PARASITIC NEMATODES OBTAINED FROM ANIMALS DYING IN THE CALCUTTA ZOOLOGICAL GARDENS.[1]

PARTS 9—11.

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

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

PART 9.—A COLLECTION OF FOUR NEW GENERA.

Physocephaloides, gen. nov.

This worm was found in the intestine of a Hoolock (*Hylobates hoolock*).

There is a slight, fairly long cephalic inflation, which is overlapped posteriorly by the commencement of the lateral flanges. The flanges are single on each side. The cervical papillae are asymmetrical both in size and position, one short and stout near the posterior portion of the cephalic inflation, and the other just behind the nerve ring, the latter is longer and more conical (fig. 1). There are three rounded lips on either side of the mouth opening; each one of these bears a papilla (fig. 2). The long chitinous vestibule is surrounded by irregular thickened ridges (fig. 1). The oesophagus is divided into two portions, and the nerve ring surrounds it a little distance behind its commencement (fig. 1). *Male*:—There are four pairs of pedunculate precloacal papillae and a group of about six small papillae near the tip of the tail. The caudal alae are relatively broad and symmetrical. The spicules are unequal, tapering to sharp points and there is a short but stout gubernaculum (fig. 3). *Female*:—The vulva is hard to find as it is only an oblique slit in the cuticle, without any lips. In the single specimen in which it was observed and which was 21 mm. in length, the vulva was 5·2 mm. from the tip of the tail. The tail ends in a short blunt mucronate tip (fig. 4). The eggs have a thick shell and each contains an embryo in the uterus.

This worm agrees with the genus *Physocephalus* in all particulars except that it has a single flange on either side of the body instead of three as in that genus. This may seem a small point on which to erect a new genus, but *Physocephalus* has been established since 1861 and it contains at least five species. In my opinion it is better to erect a new genus to accommodate the species under discussion rather than to change the definition of an old established genus to make it conform

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[1] The earlier parts of this series were published in *Rec. Ind. Mus.* XXXII, pp. 385-412 (1930) and *Rec. Ind. Mus.* XXXIII, pp. 71-171 (1931).

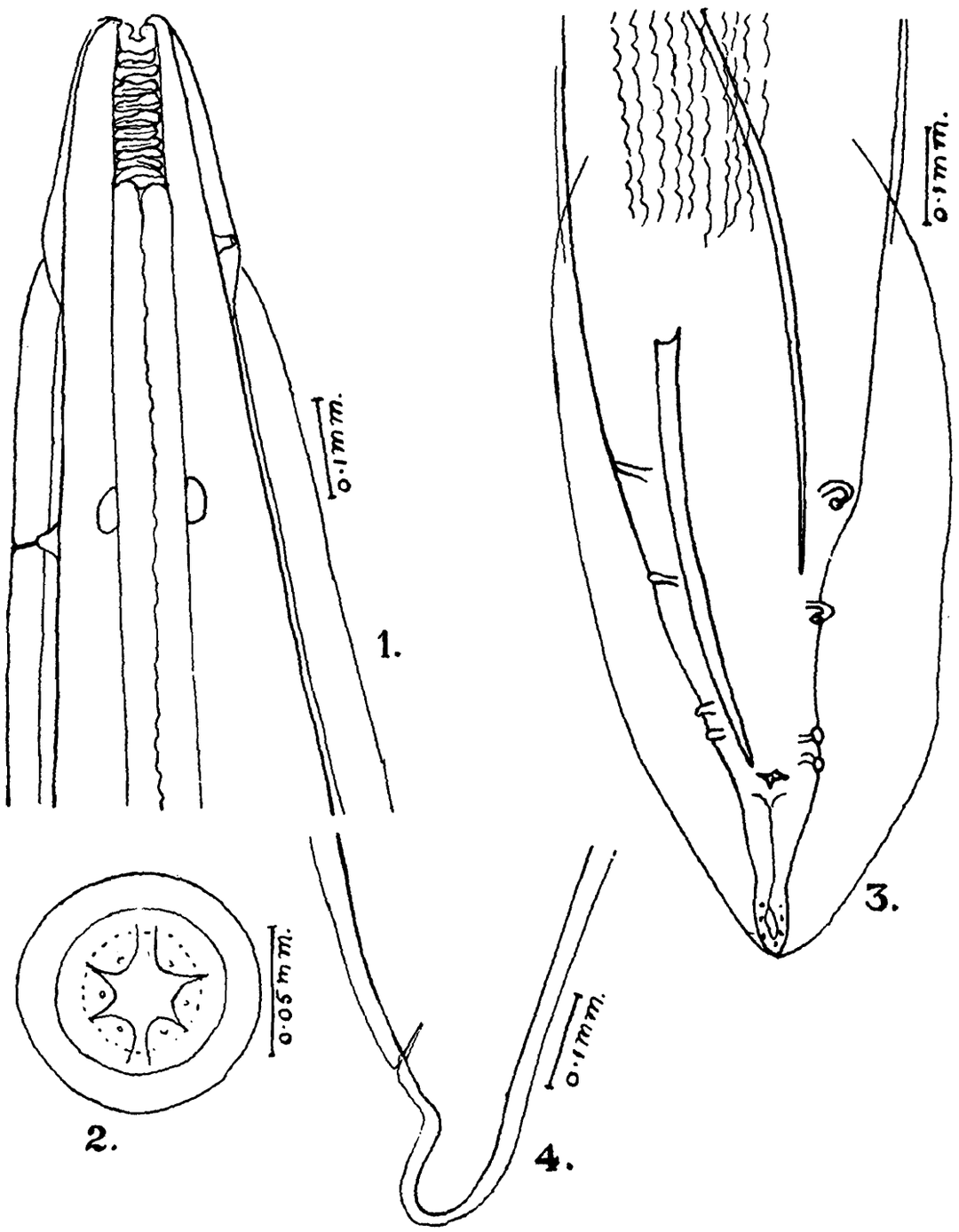
to the new worm. It is accordingly proposed to name this worm *Physocephaloides primus* gen. et. sp. nov.

Generic definition. *Arduenninae*; identical with *Physocephalus* except that there is a single lateral flange on either side of the body, instead of the triple flange characteristic of that genus.

Type species. Physocephaloides primus, sp. nov.

Host. Hylobates hoolock.

Type-specimens are in the Indian Museum, Calcutta.



Text-fig. 1.—*Physocephaloides primus.* Anterior end, dorso-ventral view.
Text-fig. 2.—*Physoceyhaloides primus.* Anterior end, end-on view.
Text-fig. 3.—*Physocephalpides primus.* Male tail, ventral view.
Text-fig. 4.—*Physocephaloides primus.* Female tail, lateral view.

Table of measurements (in millimetres).

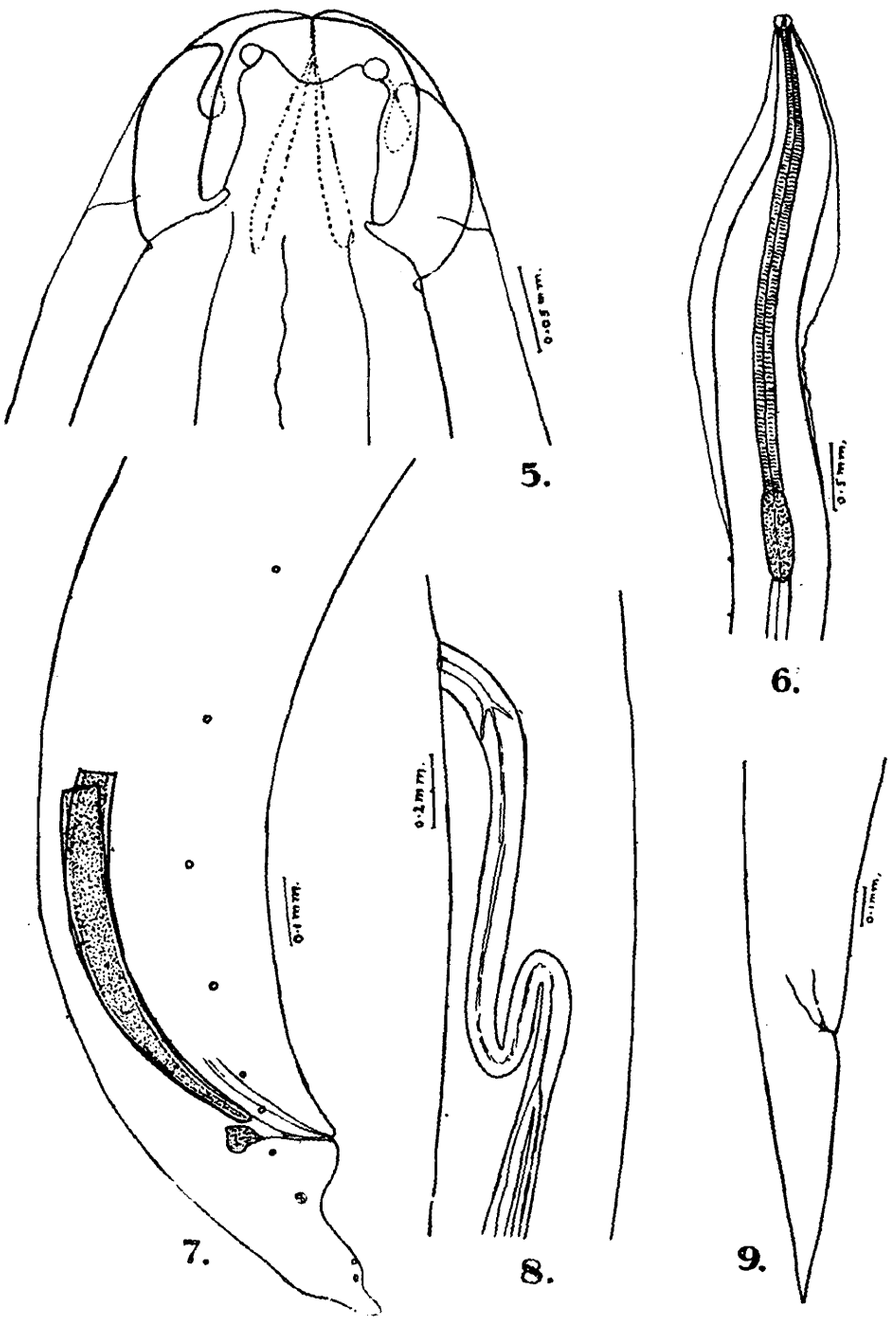
	Male.	Female.
Length	11·5—15	18—21
Diameter (maximum)	0·37—0·39	0·4—0·42
Nerve ring from ant. end	0·36—0·47	0·5
Cervical papillae from (1)	0·18—0·2	0·22—0·26
ant. end (2)	0·44—0·5	0·54
Pharynx, length	0·16—0·18	0·18
Oesophagus, length 1st part	0·475	0·5
2nd part	3·4	3·5
Spicules, length (1)	0·45—0·5	..
(2)	1·8—2·5	..
Gubernaculum, length	0·06	..
Vulva to tail	..	5·2
Anus to tail	0·14	0·12
Eggs	..	0·028—0·030 × 0·012—0·014

Belanisakis ibidis, gen. et sp. nov.

A collection of these worms was obtained from the intestine of a Black-headed ibis (*Ibis melanocephalus*).

The mouth is surrounded by three large lips separated from each other by conical interlabia. The dorsal lip has two papillae and the two sub-ventral lips have one papilla each. There are no dentigerous ridges on the inner surfaces of the lips (fig. 5). There are broad cervical alae about the same length as the oesophagus (fig. 6). On account of these alae the anterior end of the worms in the fixed state is always sharply curved. The oesophagus is without a posterior bulb, but it has a clearly defined oblong ventriculus. There are no oesophageal or intestinal diverticula (fig. 6). *Male* :—The posterior end of the male is slightly curved towards the ventral surface. The tail becomes suddenly narrower behind the cloaca, and is slightly swollen again just anterior to its tip. There is a pair of double papillae a little distance posterior to the cloaca, and two pairs of smaller papillae towards the tip of the tail (fig. 7). Beginning opposite the cloaca there is a sub-ventral row of papillae running forwards on each side ; they are eighteen in number, and become gradually further apart from behind forwards ending about four millimetres from the tip of the tail. The spicules are stout and equal and end in rounded points. A short stout gubernaculum is present (fig. 7). *Female* :—The vulva is anterior to the middle of the body ; it is an inconspicuous opening without lips. The vagina

is a muscular tube running posteriorly from the valva for a distance of about two millimetres. A short portion of the vagina at its commencement is divided off from the rest of the organ by a valvular structure, and posteriorly, just before dividing into the two uteri, it takes a close S-shaped curve (fig. 8). The uteri run parallel towards the posterior end of the worm, and pass into the ovaries a short distance



Text-fig. 5.—*Belanisakis ibidis.* Anterior end, dorsal view.
Text-fig. 6.—*Belanisakis ibidis.* Anterior end, ventral view. showing oesophagus and alae.
Text-fig. 7.—*Belanisakis ibidis.* Male tail, lateral view.
Text-fig. 8.—*Belanisakis ibidis.* Female, vulval region.
Text-fig. 9.—*Belanisakis ibidis.* Female tail, lateral view.

anterior to the anus. The ovaries pursue a very convoluted course towards the anterior end of the worm and come to an end a short distance posterior to the vulva. The tail is straight and tapering (fig. 9).

