

SOME NEW GENERA AND SPECIES OF NEMATODE
WORMS, FILARIOIDEA, FROM ANIMALS DYING IN THE
CALCUTTA ZOOLOGICAL GARDEN

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In the course of post-mortem examinations of animals which died in the Zoological Garden, Calcutta, India, a number of filarioid worms were collected. Some of these have already been described (Chandler, 1924). It is significant that every one of seven species studied has proved to be a new species, the worms belonging to at least five new genera.

Following the course adopted by most of the recent workers on this group, such as, Seurat, Skrjabin, Travassos, and Yorke and Maplestone, of splitting up the filariae into more numerous genera to conform with the accepted practice in other better known groups of parasitic nematodes, it appears advisable to erect a number of new genera for the species here described. Although a considerable number of the recently proposed genera of filariae contain only a single species, it is very probable that other species will be found in many of them, for the filariid parasites have been far less thoroughly collected and studied than some of the groups which are parasitic in the alimentary canal.

Among the forms here described is one, *Thylaconema sigmura*, new genus, new species, which seems to have closer affinities with the Thelaziidae than with any other family of the suborder Spirurata. The worm is, however, a parasite of the abdominal cavity and produces living embryos, which presumably escape from the body of the host in the orthodox manner of the filariae, that is, by being sucked up with the blood by blood-sucking arthropods. The other members of the Thelaziidae are parasitic in the orbital or nasal sacs of mammals or birds, in the air sacs of birds, or in the intestines of fishes; with the exception of some of the parasites of aquatic hosts, they produce living embryos which presumably are transmitted by blood-sucking arthropods. In this family there are, furthermore, no distinct

lips, although there is a small chitinized buccal cavity surrounded by two, four, or six poorly defined lobes. There are other genera, as *Breinlia*, *Litomosa*, and *Hamulofilaria*, the affinities of which with the Filarioidea seem not to have been questioned, which possess this characteristic. The type genus of the family, *Thelazia*, furthermore, has the vulva in the esophageal region and has a filarioid type of tail without the ornamentation or alae which are so characteristic of the majority of the spiruroids. This character is not shared by *Thylaconema*, providing the male found with the type female is actually the same species, but the habitat and probable life history of the worm is more characteristically filarioid than is the case with *Thelazia*. It seems to the writer that although the Thelaziidae are in many respects intermediate between the Filarioidea and the Spiruroidea, they can more conveniently be included with the former, as proposed by Travassos (1918), than with the latter.

The separation of a subfamily Aproctinae from the Filariinae, proposed by Yorke and Maplestone (1926) on the basis of the approximate equality or inequality of the spicules, does not seem to the writer to be acceptable, since there are no other differential characters to separate these groups.

PROTOFILARIA, new genus

Generic diagnosis.—Filariidae; Filariinae: Body slender and cylindrical, attenuated at the extremities. Head bluntly rounded, the mouth without either lips or evident papillae, the minute oral tube entering the esophagus a few micra from the anterior end. Cuticle smooth, without striations or ornamentations of any kind. Esophagus simple and cylindrical. Tail of female truncated, with a dorsoventral cleft dividing it into two short lobes, and with the anus in the cleft at the posterior extremity. Vulva near posterior end of esophagus. Opisthodelphic and viviparous. Males with posterior end curled, with short conical tail without either alae or papillae. Spicules dissimilar and unequal, one spoon shaped, the other bluntly pointed. Parasites of thoracic cavity of mammals.

Type species.—*Protofilaria furcata*, new species.

PROTOFILARIA FURCATA, new species

Figs. 1 and 2

Specific diagnosis.—Protofilaria: Moderately slender worm; cylindrical, tapering for the anterior 1.5 to 2 mm. at the head end and narrowing at the posterior end in a similar manner to a bluntly rounded and slightly indented end in the female and to a short conical tail in the male. Cuticle smooth, without striations or modifications of any kind. Head bluntly rounded, without lips or evident papillae.

