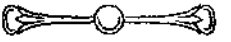
The Strongylids and other Nematodes Parasitic in the Intestinal Tract of South African Equines



THÈSE

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FACULTÉ DES SCIENCES
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La Faculté des Sciences de l'Université de Neuchâtel, sur le rapport de MM. les professeurs Fuhrmann et Monard, autorise l'impression de la présente thèse, intitulée:

The Strongylids and other Nematodes parasitic in the Intestinal Tract of South African Equines,

sans exprimer d'opinion sur les propositions qui y sont contenues.

Le Doyen,

A. BERTHOUD.

Neuchâtel, décembre 1922.

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The Strongylids and other Nematodes parasitic in the Intestinal Tract of South African Equines.

By Gertrud Theiler, B.A. (Cape).

Preface.

The work, forming the subject of this thesis, was carried out in the Laboratory of the Zoological Department at the University of Neuchâtel, during 1921-22. under the direction of Professor Dr. O. Fuhrmann. I take this opportunity of expressing my deep gratitude to him, for the constant interest in my work and for his friendly advice and encouragement.

For the material I am indebted to Sir A. Theiler, who had intended to work up the collection, but had to forego this pleasure in favour of more urgent matters. More justice would doubtlessly have been done to the subject, had my father been at liberty to bring his scientific mind and trained powers of observation to bear on it.

My thanks are also due to Professor F. W. Gamble and Dr. C. L. Boulenger of the University of Birmingham, to Professor R. T. Leiper of the London School of Tropical Medicine, and to Professor W. Yorke of the Liverpool School:

To Professor Gamble, for so obligingly providing me with laboratory facilities, and for his kindly interest during my short stay in Birmingham;

To Professor Boulenger, for putting his horse-nematode material at my disposal, and for his kind and willing assistance, in helping me over my initial difficulties;

To Professor Leiper, for permitting me to study his type species of *Cylindropharynx longicauda* and *C. brevicauda;*

To Professor Yorke, for placing at my disposal his cylicostome material, thus enabling me to arrive at a definite conclusion, regarding the identity of *Triodontophorus serratus* and *T. intermedius.*

To Professor Fuhrmann I am further indebted for obtaining German translations of Dr. Kotlán's Hungarian publications.

In cases where the Hungarian species were not represented in my material, I have given an English rendering of the German. Throughout, I have adopted the original descriptions without alteration, wherever possible, so that there can be no doubt as to their correctness. The drawings on the contrary, unless otherwise indicated are taken from the specimens in my material.

I very much regret that Professor Ihle's report of the Commission appointed to inquire into the Sclerostomiasis in Holland. Part I. only came to hand after I had finished this thesis.

G. THEILER.

Neuchâtel. September. 1922.

HISTORICAL.

It was not until Looss' important monograph on the Sclerostomidae of horses and donkeys in Egypt that much attention was paid to the determination of the intestinal nematodes of equines. Prior to Looss four species only were recognized (armatum, equinum, tetracanthum, and robustum), and all were assigned either to the genus *Strongylus* or *Sclerostomum*. In his investigations Looss discovered that these "species" were in reality composed of a number of independent and easily distinguishable forms, of which he described 19; these he divided into the four genera *Strongylus*, *Triodontophorus*, 1902 (*Triodontus* Looss, 1900), *Cylichnostomum* (*Cyliscostomum* Railliet and Henry, 1902), and *Gyalocephalus*, according to the structure of the cephalic and caudal regions of the worm. It was not until several years after the publication of this work that the subject was again studied by helminthologists. In 1909 Georgina Sweet found a new species of *Triodontophorus*, **T. intermedius*, from Australia. Since then the Sclerostomes have been investigated and several new species and genera have been described by Boulenger, from England and East Africa; by Ihle, from Holland; by Kotlán, from Hungary; by Yorke and MacFie, from England and West Africa.

At the present day eight genera belonging to the family *Strongylidae*, and consisting of over fifty species, are recognized in equines, viz.:—

Genus *Strongylus* Mueller, 1780 (= *Sclerostoma* Rudolphi, 1809), four species.

Genus *Triodontophorus* Looss, 1902 (*Triodontus* Looss, 1900), five species.

Genus *Gyalocephalus* Looss, 1900, one species.

Genus *Oesophagodontus* Railliet and Henry, 1902, one species.

Genus *Cylicostomum* Railliet and Henry, 1902 (= *Cylichnostomum* Looss, 1902 = *Cyathostomum* Molin, 1861) thirty-one definite species.

Genus *Craterostomum* Boulenger, 1920, three species.

Genus *Poteriostomum* Quiel, 1919, two species.

Genus *Cylindropharynx* Leiper, 1911 (thus far reported from the zebra only) four species.

Gough (1908), in his notes on South African parasites, enumerates thirteen of Looss' species, as occuring in South Africa. Working on the Onderstepoort collection I find that not only are all Looss' Egyptian *Sclerostomes* to be found, but also the majority of the forms recently discovered in equines from other countries. Thus all the species described by Ihle from Holland, and by Boulenger from England and East Africa, are also present in South Africa. Some of the *Cylicostomes* reported from Hungary, viz., *C. ornatum*, *C. sagittatum*, and *C. hybridum*, however, do not seem to occur in South Africa.

COLLECTION AND PREPARATION OF MATERIAL.

Collection.

Owing to the large size of the intestine and the smallness of the *Strongylidae*, their collection presents some difficulty. Looss recommends the following procedure:—The bowel is divided up into a number of parts by several ligatures. Having separated the portions

* See footnote, page 8.

from one another, the ligatures are then loosened and the piece of intestine opened longitudinally. By lifting up one side of the intestinal wall the contents are then gradually rolled off into separate dishes. In this manner the worms can be easily collected, especially the *Cylicostomes*, which are found either in direct contact with the intestinal wall or on the surface of the mass of contents. The three species of *Strongylus*, however, are usually found firmly attached to the wall. The genus *Triodontophorus* is usually found scattered throughout the ingesta, and is thus more difficult to find; should there be a large quantity of fluid present, the contents of each separate piece of gut is first shaken up energetically, and then poured out into shallow basins. When the heavier elements have sunk to the bottom, the fluid is gradually decanted off, until only enough remains to cover the sediment. After several minutes the worms come to the surface, where they can be readily collected at short intervals. An important condition for success seems to be that the collecting dishes be kept warm. This method of course can only be used for fresh material, where the parasites are still in possession of their vitality. From the basins the worms are then transferred into a warm physiological salt solution, in which they may be kept for several hours, without being damaged.

Preparation and Clearing.

The most satisfactory method of preservation is that recommended by Looss. The worms are killed in hot (80° C.) 70 per cent. alcohol, to which 5 per cent. glycerine is added. They are then set aside and the alcohol is allowed to evaporate. This gradual change from alcohol to glycerine prevents the ruinous shrinkage which would result by more abrupt changes from fluids of one specific gravity to one of another. For the larger forms this evaporation must not be allowed to take place too rapidly, especially in species with a thick and resistant skin, in which diffusion takes place slowly. The specimens may be kept for years in glycerine without any risk of damage.

The bulk of the Onderstepoort collection was fixed by this alcohol-glycerine method and was kept in glycerine. After five years the material was in excellent condition, the worms being transparent and straight, and thus easy to examine under the microscope.

Besides this method of clearing in glycerine, for the larger *Sclerostomes*, Boulenger (5) recommends pure white creosote, into which the worms may be transferred, direct from alcohol, without shrinkage.

A small portion of the South African collection had been preserved in formalin, but was in a very poor condition indeed. Some of the worms had shrunk beyond all recognition and were practically opaque, so that their identification was difficult.

For specimens preserved in alcohol, carbolic acid or *lacto-phenol may adavantageously be used for clearing purposes.

Mounting and Embedding.

For examination under the microscope the worms, fixed according to Looss' method, can be mounted in a drop of glycerine. If the worms are well fixed and straight, they can easily be rolled

*I must thank Mr. Ortlepp of the London School of Tropical Medicine for drawing my attention to this useful reagent.

by gently pushing the cover slip. In cases where the worms refuse to roll, Looss' method of procedure is the most satisfactory. The worm is first carefully dried on filter paper, and then brought on to the slide. The cover slip is put on with the worm near its one border and its longitudinal axis parallel to this border. A drop of glycerine is then let in on the opposite side, where cover glass and slide are in direct contact with each other. The worm can now be moved about at will, and when the desired position has been obtained more glycerine is added, so as completely to surround the preparation. Many specimens can still be rolled even when surrounded with glycerine.

For permanent mounts Looss recommends glycerine jelly, care being taken in mounting that the slide with the preparation is first heated to the temperature of the embedding medium, before the latter is added. If carefully ringed these preparations will last for a long time.

THE SOUTH AFRICAN MATERIAL.

The material forming the subject of this paper was collected at the Veterinary Research Laboratories at Onderstepoort, during the year 1916; except the bottles numbered 56-61 inclusive, which come from Pietermaritzburg, Natal.

The parasites from each animal, most of which were victims of horse-sickness, or had been killed owing to debility or other causes, were collected into four separate bottles: (a) *caecum*, (b) *ventral colon*, (c) *pelvic flexure*, and (d) *dorsal colon*. This division of the colon, into three parts, was to ascertain whether any single species showed a preference for a particular portion of the colon.

The collection consisted of the parasites taken from the intestines of 30 horses, 4 mules, 11 donkeys, and 3 zebras.

Distribution of the Parasites in the Intestine of the Host.

Looss working in Egypt had remarked that most Strongylidae were usually limited to the caecum and the first third of the large loop of the colon, i.e. to the point where the colon begins to narrow, near the apex of the loop. *T. minor*, however, was confined to the thickened end-portion of the colon. He also observed that some species display a manifest partiality for horses and others for donkeys, and attributes this "partiality" to the different manner of life of the two hosts. The donkeys, which live mainly in the villages and which only come to town as riding animals or to carry vegetables, have thus more opportunity of picking up larvae than the town-horses, and it is in accordance with these facts that he usually found the donkeys more heavily infected than the horses.

In South Africa there was also a decided difference between the *Strongylid* fauna of the horse and that of the donkey—though here the divergence cannot be definitely attributed to a difference in the mode of life of the two respective hosts. Most of the animals had been kept in the laboratory stables for some time before they succumbed to disease or were killed, and were thus, to a certain extent, exposed to the same chances of picking up larvae during the last few months of life.

The typical fauna of a South African donkey usually presents *Triodontophorus intermedius*, *[*T. serratus* (?)], *T. minor*, *and Stron-*

* Since writing this I have come to the conclusion that *T. intermedius and T. serratus* are identical (see page 78). Consequently, all reports of occurrence of *T. intermedius* are to be considered as reported occurrences of *T. serratus*.

gylus vulgaris, *S. equinus*, *S. edentatus*, *T. tenuicollis*, and *T. brevicauda* may also be seen. Of the *Cylicostomes*, *C. auriculatum* occurs most frequently and most abundantly. *C. elongatum* likewise occurs in every animal, but it is never present in very great numbers. The *Tetracanthum* group—(or subgenus *Cylicostomum* of Ihle, 1922) is usually well represented. Besides the above forms characteristic of the donkey, i.e. *C. auriculatum*, *C. elongatum*, and *C. tetracanthum*, most of the other species hitherto described may also be found in greater or lesser numbers; the only exceptions are:—

[*T. serratus*, which does not occur in South Africa at all. (?)]

C. poculatum, which Looss also only found in the horse.

C. alveatum and *C. triramosum*, which, however, are very characteristic of the zebra. In Egypt *C. alveatum* was found exclusively in the donkey.

On the whole, however, the forms most characteristic for the donkey are the same as those given by Looss.

No matter at what season of the year the parasites be collected the *Fauna of horses and mules* (see Tables I and II) is always practically the same. Thus in the caecum (Table III) one hardly ever fails to find *C. coronatum* in great abundance, and *C. nassatum*, *C. catinatum*, *C. calicatum*, and *C. minutum* are also usually present, sometimes even in great numbers.

In the ventral colon (Table IV) the most heavily infected portion of the intestine, *C. catinatum* and *C. nassatum* play the most important rôle. *C. coronatum*, though nearly always present, yet never occurs as plentifully as it does in the caecum. *C. calicatum* and *C. minutum* thrive as well here as they do in the caecum. *C. labratum* and *C. labiatum*, which may be present in the caecum, are more abundant here. Kotlán (1) gives the ventral colon as the favourite seat of *C. radiatum*, *C. pateratum*, *C. bicoronatum*, and *C. tetracanthum*. *C. radiatum* and *C. tetracanthum*, however, may exceptionally occur, sometimes even in fairly large numbers, in the dorsal colon.

The pelvic flexure (Table V) which is never heavily infected, is not very characteristic, but merely forms a transition from the fauna of the ventral colon to that of the dorsal colon (Table VI). In the latter the most abundant species are *C. goldi* and *C. longibursatum*. Other worms which show a preference for the dorsal colon are *P. ratzii*, *Craterostomum*, *Mucronatum*, and *C. asymetricum*, n.sp. Kotlán (1) gives the dorsal colon as a favourite seat of *C. elongatum*. In the South African material this species occurred in all three portions of the colon, but, if anything, showed a partiality for the caecum. In India (Boulenger and Smit), *C. insigne* is the most frequent parasite of the dorsal colon.

The genera *Strongylus* and *Triodontophorus* seem to have no very definite predilection seat, though all seem to show a slight preference for the dorsal colon. *T. minor*, which is usually quoted as only occurring in the last portion of the colon, was very often present in the other parts as well. In donkeys it even occurred in great numbers in the ventral colon.

Of infrequent occurrence are *C. radiatum* (6 cases), *C. poculatum* (8), *C. elongatum* (6), *C. euproctus* (6), *C. ihlei* (2), *C. ultrajectinum* (3) and *C. brevicapsulatum* (1). *C. tetracanthum* and *C. auriculatum* seem to be confined to the donkey.

Although most of the *Sclerostomes* show a partiality for some definite portion of the intestinal tract, as can be seen in the tables, yet this does not prevent them occurring in other portions as well. Thus *C. coronatum* may be found in the dorsal colon, and in one case *C. longibursatum*, whose distribution is usually limited to the dorsal colon, was found in great numbers in the ventral colon.

The typical intestinal fauna of the zebra is peculiar to this animal, but at the same time it may harbour the usual equine parasites. Thus the genera *Cylindropharynx* and *Crossocephalus* have never been reported from the horse, and up to the present the two *Cylicostomes*, *C. montgomeryi*, and *C. triramosum* have only been found in the zebra. It still remains to be seen whether *Ascaris zebrae* and *Habronema zebrae*, n.sp., do not occur in other equines besides the zebra.

The strongylid parasites of the three South African zebrae showed some interesting peculiarities. Not one species of the otherwise ubiquitous genus *Triodontophorus* was met with, and it is rather remarkable that the forms of common occurrence in the other South African equines, such as *Cylicostomum nassatum*, *C. catinatum*, *C. goldi*, *C. calicatum*, *C. auriculatum*, and *C. longibursatum*, were entirely absent. Whereas *C. alveatum*, which Looss mentions as being exclusively parasitic in the donkey, was present in all the zebrae and was only met with in one of the many horses examined, and was entirely lacking in the mule and the donkey.

From the comparative point of view, the South African material unfortunately contains no nematodes of horses or donkeys, collected in the same region as the zebra material. No definite conclusion can thus be arrived at as to whether the difference existing between the Sclerostome fauna of the zebra, and that of other equines is entirely due to the nature of the host or whether (in this case) it is merely due to the poor fauna of the locality (Bossieshoek, Rustenburg), in which the zebrae were shot.

The typical fauna parasitic in the caecum is mainly composed of *Crossocephalus viviparus* (*zebrae*) and *Cylicostomum alveatum*. *Strongylus vulgaris* was also *always present*, but never in great numbers. *Crossocephalus viviparus* (*zebrae*), which is numerous in the caecum, is even more abundant in the ventral colon, where it may be present in such large quantities as to prevent other forms from thriving in this part of the colon. *C. tetracanthum*, in the one zebra in which it was present, was found in the ventral colon, as in the donkey. This portion of the colon is likewise the favourite seat of *C. triramosum*, which was not found to occur anywhere else.

That the fauna of the pelvic flexure is merely a transition from that of the ventral colon to that of the dorsal colon is well seen in the zebra, for here *Crossocephalus*, which is the commonest form in the ventral colon, is present in company with *Cylindropharynx intermedia*, the chief parasite of the dorsal colon. Other nematodes, whose seat is in the dorsal colon, may also be present in the pelvic flexure, but their numbers are never so great.

The fauna of the dorsal colon is characterized by *Cylindropharynx intermedia* and *Cylicostomum adersi*. *Poteriostomum ratzii* may be present in fairly large numbers; rarer are *P. imparidentatum*, *C. insigne*, and *Craterostomum mucronatum*. One specimen of *C. coronatum*, whose favourite seat is usually the caecum, was found.

Oxyuris equi, which is common in the other equines, is also very numerous in the colon of the zebra, especially in its dorsal portion. In the zebra, which was heavily infected with *Crossocephalus*, *Oxyuris equi* was also found in the ventral colon.

The material from the stomachs of two of the zebrae consisted mainly of various species of the genus *Habronema*. Several specimens of *Setaria equina* were also present, as well as some *Cylindropharynx intermedia* and *Cylicostomum insigne*.

The South African zebra material showed the following parasites: —

	Caecum.			Ventral Colon.			Pelvic Flexure.			Dorsal Colon.			Stomach.		
Number of bottle.....	641	642	643	641	642	643	641	642	643	641	642	643	641	642	643
Strongylus															
equinus.....	+														
vulgaris.....	+	+	+												
Crossocephalus															
viviparus.....	+	+	∞	∞	∞	∞	+	+	+		+	+			
Cylindropharynx															
intermedia.....							∞	+	∞	∞	+	∞		+	
Cylicostomum															
alveatum.....	+	∞	+	+		+									
triramosum.....				+											
tetracanthum.....								+	+		+	+			
adersi.....									+			+			
insigne.....														+	
coronatum.....															
Poteriostomum															
imparidentatum.....									+			+			
ratzii.....							+			+	+				
Craterostomum															
mucronatum.....									+	+					
Oxyuris															
equi.....								∞			∞	+			
Probstmayria															
vivipara.....					∞										
Habronema															
muscae.....														+	
microstoma.....													+	+	
megastoma.....													+	+	
zebrae, n.sp.....															
Setaria															
equina.....													+	+	

Complete List of Nematodes reported from the Digestive Tract of the Zebra.

Strongylus: *S. equinus*, *S. vulgaris*, *S. edentatus* (Turner, 1920).

Triodontophorus: *T. serratus* [Boulenger (4)], *T. intermedius* (Turner, 1920).

Cylicostomum: *C. tetracanthum*, *C. coronatum*, *C. alveatum*, *C. insigne*, *C. adersi*, *C. goldi* (Vevers, 1920), *C. nassatum* (Vevers, 1920), *C. montgomeryi* [Boulenger (4)], *C. minutum* [Boulenger (4)], *C. triramosum*.

Poteriostomum: *P. imparidentatum*, *P. ratzii*, *P. ratzii* var. *nanum*.

Craterostomum: *C. tenuicauda* [Boulenger (4)], C. mucronatum.
Oesophagodontus: *O. robustus* (Turner, 1920).
Oxyuris: *O. equi.*
Probstmayria: *P. vivipara.*
Habronema: *H. muscae*, *H. microstoma*, *H. megastoma*, *H. zebrae*, n.sp.
Setaria: *S. equina.*
Crossocephalus: *C. viviparus* [Von Linstow, 1899, Gedoelst (2)], *C. zebrae* (Yorke and Southwell, 1920).
Cylindropharynx: *C. longicauda* [Leiper (2) and Boulenger (4)], *C. brevicauda* [Leiper (2) and Boulenger (4)], *C. rhodesiensis* [Yorke and MacFie (11)], *C. intermedia*, n.sp.
Ascaris: *A. magalocephala*, *A. zebrae* (Sckrijabin, 1916).

If we compare the two foregoing tables it will be seen that *Strongylus edentatus*, *Triodontophorus intermedius*, *T. serratus*, *Oesophagodontus robustus*, *Cylicostomum goldi*, *C. nassatum*, *C. minutum*, *C. montgomeryi*, as well as *Cylindropharynx longicauda*, *C. brevicauda* and *C. rhodesiensis*, which have been reported from the zebra by Boulenger (4), Vevers, 1920, and Miss Turner, 1920, are not present in the South African list. The genus *Cylindropharynx* is represented by *C. intermedia*, n.sp. The species present, which have not been recordeil from the zebra before, are:—

Strongylus equinus.
Cylicostomum tetracanthum, *C. alveatum*, *C. adersi*, *C. coronatum.*
Poteriostomum ratzii.
Cylindropharynx intermedia, n.sp.
Habronema muscae, *H. microstoma*, *H. megastoma*, *H. zebrae* n.sp.
Setaria equina.

The presence of *C. tetracanthum* and *C. adersi* indicates a relationship between the fauna of the donkey and that of the zebra, whereas the absence of *C. auriculatum* and *C. elongatum*, the other two Cylicostomes very characteristic of the donkey, tends to lessen the slight connection which might exist between the fauna of these two hosts.

Seasonal Influences on the Parasitic Fauna of Equines.

As far as I am able to affirm, the age or sex of the host does not affect the parasitic fauna in any way. The heaviest infections seem to be during the months from March to July, i.e. during early winter, after the rainy season. This, however, I will not put forward as a definite statement, as, judging not only from the smaller number of worms present in the bottles collected last, but also from the fact that they usually contain only the larger, and thus more easily seen, forms, with but a few specimens of the smaller species, I am very much inclined to believe that towards the end of the year the worms were collected less conscientiously than during the first few months.

Kotlán (2) found no difference either as regards the species of worm present at any given season of the year, but definitely states that each separate species is more abundantly represented in spring.

The proportion between the number of females and the number of males present is very variable. The females are always in the majority, from 2 to 7, or even more, females to one male. This

variation, however, shows no relationship with the seasons of the year. Nor was I able to establish any connection between the presence of larvae or worms in coitu, and any definite period of the year. Kotlán remarks that copulating pairs were particularly numerous in autumn.

A comparison of the fauna of horses and donkeys from different localities in South Africa shows no appreciable difference. The material sent from Pietermaritzburg was not very abundant; either the locality has a poor strongylid fauna or the material was not collected very conscientiously. The latter seems to be the case. It presents all the *Strongyles* and all the *Triodontophorus*; of the *Cylicostomes*, however, only a few specimens of the very commonest forms were present, e.g. *C. labiatum*, *C. labratum*, *C. nassatum*, *C. calicatum*, *C. catinatum*, and besides these the large forms *C. bicoronatum* and *C. ultrajectinum*, i.e. forms which one would be liable to pick out in but a hasty and superficial search. That other *Cylicostomes* are to be found at Pietermaritzburg is proved by the material from a mule (58), which was collected there. This showed, besides the above forms, *C. goldi*, *C. radiatum*, *C. adersi*, *C. insigne*, *C. longibursatum*. *C. euproctus*, and *P. ratzii*, as also the only specimen of *O. robustus* which was in the collection.

One horse (34), originally bought at Mafeking, and which was three months at the laboratory, at its post-mortem showed *S. vulgaris*, *T. minor*, *G. capitatus*, *C. coronatum*, *C. nassatum*, *C. calicatum*. *C. longibursatum*, *C. minutum*, *C. catinatum*, *C. pateratum*. *C. bicoronatum*, *P. imparidentatum*, and *P. ratzii*.

The donkeys (49, 50, 51) sent from Mafeking, and which had been at the laboratories for two, four, and six months respectively, showed a fairly normal infection of Selerostomes, except that the genus *Strongylus* was absent, except in one case (50), where but three specimens of *S. equinus* were present.

The material collected from three donkeys (37, 38, 39), which had been sent from Kokstad, and which had spent five months in the laboratory stables before being killed, proved plentiful and rich in species.

The two bottles 54-55 contained nematodes from two donkeys, killed in an experiment for parasitic nodules of the lungs. Both donkeys, which were born and reared at the laboratory, were heavily infected and showed a rich fauna in their intestinal tract. Immature forms of *S. equinus* were collected from cysts in the pancreas, kidneys, mesentery of the aorta, radix linguae, and from the lungs.

Of the horses bought from the Defence Force, the first batch (bottles 1, 3, 5, 7, 9, 10, 11, 12) is rather more heavily infected and richer in species than the second lot (bottles 40-47). Of especial note is the high percentage of *S. vulgaris*, *T. tenuicollis*, and *C. poculatum* in the first lot, whereas in the other *T. tenuicollis* is not present at all, and *S. vulgaris* and *C. poculatum* in but two animals. Otherwise the fauna present no striking differences.

Taken on the whole, the animals coming from different parts of South Africa show no appreciable difference in their parasitic fauna, so that one cannot say that one locality is characterized by one particular species or group of species. The only definite statement that can be made is that the Defence Force horses, which doubtlessly had been left to graze on the veld, show a slightly richer fauna than horses which had been mainly stable fed.

BIOLOGICAL REMARKS.

Strongylus.

The adult worms of the genus *Strongylus* are usually found firmly fixed to the wall of the intestine, producing lesions at the point of attachment. They are essentially blood suckers and of pathological importance, and when present in greater numbers cause emaciation, weakness, anaemia, oedema, etc.

So far as we know at present the *Strongyles* have a direct life-history, the eggs undergoing their development in the manure and giving rise to an infective larval stage. These larvae, when ingested by equines, however, take different routes in the body of the host, according to the species involved.

The larvae of *S. vulgaris* usually undergo their development in aneurisms of the blood vessels, occurring mainly in the mesenteric artery, though other branches from the abdominal portion of the aorta may be involved. *"These aneurisms may rupture, causing the death of the animal from haemorrhage, or parts may break off, forming emboli, which may obstruct the blood supply to a portion of the intestine, and thereby causing a cessation of peristalsis. The contents of the affected portion of the intestine undergo fermentation; the intestine becomes distended with gas, and the animal shows evidence of colic. Occasionally the gas formation will cause a rupture of the intestine, stomach, or diaphragm. The plugging of an artery may cause the affected part of the intestine to become gangrenous. Emboli which pass to the circulation of the hind legs give rise to an intermittent lameness, not amenable to radical or permanent cure. These aneurisms persist even after the worms have left them and remain a constant threat to the life and health of the animal."

The last phase of *Strongyle* larvae shows two tri-lobed lips. In *S. vulgaris* these are markedly grooved, and their posterior margin serrated. At this stage the anus and vulva are well developed in the female, and the vagina and uteri are formed, but the ovaries are still very small. Just before the last ecdysis, that is when the final mouth capsule is present, there is as yet no sign of the buccal tooth. This apparently is only formed very late.

The larval and agamic forms of *S. equinus* are to be found in the parenchyma of the liver, lungs, and pancreas. In my material I found some in company with *S. vulgaris* in a bottle labelled "aorta hepatica." It is possible that the larvae of *S. equinus* were collected from the hepatic ligament and inadvertently put in with the *S. vulgaris* larvae, from the aorta; for, as a rule, *S. equinus* larvae do not undergo their development in the blood vessel.

The chitinous structure surrounding the provisional mouth-opening of *S. equinus* is not grooved, and its posterior margin is smooth. As in *S. vulgaris*, there is no indication of the buccal teeth at this stage of the development.

The larvae of *S. edentatus* may occur under the pleura and peritoneum, in the hepatic ligament, the perirenal connective tissue, the muscles of the forearm, and even in the aorta, in the cryptorchid testes.

There were no larvae of *S. edentatus* in the South African collection.

* Copied from Ransom & Hall, 1919.

Triodontophorus.

Like the *Strongyles*, the adults of the genus *Triodontophorus* are usually found firmly fixed to the gut wall. They are essentially blood suckers, being mostly found gorged with blood, which communicates to their bodies a deep, reddish-brown colour, which in preserved material enables one to distinguish them easily from the larger members of the genus *Cylicostomum*. Yorke and MacFie (7) draw attention to the relationship existing between members of this genus and the ulcerations of the mucosa of the colon, especially as regards *T. tenuicollis*.

The larvae undergo development after the fashion of the *Cylicostomes* and are not concerned with the formation of aneurisms. In the later stages of their development they can be distinguished from *Cylicostome* larvae by the presence of the oesophageal teeth, which seem to be formed very early.

Oesophagodontus.

O. robustus resembles the genus *Triodontophorus* in its mode of life. When present in greater numbers it may produce severe symptoms of anaemia (Giles). The larval development most probably is after the fashion of the *Cylicostomes*, i.e. the larvae are encysted in the mucosa, escaping into the intestine during their last larval stage.

Cylicostomum.

The *Cylicostomes* do not adhere to the mucous membrane, are not blood suckers, but feed mainly upon the contents of the intestine of their host. Nevertheless, they are not actually harmless. According to Looss they feed upon a whitish pus-like substance, resulting from the destruction of the epithelium, this destruction being brought about by the secretion, poured out by the head glands. Looss also remarks that the quantity of this matter is proportional to the number of worms present. In the South African material were two bottles containing pieces of intestinal wall and some of this substance which presented a mealy aspect. Contrary to Looss I did not find many adult worms, but mainly larvae. These were also present in cysts in the portions of the accompanying intestinal walls. This fact suggests that the breaking up of the intestinal wall is due rather to the action of the larvae than to that of the juices secreted by the adults.

According to Kotlán (2) the presence of numerous adult Cylicostomes may cause a haemorrhagic inflammation of the mucosa. There can be no doubt that a heavy infection of encysted *Cylicostome* larvae interferes with the normal functioning of the mucosa. Kotlán further states that these cysts show a more or less well pronounced infiltration of round cells, which are often accompanied by eosinophile cells. After the escape of the worm, these cysts become obliterated in the course of time.

The life-history of the *Cylicostomes* is direct, the larvae undergoing one (or two?) ecdyses outside their definite host.

In a bottle containing donkey droppings kept for 24 hours at 36° C. the youngest form is easily recognized by its extraordinarily long tail, which may measure as much as 200μ. At this stage the larva is from 320-400μ in length, with a maximum breadth of 18-20μ.

The oral opening leads into a straight buccal cavity; the oesophagus is rhabditiform. As in the *Ankylostomes* the lumen of the chyle intestine shows a zig-zag course.

During the first ecdysis the old skin may measure as much as 480μ in length, whereas the new one was never longer than 450μ (average 320-360μ).

Specimens of larvae, which had been kept for 72 hours, averaged 480μ and were in the act of ecdysis. The posterior portion of the loosened old skin shows the lateral lines quite distinctly. Anteriorly it comes away with a portion of the buccal cavity and shows refractive spots. In the resulting new larva the oral cavity seems to be surrounded by a thickened chitinous ring. The oesophagus still shows the divisions of the first stage, but these are less marked. The lumen of the chyle intestine follows a straighter course. The tail is short and terminates not very far behind the anus. At this stage the larvae average 420μ in length. i.e. they are rather larger than those which were already in ecdysis at the end of 24 hours.