This worm resembles the genus *Paranisakis* in possessing interlabia, and it has an oesophagus similar to that of *Anisakis*, but it differs from this and all other genera in the possession of cervical alae combined with the above characters. It is therefore necessary to create a new genus for this worm, and for this the name *Belanisakis* is proposed, the name of the species being *Belanisakis ibidis*, sp. nov.

Host. *Ibis melanocephalus.*

Type-specimens are in the Indian Museum, Calcutta.

Belanisakis, gen. nov.

Definition:—*Anisakinae.* Interlabia present; dentigerous ridges absent. Oesophagus with an anterior muscular portion and a posterior oblong ventriculus; oesophageal appendix and intestinal caeca absent. Broad cervical alae present. *Male*:—Spicules stout and equal; gubernaculum present. *Female*:—Vulva anterior to the middle of the body, oviparous. Parasites of birds.

Type-species. *B. ibidis*, sp. nov., in *Ibis melanocephalus.*

Table of measurements (in millimetres).

	Male.	Female.
Length	23	34
Diameter	0·535	0·71
Oesophagus, length	2·7	3·1
Ventriculus, length	0·79	1·0
Tail, length	0·24	0·79
Spicules, length	0·5	..
Gubernaculum, length	0·06	..
Vulva from anterior end	..	11·7
Eggs	..	0·06×0·048
Cervical alae, maximum width	0·16	..

Quasithelazia tenuis, gen. et sp. nov.

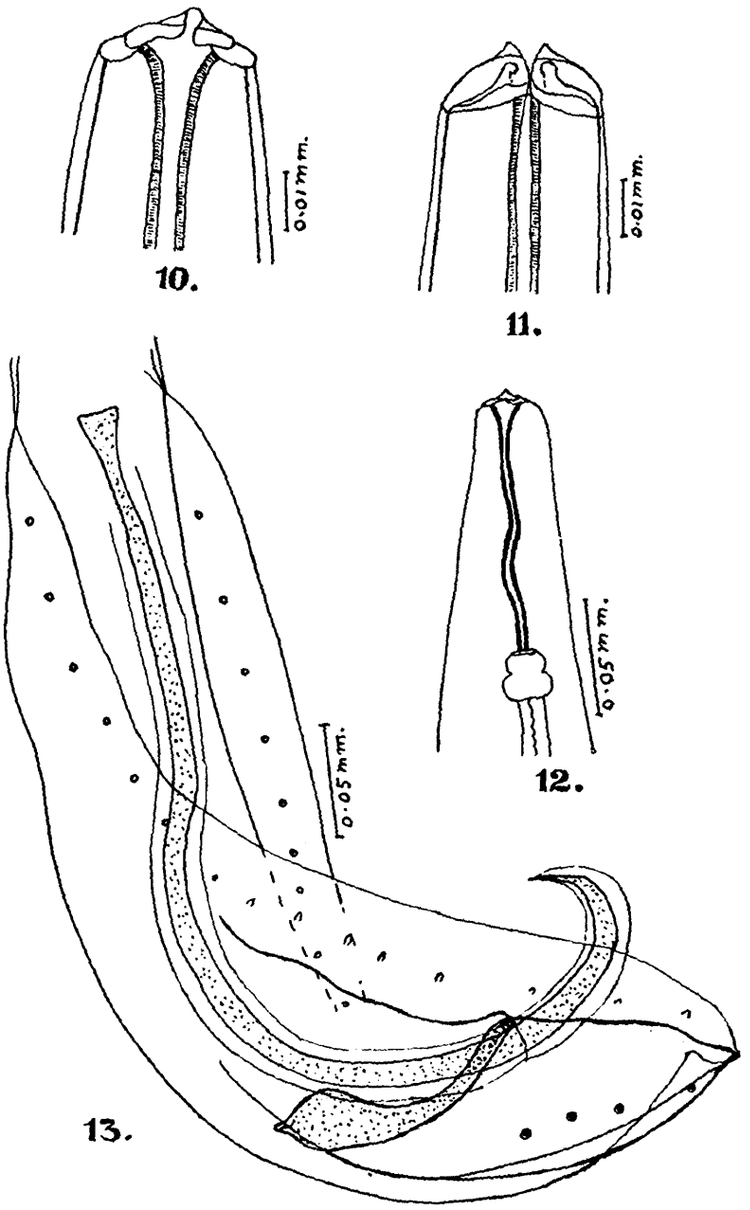
A single male specimen was found in the gizzard of a kingfisher (*Ceryle smyrnensis*), in company with a female of the species *Rusguniella brevis.*

The mouth is bounded by two conical lateral lips which appear to be surmounted by chitinous caps (figs. 10 and 11). There are no cervical cordons or other ornamentation. Cervical papillae are apparently absent, as they could not be found even after prolonged search. The mouth leads directly into a long chitinous vestibule which has thick striated walls (figs. 10 and 11). The walls of the vestibule curve dorsally and ventrally at the anterior end, so that the opening is probably oval. (fig. 10). Between the vestibule and oesophagus there

is a swollen, slightly lobulate structure, which is probably glandular in function. (fig. 12). The oesophagus is divided into two parts.

Male :—The tail is strongly curved ventrally, and is furnished with long stout caudal alae. There are twelve pairs of pedunculate papillae anterior to the cloaca, and four pairs posterior to it. The spicules are dissimilar and unequal, and there is no gubernaculum (fig. 13).

Female :—Unknown.



Text-fig. 10.—*Quasithelazia tenuis.* Anterior end, lateral view.
Text-fig. 11.—*Quasithelazia tenuis.* Anterior end, dorso-ventral view.
Text-fig. 12.—*Quasithelazia tenuis.* Anterior end, showing vestibule and bulb.
Text-fig. 13.—*Quasithelazia tenuis.* Male tail, semi-ventral view.

This worm resembles Acuariinae in the possession of two conical lateral lips and a long thick-walled vestibule, while the numerous pre-anal papillae bring it much nearer to Thelaziinae. The sub-family Schistorophinae is not accepted by all authorities, the genera contained in it being variously scattered among the Acuariinae Spirurinae, and

Thelaziinae. It is thus clear that Schistorophinae is a somewhat heterogeneous group of genera, having affinities with all the above sub-families. In the present stage of classification it is a useful dumping-ground for doubtful genera. The species under discussion is a good example, and it is proposed to create a new genus for it and to place it in the sub-family Schistorophinae. The name *Quasithelazia tenuis*, gen. et sp. nov. is proposed for this worm.

Host.—Ceryle smyrnensis.

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

Quasithelazia, gen. nov.

Definition.—*Schistorophinae.* Mouth with conical lateral lips surmounted by chitinous caps. Cervical cordons absent. Long thick-walled vestibule present. *Male* :—Tail furnished with well-marked caudal alae, and numerous preanal papillae. Spicules unequal and dissimilar. Gubernaculum absent. *Female.*—Unknown.

Type species.—*Q. tenuis*, sp. nov.

Table of measurements (in millimetres).

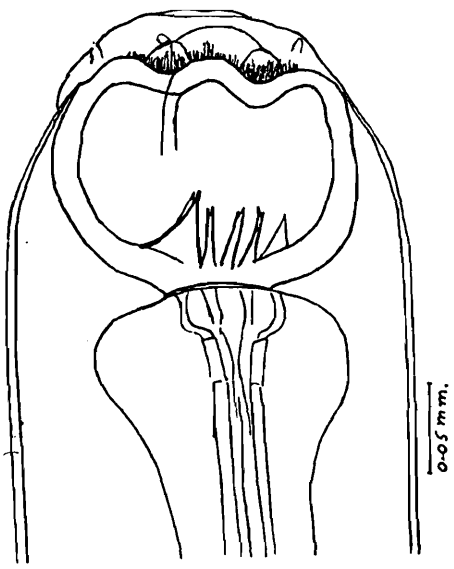
	Male.
Length	8·48
Diameter	0·120
Vestibule, length	0·160
Oesophagus, length, 1st part	0·396
2nd part	0·931
Spicules, length	0·54 0·11
Tail, length	0·1

Quasistrongylus rheae, gen. et sp. nov.

This worm was found in the intestine of an American ostrich (*Rhea americana*).

The mouth is directed straight forwards and there is a lateral and two submedian papillae on either side. There is a leaf-crown consisting of numerous very fine elements arising from the anterior border of the buccal capsule (figs. 14 and 15). The buccal capsule is large and subglobular and its anterior border has an undulating contour (figs. 14 and 15). Arising from the base of the capsule and surrounding the oesophageal opening, there are several pairs of large teeth. The pair on the dorsal side are larger than the others and they end in a simple point, and the remaining three or four pairs on the lateral and subventral aspects are somewhat shorter and end in bifid points (fig. 14). The oesophagus is slightly expanded anteriorly, and from a narrower portion immediately behind this it gradually increases in diameter to the posterior end (fig. 16). The lining of the oesophagus is heavily chitinized and anteriorly it expands into a funnel-shaped cavity furnished

with longitudinal ridges in its walls (figs. 14 and 15). *Male* :—The bursa is relatively short, but it is broad antero-posteriorly, and there is no distinct dorsal lobe (figs. 17 and 18). Prebursal papillae are absent. The ventral rays are cleft; the lateral rays arise from a common trunk and are approximately equal; the externo-dorsal rays arise from a common trunk with the dorsal; the dorsal gives off a branch on either side about two-thirds of its length from the origin of the externo-dorsal rays and its tip and it ends in two points (figs. 17 and 18). The spicules are equal and similar, with recurved tips, and the gubernaculum is in the form of a chitinized tube (fig. 17). The genital cone consists of two broad mammilate papillae (fig. 19). *Female* :—The vulva opens



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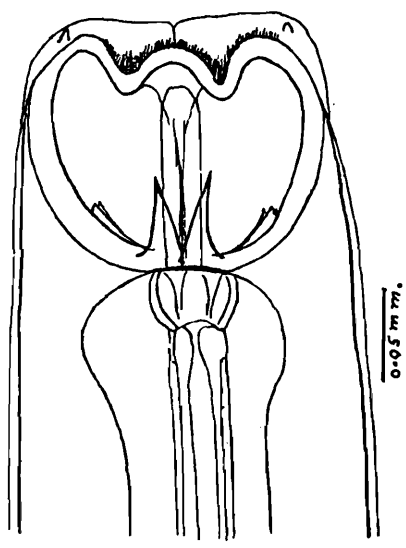

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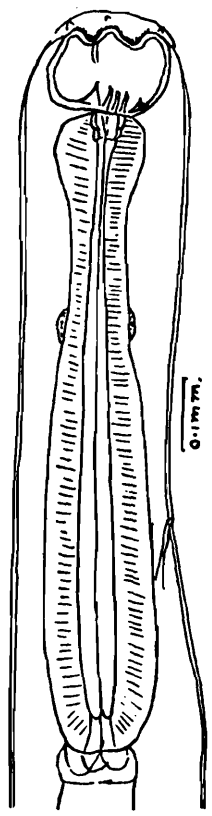

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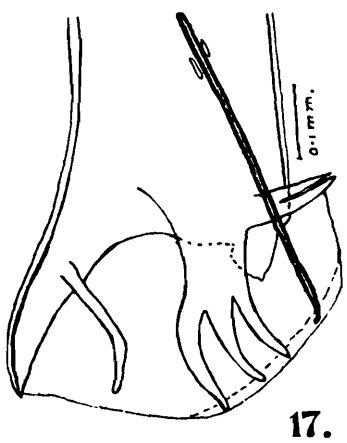

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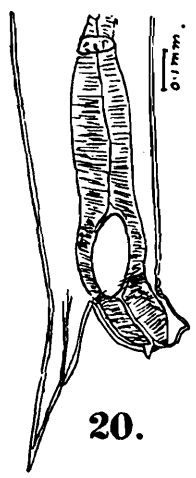

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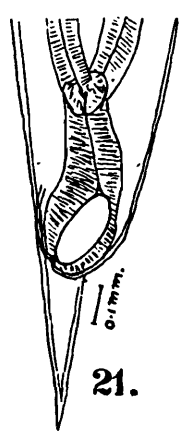

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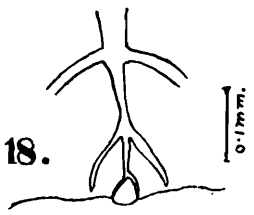

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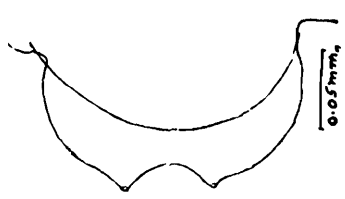

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TEXT-FIG. 14.—*Quasistrongylus rheae.* Anterior end, lateral view.
TEXT-FIG. 15.—*Quasistrongylus rheae.* Anterior end, lateral view.
TEXT-FIG. 16.—*Quasistrongylus rheae.* Anterior end, lateral view showing oesophagus.
TEXT-FIG. 17.—*Quasistrongylus rheae.* Male bursa, lateral view.
TEXT-FIG. 18.—*Quasistrongylus rheae.* Male bursa, dorsal ray.
TEXT-FIG. 19.—*Quasistrongylus rheae.* Male, genital cone.
TEXT-FIG. 20.—*Quasistrongylus rheae.* Female tail, lateral view.
TEXT-FIG. 21.—*Quasistrongylus rheae.* Female tail, lateral view.

just anterior to the anus on a large prominence (fig. 20). There is a very muscular vagina running forwards which divides into two muscular tubes ; these pursue an anterior parallel course for about 2 mm. when they merge into the thinner-walled uteri. (fig. 21). The tail ends in a sharp point. The eggs are large and oval and they contain a segmented morula.