Mouth opening very minute, leading by a minute tube about 10μ in length to the esophagus. Esophagus simple, cylindrical, about 800μ to 1 mm. long. Nerve ring about 240μ to 260μ from anterior end.

Male about 13 to 15 mm. long with a maximum diameter of 150μ to 175μ . Head about 73μ to 75μ in diameter. Esophagus 790μ to 850μ long, the nerve ring 240μ to 260μ from its anterior end. Tail conical, 85μ to 90μ in length, about 75μ wide at the level of the cloaca and tapering to a rounded tip about 10μ wide. Spicules dissimilar and unequal in length, the short right one curved, troughlike, about 70μ long, ending in a blunt point somewhat resembling the point of a stub pen; left one trough shaped, with the sides rolled together proximally, but distally expanded into a curved, spoon-shaped structure; total length about 115μ with a width of about 12μ to 13μ . The body substance inside the cuticle at the posterior end of the tail ends in a number of inconspicuous digitations, but there are no papillae.

Female 29 to 30 mm. long with a maximum diameter of about 325 to 330μ . Head about 95μ in diameter. Esophagus about 980μ long, the nerve ring about 260μ from its anterior end. Posterior end of body tapers down in about the last 1.5 mm. of its length to a diameter at its posterior end of about 145μ . The tip of the body is abruptly truncated with a terminal indentation giving the appearance of a cleft chin, the cleft running around the end of the body from the dorsal to the ventral side. The anus is situated in the cleft at the posterior extremity of the body. The vulva is situated about 1.4 mm. from the anterior end. The uteri and ovaries extend posteriorly and terminate a few hundred micra from the posterior extremity. Uteri filled with hatched embryos.

Host.—Ruffed lemur (*Lemur ruber*).

Location.—Thoracic cavity.

Locality.—Calcutta Zoological Garden, Calcutta, India.

This lemur is an inhabitant of Madagascar, and presumably acquired the filariae in its native home.

Type specimens.—United States National Museum Helminthological Collections No. 8004; No. 8005.

APROCTOIDES, new genus

Generic diagnosis.—Filariidae; Filariinae: Body rather coarse, cylindrical, with rounded ends. Cuticle smooth, unstriated. Mouth provided with three very flat inconspicuous lips. Esophagus short, divided into a very short anterior portion and a longer posterior portion. Posterior end of male rolled in a close spiral, the tail short and rounded, without alae or papillae. Cloaca situated on a conspicuous prominence. Posterior part of intestine slender but not

atrophied. Spicules very small, similar in form but unequal in size, the left one more than twice as long as the right. Female unknown. Habitat, orbital cavity of birds.

Type species.—*Aproctooides lissum*, new species.

This genus is unquestionably closely related to *Aprocta* but differs from all the species included in that genus in two characteristics; first, in the division of the esophagus into two distinct portions and, second, in the very marked difference in the length of the spicules. The latter by itself does not appear to the writer to be a character of generic value, although Yorke and Maplestone separate the Aproctinae from the Filariinae on the basis of similarity and approximate equality of the spicules in the former group and dissimilarity and inequality in size in the latter. There would appear to be as much justification for splitting up the Filariinae of Yorke and Maplestone into a number of subfamilies, since they differ so greatly in the form of their spicules, as for separating off one group in which the spicules chance to be approximately equal and not widely different in structure, especially in view of the fact that these two characteristics tend to go together. The character of the esophagus, however, especially when accompanied by another minor difference, seems to the writer sufficient reason for the erection of a new genus. Furthermore, in the male at least, the posterior part of the intestine is not degenerate or atrophied, but according to Railliet and Henry (1910) and also Skrjabin (1917*a* and 1917*b*) the absence of an anus and the atrophy of the posterior part of the digestive tract appears not to be a characteristic of the genus *Aprocta* as was at first thought to be the case by von Linstow (1883). In some species at least the posterior end of the digestive tract is very much attenuated.