Unfortunately there was no material which had been kept longer than 72 hours, so I am not in a position to state definitely that the larva undergoes another ecdysis before entering its host. This, however, seems to be the case, as I did not find any larvae encysted at this stage. On the other hand the larvae from the cysts examined may already have been encysted for a long time, and have undergone further development. In the youngest encysted larvae the rhabditic divisions of the oesophagus have already become obliterated, and the anus and rectum have assumed their definite adult structure. Owing to the fact that my material was composed of larvae of more than one species, I was unable to make out any definite stages of growth between this form and the last larval phase. This latter in its younger stages has an oesophageal tooth projecting into its provisional mouth cavity; behind which the final oral cavity is formed. The differentiation into the two sexes commences at a time when the mouth capsule has assumed its definite shape. At this stage the larvae may also be found free in the gut.

Concerning the distribution of the adults and their larvae in the digestive tube Boulenger (5) found that the adults of *C. insigne* were almost completely restricted to the posterior part of the colon, only rarely occurring in the anterior region of this organ; the larvae on the other hand were found to be abundantly encysted in the caecal walls, and occasionally free in the anterior colon. But whether all *Cylicostomes* show this difference of habit remains to be investigated.

Concerning the mode of life of the genera *Poteriostomum*, *Craterostomum* and *Gyalocephalus*, we have not much information. It is in all probability similar to that of the *Cylicostomes*.

According to the conformation of their posterior extremities, the different *Strongylids* when in copulation do not behave in the same manner. In the genera *Strongylus*, *Triodontophorus*, and *Gyalocephalus*, in which the vulva is some distance from the tip of the tail, the heads of the two individuals point in the same direction. In the genera *Cylicostomum* and *Oesophagodontus* they point in opposite directions.

GEOGRAPHICAL DISTRIBUTION OF THE EQUINE STRONGYLIDS. (Table VII.)

With a few interesting exceptions, most of the horse *Strongyles* seem to have a world-wide distribution (see page 112). Of the three

species of the genus *Strongylus*, *S. vulgaris* is the commonest form; *S. equinus*, which is of comparatively rare occurrence in Europe, is more abundant in South Africa and in India [Boulenger (5) and Smit], but nevertheless is the form least frequently met with.

Genus *Triodontophorus*. *T. minor* is mainly confined to India (Boulenger and Smit) and the African continent. In Europe it has only been reported from Hungary (Kotlán), otherwise its distribution seems to be mainly tropical or sub-tropical. *T. serratus* also seems to prefer tropical climates, thus far being only definitely reported from Egypt, Belgian Congo [Gedoelst (2)], Ceylon [Von Linstow (1904)], and Mesopotamia [Boulenger (5)]. Kotlán (2) enumerates it as present in Hungary, at the same time, however, questioning whether a definite difference can be said to exist between *T. serratus* and *T. intermedius*.* Judging by the common occurrence of the latter worm, one is led to the conclusion that the form present in Hungary is *T. intermedius*, rather than *T. serratus*, *T. brevicauda*, and *T. tenuicollis*, though less abundant than *T. intermedius*, will doubtlessly also prove to be universally present.

Cylicostomes. *C. tetracanthum*, which Looss reported as the commonest form in Egypt, is very limited in distribution. In South Africa, though occurring frequently in the donkey and zebra, it has never once been found in the horse or mule. Kotlán (2) mentions it as the second commonest form present in Hungary, but does not state whether it occurs in the donkey only or in the horse as well. Besides this, it has been reported from Australia; otherwise, it seems to be entirely absent in Europe, America, and India.

C. nassatum and *C. coronatum* are among the commonest and most frequently occurring forms all the world over. *C. calicatum* *C. poculatum*. *C. goldi*, and *C. longibursatum* likewise are present everywhere, very abundant in some regions and in others never very numerous.

The forms *C. labratum*, *C. labiatum*, *C. pateratum*, *C. insigne*, *C. calicatum*, *C. minutum*, and *C. bicoronatum* also seem to occur practically everywhere, but they are never very frequent, nor do they occur in great numbers. In the Punjab [Boulenger (5)], *C. insigne* is the commonest *Cylicostome*.

C. catinatum with its two varieties is peculiar, in that it does not seem to occur in England or on the European continent.

C. alveatum is confined to the African continent.

C. auriculatum also is essentially African, and has never been known to be parasitic in any equine but the donkey. Other forms peculiar to the donkey are *C. adersi* and *Strongylus asini*. *C. adersi*, however, may also occur in the zebra.

The four worms *C. ornatum* [Kotlán (1)], *C. sagittatum*, *C. hybridum* [Kotlán (3)], and *C. prionodes* [Kotlán (4)], have up to the present only been known to occur in Hungary. *C. mettami* has only once been reported from England [Leiper (4)].

C. euproctus is now known from England [Boulenger (1)], Holland [Ihle (10)], and South Africa. It may be that this is a European form imported into South Africa, where it may be considered as one of the rarer Cylicostomes.

* See footnote, page 8.

C. ihlei has a distribution similar to that of *C. euproctus* occurring in Holland [Ihle (10)], Hungary [Kotlán (1)], and South Africa.

Up to the present *C. ultrajectinum* and *C. brevicapsulatum* are only known from Holland [Ihle (10)] and the Transvaal. Of the last-mentioned form, but one female was found in the South African material. Ihle also reports it as being very rare in Europe.

The genus *Poteriostomum* originally described from Germany (Quiel, 1919) has since been found in other parts of the world. Thus *P. imparidentatum* is now known from Germany [Quiel (1)], India [Boulenger (5)], and South and West Africa [Yorke and MacFie (10)] and *P. ratzii* from Hungary [Kotlán (1)], Holland [Ihle (10)] and South and West Africa [Yorke and MacFie (10)].

The genus *Craterostomum* has representatives in Hungary [Kotlán (1)], Holland [Ihle (10)], East Africa [Boulenger (4)] and South Africa.

The South African fauna is thus seen to be rich in species. Nearly all the *Strongylids* hitherto described as occurring in other countries are present; the tropical and sub-tropical, as well as the "European" forms being represented.

SYSTEMATIC.

Superfamily *STRONGYLOIDEA* Weinland, 1858.

Synonyms *Strongylidea* Carus, 1863, in Travassos, 1914; *Strongyloidae* Travassos, 1914; *Strongyloidea* Weinland, 1858, of Travassos, 1914.

Superfamily diagnosis.—Nematoda. Meromyarian or polymyarian. Males with well developed caudal bursa supported by rays; in forms near the outer limit of the superfamily the bursa is occasionally very small, and the rays atypical, or the bursa may be lacking altogether, the species in question being only referable to this superfamily on the ground that transitional, but recognizably strongyle forms, found at times in the same locations and with the same habits, relate them to it. Oesophagus without posterior bulb. Mouth naked or with a buccal capsule and six papillae, distinct or indistinct. Male usually with two spicules and female usually with two ovaries. Oviparous or viviparous.

The superfamily strongyloidea may be divided into the following families (Travassos, 1921):—

Strongylidae Baird, 1853 (see below).
Trichostrongylidae Leiper, 1912 (page 24).
Metastrongylidae Leiper, 1908 (page 25).

1. Family Strongylidae Baird, 1853.

Family diagnosis.—Strongyloidea. Meromyarian. Buccal capsule present. Bursa highly developed, with a typical system of supporting rays, consisting of one or two dorsal rays and two lateral ray systems of six rays each. Male with two spicules and female with two ovaries. Vulva at times anterior, but usually posterior to

* For the classification I have mainly followed that adopted by Hall, 1916.

the middle of the body. Oviparous, eggs segmenting when laid. Development so far as known, direct. Embryo rhabditiform. In digestive, rarely in respiratory system.

Type genus *Strongylus* Mueller, 1780.

Subfamily *Strongylinae* Railliet, 1893.

Subfamily diagnosis.—Strongylidae. Meromyarian. Buccal capsule present. In digestive, occasionally in respiratory, system. Development direct, at times complex, involving cutaneous infection, nodular development or other embryonic or larval migration.

Type genus *Strongylus* Mueller, 1780, may be divided up into the following tribes:—

(*a*) *Strongyleae* Railliet and Henry, 1912 (see below).

(*b*) *Cylicostomeae* Railliet and Henry, 1912 (page 20).

(*a*) *Tribe Strongyleae* Railliet and Henry, 1912.

Synonym *Ankylostomeae* Railliet and Henry, 1909.

Tribe diagnosis.—Strongylinae. Ventro-ventral and latero ventral rays close together and parallel. Dorsal and externo-dorsal rays originate in a common trunk, the dorsal ray ending in tridigitate terminations, the vulva in the posterior third of the body and the uteri divergent.

Type genus *Strongylus* Mueller. 1780.

Genus *Strongylus* Mueller, 1780.

Synonyms *Strongilus* Rudolphi, 1801; *Sclerostoma* Rudolphi, 1809; *Sclerostomum* Dujardin, 1845; *Sclerostomum* Sonsino, 1878; *Strongylus* Giles, 1892.

Generic diagnosis.—Strongyleae. Anterior extremity truncated, straight or slightly curved towards the ventral surface, the open, circular mouth, transverse or oblique, is followed by a chitinous buccal capsule, and the edge of the mouth is furnished with one or several series of numerous denticles, the corona radiata. The two equal spicules are long and slender. Bursa is trilobed. The ventro-ventral and latero-ventral rays are parallel, close together, and have a common origin. The externo-lateral, medio-lateral, and postero-lateral rays originate in a common trunk, and proceed in slightly diverging lines; they are of much the same shape, all tapering somewhat from the base. The dorsal and externo-dorsal rays originate in a common trunk, the latter originating near the base of the common trunk and occupying a relatively independent position. The main stem of the dorsal ray divides to form the two terminal dorsal rays, and each of these gives off an external branch and then forks again distally, to form two terminal branches. One of the three branches of the dorsal rays may be missing. Vulva in the posterior third of the body. Uteri divergent.

Type species *Strongylus equinus* Mueller, 1780.

Four species of this genera are found parasitic in equines:—

Strongylus equinus Mueler, 1780 (page 30).

Strongylus edentatus Looss, 1900 (page 31).

Strongylus vulgaris Looss, 1900 (page 31).

Strongylus asini Boulenger, 1920, only reported from the donkey (page 32).

(*b*) Tribe *Cylicostomeae* Railliet and Henry, 1912.

Raised to subfamily *cylicostominae* Railliet and Henry, 1914.

Synonym *Cylichnostomidae* Looss, 1902; *Cylicostominae* Railliet, 1915.

Tribe Diagnosis.—Strongylinae. Ventro-ventral and latero-ventral rays close together and parallel. Medio-lateral and postero-lateral rays not close together and parallel. Dorsal and externo-dorsal rays originate separately. The vulva is close to the anus and the uteri are convergent.

Type genus *Cylicostomum* Railliet, 1901.

The tribe *Cylicostomeae* contains the following genera:—

Cylicostomum Railliet, 1901.
Poteriostomum Quiel, 1919 (page 23).
Craterostomum Boulenger, 1920 (page 23).
Triodontophorus Looss, 1902 (page 23).
Oesophagodontus Railliet and Henry, 1902 (page 22).
Gyalocephalus Looss, 1901 (page 23).
Cylindropharynx Leiper, 1911 (page 24).

Cylindropharynx thus far has only been reported from the zebra.

*Genus *Cylicostomum* Railliet and Henry, 1902 (= *Cylichnostomum* Looss, 1902 = *Cyathostomum* Molin, 1861); *Trichonema* Cobbold, 1874.

Most of the species thus far recorded measure, in the adult stage, less than 15 mm. in length; several are even less than half this size. A prominent circular mouth collar is present surrounding the mouth opening, more or less distinctly set off from the rest of the body. The mouth collar is regularly rounded, slightly flattened or depressed or with its outer edge projecting forward. Inner surface of mouth collar occupied by the external leaf crown, consisting of narrow flattened leaf-like processes, with pointed or rounded tips according to the species. Mouth capsule subcylindrical in shape, usually broader than long, but may be longer than broad. Internal leaf crown comes off from the inner surface of the mouth capsule near its anterior border and is composed of elements, varying from small inconspicuous tubercles to long flattened leaf-like processes. Dorsal lobe of the male bursa is set off from the lateral lobes by a notch. Dorsal rays of bursa large, split down or almost down to the roots of the externo-dorsal rays, each with two lateral branches of about the same size as the posterior portions of the rays themselves. Externo-dorsal rays closely approached to the postero-lateral rays and with their terminal portions turning off backwards, more or less suddenly from their main course at an obtuse angle. Genital cone well developed, usually bluntly conical, but sometimes long and almost cylindrical. Spicules long and slender, equal in size, terminating posteriorly in a double hook, one branch of which bends sharply backwards. Vulva of female closely approached to the anus.

Type species *C. tetracanthum* Mehlis, 1831.

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*According to the law of priority, this genus ought to be termed *Trichonema*. In 1874 Cobbold described a larva *Trichonema arcuata*, which at a later date he stated to be a larval form of *S. tetracanthum*. As according to the rules of zoological nomenclature, the law of priority must also be applied when any stage in the life-history is named before the adult, the name *Cylicostomum* Raillet ought to be replaced by *Trichonema* Cobbold, 1874; this would mean introducing an entirely unknown name and discarding a very familliar one.

The genus description is taken from Ransom and Hadwen, 1918.

In his monograph Looss 1901 distinguished three definite groups:—

1. *Radiatum—elongatum* group.
2. *Tetracanthum* group.
3. *Alveatum—catinatum* group.

Since then several more species have been described and a clearer idea of the mutual relations of the different forms has been arrived at. In his recent publications Ihle (11 and 12) recognizes seven distinct groups, five of which he raises to subgenera.

Recently new varieties of species have been created, which are based on a difference in the appendages of the genital cone. As these appendages are capable of some variation in certain species, e.g. *C. goldi* and *C. nassatum*, the creation of a new variety based on their structure alone is unjustifiable. In cases where the difference of the appendages is accompanied by a slight variation, say, in the size of the bursa or in the arrangement of the bursal rays, the creation of a new variety is permissible.

Group 1.—*Tetracanthum* group or subgenus *Cylicostomum* Ihle, 1922, contains the following species:—

C. tetracanthum Looss, 1902 (page 33).
C. labratum Looss, 1902 (page 34).
C. ornatum Kotlán, 1919 (page 35).
C. labiatum Looss, 1902 (page 36).
C. labiatum Looss, var. *digitatum* Ihle, 1921.
C. coronatum Looss, 1902 (page 37).
C. sagittatum Kotlán, 1920 (page 38).

External leaf crown is composed of 18-24 elements; those of the internal leaf crown are thin, triangular plates, whose place of origin extends backwards, to some distance from the anterior margin of the mouth capsule. Mouth capsule rather short. Posterior extremity of the female straight or slightly bent in a dorsal direction.

Group 2.—*Alveatum—catinatum* group or subgenus *Cylicocercus* Ihle, 1922:—

C. alveatum Looss, 1902 (page 39).
C. catinatum Looss, 1902 (page 40).
C. catinatum Looss, var. *litoraureum* Yorke and MacFie, 1920 (page 40).
C. catinatum Looss, var. *pseudocatinatum* (page 40), Yorke and MacFie, 1919,
C. pateratum Yorke and MacFie, 1919 (page 42).
C. goldi Boulenger, 1917 (page 43).
C. mettami Leiper, 1913 (page 44).

External leaf crown of 20-29 elements, those of the internal leaf crown are thin triangular plates, and their point of origin may be some distance from the anterior edge of the mouth capsule. Posterior extremity of the female strongly bent dorsally and usually has a swelling in front of the vulva, giving it a resemblance to the human foot when seen laterally.

Group 3.—*Radiatum—elongatum* gronp or subgenus *Cylicocyclus* Ihle, 1922:—

C. radiatum Looss, 1902 (page 44).
C. triramosum Yorke and MacFie, 1920 (page 45).
C. elongatum Looss, 1902 (page 46).
C. elongatum Looss, var. *Kotláni* Ihle, 1920 (page 47).

C. insigne Boulenger, 1917 (page 48).
C. adersi Boulenger, 1920 (page 49).
C. nassatum Looss, 1902 (page 50).
C. nassatum (Looss) var. *parvum* Yorke and MacFie, 1918 (page 50).
C. leptostomum Kotlán, 1920 (page 51).
C. auriculatum Looss, 1902 (page 52).

Mouth capsule with a hoop-like thickening at the posterior margin. Elements of the internal leaf crown generally small and numerous, originating close to the anterior margin of the mouth capsule. Posterior extremity of the female straight or only slightly bent dorsally.

Group 4.—*Calicatum* group or subgenus *Cylicostephanus* Ihle, 1922:—

C. calicatum Looss, 1902 (page 53).
C. minutum Yorke and MacFie, 1918 (page 54).
C. longibursatum Yorke and MacFie, 1918 (page 55).
C. hybridum Kotlán, 1920 (page 56).
C. poculatum Looss, 1902 (page 56).
C. asymetricum, n.sp. (page 57).

Mouth capsule usually cylindrical or may be trapezium-shaped in optical section. Elements of the internal leaf crown mostly short and originating near the anterior margin of the mouth capsule. Posterior extremity of female usually straight.

Group 5.—*Bicoronatum* group or subgenus *Cylicodontophorus* Ihle, 1922:—

C. bicoronatum Looss, 1902 (page 58).
C. euproctus Boulenger, 1917 (page 59).
C. ihlei Kotlán, 1921 (page 60).
C. ultrajectinum Ihle, 1920 (page 61).

Submedian papillae mostly conical in shape, with short rounded tips; external leaf crown usually composed of numerous thin elements; those of the internal leaf crown are exceptionally large. Mouth capsule short and wide. Posterior extremity of the female straight. Vulva may be situated some distance away from the anus.

Group 6.—*Brevicapsulatum* group:—

C. brevicapsulatum Ihle, 1920 (page 62).
C. prionodes Kotlán, 1921 (page 63).

Characterized by the extreme shortness of the mouth capsule. Posterior extremity of the female straight.

Group 7.—*Montgomeryi* group.—Dorsal and ventral walls of the mouth capsule are much longer than the lateral walls:—

C. montgomeryi Boulenger, 1920 (page 64).

Genus *Oesophagodontus* Railliet and Henry, 1902.

Oesophageal funnel well developed and with three teeth, which, however, do not project into the buccal cavity. Bursa is bilobed and closed all round, no trace of a median (dorsal) lobe present. No median dorsal ray. The postero-lateral ray has an accessory branch. Margins of bursa finely denticulated. Post termination of female body pointed or mucronate, vulva comparatively far removed from tip of tail.

Type species *O. robustus* (Giles, 1892) Railliet and Henry, 1902 (page 64).

Genus *Poteriostomum* Quiel, 1919.

Adult stage usually measures more than 15 mm. in length. Elements of the external leaf crown small and numerous; those of the internal large and well developed; according to the species these may all be equal in size, or some of the elements may be differentiated from the others by their greater length.

The supporting rays form two distinct groups antero-median and posterior. The postero-external (externo-dorsal) ray arises from a common trunk with the dorsal. The main trunk of the dorsal ray is not split to the base, but only for about half its length, the two lateral branches arising from the undivided portion close to the point of origin of the postero-external rays. These two lateral branches run parallel to one another and to the externo-dorsal ray, and are almost at right angles to the main dorsal ray. Posterior extremity of the female shows no bosses; anus and vulva some considerable distance from one another; anus situated far from the tip of tail.

Type species *Posteriostomum imparidentatum* Quiel, 1919. But two species of this genus are recognized at present, viz.:—

P. imparidentatum Quiel, 1919 (page 66).
P. ratzii Kotlán, 1919 (page 67).

Genus *Craterostomum* Boulenger, 1920.

Mouth capsule constricted at its anterior and posterior openings. Mouth capsule wall thickened at its anterior border. Elements of external leaf crown large and few in number. Those of internal leaf crown are short and broad, originate from anterior edge of the mouth capsule, and are more numerous than those of external leaf crown. Dorsal gutter well developed. Border of the bursa finely denticulated. Bursa is continuous over ventral side of the body. Anus and vulva removed from one another; anus some distance in front of tip of tail.

Type species *Craterostomum tenuicauda* Boulenger, 1920.

This genus contains the three forms:—

C. tenuicauda Boulenger, 1920 (page 69).
C. mucronatum Ihle, 1920 (page 70).
C. acuticaudatum Kotlán, 1919 (page 70).

Genus *Gyalocephalus* Looss, 1901.

Head separated from the rest of the body by a definite neck. Mouth capsule and anterior portion of oesophagus highly complicated in structure. At the base of the chitinized oesophageal funnel are three pairs of chitinized ridges, which project anteriorly as six pointed teeth. Bursa completely surrounds genital cone—prebursal papillae long and assume shape of genuine rays.

Long retractile genital cone.

Posterior extremity female long and tapering. Anus and vulva far apart; anus some distance from the tip of the tail.

Type species *Gyalocephalus capitatus* Looss, 1900 (page 71).

Genus *Triodontophorus* Looss, 1902.

Characterized by the presence of three large teeth, which project into the buccal cavity. Elements of external leaf crown numerous; elements of internal leaf crown low and project internally as small septa.

Dorsal gutter well developed. Margin of bursa finely denticulate. Bursa closed ventrally.

Type species *T. minor* Looss, 1901.

This genus contains four species parasitic in equines:—

T. minor Looss, 1900 (page 72).
T. serratus Looss, 1900 (page 73).
T. brevicauda Boulenger, 1916 (page 77).
T. tenuicollis Boulenger, 1916 (page 77).

Genus *Cylindropharynx* Leiper, 1911.

Buccal capsule abnormally deep. External leaf crown consists of six large teeth corresponding in position to the head papillae. The two situated laterally are larger than the four submedians, each is notched, longitudinally grooved, suggesting an origin by fusion of at least two elements. Dorsally and ventrally the external leaf crown is deficient, but from each of the dorsal and ventral lips of the mouth collar, there projects horizontally inwards a broad crescentic plate, the free concave margin of which is directed towards the axis of the mouth. Internal leaf crown consists of 12 large elements.

Margin of bursa denticulate. Posterior extremity of female straight and pointed.

Type species *C. brevicauda* Leiper, 1911:—

C. brevicauda Leiper, 1911 (page 78).
C. longicauda Leiper, 1911 (page 79).
C. rhodesiensis Yorke and MacFie, 1920 (page 80).
C. intermedia, n.sp. (page 81).

This genus has up to the present only been reported from the zebra.

*2. Family Trichostrongylidae (Leiper, 1912).

Strongyloidea, meromyarian or polymyarian, body filiform (capillaire); mouth surrounded by six papillae (not always very distinct). Bursa capulatrix typical and well developed, dorsal ribs simple or double; buccal capsule, absent or only rudimentary; oviparous, eggs undergoing segmentation at ovi-position; female genital organs simple or double.

Habitat digestive tract of vertebrae.

Type species *Trichostrongylus* Looss, 1905.

Subfamily *Trichostrongylinae* Leiper, 1908.

Trichostrongylidae: Usually reddish, female genital apparatus double; ovijector well developed; vulva in the posterior half of the body; uteri usually divergent; gubernaculum and prebursal papillae may be present or absent; dorsal ray single or double.

Genus *Trichostrongylus* Looss, 1905.

Trichostrongylinae: Small, delicate, and generally reddish, body gradually tapering towards anterior extremity commencing in front of genital aperture. Head without inflations; three lips not very distinct; papillae "ponctiformes" or noduliform, very small; transverse striation very fine and longitudinal ridges not always distinct; cervical papillae not visible; oesophagus long, with single dorsal gland well developed; nerve ring and excretory pore at level of middle of oesophagus. Lateral bursal lobes very large, posterior lobe not well developed. Ventral rays widely separated and of different sizes, the ventro-ventral ray slender and directed ventrally,

* The classification of the Trichostrongylidae is that adopted by Travassos (2).

the ventro-lateral large and near the three laterals; the latero-posterior more slender than the other two and near to the externo-dorsal; dorsal ray short and split at its extremity; spicules of a peculiar shape, typical for each species. At the proximal extremity there is an expansion in the form of an escutcheon where the retractor muscle is inserted, at its distal extremity there is an angular projection, which may be absent; gubernaculum also of peculiar shape prebursal papillae very small or entirely absent, testes single, uterus and ovary slightly sinuous, ovijector well developed, vulva in posterior half of the body, in the form of a straight or semilunar slit, surrounded by chitinous lips, which project but slightly; tail short, with a pair of small papillae near its extremity; eggs of average size, with thin colourless shell; segmentation commences in the uterus.

Habitat.—Small intestines and stomach of vertebrates.

Type species *Trichostrongylus retortaeformis* (Zeder, 1800) Looss, 1907.

Only one species of this genus is present in equines *Trichostrongylus axei* (page 83).

3. Family Metastrongylidae Leiper, 1908.

Strongyloidea: Buccal capsule absent. Bursa not well developed, supported by atypical rays; oviparous or ovoviparous; embryos developed at oviposition.

Habitat.—Circulatory or respiratory systems of mammals, rarely in digestive tract.

Subfamily *Metastrongylinae* Leiper, 1908.

Metastrongylidae: Buccal capsule absent. Male with two equal spicules and female with two ovaries. Eggs in varying stages of development when oviposited, embryo not rhabditiform.

Type genus *Metastrongylus* Molin, 1861.

Genus *Dictyocaulus*.

Mouth circular and naked; caudal bursa has the posterior rays lobed; median rays simple, bilobed or bifid; anterior double, the anterior branch being the shorter. Two thick short spicules brown and alveolated, accessory piece present. Vulva situated in the middle of the body: uteri divergent; embryos developed in eggs at oviposition:—

D. viviparus (*S. micrurus* Mehlis) (page 83).
D. arnfieldi Cobbold, 1884 (page 83).

Superfamily *ASCAROIDEA* Railliet and Henry, 1915.

Synonym *Ascaridea* Diesing, 1861, of Travassos, 1914.

Diagnosis.—Mouth commonly provided with two or three prominent or inconspicuous lips, which are often supplied with papillae, but the mouth may be of variable shape and without lips. When three lips are present one is median and dorsal, the others are submedian and are approximated in the ventral line. Buccal capsule is not present. Males are provided with one or two spicules, rarely with none. Female with two ovaries, oviparous. As a rule development is direct and without an intermediate host; exceptionally (as in Ascarids of fish) there is an intermediate host. The two families *Ascaridae* and *Oxyuridae* have representatives, parasitic in the horse. (Oxyuridae, page 60.)

Type family *Ascaridae* Cobbold, 1864.

1. Family Ascaridae Cobbold, 1864.

Ascaroidea: Polymyarian, mouth with three prominent lips supplied with papillae, the dorsal lip being median and the two others submedian and approximated in the ventral line; or with three main lips and three relatively prominent or inconspicuous intermediate lips (interlabia). Male usually with two spicules. Caudal extremity of female terminates conically and fairly abruptly.

Type genus *Ascaris* Linnaeus, 1758.

Subfamily *Ascarinae* Travassos, 1915, has the characters of the family.

Genus *Ascaris* Linnaeus, 1758.

Synonyms *Stomachida* Pereboom, 1780; *Fusaria* Zeder, 1800; *Lombricoides* Mérat, 1821.

Ascarinae: Mouth with three well-developed lips. Male with two equal spicules, and with numerous papillae on the ventral surface of the body in front of and behind the anus. Vulva near middle of body or anterior to this point. Shell of egg thick, with numerous mamillate projections on its outer albuminous layer.

Type species *Ascaris lumbricoides* Linnaeus, 1758.

Two species of the genus are parasitic in equines.

1. *Ascaris megalocephala* (Cloquet, 1824) (page 83).
2. *Ascaris zebrae* (Sckrijabin, 1916) (page 84); *A. zebrae* has only been reported from the zebra.

2. Family Oxyuridae (Cobbold, 1864).

Ascaroidea: Meromyarian. Mouth with simple usually inconspicuous lips. Males usually with one spicule, at times reduced, imperfectly chitinized or absent. Caudal extremity of female much elongated and subulate. Vulva anterior. Eggs characteristically flatteued on one side.

Type genus *Oxyuris* Rudolphi, 1803.

Seurat, 1915, states that the *Oxyuridae*, although considered by most authors as belonging to the *Ascaridae*, are very distinct and should be considered as a special group having the same origin as the *Heterakidae*, but having evolved independently of the latter. The *Ascaridae* he would consider as the extreme type of ramification of what he calls the phylum *Heterakidae*.

Railliet and Henry, 1916 (5), have divided the *Oxyuridae* into five groups:—

1. One spicule, no accessory piece:—
   (*a*) Vulva anterior *Oxyuris*.
   (*b*) Vulva posterior.
2. One spicule, and accessory piece:—
   (*a*) Vulva anterior.
   (*b*) Vulva posterior.
3. Two unequal spicules, vulva in or behind middle.
4. Two equal spicules, vulva in middle, rarely before that point.
5. Two unequal spicules and accessory piece. Vulva near anus. *Atractis. Crossocephalus.*

Gedoelst, 1916 (2), divides the *Oxyuridae* into two groups according to the arrangement of the female genital organs:—

Group 1.—Genital apparatus simple, vulva near to anus. *Atractis. Crossocephalus.*

Group 2.—Genital apparatus double.
= Group 1-4 of Railliet and Henry *Oxyuris*.

1. Genus *Oxyuris* Rudolphi, 1803.

Synonyms *Oxyurus* Lamarck, 1816; *Lepturis* Schlotthauber, 1860; *Dermatoxys* Schneider, 1866; *Oxiurus*, Sonsino, 1878; *Oxyurus* Rudolphi, 1803, of Brumpt, 1910; *Syphacia* Seurat, 1916; *Fusarella* Seurat, 1916.

Oxyuridae: Mouth naked or surrounded by slightly salient lips. Oesophagus long, followed by a bulb, usually quite distinct. Males small and of relatively rare occurrence; provided with one spicule, which may be imperfectly chitinized or not developed. One or more pairs of papillae in the vicinity of the cloacal aperture. Females have the caudal extremity greatly elongated or subulate; there are two ovaries. As a rule the vulva is located in the anterior portion of the body. Eggs elongated, thin-shelled, asymmetrical, flattened on one side and ending in rounded points. Embryo may or may not be formed at oviposition.

Type species *Oxyuris equi* (Schrank, 1788) Blanchard, 1849 (page 85).

2. Genus *Crossocephalus*.

Synonym *Pterocephalus* Von Linstow, 1899 (page 85).

Crossocephalus is now placed in the family *Oxyuridae* next to *Atractis*, with which it shows the following affinities:—

Oesophagus composed of two parts with a distinct bulb; excretory pore complex, two unequal spicules, vulva in posterior part of body just in front of anus; female genital apparatus simple; viviparous; embryos well developed before leaving uterus.

Type species *Pterocephalus viviparus* Von Linstow, 1899.