This worm shows many affinities to several genera of the sub-family Strongylinae but it differs distinctly from all of them, it is, therefore, proposed to create for it a new genus and to name this worm *Quasistrongylus rheae*, gen. et. sp. nov.

Quasistrongylus, gen. nov.

Definition.—*Strongylinae* :—Mouth directed straight forwards with an internal leaf-crown arising from the anterior border of the buccal capsule. Buccal capsule large and subglobular with an undulating anterior border ; several pairs of stout teeth arise from the depth of the capsule. *Male* :—Bursal formula—Prebursal papillae absent ; ventral rays cleft ; lateral rays arise from a common trunk ; externo-dorsal ray arises from a common trunk with the dorsal ; dorsal gives off a lateral branch on each side and ends in a forked tip. Spicules equal, gubernaculum present. *Female* :—Vulva opens near anus on a large prominence. Parasites of birds.

Type species.—Quasistrongylus, rheae, sp. nov.

Host.—Rhea americana.

Type-specimens are in the Indian Museum, Calcutta.

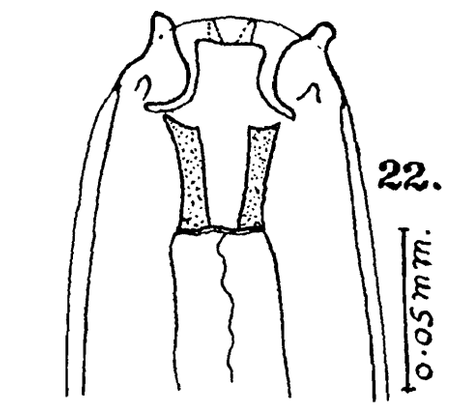
Table of measurements (in millimetres).

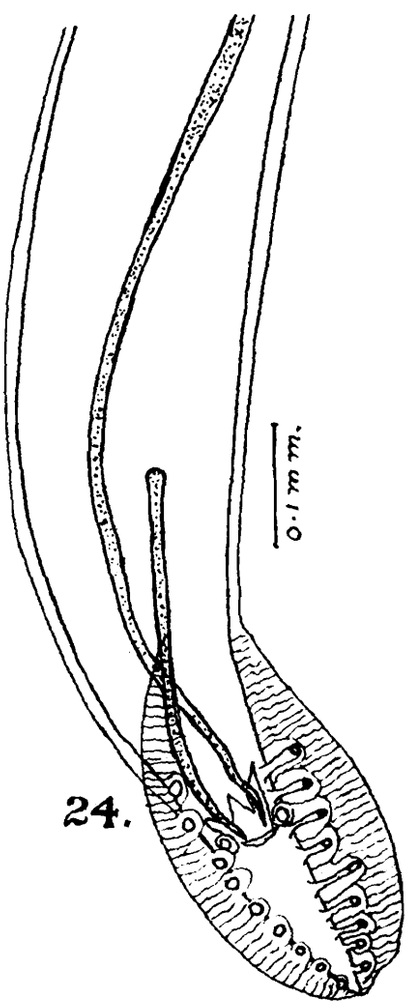
	Male.	Female.
Length	8·5—10·0	13·5—14·5
Diameter (maximum)	0·495	0·495
Buccal capsule (depth)	0·125	0·130
(diameter) . .	0·140	0·144
Excretory pore from ant. end .	0·535	0·693
Nerve ring from ant. end .	0·336	0·356
Cervical papillae from ant. end .	..	0·693
Oesophagus (length) .	0·75—0·8	0·85
Spicules (length) .	1·0	..
Gubernaculum	0·06	..
Vulva to anus	..	0·4
Anus to tip of tail	..	0·27—0·36
Vagina (length)	..	0·39—0·42
Eggs	..	0·16—0·17 × 0·7—0·8

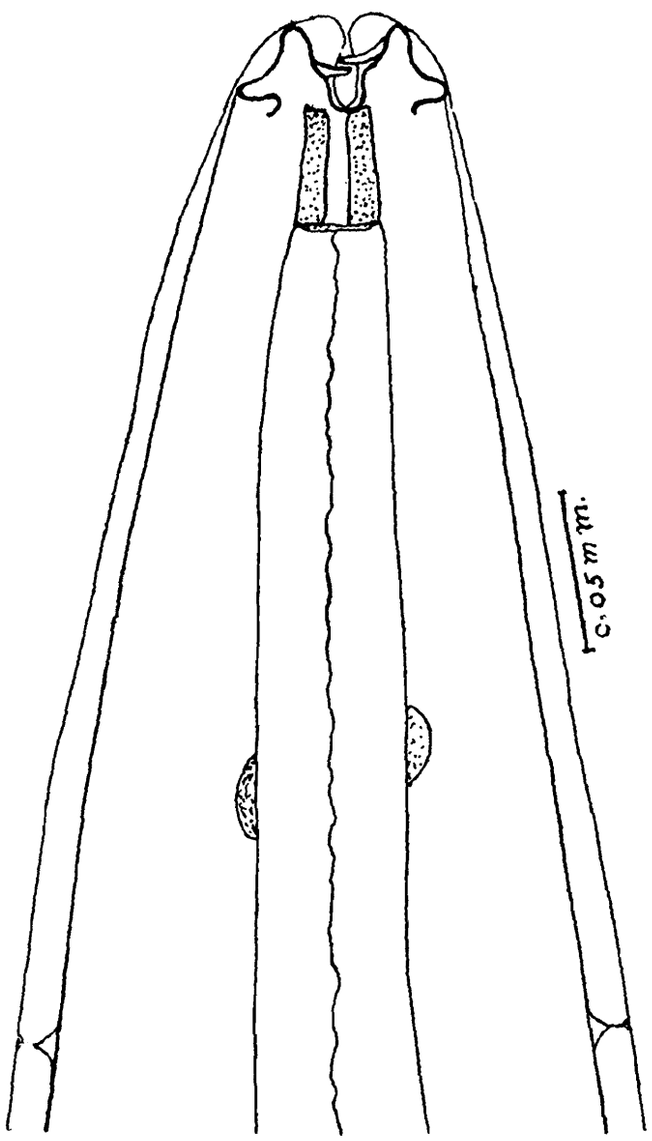
Part 10.—Spirurids from Birds.

Habronema diesingi, sp. nov.

One male and one female of this species was found in the gizzard ef a Vulturine guineafowl (*Acryllium vulturinum*).







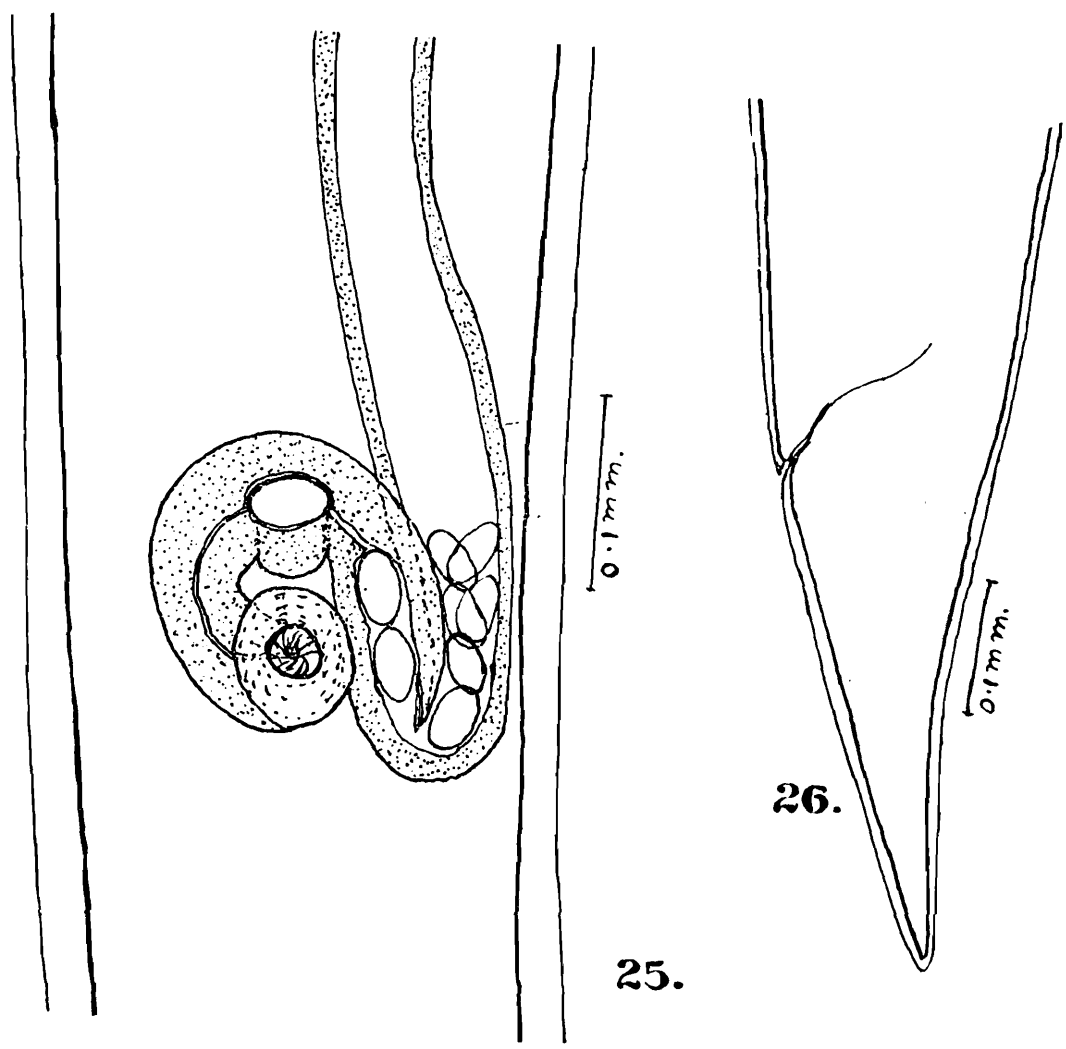
Text-fig. 22.—*Habronema diesingi.* Anterior end, lateral view.
Text-fig. 23.—*Habronema diesingi.* Anterior end, dorso-ventral view.
Text-fig. 24.—*Habronema diesingi.* Male tail, ventral view.

There are narrow lateral alae on either side of the body. The cervical papillae and excretory pore are relatively far back, being somo

distance posterior to the nerve ring. The mouth is bounded by two large lateral lips, which have a central quadrangular papilla and two prominent submedian papillae on each side (fig. 22). The submedian papillae have prominently projecting posterior angles (fig. 23). There is no dorsal or ventral cuticular lip such as is present in many species of the genus, but a pointed process arises from the inner surface of each submedian papilla, and running inwards it overlaps that arising from the opposite lip (fig. 23). The vestibule is stout and cylindrical (figs. 22 and 23), and the oesophagus is divided into two parts.

Male :—There are well-developed caudal alae supported by nine pairs of pedunculate papillae two of which are precloacal, and there is an additional pair of sessile papillae, one on either side of the cloaca (fig. 24). The spicules are markedly unequal and there is a broad gubernaculum.

Female :—The vulva opens in the posterior half of the body, dividing the body length into the proportions of 7·3 : 1. The vulva is slightly prominent and it leads directly into a thick-walled muscular ovejector, which describes almost a complete circle before turning forwards into



TEXT-FIG. 25.—*Habronema diesingi.* Vulval region, female, ventral view.
TEXT-FIG. 26.—*Habronema diesingi.* Female tail, lateral view.

a thinner-walled unpaired trunk (fig. 25). This single uterine stem pursues an undulating course to a point about one millimetre anterior

to the vulva, where it divides into the two uteri. The single specimen available is so crowded with eggs that the uteri and ovaries cannot be studied in detail, but they appear to be similar to those of *Habronema euplocami*, as the ovaries are at opposite ends of the worm. The tail ends in a straight tapering point (fig. 26), and the eggs are thick-shelled and contain embryos.

This worm has a superficial resemblance to *H. euplocami*, but differs from it in several particulars. The cervical papillae are opposite the middle of the vestibule in *H. euplocami*, while in the present species they are behind the nerve ring and only a short distance anterior to the junction of the two parts of the oesophagus. There are small pointed dorsal and ventral cuticular lips in *H. euplocami*, these are absent in the present species and their place is taken by the overlapping processes arising from the submedian papillae, described above. Both sexes of the present species are considerably smaller than those of *H. euplocami*, but despite this fact the long spicule is considerably longer in the former, and in addition the short spicule is shorter ; the inequality between the two is thus more marked in the new worm than it is in *H. euplocami*. The caudal papillae are similar in both species, but the new worm has an additional pair of sessile papillae near the cloaca. In the female the ovejectors are of different shape and the vulva is relatively much further back in *H. euplocami* than it is in the new species. It is accordingly proposed to name this worm *Habronema diesingi*, sp. nov.

Host.—Acryllium vulturinum.

Type-specimens are in the Indian Museum, Calcutta.

