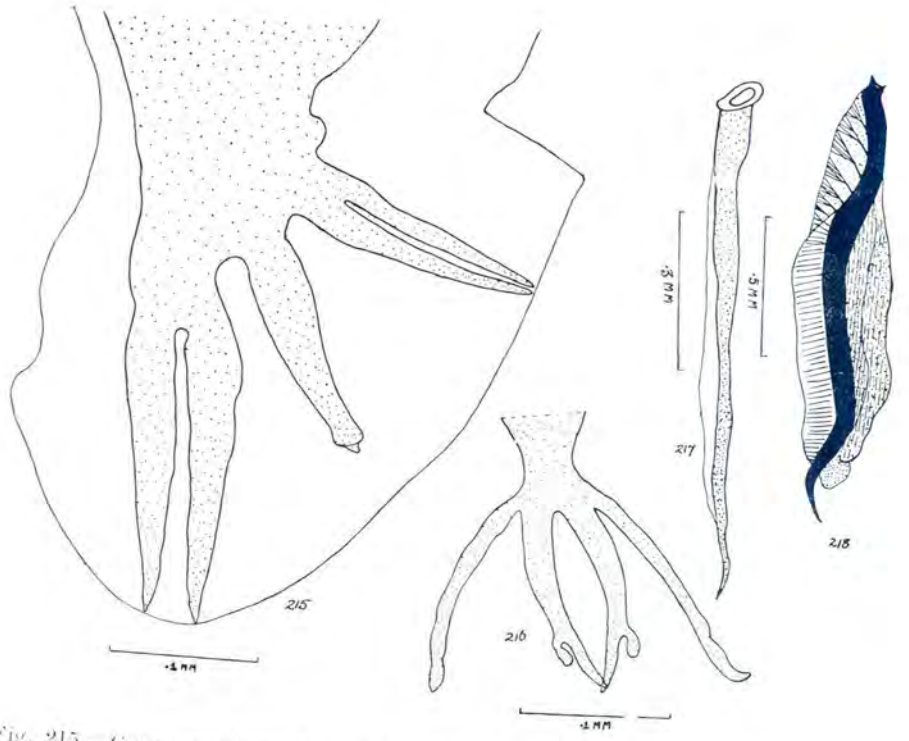


Fig. 215.—*Grammocephalus hybridatus*—n.sp.—larval male bursa, lateral view. (Orig.)

Fig. 216.—*Grammocephalus hybridatus*—n.sp.—larval male, dorsal ray. (Orig.)

Fig. 217.—*Grammocephalus hybridatus*—n.sp.—left spicule of larval male. (Orig.)

Fig. 218.—*Grammocephalus hybridatus*—n.sp.—right spicule of adult male. (Orig.)

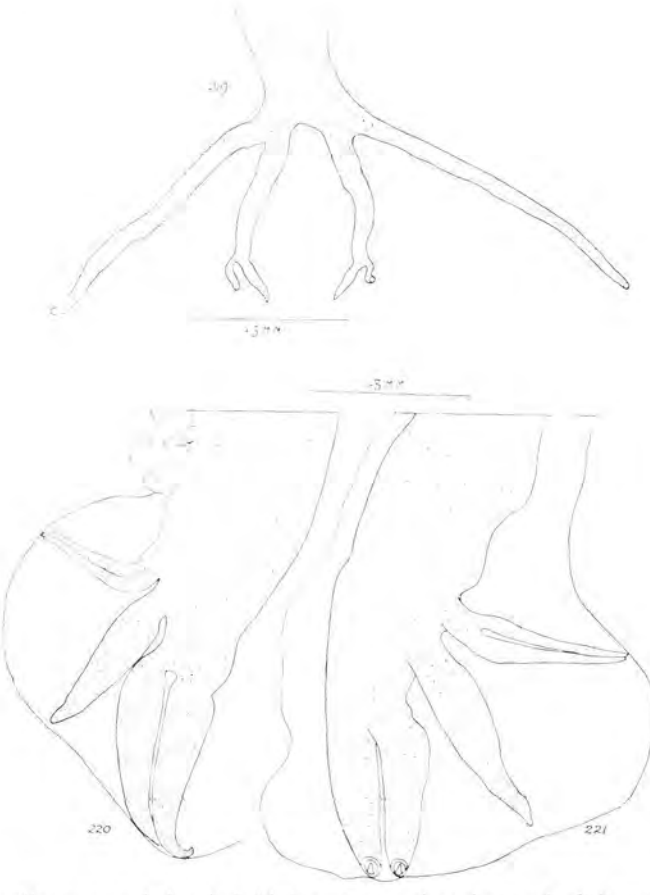


Fig. 219.—*Grammocephalus hybridatus*—n.sp.—dorsal ray of adult male. (Orig.)
Fig. 220.—*Grammocephalus hybridatus*—n.sp.—lateral lobe of bursa, external view. (Orig.)
Fig. 221.—*Grammocephalus hybridatus*—n.sp.—lateral lobe of bursa, inside view. (Orig.)