Before this Leiper (3) was inclined to create a new family for *Crossocephalus*. Railliet and Henry (3) in their classification of *Ascaridae* suggested that *Crossocephalus* might be ranged next to *Anisakies* Dujardin, 1845, in the subfamily *Anisakinae*; Travassos (1) places it in the superfamily *Rhabiasoidea* (Railliet and Henry, 1916) in the family *Atractidae* (Travassos, 1920).

Family Anguillulidae Dujardin, 1845.

Very small nematodes; oesophagus with two bulbs; chitinous spines or teeth present in the buccal cavity; two equal spicules; caudal bursa may be present; vulva at middle of the body. Usually free living in fresh water or decaying matter, a few parasitic on plants, rarely on animals.

Genus *Probstmayria* Ransom, 1907.

Small spindle-shaped forms, truncated anteriorly and with long gradually attenuated, acutely pointed tail. Cuticula thin, transparent and free from spines or setae. Mouth with six lips. A small lateral organ of unknown function in relation with each lateral lip and the anterior portion of the body. Pharynx elongated, cylindrical. Oesophagus with two portions; anterior portion long and slender; posterior portion shorter and pyriform with a bulb containing a denticular apparatus. Anus about two-thirds the length of the body

from the anterior end. Male with two short, nearly equal spicules; without bursa, and with a number of pairs of post anal papillae. Vulva of female at about the middle of the body. Eggs few, hatching in the uterus, and developing into embryos, which at birth exactly resemble the parent, except that the sexual organs are undeveloped.

Type species *Probstmayria vivipara* (Probstmayr, 1865), Ransom, 1907 (page 90).

Synonyms *Oxyuris vivipara* (Probstmayr, 1865, of several authors); *Rhabdonema vivipara* Railliet, 1893; *Strongyloides viviparus* (Probstmayr) Linstow, 1905; *Oxyuris* sp. Looss.

This species was first described by Probstmayr, 1865, under the name of *Oxyuris vivipara*. Perroncito, 1882, considered that it should be placed more properly in one of the two genera *Rhabdonema* or *Anguillula*, and in 1893 Railliet assigned it to the genus Anguillula.

Gedoelst, in his "Synopsis de Parasitologie," places it next to the genus *Strongyloides* in the family *Angiostomidae*. However, in 1907 Ransom indicated its definite position and raised it to a new genus *Probstmayria*, of which it is the sole representative.

Travassos (1) places it in the family *Oxyuridae* (Cobbold, 1864), subfamily Oxysomatinae (Railliet, 1916).

SUPERFAMILY *FILARIOIDEA* (WEINLAND, 1858) STILES, 1907.

Body usually very long and slender. Mouth with two lips or without lips and surrounded by circumoral papillae. Oesophagus slender, without posterior bulb. Anus subterminal. Male with a single spicule or with two unequal spicules. Tail provided with papillae, usually curved spirally, bursal alae may be present or absent. Female larger than male. Vulva present or, less often, absent in gravid females; when present, usually anterior of the middle of the body or near the middle, rarely near posterior extremity. Two, four, or five uteri. Oviparous, ovoviparous or viviparous. Development in many cases, perhaps all cases, requires an intermediate host.

Type family *Filariidae* Claus, 1885.

Analytical key to families of *Filarioidea*:—

1. Mouth without lips; vulva near anterior extremity of body. *Filariidae* (page 28).
2. Mouth with two lips; or mouth without lips in forms where vulva is near posterior extremity of body. *Spiruridae* (page 29).

1. Family FILARIIDAE Claus, 1885.

Filaroidae: Body long and filiform. Mouth without lips. Male with two spicules, usually quite dissimilar. Vulva near the anterior extremity of the body. Adults subcutaneous, in blood or on serous surfaces.

Subfamily *Filariinae* Stiles, 1907.

Filariidae: Vulva anterior, near mouth. Spicules quite dissimilar. Intermediate stages so far as is known occur in blood-sucking arthropoda.

Type genus *Filaria* Mueller, 1787.

Genus *Setaria* (Viborg, 1795) Railliet and Henry, 1911.

Filariinae: Mouth with projecting peribuccal armature deeply notched on the lateral margins, less so dorsally and ventrally; so as to give the impression of two teeth when seen laterally and four when seen at an angle. Tail in both sexes with peculiar caudal appendages.

Type species *Setaria (Gordius) equina*. Abildgaard, 1789 (page 90).

2. Family Spiruridae Oerley, 1885.

Synonyms *Spiruroidea* Railliet and Henry, 1915; *Spirurata* Descazeaux, 1915.

Filarioidea: Mouth with two lips, or without lips in forms where vulva is near posterior extremity of body. Male with posterior extremity of body commonly expanded and alate. Female with vulva usually in middle of body, exceptionally near the posterior extremity as noted above. Railliet and Henry, 1915, treat this as a superfamily the *Spiruroidea*.

(*a*) Subfamily *Spirurinae* Railliet, 1915.

Synonym *Physalopterinae* (Railliet and Henry, 1912, in part).

Spiruridae: Females with two uteri and with vulva in the middle portion of body, not close to anterior or posterior extremities. Pharynx without circular rings or spirals.

Type genus *Spirura* Blanchard, 1849.

Genus *Habronema* Diesing, 1861, Seurat (3).

Characterized by lateral wings (organs of support and propulsion) sensorial organs (papillae) situated in very anterior region of the body, mouth surrounded by lips, spicules unequal, guiding piece or gubernaculum present; post anal papillae asymmetrical; vulva small and not projecting, uteri divergent, especially at ovijector.

Type species *Habronema muscae* Carter, 1861.

The following species are parasitic in equines in South Africa:—

Habronemae muscae Carter, 1861 (page 91).
H. (*Spiroptera*) *megastoma* Rudolphi, 1819 (page 93).
H. (*Spiroptera*) *microstoma* Schneider, 1866 (page 94).
H. zebrae, n.sp. (page 95).

(*b*) Subfamily *Arduenninae* Railliet and Henry, 1911.

Spiruridae: Mouth with two lips leading into a pharynx, which is strengthened by cuticular ridges in the form of rings or spirals. Spicules unequal, the longer several times the length of the shorter. Four pairs of preanal papillae. Eggs containing embryos when oviposited.

Type genus *Arduenna* Railliet and Henry, 1911.

Genus *Physocephalus* Diesing, 1861.

Arduenninae: Body elongated, tapering slightly anteriorly. Head marked off from the remainder of the body by a cuticular inflation, ending abruptly in a circular line a short distance, in front of the posterior end of the pharynx. Extending from the base of the cuticular inflation to about the middle of the body are six lateral alae, three on each side, the middle wing on each side being wider than the others. Mouth with two lips, each incised to form three lobes and each lobe bearing a papilla. The mouth communicating with an inconspicuous buccal cavity, which is without teeth, and this in turn opens into a relatively long and wide pharynx. The

walls of the pharynx are marked by cuticular ridges in the form of both spirals and rings, and extending the length of the pharynx. The tail of the male is twisted spirally and furnished with a narrow symmetrical bursa, supported by four pairs of preanal papillae. Spicules long and unequal, the left spicule about five times as long as the right. Vulva somewhat posterior of the middle of the body. Eggs smooth, with thick shells and containing embryos when oviposited. Usually parasitic in the stomach of Suidae and rodents.

Type species *Physocephalus sexalatus* (Molin, 1860) Diesing, 1861.

Physocephalus sexalatus (Molin, 1860) Diesing, 1861, has been reported from the donkey by Seurat (1) (page 98).

SPECIFIC DIAGNOSIS.

Strongylus equinus (Müller, 1780). Looss, 1900. (Plate I.)

Synonyms *Strongylus armatus* (Rudolphi, 1803); *Sclerostomum equinum* (De Blainville, 1828); *Strongylus neglectus* (Poeppel), 1897; *Sclerostomum quadridentatum* (Sticker, 1901).

Size.—Very large. Male 26-35 mm., with a maximum breadth of 1.1-1.3 mm. Female, 38-41 mm. (45-47, Looss), with a maximum breadth of 1.8-2.10 mm.

Head.—1.1-1.2 mm. is not marked off from the rest of the body. *Mouth collar* high.

Head papillae.—Submedian, projecting as short points beyond the surface of the mouth collar. Lateral papillae not prominent.

Mouth capsule shows a regular ellipsoidal shape almost equally rounded at both the anterior and posterior ends. 1.1 mm. deep, 0.8-0.9 mm. wide. Three teeth project into the buccal cavity; one of which is a projection formed by the walls of the dorsal gutter, and has its free extremity divided into two points. The two others, smaller in size, arise at a position which corresponds to the tops of the two subventral divisions of the oesophagus. All the teeth have a fairly elongated conical shape with rounded terminations.

Dorsal gutter well developed, its wall bearing the projection forming the dorsal tooth.

Leaf crowns.—External leaf crown consists of numerous elongated leaf-like elements arising from the anterior extremity of the mouth collar. Internal, a row of small hair-like elements.

Oesophagus.—Long and slender 1.8-2.5 mm.; slightly dilated at its junction with the mouth capsule, then gradually narrows down to the level of the nervous system; behind which it dilates, reaching its maximum thickness of 0.5 mm. a short distance before its termination.

Excretory pore far forward, just behind the mouth collar.

Cervical papillae at the level of the nerve ring.

Posterior extremity, male.—Bursa small, median lobe short and somewhat square in outline. Lateral lobes large and marked off from the posterior. Dorsal ray rather slender, short, 500-600μ in length, its branches arising near to one another, and are sub-equal. Externo-dorsal and laterals long and tapering. Ventrals short. Prebursal papilla very short.

Posterior extremity, female.—Long and tapering to a blunt tail. Anus 0.5-0.6 mm. from the tip. Vulva 12-14 mm. from the posterior extremity. At this level the body has a breadth of 1.6-1.8 mm.

Occurrence.—May occur throughout the colon and caecum, though preponderant in the ventral colon. Parasitic in the horse, mule, and donkey.

Strongylus edentatus Looss, 1900. (Plate 11.)

Synonyms *Sclerostomum equinum* Looss, 1900; *Sclerostomum equinum* pro parte.

Size.—Male, 23-26 mm. in length; maximum breadth 1.3 mm. Female, 33-38 mm. in length; maximum breadth 1.6-2.2 mm.

Head.—Is distinctly divided off from the remainder of the body, the neck-like construction being particularly marked in the female. *Mouth collar* comparatively high.

Head papillae.—The distal portions of the submedian scarcely projecting beyond the level of the mouth collar. Lateral papillae short, with a broad base.

Mouth capsule cup-shaped, its largest diameter of 0.85-1.1 mm. being near its anterior opening, and gradually diminishing towards the floor.

Dorsal gutter well developed, no tooth-like projections make their appearance from its base. Small irregular teeth may make their appearance at the top of the subventral divisions of the oesophagus.

Leaf crowns, external of numerous sharply-pointed leaves. Internal consists of a row of low conical teeth.

Oesophagus long and slender, 1.8-2 mm. in length with a maximum breadth of 0.4-0.6 mm.

Excretory pore far forward, shortly behind the mouth collar.

Cervical papillae at level of the nerve ring.

Posterior extremity, male.—Median lobe square and very short indeed, two well developed rounded lateral lobes, marked off from the posterior. Dorsal ray 400-475μ in length, bears small, very slender, branches, the external branch being the longest. Externo-dorsal ray slender. Lateral rays have very broad bases, with slender terminal portions, the medio-lateral and postero-lateral converge slightly. Anterior rays slender. Prebursal papilla long. Genital cone not well pronounced; dermal collar slightly developed on ventral surface.

Posterior extremity, female, tapers bluntly. Anus 450-600μ from tip. Vulva 10 mm. from tip. Breadth of body at level of vulva 1.6-1.9 mm.

Occurrence.—*S. edentatus* shows a decided preference for the ventral colon, where it may occur in large numbers. On the whole, however, it is less frequently met with than the other two of Looss' forms. It occurs as a parasite of the horse, mule, and donkey, and has been reported from a zebra from the Zoological Gardens in London.

Strongylus vulgaris Looss, 1902. (Plate III.)

Synonyms *Scelerostomum vulgare*, Looss, 1900; *Sclerostomum armatum* Rudolphi, according to Poeppel, 1897; *Sclerostomum bidentatum* (Sticker, 1901).

Size.—The smallest of the strongyli, the male, measuring 14-16 mm. in length, with a maximum breadth of 0.75-0.95 mm. The female is 20 mm. (23-24 mm., Looss), with a maximum breadth of 1.25-1.4 mm. The anterior extremity presents a truncate appearance; the caudal extremity in the female is slender and pointed.

Head.—Head not set off from the rest of the body.

Mouth collar comparatively high.

Head papillae.—The distal portions of the submedian scarcely projecting beyond the surface of the mouth collar. Lateral papilla short.

Mouth capsule slightly cup-shaped, its dorsal aspect a little more convex than the ventral one. Its maximum diameter 560-600μ near its anterior opening; its average depth 46-53μ.

Dorsal gutter well developed, a tooth projecting from its base. Seen from the ventral or dorsal view the termination of this tooth presents two fairly large and broad ear-shaped projections.

Leaf crowns, external composed of numerous sharply-pointed leaves. Internal consists of a row of low conical teeth or plates.

Oesophagus.—Long and slender; 140-170μ in length, with a maximum thickness of 32-40μ.

Excretory pore and cervical papillae situated at about the level of the nerve ring, 1.45 mm. from anterior extremity.

Posterior extremity, male.—Bursa has a median lobe of average length, roughly triangular in outline; lateral lobes well developed. Dorsal ray comparatively broad, 550-600μ in length. The arrangement of its branches may vary somewhat. Lateral rays divergent, ventrals long and parallel; prebursal papilla fairly long. Genital cone small; dermal collar not developed; the cuticle of the cone, however, being raised into a number of small hemispherical or button-shaped elevations.

Posterior extremity, female.—Slender and pointed; Anus 1-1.2 mm. from tip. Vulva 6-6.5 mm. (8 mm., Looss). Breadth of body at vulva about 1.2 mm.

Occurrence.—The commonest form in South Africa occurring in the caecum and ventral colon of the horse, mule, donkey, and zebra.

Strongylus asini Boulenger, 1920 (3). (Plate IV.)

Size.—Body large; male 18-32 mm. in length, with a maximum breadth of 1.8 mm. Female 30-42 mm., with a maximum breadth of 1.8-2.5 mm.

Head.—0.6-1.3 mm., is marked off from the rest of the body by a slight constriction, similar to but not nearly as well defined as that of *S. edentatus.*

Mouth collar deep and sharply marked off from the rest of the skin.

Head papillae as in the other species.

Mouth capsule strongly developed, markedly cup-shaped when seen in ventral or dorsal view. In lateral view the dorsal wall is seen to be shorter and more convex than the ventral, recalling the similar structure of *S. vulgaris.*

Dorsal gutter well developed, but considerably shorter than in the other species, its anterior termination being some distance behind the anterior margin of the mouth capsule. A single tooth arises from its base; like that of *S. vulgaris* it is divided into two broad

lateral projections, which are, however, relatively much lower than in that species, and subdivided by ill-defined grooves into a number of rounded cusps. The latter are variable in number; in the majority of specimens, however, three principal cusps are conspicuous, each composed of several smaller ones. There are no sub-ventral teeth such as are found in *S. equinus*.

Leaf crowns as in the type species.

Oesophagus.—1.6-2.4 mm. in length.

Excretory pore situated in the head region just behind the mouth collar.

Cervical papillae are in the neighbourhood of the nerve ring, about 1.5 mm. from the anterior extremity of the body.

Posterior extremity, male.—The bursa is small as compared with the size of the body, measuring up to 1.1 mm. in width. Median lobe is short. Rays of the bursa are similar to those of *S. edentatus*, i.e. they are more slender than those of *S. equinus*. The branches of the posterior ray differ from those of the other species, in that the inner dorsal branch is simple, the external branch divided, the converse of the arrangement prevailing in the genus. This character may, however, not be specific. Boulenger was only able to examine three male specimens, and the mode of branching of the posterior ray is liable to variation in many species of Strongyli. The spicules measure approximately 1.6 mm. in length.

Posterior extremity of female.—Tapering. Vulva 6-7 mm. from the posterior end of the body; the anus is 0.4-0.6 mm. from the posterior extremity.

Occurrence.—Described from the caecum and from a cyst in the liver of the donkey in East Africa.

Cylicostomum tetracanthum (Mehlis, partem Looss). (Plate V.)

Synonyms *Cylicostomum tetracanthum* (Mehlis, partem); *Strongylus tetracanthus* (Mehlis, 1831); *Sclerostoma quadridentatum* (Dujardin, 1845); *Sclerostomum tetracanthum* (Diesing, 1851); *Cyathostomum tetracanthum* (Molin, 1861); *Strongylus tetracanthus* (Schneider, 1866); *Cyathostomum tetracanthum* (Looss, 1900); *Cylichnostomum tetracanthum* (Looss, 1902).

Size and shape.—Males vary in length from 7-8 mm. (Looss, 9); average thickness about 0.3 mm. Females, 8-9.5 mm. (Looss, 10-12).

Head insignificantly separated from the remainder of the body, and in the females averages 130μ in breadth.

Mouth collar somewhat flattened towards its lateral border, scarcely projecting laterally when mouth opening is shut.

Papillae.—Lateral head papillae not prominent. Submedian head papillae moderately long, their bases somewhat broadened and separated from the slender extremities by lateral notches.

Mouth capsule.—Circular, not deep, 12μ deep, 60μ wide, its walls irregularly outlined, somewhat knee-shaped in profile, the chitinized extra portion of irregular outline converging from before backwards. Its posterior point of origin at anterior edge of mouth capsule.

Dorsal oesophageal gutter.—A blunt tubercle at the floor of the mouth capsule.

Leaf crowns.—External leaf crown of about 22 elongated septa-like leaves. Internal leaf crown originating from above the angle of the knee, well developed leaves about twice as numerous as those of external leaf crown.

Oesophagus.—Short and stout 360-400μ long, maximum breadth 112-120μ; cylindrical, with a slight thickening at its commencement.

Excretory pore immediately behind nerve ring.

Cervical papillae at about same level 280μ from anterior end.

Posterior extremity, male.—Medium sized median lobe, rounded in outline, not definitely marked off from laterals. Dorsal rays irregular in outline, and may have accessory branches. External dorsal branch slightly shorter than the medium and posterior dorsal branches. Laterals diverging; the tip of the median lateral converging with the externo-lateral, genital cone short, dermal collar developed on ventral surface only. Prebursal papillae short. Appendages of the genital cone separated from one another, but contiguous in the median line; ovoid, with a short blunt point arising on its posterior surface.

Posterior extremity, female.—Usually straight, but with strongly pronounced lateral prominences. Tail represented by a short acute point, which may be slightly bent dorsally, anal opening at its base 100-120μ from tip. Vulva 140-200μ in front of anus. Breadth of body at level of vulva 360-420μ. Vagina short. Eggs 76-80μ by 36-40μ.

Occurrence.—In South Africa this species displays a manifest partiality for donkeys, being present in nine of the eleven (donkeys) examined.

In horses and mules it never occurred, and once only in the zebra. Looss and Kotlán did not find it exclusively in donkeys. Looss does not even enumerate it in his list of forms characteristic for the donkey. Its chief haunt is the ventral colon, nor is it infrequent in the dorsal colon. I only found it once in the caecum, and then only in small numbers.

In Egypt (Looss) *C. tetracanthum* is found both in the horse and the donkey, and is the commonest form. In Hungary (Kotlán) it is also of frequent occurrence " am häufigsten in der unteren Colonlage."

Cylicostomum labratum (Loos, 1902). (Plate VI.)

Size and shape.—Delicate markedly slender worms. Male, 6.5-7 mm. (7-8 mm., Looss) in length; maximum breadth 280-340μ. Female, 7.5-9 mm. (9-9.5 mm., Looss), maximum breadth 320-380μ.

Head 104μ, separated from body by a slight constriction.

Mouth collar distinctly set off, projecting anteriorly into four lips.

Head papillae.—Lateral head papillae not prominent. Submedian head papillae moderately long, slender, distal extremity separated off by a slight notch.

Mouth capsule circular in transverse section, short, in the main cylindrical, 14-16μ deep, 40-44μ wide; its walls of moderate thickness throughout. Extra chitinous support of the external leaf crown present.

Dorsal oesophageal gutter does not project into the buccal cavity.

Leaf crowns.—Leaves of external leaf crown about 18 in number, their sharply-pointed tips clearly projecting beyond the mouth collar. Internal leaf crown shorter and leaves more numerous, originating just behind anterior border of mouth capsule.

Oesophagus.—Average length 340μ. Slightly swollen immediately behind the oral cavity, practically cylindrical, with but slight increase in width in its posterior portion, where it attains its maximum breadth of 80μ.

Excretory pore slightly in front of the long cervical papillae 240-280μ from anterior end.

Posterior extremity, male.—Bursa exhibiting a rather short median lobe, roughly triangular in outline, sometimes rounded. The dorsal rays do not spread out much, but run backwards, keeping nearly parallel, except at their tips, which diverge. Rays not very thick. Accessory branches may be present. Laterals diverge. Externo-dorsal arising near the postero-lateral, appendages of the genital cone without projecting points, pear-shaped, their thinner extremities diverging laterally.

Posterior extremity, female.—Straight, usually with pronounced lateral notches; blunter than *labiatum*. Tail representing a short point. Anus 60-70μ from tip of tail. Vulva 80-100μ in front of anus. At level of vulva the width of body is 140-160μ. Vagina short. Eggs 64-80μ by 32-40μ.

Occurrence.—Up to the present it has not been found in the zebra, but it occurs frequently, though never in great numbers, in the horse, donkey, and mule. Its favourite haunt is the ventral colon, but it may also be met with in the caecum, or other parts of the colon.

Looss cites it as the most characteristic form of donkeys, whereas in South Africa it is present in proportionately the same number of donkeys as horses, i.e. 55 per cent.

Cylicostomum ornatum (Kotlán, 1919) (1). (Plate VII.)

Size.—Female, 10-11 mm.; maximum thickness 0.51 mm. Male, 8-9 mm.; maximum thickness 0.34 mm.

Head.

Mouth collar similar to that of *C. calicatum*, its height is equivalent to half that of the mouth capsule.

Head papillae.—Submedian papillae are long, needle-shaped, and project well beyond the mouth collar. Lateral papillae shorter with a broader base.

Mouth capsule is similar in structure to that of *C. labratum* (Looss), 29μ high; walls diverging from before backwards, immediately in front of posterior opening of oral cavity, it is nearly twice as broad as high, 56μ. The walls of the buccal cavity are thin anteriorly (pointed in optical section), but soon attain their greatest thickness; after this they decrease in breadth, and end bluntly at their posterior end.

Dorsal oesophageal gutter opens as a slight tubercle in the posterior third of the mouth capsule.

Leaf crowns.—External leaf crown inserted at the base of the mouth collar, consists of 20-24 long lancet-like elements; not very refractive, project for a third of their length beyond the mouth collar.

Internal leaf crown arises at the anterior thickened portion of the mouth capsule. It consists of 36-44 comparatively short pointed elements, which are nearly three times as long as broad.

Oesophagus.—Slightly swollen immediately behind the buccal cavity, cylindrical up to the level of the nerve ring. On the whole, however, flask-shaped, female 0.51-0.53 mm. in length, male 0.44-0.47 mm.; maximum thickness 0.121 mm.

Excretory pore in the last third of the oesophagus. The thin pointed cervical papillae are at about the same level.

Posterior extremity, male.—The middle lobe of the bursa is comparatively short and broad. The dorsal rays originate in a thick trunk, no accessory branches.

Posterior extremity, female.—Resembles that of *C. tetracanthum*, somewhat " knotty," lateral notches present, with result that tail region is at an angle to longitudinal axis of body. Anus immediately in front of tail region, vulva near to anus.

Occurrence.—This species has up to the present only been reported from Hungary (Kotlán) (1).

Discussion.—There is a striking resemblance between this new species and *C. labratum*, especially in the size of the worm and in the structure of the posterior extremity of both the male and the female. The structure and the outlet of the dorsal gutter, however, differentiate it from Looss' form. In his description Kotlán states that " Die mundkapsel ist nach dem Typus derjenigen von *C. labratum* gebaut." In his drawing, however, he does not figure the extra chitinous supports of the external leaf crown, which is so characteristic of the *tetracanthum* group. According to the drawing of the head region *C. ornatum* ought rather to be placed in the *alveatum-catinatum* group, where it would come next to *C. goldi*.

Cylicostomum labiatum (Looss, 1902). (Plate VIII.)

Synonym *Cyathostomum labratum* (Looss, 1900), *ex parte*.

Size considerably larger and stouter than *C. labratum*. Males, 7.75-8.5 mm. (Looss, 8.5-9 mm.); maximum thickness, 360-400μ. Females, 9.5-10.75 mm. (Looss, 10-11 mm.); maximum thickness, 440-520μ.

Head.

Mouth collar distinctly set off, projecting anteriorly into four large lips, covering almost entirely the front of the head.

Papillae as in *C. labratum*, the distal portions of the submedian papillae, however, slightly longer.

Mouth capsule circular, extraordinarily short, 12-16μ deep and 50-56μ wide. Its walls thick, but decreasing in thickness toward the anterior and posterior openings. Extra chitinous supports of the external leaf crown are present.

Dorsal gutter represented by a well developed blunt tubercle.

External leaf crown composed of about 19 long and sharply-pointed leaves, their extremities scarcely projecting out of the mouth opening. *Internal leaf crown* starting at thickest portion of the wall of the mouth capsule.

Oesophagus rather thicker than in *C. labratum*. 360-380μ long, with a maximum breadth of 96-112μ.

Excretory pore and *Cervical papillae* at about the same level just behind the nerve ring 300-380μ from anterior extremity.

Posterior extremity, male.—Bursa possessing a rounded median lobe of extreme shortness. Dermal collar exceptionally well developed ventrally, medio- and postero-lateral rays converge, the dorsal rays show a tendency to develop irregular outlines or even accessory branches. Appendages of the genital cone absent; replaced by two medium-sized pointed prominences of the posterior part of the dermal collar directed towards each other.

Posterior extremity, female, constantly raised towards the dorsal aspect; tail represented by a short point usually bent ventrally. One pair of flat lateral knots. Anus 45-80μ from tip of tail measured diagonally. Vulva 120μ in front of anus; at this level the body has an average thickness of 140-160μ. Eggs 76-80μ by 32-38μ. Vagina of average length.

C. labiatum (Looss) var. *digitatum.* Ihle, 1921 (10).

Ihle describes a variety of *C. labiatum* Looss which agrees in the main with the typical form.

Males, 7-8 mm.; immature females, 8-8.75 mm. *Oesophagus,* 345-410μ. The dorsal lobe of the bursa varies in length, and is generally longer than in Looss' form. Length of the dorsal ray measured from point of origin of the postero-external ray varies from 310-380μ. Besides the processes of the dermal collar present in the typical form, this variety shows finger-like processes on both sides of the posterior part of the genital cone; the number and form of these processes fluctuate—as many as three may be present.

Posterior extremity of female as in the typical form. Distance from anus to vulva is smaller (ca, 95μ in immature), and the distance from anus to tip is 80-110μ measured along the axis of the body.

Occurrence.—Both these forms occur in South Africa; the typical form, however, being the more abundant. In size it is generally somewhat smaller than the Egyptian form. They are to be found in practically all portions of the colon, but more especially in the ventral colon of horses, mules, and donkeys. Not reported from the zebra as yet.

Cylicostomum coronatum (Looss, 1902). (Plate IX.)

Size.—Males 8.75-9 mm. (Looss, 7-8 mm.); maximum breadth 340-360μ. Females 9.5-10 mm. (Looss, 9-10 mm.); maximum breadth 400-440μ. Body slender and delicate, females easily recognized even with the naked eye by their whip-like posterior extremity.

Head.—116-120μ, sometimes appears separated from the body by a very slight neck.

Mouth collar sharply set off against the remainder of the skin, about as high as it is thick.

Head papillae submedian, with the distal portion rather long and narrow. Lateral papillae not prominent.

Mouth capsule nearly cylindrical, considerably longer than in the other species of this group (except perhaps *ornatum*), 44-50μ deep by 24-28μ wide. Its walls remarkably thick throughout, except at extreme anterior end, slightly bent inwards at about the middle. The extra chitinous support of the external leaf crown may sometimes be at right angles to the mouth capsule walls or nearly parallel to them, according to the state of contraction of the mouth opening.

Dorsal gutter does not project into the buccal cavity.

Leaf crowns.—External leaf crown composed of about 22 long sharply-pointed leaves, which project beyond the mouth opening. Internal leaf crown applied to the thin portion of the mouth capsule; its elements fairly short.

Oesophagus.—Cylindrical, with slight swelling at its posterior extremity, 380-400μ long, with a maximum thickness of about 100μ.

Excretory pore and *cervical papillae* at a short distance behind the nerve ring, 280-300μ from anterior extremity.

Posterior extremity, male.—Possessing a median lobe of considerable length, and with almost parallel borders. Length of dorsal ray measured from point of insertion of postero-external ray averages 600μ, medio- and postero-lateral rays rather thicker than the rest. Accessory branches may be present on the dorsal rays. Appendages of the genital cone somewhat removed from one another, almost spherical, their apices beset with a number of delicate points.

Posterior extremity, female.—Straight and slender, the sub-lateral knots hardly ever prominent. Distance from anus to tip of tail 160-200μ. Distance from anus to vulva 120-140μ (Looss, 115μ). At this level the body has a width of 140-160μ. Vagina 280-360μ, fairly long. Eggs 80-90μ by 36-44μ.

Occurrence.—Mainly in the caecum, but may also be present in comparatively large numbers in the ventral colon. Found in the zebra as well as in the domesticated equines.

Cylicostomum sagittatum (Kotlán, 1920) (3). (Plate X.)

Size.—Males 10-11 mm.; maximum breadth 0.4 mm. Females 12-12.5 mm.; maximum breadth 0.5 mm.

Mouth collar is of medium height.

Papillae.—Submedian papillae project beyond the mouth opening, conical base; lateral papillae not prominent.

Mouth capsule.—Depth 0.04 mm., decreasing in thickness towards the anterior and posterior openings (0.1-0.12 mm.) converging slightly from before backwards. The extra chitinous supports of the external leaf crown (i.e. problematic structure of Loos in the substance of the mouth collar) greatly converging from before backwards.

Dorsal gutter opens at the base of the buccal cavity.

Leaf crowns.—External leaf crown composed of about 18-20 fairly broad pointed elements, hardly projecting beyond the mouth opening, originating at anterior extremity of mouth capsule. Internal leaf crown of numerous (70-80) narrow leaves, inserted at the thickest portion of the mouth capsule.

Oesophagus.—0.6-0.7 mm. long, with a maximum breadth of 0.18 mm.

Excretory pore and cervical papillae just behind nerve ring in the middle third of the oesophagus.