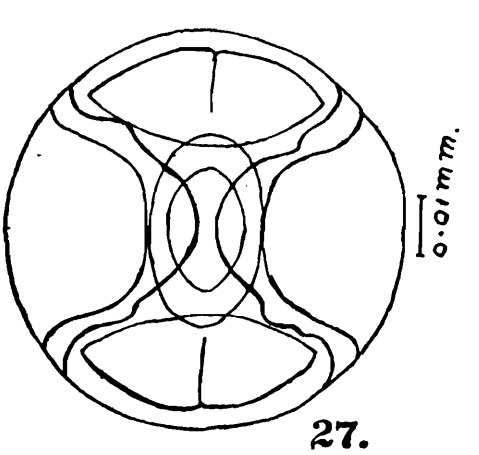
Table of measurements (in millimetres).

	Male.	Female.
Length	8·8	14·5
Diameter	0·257	0·336
Depth of buccal cavity and vestibule	0·056	0·068
Oesophagus, length, 1st part	..	0·356
2nd part	..	2·344
Cervical papillae from ant. end	..	0·317
Excretory pore from ant. end	..	0·317
Nerve ring from ant. end	..	0·235
Spicules	1·7 & 0·297	..
Vulva to tip of tail	..	1·74
Anus to tip of tail	..	0·396
Caudal papillae from tip of tail	..	0·055
Eggs	..	0·040×0·024

Habronema magnilabiata, sp. nov.

This worm was found in the gizzard of an Indian eagle (*Polioaetus plumbeus*).

There are two large lateral lips and large dorsal and ventral lips (fig. 27). The external surface of the lateral lips have a central prominent mass with large papillae running dorsally and ventrally from it. It differs from most species of *Habronema*, which usually have a broad rectangular central portion separated off from the large subdorsal and subventral papillae on the external surface of the lateral lips (fig. 28). The dorsal and ventral lips are rounded and partially divided by a longitudinal groove (fig. 27). The vestibule is of the usual type, being oval with the long diameter dorso-ventral. There is a lateral



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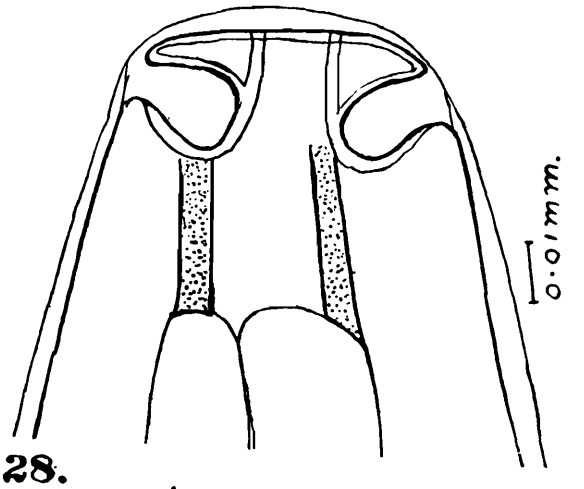

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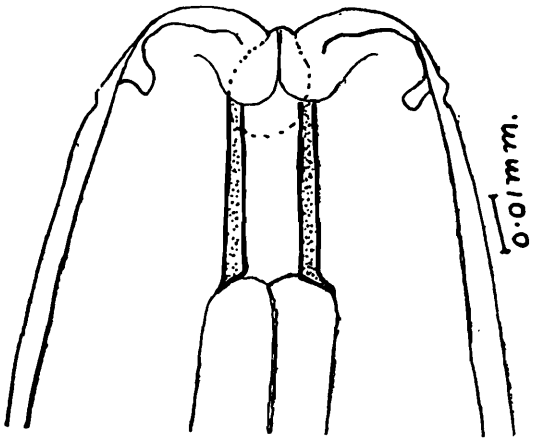

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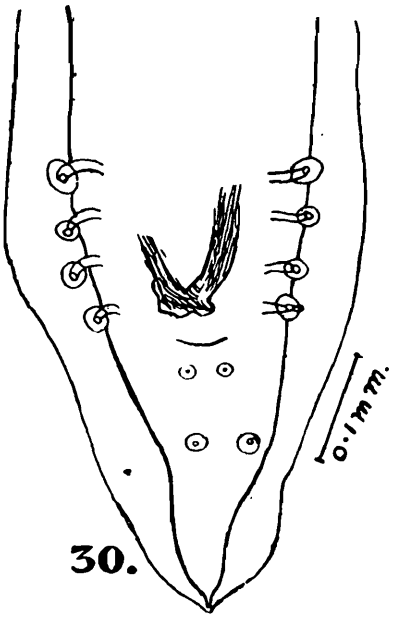


30.

TEXT-FIG. 27.—*Habronema magnilabiata.* Anterior end, end-on view.
TEXT-FIG. 28.—*Habronema magnilabiata.* Anterior end, lateral view.
TEXT-FIG. 29.—*Habronema magnilabiata.* Anterior end, dorso-ventral view.
TEXT-FIG. 30.—*Habronema magnilabiata.* Male tail, ventral view.

flange on one side of the body only, which begins about 0·24 mm. from the anterior end and runs posteriorly for a distance of about 1·3 mm.

Male :—The tail of the male is strongly curved ventrally and it has relatively narrow asymmetrical alae. The ventral surface of the alae and the portion of the worm immediately anterior to the cloaca is marked with longitudinal grooves and ridges. There are four pairs of long precloacal papillae and two pairs of shorter papillae posterior to the cloaca (fig. 30). The spicules are curved and they both end in simple points, and there is a rugged asymmetrical gubernaculum.

Female :—The tail is short and tapers to a point. The vulva opens just anterior to the middle of the body length, and the eggs are thick-shelled.

The character of the lateral lips alone is sufficient to separate this worm from other species of *Habronema*, and the name *Habronema magnilabiata*, sp. nov. is proposed for it.

Host.—Polioaetus plumbeus.

Type-specimens are in the Indian Museum, Calcutta.

Table of measurements (in millimetres).

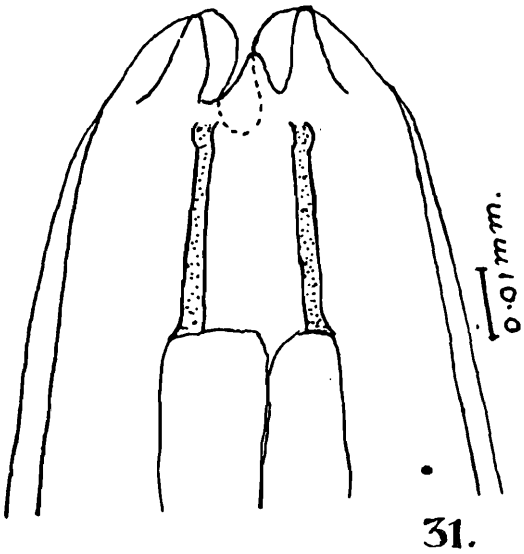
	Male.	Female.
Length	9·1	15·6
Diameter (maximum)	0·26	0·39
Vestibule, length	0·028	..
Oesophagus, length, 1st part . . .	0·396	0·396
2nd part . . .	2·63	3·6
Nerve ring from ant. end	0·297	..
Ex. pore from ant. end	0·327	0·356
Cervical papillae from ant. end	0·198	..
Spicules 1 .	1·78	..
2 . .	0·554	..
Vulva to tail . .	..	8·1—8·5
Anus to tail	..	0·18
Eggs . .	..	0·040×0·030

Habronema asymmetrica, sp. nov.

This worm was found in the gizzard of a Pied lanier (*Circus micrurus*).

There are two broad lateral lips and a small dorsal and ventral lip (fig. 31). The central mass on the lateral lips is crescentic, the two papillae are relatively stout, and the anterior border of the lips is truncate and not rounded as it is in most species of this genus (fig. 32). There is a cuticular flange on one side of the body only. The vestibule is oval and its dorsal and ventral walls are thicker than the lateral walls.

Male :—The caudal alae are asymmetrical the longer one being on the same side as the lateral flange. The ventral portion of the worm between the alae, and the ventral surfaces of the alae are marked by longitudinal ridges interrupted by irregular transverse lines. The caudal



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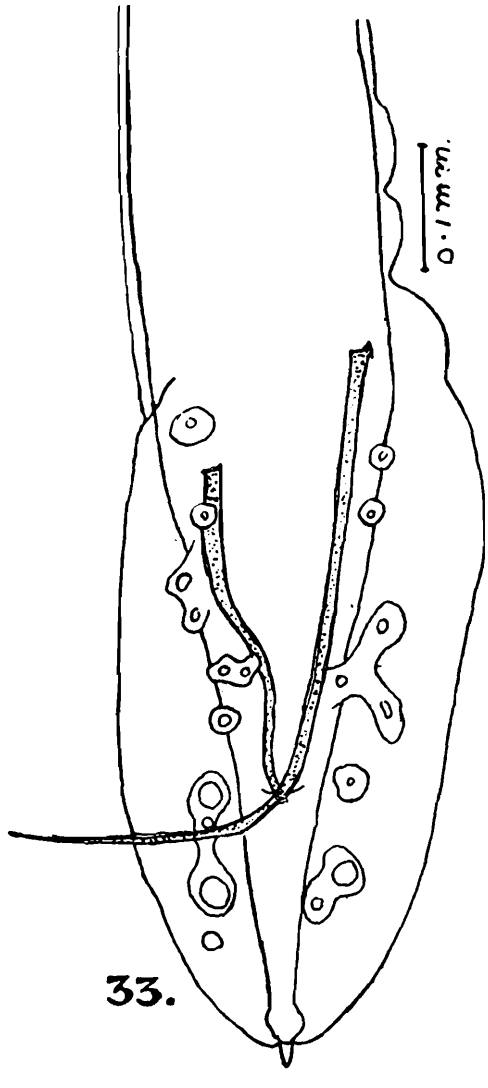


33.

TEXT-FIG. 31.—*Habronema asymmetrica.* Anterior end, dorso-ventral view.
TEXT-FIG. 32.—*Habronema asymmetrica.* Anterior end, lateral view.
TEXT-FIG. 33.—*Habronema asymmetrica.* Male tail, ventral view.

papillae are quite irregularly placed, some being double, and as they differ in different specimens a detailed description of their arrangement is of no value (fig. 33). The spicules are straight, pointed and of unequal length, and no gubernaculum was seen.

Female :—The vulva opens just anterior to the middle of the body length, and the eggs are thick-shelled and oval.

The peculiar shape of the lateral lips, and in the male the asymmetrical alae with irregularly arranged papillae serve to distinguish this species from other members of the genus, and the name *Habronems asymmetrica*, sp. nov. is proposed for it.

Host.—Circus macrurus.

Type-specimens are in the Indian Museum, Calcutta.

Table of measurements (in millimetres).

	Male.	Female.
Length	7·5	11
Diameter (maximum)	0·23	0·29
Depth of mouth	0·16	0·24
Depth of vestibule	0·18	0·22
Oesophagus, length, 1st part	0·178	0·29
2nd part	2·1	4·0
Nerve ring from ant. end	0·2	0·28
Ex. pore from ant. end	0·2	0·28
Cervical papillae	(not observed).	
Vulva to tail	..	5·9
Anus to tail	..	0·198
Spicules 1	0·65	..
2	0·24	..

Habronema casuarii, sp. nov.

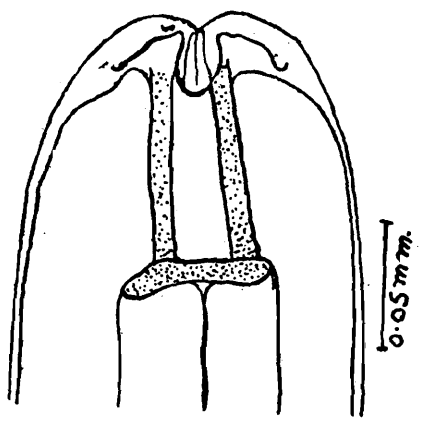
This worm was found in the gizzard of a double-wattled cassowary (*Casuarius bicarunculatus*).

There are two broad lateral lips and no dorsal and ventral lips. The lateral lips are typical, having a broad central mass separated from the large submedian papillae, and on the inner surface of the lips there are four dental ridges (fig. 35). The worm is marked by deep circular striations towards the posterior end of both sexes.

Male :—There are a pair of broad symmetrical caudal alae, which are strongly marked on their ventral surfaces by longitudinal and transverse grooves. There are five pairs of large pedunculate papillae, three pairs of which are anterior to the cloaca, one pair about opposite the cloaca, and the fifth pair posterior to it. There are also two pairs of sessile papillae more centrally placed, just posterior to the cloaca, and in addition there is a group of six or seven minute papillae on the ventral surface of the tip of the tail. The spicules are unequal, the shorter being relatively stout, with broad mambraneous alae and it ends in a straight rounded tip ; the longer spicule is more delicate and it ends in a barb like a crochet needle, and there is a stout V-shaped gubernaculum (fig. 36).

Female :—The vulva opens well behind the middle of the body length, and an unpaired vagina runs anteriorly from it for a distance of about 0·8 mm. The uteri are divergent, the anterior ovary ending far forwards, opposite the junction of the first and second parts of the oesophagus, and the posterior ovary reaches almost to the anus. The eggs are oval with thick shells.

This worm is almost twice the size of any previously described species of *Habronema*, and is clearly a new species. It is accordingly proposed to name it *Habronema casuarii*, sp. nov.