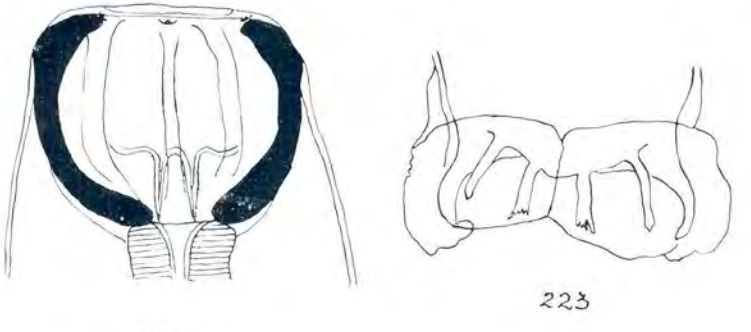


Fig. 222.—*Syngamus indicus*—head, lateral view. (After Mönnig, 1932.)
Fig. 223.—*Syngamus indicus*—male bursa, dorsal view. (After Mönnig, 1932.)

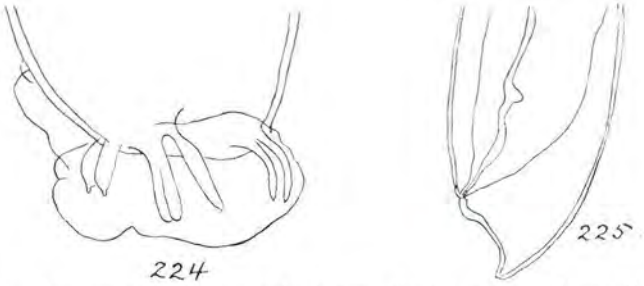


Fig. 224.—*Syngamus indicus*—male bursa, lateral view. (After Mönnig, 1932.)
Fig. 225.—*Syngamus indicus*—female tail. (After Mönnig, 1932.)

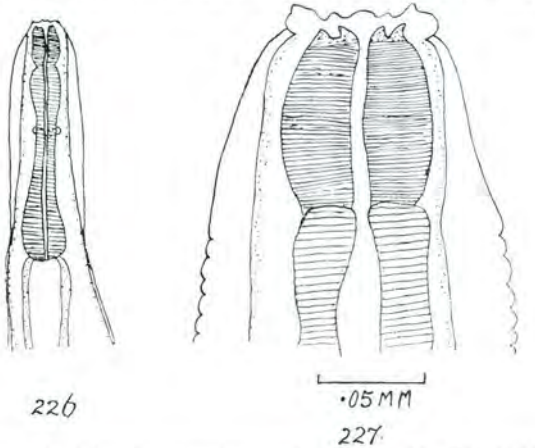


Fig. 226.—*Leiperenia leiperi*—anterior end. After Khalil, 1922.)
Fig. 227.—*Leiperenia leiperi*—head. (After Khalil, 1922.)

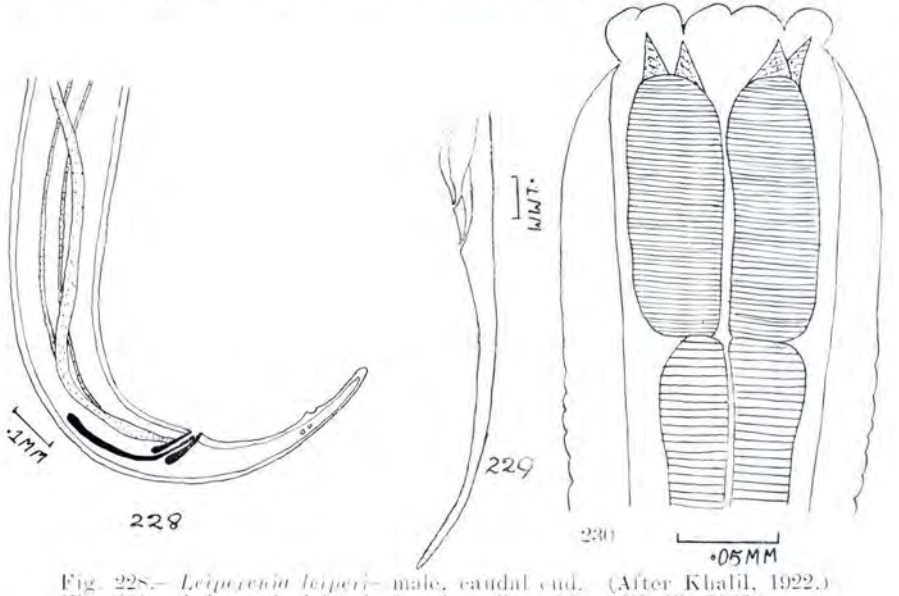


Fig. 228.—*Leiperenia leiperi*—male, caudal end. (After Khalil, 1922.)
Fig. 229.—*Leiperenia leiperi*—female tail. (After Khalil, 1922.)
Fig. 230.—*Leiperenia galebi*—anterior end. (After Khalil, 1922.)