Posterior extremity, male.—Middle lobe is long, and consequently dorsal rays are also long. Appendages of the genital cone almost spherical, their apices beset with a number of delicate points—similar to those of *C. coronatum*.

Posterior extremity, female.—Similar in structure to that of *C. elongatum*, i.e. gradually tapering down to the anus, behind this suddenly falling away into the short stout tail, lateral knots removed

from one another and fairly prominent. At the base of the tail 0.14 mm. from the tip is the anus, distance between anus and vulva 0.16 mm.

Occurrence.—Only reported once from the caecum of a horse in Hungary.

Cylicostomum alveatum (Looss, 1902). (Plate XI.)

Size.—Males 10-10.5 mm.; maximum breadth 0.5-0.55 mm. Females 10.5-12.5 mm. (up to 13 mm., Looss); maximum breadth 0.62 mm.

Head.—Males 140μ. Females, ca. 160μ, continuous with the rest of the body.

Mouth collar ellipsoidial with its dorso-ventral axis, somewhat longer than its lateral one, rounded in profile, separated from the remainder of the skin by a flat furrow, or merely by a constriction.

Head papillae.—Submedian papillae very short, laterals not prominent.

Mouth capsule fairly deep, 48-54μ, not cylindrical, ellipsoidal in cross section, its longer axis dorso-ventrally. Walls of the mouth capsule tolerably thick, slightly bent inwards laterally, and thicker than on the dorsal and ventral aspects. Owing to this arrangement the mouth capsule offers a rather dissimilar appearance according to whether it be viewed dorso-ventrally or laterally.

Dorsal gutter entirely absent; orifice of the dorsal oesophageal gland situated on the floor of the oral cavity.

Leaf crowns.—External composed of 29 short pointed leaves, which hardly project beyond the mouth opening. Internal leaf crown not originating in a single plane, but slightly nearer the anterior extremity at the sides than dorsally and ventrally.

Oesphagus relatively short 660-800μ (Looss, 600μ), swelling behind oral cavity, slightly narrowed down to the nerve ring, then gradually enlarging, extreme diameter 160-190μ.

Excretory pore and the fairly long *cervical papillae* at about the level of the nerve ring; 360-390μ from anterior extremity.

Posterior extremity, male.—Medium sized, rounded median lobe, which is usually somewhat closed; not distinctly separated off from the lateral lobes by the usual notch. Length of posterior dorsal ray measured from point of origin of postero-external ray 560-620μ. Rays all divergent. Accessory branchings very frequent. Dermal collar not well developed. Appendages of the genital cone cylindrical, somewhat diverging towards the sides; their free extremities continued into a rod-like process with rounded termination.

Posterior extremity, female.—Sharply bent to the dorsal aspect at an obtuse angle; a pair of knot-like prominences arising on the opposite side. The whole termination of the body thus assumes a rather truncate appearance. A clitellum-like thickening of the subcuticular substance is often seen embracing the body in front of the sub-ventral prominences. Tail very short indeed. Anus 60-72μ from tip, vulva 70-80μ in front of anus. Vagina long up to 900μ. Eggs 80μ by 40μ.

Occurrence.—Mainly in the caecum. Very frequent in the zebra. In the domesticated equines it is rare; it was only present in small numbers in one horse.

Cylicostomum catinatum (Looss, 1902). (Plate XII.)

Size.—Males 7-8 mm.; females 9-9.5 mm., of an average thickness of 0.35 mm.

Head slightly thickened.

Mouth collar well developed and distinctly set off against the remainder of the skin, its shape slightly ellipsoidal, with dorso-ventral axis slightly longer than the lateral one; rounded in profile.

Head papillae.—Submedian papillae with fairly long distal portions. Lateral papillas fairly prominent.

Mouth capsule fairly deep, ellipsoidal in cross-section with its longer axis dorso-ventrally. Walls of considerable thickness at the sides slightly bent inwards and thicker than on the dorsal and ventral aspects; so that the mouth capsule presents a different appearance when seen laterally than from a dorsal or ventral aspect.

Leaf crowns.—External leaf crown of 21 pointed leaves, which project beyond the mouth opening. Internal leaf crown not arising in one place, but originating at the sides, somewhat nearer to the anterior margin of the mouth capsule than dorsally and ventrally.

Dorsal gutter absent, orifice of the dorsal oesophagus gland opening on the floor of the oral cavity.

Oesophagus only slightly narrowed at the level of the nerve ring.

Excretory pore and *cervical papillae* at the level of the nerve ring.

Posterior extremity, male.—Bursa remarkable for its extremely short, not quite semi-circular, median lobe, accessory branches present, genital cone short, directed almost exactly backwards. Dermal collar well developed, appendages of the genital cone medium length processes, with notched outlines and rounded extremities.

Posterior extremity of the female.—Terminal portion bent to the dorsal aspect at about a right angle; the portion itself markedly thin in comparison with the preceding portion of the body. Ventral prominences large and projecting; tail exceedingly short; vulva 0.06 mm. in front of the anus.

Cylicostomum catinatum Looss var. *litoraureum.* (Yorke and Macfie, 1920) (10). (Plate XII.)

Size.—Male 9 mm., Females 8.75-12 mm., average 9.9 mm.

Indistinguishable from *C. catinatum* (Looss) excepting by the characters of the genital cone, which exhibited a striking difference. The appendages of this worm consist of two long finger-like processes, each bearing a tubercle on its inner aspect and a short process between them.

Cylicostomum catinatum (Looss) var. *pseudocatinatum* Yorke and Macfie, 1919 (6). (Plate XII.)

* Synonym: *Cylicostomum pseudocatinatum* Yorke and Macfie, 1919.

Size.—Small delicate species. Males 5.2-6.6 mm., greatest breadth 260μ. Females 6.1-7.7 mm., greatest breadth 320μ.

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* Yorke and Macfie originally described this worm as a new species, but as it does not differ more from *C. catinatum* than does *C. catinatum* var. *litoraureum* it cannot be considered as a new species, but is rather to be looked upon as a variety of *C. catinatum* Looss.

Head.—Neck separating the head from body is distinct. Mouth collar marked off from rest of skin by a definite constriction.

Head papillae.—Submedian papillae pointed and projecting beyond mouth opening. Lateral papillae prominent.

Mouth capsule.—Ellipsoidal with its longer axis dorso-ventrally. Walls of mouth capsule are slightly kneed inwards, very stout posteriorly and slender anteriorly. When viewed laterally the walls converge considerably from before backwards; ventral wall longer than dorsal as also in the typical form.

Dorsal gutter does not project into the buccal capsule.

Leaf crowns.—External of 20 large pointed elements. Internal of numerous long narrow elements arising from the middle of the mouth capsule, just anterior to the knee; the line of origin laterally is somewhat nearer the anterior opening of mouth capsule than it is dorsally and ventrally.

Oesophagus.—In the males 314-349μ long and 70-82μ broad. In the females 322-363μ long and 72-83μ broad.

Excretory pore and *cervical papillae* at about the same level; they lie over the third or fourth fifth of the oesophagus behind the nerve ring.

Posterior extremity, male.—Dorsal lobe short almost semi-circular. Accessory branches present. Length of main trunk of posterior ray from tip to point of origin of postero-external ray varies from 230-298μ. Dermal collar well developed. Appendages on each side are represented by slight elevations, furnished with two conical processes, the inner being the larger.

Posterior extremity, female, is bent dorsally at right angles. Ventral prominence large and projecting. Tail short and conical. Distance between anus and vulva 45-85μ, distance from tip to anus 54-81μ.

Discussion.—These three forms which are essentially the same except for a slight difference in size and slight variations in the appendages of the male genital cone, may yet prove to be the same worm.

Looss' *typical form* has medium long processes with notched outlines and rounded extremities.

Var. *litoraureum* has two long finger-like processes, each bearing a tubercle on its inner aspect and a short process between them.

Var. *pseudocatinatum.*—Appendages on each side are represented by slight elevations furnished with two conical processes, the inner being the larger.

Even here the differences are not very great. The South African worms presented appendages, which in the main resembled those of the *pseudocatinatum* variety, with slight variations. Thus a third lateral process was occasionally developed, or more often tubercles were added to the two original conical processes, some forms thus presenting more the appearance of the *litoraureum* appendages. Besides these slight differences in the appendages the measurements of the South African worms were on the average slightly larger than those given by Yorke and Macfie.

Males 5.75-7.25 mm. Maximum breadth 250μ-300μ. Females 6-7.75 mm. Maximum breadth 360μ.

Occurrence.—*C. catinatum* var. *pseudocatinatum* displays a decided partiality for the ventral colon, but may also be found in the caecum and other parts of the colon. It may be present in great numbers in horses, donkeys, or mules, but is entirely missing in the parasitic fauna of the zebra.

Cylicostomum pateratum Yorke and Macfie, 1919 (6). (Plate XIII.)
=*Cylicostomum cymatostomum* Kotlán, 1919 (1).

Size.—Males 8-9.5 mm. (10-11 mm. Kotlán), maximum breadth 380μ (0.6 mm. Kotlán). Females 8.4-11 mm. (13-15 mm. Kotlán), maximum breadth 393μ (0.7 mm. Kotlán).

Head separated from the body by a neck.

Mouth Collar.—High and marked off from the rest of the skin by a constriction; is characterized by a peculiar narrowing opposite the lateral papillae.

Head papillae submedian, pointed and projecting, their distal extremities separated off by lateral notches. Lateral prominent.

Mouth capsule ellipsoidal in transverse section, its longer axis running dorsal-ventrally. The lateral walls, seen in optical section, are wedge-shaped, being slender anteriorly and stout posteriorly. Anteriorly they are continued into the extra chitinous structure. Inner surface notched at the insertion of the internal leaf crown. When viewed laterally the walls of the buccal capsule converge considerably from before backwards. 25-28μ deep; when seen from the side the mouth capsule appears less deep owing to the fact that the walls of the buccal capsule are set obliquely. Lateral diameter at anterior opening 85-89μ, posterior opening 79-88μ.

Dorsal gutter does not project into the buccal cavity.

Leaf Crowns.—External leaf crown composed of about 22 large pointed elements projecting out of the mouth opening. The internal consists of numerous long narrow elements arising from a sinuous line situated deep in the mouth capsule.

Oesophagus of medium size 530-595μ (Kotlán 0.76 mm.) slightly swollen immediately behind the buccal cavity, cylindrical up to the nerve ring, increasing in breadth behind this level and reaching its maximum thickness 146-149μ (Kotlán 180μ) just before the posterior extremity.

Excretory pore and *cervical papillae* immediately behind the nerve ring 300-360μ from anterior extremity.

Posterior extremity, male.—The dorsal lobe of the bursa is short, about semi-circular. Length of main trunk of posterior ray from the tip to point of origin of the postero-external ray 442μ. Small accessory branches may be present. Externo-dorsal ray sharply bent backwards. Lateral ray comparatively plump, all diverging slightly, Ventrals parallel but not long; prebursal papilla of average length. Dermal collar well developed on both the ventral and the dorsal surface of the genital cone. The appendages are represented by slight elevations, furnished with three conical processes, the innermost bearing a long finger-like process. In some cases only the innermost elongated process is present.

Posterior extremity, female.—The end of the body is bent dorsally at right angles. Ventral prominence large and projecting. Tail short and conical. Distance measured straight along the middle

line of the tail from the tip to a line drawn horizontally through the anus averages 114μ; distance between anus and vulva 104μ. Vagina short 360-420μ. Eggs 88-100μ by 40-44μ.

Occurrence.—Of frequent though never numerous occurrence in the horse; rare in the donkey and mule and as yet not reported from the zebra. It is mostly found in the ventral colon.

Cylicostomum goldi (Boulenger, 1917) (2). (Plate XIV.)

Synonym *C. tridentatum* Yorke and Macfie, 1920 (8).

Size.—A moderately small species of the genus *Cylicostomum*. Males 5.2-6 mm. (7-7.5 mm. Y. and M.); maximum breadth 230-280μ (307μ Y. and M.). Females 6-7.8 mm. (7.6-9.75 mm. Y. and M.); maximum breadth 280-300μ (450μ Y. and M.).

Head.—80-100μ in breadth, may be marked off from the rest of the body by an ill-defined neck.

Mouth Collar.—High and separated from the rest of the skin by constriction.

Head papillae.—Submedian, conical and projecting, their small distal extremities separated off by a constriction; lateral inconspicuous.

Mouth capsule.—Almost circular in transverse section. Walls of almost uniform thickness throughout, kneed slightly at the insertion of the internal leaf crown, decreasing in thickness anteriorly. Mouth capsule fairly deep 20μ (29μ Yorke and Macfie), and 45-60μ in breadth.

Dorsal oesophageal gutter projects into the buccal capsule as a small tubercle.

Leaf crowns.—External consists of about 20 large leaf-like elements. Internal is composed of about 36 rather long, moderately broad elements, having a pallisade-like appearance.

Oesophagus.—Moderately long, somewhat slender and cylindrical, 300-500μ, its maximum breadth 70-75μ (104-131μ Y. and M.). Oesophageal funnel very well developed and from its chitinized walls three small triangular teeth, corresponding to the three divisions of the oesophagus, project into the mouth capsule one dorsal and two ventro-lateral.

Excretory pore and *cervical papillae* situated rather far back on the body, at a level half-way between the nerve ring and the posterior extremity of the oesophagus, 250-300μ from the anterior end of the body.

Posterior extremity, male.—Bursa has a medium-sized dorsal lobe, rounded in outline and in some cases appears almost semicircular. Length of main trunk of posterior ray about 450μ. Dorsal rays diverging but slightly; accessory branchings may be present on the main dorsal branch. Lateral rays small, diverging; the posterolateral rather longer than the other two. Prebursal papilla short. Dermal collar is well developed on both the dorsal and the ventral surfaces of the genital cone. Appendages of the genital cone (Boulenger) have the form of very thin delicate plates, each provided with two slender, finger-shaped processes. Appendages (Yorke and Macfie) are absent; two finger-like processes similar to those of *C. labiatum*, however, may be present on the posterior part of the dermal collar.

Posterior extremity, female, is bent dorsally almost at right angles to the main axis of the body. Ventral prominence usually large. Tail short and conical. Anus 100-110μ from the posterior extremity. Vulva about 110μ in front of anus. Vagina short. Eggs have an average length of 100μ by an average breadth of 50μ.

Discussion.—In his original description Boulenger (2) stated, that the dorsal oesphageal gutter was absent. Upon further examination, however, he remarked, that it is present as a small tubercle and also draws attention to the three chitinous teeth which project from the oesophageal funnel into the oral cavity. This modified description of *C. goldi* agrees entirely with that given for *C. tridentatum*, except for the structure of the genital appendages. In most of the South African worms I not only found either the typical *C. goldi* or *C. tridentatum* appendages or their modifications separately, but very often both in the same worm. Thus *C. tridentatum* can no longer be considered as a separate species.

Occurrence.—A very common parasite of the colon, especially the dorsal portion; very rare in the caecum. Has also been reported from the zebra (Vevers) as well as from the horse, mule, and donkey.

Cylicostomum mettami Leiper 1913 (4).

Size.—The worms, male and female, are fairly large and stout, as compared with the other species in the genus ranging about 12-44 mm. in length.

Mouth collar is separated off from the rest of the skin by a slight constriction. Head papillae are not specially well defined.

Mouth capsule has a depth in proportion to its transverse diameter as 2:5.

Dorsal gutter not mentioned in the description.

Leaf crowns not mentioned.

Oesophagus is short and thick.

Excretory pore lies on a level with the greatest diameter of the oesphagus.

Posterior extremity, male.—Genital cone is enormously developed, extending beyond the bursal membrane, which latter is itself abnormally enlarged ventrally, in consequence of which the prebursal papillae are very stoutly developed and resemble the ventral rays. Spicules long and hair-like.

Posterior extremity, female.—Tilted dorsally and ends in a blunt and well defined stump. Immediately in front of the anus lies the vaginal orifice, into which, in the original specimen the spicules of the male were inserted.

Occurrence thus far reported but once from England.

Cylicostomum radiatum Looss, 1902. (Plate XV.)

Size.—General appearance rather bulky. Male 10-11 mm. long; maximum breadth 550-580μ. Female 11.5-12 mm. (Looss 13-14 mm.) maximum breadth 700-720μ.

Head.—140-200μ, continuous with the body.

Mouth collar bulky, marked off from the rest of the skin by a definite constriction; mobile, presenting therefore various aspects according to the state of contraction of the mouth opening; notches present in its anterior border, when the mouth opening is shut.

Head papillae.—Submedium head papillae, with long distal extremities; laterals slightly prominent, especially when the mouth collar is wide open.

Mouth capsule gently ellipsoidal in cross section with the longer axis running from side to side; fairly low 52μ, with a maximum width of 112μ. Walls thin and straight, with a hoop-like thickening at their posterior margin. When seen in cross sections the wall presents a more or less pronounced undulating course.

Dorsal gutter entirely absent.

Leaf crowns.—External composed of 26 rather flat elements, originating about midway up the mouth collar and converging in the main horizontally towards the axis of the body. Their internal, regularly rounded extremities usually bent slightly upwards.

Internal leaf crown conspicuous, composed of numerous short rectangular plates.

Oesophagus.—Long and narrow and relatively little enlarged posteriorly. It ranges from 0.8 mm. to 1 mm. in length, with its greatest breadth 104-200μ.

Excretory pore and *cervical papillae* at a short distance behind the nerve ring 540-670μ from anterior extremity.

Posterior extremity, male.—Bursa has a medium sized median lobe with rounded outline which is separated from the lateral lobes by a definite notch. Dorsal ray varies between 720μ and 800μ. Lateral branching present. The lateral rays of unequal size; the postero-lateral being the longest and thickest and the externo-lateral the smallest; all diverging. Prebursal papilla very short. Appendages of the genital cone blended together in the median line and adhering to the cone on a broad base; their shape is transversely oval; their rounded free extremities are bent towards the ventral aspect; a short blunt point arises on their posterior surface.

Spicules about 1.8 mm. in length.

Posterior extremity, female, somewhat tapering towards the short stout tail; the lateral prominences may be well developed. Distance between anus and tip (measured in a straight line) 200-250μ; distance between anus and vulva 250-280μ; at this level the body measures 290-300μ. Vagina long 0.6-0.75 mm.

Eggs 92μ long by 45-48μ wide.

Occurrence.—C. radiatum is one of the rarer *Cylicostomes,* it was never present more than four or five at a time and was only to be found either in the ventral colon or pelvic flexure. It may occur in the horse, mule, or donkey.

Cylicostomum triramosum Yorke and MacFie, 1920 (12). (Plate XVI.)

Size.—A fairly large species. Male measuring 12.3 mm., with greatest breadth 630μ. Female 14 mm., with greatest breadth 640-690μ (Yorke and MacFie give 12.3 mm. long; greatest breadth 750μ).

Head.—Continuous with the body.

Mouth collar high and voluminous, marked off from the skin by a slight constriction.

Head papillae.—Submedian prominent, their extremities marked off by a constriction; lateral prominent and projecting as slight horns, accentuated when the mouth opening is wide open.

Mouth capsule gently ellipsoidal in transverse section, with its longer axis running from side to side. Walls as seen in optical section are thin and slightly curved, with a hoop-like thickening posteriorly. Capsule not deep, 38μ, but wide, having a maximum diameter of over 90μ.

Dorsal gutter does not project into the buccal capsule.

Leaf crowns.—External consists of at least 30μ long, sharply pointed elements, arising from the anterior half of the mouth collar. Internal consists of numerous minute blunt elements, arising from the anterior margin of the mouth capsule.

Oesophagus long with a marked swelling behind the nerve ring. Its length in the male 840μ; in the female 880-940μ, with a maximum breadth of 200μ.

Excretory pore and *cervical papillae* lie just behind the nerve ring. 520μ from the anterior extremity of the body.

Posterior extremity, male.—Dorsal lobe of the bursa is of moderate length; length of the main trunk of the posterior ray from the tip to the point of origin of the externo-dorsal ray 635μ. The posterior ray gives off three lateral branches, the upper two of which arise close together. The dermal collar is well developed on both the ventral and dorsal surfaces of the genital cone. The genital appendages consist of two large plates arising separately, diverging from the middle line and each terminating in two finger-like processes, the inner of which is the larger. The finger-like processes are bifid at their tips.

Posterior extremity, female.—Straight; body gradually tapering down to the anus, behind this suddenly falling away to the short tail. Distance of anus from tip of tail 160-200μ, measured in a straight line Distance between anus and vulva 290-360μ (264μ Y. and M.). Vagina short 320-360μ.

Occurrence.—*C. triramosum* seems to be peculiar to the zebra. It is a rare form, Yorke and MacFie only having found one male and one female. In the South African material out of three zebras only three worms were found, one zebra harbouring two of these. All three came from the ventral colon.

Cylicostomum elongatum Looss, 1902.

Size.—One of the largest *Cylicostomes;* both anterior and posterior portions slightly tapering towards the extremities. Length of male 12-13 mm., that of female up to 17 mm.

Head.—Marked off from the rest of the body by a slight neck.

Mouth collar bulky, fairly mobile, distinctly separated off from the rest of the skin by a constriction.

Head papillae.—Submedian long, somewhat broadened at their base, the broader part separated from the short distal portion by lateral notches and exhibiting a small median furrow. Lateral papillae large, prominent.

Mouth capsule ellipsoidal in cross section, its longer axis running dorso-ventrally 52μ. Walls thin and slightly curved outwards, with a well pronounced posterior hoop-like thickening; when the mouth opening is wide open the walls diverge slightly from before backwards.

Dorsal gutter absent, oesophageal gland opening at the base of the mouth capsule.

Leaf crowns.—External composed of about 36 rather flat elements, originating near the posterior margin of the mouth collar, their rounded extremities projecting out of the mouth opening and usually curved outwards. Internal leaf crown fairly conspicuous composed of small elongated plates.

Oesophagus elongated to a striking degree, 1.4 mm. in large females. Cylindrical up to the nerve ring; behind this it swells suddenly and is cylindrical, with an average breadth of 200μ, posterior portion showing darker pigmentation than the anterior.

Excretory pore and *cervical papillae* behind the nerve ring, far forward on the oesophagus, 630-700μ from the anterior extremity of the body.

Posterior extremity, male.—Bursa fairly broad; the median lobe elongated, but rather narrow; separated from the lateral lobes by distinct notches. Posterior ray up to 1 mm. Appendages of the genital cone strongly granular and completely opaque, sausage shaped, the rounded extremities bent inwards; no posterior point developed.

Posterior extremity, female.—Body gradually tapering down to the anus, behind this suddenly falling away into the short stout tail. Distance between vulva and anus 0.18 mm.; lateral knots removed from one another and fairly prominent.

Cylicostomum elongatum var. *Kotláni* Ihle, 1920 (7). (Plate XVII.)

Synonym *C. elongatum* var. *Macrobursatum* Kotlán, 1920.

Distinguishable from *C. elongatum* Looss by its median lobe, which is elongated to a striking degree. In a male of 13 mm. the distance between the tip of the posterior ray and the insertion of the externo-dorsal ray was 1.5 mm.; in the typical form this is only up to 1 mm.

The worms present in the South African material belong to *C. elongatum* var. *Kotláni*, having the following measurements:—

Size.—Males 12-14 mm.; maximum breadth up to 0.75 mm. Females 14-15.5 mm.; maximum breadth up to 0.8 mm.

Oesophagus.—Males 1.3-1.6 mm.; maximum diameter 180-200μ. Females 1.5-1.6 mm.; maximum diameter 180-220μ.

Excretory pore 630-700μ from anterior extremity.

Posterior lobe elongated to a striking degree in adults; posterior ray measuring 1.65 to 1.9 mm. The rays show the following peculiarities:—The comparatively thin externo-dorsal arises at the base of the posterior lobe; the external branch of the dorsal ray originates not far from this; whereas the median branch only arises far down, in about the last third of the posterior ray, and runs parallel with the main or internal branch. Behind the point of insertion of the external branch, the dorsal ray bears numerous accessory branches, the lateral rays are comparatively short and thick; the curved postero-lateral being the largest and the externo-lateral the smallest. The two ventrals are narrow and parallel.

Posterior extremity, female.—Distance of anus from tip 150-200μ. Distance between anus and vulva 160-200μ; at this level the body has an average diameter of 300μ. Vagina strikingly long 1.2-1.4 mm., when not contracted. Eggs 84-88μ by 40-44μ, usually not beyond the 2 to 4 celled stage at oviposition.

Occurrence.—Is a characteristic form of the caecum of the donkey, rarely occurring elsewhere. May also be found in the horse.

Cylicostomum insigne Boulenger, 1917 (2). (Plate XVIII.)

Synonym *C. zebrae* Boulenger, 1920.

Size.—Fairly large. Males 11-12.5 mm.; maximum breadth 650-700μ. Females 13.5-15 mm. long; maximum breadth 750-850μ.

Head continuous with the body, averaging 240μ in breadth.

Mouth collar comparatively narrow and marked off from the rest of the skin by a definite constriction.

Head papillae.—Submedian short; short distal portion well marked off from the narrow proximal portion. Lateral papillae prominent and project as horn-like processes.

Mouth capsule large, with a depth of 46-66μ and a maximum breadth averaging 180μ. Walls thin anteriorly, slightly curved, increased posteriorly to form a hook-like thickening.

Dorsal gutter is absent, oesophageal funnel hardly developed.

Leaf crowns.—External consists of about 36 pointed leaves, whose extremities are curved outwards out of the mouth opening. Internal is composed of numerous almost inconspicuous elements, appearing as a finely striated zone, immediately in front of the mouth capsule.

Oesophagus is long 800-1000μ (700-900μ Boulenger) rather narrow at nerve ring, it broadens out posteriorly and attains a maximum thickness 240-260μ (200-300μ Boulenger).

Excretory pore, situated at approximately the level of the junction of the oesophagus and intestine, 0.920-1.1 mm. from anterior extremity of body. Cervical papillae placed immediately anterior to the excretory pore.

Posterior extremity, male.—Bursa is broad; median lobe of average size, roughly triangular in outline. Dorsal ray, measured from the tip to the point of insertion of externo-dorsal ray, 0.7-0.73 mm.; fairly thick with smooth outlines. Lateral rays of unequal size; the externo-lateral being smaller and thinner than the other two, from which it diverges. Ventrals short, broad at their bases, and tapering suddenly distally. The dermal collar of the genital cone is well developed, especially on the ventral surface; prehursal papilla long. Appendages are broad and fused together in the middle line, each bears one or more small processes which are usually filled with dark granulations. Seen laterally they are conspicuous as a dark globule.

Posterior extremity, female, is bent slightly dorsally, tapering gradually to the anus, behind which point it narrows suddenly and forms a little conical tail. Irregular swellings are often present in front of the vulva. Distance from tip of tail to anus 160-250μ; distance between anal cleft and vulva 200μ; at this level the body has a breadth of 280-340μ. Vagina very long 1.35-1.8 mm. when not contracted. Eggs measure 84-88μ (75-86μ Boulenger) in length, with a breadth of 36-40μ (45-50μ Boulenger).

Occurrence.—Reported as the commonest *Cylicostome* in Indian horses, where it is found almost solely in the dorsal colon. Is met with fairly often in South African equines, but never in great numbers. Zebra as well as the horse, mule, and donkey harbour it.

Cylicostomum adersi Boulenger, 1920 (3). (Plate XIX.)

Size.—A large species. Males 12.5-14 mm. long, with a maximum breadth 0.75-0.9 mm. Females 14-16 mm. long, maximum breadth up to 1.1 mm.

Head.—Over 200μ may be marked off from the body by a very slight neck.

Mouth collar comparatively narrow.

Head papillae.—Submedian short, with short and blunt distal extremities, projecting well beyond the mouth collar when the mouth opening is open. Lateral papillae not prominent as a rule.

Mouth capsule is broad, having a depth of 60-72μ, with a breadth of 140-160μ. Wall thin, curved, increased posteriorly to form a well marked hoop-like thickening, behind which it sends out a thin projection into the anterior end of the oesophagus. Oesophageal teeth, as characteristic as in *C. goldi*, may project into the buccal-capsule.

Dorsal gutter present, but is very short, just projecting into the mouth capsule.

Leaf crowns.—External consists of 28-30 long, narrow, pointed leaves, the extremities of which curve outwards out of the mouth opening. Internal composed of about twice this number, smaller and less conspicuous elements.

Oesophagus short and squat, with its length varying between 600-660μ (700μ Boulenger) in the males, and 640-720μ in the females. The almost globular posterior portion attains a maximum breadth of 220-280μ (170μ Boulenger).

Excretory pore and *cervical papillae* behind the nerve ring 600-650μ from the anterior extremity in the female; 500-540μ in the male.

Posterior extremity, male.—The bursa has a broad round median lobe 1 mm. in length, which is marked off from the voluminous lateral lobes by a well marked notch at the apex of its posterior margin. All the branches of the dorsal ray originate very near to one another, diverging slightly, and reaching almost to the free edge of the lobe. Accessory branchings may be present. Laterals diverging, externo-lateral being shorter and thinner than the other two. Genital cone completely surrounded by a well developed dermal collar. Prebursal papillae slender and very long (250μ). The appendages of the genital cone are completely fused in the middle line, forming a thin semi-circular plate, the margin of which bears four pairs of delicate finger-shaped processes, some of which have bifurcated extremities. On each side of this is an additional process arising from the dermal collar.

Posterior extremity, female, irregularly tapering to long tail. Lateral and ventral bosses developed to a striking degree; when viewed from the dorsal aspect the posterior extremity may be seen to have been displaced laterally so as to be ont of a line with the main axis of the body. Distance of anus from tip 150-220μ measured in a straight line, distance between anus and vulva 260-400μ according to the state of contraction of the posterior extremity. Vagina short 0.95-1.3 mm. Eggs 80-88μ by 36-40μ.

Occurrence.—*C. adersi* was never found in great numbers; it is usually present in the posterior portion of the colon, i.e. pelvic flexure and dorsal colon. It seems to show a marked preference for the donkey and zebra. It was only found once in the mule and never in the horse.

Cylicostomum nassatum Looss, 1902.

Size.—In general appearance rather bulky. Length of males about 10 mm., breadth 0.3 mm.; length of females up to 14 mm., breadth 0.6-0.7 mm. (perfectly mature individuals, however, were met with, the length of which is not more than 8 mm. in the male and 9 mm. in the female).

Head not at all separated from the body.

Mouth collar very mobile and presenting various aspects in preserved specimen, very transparent, not broader than the body, sharply set off from the skin by a deep constriction; about as thick as it is high, its anterior border more or less notched according to the state of contraction.

Head papillae.—Submedian moderately long; lateral slightly prominent; when the mouth collar is wide open, they project as small ear-like processes.

Mouth capsule low, presenting a gently ellipsoidal cross section, the longer axis of which runs from side to side; its anterior opening is commonly somewhat contracted. Walls very thin at the anterior margin, slightly increasing in thickness backwards, presenting a sharply pronounced hoop-like thickening at the posterior margin.