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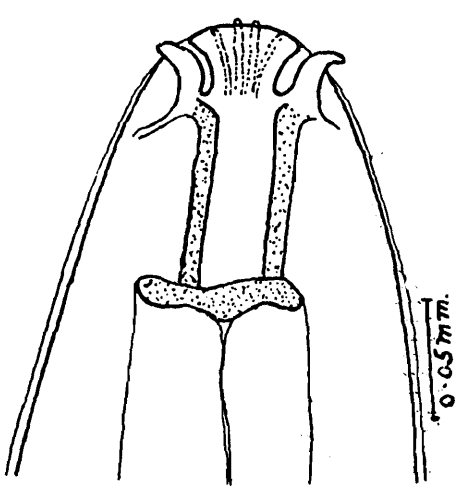

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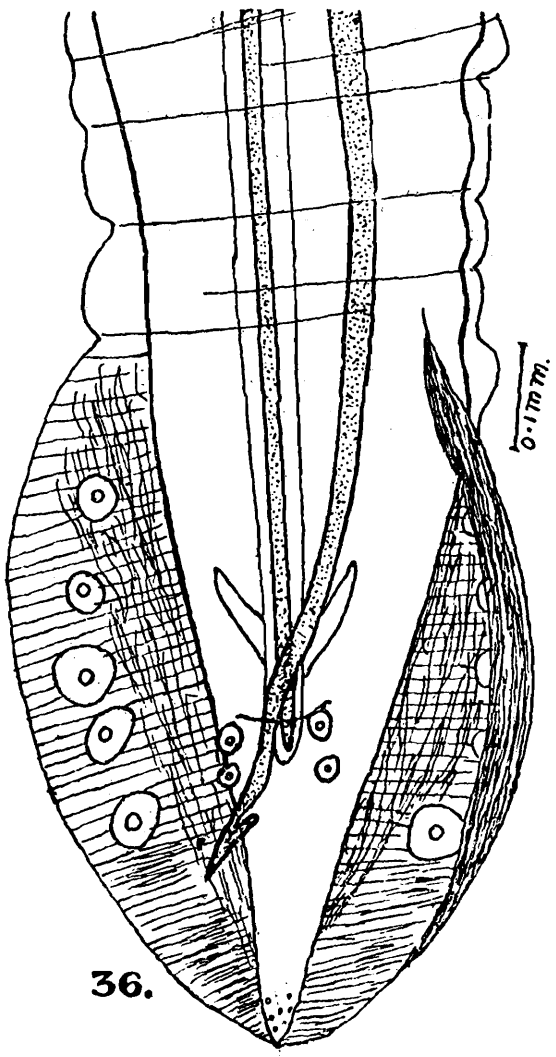

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TEXT-FIG. 34.—*Habronema casuarii.* Anterior end, dorso-ventral view.
TEXT-FIG. 35.—*Habronema casuarii.* Anterior end, lateral view.
TEXT-FIG. 36.—*Habronema casuarii.* Male tail, ventral view.

Host.—Casuarius bicarunculatus.

Type-specimens are in the Indian Museum, Calcutta.

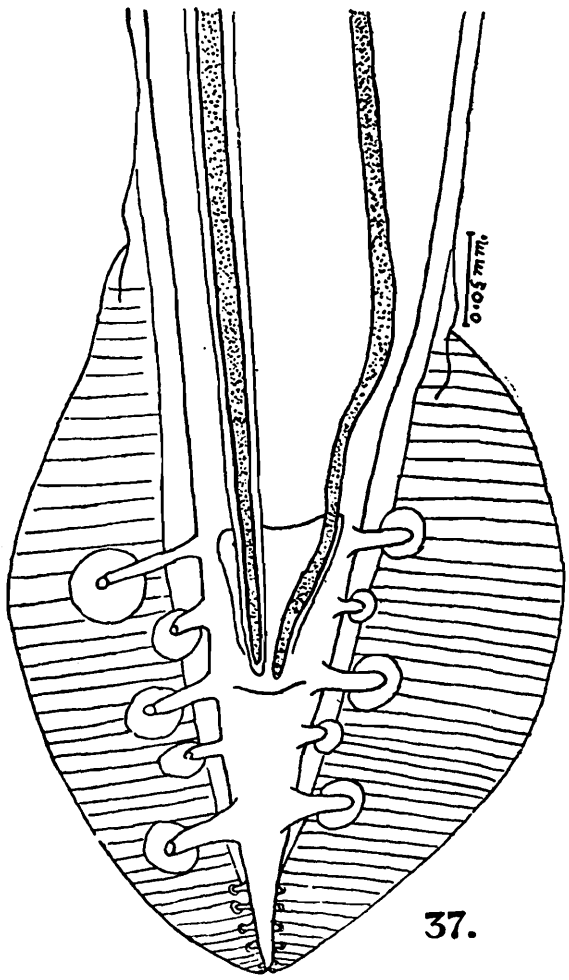
Table of measurements (in millimetres).

	Male.	Female.
Length	26·5	53
Diameter (maximum)	0·554	0·89
Vestibule, length	0·1	0·15
Ex. pore from ant. end	0·574	0·693
Nerve ring from ant. end	0·436	..
Cervical papillae from ant. end	0·495	..
Oesophagus, length, 1st part	0·695	0·832
2nd part	8·3	11·5
Spicules, length 1	1—1·3	..
2	3·1—3·9	..
Vulva to tail	..	8·3—9·2
Anus to tail	..	0·39—0·44

The male of **Habronema euplocami** Maplestone, 1930.

The female of this species was described by Maplestone (1930) from a Kalij pheasant (*Euplocamus leucomelanus*), and since that time both males and females of this worm have been found in the gizzard of the Peacock pheasant (*Polyplectrum bicalcaratum*) on three occasions.

Male:—The caudal alae are broad and symmetrical, and there are nine pairs of pedunculate papillae. Two pairs are precloacal, and one pair (the longest) are opposite the cloaca. The remaining six pairs are posterior to the cloaca and they are of regularly diminishing length from before backwards, except in the case of the fifth pair, which is slightly longer than the fourth. The spicules are thin and tapering and are markedly unequal in length. There is a well-developed gubernaculum, which appears trident-shaped when viewed from the ventral surface (fig. 37).



TEXT-FIG. 37.—*Habronema euplocami*. Male tail, ventral view.

Examination of the females of the later collections showed that the dimensions may be slightly larger than I gave in my original description. For instance the vulva may be 1·6 mm. from the tip of the tail and the anus 0·45 mm. from the same point. The ovejector is 0·237 mm. in length and the unpaired trunk runs forward from it for a distance of 0·396 mm. The two uterine tubes run forwards to about the centre of the worm, and at this point one of them bends backwards and the other pursues a course towards the anterior, to end as previously described.

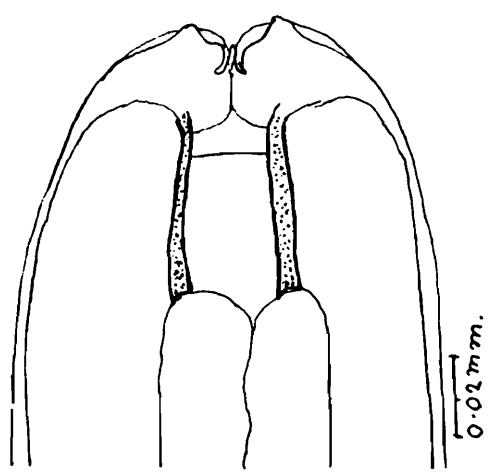
The type-specimen of the male is deposited with that of the female in the Indian Museum, Calcutta.

Table of measurements (in millimetres).

	Male.
Length	10·4
Diameter	0·257
Caudal alae, length	0·336
breadth	0·297
Distance of cloaca from tip of tail	0·136
Spicules, length	1·0 & 0·436

Habronema bulbosa (v. Linstow, 1906).

This worm was originally described by von Linstow (1906) under the name *Physaloptera bulbosa* from *Pavo specifer*. Ortlepp (1922) obtained collections of worms from *Pavo cristatus* and *Pavo muticus*, which only differed from Linstow's description in minor details, so that he assigned them to the same species, but he transferred the worm to the genus *Cyrnea*; this genus I regard as a synonym of *Habronema*.



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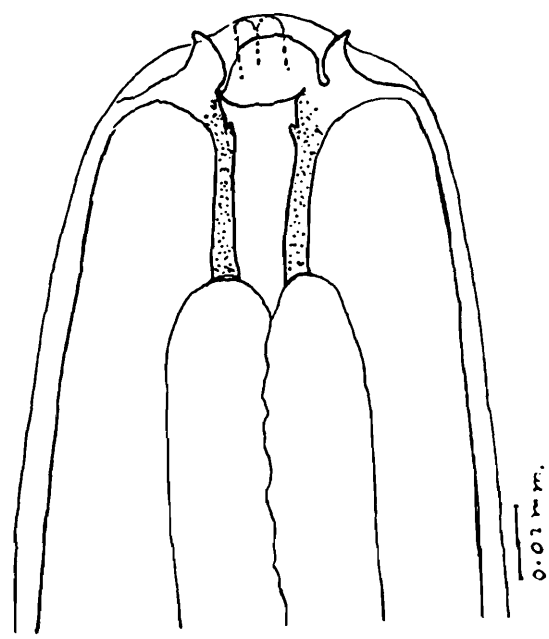


39.

TEXT-FIG. 38.—*Habronema bulbosa*. Anterior end, dorso-ventral view.
TEXT-FIG. 39.—*Habronema bulbosa*. Anterior end, lateral view.

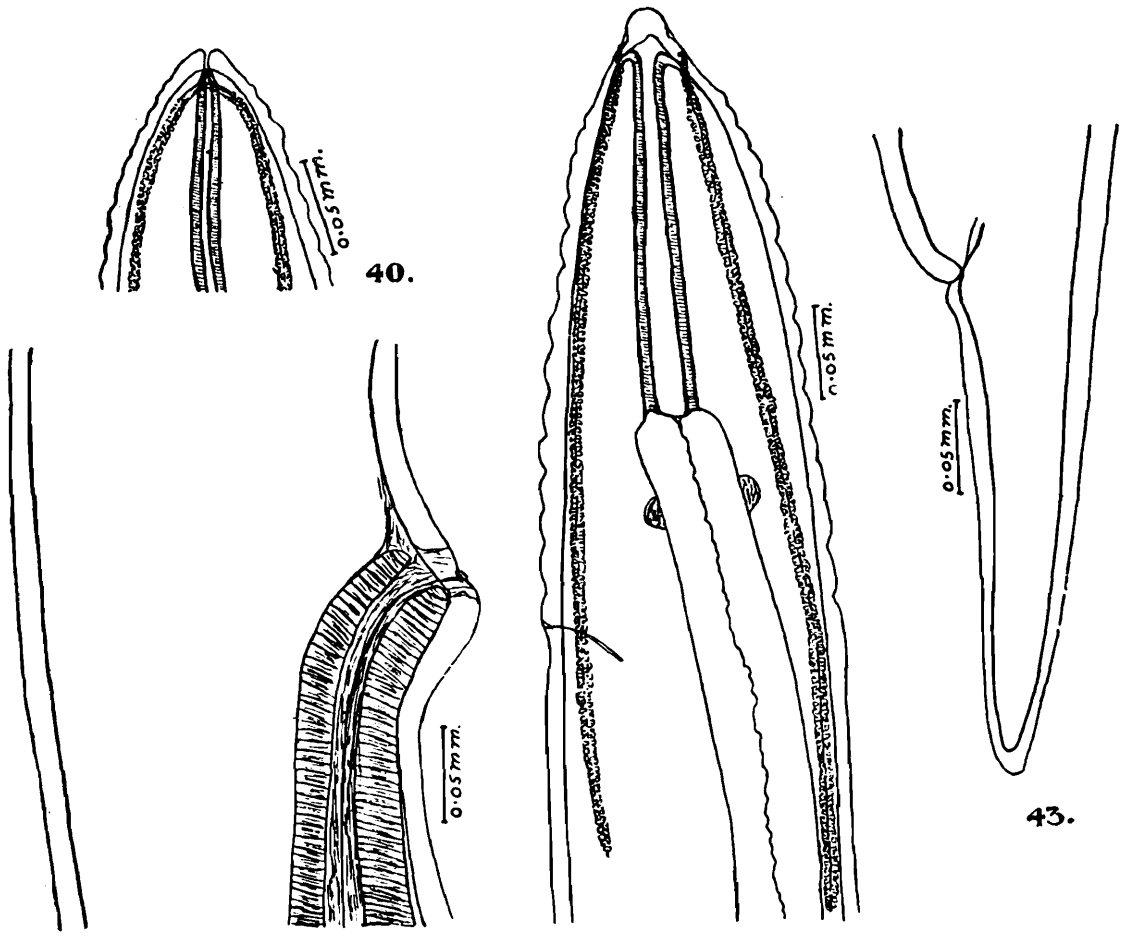
I have obtained a collection of this species of worm from a Burmese peafowl (*Pavo muticus*), one of the hosts from which Ortlepp obtained his material. These worms agree in measurements and in practically all anatomical details with Ortlepp's material and apparently belong to the same species. Ortlepp's drawing of the anterior end of the worm

is completely lacking in detail and gives no idea of the true appearance of this portion of the animal, I have accordingly drawn the anterior end as seen in lateral and dorsal views (figs. 38 and 39). These drawings show that the lateral lips are typical and that there are small dorsal and ventral cuticular " lips " between the submedian papillae.