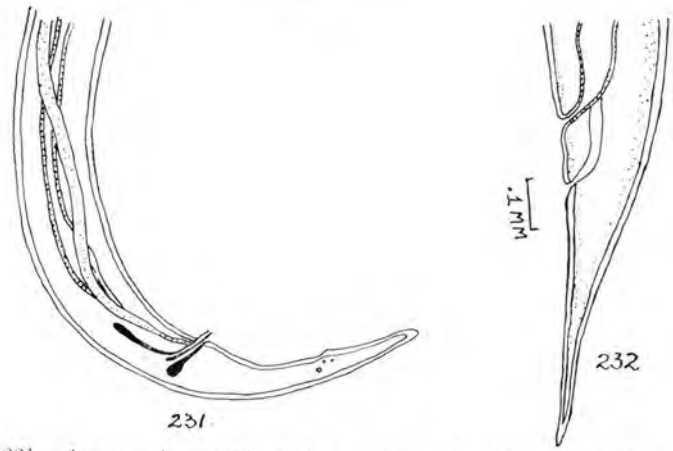


Fig. 231.—*Leiperonia galebi*—male, caudal end. (After Khalil, 1922.)
Fig. 232.—*Leiperonia galebi*—female tail. (After Khalil, 1922.)

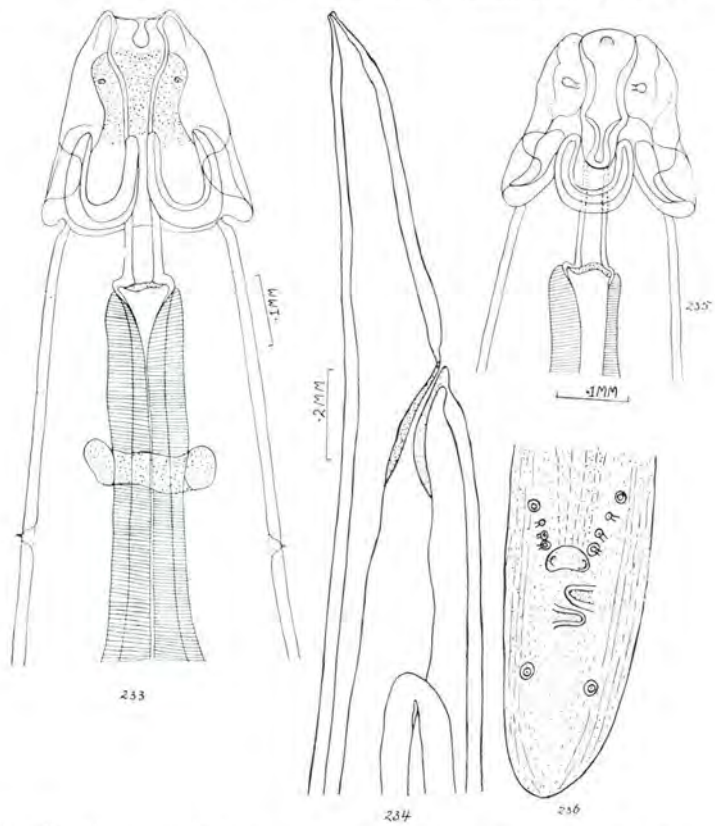


Fig. 233.—*Parabronema indicum*—anterior end, dorsal view. (Orig.)
Fig. 234.—*Parabronema indicum*—female tail. (Orig.)
Fig. 235.—*Parabronema indicum*—head, lateral view. (Orig.)
Fig. 236.—*Parabronema indicum*—male, caudal end, ventral view. (After Baylis, 1921.)

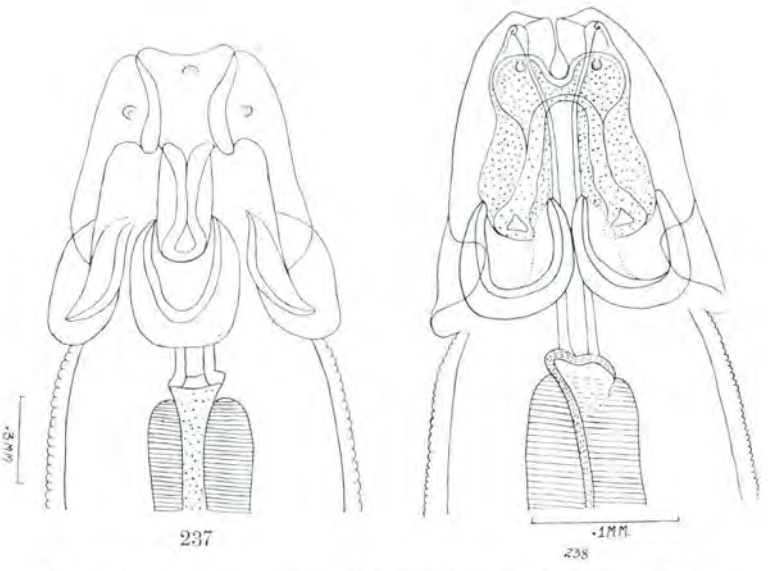


Fig. 237.—*Parabronema smithii*—head, lateral view. (Orig.)
Fig. 238.—*Parabronema smithii*—head, dorsal view. (Orig.)