APROCTOIDES LISSUM, new species

Figs. 5 and 6

Specific diagnosis.—*Aproctooides*:

Male 12 mm. long with a maximum diameter of about 350 μ ; both ends bluntly rounded, the diameter at the posterior end of the esophagus being about 300 μ , and just anterior to the cloaca about 215 μ . Cuticle smooth, without either transverse or longitudinal striations. Mouth provided with three very inconspicuous flattened lips. Anterior portion of the esophagus about 155 μ long, with rather ill-defined and not quite cylindrical sides; posterior part about 575 μ long, cylindrical, with sharply defined walls, somewhat broader than the anterior part, with a uniform diameter of about 105 μ . Genital tube much folded and twisted, but not spirally wound around the intestine. Tail bluntly rounded, the cloaca situated on a conspicuous prominence about 145 μ from the posterior end. Spicules similar in form, much broader proximally than distally, and

with the sides rolled to form troughs; right spicule about 130μ long, the left one about 300μ long and curved more or less to follow the ventral contour of the body.

Female.—Unknown.

Host.—Dhyal bird or magpie robin (*Copsychus saulatus*).

Location.—Orbital cavity.

Locality.—Calcutta Zoological Garden, Calcutta, India.

Type specimen.—United States National Museum Helminthological Collection No. 8006.

DIROFILARIA (?) DIGITATA, new species

Figs. 3 and 4

Specific diagnosis.—?*Dirofilaria*:

Male.—Unknown.

Female a long slender worm, attenuated at each end to a very slender head and tail. Length 170 to 210 mm. with a maximum diameter of about 380μ . Cuticle smooth, unstriated, and without other ornamentation. Head very slender, with a diameter of about 55μ to 60μ . Mouth opening extremely minute, without lips or evident papillae, and no vestibule present. Esophagus very fine and slender, only about 11μ to 12μ in diameter, and not easily observable except where it is bent and runs at an angle to the long axis of the body. The junction with the intestine is not sharply demarcated, the intestine tapering conelike to the junction with the esophagus. The esophagus is about 1.1 to 1.3 mm. in length; nerve ring about 160μ from the anterior end. The anus is a very minute opening, situated about 330μ from the tip of the tail. The intestine in the last half millimeter of its length tapers down to a narrow tube of uneven diameter. The vulva is a longitudinal slitlike opening, bounded by slightly salient lips, situated just anterior to the junction of esophagus and intestine. The lumen of the anterior part of the vagina is narrow, and the wall is very thick and muscular (fig. 3), but a few hundred micra from the vulva the lumen widens and the wall narrows. The uterus bifurcates about 4 to 5 mm. from the anterior end of the body and the ovaries terminate a short distance anterior to the anus in the posterior part of the body. The tail of the female (fig. 4) is long, slender, and cylindrical, 40μ in diameter, and bluntly rounded at its termination, where it bears two pairs of digitiform papillae as shown in figure 4.

Host.—Hoolock ape (*Hylobates hoolock*).

Location.—Abdominal cavity.

Locality.—Calcutta Zoological Garden, Calcutta, India.

Type specimens.—United States National Museum Helminthological Collection No. 8007; paratypes No. 8008.

Three females of this worm were found. In the absence of any male specimens its generic affinities can not be determined with certainty, but so far as the female characters indicate, it appears to be closely related to *Diroflaria*, in which genus it is provisionally placed. It differs from *D. corynodes* (Linstow, 1899), a species found in West African monkeys, in the much greater diameter relative to the length, in the presence of four instead of two digitiform processes at the end of the female tail, and in the position of the anus.