In the male, Ortlepp (1925) describes two pairs of precloacal and three pairs of postcloacal papillae. In the males of my collection I have one male with three pairs of precloacal and four pairs of postcloacal papillae, another one with three pairs of precloacal and three pairs of postcloacal papillae and two others with papillae according to Ortlepp's description. These worms, both male and female, are apparently identical with Ortlepp's in all other particulars, so it seems that the number of papillae in relation with the male cloaca is not a constant character in this species.

Acuaria indica, sp. nov.

Three female worms of this species were found in the gizzard of a shrike (*Astur badius*).



TEXT-FIG. 40.—*Acuaria indica.* Anterior end, dorso-ventral view.
TEXT-FIG. 41.—*Acuaria indica.* Anterior end, lateral view.
TEXT-FIG. 42.—*Acuaria indica.* Vulval region, female, lateral view.
TEXT-FIG. 43.—*Acuaria indica.* Female tail, lateral view.

There are two conical lateral lips each bearing two submedian papillae. The four cordons arise in pairs on the dorsal and ventral sur-

faces of the head; curving outwards and backwards they run posteriorly in the submedian fields and they come to an end without anastomosing or turning forwards (figs. 40, 41). There is a long narrow vestibule with thick walls (fig. 41). The cervical papillae are short and relatively stout. The oesophagus is divided into two parts and the nerve ring surrounds the first part very near its commencement (fig. 41).

Male:—Unknown.

Female:—The vulva opens posterior to the middle of the body length, and a long muscular vagina runs directly posteriorly from it (fig. 42). The anus is surrounded by relatively prominent lips and the tail ends in a bluntly rounded tip (fig. 43). The eggs are thick-shelled and contain embryos in the uterus.

At first sight this worm appears similar to *Acuaria conica* Maplestone 1931, except that it is considerably longer. Closer comparison of the species, however, reveals more distinct differences. In the present species the lips are not so conical, the vulva is more salient, and the lips of the anus are more marked than they are in *A. conica*. Another difference is that in *A. conica* the vagina runs dorsally until it reaches the centre of the body cavity before it turns posteriorly, and in the present species the vagina runs directly backwards from the vulva along the ventral surface of the body cavity. It is therefore proposed to name this species *Acuaria* (*Acuaria*) *indica*, sp. nov.

Host.—Astur badius.

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

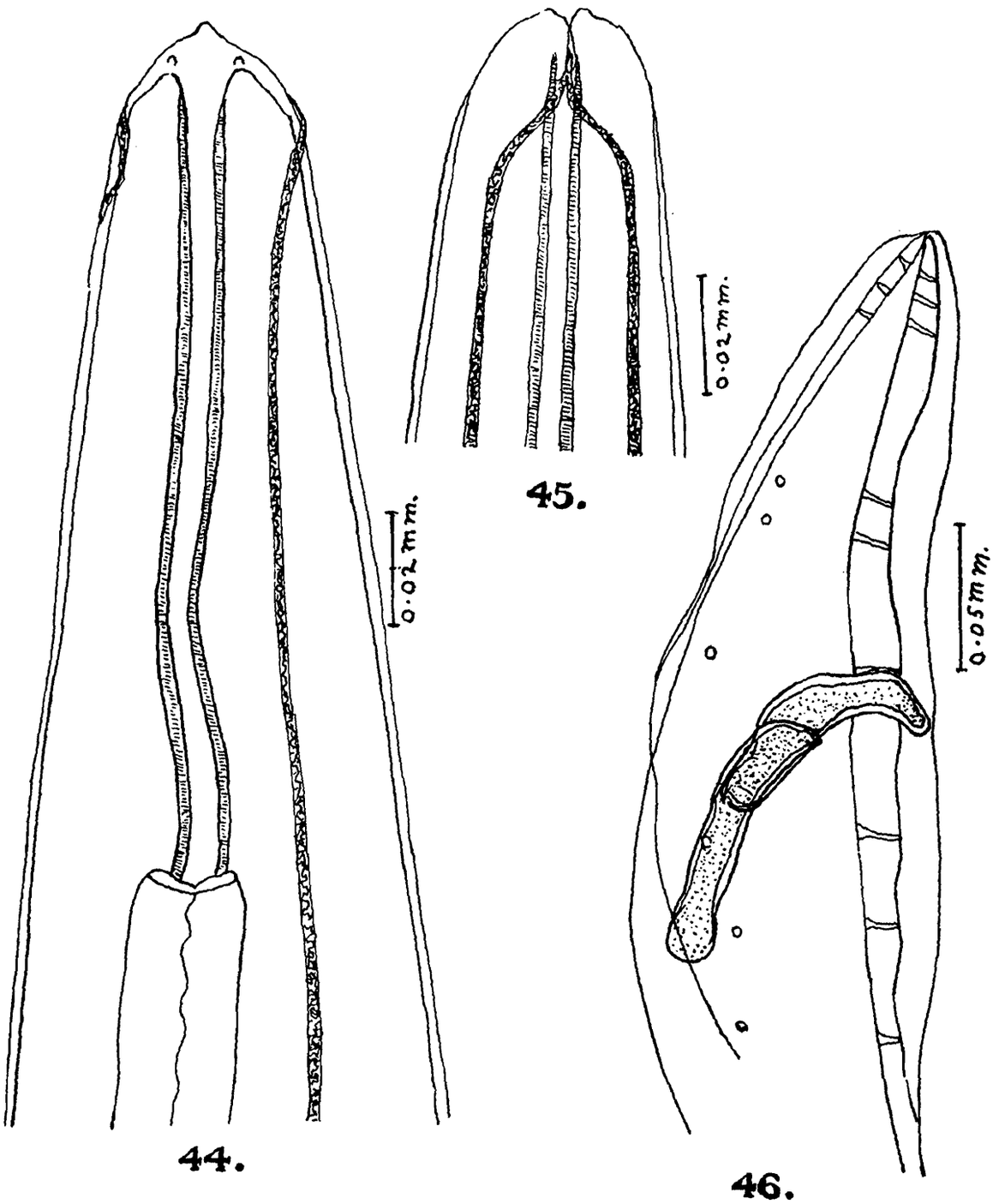
Table of measurements (in millimetres).

	Female.
Length	22-26
Diameter, maximum	0·18—0·2
Cordons, length	0·44
Vestibule, length	0·2—0·21
Ex. pore from ant. end	0·36
Cervical papillae from ant. end	0·25
Nerve ring from ant. end	0·26
Oesophagus, length, 1st part	0·55—0·61
,, 2nd part	1·3—1·4
Vulva to tail	9·8—12·6
Anus to tail	0·24—0·25

Acuaria brevispicula, sp. nov.

A single male of this species was found in the gizzard of a Magpie robin (*Copsychus saularis*).

The worm is small with lateral conical lips each bearing two papillae (fig. 44). The cordons are typical in form, and they arise in pairs on the dorsal and ventral surfaces of the head, from which point they curve outwards and backwards to pursue a posterior course in the sublateral areas, and they end a little distance anterior to the end of the oesophagus (fig. 45). The vestibule is long with thick striated walls, and the oesophagus is divided into two parts.



Text-fig. 44.—*Acuaria brevispicula.* Anterior end, lateral view.
Text-fig. 45.—*Acuaria brevispicula.* Anterior end, end-on view.
Text-fig. 46.—*Acuaria brevispicula.* Male tail, ventral view.

Male:—The caudal alae are relatively long and they are divided into inner and outer areas. There are nine pairs of pedunculate papillae, which fall into three natural groups of three pairs each, *viz.*, a

first group anterior to the cloaca, a second group posterior to the cloaca, and a third group near the tip of the tail. The spicules are short, stout and curved, they are subequal and slightly dissimilar (fig. 46).

Female :—Unknown.

This worm is readily distinguished from other members of the genus to which it approximates in size. It is therefore proposed to name it *Acuaria* (*Acuaria*) *brevispicula*, sp. nov.

Host.—Copsychus saularies.

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

Table of measurements (in millimetres).

	Male.
Length	4·4
Diameter	0·126
Excretory pore from anterior end	0·26
Vestibule, length	0·148
Oesophagus, length, 1st part	0·308
2nd part	1·07
Spicules	0·09 & 0·075
Distance from cloaca to tip of tail	0·172

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PART II.—SOME NEW SPECIES OF STRONGYLIDAE.

The Male of **Kalicephalus brachycephalus** Maplestone, 1931.

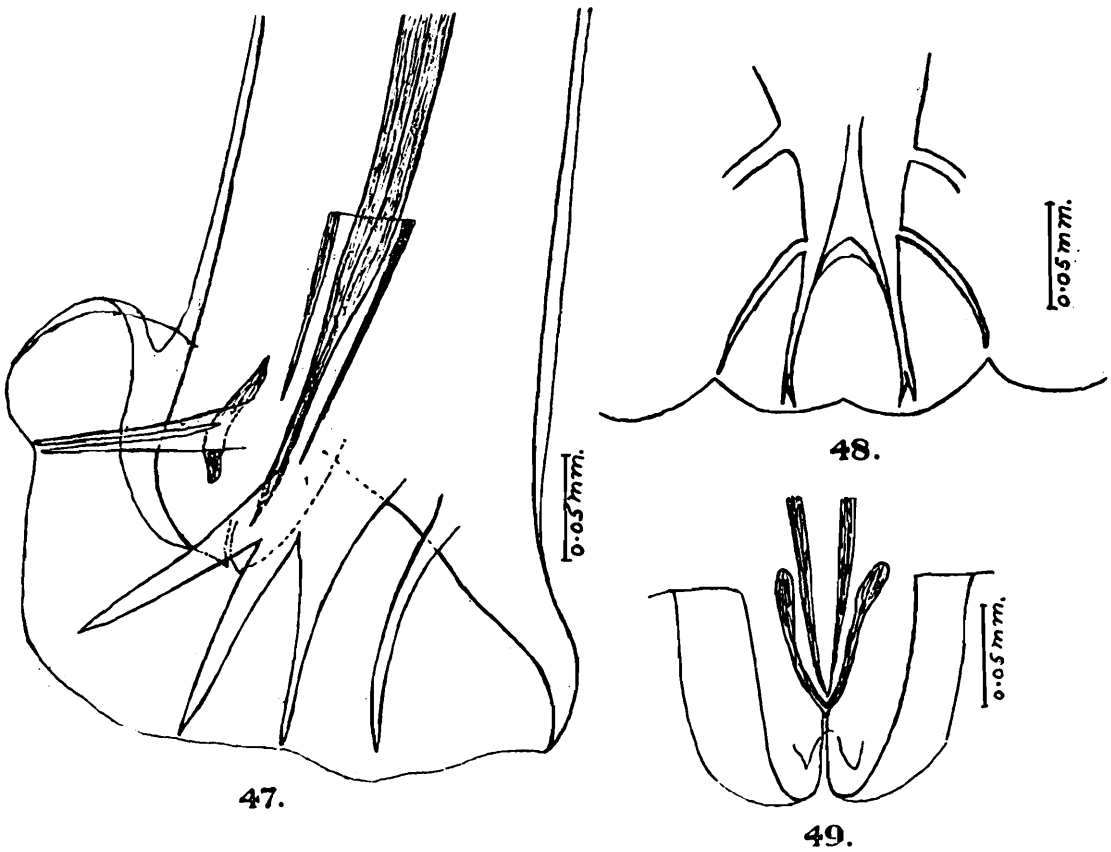
A single male and two young females were found in the intestine of a rat snake (*Zamenis mucosus*).

It is possible that this specimen is not quite fully grown as the two females accompanying it were obviously not mature. The measurements given below may, therefore, be on the small side ; this applies

especially to the spicules and gubernaculum, which seem to be the last structures to reach full size in most nematodes.

The general description and that of the female will be found in Maplestone (1931).

Male :—The bursa consists of two lateral lobes and a small dorsal lobe (figs. 47, 48). The ventral rays are cleft for practically their whole length ; the three lateral rays arise from a common trunk and are well separated from each other, the externo-lateral does not approach so near the edge of the bursa as do the other two (fig. 47) ; the externo-dorsal ray arises from a common trunk with the dorsal ; the trunk of the dorsal ray is relatively stout, and at about one-third the distance



Text-fig. 47.—*Kalicephalus brachycephalus.* Male bursa, lateral view.
Text-fig. 48.—*Kalicephalus brachycephalus.* Male bursa, dorsal ray.
Text-fig. 49.—*Kalicephalus brachycephalus.* Male, genital cone.

of the origin of the externo-dorsal rays from the edge of the bursa it divides into four slender branches, the inner two of which end in two points (fig. 48). The spicules are equal and straight, tapering from stout bases to fine points. The dorsal and ventral walls of the spicule canal are chitinized, and in addition there is a slightly curved chitinous structure in the genital cone, which is V-shaped on ventral view (fig. 49). This last structure with the chitinous ventral wall of the spicule canal are possibly the representatives of a telamon, which is only partly developed in the present specimen. The genital cone is a simple straight rounded eminence surrounded by a cuticular inflation (fig. 49).