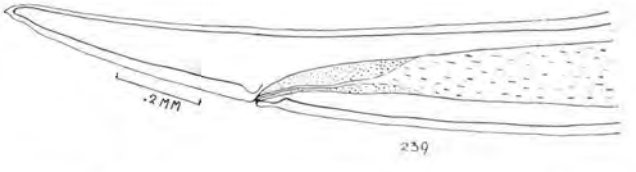


Fig. 239.—*Parabronema smithii*—female tail. (Orig.)

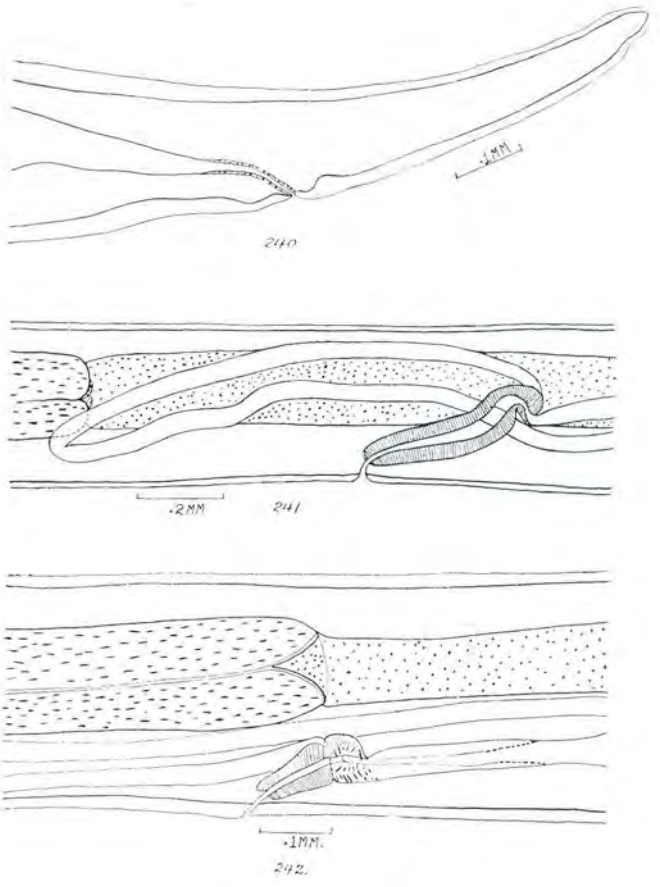


Fig. 240.—*Parabronema smithii*—female tail. (Orig.)
Fig. 241.—*Parabronema smithii*—vulvar region. (Orig.)
Fig. 242.—*Parabronema smithii*—vulvar region. (Orig.)

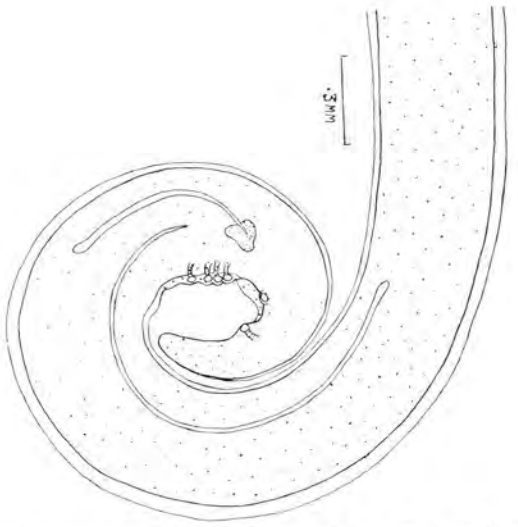


Fig. 243.—*Parabronema smithii*—male, caudal end, lateral view. (Orig.)

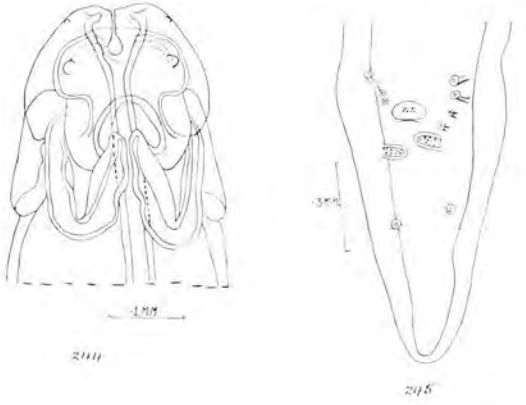


Fig. 244.—*Parabronema africanum*—head, dorsal view. (After Baylis, 1921.)
Fig. 245.—*Parabronema africanum*—hale, caudal end, ventral view . (After Baylis, 1921.)