HASTOSPICULUM SPINIGERUM, new species

Figs. 7 to 11

Specific diagnosis.—*Hastospiculum*: A very long, stout, cylindrical worm, bluntly rounded at each end, but slightly greater in diameter near the anterior than near the posterior end. Cuticle in both sexes with moderately fine striations, becoming finer at the extreme anterior end. In the female certain of the striations become greatly thickened, forming prominent ridges which partially encircle the body. Each ridge is produced into one or more spinelike processes, which gives the cuticle a very rough texture. (Fig. 11.) In the male certain of the fine striations are also enlarged at intervals, but they are not produced into spines as in the females. The anterior end has a small craterlike depression, in the center of which is the mouth. On each side of the mouth is a small, truncated, pillarlike chitinous process, with three minute papillae at the base of each, not clearly visible except in end view. (Fig. 10.) The chitinous epaulettelike structures and circumoral papillae described for the other species of the genus are very rudimentary if present at all, and do not correspond either with the figures given by Skrjabin (1923) for *H. varani* or by Yorke and Maplestone (1926) for *H. gouldi*. The depression in the center of which the mouth is situated is about 350μ to 400μ in diameter in the female, bounded only by irregular and discontinuous chitinous folds or ridges. Immediately around the mouth is a more or less rectangular area of slightly thicker chitin, at either side of which is situated one of the chitinous pillars with three minute papillae at its base. Indications of another demarcated chitinized area widening the oral region dorsoventrally can also be seen. The esophagus consists of two parts as in other members of the genus, the anterior part being short and of moderate diameter, the posterior part long and very wide.

Male.—The single male specimen available lacks the head end. The portion available is about 75 mm. long, with a diameter of about 560μ . The posterior extremity tapers for about the last 4 or 5 mm. of its length and has a bluntly rounded end provided with a bursa-like structure formed by short caudal alae which meet posterior to

the end of the tail. (Fig. 8.) The bursalike structure (fig. 9) is about 230μ long and 220μ wide. The cloaca is situated slightly to the right of the posterior end of the body. The pedunculated preanal papillae are asymmetrical. On the right side there are three consecutively larger papillae situated near the junction of the right ala with the body; posterior to these there are two large papillae more ventrally situated, then a very short ventrally placed papilla, and finally, in the right ala just anterior to the cloaca, is another long papilla. At the posterior extremity, to the left of the cloaca, is a group of three sessile papillae, one larger than the other two. In the left ala only three papillae could be observed, two situated near the junction of the anterior end of the ala with the body, and one near the middle of the ala. The spicules are very unequal; the right one is about 2.75 mm. long with a nearly uniform diameter of about 42μ . Its tip is flattened and very slightly expanded, ending in a sharp, curved point. The small left spicule is curved, its sides rolled over to form a partially closed tube; it measures about 420μ in length with a diameter, before its slight expansion at the proximal end, about the same as that of the longer spicule.

Female.—The females are very large and measure 220 mm. or more in length, with a diameter of about 2 mm. The anterior part of the esophagus is about 550μ to 570μ in length with a diameter of about 220μ . The posterior part is about 520μ in diameter; its length could not be determined on account of the thickness of the worms. The vulva opens by a transverse slitlike aperture about 850μ from the anterior end. The tail is bluntly rounded, but slightly smaller in diameter than the head. The anus is at the posterior extremity. The eggs measure from 50μ to 52μ by 33μ to 34μ ; they have a thick shell, further thickened into a collar near each end, the ends being covered by thin opercula; they contain developed embryos while still in the uteri.

Host.—*Varanus flavescens*.

Location.—Under lining of peritoneum.

Locality.—Calcutta Zoological Garden, Calcutta, India.

Type specimens.—United States Natural Museum Helminthological Collection No. 8009; paratypes No. 8010.

This worm was found in three of six specimens of the above host. The worms were lying just under the serous membrane lining the peritoneal cavity, their bodies being thrown into rather regular waves. The method of escape of the eggs from the body was not determined, and nothing is known of the life cycle.

Although the complicated epaulettelike structures and oral papillae described by Skrjabin in his species, *H. varani*, which is the type species of the genus, are not developed in this species, there can be

no question of the close relationship of the two worms. *Hastospiculum gouldi* Yorke and Maplestone 1926, is a small worm with a number of oral papillae, small spicules, and a different arrangement of the caudal papillae of the male. *Filaria bipinnata* Linstow 1899 is also clearly a member of this genus, and should therefore be known as *Hastospiculum bipinnatum*; *H. gouldi* may possibly be identical with this species.