Dorsal gutter well developed and terminates about midway between the anterior and posterior openings of the mouth capsule.

Leaf crowns.—External composed of 20 elements arising internally, from the base of the collar and directed obliquely forwards, their pointed extremities pointing as a rule out of the mouth opening. Internal composed of minute rectangular plates (visible only under high powers).

Oesophagus about cylindrical in its anterior half, gradually enlarging behind the nerve collar.

Excretory pore and *cervical papillae* shortly behind the nerve collar.

Posterior extremity, male.—Bursa rather broad, with a relatively short rounded median lobe. Appendages of the genital cone blended together in the median line, and adhering to the cone at a broad base; their shape transversely oval or pyriform, the posterior surface endowed with a short, blunt point.

Posterior extremity, female, somewhat tapering towards the tail; the latter about 0.2 mm. in length with a slender terminal point. Distance between genital and anal openings about 0.17 mm., sublateral knots well developed.

Cylicostomum nassatum Looss var. *parvum.* [Yorke and Macfie, 1918 (3)]. (Plate XX.)

Apart from its small size, average length of males 7 mm., females 8.8 mm.; and from the possession of a third (small) lateral branch to the posterior ray, this worm is indistinguishable from *C. nassatum* Looss. The forms present in the South African material more closely approach the smaller variety than the typical form. The third (small) lateral branch of the posterior ray, however, is more in the nature of the usual variety accessory branches, so often found on the posterior ray, than a constant ray. In the appendages the short blunt point may be prolonged into a finger-like process, and the entire appendage may be lobed. The following are the measurements:—

Male 7-8 mm.; maximum breadth 360μ. Female 7-10 mm.; maximum breadth 400-440μ; or in the larger worms up to 560μ.

Head.—120-140μ.

Mouth capsule very variable according to the degree of contraction of the mouth opening, 36-40μ deep—with a maximum width of 80μ.

Leaf crowns.—The internal is usually clearly visible even with the lower powers.

Oesophagus.—In the males 480-520μ by 116-125μ; in the females average 600μ by 144-160μ.

Excretory pore 320-380μ from anterior extremity.

Posterior extremity, male.—The length of the median lobe is variable; the posterior ray ranging between about 380 and 500μ.

Posterior extremity, female.—Distance of anus from tip 120μ, distance between anus and vulva 120-160μ; at this level the body measures 160-180μ in diamater. Vagina has an average length of 400μ. Eggs 80-84μ by 40-44μ.

Occurrence.—After *C. catinatum* this is the commonest and most abundant parasite of the ventral colon. It was present in practically all the animals examined and usually in great numbers. It may occur in the other parts of the colon and in the caecum, especially if the horse is heavily infected with *Cylicostomes*. On the whole, however, it is rare in the dorsal colon. Horses, mules, and donkeys harbour this form; it has also been reported as occurring in a zebra (Vevers, 1920).

Cylicostomum leptostomum Kotlán, 1920 (3). (Plate XXI.)

Size.—A moderately small species, the males average 6 mm. and the females 7-8 mm.

Head.—84μ marked off by a slight neck.

Mouth collar high, separated off from the rest of the skin by a well defined constriction, mobile as in *nassatum*.

Head papillae.—Submedian long, with fairly long and narrow distal portions. Lateral prominent, but do not form definite horn-like processes as in *C. nassatum*.

Mouth capsule.—Almost cylindrical. Its walls very thin at the anterior margin, slightly increasing in thickness backwards, presenting a sharp pronounced hoop-like thickening at the posterior margin. 18μ deep by 36μ in width.

Dorsal gutter present as a small tubercle.

Leaf crowns.—External of about 24 long elements, arising internally from the base of the collar and directed obliquely forwards, their extremities reaching to the anterior edge of the mouth collar. Internal leaf crown composed of numerous small rectangular plate-like elements.

Oesophagus fairly long and cylindrical 430-480μ (520-650μ Kotlán) by 84-120μ.

Excretory pore and cervical papillae behind the nerve ring 280-320μ from anterior extremity.

Posterior extremity, male.—Bursa rather broad with a fairly long posterior lobe marked off from the laterals by a notch. Dorsal ray long 360-440μ and provided with numerous large accessory

branches. External dorsal branch somewhat removed from the median branch. Lateral rays equally divergent; the externo-lateral and the medio-lateral showing a tendency to converge at their tips. Prebursal papilla moderately long. Genital cone and dermal collar well developed. The lobed genital appendages adhere to the cone by a broad base; transversely oval with numerous processes on their posterior surface.

Posterior extremity, female.—Straight and slightly blunt, tail short, slender, and sharply set off from the body. Distance of anus from tip 64-70μ. Distance between anus and vulva 80-90μ. Vagina 300-400μ.

Occurrence.—Usually present with *C. nassatum* var. *parvum* but never in great numbers in the domesticated equines.

Cylicostomum auriculatum Looss, 1902. (Plate XXII.)

Size the largest *Cylicostome*. Body present a very bulky and blunt aspect, cephalic and caudal extremities of the female markedly truncate. Length of males 15-17 mm., breadth 0.89-0.95 mm.; length of females up to 26 mm., thickness about 1 mm.

Head.—240-280μ continuous with the body, which increases rapidly in breadth, attaining at the level of the nerve ring a diameter of 480-550μ.

Mouth collar low dorsally and ventrally, but strongly enlarged laterally owing to the peculiar shape of the lateral head papillae. Marked off by a deep constriction.

Head papillae.—Submedian short, with extremely long narrow rod-like distal portions. Lateral of unusually strong development, appearing in the form of two small horns when viewed from the dorsal or ventral side of the animals.

Mouth capsule of tolerable depth 64-75μ, with an average width of 160μ. Its walls thin, slightly curved outwards; with a well pronounced hoop-like thickening at its posterior extremity.

Dorsal gutter absent.

Leaf crowns.—External composed of about 42 leaves, rather flat; originating about mid-way up the mouth collar and converging in the main horizontally towards the axis of the body, their rounded extremities usually slightly bent upwards. Internal represented by a row of minute tubercles.

Oesophagus.—Long 1.15 mm. and of peculiar shape. Swollen at junction of the mouth capsule, narrowing to nerve ring, reaches its maximum thickness, 300μ, at about the midle of the posterior half; behind this decreases appreciably in thickness again.

Excretory pore placed extraordinarily far back, about half the length of the oesphagus, behind the commencement of the intestine, about 1.65 mm. from anterior extremity of the body.

Cervical papillae a short distance in front of the pore.

Posterior extremity, male.—Bursa broad, possesses a broad median lobe of moderate length, marked off from the lateral lobes, with a well-defined notch at the apex of its posterior margin. Length of posterior ray 900μ. Dorsal rays very irregular in outline and bear accessory branches; externo-dorsal, arising near the external branch of the posterior ray, may also have accessory branchings. Laterals of about equal length, diverging slightly from one another. Ventrals comparatively short. Genital cone short, dermal collar

developed on ventral side only. Appendages blended together in the median line, transversely oval; a short point may be present on the posterior surface, usually densely granulated and almost opaque.

Posterior extremity, female, presents various aspects, according to the degree of protrusion of the ventral prominences, is usually bent towards the dorsal aspect, tapers somewhat towards the anus, behind which it suddenly narrows into the very short and broad triangular tail. Distance between anus and tip of tail, measured in a straight line, 70-100μ; distance between anal cleft and vulva 130-190μ; at this level the body has a diameter of 280-350μ. Vagina long 1.7-1.9 mm. Eggs 86-90μ by 44-48μ.

Occurrence.—C. auriculatum together with *C. elongatum* and *C. tetracanthum* is the commonest *Cylicostome* parasitic in the donkey, where it is to be found in any part of the colon. The donkey, in South Africa as in Egypt, seems to be the only equine harbouring this species.

Cylicostomum calicatum Looss, 1902. (Plate XXIII.)

Size.—Very delicate and slender; in preserved material is recognized by its darker colour. Length of males 5.5-6.5 mm.; maximum thickness 260-280μ. Length of females 6.5-8 mm.; maximum thickness 280-340μ.

Head.—75-88μ, slightly narrowed, marked off from the body by a slight neck.

Mouth collar low, may be flattened, separated off from the rest of the skin by a definite constriction, which in some cases takes the form of groove.

Head papillae.—Submedian, long and narrow, distal portions marked of by a deep notch. Lateral head papillae not prominent.

Mouth capsule usually slightly deeper than wide, 28-40μ by 24-38μ; practically cylindrical. Walls straight and slightly thickened posteriorly.

Dorsal gutter well developed, extending to anterior margin of mouth capsule.

Leaf crowns.—External composed of about 10 (more than 8 Looss) rather broad elements, with bluntly pointed extremities. Internal composed of numerous short refractive rod-like elements arising at anterior margin of mouth capsule.

Oesophagus long, 300-400μ; anterior portion cylindrical, with a slight swelling at junction with the mouth capsule; posterior portion swollen, reaching a maximum breadth of 68-80μ.

Excretory pore a little behind nerve ring, 220-250μ from anterior extremity. *Cervical papillae* a little behind this (or in front of this, Looss).

Posterior extremity, male, characterized by a long narrow bursa. Dorsal ray 400-480μ. Branches of posterior ray arise at approximately equal distances from one another and all run backwards. Occasional accessory branches may be present. Postero- and medio-lateral rays short, with broad bases, whose distal extremities fall away to short sharp points; slightly convergent. Externo-lateral slender and divergent. Dermal collar surrounding the short genital cone. Genital appendages removed from one another, roughly spherical their apices set with a number of long finger-like projections, which may be bifid.

Posterior extremity, female.—Straight, tail slender and sharply set off from the body. Distance from tip to anus measured in a straight line 80-100μ; distance between anus and vulva 60-80μ; at this level the body has a diameter of 100-120μ. Lateral prominence may be feebly developed. Vagina of average length 320-400μ when not contracted. Eggs 64-68μ by 36μ.

Occurrence.—Together with *C. catinatum* and *C. nassatum*, *C. calicatum* may be said to be the commonest form occurring in South African horses. It thrives equally well in the caecum and ventral colon, and, except in heavily infected hosts, never wanders into the dorsal colon. It is also abundant in the mule and donkey, but up to now has not been found in the zebra.

Cylicostomum minutum [Yorke and Macfie, 1918) (2).] (Plate XXIV.)

Synonym *C. calicatum* var. *minus* Kotlán, 1920.

Size.—The smallest *Cylicostome* described. Males average 4.5 mm. in length; with greatest breadth 230μ. Females up to 6 mm.; with greatest breadth 280μ.

Head.—60μ, continuous with the body.

Mouth collar fairly high, set off from rest of the cuticle by a definite constriction.

Head papillae.—Submedian long and projecting, distal portions short. Lateral scarcely projecting beyond the surface of the mouth collar.

Mouth capsule.—Circular in transverse section. Walls slightly curved, and diverge from before backwards, practically of equal thickness throughout. Capsule deeper than broad. Having a depth of 23-28μ with a maximum diameter of 20μ.

Dorsal gutter well developed, extending nearly to the anterior opening of the buccal cavity.

Leaf crowns.—External composed of 8 broad leaves. Internal of about 20 stout elements arising from the anterior margin of the mouth capsule.

Oesophagus very long, 300-320μ in length, cylindrical, with but a slight posterior swelling, which has a maximum breadth of 50-60μ.

Excretory pore and *cervical papillae* at about the same level, some distance beind the nerve ring 240-248μ from anterior extremity of the body.

Posterior extremity, male.—Dorsal lobe broad and short, if anything less than a semicircle. Dorsal ray 140-170μ. Branches of posterior ray regularly divergent. Lateral rays diverge; mediolateral somewhat longer than the other two. Ventrals very long. Dermal collar extremely well developed, both on dorsal and ventral surface. Appendages are slightly elevated bodies, having on their posterior surfaces two long finger-like processes; they do not meet in the middle line or meet to form a circular mass, bearing four projections.

Posterior extremity, female.—Straight, but may be bent either dorsally or ventrally according to the state of contraction of the posterior body muscles. It tapers to the slender well marked off pointed tail, which is usually tucked in ventrally. Distance of anus from tip of tail, measured in a straight line, 60-64μ. Distance between anus and vulva 80μ; at this level the body has a breadth of 120μ. Vagina short 120μ.

Occurrence.—Is fairly frequently met with, its favourite haunt being the ventral colon, and it may occasionally appear in the caecum. In the South African material it was found in the horse, mule, and donkey, but not in the zebra. It is, however, reported as occurring in the zebra in British East Africa (Boulenger, 1920).

Cylicostomum longibursatum [Yorke and Macfie, 1918 (1).] (Plate XXV.)

Synonym *C. calicatiforme* Kotlán, 1919 (1), *C. nanum* Ihle, 1919 (1).

Size.—A small slender *Cylicostome.* Male and females are of about the same length, between 5 and 7 mm., with their greatest breadth varying between 220μ and 280μ.

Head 68μ, marked off from body by a slight neck.

Mouth collar low, separated from the rest of the cuticle by a definite constriction.

Head papillae.—Submedian, fairly long, and project beyond mouth collar. Distal ends separated off by the notches; are short. Lateral papillae not prominent.

Mouth capsule.—Circular in transverse section; the walls seen in optical section are slightly kneed, moderately stout, and diverge in the main from before backwards so that the buccal cavity is trapezium-shaped. The capsule has an average depth of 19-24μ, with a maximum diameter of 26-32μ at its posterior opening.

Dorsal gutter projects into the posterior quarter of the buccal cavity.

Leaf crowns.—External composed of 18 long narrow elements pointed at the tips. Internal consists of about the same number of short broad elements arising immediately behind the anterior margin of the mouth capsule.

Oesophagus fairly short, its length varying between 240μ and 280μ (306-340μ, Kotlán), with an average maximum breadth of about 60μ.

Excretory pore and *cervical papillae* far back over the posterior fourth of the oesophagus, 200-220μ from anterior extremity of body.

Posterior extremity, male.—Dorsal lobe strikingly long and narrow. Posterior ray may measure as much as 660-800μ in length. The branches of the posterior ray arise far apart, and in the main run parallel to the main axis of the body. Lateral rays are stout, have a very small sharp point at their distal extremities, and are divergent. Ventrals small. Dermal collar developed on both dorsal and ventral surface of cone. Appendages conical when viewed laterally, broad and united when viewed ventrally, ventral surface beset with small papillae.

Posterior extremity, female.—Straight and tapering. Tail, which is distinctly demarcated from the end of the body, is straight, fairly long, and tapers gradually to a point. Distance from tip of tail to anus, measured in a straight line, 80-120μ. Distance between anus and vulva 60-70μ; at this level the body has a diameter of 76-90μ. Vagina long 240-280μ. Eggs 76-80μ by 32-36μ.

Occurrence.—The commonest and most characteristic form present in the dorsal colon, though it may sometimes be found in large numbers in other parts of the colon as well. Parasitic in the donkey and mule as well as in the horse.

*Cylicostomum hybridum** Kotlán, 1920 (3). (Plate X.)

Size.—Males 9-9.5 mm. in length; maximum breadth 0.34 mm. Females 10-10.5 mm. in length; maximum breadth 0.37 mm.

Head continuous with the body.

Mouth collar low, marked off from the rest of the cuticle by a definite constriction.

Head papillae.—Submedian long and projecting, with short distal portions. Lateral not prominent.

Mouth capsule. circular in cross section, roughly trapezium-shaped, fairly deep 32μ; with a breadth of 37μ at its anterior and 54μ at its posterior opening. Walls of the mouth capsule increase in thickness posteriorly.

Dorsal gutter well developed, reaching into the anterior quarter of the mouth capsule.

Leaf crowns.—External composed of 14-16 long pointed elements 18μ in length. Internal consists of numerous small rod-like elements arising from the anterior border of the mouth capsule.

Oesophagus.—0.44 mm. in length, swollen immediately behind the buccal cavity, otherwise cylindrical up to the nerve ring with a diameter of 0.54 mm.; increase behind this flask-like in width and attains a maximum diameter of 81μ just in front of its posterior extremity.

Excretory pore and *cervical papillae* immediately in front of the posterior end of the oesophagus.

Posterior extremity, male.—Bursa has a short median lobe. In my only specimen the left external branch of the posterior ray is only half as long as the right external, and does not seem to be fully developed. On the right side the branches are of equal length and originate close together. Genital cone bears a broad dermal collar. Appendages below the anterior lip of the cone resemble those of *C. labratum*, i.e. pear-shaped, with a small projection on each; besides this there are two medium sized prominences on the posterior part of the dermal collar.

Posterior extremity, female, bears a short (56μ) terminal point. Immediately in front of this is the anus. Distance between anus and vulva 94μ.

Occurrence.—Does not occur in South Africa and seems to be rare in Hungary. Kotlán only once found a few specimens.

Cylicostomum poculatum Looss, 1902. (Plate XXVI.)

Size.—Long and slender. Males 8-9 mm. in length; maximum breadth 360μ. Females up to 10 mm. in length, maximum breadth 440μ.

Head.—120-128μ, continuous with the body.

Mouth collar markedly flattened and separated from the skin by a definite constriction.

Head papillae very long, flattened, imitating the shape of pine needles with a groove down the centre. Distal portion marked off by definite notches.

Mouth capsule slightly deeper than wide 60-64μ by 56-60μ; cylindrical anterior margin somewhat contracted; walls thin, but gradually thickening towards their posterior border, in the vicinity of which they are fairly thick.

* Description taken from Kotlan, 1920 (3).

Dorsal gutter projecting for a short distance into the mouth capsule.

Leaf crowns.—External composed of 30-35 elongated, slender and pointed elements, whose tips project somewhat beyond the apex of the collar. Internal of short but stout, refractive rod-like elements.

Oesophagus remarkably long 0.8-1 mm.; approximately cylindrical, somewhat swollen behind the nerve ring, reaching its maximum diameter 140-170μ at about the middle of its posterior half.

Excretory pore and *cervical papillae* just behind the nerve ring 460-560μ from anterior extremity.

Posterior extremity, male.—Bursa entirely surrounds the genital cone, with an average size rounded median lobe, which is definitely marked off from the voluminous lateral lobes, its edge finely denticulated. Dorsal ray, 320μ, has accessory branches. Branches of posterior ray do not reach edge of the lobe. Projections not infrequently arise from its inner surface between the posterior rays. Laterals, slender pointed rays diverge, the angle between the medio-lateral and postero-lateral being greater than that between the medio-lateral and extero-lateral. Ventral rays long and slender. Genital cone elongated and almost cylindrical and reaches beyond the free edge of the bursa. Looss remarks that "its terminal portion looks as if transversely annulated." This annulation is merely due to the retraction of the cone. Dermal collar well developed, but on the ventral surface only. Appendages of the genital cone hemispherical. Ano-genital opening apparently directed upwards towards the dorsal aspect, more markedly so when the cone is strongly contracted.

Posterior extremity, female.—Straight and markedly slender; with a long pointed tail. Distance of anus from tip 290μ. Distance between anus and vulva 160μ. At this level the body has an average diameter of 200μ. Lateral prominences may be feebly developed. Vagina very short, 128μ.

Occurrence.—Very restricted distribution, only occurring in small numbers in the caecum of the horse. This agrees with Looss' observation in Egypt.

Cylicostomum asymetricum, n.sp. (Plate XXVII.)

Size.—A moderately small species. Males 7.5-8 mm.; maximum breadth 400-440μ. Females 7.5-8 mm.; maximum breadth 440-520μ.

Head.—Anterior extremity tapers slightly to the head; there is no definite neck.

Mouth collar comparatively high and marked off from the rest of the skin by a slight constriction. Narrows slightly opposite the lateral papillae.

Head papillae.—The submedian project and are as long as the external leaf crown; their distal portions are marked off by a slight notch. Laterals not prominent.

Mouth capsule.—Of average depth; slightly deeper ventrally than dorsally, i.e. 24μ ventrally, 18-20μ dorsally. In some specimens this difference in depth is very marked indeed, making the mouth capsule appear as though set obliquely. It has an average width anteriorly of 40-50μ, and 50-60μ posteriorly. The walls are thick and swollen at the anterior end and decrease in thickness posteriorly.

Dorsal gutter well developed and projects far up, extending nearly to the level of the anterior opening of the mouth capsule.

Leaf crowns.—External composed of about 15 large pointed elements, projecting well beyond the mouth collar. Internal of about 26 short, broad elements having a palisade-like appearance.

Oesophagus not very long, 440-500μ, with a slight swelling immediately behind the oral cavity, thins towards the nerve ring, and attains its maximum thickness, 120-140μ, immediately before its posterior extremity.

Excretory pore and *cervical papillae* at about the same level immediately behind the nerve ring, 340μ from anterior extremity.

Posterior extremity, male.—Fairly short median lobe; lateral lobes marked off from the dorsal by a notch, rays well developed, dorsal trunk split far back. Accessory branches may be present on all the dorsal branches. Main dorsal ray, measured from point of insertion of postero-external ray, is 380μ in length. Lateral rays thick at their bases, distally tapering suddenly to sharp points, divergent. Dermal collar only developed on ventral surface of cone. Genital appendages may be absent. If present, they are fused and viewed ventrally, appear circular, and have two to three projections on both sides.

Posterior extremity, female, straight. Tail comparatively short. Distance from tip of tail to anus 120μ. Distance from anus to vulva 200μ. Vagina fairly long 400-480μ. Eggs average 90-100μ by 40-48μ.

Occurrence.—Only a few specimens have been found. They occur mainly in the dorsal colon of the horse, mule, or donkey.

Cylicostomum bicoronatum Looss, 1902. (Plate XXVIII.)

Size.—Body manifestly stout and but slightly tapering towards the extremities. Male 12 mm. long; maximum breadth 400-440μ. Female 13-14 mm. long; maximum breadth 480-550μ.

Head continuous with the body.

Mouth collar separated from the remainder of the skin by a feeble constriction; somewhat flattened towards its lateral margin.

Head papillae.—Submedian papillae represented by rather short points. Lateral papillae but slightly prominent.

Mouth capsule extremely short; 18-20μ deep, 68-72μ wide. Walls thick throughout.

Dorsal gutter well developed, terminating near the anterior border of the mouth capsule.

Leaf crowns.—External leaf crown, composed of about 30 narrow sharply pointed elements, forms the apex of the head. Internal leaf crown most conspicuous. Its long, strongly refractive elements start from inside the anterior border of the mouth capsule and converge towards the inner base of the mouth collar.

Oesophagus thickened to a striking extent, fills almost the whole of the body cavity. At its commencement it is thicker than the buccal cavity; its diameter reaching posteriorly 0.22 mm. Its average length is 0.6 mm. or more.

Excretory pore and *cervical papillae* at about the same level. 320-400μ from anterior extremity, a little distance behind the nerve ring.

Posterior extremity, male.—Bursa with an elongated triangular median lobe; genital cone presents its original conical shape almost unaltered, the dermal collar being rather flat and slightly prominent. Appendages of the genital cone long and slender, with rounded extremities and directed parallel to the cloacal cavity.

Posterior extremity, female.—Generally looks as if it were cut off somewhat obliquely. Tail bluntly triangular. Distance from anus to tip 0.06-0.1 mm. Vulva a short distance in front of anus 0.15-0.25 mm. Ventral prominences strongly pronounced. Vagina fairly long, 0.75-0.8 mm. Eggs 112-120μ by 56-58μ.

Discussion.—The worms present in the South African material were on the average slightly smaller than Looss' typical form. Males 10-10.5 mm., females 10.75-12 mm. The females otherwise agreed in all respects with Looss' description and drawings. The males showed a slight difference in the bursa. In all the specimens examined the bursa presented a cramped appearance when seen from the lateral aspect. The dorsal lobe is shorter and rounder and of variable length and the laterals rather larger Except for the slight differences in length, the rays, however, have the same disposition as in the typical form. Prebursal papillae are short and stout. The ventral rays are thin and curved and the latero-ventral touches the ventro-ventral at its tip; the laterals are thin, long, and diverge but slightly, the medio-lateral, however, being somewhat shorter than its two neighbours; the externo-dorsal ray is remarkably thin; the posterior rays are thin, irregular in outline, and may bear accessory branches. Length of posterior ray 450-520μ. Genital appendages as described by Looss. Spicules about 2.1 mm.

These slight differences in the length of the worm and in the size of the bursa, however, are well within the limits of variability of a species; nevertheless, I think they are of sufficient importance to be noted.

Occurrence may be said to be one of the rarer forms, occurring only in small numbers in any part of the colon. When present it shows a very slight preference for the ventral colon. Found in the horse, donkey, and mule, but not in the zebra.

Cylicostomum euproctus Boulenger, 1917 (2). (Plate XXIX.)

Size comparatively stout and tapering towards both extremities. Males 6.75-7 mm. long, with a maximum thickness of 400-440μ. Females 8.5-9.5 mm. (6-8 Boulenger); maximum breadth 540-640μ (350-450μ Boulenger).

Head marked off from the body by a slight neck; its diameter 110-130μ.

Mouth collar rather high; somewhat flattened towards its lateral margin, so as to appear hemispherical when seen from the dorsal or ventral aspect. No definite constriction marking it off from the rest of the skin.

Head papillae.—Submedian short and spherical. The laterals are not prominent.

Mouth capsule.—Depth 14-20μ, width at point of insertion of internal leaf crown 64-80μ. Walls thick, with greatest breadth at point of insertion of internal leaf crown, behind which they become thinner. They diverge slightly from before backwards, especially

when seen from the ventral or dorsal aspect. Their shape as seen in optical section varies considerably in the different specimens and also according to the orientation of each particular worm.

Dorsal gutter absent, oesophageal gland opening at the base of the capsule.

Leaf crowns.—The external leaf crown consists of about 40 narrow and pointed leaves. The elements of the internal leaf crown are conspicuous, being highly refractive; about 30 in number, they arise within the anterior half of the capsule, but not in the same plane; laterally the point of origin is slightly nearer the anterior opening than dorsally and ventrally. This difference, however, is not very marked.

Oesophagus short and thick, 360-410μ by 130-170μ; approximately flask-shaped, widest at its posterior extremity.

The excretory pore and *cervical papillae* are situated about halfway (or posteriorly to this) between the nerve ring and the posterior extremity of the oesophagus, 320-400μ from the anterior end of the worm.

Posterior extremity, male.—Dorsal lobe of moderate length; the lateral lobes are distinctly marked off from the dorsal and are voluminous, embracing the cone ventrally. The prebursal papillae are long, and in this worm appear to be true rays, in that they support the anterior portions of the lateral lobes. The ventral rays are also exceptionally long. The externo- and medio-laterals converge and the postero-lateral diverges from the medio-lateral. There are no accessory branches. The genital cone is of enormous length and projects well beyond the free edge of the bursa; it is retractile in some worms, being drawn in so as to be well within the limits of the lobes. The dermal collar is well developed ventrally and laterally, but only slightly dorsally. Appendages are long, narrow, and cirrus-shaped.

Posterior extremity, female, is straight and tapers to a point. The anus is situated 180-240μ from the posterior extremity, and the vulva 320-400μ; at this level the thickness of the body measures 160-200μ. Vagina fairly short 360-440μ. Eggs 84-92μ long by 52-56μ broad.

Discussion.—In 1918 Yorke and MacFie created a new species of *Gyalocephalus* (*G. equi*), which differed from the type species *G. capitatus* solely in the greater length of its genital cone; stating, however, "possibly the cone may be protusible and retractile, but we must point out that there is no evidence that such is the case in allied genera." Not only can the cone be retracted in *Gyalocephalus capitatus*, but also in *C. euproctus* and to a lesser extent in *C. poculatum* and *Cylindropharynx intermedia*.

Occurrence.—*C. euproctus* is not one of the commoner forms; it is occasionally present in the dorsal colon and pelvic flexure. In one case only were there more than ten. Is parasitic in the horse, mule, and donkey.

Cylicostomum ihlei Kotlán, 1921 (4). (Plate XXX.)

Size.—Large and fat. The males are 9-10 mm. long, with a maximum breadth of 595μ. The females are 10-14 mm. long, with a maximum breadth of 600-900μ.

Head.—260-270μ. A slight neck may be present.

Mouth collar fairly high; the constriction separating the mouth collar from the rest of the skin is but feebly marked.

Head papillae.—The submedian are conical and their distal extremities rounded. Lateral papillae large, but not projecting beyond the mouth collar.

Mouth capsule circular in transverse section, nearly cylindrical, diverging slightly from before backwards, with a maximum width of 140-150μ; walls increase slightly in thickness from before backwards, and immediately before their posterior extremity they thin suddenly. In certain worms belonging to this species, the external surface of the anterior margin of the mouth capsule is characterized by the presence of eight semicircular (in dorsal or ventral view) ledges, whose arrangement is regular, namely, between every two submedian papillae there is a pair of ledges, and between every lateral and submedian papillae a single ledge.

Dorsal gutter absent.

Leaf crowns.—External is composed of about 60 slender and sharply pointed elements; internal originating just behind the anterior border of the mouth capsule, consists of 40-46 large bluntly pointed leaves; they extend mid-way up the mouth collar.

Oesophagus thick, and has a length of 640-720μ; almost cylindrical up to nerve ring, behind which it slightly increases in thickness up to a maximum of 200-260μ.

Excretory pore and *cervical papillae* lie over the posterior third of the oesophagus; 500-650μ from anterior extremity of the body.

Posterior extremity, male.—The bursa has a moderate sized median lobe which is rounded. Long prebursal papillae. Dorsal rays of equal length. Genital cone appendages in some respects similar to those of *P. ratzii*, i.e. irregularly lobed.

Posterior extremity, female, gradually tapering down to the anus, behind which it suddenly falls away especially ventrally into the short stout tail. Distance of anus from tip 250-300μ. Distance of anus from vulva 140-170μ. Vagina over 800μ when not contracted. Eggs 124-128μ by 60-62μ.

Occurrence.—*C. ihlei* is very rare; it was only present in four animals, twice in the horse and once in the mule and donkey. No males were found.

Cylicostomum ultrajectinum Ihle, 1920 (4, 8, 9). (Plate XXXI.)

Size.—A large fat worm. Males range between 11-12.5 mm., maximum breadth 580-610μ. Females range between 11-17 mm., maximum breadth 880-940μ.

Head.—300-350μ broad, continuous with the body.

Mouth collar fairly high, when the mouth is open, separated off from the rest of the skin by a constriction.

Head papillae.—Submedian project, are broad, with a slight constriction cutting off rounded distal portion. Laterals short.

Mouth capsule wide, 170-190μ, but not deep, 60μ, almost cylindrical in shape, converging slightly from before backwards. Walls of average thickness, with a definite hoop-like thickening at their posterior extremity.

Dorsal gutter absent.

Leaf crowns.—External composed of 10-12 large elements, whose extremities are usually bent outwards and backwards. Internal composed of about 46 leaves, of which about 12 are larger than the others. Leaves all point towards the centre of the mouth opening, two to four ordinary leaves present between every two of the larger elements.