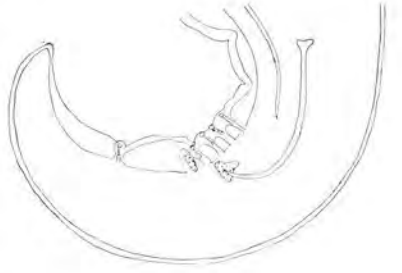
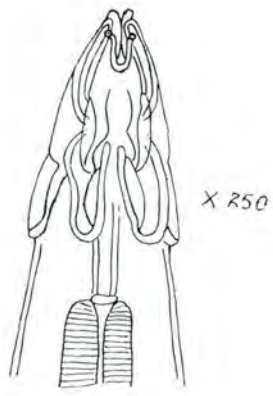
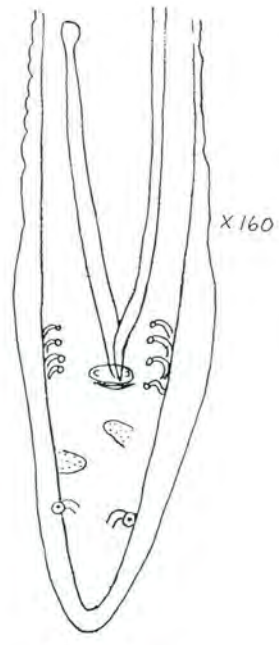


Fig. 246.—*Parabronema africanum*—male, caudal end, lateral view. (After Baylis, 1921.)





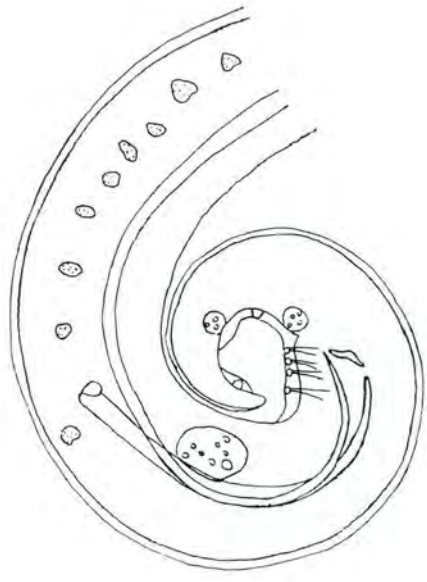


Fig. 247.—*Parabronema rhodesiense*—anterior end. (After York & Maplestone, 1926.)

Fig. 248.—*Parabronema rhodesiense*—male, caudal end, ventral view. (After York & Maplestone, 1926.)

Fig. 249.—*Parabronema rhodesiense*—male, caudal end, lateral view. (After York & Maplestone, 1926.)

ABBREVIATIONS.

c.	= cirrus sac.	o.b.	= oesophageal bulb.
c.f.	= caudal flap.	o.d.	= oral diverticulum.
c.p.	= cirrus pouch.	oes.	= oesophagus.
c.s.	= cirrus sac.	o.s.	= oral sucker.
e.p.	= excretory pore.	ov.	= ovary.
e.v.	= excretory vesicle.	p.p.	= pars prostatica.
g.p.	= genital pore.	p.s.	= posterior sucker.
g. pap.	= genital papilla.	s.b.	= suctorial bulb.
g.s.	= genital sucker.	sh. gl.	= shellgland.
h.b.	= hermaphroditic bulb.	s.p.	= suctorial pouch.
h.d.	= hermaphroditic duct.	s.v. (v.s.)	= seminal vesicle.
i.c.	= intestinal caeca.	t.	= testes.
L.c.	= Laurer's canal.	ut.	= uterus.
m.	= musculosa.	vit.	= vitellaria.

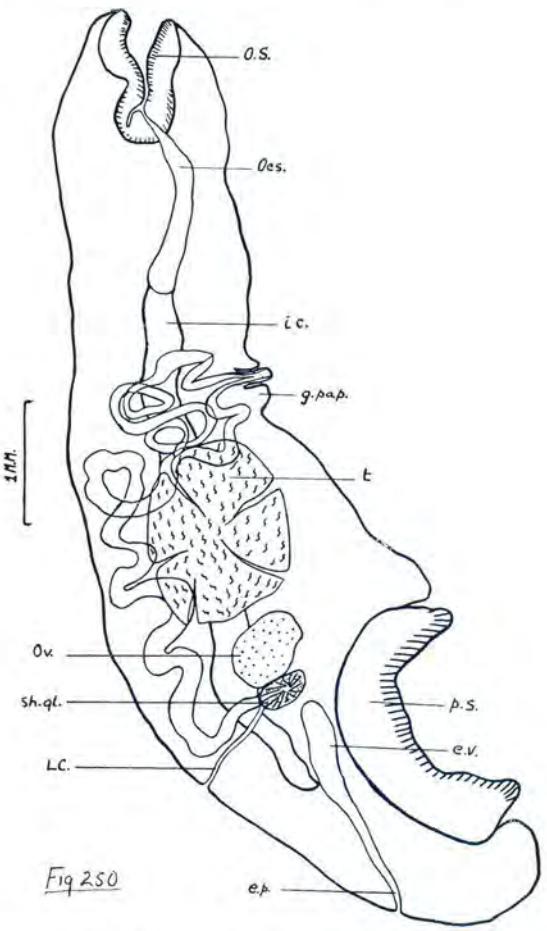
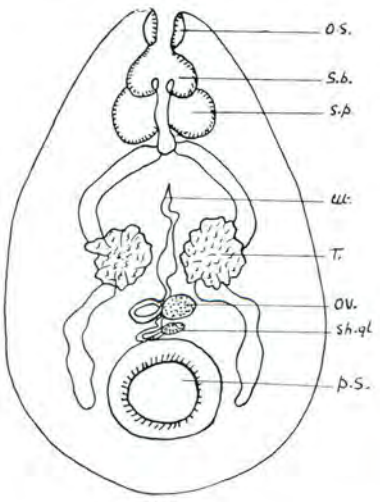