THYLACONEMA, new genus

Generic diagnosis.—Thelaziidae: Body comparatively coarse, tapering at each end. Cuticle coarsely annulated, the annulations provided with numerous backward projecting spines, most marked on the anterior half of the body. Mouth provided with a distinct and nearly square buccal cavity, the anterior borders of which close together slightly and have four very slightly salient lobes. Esophagus short and straight, not divided into two parts, and its demarcation from the intestine indistinct; the esophagus and intestine together form a straight narrow tube of uniform diameter for the whole length. Vulva in the esophageal region, the vagina an elongate saclike structure; opisthodelphic. Tail of female a short, narrow, fingerlike structure. Male uncertain; specimen found with type female lacks anterior end and can not be positively identified as the mate of the female worm. The generic characters of this specimen are as follows: Tail with broad and relatively short alae with a few large pedunculated preanal papillae and a few large and several small postanal ones. Spicules unequal, both long and slender; gubernaculum present. Parasites of the peritoneal cavity of birds.

Type species.—*Thylaconema sigmura*, new species.

THYLACONEMA SIGMURA, new species

Figs. 12 to 15

Specific diagnosis.—*Thylaconema*:

Male found associated with the type female lacks anterior end, and so can not be definitely diagnosed as the same species or even genus, although it probably is the same species. Maximum diameter 270μ ; tail (fig. 15) with broad and relatively short alae, forming a bursa-like structure 400μ long and about 300μ wide, marked with fine striations; two pairs of large pedunculated preanal papillae, one pair at the level of the anus, two pairs of postanal ones, and three or possibly four pairs of small ones near the tip of the tail. Anus 175μ from tip of tail. Spicules long and slender, the right one 1.35 mm. long, the left one 590μ long; gubernaculum present, consisting of two convergent chitinized bars connected by a delicate membrane.

Female about 15 mm. long with a maximum diameter of about 400μ . Diameter of head about 65μ , the diameter very gradually increasing posteriorly and more rapidly decreasing again near the

posterior end, terminating in a narrow fingerlike tail with bluntly rounded end. Cuticle with coarse annulations set about 12μ apart in the esophageal region and gradually becoming more widely spaced to intervals of 25μ to 30μ in the posterior part of the body; annulations provided with numerous small recurved spines. Mouth cavity (fig. 14) rectangular, about 25μ broad and 15μ deep with a further interval, with a narrow lumen, between the floor of the capsule and the anterior end of the esophagus. Anterior border of esophagus projecting slightly toward median line, giving the appearance of a pair of hawklike jaws in optical section. Head bounded by an inconspicuous ridge. Esophagus a straight narrow tube about 875μ long with a diameter of about 55μ ; nerve ring about 450μ from the anterior end. The intestine has the same diameter as the esophagus, the demarcation between the two being very indistinct; it continues back to the anus as a straight narrow tube; the anus is about 155μ from the posterior end. The posterior end of the body (fig. 13), gradually narrowing, curves S-like, ending in a ventrally curved, fingerlike tail with nearly parallel sides, about 55μ in diameter. At the anus it widens out to a diameter of about 85μ . Vulva 390μ from the anterior end, situated on a distinct prominence. Vagina an elongated saclike structure, about 1.4 mm. in length, gradually widening out to a diameter of about 155μ near its bluntly rounded end. The uteri open into the vagina by a narrow tube about 35μ in diameter; the two uteri split apart almost immediately and continue almost straight to the posterior part of the body where they abruptly narrow, ending in two slightly coiled ovaries.

Host.—Argus pheasant (*Argusianus argus*).

Location.—Peritoneal cavity.

Locality.—Calcutta Zoological Garden, Calcutta, India.

Type specimens.—United States National Museum Helminthological Collection No. 8011.

EXPLANATION OF PLATES

PLATE 1

- FIG. 1. *Protofilaria furcata*. Posterior end of male.
 2. *Protofilaria furcata*. Posterior end of female, showing posterior extremities of ovaries. Anus in cleft at end, intestine not shown.
 3. *Dirofilaria digitata*. Vulval region, showing vagina and union of esophagus and intestine.
 4. *Dirofilaria digitata*. Tail of female, showing anus and posterior digitations.
 5. *Aproctooides lissum*. Tail of male, showing spicules, intestine and sperm duct.
 6. *Aproctooides lissum*. Head of male, showing esophagus and anterior end of testis.