Oesophagus short and thick, 690-700μ long by 250μ broad in the male and 750μ by 280-310μ in the female.

Excretory pore and *cervical papillae* lie far back, immediately before the junction of the oesophagus and chyle intestine, 800-900μ from anterior extremity of body.

Posterior extremity, male.—The broad bursa has a short median lobe. Dorsal rays branch regularly from the same point of origin and are of equal length, 620-650μ. Medio-lateral and postero-lateral diverge, but both reach to edge of bursa. Externo-lateral and medio-lateral converge, the former, however, ending some distance away from the edge of the lobe. The ventral rays and prebursal papillae are comparatively long. The broad genital cone bears a well developed dermal collar. Genital appendages are absent in some worms, but when present they appear as narrow plates with two short projections, one pointing posteriorly and the other postero-laterally. Spicules about 1.75 mm.

Posterior extremity, female.—Gradually tapering down to vulva, behind which it suddenly falls away—especially ventrally—into the short stout tail. Distance of anus from tip (measured in a straight line) 250-300μ. Distance between anus and vulva 300-350μ; at this level the body has a breadth of 350-400μ. Vagina short, about 500μ, when not contracted. Eggs 120-128μ by 56-60μ.

Occurrence.—Occurs very rarely, and when present is usually to be found in the dorsal colon, but never in great numbers. It was only met with in the horse and mule.

Cylicostomum brevicapsulatum Ihle, 1920 (3). (Plate XXXII.)

Size.—Males 9-11.5 mm., with maximum breadth 480-560μ. Females 10-13.5 mm., with maximum breadth 650-750μ.

Head.—Immediately behind the anterior extremity the worm increases in thickness, so that the head is marked off from the rest of the body by its smaller diameter.

Mouth collar high, marked off from the rest of the skin by a constriction. It seems to be highly contractile; when the mouth is wide open its anterior border is flat; when it is contracted, however, it shows deep indentations.

Head papillae.—Lateral not prominent. Submedian fairly short (10μ), and their thinner distal portions are almost as long as the broader proximal portion.

Mouth capsule ellipsoidal in cross-section, with its longer axis running dorso-ventrally 110μ. The inner surface of the mouth collar may show a more or less well developed groove, which in longitudinal sections is visible as a fine line. On to this constriction a septum is inserted, which divides the cavity of the mouth collar into a larger dorso-lateral and a smaller ventro-lateral portion. The lining of the mouth collar continues into the mouth capsule, which is exceptionally short and corresponds only with the posterior portion of the buccal capsule of other *Cylicostomes*. The posterior border of the mouth capsule is peculiar; in three places (dorso-lateral and ventral) it has

a posteriorly directed dent. The anterior border shows the same dents, only here they are not so well marked. The mouth capsule thus has its greatest depth at the dents, and is least deep between these dents (ca. 7μ).

Dorsal gutter present as a small tubercle at the base of the mouth capsule.

Leaf crowns.—External is composed of about 42-45μ slender, pointed elements which project beyond the mouth opening. Internal leaf crown seems to be lacking.

Oesophagus thick, in the male 450-500μ long, with a maximum breadth of 165μ. In the female 551-635μ, breadth up to 245μ. Immediately behind its commencement it decreases in width, becomes practically cylindrical and swells again just behind the nerve ring to attain its greatest breadth.

Excretory pore and *cervical papillae* a short distance in front of posterior end of oesophagus, 520μ from anterior extremity of body.

Posterior extremity, male.—Median-lobe broad and rounded in outline and of medium length, has no very well marked notches between the dorsal lobe and the two laterals. The dorsal rays are split far down, almost to the point of origin of the externo-dorsal ray. Accessory branches may be present on the dorsal rays. The postero-lateral and the medio-lateral rays reach almost to the free edge of the lobe; the externo-lateral runs forward and ends some distance away from edge of bursa. The distance between the tips of the externo-lateral and medio-lateral rays is thus greater than the distance between the tips of the medio-lateral and postero-lateral rays. The ventral rays end near the edge of the bursa. Dermal collar exceptionally well developed. There is but a single appendage, which is variable, may be more or less lobed and may bear a variable number of processes of different sizes.

Posterior extremity, female, already decreases in breadth before the vulva (at which level it measures 320μ). Tail comparatively long and pointed, and usually bent slightly in the dorsal direction. Distance between anus and tip of tail 210-300μ (measured in a straight line). Vulva some distance in front of anus 330-350μ. Vagina long 0.9-1.06 mm. Eggs 100μ by 48μ.

Occurrence.—The only specimen found, a female, was parasitic in the pelvic flexure of a horse. This worm seems to be rare. Ihle who described it having only found it in one horse, out of the many examined.

Cylicostomum prionodes Kotlán, 1921. (Plate XXXII.)

Size.—Medium sized, the females only being known. These measure 10-11.5 mm. in length, with maximum breadth of 520μ.

Head, continuous with the body.

Mouth collar is distinctly marked off from the rest of the skin, especially when seen laterally.

Head papillae.—Submedian are pointed, rather long and prominent; the lateral rounded and not projecting. Mouth opening oval and very spacious.

Mouth capsule is particularly shallow, having a depth of 12-14μ. The dorsal-ventral axis is shorter than the transverse, which measures about 90-100μ. Walls of mouth capsule relatively thin.

Dorsal gutter absent.

Leaf crowns.—The elements of the external leaf crown resemble the teeth of a saw, about 24-26 in number, and arise from the posterior margin of the mouth collar. The length of these elements is 32μ, their breadth at the base 16μ. Internal leaf crown consists of numerous small and inconspicuous elements originating from the anterior margin of the mouth capsule.

Oesophagus is flask-shaped 800-935μ in length, with a maximum breadth in the posterior third of 172μ.

Excretory pore and *cervical papillae* lie over the posterior third of the oesophagus.

Posterior extremity, female, diminishes gradually up to anus; the tail is distinctly marked off from the body and measures 125μ in length. Vulva is situated about 108μ from the anus.

Occurrence.—Reported from the caecum of a horse in Hungary. This form was not represented in the South African material.

Cylicostomum montgomeryi Boulenger, 1920 (4). (Plate XV1.)

Size.—A small species, males 4.3-6 mm. in length; females 4.5-6.5 mm. The greatest thickness of the body is 0.28 mm., decreasing to 0.2 mm. at the level of the commencement of the intestine.

Head 80-90μ broad, not separated from the body by a constriction to form a neck.

Mouth collar is thick and depressed at the margin.

Head papillae.—Submedian slender with leaf-shaped appendages; laterals prominent.

Mouth capsule ellipsoidal, longer axis running from side to side; characterized by its peculiar bilateral symmetry, its dorsal and ventral walls being considerably higher (32μ) than the lateral walls (22μ); this absence of radial symmetry makes an optical section of the head in a lateral view present a totally different appearance to that seen dorso-ventrally.

Dorsal gutter absent; the oesophageal funnel is poorly developed.

Leaf crowns.—External composed of about 18 slender, pointed leaves; internal of twice that number of rather similar, but shorter elements.

Oesophagus slender with an average length of 0.33 mm.

Excretory pore and *cervical papillae* at the same level 0.24 mm. from the anterior extremity.

Posterior extremity, male.—The bursa is 0.25 mm. broad when viewed from the dorsal or ventral surface; dorsal lobe of medium length, 0.12 mm. Dermal collar poorly developed and almost flat on the ventral surface of the genital cone. The latter is short and its appendages are ovoid in shape, with a short blunt point on the posterior margin.

Posterior extremity, female.—The vulva is 0.13 mm., the anus 0.06 mm., from the posterior extremity of the body. The tail region behind the anus is narrow and ends in a fine point.

Occurrence.—Parasitic in the zebra. Not found in South Africa up to the present.

Oesophagodontus robustus (Giles, 1892) Railliet and Henry, 1902 (1). (Plate XXXIII.)

Synonyms *Sclerostomum robustum* Giles, 1892; *Pseudoscleros-tomum securiferum* Quiel, 1919.

Size and Shape.—Body stout, tapering only slightly towards the anterior extremity. Colour during life is brown, intestine deeply pigmented, showing through the semi-transparent body wall. Males average about 15-16 mm. in length, maximum breadth 0.59-1 mm. Females 19-22 mm., with a maximum breadth of 1.15-1.5 mm.

Head.—Separated from the body by a slightly constricted neck and is of considerable breadth, 560-660μ (500-800μ Boulenger).

Mouth Collar.—Is depressed and its oral margins considerably notched so as to present a tuberculated appearance.

Head papillae.—Submedian; each consists of a slender tactile appendage carried on a basal, wart-like prominence of the mouth collar; this basal region bears in addition a second appendage in the form of a delicate trumpet-shaped process directed externally. Lateral papillae not markedly raised from the surface of the mouth collar, and their bases are broad and carry a pair of lateral horn-like processes; a pair of similar but smaller processes are situated near the anterior extremity of each papilla.

Mouth capsule.—Is goblet shaped, its greatest width of 355-400μ (320-470μ Boulenger) near its anterior margin and narrowing considerably posteriorly. Depth 250-320μ. Wall of capsule is comparatively thin except posteriorly, where it is greatly thickened to form a hoop-like transverse ridge encircling the base of the mouth capsule. Mouth capsule furnished with strong muscles.

Dorsal gutter absent.

Leaf crowns.—External elements are large and number about 18. Internal are smaller, about twice as numerous; they do not arise in one plane, originating nearer the anterior margin of the mouth capsule dorsally and ventrally, than laterally; thus appearing shorter laterally.

Oesophagus long, 1.5-1.7 mm. in length; broadest anteriorly, immediately behind the mouth capsule, narrows somewhat towards the middle, increasing again in width posteriorly. On the whole, very narrow throughout its length, having a maximum diameter of 310μ. Oesophageal funnel well developed, and the lining of its triradiate cavity is modified to form three tooth-like structures, which do not, however, protrude into the mouth capsule.

Excretory pore and *cervical papillae* slightly posterior to the nerve ring, 1.2-1.3 mm. from the anterior extremity. Cervical papillae extremely small.

Posterior extremity, male, has a breadth of 0.9-1 mm. bilobed, with no trace of a median lobe. Margin of the lateral lobes finely denticulated. The ventral rays are slender and parallel and of equal size. The medio-lateral ray is a little shorter than the other lateral rays, and the postero-lateral possesses a short thick branch, arising from near its base, and projecting dorsally. This extra lateral ray terminates very bluntly, and its exact shape and length vary considerably. There is no median-dorsal ray, the dorsal rays arising in two groups of four. The externo-dorsal is the longest, the three other dorsals being sub-equal, and the middle one is a little shorter than the others. Genital cone is short and broad, almost hemispherical in shape, and bears a pair of small lateral papillae; a conical lip-like process is situated medianly, just ventral to the cloacal opening. Dermal collar is well developed on the ventral surface only. Spicules

long and slender, ending bluntly without hook-like terminations, enclosed in a finely striated sheath, which is very conspicuous when the spicules are protruded.

Posterior extremity, female.—Straight, body tapers rapidly from the level of the vulva to the end, forming a pointed tail region. Extremity has a rather variable shape according to the degree of contraction, and it frequently appears mucronate. Anus lies 0.5-0.7 mm. from the tip of the tail. Distance between anus and vulva 2.6-2.7 mm.; at this level the body has a maximum diameter 0.67-0.76 mm. Vagina remarkably short. Eggs are large, oval, and thin shelled, 88-100μ by 40-48μ (100-130μ by 56-60μ Boulenger). Early morula stage at oviposition.

Occurrence.—O. robustus is of very rare occurrence in South Africa, only three females having been found: one in a horse and two in a mule. Has been recorded as occurring in a zebra from the London Zoological Gardens (Turner, 1920).

Poteriostomum imparidentatum Quiel, 1919. (Plate XXXIV.)

Synonyms *Hexodontostomum markusi* Ihle, 1920; *Cylicostomum zebrae* Turner, 1920; *Poteriostomum pluridentatum* Quiel, 1919.

Size.—One of the larger *Sclerostomes*. Adult male 11-14 mm. in length, with maximum thickness 640-760μ. Females are very variable in length, ranging between 13 and 21 mm., with a maximum thickness between 0.9 and 1.15 mm.

Head.—300-350μ may be marked off from the rest of the body by a very slight constriction.

Mouth collar comparatively high and separated off from the rest of the cuticle by a definite constriction.

Head papillae are short, conical, with broad bases resting on the oral collar; their distal extremities are short and blunt, projecting only slightly beyond the mouth opening. Lateral papillae are broad, but do not project.

Mouth capsule ellipsoidal, with its longer axis running dorso-ventrally, not deep (52-60μ) (85-90μ Turner) in proportion to its width (150-220μ); the walls of the mouth capsule diverge slightly from before backwards. Seen in optical section they are thin anteriorly, and show a considerable swelling posteriorly, and their anterior margin may also be slightly swollen at the point of insertion of the internal leaf crown.

Dorsal gutter well developed and most conspicuous and extending more than half-way up the mouth cavity.

Leaf crowns.—External composed of numerous small and pointed elements originating near the anterior margin of the mouth collar. Internal consists of about 36 long and bluntly pointed elements, their number seems to be very variable (48 according to Quiel; 43-45 Ihle; 48-59 Turner; 38 Boulenger). Of these six, corresponding in position to the head papillae, are considerably longer than the others. The number of small elements between these longer ones is variable.

Oesophagus short (680-800μ) and stout (240-320μ), roughly flask-shaped.

Excretory pore and *cervical papillae* some distance behind the nerve ring, 460-550μ (Turner 660-700μ) from the anterior extremity of the body.

Posterior extremity, male.—Bursa short and broad, median lobe continuous with the laterals; their free edges may be finely denticulated. The dorsal rays form one group and the lateral and ventral rays another. The dorsal rays originate from a common trunk, which forms posteriorly the main, median, and external branches and also the externo-dorsal; these are united at their bases. The external dorsal and median dorsal branches and the externo-dorsal ray are placed at right angles to the main dorsal trunk and are parallel to one another. The external branch and the externo-dorsal ray are bent backwards at their tips. The main or internal dorsal ray thick, narrowing abruptly to form a finger-like distal extension. The postero-lateral ray has a peculiar short, backwardly directed branch, which is also present in *O. robustus*. Dermal collar well developed, pre-bursal *papillae long*. Genital appendages, a narrow disc bearing two short projections.

Posterior extremity, female.—Straight, tapering to the tip, which may be rounded and knob-like. Distance from anus to tip 0.760-1 mm.; distance between anus and vulva 720-900μ; at this level the body has a maximum diameter of 600-700μ. Vagina extremely short (720μ).

Occurrence.—*Poteriostomum imparidentatum* is not very common in South Africa; it may occur in any part of the colon as well as in the caecum in either the horse, mule, donkey, or zebra.

Poteriostomum ratzii Kotlán, 1919 (1). (Plate XXXV.)

Synonym *Cylicostomum ratzii* Kotlán, 1919.

Size and shape.—Thick and fat; cephalic end somewhat truncate, caudal extremity pointed in the female. Their length is variable; males 9.5-11 mm. in length, with a maximum breadth of 0.68 mm. Females are 14-17 mm. in length, although smaller (9 mm.) sexually mature females may occur; maximum breadth up to 1.3 mm.

Mouth collar transparent, not broader than the body; separated off by a marked constriction.

Papillae hardly project beyond the mouth collar, narrow, in the shape of pine needles. Laterals hardly reach to surface of the mouth collar.

Mouth capsule fairly wide, almost cylindrical, anterior border slightly bent outwards. Walls fairly thin, posteriorly suddenly increasing into a hoop-like thickening.

Dorsal gutter present, reaching to the level of the middle of the mouth capsule.

Leaf crowns.—External composed of 60-64 fine, pointed elements projecting beyond the mouth opening. Internal conspicuous, 40-44 stout, highly refractive elements, ending suddenly in a short sharp point, arise at anterior margin of the mouth capsule, reaching into the anterior half of the mouth collar.

Oesophagus short, 0.93 mm. in length, hardly swollen at its junction with the mouth capsule; cylindrical; minimum breadth 0.32 mm.; maximum breadth 0.37 mm., which is attained in the posterior third of its length.

Excretory pore and *cervical papillae* at the level of the nerve ring, 0.5 mm. from the anterior extremity.

Posterior extremity, male.—Well developed; median lobe short, broad, round in outline, margin finely denticulated. Bursal rays well developed; seen ventrally the two anterior branches of the dorsal

ray run parallel to the externo-dorsal ray at a right angle to the longitudinal axis of the body. The postero-median ray, as also the latero-ventral, bears at its base a short broad branch.

Posterior extremity, female.—Without subventral knots, long and well developed. Anus 0.95 mm. from the tip. Vulva 1.5 mm. in front of anus.

Occurrence.—*P. ratzii*, present throughout the colon of all South African equines, is somewhat larger than the form described by Kotlán, but is identical with it in every other respect, its measurements being as follows:—Length of males 14.5-16 mm.; maximum breadth 650-700μ. Length of females 16-20 mm.; maximum breadth 1-1.25 mm. Head 280-350μ.

Oesophagus in males 700-800μ; maximum breadth 330μ. In females 750-900μ; maximum breadth 300-400μ.

Excretory pore 430-560μ from anterior extremity. Length of dorsal ray in male 550-600μ.

Female.—Distance of anus from tip 750-950μ; vulva 0.9-1.1 mm. in front of anus; diameter of body at level of anus 560-700μ. Vagina short.

Discussion.—In his description Kotlán states:—"Bursal rays well developed; seen ventrally the two anterior branches of the dorsal ray run parallel to the externo-dorsal ray at a right angle to the longitudinal axis of the body." In their drawing, Vol. XIV, 27th November, 1910, of *P. ratzii*, Yorke and MacKie only give the external-dorsal branch, running parallel to the externo-dorsal ray and at right angles to the longitudinal axis of the body, the median-dorsal running at an angle to this. In the South African forms the externo-dorsal ray and the two anterior branches of the dorsal ray run parallel to one another, but are not at right angles to the main axis of the body, resembling somewhat the arrangement as drawn by Turner for *C. zebrae*. The branch on the postero-lateral ray is well developed.

In another form (Plate XXXVI), of which I only found three males, the arrangement of the rays differed slightly from the above. This form differs from the typical South African *P. ratzii* in its smaller size (males 11-12 mm., maximum breadth 590μ); its mouth collar is comparatively higher; external leaf crown of over 70 leaves, internal of about 36 elements; the mouth capsule is perhaps slightly wider in comparison to its depth (33-50μ by 160-200μ). The bursa is well developed and comparatively longer than in the typical form, as represented in South Africa; the lateral and ventral rays diverge from one another at about equal angles; the postero-lateral is remarkably long and without the branch so characteristic of the type species. The externo-dorsal ray and the external branch of the dorsal ray run parallel, and at right angles to the main axis of the body, the median-dorsal branch at an angle to this, the internal or main dorsal branch (600μ) tapers to a fine point, whereas in the typical form it is fat throughout its length, narrowing abruptly to form a short finger-like distal extremity. For this form I propose the name *P. ratzii* var. *nanum* until the examination of further material and the discovery of the female establish its definite position in the Poteriostomum group. It is quite probable that the smaller, sexually mature females 9 mm. of Kotlán may still prove to be the females of the variety *nanum*.

TABLE OF COMPARATIVE MEASUREMENTS OF THE DIFFERENT FORMS OF *P. ratzii*.

	Hungarian.	South African.	Var. *nanum*.
Body—			
Length:			
Male	9·5–11 mm.	14·5–16 mm.	11–12 mm.
Female	14–17 mm. (9)	16–20 mm.	—
Maximum breadth:			
Male	0·68 mm.	0·650–0·7 mm.	0·59 mm.
Female	1·3 mm.	1–1·25 mm.	—
Mouth capsule—			
Depth	—	—	33–50μ
Width	—	—	160–200μ
Oesophagus—			
Length	0·93 mm.	0·7–0·9 mm.	0·65–0·7 mm.
Width	0·37 mm.	0·36–0·4 mm.	0·280 mm.
Excretory pore from anterior end	0·5 mm.	0·43–0·56 mm.	0·45 mm.
Dorsal ray	—	0·55–0·6 mm.	0·6 mm.
Anus-tip	0·95 mm.	0·750–0·950 mm.	—
Anus-vulva	1·5 mm.	0·9–1·1 mm.	—
External leaf crown	60–64	over 60	over 76
Internal leaf crown	40–44	about 40	about 36

Craterostomum tennicauda Boulenger, 1920 (4).

Size.—Small rather robust worms, the type specimens consist of three immature females only, 4-5.5 mm. in length. Cuticle transversely ringed. Body with a maximum breadth of nearly 0.4 mm., reduced to 0.28-0.32 mm. at the level of the termination of the oesophagus.

Head.—0.17 mm. broad, not separated from the body by a definite constriction.

Mouth collar.—Narrow and depressed at the margins.

Head papillae.—Submedian, small, with leaf-like terminations; lateral not prominent.

Dorsal gutter.—Well developed, similar in structure to that of *Triodontophorus*.

Mouth capsule circular, similar in structure to that of *Triodontophorus*, a little broader than long, measuring 0.07 by 0.05 mm.

Leaf crowns.—External consists of 9 comparatively large, almost triangular leaves, arising from the inside of the mouth collar, as in *Triodontophorus*. The elements of the internal leaf crown are also similar to those found in the above genus, being septa-like projections, numbering 18 only.

Oesophagus.—The oesophageal funnel is poorly developed and there are no teeth projecting from it into the mouth capsule. Oesophagus is narrow and has a length of 0.37-0.4 mm.

Excretory pore and *cervical papillae* are at the same level about 0.25 mm. from the anterior extremity.

Posterior extremity, female.—The genitalia are similar to those of some species of *Triodontophorus*. Vagina is very short. Vulva opens 0.53-0.57 mm. from the posterior extremity; at this level the body has a thickness of 0.2 mm., which is reduced to 0.07-0.08 mm. in the anal region; 0.25-0.27 mm. from the end of the body. The tail region behind the anus is greatly attenuated and terminates in a point.

Occurrence.—No forms approaching these measurements occur in the South African material. Originally reported as occurring in the zebra.

Craterostomum mucronatum Ihle, 1920 (6). (Plate XXXVII.)

Synonym *Cylicostomum mucronatum* Ihle, 1920.

Size.—Males 6.5-7.25 mm. in length; maximum breadth 360μ. Females 7.75-8.25 mm. in length; maximum breadth 440-500μ.

Head.—120-140μ, continuous with the body.

Mouth collar.—Narrow and depressed, marked off by a deep constriction from the rest of the cuticle.

Head papillae.—Submedian slender, distal part marked off by a notch, lateral short and broad.

Mouth capsule not quite circular; broader than deep, i.e. 60-72μ by 40-48μ. Walls are curved outwards, fairly thick, slightly swollen at their anterior margins.

Dorsal gutter.—Well developed and reaching almost to level of anterior opening of mouth capsule.

Leaf crowns.—External composed of about 8 large, transparent elements, with broad basis; seen laterally they present the appearance of a trapezium or of a triangle whose corners have been rounded off. Internal consists of about 24 short, broad elements, originating at the anterior margin of the mouth capsule.

Oesophagus of average length 360-440μ, with a maximum breadth of 100-120μ.

Excretory pore and *cervical papillae* a little behind the nerve ring; 320-360μ from anterior end of body.

Posterior extremity, male.—Edges of bursa are finely denticulated. Bursa continuous ventrally. Median lobe fairly short. Dorsal rays slightly divergent, the median branch not quite reaching to the edge of the lobe. Length of main dorsal ray 350μ, no accessory branches. The externo-lateral ray branches off from the common median trunk before the latter divides to form the medio-lateral and postero-lateral rays. The externo- and medio-lateral approach one another, the postero diverges at a wide angle. Ventral rays long and straight. Dermal collar well developed both dorsally and ventrally. Appendages, two long and pointed projections. Prebursal papillae long.

Posterior extremity, female, narrows gradually to a point behind the vulva. Distance of anal cleft from the tip of tail 500-600μ; distance between anus and vulva 600-680μ; at this level the diameter of the body measures 250-300μ. Vagina very short indeed. Eggs 86-88μ by 40-44μ.

Occurrence.—Not very often met with; may occur in any part of the colon of the horse, donkey, mule, or zebra. Ihle reports it present in the caecum as well; up till now I have never once found it in this part of the intestinal tract.

Craterostomum acuticaudatum Kotlán, 1919 (1).

Synonym *Cylicostomum acuticaudatum* Kotlán, 1919, This form agrees in character with *C. mucronatum*, but is distinguished from the latter by its larger size.

Size.—The males have an average length of 9.5 mm. Females 9-11 mm. long; maximum breadth 500μ.

Leaf crowns.—Elements of the external leaf crown pointed 6-8 in number; internal leaf crown of 12-16 elements.

Oesophagus 520-590μ. Greatest breadth 140μ. Distance between vulva and anus 760-850μ. Anus 510-590μ from tip of tail.

Occurrence.—Not found in South Africa. Ihle is inclined to think that *C. tenuicauda* may prove to be the immature form of *C. acuticaudatum*.

Gyalocephalus capitatus Looss, 1900. (Plate XXXVIII.)

Synonym *Gyalocephalus equi* Yorke and Macfie, 1918.

Size.—A small slender species, easily recognized with the naked eye as it has a black and white appearance, the coils of the gut standing out clearly on account of their dark contents. Males 7-8.5 mm. in length, maximum breadth 400μ. Females 10-11 (8.5-10 Yorke and Macfie); maximum breadth 550μ.

Head.—220-300μ, distinctly separated by a well marked neck.

Mouth collar well developed and sharply set off from the skin.

Head papillae.—Submedian fairly stout conical projections. Laterals not prominent.

Mouth capsule.—Circular in transverse section. It is a highly complicated structure, consisting of two portions: (*a*) an extra-oesophageal part, which corresponds to the true buccal capsule of other *Cylicostomes*, and (*b*) an intraoesophageal portion formed by the chitinization of the oesophageal funnel. (*a*) The walls of the extra-oesophageal portion consist anteriorly of a thick chitinous ring, which becomes thinner posteriorly and extends backwards over the anterior portion of the oesophageal funnel as three delicate triangular prolongations, the apices of which coincide with the point of contact of the three oesophageal divisions. (*b*) The intraoesophageal part is a hemispherical cavity, into which project from the wall three wedge-shaped septa, representing the continuation of the three oesophageal segments. Each process extends anteriorly to about the level of the posterior margin of the true buccal capsule and there terminates as a tooth. At the base of the oesophageal funnel are three pairs of chitinized ridges, forming the edges of the triradiate cavity of the oesophagus. These ridges are crescentic in form, and following the base of the funnel exteriorly they are lost in the wall of the cavity, but internally they project forward as six pointed teeth. Maximum breadth of the mouth capsule 110-120μ.

Dorsal gutter absent.

Leaf crowns.—External composed of numerous slender and sharply pointed elements. Internal consists of about 30 large and stout elements originating from the inner surface of the true buccal capsule. Posteriorly each element terminates in two processes, giving rise to a cogwheel or battlement appearance.

Oesophagus dilates into a large cup-shaped cavity lined with chitin and armed with teeth as already described. This dilatation almost completely fills the worm. Posterior to this the oesophagus becomes very narrow, enlarging again behind the nerve ring. Length of oesophagus, measured from the anterior end of the cup-like dilatation, is 1-1.2 mm. Greatest breadth behind nerve ring 200-280μ.

Excretory pore and *cervical papillae* immediately behind the nerve ring 440-600μ from anterior extremity.

Posterior extremity, male.—Body tapers gradually to the bursa. Median lobe rounded in outline; the laterals are distinctly marked off, and are voluminous, embracing the cone ventrally. The ventrals, externo-lateral, and lateral rays arise from a common trunk. The latero-ventral ray is longer than its companion, reaching to the edge of the bursa. The externo-lateral arises just before the point of bifurcation of the median ray. The dorsal ray bifurcates after a short course, the branches arising immediately behind this bifurcation. The prebursal papillae are very long and assume the shape of genuine rays in that they support the anterior portions of the voluminous lateral lobes. Length of posterior ray 440-480μ (363μ Yorke and Macfie). Genital cone very long and retractile, runs obliquely posteriorly and ventrally; surrounded by a cuticular expansion. Dermal collar not well developed.

Posterior extremity, female.—Straight and tapers slightly to the tail. The tail is straight, very long, and slender. Anus 280-300μ in front of tip of tail. Distance between anus and vulva 450μ; at this level the body has a breadth of 200μ. Vagina of average length 500-600μ. Eggs 116-120μ by 48-56μ.

Occurrence.—Is of frequent occurrence in the caecum, but more especially the ventral colon, in the horse, mule, and donkey.

Yorke and Macfie, 1918, described a form *G. equi* which agreed with *G. capitatus* in all respects except that it differed from it by the enormous length of its genital cone, which protrudes far beyond the bursa, whereas in Looss' form it only extends as far as the free edge of the lobes. This difference of length is merely due to contraction of the cone. I have seen worms with their cone retracted to such an extent that it did not even reach half-way to the free edge of the lobes. All intermediate stages between this contracted form and the long protruded form are not infrequently met with. This same power of contraction of the genital cone is also possessed by *C. euproctus* (Boulenger). Thus *G. equi* is the same as *G. capitatus.*

Triodontophorus minor Looss, 1902. (Plate XXXIX.)

Synonym *Triodontus minor* Looss, 1900.

Size.—The worms have a rather blunt aspect. Males 11-13 mm. (9-12 mm. Boulenger) in length with a maximum breadth of 700-800μ. Females 13-16 mm. (11-14 mm. Boulenger) in length with a maximum breadth 750-850μ.

Head.—200-240μ, continuous with the body.

Mouth collar is depressed at the margins; the latter may curl forwards, marked off by a constriction.

Head papillae.—Submedian represented by short points. Laterals not prominent.

Mouth capsule ellipsoidal in cross section, longer axis running dorso-ventrally; it is comparatively large, the breadth being a little greater than the depth, 140-160μ wide by 120-140μ deep. Three teeth arising from the oesophageal funnel project into the capsule. These may be denticulated at their anterior margins; otherwise they

show three prominent points, corresponding in each tooth, to the free borders of the two component lamellae and the edge formed by their junction.

Dorsal gutter present, reaching to the level of anterior edge of mouth capsule.

Leaf crowns.—External about 50 sharply pointed leaves arising from inner surface of the mouth collar. Internal of the same number of small septa-like elements.

Oesophagus has an elongated and slender aspect. Slightly dilated just behind the mouth capsule, cylindrical up to the nerve ring, behind which it becomes gradually enlarged attaining its maximum diameter of 150-220μ, a short distance before its rounded end. Its total length 920μ-1.15 mm.

Excretory pore and *cervical papillae* somewhat posterior to the nerve ring 600-800μ from anterior extremity.