Fig. 250.—*Pseudodiscus collinsi*—sagittal section. (Orig.)



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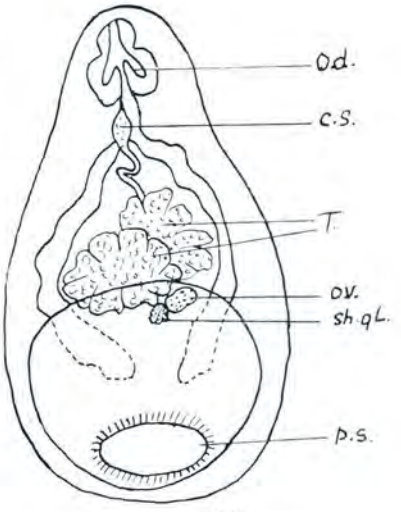

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Fig. 251.—*Pseudodiscus collinsi*—(From Travassos, 1934, after Stiles & Goldberger, 1910.)

Fig. 253.—*Pseudodiscus hawkesii*—(From Travassos, 1934, after Stiles & Goldberger, 1910.)

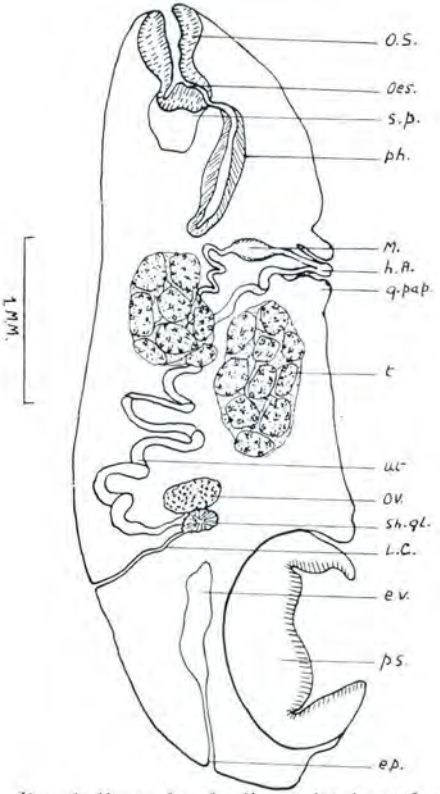


Fig. 252.—*Pseudodiscus hawkesii*—sagittal section. (Orig.)