PLATE 2

Hastospiculum spinigerum

- FIG. 7. Anterior end of female, showing mouth, anterior end of esophagus, and vulva.
8. Posterior end of male, showing bursa-like structure and spicules.
9. Bursa-like structure, enlarged.
10. End view of mouth region, showing mouth opening, two pillar-like structures with three papillae at the base of each, and crater-like oral region.
- 10a. Egg.
11. Portion of cuticle on anterior part of body of female.

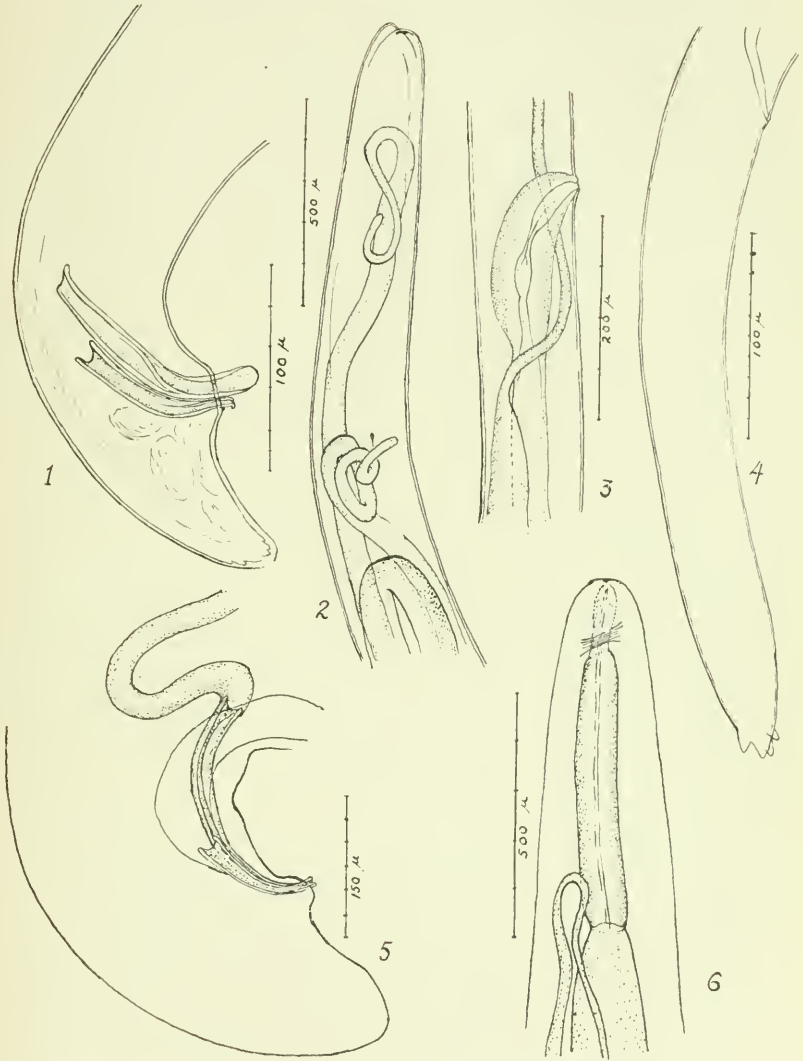
PLATE 3

Thylaconema sigmura

- FIG. 12. Anterior end of female, showing head, esophagus, and vagina.
13. Posterior end of female, showing anus, tail and posterior loops of ovaries.
14. Head, much enlarged, showing buccal cavity and slender connection with esophagus.
15. Posterior end of male found with the type female, showing alae and spicules.