Posterior extremity, male.—Bursa has a rather triangular median lobe which is marked off from the laterals by a notch. Length of dorsal ray 650-750μ (in some it averages 900μ), its median branch shorter than the other dorsal branches. Laterals runs close together, the medio-lateral only reaching to edge of bursa. Ventrals long and slender and their extremities diverge slightly. The dermal collar completely surrounds the genital cone, but is better developed on the ventral surface. Small finger-like appendages may be present at the genito-intestinal opening. Prebursal papillae long. The part of the bursal membrane uniting the two lateral lobes ventrally is not much raised from the surface below. Spicules about 1.7 mm.

Posterior extremity, female, is short and blunt, anus near to tip of tail 130-160μ. Distance between anus and vulva 440-520μ (in some as much as 600-700μ); at this level the body has a width of 280-400μ.

Vagina very short. Eggs 76-80μ by 40-44μ (83μ by 119μ Smit).

Occurrence.—Looss reports that this species is remarkable for its habitat in the posterior region of the colon. In South Africa, though preponderant in the dorsal colon, it also occurs frequently and sometimes in larger numbers in the ventral colon. It may be said to be the commonest form of *Triodontophorus* in South Africa, where it is found in the horse, mule, and donkey. Up to the present it has not yet been reported from the zebra.

Triodontophorus serratus (Looss, 1900). (Plate XL.)

Synonyms *Triodontus serratus* (Looss, 1900); *Triodontophorus intermedius* (Sweet, 1909).

Size.—The largest species of the genus *Triodontophorus.* The females tapering anteriorly and posteriorly. The length of the male is 17-20.25 mm. (18 mm. Looss) with a maximum breadth of 700-800μ. The length of the female is 20-26 mm. (25 mm. Looss) with a maximum breadth 0.8-1.1 mm.

Head.—Not definitely marked off from rest of body.

Mouth collar high, approximately circular when seen in profile.

Head papillae.—Submedian short, with a notch marking off the small conical distal portion. Lateral papillae broad.

Mouth capsule comparatively small and shallow, 100-118μ deep by 140-180μ wide. The three teeth project almost to the level of the middle of the buccal cavity. Their anterior margins usually denticulated.

Dorsal gutter well marked, reaching to anterior margin of mouth capsule.

Leaf crowns.—External is composed of about 50 large pointed elements; the internal consists of an equal number of small plate-like elements, which project into the cavity of the mouth capsule.

Oesophagus elongated and slender, 1.3-1.17 mm. in length, with a maximum breadth of 200-300μ at its posterior extremity.

Excretory pore and *cervical papillae.*—At the same level just behind the nerve ring—540-950μ from anterior extremity.

Posterior extremity, male.—The median lobe is broad and very short; the laterals are large. Length of dorsal ray 360-500μ. The external dorsal branch comes off near the externo-dorsal ray. The median branch comes off late and is almost as long as the internal. The postero-lateral diverges from the medio-lateral by a fairly large angle; the medio-lateral and externo-lateral are approximately parallel. Ventrals long and parallel. Prebursal papillae fairly long. Genital cone has dermal collar on ventral surface only. Spicules according to Looss are "considerably longer than in *T. minor* and much thicker. The terminal hooks fairly powerful." Looss does not mention the barbs situated a short distance behind the hooks, which projects backwards from the shafts.

Posterior extremity, female, is elongated. Anus 450-800μ from tip of tail, vulva situated 1.3-2.3 mm. in front of anus; that is 1.8 to 2.7 mm. (more than 2 mm. Looss) from tip of tail. Eggs 76-84μ by 40-48μ. According to Boulenger's calculations made from Looss' drawings given in his memoir on *Anchylostomum duodenale*, the eggs measure 130μ in length.

Occurrence.—Is mainly present in the ventral colon and caecum of the horse, mule, and donkey.

Discussion.—In 1909, Georgina Sweet described a new species of *Triodontophorus*, *T. intermedius* basing the description on the characters of three females only. This species she mentions as being intermediate in size and character between *T. serratus* and *T. minor*, though more closely approaching *T. serratus*. Judging by her remarks, (*a*) that "the cervical papillae appear much nearer the median ventral line than in *T. minor* or *T. serratus*," (*b*) that "unfortunately the material was in a very unsuitable condition for histological examination," as also, by the position given the cervical papillae in her Fig. 2, it is obvious that her material was in a very shrunken condition.

Boulenger, 1916 (1), amplified Sweet's original diagnosis by a description of worms found in England. He remarks that "*T. intermedius* is certainly very closely allied to *T. serratus;* it can, however, be readily distinguished from that species by its smaller size, the shape of the mouth collar, the position of the vulva and the size of the eggs in the females, and by the character of the spicules in the males."

Concerning the mouth collar of the genus *Triodontophorus*, Looss (p. 79) states that it "is well developed, flat rather than high . . .," and in his specific diagnosis of *T. serratus* he mentions it as a little higher than in *T. minor*. In the larger magnification of the head on Plate III he figures it "as slightly depressed," whereas in the drawing of the anterior end it is figured as being definitely "circular in outline." In the specimens of *T. serratus* from Cairo from the collection at the Liverpool School of Tropical Medicine, most kindly put at my disposal by Professor Yorke, the mouth collar in all cases was definitely circular in outline. All the South African worms likewise presented this circular outline.

Concerning the position of the vulva, Looss gives it as more than 2 mm. from the tip of the tail; the corresponding measurements given for *T. intermedius* are 1.32-1.54 mm. (Sweet), 1.45-1.7 mm. (Boulenger). In the material from Cairo this distance is 1.8-2.15 mm.

Working on the South African material, I find that there is a definite gradual increase in the distance between the vulva and the tip of the tail in proportion as the worms get larger. This distance, however, may vary to a certain degree in worms of the same length, as can be seen from the following table:—

Size of worm	20 mm.	21 mm.	22 mm.	23 mm.	24 mm.	25 mm.	26 mm.
Distance between vulva and tip:							
minimum ...	1·8 mm.	1·95 mm.	1·95 mm.	2·1 mm.	2·25 mm.	2·4 mm.	2·31 mm.
maximum ...	2 „	2·15 „	2·25 „	2·45 „	2·85 „	2·6 „	2·5 „

There is no doubt that the tail is capable of a certain amount of contraction. This contraction shows most markedly in the region between the anus and the tip.

This increase in distance between the vulva and tip corresponding in increase to the size of the worms would account for the difference in position of the vulva in *T. intermedius*, given as 1.32-1.54 mm. for worms 16.9-20.25 mm. long, by Sweet; and as 1.45-1.7 mm. for worms 16.5-18.7 mm. long, by Boulenger.

In his generic diagnosis of *Triodontophorus*, Looss (page 82) remarks that "the two spicula are of equal length in one of the species, of comparatively considerable thickness. In cross-sections they exhibit a shape similar to that of the Arabic numeral 9, their free termination being transformed into a simple hook." In his specific diagnosis he further adds that the terminal hooks are fairly powerful. In his drawing (Plate III) he also figures them as simple hooks. In the material from Cairo, however, these hooks are furnished with bars in the manner described and drawn by Boulenger for *T. intermedius*.

Worms of all sizes are to be found intermediate in length between the smallest *T. intermedius* (16.15 mm.) and the largest *T. serratus* 26 mm. (compare the following table). In the females of *P. inparidentatum* we find the same range of difference in the lengths of the various worms, i.e. 13-21 mm. It would thus seem that the worms described by Sweet and Boulenger as *T. intermedius* are in reality but small forms of *T. serratus*.

	Intermedius (Sweet).	*Intermedius* (Boulenger).	*Serratus* (S.Af. 54*b*).	*Serratus* (S.Af. 35*d*, 51*a*).	*Serratus* (S.Af. 35*b*).	*Serratus* (Cairo).	*Serratus* (Looss).
Length—							
Male	—	14·5–15·5 mm.	17–19 mm.	17–19·5 mm.	18–20·25 mm.	18·5 mm.	18 mm.
Female	16·9–20·25 mm.	16·5–18·7 mm.	20–22 mm.	23–25 mm.	24–26 mm.	21–23 mm.	25 mm.
Maximum breadth—							
Male	—	650 μ	—	700–800 μ	—	—	1 mm. or more
Female	600–830 μ	650–750 μ	800–1,000 μ	1,100 μ	900–1,100 μ	830–1,000 μ	—
Mouth capsule—							
Deep	120–150 μ	100–130 μ	100 μ	100–120 μ	100–112 μ	100–118 μ	110 μ
Wide	110–150 μ	150–180 μ	140–160 μ	140–180 μ	160–176 μ	140–168 μ	180 μ
Oesophagus—							
Long	—	970–1,300 μ	1·4–1·55 mm.	1·3–1·8 mm.	1·5–1·75 mm.	1·3–1·4 mm.	1·3–1·6 mm.
Broad	160–210 μ	—	200–240 μ	270–300 μ	300 μ	210–250 μ	200 μ
Breadth at Vulva	—	450 μ	650–700 μ	900–1,000 μ	620–700 μ	600–650 μ	—
Anus-Vulva	—	—	1·3–1·6 mm.	1·65–1·8 mm.	1·6–2·3 mm.	1·3–1·7 mm.	—
Vulva-tip	1·32–1·54 mm.	1·45–1·7 mm.	1·8–2·15 mm.	2·34–2·6 mm.	2·31–2·7 mm.	1·8–2·15 mm.	more than 2 mm.
Anus-tip	280–310 μ	450 μ	450–500 μ	650–800 μ	500–800 μ	450–650 μ	about 500 μ
Eggs—							
Long	—	90–100 μ	80–85 μ	76–80 μ	80–90 μ	—	about 130 μ
Broad	—	40–50 μ	40–44 μ	44–48 μ	45–48 μ	—	—
Dorsal ray	—	—	500 μ	500–600 μ	360–400 μ	340 μ	—

Triodontophorus brevicauda Boulenger, 1916 (1). (Plate XLI.)

Size.—Body appears rather blunt, especially in the female. Male 13.5-15 mm. in length; maximum breadth 650-750μ. Female 13.5-17 mm. in length; maximum breadth 750-900μ.

Head broad, 280-320μ, may be separated from the body by a gentle constriction behind the mouth capsule.

Mouth collar is high and erect, attaining its greatest breadth anteriorly, so as to appear separated from the rest of the head by a deep constriction.

Head papillae.—Submedian short, hardly projecting beyond the surface of the mouth collar. Lateral not prominent.

Mouth capsule large, nearly as deep as wide, 150-160μ by 180-190μ (160-210μ by 200-250μ Boulenger). Anterior surface of teeth are usually not denticulated.

Dorsal gutter well developed and reaching to level of anterior margin of mouth capsule.

Leaf crowns.—External composed of numerous slender leaves. Internal of about the same number of septa-like elements.

Oesophagus long and slender 0.9-1.4 mm. long with a maximum diameter 250-300μ.

Excretory pore and *cervical papillae* near the level of the nerve ring 850-900μ (730-880μ Boulenger) from the anterior end.

Posterior extremity, male, elongated median lobe, which is at a small angle to the main axis of the body. Length of dorsal ray 750-800μ; long and slender. The median and external-dorsal branches end at the same level; the former not reaching the edge of the bursa, postero-lateral diverges from medio-lateral. Externo-lateral parallel to medio-lateral, but shorter than it. Ventrals long and slender. Prebursal papilla short. Dermal collar surrounds the genital cone. Spicules slender, with strongly recurved hooks with peculiar hammer-shaped barbs at their junction with the shafts.

Posterior extremity, female, blunt and obliquely truncate. Anus near to tip of tail 150μ; distance between anus and vulva 170-200μ, immediately in front of which the body has a width of 420μ. Vagina extremely short. Eggs 76-80μ by 40μ (91-100μ in length, Boulenger).

Occurrence.—Only found on several occasions in the colon of the horse and donkey.

Triodontophorus tenuicollis (Boulenger, 1916) (1). (Plate XLII.)

Size.—Body tapers to both extremities, especially thin anteriorly. Male 18-20 mm. (13.5-19 mm. Boulenger) in length, with maximum breadth 680-750μ (450-650μ Boulenger). Female 18.5-21 mm. (16-19.5 Boulenger) maximum thickness 850-920μ (700-770μ Boulenger).

The cuticular transverse rings are much accentuated in the narrow anterior region of the body, and are modified in such a way as to give the body margins a coarsely serrated appearance.

Head, 160-180μ small, the anterior region of the body somewhat narrowed.

Mouth collar depressed.

Head papillae.—Submedian short, distal portion short. Lateral papillae not prominent.

Mouth capsule comparatively small, slightly wider than deep, 100-120μ by 75-90μ. Anterior margins of teeth provided with sharp denticulations; these, however, may be absent and the margins quite smooth.

Dorsal gutter well developed, reaching to level of anterior margin of mouth capsule.

Leaf crowns.—External composed of numerous slender leaves, about 50 in number; internal of the same number of septa-like elements.

Oesophagus long and slender, 0.9-1.1 mm. in length, with a maximum breadth 130-150μ.

Excretory pore and *cervical papillae* near level of the nerve ring.

Posterior extremity, male.—Bursa has a short median lobe, which is almost at right angles to main axis of body. Laterals large and distinctly marked off from the median by definite notch. Dorsal ray short, 50-66μ, its branches equally divergent. Median branch does not reach to edge of bursa. Lateral rays long; the postero-lateral divergent; median lateral longer than the externo-lateral. Ventrals narrow; prebursal papilla long and slender. Dermal collar enormously developed and completely surrounds the genital cone. Finger-like projections of the dermal collar may be present at the genito-intestinal opening. Spicules slender, with feebly developed hooks, which form wide angles with their shafts.

Posterior extremity, female, tapering to a short blunt point. Anus near to tip of tail, 50-100μ from it. Distance between anus and vulva 500μ; at this level the body has a breadth of 320-380μ. Vagina short. Eggs 84-92μ by 44-48μ.

Occurrence.—Is more definitely restricted to the dorsal colon than *T. minor,* where it may occur in large numbers. Is fairly frequently met with (33 per cent.) in the horse, mule, and donkey.

Cylindropharynx brevicauda (Leiper, 1911) (2). (Plate XLIII.)

Size.—Small worms, the males measure 5-7.3 mm.; the females 5.6-8 mm. in length; maximum breadth of body 0.45 mm.

Head, measures 120-150μ in breadth at the level of the anterior extremity of the mouth capsule.

Mouth collar appears almost circular in a lateral view.

Head papillae.—Submedian papillae are conspicuous, each consists of a leaf-shaped appendage carried on a cylindrical base. Laterals are not prominent, they are situated in a slight depression of the oral margin and have trifurcated extremities.

Mouth capsule, circular in transverse section. Cylindrical, 300-400μ in length with a maximum diameter of 90-120μ, its internal surface lined with a transparent chitinous layer. Walls are comparatively thick and straight, with a slight outward curve anteriorly.

Dorsal gutter does not project into the mouth capsule.

Leaf crowns.—The external consists of 6 large elements corresponding in position to the head papillae. The two situated laterally

are larger than the four submedians; each is notched and longitudinally grooved, suggesting an origin by fusion of at least two elements. Dorsally and ventrally the external leaf-crown is deficient, but from each of the dorsal and ventral lips of the mouth collar there projects horizontally inwards a broad crescentic plate, the free concave margin of which is directed towards the axis of the month. The internal leaf crown consists of twelve broad elongated leaves arising from the anterior margin of the mouth capsule; the leaves are extremely thick; in profile they might be taken for anteriorly directed branches of the oral capsule.

Oesophagus exceedingly short and fleshy, almost cylindrical in shape and measures 0.47-0.53 mm. in length, with a maximum width of 0.13-0.18 mm.

Excretory pore and *cervical papillae* 450μ from anterior extremity. Nerve ring surrounds oesophagus immediately behind its union with the buccal capsule.

Posterior extremity, male.—The bursa has a denticulated margin. the dorsal lobe measures about 0.2 mm. in length, the lateral lobes are comparatively narrow and do not completely embrace the genital one. The bursa shows a characteristic position of the rays. The posterior ray is split to its base into two portions, and each of these is again split as far back into an internal and external ray. The external ray is deeply bifurcated as it reaches the edge of the bursa. There is a stout, thick accessory or guiding piece. Genital cone large. almost cylindrical. up to 0.4 mm. in length with a breadth of 0.17 mm., it is completely surrounded by the dermal collar which, however, shows its greatest development on the ventral surface. Appendages are quite peculiar: a pair of finger-shaped appendages with rounded ends occur just behind the genital opening; whilst an irregular number of delicate processes are scattered over the dorsal surface of the cone. Spicules are long, about 1.1 mm., rather stout, with hook-like terminations, recalling those of *Triodontophorus*.

Posterior extremity, female.—The tail is pointed; tapering very quickly from a diameter of 0.25 mm. at the level of the vulva to a pencil point. The vulva is situated 0.45-0.75 mm., the anus 0.15-0.2 mm. from the posterior extremity. Caudal region capable of a certain amount of contraction.

Occurrence.—This form was not found in South Africa.

Cylindropharynx longicauda (Lieper. 1911) (2). (Plate XLIII.)

Size.—Males 4.7-5.8 mm.; female 6.2-7 mm. in length. The greatest breadth of the body is about 0.45 mm.

Head has a breadth of 0.14-0.15 mm.

Mouth collar and *head papillae* as in the type species.

Mouth capsule smaller, and considerably shorter than that of *C. brevicauda*, measuring 0.18-0.2 mm., with a breadth of 0.07-0.09 mm.

Leaf crowns as in the type species.

Oesophagus more slender, 0.42-0.45 in length, the greatest breadth 0.08-0.12 mm.

Excretory pore and *cervical papillae* as in the type series.

Posterior extremity, male.—Bursa broad, measuring nearly 0.5 mm. in lateral view. The lateral lobes enclose the genital cone, which is shorter and more globular than in the type species. The external branch of the posterior ray may be undivided; or a small branch may be given off close to the termination of the ray. Guiding piece less developed and shorter, 0.13 mm. The appendages of the genital cone consist of a single pair of rather stout, finger-shaped processes.

Posterior extremity, female, long and pointed. Vulva situated farther forward, 1.1-1.5 mm. from the posterior extremity; anus 0.28-0.32 mm. from tip.

Occurrence.—This form was not found in the South African material.

Cylindropharynx rhodesiensis (Yorke and Macfie, 1920) (II). (Plate XLIII.)

Size.—Male 12.5 mm. in length with maximum breadth of 650μ. Female 13.5-15.8 mm. in length, greatest breadth 830μ.

Head.—Mouth collar marked off by a constriction; it is distinctly higher dorsally and ventrally than laterally.

Head papillae as in the type species.

Mouth capsule almost circular in transverse section, its longer axis running dorso-ventrally. Very long, 511-544μ, with a maximum breadth of 144-175μ. The walls of the mouth capsule are stout, of almost uniform thickness, except at the two extremities, where they taper slightly; they are almost parallel, and the greatest diameter, as in the type species, is found near the anterior opening.

Dorsal gutter as in type species; does not project into the buccal capsule.

Leaf crowns as in *C. brevicauda*.

Oesophagus short and broad. Nerve ring situated near the anterior extremity. Its length in the male measures 767μ, in the female 833-841μ.

Cervical papillae lie in front of the *excretory pore*, half-way between the nerve ring and the posterior end of the oesphagus.

Posterior extremity, male.—Dorsal lobe of the bursa is short. The posterior ray exhibits the following characters:—It is split to its base, and from each limb arises one lateral branch, close to the point of origin of the externo-dorsal ray (posterior external). The extremity of the lateral branch bifurcates into two finger-like processes, the external of which is slightly the longer. The main trunks of the posterior ray taper to very fine points. Genital cone is globular, and surrounded by a dermal collar, which is well developed on the ventral surface. Genital appendages appear to be absent. Spicules long, stout, and barbed.

Posterior extremity, female.—The end of the body is straight and gradually tapers to a point. The distance from the anus to tip of the tail varies from 388-480μ; and that from the vulva to the tip from 1.7-2.196 mm.

Occurrence.—Originally reported from the large intestine of a zebra shot in Northern Rhodesia; it was, however, not found in the Transvaal material.

Cylindropharynx intermedia, n.sp. (Plate XLIV.)

Size.—The males measure 8.5-10 mm. in length, with a maximum breadth of 420-480μ. The females measure 10-11 mm. in length, with a maximum breadth of 520μ. Cuticle shows transverse annulation except in the cephalic region.

Head 140-160μ in breadth, head and neck narrower than the rest of the body, increase in breadth, about midway down the oesophagus.

Mouth collar and *head papillae* as in *C. brevicauda*.

Mouth capsule has a depth of 440-460μ in the male, 500-520μ in the female, with a maximum breadth at its anterior extremity of 85-96μ in the male and 120μ in the female. Walls stout, not straight tapering slightly at both extremities.

Dorsal gutter and *leaf crowns* as in the type species. *Oesophagus* short and roughly cylindrical in shape, shows a slight decrease in width at the level of the nerve ring, immediately behind its union with the buccal capsule. It is 470-540μ in length in the male and 600-640μ in the female, with a maximum breadth of 160μ in the male and 200μ in the female.

Excretory pore and *cervical papillae* at about the same level behind the nerve ring, 560-640μ in the male and 620-660μ in the female from the anterior extremity. The left papilla is a little in front of the right.

Posterior extremity, male.—The bursa has a short dorsal lobe (280-300μ in length), whose outline may be rounded or bluntly triangular. The lateral lobes do not embrace the genital cone. The external branch of the dorsal ray is deeply bifurcated into two finger-like processes, the external of which is the longer. The externo-dorsal ray shows a groove down its centre, suggesting a fusion of two rays. Genital cone of remarkable size, measuring 240-280μ in length, with an average breadth of 160μ. It is retractile. Dermal collar well developed, more especially ventrally. Genital appendages as in the type species, i.e. a pair of finger-shaped appendages with rounded ends occur just behind the genital opening, whilst an irregular number of delicate processes are scattered over the dorsal surface of the cone. Spicules 920μ.

Posterior extremity, female.—At the vulva, situated 1.5-1.6 mm. from tip of tail, the body has a diameter of 360μ; behind this level the body tapers to a pointed tail. Anus 260-320μ from the posterior end.

Occurrence.—Present in the pelvic flexure and dorsal colon, where it is the commonest parasite of the three zebrae examined.

Discussion.—This worm most closely resembles *C. brevicauda*, from which, however, it may be distinguished by its greater size and by the posterior extremity of the female. It is easily distinguished from *C. longicauda* and *C. rhodesiensis* by the nature of its genital cone.

COMPARATIVE TABLE OF THE DIFFERENT SPECIES OF THE GENUS *CYLINDROPHARYNX*.

	C. longicauda.	*C. brevicauda.*	*C. intermedia.*	*C. rhodesiensis.*
Total length—				
Male	4·5–5·8 mm.	5–7·3 mm.	8·5–10 mm.	12·5 mm.
Female	6·2–7 mm.	5·6–8 mm.	10–11 mm.	13·5–15·8 mm.
Mouth capsule—				
Depth:				
Male	180–200μ	300–400μ	440–460μ	311–344μ
Female	70–90μ	90–120μ	500–520μ	144–175μ
Breadth			85–120μ	
Oesophagus—				
Length:				
Male	420–450μ	470–530μ	470–540μ	767μ
Female			600–640μ	833–841μ
Breadth	—	—	—	—
Posterior extremity (Male)—				
External branch of posterior ray	Undivided, or with only a minute process	Bifurcated	Deeply bifurcated	Bifurcated.
Genital cone	Short and globular	Almost cylindrical and surrounded by a dermal collar; retractile		Globular.
Genital appendages	A single pair of rather stout processes	A pair of finger-shaped processes and behind them a number of delicate processes		Apparently absent.
Posterior extremity (Female)—				
Distance from tip of tail to:				
(1) Anus	280–320μ	150–200μ	260–320μ	388–480μ
(2) Vulva	1,100–1,500μ	450–750μ	1,500–1,600μ	1,700–2,196μ

Trichostrongylus axei (Cobbold, 1880) Railliet and Henry, 1909.
Synonym *Strongylus tenuissimus* (Mazzanti). (Plate XLV.)

Size.—Male 3.8-6 mm. Female 5-8 mm.

Body, filiform; tapering towards the extremities; mouth naked.

Male.—Bursa bilobed; posterior ray bifid, branches bifid at their extremity; ventral and lateral rays separated from their commencement; spicules short and twisted; 0.150-0.110μ in length; gubernaculum present.

Female, with a conical caudal extremity, terminated by a delicate point. Vulva in the posterior sixth of the body; eggs elliptical, 0.100 to 0.112 mm. long by 0.063 mm. broad, segmented in the uterus.

Habitat.—Stomach of the horse and donkey.

Geographical distribution.—Europe.

Discussion.—This species has only been reported twice, once by Cobbold and once by Mazzanti, but their descriptions are not very good; and the figure after Cobbold is not satisfactory. Nevertheless, it seems that we are treating with a *Trichostrongylus*, as Railliet also considers it.

This description is taken from Travassos (2).

Dictyocaulus Arnfieldi (Cobbold, 1884). (Plate XLV.)

Male 28-36 mm.; female 43-55 mm.

Caudal bursa short and faintly lobed; median rays bifid; posterior rays bilobate and widely united at their base. Spicules curved, measuring 200-240μ. Tail of female short, slightly curved, terminating in a blunt point. Vulva situated in anterior three-fifths of the body. Eggs 80-100μ long by 50-60μ wide. Embryo 0.4-0.5 mm. long developed in uterus.

Habitat.—Lungs of horse and donkey—capable of producing verminous bronchitis. In the South African material one specimen was found in the caecum of a horse.

Dictyocaulus viviparus Bloch, 1782.

Males 40 mm., females 60-80 mm.

Caudal bursa small, not lobed; middle rays simple, posterior tridentate; spicules small acute. Tail of female short and sharp; vulva near middle of body. Eggs 85μ by 35μ.

Habitat.—Found in the bronchi of cattle and horse.

Ascaris megalocephala Cloquet, 1824.

Synonym *Ascaris equorum* (Goeze).

Size.—Males 15-18 cm., females 18-37 cm.

Head.—The three lips are marked off from the rest of the body by a well defined constriction. On their inner surface the lips bear a large number of very fine teeth.

Head papillae.—The dorsal lip bears two papillae, and each of the ventral lips only one papilla.

Posterior extremity, male, bears two small alae, and on each side has 79-105 papillae; 7 of these are postanal, whereas the 4th and 5th as well as the 7th and 8th are fused. An unpaired papilla in front of cloacal opening. The rest are arranged at first in one line, but later in several.

Female.—The vulva is in anterior third; vagina short; uteri parallel. Eggs almost spherical 0.09-0.1 mm.

Occurrence.—Gough states that *Ascaris equorum* appears to be frequent in South African equines; he reports it from the horse and from the zebra.

Ascarids were not included in the Onderstepoort material.

Life-history.—The course of development of *A. lumbricoides* (a form very closely related to *A. megalocephala*) as given by Ransom and Foster (1 und 2) is briefly as follows:—

Infective eggs, i.e. eggs in which the contained embryo have reached the vermiform stage, hatch out in the small intestine, from whence they migrate to the liver, where they remain for a few days. They then migrate to the lungs evidently by way of the hepatic veins, inferior vena cava, heart, and pulmonary arteries. From the lungs they pass up the bronchi and trachea and finally reach the small intestine again by way of the oesophagus. Some larvae may go astray and may occur in the spleen under the peritoneum of the abdominal cavity and in other locations which they could scarcely reach except in the systemic circulation.

It is most probable that the life-history of *A. megalocephala* may prove to be the same as that of *A. lumbricoides*.

Yoshida favours the view that the larvae may penetrate into the lungs from the surface after passing through the diaphragm, though he obtained no clear evidence to support this theory.

Ascaris zebrae Sekrijabin, 1916. (Plate XLVI.)

Size.—Male reaches 150-180 mm. in length with a maximum width of 0.85 mm. to 1.36 mm. The female 75-100 mm. in length with a maximum breadth of 1.3-1.5 mm. in the middle of the body.

Cuticle is transversely striated.

Head.—The cephalic extremity is surrounded by three basal and three accessory lips, whose length only reaches one-third of that of the basal lips.

The lips are of nearly regular quadrangular form with traces of a slight groove both on the anterior and lateral edges, the peripheral part of the lip is occupied by a transparent fine membrane, bordered by a dentated margin. The median part of the lip has a deep fissure on the interior, the fissure widens anteriorly. The fissure divides both lobes of the pulp, which latter has no remarkable features in this species. The most characteristic feature in our species is the presence of dentated formations on the interior surface of the lips, in their posterior half. Here there is a formation which is concave towards the oral lumen. Its upper slightly concave edge, as well as its lateral edges are covered with small denticles, whose points are directed anteriorly. This character distinguishes *A. zebrae* from other related forms.

Oesophagus is comparatively short; only 6-7 mm. long.

Male.—The caudal end is rounded, and has a small knobbed tip. The aperture of the cloaca is situated 0.255 mm. from the posterior extremity. At this level the body has a width of 0.476 mm. At the level, where the oesophagus passes into the intestine, it has a breadth of 0.765 mm.

Two equal spicula; 4.08 mm. long. These are slightly curved, of a simple structure, and without any alate diverticula. The posterior end is rounded in the shape of a spoon.

There are 48 pairs of preanal papillae, of which six pairs are arranged laterally and 42 submedially. The lateral papillae are concave formations with rounded knobbed tips; the submedian papillae on the contrary, are flat bodies, not protruding above the

surface of the cuticle, each is surrounded by an oval ridge, which gives it the appearance of an eye. The arrangement of the papillae is as figured on Plate XLVI.

Female.—The anal aperture is situated at a distance of 0.39 mm. from the posterior end; at this level the body has a diameter of 0.68 mm. The tail is rounded and provided with a small conical process 34μ long. The genital aperture is situated somewhat posterior to the middle of the body length. The eggs are round or oval, 85-90μ in length and 68-72μ in width. The egg-shell is finely punctuated.

Occurrence.—Parasitic in the intestine of the zebra. It was not present in the South African material.

Oxyuris equi Schrank, 1788. (Plate XLIX.)

Synonyms *Oxyuris curvula* (Rudolphi, 1803); *Oxyuris mastigodes* (Nitsch).

Size.—Males 9-12 mm., females up to 150 mm. in length. Body usually whitish, without any cuticular inflations at its anterior end. Mouth surrounded by three large lips. Two lateral papillae, which are low and near to the mouth opening, and four submedian papillae. These latter are thick, their surface showing a radially arranged grooving.

Oesophagus in the female about 3 mm.; showing a denticular apparatus.

Male.—Posterior extremity obtuse with a caudal bursa of peculiar structure. There are two dorsal papillae carrying the cuticular expansion; ventrally the bursa is also supported by two papillae. Dorsally to the cloaca is the spiculum surrounded by a cuticular sheath, which is supported laterally by two slender papillae. Behind these two stand two larger spicules carrying a membranous structure, which surrounds the spiculum and its sheath. Outside these is a pair of large papillae, which likewise possess a serrated additional piece each bearing a free cuticular edge.