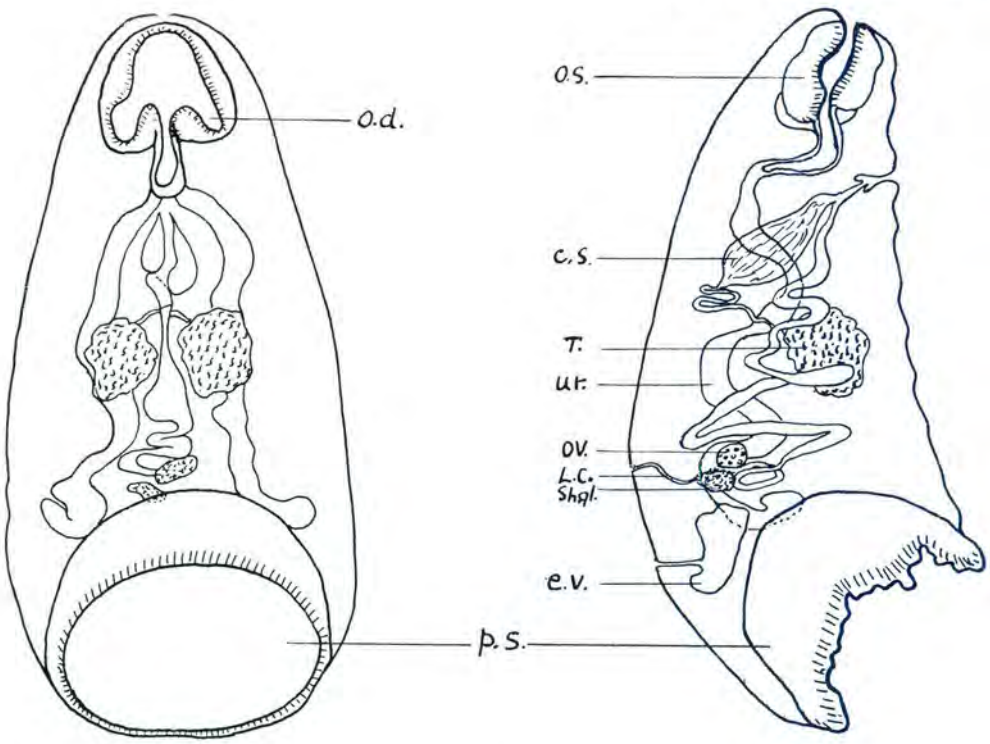


Fig. 254.—*Pfenderius papillatus*—(From Travassos, 1934, after Stiles & Goldberger, 1910.)

Fig. 255.—*Pfenderius papillatus*—sagittal section. (From Travassos, 1934, after Stiles & Goldberger, 1910.)

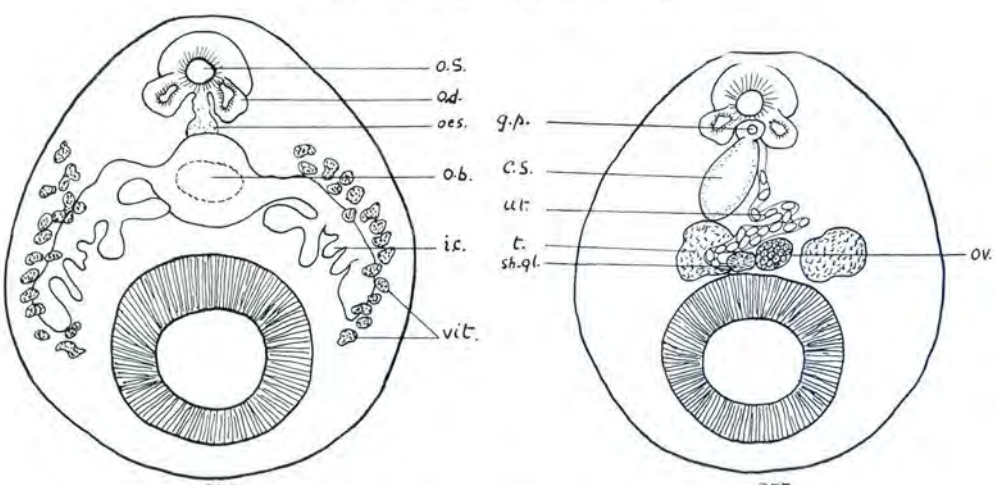
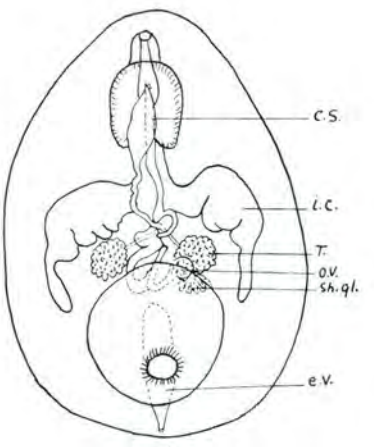


Fig. 256.—*Pfenderius birmanicus*—(After Bhalerao, 1935.)
Fig. 257.—*Pfenderius birmanicus*—(After Bhalerao, 1935.)



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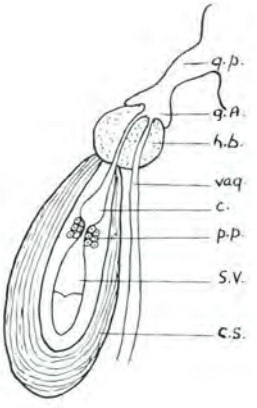

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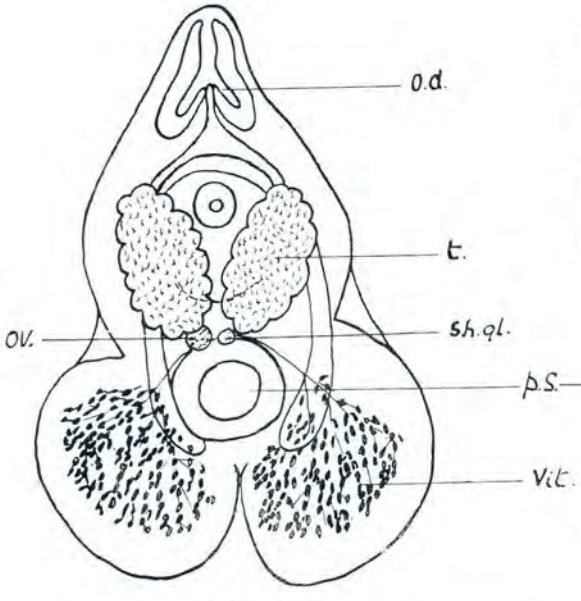
Fig. 258.—*Pfenderius heterocaeca*—(From Trav., 1934, after Fukui, 1926.)