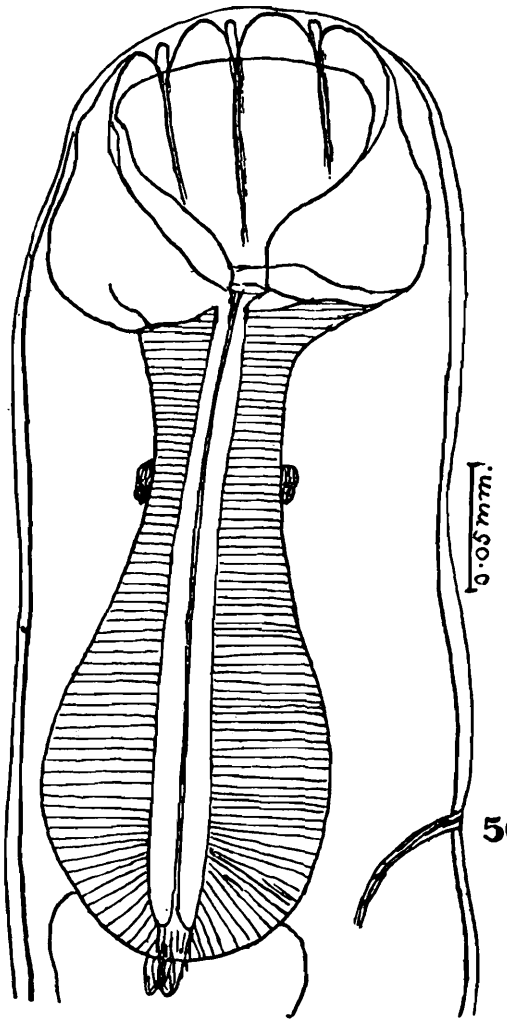
This specimen is deposited in the Indian Museum, Calcutta.

Kalicephalus parvus, sp. nov.

Three male specimens of this worm were found in the intestine of a cobra (*Naia tripudians*).

This worm is typical in its general characters and therefore it needs no detailed description (fig. 50).

Male :—The bursa is relatively short and is distinctly divided into three lobes (fig. 51). The ventral rays are cleft almost to their bases ; the three lateral rays arise from a common trunk, the externo-lateral being somewhat shorter than the other two ; the externo-dorsal rays arise from a common trunk with the dorsal ; the dorsal ray gives off two lateral branches opposite the point of bifurcation, and the two inner branches end in two points (fig. 51). The genital cone is a simple rounded eminence without accessory papillae. The spicules are equal and taper evenly to end in sharp points ; the spicule canal is chinitized for a distance of about 0·08 mm., forming a gubernaculum.



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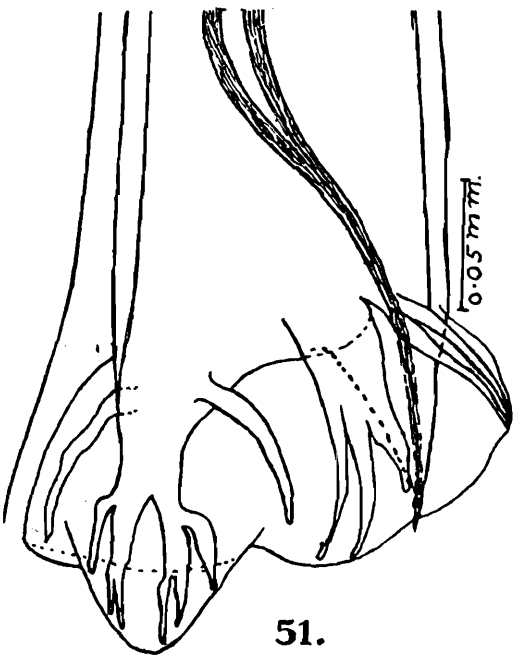

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TEXT-FIG. 50.—*Kalicephalus parvus.* Anterior extremity, lateral view.
TEXT-FIG. 51.—*Kalicephalus parvus.* Male bursa, semi-dorsal view.

This worm is smaller than *K. minutus* Baylis, and Daubney, 1922, and *K. naiae* Maplestone, 1931, the other two small species found in the cobra. In addition to size there are other points of difference, *viz.*, the spicules are longer in this species than in *K. minutus*, while in *K. naiae* the spicules are unequal. The excretory pore in *K. naiae* opens further forward in relation to the oesophageal bulb than it does

in this species. The lateral branches of the dorsal ray are given off quite close to the externo-dorsal rays in both *K. naiae* and *K. minutus*, whereas in this species the lateral branches of the dorsal ray are opposite the point of final bifurcation. It is very like *K. indicus* Ortlepp, 1923, but this species is larger and the excretory pore opens relatively further forward than in my worm. Also in *K. indicus* the bursa is longer than in my species, and there is no genital cone. It is accordingly proposed to name this worm *Kalicephalus parvus*, sp. nov.

Host.—Naja tripudians.

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

Table of measurements (in millimetres).

	K. brachycephalus (male).	*K. parvus* (male).
Length	7·2	3·2—3·6
Diameter, maximum	0·336	0·2—0·22
Head, dorso-ventral diameter	0·376	0·156
Lips, width	0·317	0·128
Buccal capsule, depth	0·297	0·108
Oesophagus, length	0·515	0·24—0·26
Oesophageal bulb, diameter	0·237	0·12
Nerve ring from ant. end oesophagus	0·12	0·076—0·08
Ex. pore from ant. end of oesophagus	0·18	0·22
Genital cone, length	0·1	0·06
Spicules, length	0·4	0·32
Gubernaculum, length	0·16	0·08

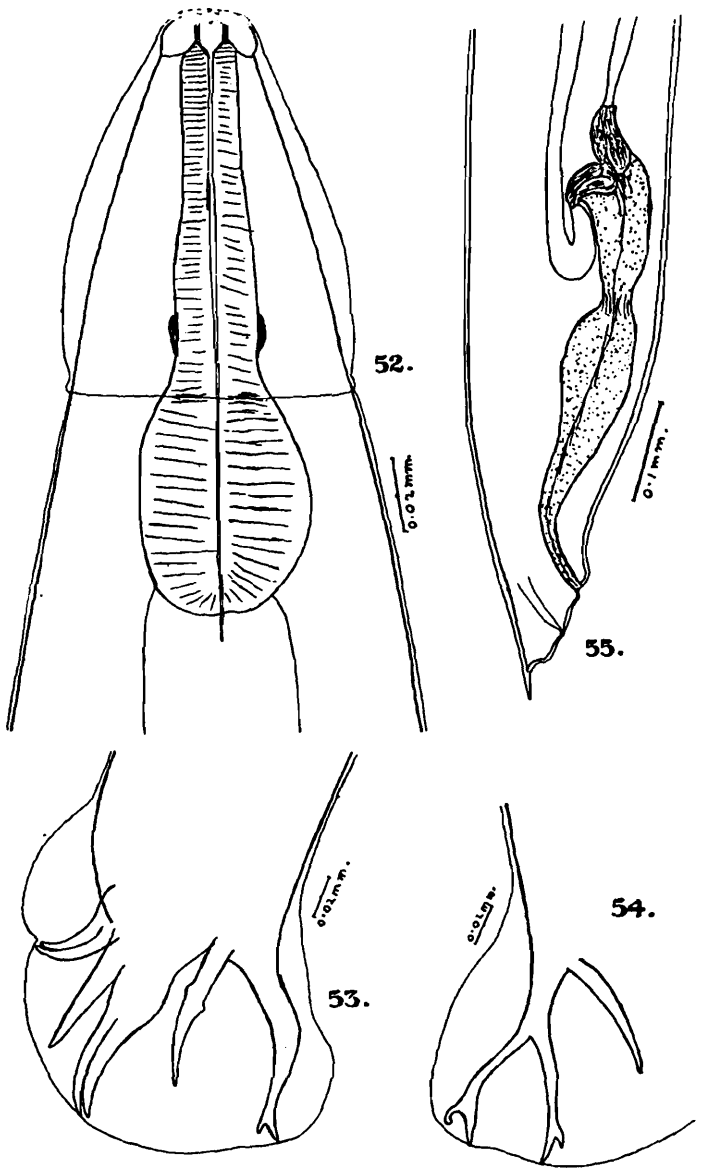
Oesophagostomoides traguli, sp. nov.

This worm was found in the intestine of a Java mouse deer (*Tragulus javanicus*).

The worms are very small. The mouth looks straight forwards and is surrounded by eight (? ten) coarse rounded elements. These arise from the anterior border of the buccal capsule, and curving outwards they become continuous with the body pulp, so they may be regarded as a leaf crown. There is no ventral cervical groove, but there is a distinct cephalic inflation which is marked posteriorly by a projecting ridge followed by a groove in the cuticle which completely encircles the body (fig. 52). On account of their poor state of preservation the worms could not be manipulated sufficiently to discover the excretory pore and the cervical papillae. There appear to be two pairs of submedian and one pair of lateral papillae which project slightly beyond the anterior end. There is a small cylindrical buccal capsule. The oesophagus is club-shaped, the anterior portion is of about the same

thickness for two-thirds of its length, at which point it expands into a slightly elongate bulb. The nerve ring is just anterior to the commencement of the bulb (fig. 52).

Male :—The bursa is of the same type as that seen in the genus *Oesophagostomum* (figs. 53, 54). The spicules are relatively long and



TEXT-FIG. 52.—*Oesophagostomoides traguli.* Anterior end.
TEXT-FIG. 53.—*Oesophagostomoides traguli.* Male bursa, lateral view.
TEXT-FIG. 54.—*Oesophagostomoides traguli.* Male bursa, dorsal ray.
TEXT-FIG. 55.—*Oesophagostomoides traguli.* Female tail, lateral view.

equal, they taper from base to tip and end in sharp points, and they are furnished with narrow striated membranous alae. A gubernaculum is present.

Female :—The tail ends in a sharp point, becoming suddenly narrower about half-way between the anus and the tip of the tail. The vulva is close to the anus, and a long muscular vagina with a constriction near its centre runs anteriorly from it. It divides into two very muscular ovejectors, from the ends of which the uteri arise. The uteri are parallel (fig. 55).

This worm resembles *Oesophagostomoides giltneri* Schwartz, 1928, in most of its characters, although the female genital apparatus appears

to be slightly different, but as these differences do not appear to be very great it is not considered justifiable to create a new genus on this single point, so it is proposed to name this worm *Oesophagostomoides traguli*, sp. nov.

Host.—Tragulus javanicus.

Type-specimens are in the Indian Museum, Calcutta.

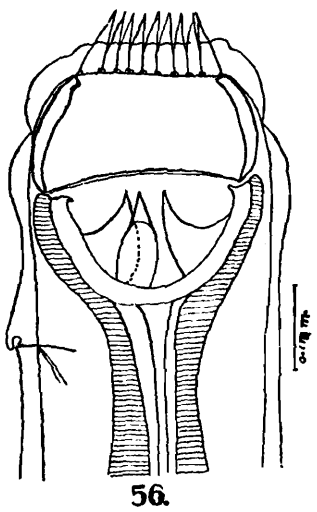
Table of measurements (in millimetres).

	Male.	Female.
Length	2·9	3·0
Diameter	0·218	0·218
Buccal capsule, depth	0·006	0·006
breadth	0·004	0·004
Oesophagus, length	..	0·164
Nerve ring from anterior end	..	0·009
Spicules, length	0·872	..
Distance of vulva to anus	..	0·040
Dist. of anus to tip of tail	..	0·084
Vagina, length	..	0·396
Eggs	..	0·056—0·052 × 0·030—0·036

Remarks :—The position of this genus is at present doubtful as Schwartz (1928) merely assigned it to Strongylidae without attempting to define its sub-family position. This was because it closely resembles *Oesophagostomum* in most respects, but the cervical groove is absent. Sandground (1929) expresses the same difficulty regarding the position of the genus *Colobostrongylus*. In his discussion Sandground suggests that the ventral cervical groove, which is the distinguishing character of *Oesophagostominae*, is only artificial and hence unsatisfactory from an taxonomic point of view, as it has led to the separation of otherwise closely allied genera. But if one passes in review the genera included in the sub-families Strongylinae and Trichoneminae it is at once evident that their definition is also founded on artificial characters, and that genera exhibiting exceptions or great variations from the type genera are accepted in both sub-families. However unsatisfactory it may be, the use of the ventral cervical groove in defining *Oesophagostominae* is the most definite character employed in the classification of the sub-families in Strongylidae, and its suppression would render the classification of this group even more unsatisfactory than it is at present. Therefore it is my opinion that both *Colobostrongylus* and *Oesophagostomoides* should be placed in *Trichoneminae*, where they may be quite as readily accommodated with such genera as *Bourgelatia* and *Gyalocephalus* which are accepted as members of this sub-family.

Oesophagostomum tridentatum, sp. nov.

This worm was found on three occasions in the stomach of a Dusky langur (*Semnopithecus obscurus*).