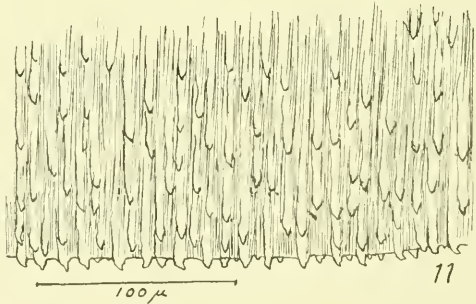
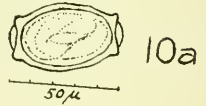
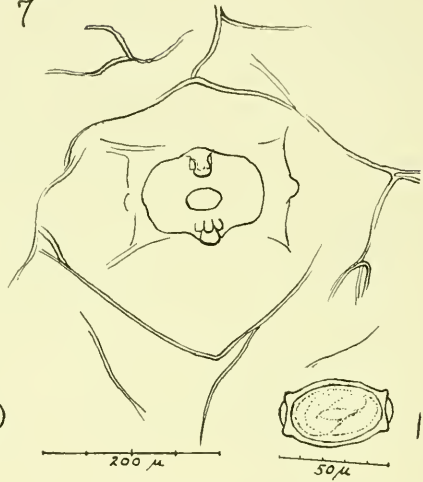
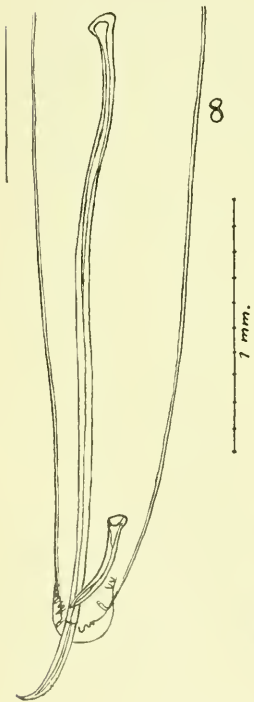
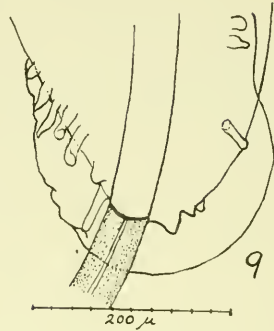
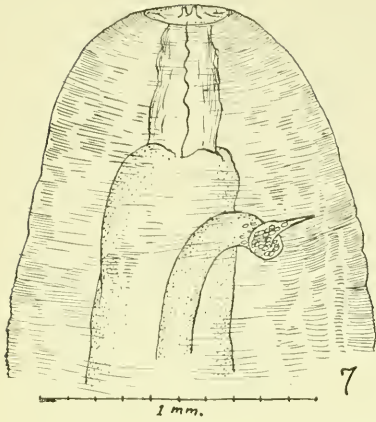
REFERENCES CITED

- CHANDLER, ASA C. 1924. New filariae from Indian Birds. *Parasitology*, Cambridge, [Eng.], vol. 16, December, pp. 398-404, figs. 1-10.
- VON LINSTOW, O. 1883. Nematoden, Trematoden und Acanthocephalen, gesammelt von Prof. Fedtschenko in Turkestan. *Arch. f. Naturg.*, Berlin., 49. J., vol. 1, pt. 2, pp. 274-314, pls. 6-9, figs. 1-52.
1899. Nematoden aus der berliner zoologischen Sammlung. *Mitt. a. d. zool. Samml. d. Mus. f. Naturk. in Berlin*, vol. 1, pt. 2, pp. 3-28, pls. 1-6, figs. 1-78.
- RAILLIET, A.; and HENRY, A. 1910. Deux espèces nouvelles du genre *Aprocta* Linstow. *Bull. Soc. de path. exot.*, Paris, vol. 3, pt. 3, 9 March, pp. 152-155.
- SKRJABIN, K. I. 1917a. *Aprocta microanalisis* nov. sp., nouvelle filaire des yeux d'oiseaux. *Compt. rend. Soc. de biol.*, Paris, vol. 80, pt. 6, 17 March, pp. 303-306, figs. 1-3.
- 1917a. Sur quelques nématodes des oiseaux de la Russie. *Parasitology*, Cambridge, [Eng.], vol. 9, pt. 4, July 27, pp. 460-481, fig. 1, pls. 18-19, figs. 1-19.
- TRAVASSOS, LAURO. 1918. Contribuição para o conhecimento da fauna helminthologica brasileira. VII. Especies brasileiras do genero *Thelazia* Bosc. 1819. *Rev. do Mus. Paulista*, São Paulo, vol. 10, pp. [215]-230, 3 pls., figs. 1-13.
- YORKE, WARRINGTON; and MAPLESTONE, P. A. 1926. The nematode parasites of vertebrates. 536 pp., 307 figs. London.