Fig. 259.—*Pfenderius heterocaeca*—cirrus sac, and terminal portion of genitalia. (After Bhalerao, 1935.)



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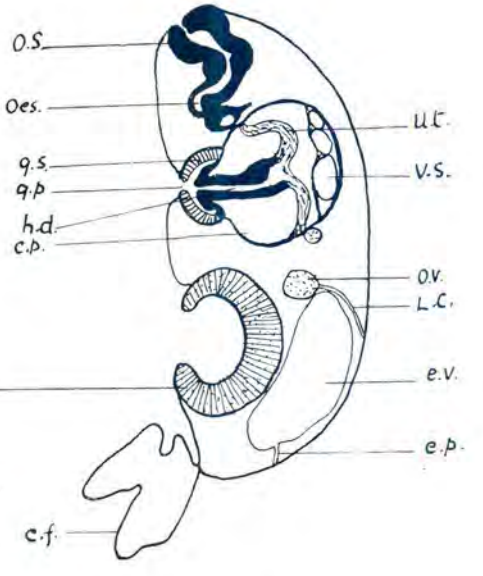

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Fig. 260.—*Brumptia bicaudata*—(After Trav., 1934.)

Fig. 261.—*Brumptia bicaudata*—sagittal section. (After Maplestone, 1923.)

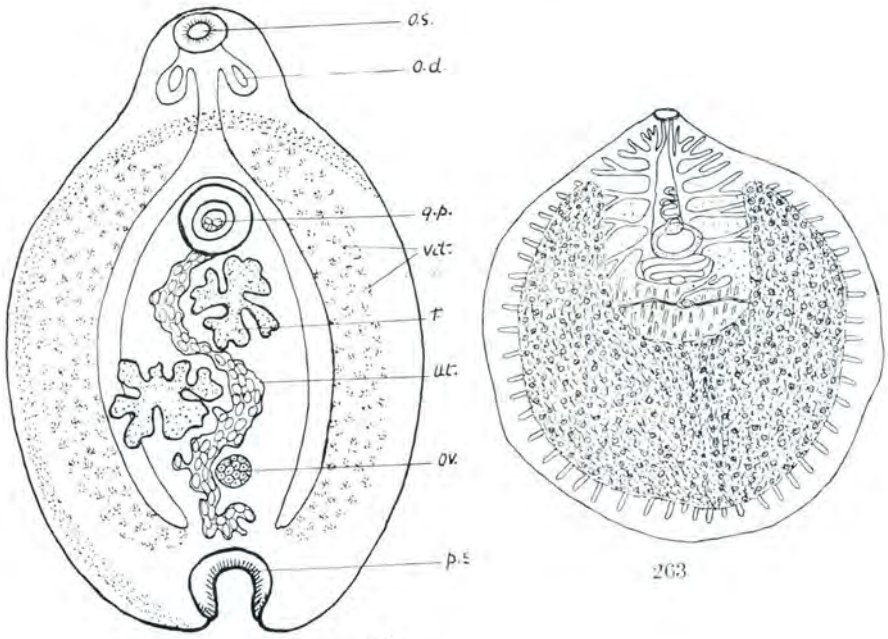

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Fig. 262.—*Gastrodiscus secundus*×10.—ventral view. (After Bhalerao, 1934.)
Fig. 263.—*Fasciola jacksoni*—(After Evans & Renne, 1909.)

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Fig. 264.—*Anoplocephala manubriata*—scolex, dorsal view. (After Raill., Henry & Bauche, 1914.)

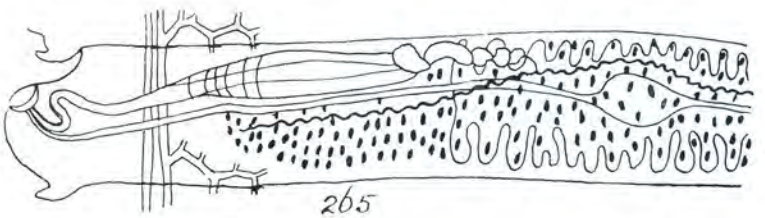

Fig. 265.—*Anoplocephala manubriata*—marginal portion of segment, dorsal view.

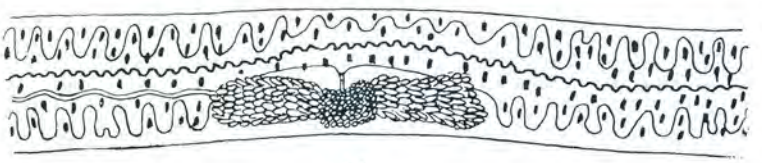

Fig. 266.—*Anoplocephala manubriata*—median portion of segment, dorsal view.