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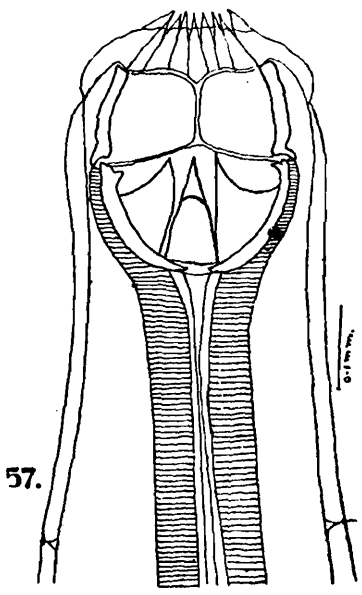

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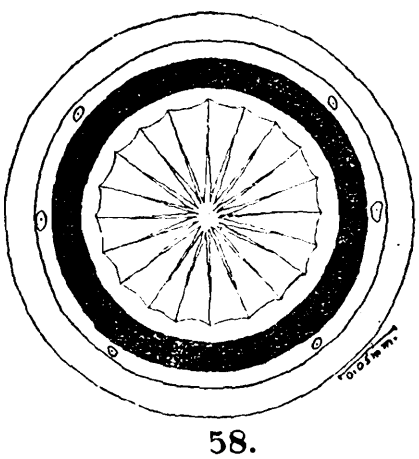

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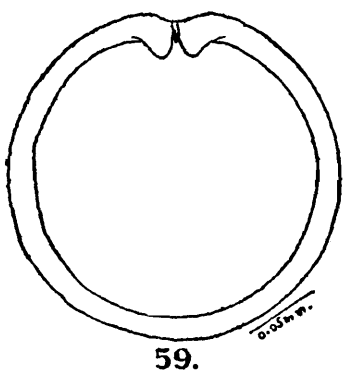

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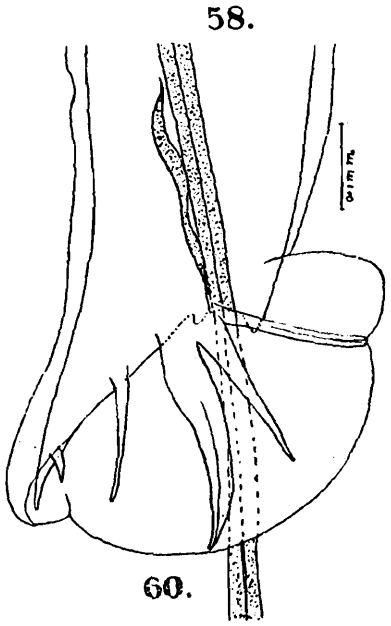

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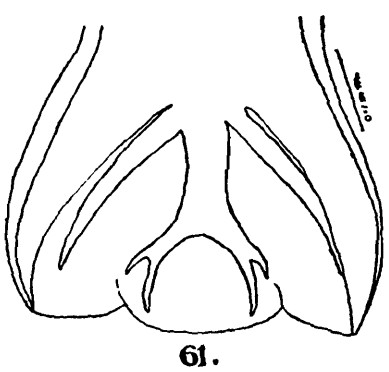

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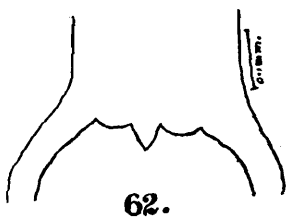


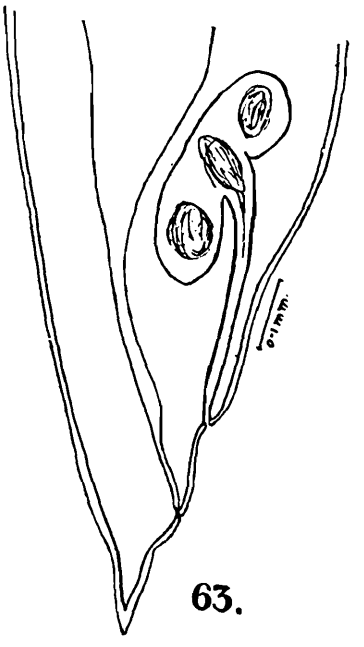
62.

TEXT-FIG. 56.—*Oesophagostomum tridentatum.* Anterior end, lateral view.
TEXT-FIG. 57.—*Oesophagostomum tridentatum.* Anterior end, dorsal view.
TEXT-FIG. 58.—*Oesophagostomum tridentatum.* Buccal capsule, end-on view.
TEXT-FIG. 59.—*Oesophagostomum tridentatum.* Buccal capsule, optical section about middle of depth.
TEXT-FIG. 60.—*Oesophagostomum tridentatum.* Male bursa, lateral view.
TEXT-FIG. 61.—*Oesophagostomum tridentatum.* Male bursa, dorsal ray.
TEXT-FIG. 62.—*Oesophagostomum tridentatum.* Male, genital cone.

The mouth looks directly forwards and there is a distinct cuticular mouth collar. The ventral cervical groove, into which the excretory pore opens, is clearly defined (fig. 56). The cervical papillae are some distance posterior to the cervical groove (fig. 57). There is an external leaf crown arising from the anterior border of the buccal capsule, it consists of twenty broad pointed elements which project beyond the mouth collar (figs. 56, 57). There is no internal leaf crown, but on each side of the base of the leaves of the external leaf crown there is a small knob-like thickening which, probably represents a rudimentary internal leaf crown (fig. 56). The buccal capsule is circular (fig. 58) with slightly curving walls. Its dorsal wall is slightly shorter than the rest of the capsule and the duct of the dorsal gland is marked by two longitudinal ridges internally and by a slight groove externally (figs. 57, 59). The anterior portion of the oesophagus is greatly expanded forming a cup-shaped cavity lined by a thick chitinous layer. One dorsal and two subventral teeth arise from the interior of the oesophageal cup, they are relatively large with sharp points, broad bases, and curved borders (figs. 56, 57).

In the male prebursal papillae are present.

All the other characters, both of the male and the female are typical of the genus *Oesophagostomum*, therefore the accompanying figures



63.

TEXT-FIG. 63.—*Oesophagostomum tridentatum.* Female tail, lateral view.

60, 61, 62, 63, and the table of dimensions will supply a sufficient description, and a detaied written account is omitted.

This worm differs from all other members of the genus by the presence of the very large cup-shaped cavity in the anterior end of the oesophagus furnished with three large teeth, so it is proposed to name it *Oesophagostomum tridentatum*, sp. nov.

Host.—Semnopithecus obscurus.

Type-specimens are in the Indian Museum, Calcutta.

Table of measurements (in millimetres).

	Male.	Female.
Length	12·08—14·04	14·14—16·9
Diameter	0·475—0·594	0·654—0·713
Cervical groove from ant. end	0·356—0·396	0·396—0·494
Excretory pore from ant. end	0·356—0·396	0·396—0·494
Cervical papillae from ant. end	0·535—0·614	0·614
Buccal capsule, diameter	0·198—0·237	0·257—0·297
Buccal capsule, depth	0·108—0·120	0·160—0·162
Oesophagus, length	0·99—1·036	1·04—1·09
Oesophageal funnel, depth	0·120—0·128	0·160
Teeth, length	0·108—0·112	0·124—0·128
Spicules, length	1·6	....
Gubernaculum, length	0·175—0·180	....
Distance of vulva to anus	....	0·160—0·204
Tail, length	....	0·164—0·200
Vagina, length	....	0·297—0·336
Ovejectors, length	....	0·277—0·297
Eggs	....	0·072—0·080 × 0·040—0·044.

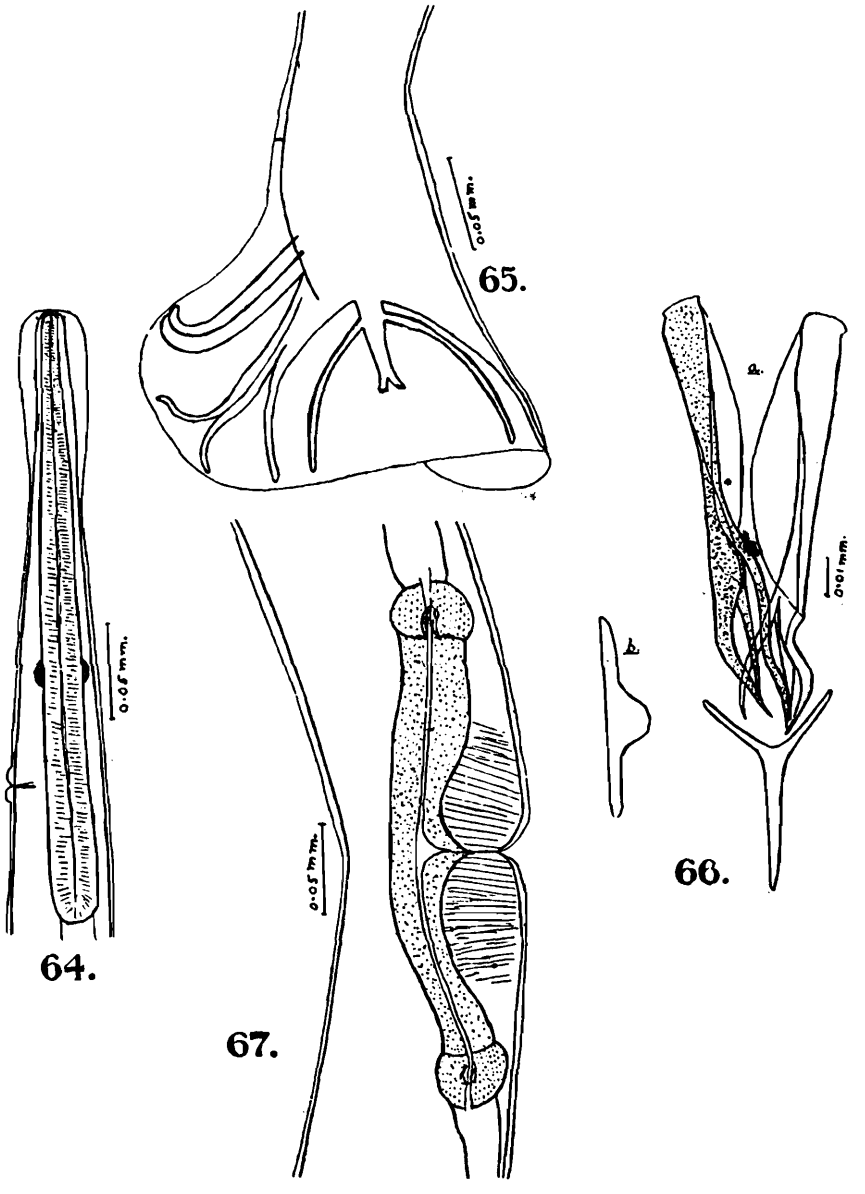
Ornithostrongylus travassosi sp. nov.

This worm has been found three times in the gizzard of the coral-billed pigeon (*Chalcophaps indica*).

There is a distinct cephalic inflation of the cuticle, which gives the anterior end a club-shaped appearance (fig. 64). The mouth is simple and it leads directly into the oesophagus, without the intervention of a buccal capsule. The oesophagus is very slightly swollen towards the posterior end. The nerve ring is a little behind the middle of the oesophagus. The excretory pore is posterior to the nerve ring and it is conspicuous as it is surrounded by a cuticular inflation (fig. 64).

Male :—The bursa consists of two broad lateral lobes, without any indication of an intervening dorsal lobe (fig. 65). Prebursal papillae are present. The ventral rays are equal and parallel and they lie close together for their whole length. The lateral rays arise from a common trunk, the externo-lateral and medio-lateral lie close together for about two-thirds of their length and they diverge at the extremities, the postero-lateral curves away from the other laterals. The externo-dorsal rays arise from the dorsal ray near its base, they are

long and thin and almost reach the edge of the bursa. The dorsal ray is short with a bifurcate tip and each branch ends in three small points (fig. 65). The spicules are stout and equal, with trifurcate tips, and broad mambraneous alae along their inner borders (fig. 66*a*). The gubernaculum is Y-shaped when seen dorso-ventrally (fig. 66*a*), and when seen from the side it appears as a straight rod with a rounded prominence running ventrally from about its centre (fig. 66*b*).



TEXT-FIG. 64.—*Ornithostrongylus travassosi.* Anterior end, lateral view.
TEXT-FIG. 65.—*Ornithostrongylus travassosi.* Male bursa, semi-dorsal view.
TEXT-FIG. 66.—*Ornithostrongylus travassosi.* *a.* Spicules and gubernaculum. *b.* Gubernaculum lateral view.
TEXT-FIG. 67.—*Ornithostrongylus travassosi.* Female, vulval region.

Female :—The vulva is well behind the middle of the body. The vagina is short and surrounded by thick muscle. It runs directly inwards to enter the double ovejector (fig. 67). The uteri are divergent.

This species comes near to *O. papillatus* in size but it is clearly distinguished from it by the disposition of the bursal rays. It is accordingly proposed to name this worm *Ornithostrongylus travassosi*, sp. nov.

Host.—Chalcophaps indica.

Type-specimens are in the Indian Museum, Calcutta.

Table of measurements (in millimetres).

	Male.	Female.
Length	5·7	7·8
Diameter	0·88	0·116
Excretory pore from ant. end	0·28	....
Head, diameter	0·24	0·24
Head and cephalic inflation, diameter	0·040	0·040
Nerve ring from anterior end	0·20	....
Oesophagus, length	0·356	0·356
Spicules, length	0·144	....
Gubernaculum, length	0·048	....
Distance of vulva to anus	..	1·87
Tail, length	..	0·120
Mucronate tip of tail, length	..	0·009
Caudal papillae from tip of tail	..	0·024
Ovejectors, length	..	0·3
Eggs	..	0·050—0·052 × 0·027—0·028

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