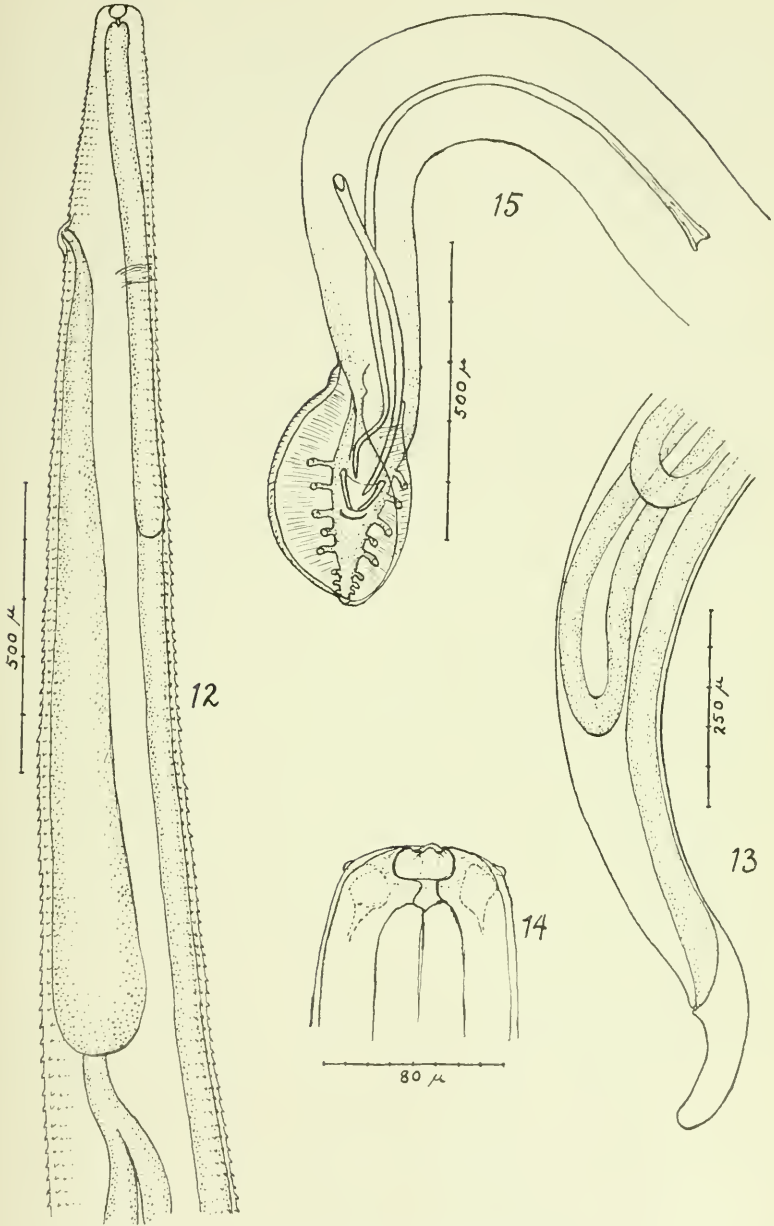
PROTOFILARIA FURCATA, DIROFILARIA DIGITATA AND APROCTOIDES LISSUM

FOR EXPLANATION OF PLATE SEE PAGE 9



HASTOSPICULUM SPINIGERUM

FOR EXPLANATION OF PLATE SEE PAGE 9



THYLAONEMA SIGMURA

FOR EXPLANATION OF PLATE SEE PAGE 10