Female.—Body thick anteriorly, behind the anus suddenly falling away into a thin tail, which is of variable length.

Vulva 7-10 mm. from the anterior extremity. Eggs elliptical, thick-shelled. At one end the shell is pierced, the hole, however, being closed up with a plug.

Occurrence.—In the South African material the larvae were of frequent occurrence in the colon and only in two cases were there any present in the caecum. Mature females were rarely met with, their usual habitat being the rectum. In one case, a donkey which had been killed on account of rickets, there were no less than 110 males. In the accompanying 7 females, the tail had not yet increased in length. This donkey must at one time have suffered from a very heavy infection indeed, the fertilized females having already migrated into the rectum at the time when the worms were collected; for in no other way can the large proportion of males, which are usually rare, be explained. *Oxyuris* is a frequent parasite in all the South African equines.

Von Linstow (3) reports an Oxyure (*O. tenuicauda*) from a zebra (Rukwa) which in all probability is a form of *O. equi*.

Genus *Crossocephalus*.

At present we have three descriptions of worms belonging to this genus: (1) that of *Pterocephalus viviparus* given by Von Linstow

in 1899; (2) that of *Crossocephalus viviparus* given by Gedoelst, 1916; and (3) that of *Crossocephalus zebrae* given by Yorke and Southwell, 1920. The three worms described and figured agree in the main, but differ in the detailed structure of the head. These differences, however, may be merely due to faulty interpretations, so that in reality, we are in all probability dealing with one worm only. Hence I will adopt the description as given by Yorke and Southwell (which corresponds to the worms found in my material) and will then note the differences between this form and the other two.

Crossocephalus zebrae Yorke and Southwell, 1920. (Plates XLVII and XLVIII.)

Size.—Moderately small species, the female being slightly larger than the male. The males are 7.6-8.3 mm. in length, with a maximum breadth of 440μ; the females are 7.4 to 9.4 mm. in length, with a maximum breadth of 498μ. The anterior extremity is truncated; the posterior extremity of the male is inrolled ventrally and that of the female straight and tapering.

Head.—The anterior end of the body tapers very slightly to the head, which is sharply truncated; there is no definite neck.

Lips.—The mouth is surrounded by three lips, one dorsal and two subventral. Each lip on its oral aspect being sub-divided into three portions, and having a finely serrated edge.

Head papillae.—These are numerous, 15 in number, and have a complicated arrangement: (*a*) the two lateral papillae are very prominent; (*b*) the four submedian just project beyond the surface of the lip; (*c*) an additional papilla situated in the middle of each lip; (*d*) three pairs of papillae, so arranged that one papilla lies on each side of the junctions of the three lips. There is no chitinized mouth capsule, but there are three pairs of pectinated laminae, situated in the anterior end of the oesophagus. Each of these laminae bears from eight to eleven pointed teeth, which are directed backwards when the mouth is closed. The mouth is capable of being everted, in which condition the lips are folded back over the anterior end of the worm, the papillae being directed backwards, the anterior portion of the oesophagus then forms the anterior end of the worm, the six pectinated laminae being erected and their teeth directed forwards. Eversion is probably brought about by the action of certain prominent longitudinal muscles.

The duct of the dorsal oesophageal gland opens into the mouth.

Oesophagus.—The length of the oesophagus in female worms, in which the mouth is closed, measures from 1.016 mm. to 1.085 mm.; when the mouth is open there is an apparent shortening of the oesophagus to the extent of about 100μ, showing the extent to which eversion of the anterior end of the oesophagus may proceed. In the males the oesophagus varied in length from 1.002 mm. to 1.013 mm. A series of yellow club-shaped bodies possibly of a glandular nature occur in the wall of the oesophagus: these commence about 220μ from the anterior extremity of the worm, and extend backwards for a distance of about 70μ. The bulb of the oesophagus contains a valvular arrangement consisting of three ridges projecting into the lumen.

Excretory pore.—This is situated about twice the length of the oesophagus from the anterior extremity; 2.041μ in the female, 2.110μ

in the male, from the anterior extremity. The pore presents the appearance of a transverse slit, and is surrounded by a palisade-like structure consisting of cuticular ridges.

Cervical papillae are nipple-like projections lying very close to the anterior extremity of the worm.

Posterior extremity, male.—Markedly inrolled ventrally. The tail tapers to a point and is furnished with three preanal and five postanal papillae; of the latter four lie towards the left and one on the right side of the body. There are no membranous expansions. Spicules are unequal in size. The larger about twice the length of the smaller (varying from 295-353μ in length; the smaller from 145-176μ). The larger spicule shows fine striations, the testes and ejaculatory duct are limited to the posterior third of the worm.

Posterior extremity, female.—Straight, the tail tapering to a point. Distance between anus and vulva varies from 170-255μ and the distance of the anus from the tip of the tail from 488-617μ. There is a single tubular ovary, the anterior extremity of which lies about 300μ behind the excretory pore (in females with large well-developed embryos, it may be pushed forwards and may come to lie at the level of the excretory pore). The oviduct runs forward for a short distance and then dilates into a receptaculum seminis. The uterus is a thin walled sac and reaches nearly as far posteriorly as the vulva; in gravid worms it contains one or more fully formed larvae, which attain to a length equal to about half that of the parent worm. The larvae exhibit clearly the six pectinated laminae. In the posterior part of the uterus developing larvae can be seen. The vagina commences as a thick muscular tube and exhibits a beaded appearance due to numerous dilations; it runs first posteriorly, then anteriorly for a short course, and then directly posterior to the vulva.

Crossocephalus viviparus (Von Linstow, 1899) Gedoelst, 1916 (2). (Plate XLVII.)

This form differs from *C. zebrae* mainly in the structure of the head.

According to Gedoelst "the cephalic extremity is sharply truncated, and bordered by a peri-buccal collar (bourrelet), the free margin of which is raised at the level of the six papillae: two laterals, prominent, conical, in the form of lateral horns, and four submedian in the form of depressed cones (*en cone surbaisse*). The region bounded by the peri-buccal collar is occupied by three low lips, or rather valves, equal in size and triangular in shape; their converging apices are divided into three lobes, a large, rounded median, and two pointed laterals; besides this, each lip bears two projecting hooks, diverging slightly." That is, according to Gedoelst, there are in all only twelve papillae. The three not mentioned being apparently the three additional papillae of *C. zebrae* situated in the middle of each lip. "These lips surround a triangular mouth which leads into the triangular cavity, or 'atrium preoesophagien,' containing six pectinated laminae arranged in pairs."

Except for slight differences in the measurements, the rest of the description corresponds with that given by Yorke and Southwell for the females of *C. zebrae*.

Pterocephalus (*Crossocephalus*) *viviparus* (Von Linstow, 1899).

Apart from some structural misinterpretations, this form further differs from *C. zebrae* in the following details:—

"The posterior extremity is limited by three rounded lips, one dorsal and two ventrals; on the former are situated two circular holes (oeffnung) and one on each of the latter. Exteriorly are six 'kegelförmige Spitzen,' and exteriorly to these are six hooks and farther out six leaves of peculiar structure, which are only attached to the body by their bases, are deeply serrated and on the edges facing one another are four bent leaves. The mouth opening can be retracted, in which case the six 'kegelförmige Spitzen' and the six hooks are also drawn into the cavity and the six leaves are raised, so that their posterior portions now point forwards." For the sexually immature worms he gives the following description of the cephalic extremity:—

"Mouth opening surrounded by six 'Spitzen,' behind which stand six hooks which curve forwards and inwards." The pectinated leaves, which are present even in very small embryos, he does not mention.

Posterior extremity, male.—"On each side of the tail are two preanal and four postanal papillae and besides these a dorsal papilla situated farther back." It would seem that Von Linstow first made his drawings and later described his worms from the drawing. This is the only plausible explanation which can be given of his doubling the number of papillae and of placing them subventrally instead of ventrally. His figure representing the lateral view of the male tail corresponds to that of *C. zebrae*, except that he only figures two instead of the three preanal papillae. Perhaps the third or middle papilla was not developed in the specimen from which he made his drawing, or perhaps owing to its smaller size it was overlooked. Von Linstow in writing his description apparently, then, assumed that his figure represented the papillae on one side of the tail only and that those of the other side were similarly arranged. This explanation might also account for his inversion of the parts of the cephalic region. The longer spicule he also mentions as being transversely striated.

Posterior extremity, female.—May be retracted telescope-wise in a certain region. (This phenomenon was also to be seen in some of the South African worms.) The "vagina" is slightly behind the middle of the body, dividing it in the proportion of 4:3. The embryos he gives as about half as long as the females.

As Gedoelst correctly points out, the vulva can obviously not be near the middle of the body, if the young embryo, measuring half the length of the female, is to escape to the exterior through it. We are thus forced to assume that the position, which Von Linstow attributes to it, is incorrect.

Occurrence.—*Crossocephalus* shows a decided preference for the "ventral colon," where it may be present in great numbers. In the caecum it may also be fairly numerous, but only a few are to be found in the dorsal colon, which is usually heavily infested with *Cylindropharynx*.

The worms in the South African material were present in two different sizes, the extremes of which, however, overlapped. The smaller worms usually had their pectinated laminae drawn into the mouth cavity, and showed signs of contraction; e.g. telescoping of the female posterior extremity. In most cases the exact structure of the head end was difficult to see, the three additional papillae situated in the centre of each lip being liable to be easily overlooked.

TABLE OF MEASUREMENTS GIVEN BY DIFFERENT AUTHORS.

	Von Linstow.	Gedoelst.	Yorke and Southwell.	Small South African.	Large South African.
Male :—					
Long	0·32 mm.	—	7·6–8·3 mm.	6·5–8 mm.	7–8 mm.
Broad	0·45 mm.	—	440μ	320–350μ	360–400μ
Oesophagus—					
Long	$\left(\frac{1}{5.3}\right)$ = 1·2 mm.	—	1·002–1·020 mm.	920–960μ	840–920μ
Excretory pore from anterior end	—	—	2·027–2·172 mm.	0·95–1·05 mm.	1·25–1·5 mm.
Spicules—					
Long	0·35 mm.	—	295–853μ	320–340μ	340–360μ
Short	0·26 mm.	—	145–176μ	160–180μ	160–180μ
Female :—					
Long	0·76 mm.	5·25–9·5 mm.	7·4–9·4 mm.	6–8 mm.	9–9·34 mm.
Broad	0·55 mm.	280–512μ	498μ	380–460μ	360–480μ
Oesophagus—					
Long	$\left(\frac{1}{7.5}\right)$ = 0·9 mm.	1–1·15 mm.	1·016–1·085 mm.	0·74–1 mm.	0·860–0·910μ
Excretory pore from anterior end	—	1·9–2·2 mm.	1·866–2·172 mm.	1·58–1·86 mm.	1·36–1·6 mm.
Tail	$\left(\frac{1}{24.3}\right)$	—	—	—	—
Vulva-anus	—	192–208μ	170–235μ	140–200μ	180–200μ
Anus-tip	—	575μ	488–617μ	420–480μ	420–520μ
Eggs	2 × 13μ–4 × 22μ	—	—	—	—
Embryo	3·16 × 0·20 mm.	4 × 0·175 mm.	$\frac{1}{4}$ parent, i.e. 3·8–4·5 mm.	3·3 mm.	3·6–4·4 mm.

From the above table it will be seen that there is much overlapping in the measurements of different parts of the worms; of special note is the fact that the spicules of the different forms are on the average all of the same size and structure, indicating that the respective worms all belong to the same species.

Probstmayria vivipara (Probstmayr, 1865), Ransom, 1907. (Plate XLIX).

Size.—Transparent, small and slender. Male 2.7 mm., female 2-2.2 mm.; truncated anteriorly bears a long slender tail.

Head.—Mouth surrounded by a very transparent collar consisting apparently of six bulbous lips.

Diameter of mouth collar 18-22μ.

Pharynx elongated cylindrical, 40-50μ long.

Oesophagus consisting of two portions, a long, slender anterior portion 240-320μ and a short pyriform portion 80-115μ with a cylindrical stem and with a denticular apparatus in the bulb.

Nerve ring surrounds anterior portion of oesophagus near its middle.

Excretory pore.—Ventral of the oesophageal bulb, a small vesicle opens to the exterior through the excretory pore.

Male genitalia consist of a single tube which anteriorly reaches as far as the oesophagus. Two spicules, similar, slightly curved and pointed, sub-equal; 67μ and 58μ in length. On the ventral surface 4 pairs of preanal and one pair postanal papillae.

Female genitalia.—Vulva about half-way between the two extremities of the body. Vagina short, uteri divergent, size depending upon stage of development of the embryos contained therein. Eggs elongated with thin shell; size of eggs in uterus 58 by 40μ to 100 by 75μ according to stage of development. Only two to four eggs present in the uterus at a time. The eggs hatch in the uterus and the embryos develop to a length of 1.8 mm. or more before they are born. At birth they resemble the parent, except that the sexual organs are not yet developed. The embryos apparently may develop directly into adults without leaving their host. Life-history outside host unknown.

Occurrence in the large intestine of the horse, donkey, and zebra. In the South African material it was present in the ventral colon of two horses and one zebra. In one case I found several *Cylicostomes* in the act of swallowing *P. vivipara* very much in the same manner as that described by Looss for a small transparent *Oxyuris*—thus it would seem that this small transparent *Oxyuris* recorded by Looss actually is *P. vivipara*.

Geographical Distribution.—*P. vivipara* is now known from Germany (Probstmayr, Jerke), Italy (Perroncito, Fiorentini), France (Railliet), Holland (Ihle), Egypt (Looss), South Africa, and in the United States (Ransom).

Setaria equina Abildgaard, 1789. (Plate L.)

Synonyms *Gordius equines* Abildgaard, 1789. *Filaria equi* Gmelin, 1789; *Hamularia* (Treutler, 1795) of Stiles, 1907; *Filaria papillosa* Rudolphi.

Body is whitish, filiform, pointed posteriorly, blunted anteriorly. Male 6-8 cm.; females 9-12 cm.

Cuticle presents a delicate transverse striation.

Head is broad. The mouth is small, round, surrounded by a chitinous ring, the border of which carries at the sides two semilunar lips, and there is on the dorsal as well as on the ventral surface a papilliform process; four submedian papillae. In the specimens before me the cylindrical oesophagus measures 0.8-0.9 mm. by 121-150μ. The darkly pigmented chyle intestine is somewhat broader. Nerve ring about 100μ from anterior end.

Posterior extremity, male, ends in a corkscrew spiral. Ventral surface chagrined and flattened into 2 cuticular appendages. Usually 8 pairs of papillae, which are not symmetrically arranged—4 postanal, of which 1 and 3 are somewhat smaller; a fifth postanal may be present; the four preanals are of equal size. Two short, thick, unequal, spicules jointed to slender guiding piece with well-developed muscles. The longer spicule, 320μ, has wings which reach to its free extremity. Shorter spicule 180μ.

Posterior extremity, female.—Vulva situated just (0.5 mm.) posteriorly to head. Tail ends in a slight swelling, chagrined; on the tail corresponding with each submedian line is a well-defined conical papilla. Eggs may accumulate in the vagina (vestibule). Viviparous.

Embryos measure 280μ in length by 7μ in breadth.

Habitat.—Is a frequent parasite of horses, asses, and mules and has also been reported in cattle. It inhabits the peritoneal cavity and from there occasionally invades the females genitalia or even the liver; it is found more rarely in the pleural cavity, the cranium, or in the intestine. Embryos live in the blood vessels.

The four worms present in my collection were from the stomach of a zebra.

Habronema muscae Carter, 1861. (Plate LI.)

Synonyms *Filaria muscae* Carter, 1861 (Ransom 3 and 4);
Filaria stomoxeos Von Linstow, 1875.
Dermofilaria irritans Rivolta, 1884.

Size and shape filiform. Male varies in length from 8-14 mm., with a maximum width, near its anterior extremity, of 250-300μ. The female measures 13-22 mm. with a width of 250-400μ in the region of the vulva.

Cuticle shows a marked transverse striations. A narrow lateral membrane begins posterior of the left cervical papilla and extends backward along the left side of the body. In the male it reaches to about the middle of the body. In the female it ends within a short distance of the vulva.

Head rounded in outline.

Head papillae.—Submedian papillae situated somewhat posterior to the two lateral.

Mouth bordered by 2 lateral trilobed lips, or if differently interpreted by 2 lateral and four submedian lips. From a lateral view the median lobe of each lateral lip presents a nearly quadrangular outline, with the lateral papilla near its anterior border.

Pharynx relatively small and slender, somewhat complicated in structure. It has an average depth of 48μ in the male, and of 52-59μ in the female; with a maximum diameter of 16-22μ.

Oesophagus is distinctly divided into two parts, a narrow, short anterior portion and a broader, longer posterior portion, the nerve ring surrounds the slender anterior portion, about 230μ in the male, 300μ in the female, from the anterior of the body.

Cervical papillae short, slender, and bristle-like at the level of the nerve ring.

Posterior extremity, male, curves ventrally, usually describing a single turn of a spiral. Narrow, almost symmetrical, bursal wings are present, measuring about 500μ in length and extending to the tip of the tail. Papillae are stalked; there are four pairs of preanal papillae, two pairs of which are adanal rather than preanal. Postanal papillae asymmetrical in arrangement. On the right side of the bursa there is only one postanal papilla, which is situated about half-way between the anus and the tip of the tail. On the left side there are two papillae, one immediately in front of the level of the postanal papilla of the right side and the other immediately behind this level. The ventral surface of the tip of the tail of the male is supplied with a cluster of very small papillae, six of which are somewhat more prominent than the others. The entire ventral face of the bursa is marked with delicate longitudinal ridges and small vesicular excrescences having a linear arrangement.

Spicules, two unequal; the left is long, slender, about 2.5 mm. in length; about 10μ in diameter near its proximal end, tapering to a sharp point, and measuring about 5μ in diameter at its middle. The right spicule is shorter and thicker, about 500μ long, tapering from a thickness of about 20μ near its proximal end to a point posteriorly; measuring about 10μ at its middle. Near the anal opening the spicules are surrounded by a small irregularly shaped gubernaculum.

Female genitalia.—The vulva is situated 7 mm., i.e. about a third of the length of the body, from the anterior end. The vulva is small and displaced dorsalward out of the usual mid-ventral position. It may be dorsal in position, or may even be displaced still further and be located on the left side of the body. The distal portion of the vagina measures less than 15μ in diameter, and is without a muscular sheath. From the vulva it passes transversely around the body, beneath the cuticle in the superficial portion of the body wall, then enters the body cavity, becoming clothed with a muscular layer [=vestibule of Seurat (5)] and passes posteriorly, joining the two uteri about 1.5 mm. posterior to the vulva.

Tail rather plump, with rounded tip and more or less curved dorsalward, the postanal portion measuring 300-350μ.

Occurrence.—H. muscae is essentially parasitic in the stomach, but was occasionally found in small numbers in the caecum and ventral colon of the horse and zebra. It seems to be the commonest representative of its genus present in South Africa.

Life-history.—The young embryos escaping from the uteri of the female worms are excreted with the faeces of the horse. In the manure they enter the larvae of the house-fly. Here they undergo

a process of growth and development, reaching their final larval stages at about the time the flies emerge from the pupal stage. Further development of the worm waits upon the swallowing of the infested fly by a horse, in which event the life-cycle becomes completed by the growth of the worms to maturity. In the flies the parasites are commonly found in the head, frequently in the proboscis, and they may also occur in the thorax or abdomen. At this stage of their development they are characterized by their spiny knobbed tail. In their discussion on the "plaies d'été" of equines. Railliet and Henry (4) come to the conclusion that the nematode causing these wounds is a *Spiropteral larva* belonging to the genus *Habronema*, the mode of infection probably being the following: The *Habronema* embryos are excreted with the faeces. From the soiled bedding they penetrate the skin in the manner of *Ankylostomes*, causing an irritation with the formation of nodules, which through the influence of rubbing and friction develop into wounds. Here the larvae continue their development analogous to that which normally takes place in the fly. Railliet and Henry likewise point out the possibility of a relationship existing between the "plaies d'été" and certain nodules of the lungs. The presence of the larvae in the lung tissue is in no way in opposition to the hypothesis put forward concerning their mode of penetration; it being known that. *Ankylostome* larvae introduced into their host through the skin pass into the lungs.

According to Roubaud and Descazeaux the larvae of *H. megastoma* are exclusively parasitic on the malphigian tubes of their intermediate host, the house-fly. Whereas the larvae of *H. muscae* and *H. microstoma* are parasitic in the cells of the adipose tissue (*H. muscae* in the house-fly, *H. microstoma* in *Stomoxys*).

Two factors are essential before the escape of the larvae can take place, viz., warmth and humidity. The infection of the definite host is realized when the proboscis of the fly comes in contact with the horse's lips or when a fly settles on an open wound.

Habronema megastoma (Rudolphi, 1819). (Plate LII.)

Synonyms *Spiroptera megastoma* Rudolphi, 1819; *Filaria megastoma* Schneider, 1866.

Size and shape; small filiform, tapering towards its extremities. Male, 7-10 mm. in length: female 10-13 mm. in length.

Cuticle.—Lateral membranes present.

Head.—Shows a definite cephalic enlargement.

Head papillae as in the other species of this genus.

Mouth differs somewhat from the type species. It shows only four lips, of which the two laterals are the smaller. These are separated off from the rest of the skin by a deep constriction, giving the appearance of a definite mouth collar. The pulp of these lips shows a peculiar and characteristic striation or grooving.

Pharynx relatively simple in structure. Its wall thick, without the complications present at its anterior margins as in *H. muscae*. Parallel at its base, opening out funnel-wise anteriorly, characterized by its extraordinarily well-developed muscles.

Oesophagus shows the two divisions: the short anterior portion and the broader, longer posterior portion.

Cervical papillae at level of nerve ring.

Posterior extremity, male, curves ventrally describing a single turn of a spiral. Lateral wings present, showing longitudinal ridges, ventral surface also shows the same scalloped markings. Four pairs of preanal papillae, arranged more or less symmetrically; one pair of postanal papillae situated about half-way between the anus and the posterior extremity.

Spicules, two unequal.

Posterior extremity, female, ends in a tail with rounded tip. Vulva in anterior third of the body 4 mm. from the cephalic end. Vagina long and curved. Eggs elongated, 330-350μ long by 8μ wide. In the uterus the embryos may attain a length of 600-700μ.

Occurrence.—Usually only found in ulcers in the stomach, but may get washed down into the intestine. In the South African material only one mule was found, and this was in a zebra.

Habronema microstoma (Schneider, 1866). (Plate LIII.)

Synonyms *Spiroptera microstoma* Schneider, 1866; *Filaria microstoma* Schneider, 1866 (Ransom 4).

Size and shape.—Body tapers to both ends, filiform; male averages 21 mm. in length (9-16 mm. Ransom; 11-22 mm. Schneider) with a maximum breadth of 360-400μ (250-300μ Ransom). Female averages 31-35 mm. (15-25 mm. Ransom; 22 mm. Schneider).

Cuticle shows marked transverse striations. As in the type species the cuticular membrane on the left side of the body is also present.

Head not marked off from the rest of the body. Broad, square, and truncate in appearance.

Head papillae as in the type species.

Mouth as in the type species.

Pharynx comparatively well developed with thick walls; is essentially the same in structure as that of *H. muscae;* in addition, two tridentate processes project into the mouth cavity, one from the dorsal wall of the anterior part of the pharynx and the other from its ventral wall. It has an average depth of 75μ. Furnished with a sheath of strong muscles.

Oesophagus shows the same divisions as the type species.

Cervical papillae and nerve ring situated rather farther back, 280-360μ from anterior extremity.

Posterior extremity, male.—The tail usually curves ventrally, not quite describing a single turn of a spiral. Narrow bursal wings present. These, as also the entire ventral face of the spiral, are marked by numerous scalloped scale-like longitudinal ridges. Papillae are stalked. There are four pairs of preanal papillae, those on the left side being somewhat farther anterior than those on the right. There are four postanal papillae. The two on the left side, slightly apart, are situated behind the anus. The two on the right side, close together, are situated farther back, not far removed from the tip of the tail. The tip of the tail shows the same cluster of papillae as in *H. muscae.*

Spicules unequal, the left about twice as long as the right; both slightly curved, their respective measurements being 760-800μ and 350-380μ. Left spicule is provided with a well developed muscle; a small irregularly shaped gubernaculum is present.

Female genitalia.—Vulva posterior to the anterior third of the body is not markedly displaced out of the mid-ventral position. At this level the body has a diameter of 560μ (350-500μ Ransom). The vagina passes inward and backward, then curves forward for a very short distance, and backward again, entering the body cavity and continuing then in a straight course posteriorly to join the terminal portion of the two uteri. The vagina, in the region of the short S-shaped curve (i.e. vestibule of Seurat), is surrounded by a mass of muscular tissue, which is very conspicuous just behind the vulva. Length of vagina measured in a straight line from the vulva to the point, where it joins the uteri, is 1.4 mm. (1 mm. Ransom). Tail as in *H. muscae*, rather plump and slightly curved dorsalward. Anus 440-520μ from tip of tail. Small cuticular tubercles may be present at tip of tail. Eggs, 45-49μ by 16μ, hatch in the uterus; the young embryo measuring about 90-98μ in length.

Occurrence.—Parasitic in the stomach of domesticated equines. In the South African material it was also present in two out of the three zebrae examined.

Habronema zebrae, n.sp. (Plate LIV.)

Size and shape.—Intermediate in size between the South African forms of *H. microstoma* and *H. muscae*. The males being 10-13 mm. in length, with a maximum breadth of 220-240μ. The females measure 17-18 mm. in length, with a maximum breadth of 340μ the worms are filiform, tapering at both ends, reaching their maximum breadth just behind the oesophagus and retaining it throughout practically their whole length.

Cuticle very much as in *H. microstoma*.

Head.—The general plan of the head, mouth parts, pharynx, and oesophagus is the same as for *H. microstoma*. It differs from the latter, however, in its exceptionally deep pharynx, which recalls that of the genus *Cylindropharynx*. This measures 140-160μ in depth and has a diameter of 22-24μ. Walls are not thick and diverge slightly anteriorly.

Cervical papillae are situated in front of the nerve ring, 280μ from anterior extremity, and the *excretory pore* opens immediately behind this level.

Entire oesophagus long, up to 3.3 mm. in length in females.

Posterior extremity, male, is usually coiled spirally. Bursal wings present showing the usual longitudinal scale-like ridges or cuticular bosses. The genital papillae are stalked. There are four pairs of preanal papillae, the left series slightly in front of the right; and one large unpaired median papilla situated on the upper lip of the cloaca. The four postanal papillae are asymmetrically arranged. On the right side the two papillae are situated at a level about half-way between the anus and the posterior extremity. On the left the one papillae is situated at a level immediately behind the anus, whilst the other is not far removed from the tip of the tail.

Rarely a third papilla may be present on the right side, in which case it is situated opposite the left posterior papilla. Tip of tail is provided with several smaller papillae.

Spicules.—Two unequal, the left very long and slender. 1.7-1.9 mm. in length; the right short and thick, 400-560μ in length. A small irregularly shaped gubernaculum is present.

Posterior extremity, female.—Vulva slightly in front of anterior third of body. The ovijector resembles that of *H. muscae*. The vulva may be displaced out of its mid-ventral position, not as much as in the type species, however. From the vulva it passes for a short distance around the body beneath the cuticle, and then enters the body cavity, where it is surrounded by a muscular layer—(this corresponds to the vestibule of Seurat 480-560μ). As in *H. muscae*, a gland is placed at the base of the vestibule, between the muscular tunic and the cuticle. The sphincter is S-shaped ("la trompe" of Seurat measuring 720-760μ), branches into the two uteri, which run backwards and run parallel for a longer distance than in *H. muscae*. The ovaries wind round the uteri. Seminal vesicle present. Tail bluntly pointed and usually curves dorsally and with a caudal gland and its opening at its extremity.

Discussion.—In general *H. zebrae* most closely resembles *H. muscae* as regards the female genital organs and male spicules, and resembles *H. microstoma* by the presence of the dorsal and ventral processes in the pharynx. It differs from both in its size, deeper pharynx, and in the arrangement of the postanal papillae.

Occurrence.—Present in fairly large numbers in the stomach of the zebra.

KEY TO THE GENUS *HABRONEMA*.

	H. muscae.	*H. zebrae.*	*H. microstoma.*	*H. megastoma.*
Size—				
Male	8–14 mm.	10–13 mm.	9–22 mm.	7–10 mm.
Female	13–22 mm.	17–18 mm.	15–35 mm.	10–13 mm.
Head—				
Mouth	2 lateral, trilobed lips	2 lateral, trilobed lips	2 lateral, trilobed lips	2 lateral and a dorsal and a ventral lip
Pharynx—				
Depth, Male	48μ	140μ	75μ	Characterized by well-developed pharyngeal Muscles
,, Female	52–59μ	140–160μ		
Width	16–22μ	22–24μ		
Pharyngeal processes	Absent	A dorsal and a ventral	dentate process present	Absent
Male—				
Anal papillæ	2 pairs preanal 2 pairs adanal 2 left postanal 1 right postanal	4 pairs preanal, left series in front of right 2 left postanal 2 right postanal Postanals asymmetrically arranged	4 pairs preanal, left series in front of right 2 left postanal 2 right postanal Postanals asymmetrically arranged; the 2 left in front of the 2 right	4 pairs preanal 1 pair postanal
Spicules—				
Left	Long, slender, 2·5 mm.	Long, slender, 1·8 mm.	Short, 760–800μ	—
Right	Short, thick, 500μ	Short, thick, 400–500μ.	Short, thick, 350–380μ	—
Female—				
Vulva	Displaced dorsalward	Displaced dorsalward	Not displaced	—
Vagina	Long, passes transversely round body	Long, passes transversely round body	Surrounded by a mass of muscular tissue	Long and curved
Anus-tip	300–350μ	—	440–520μ	—

* *Physocephalus sexalatus* (Molin, 1860) Diesing, 1861. (Plate LV.)
Synonyms *Spiroptera sexalata* Molin, 1860; *Spiroptera strongylina suis labiate* Molin, 1860.

Head about 60μ in diameter at the anterior end, furnished with two trilobed lips, each lobe being ornamented with a thick, rounded chitinous papilla. The *cuticle* of the head, extending from the mouth to a point 232μ from the anterior end, is more or less inflated. *Pharynx* cylindrical, 263 to 315μ by 53μ wide, furnished with a spiral band, which usually breaks up into separate rings in the middle of its course and resumes the spiral towards the posterior end. The number of turns to the spiral varies between 21 and 25μ. There is a cervical papilla on the left side, 281μ from the anterior end. The *excretory pore* opens on the right side, 526μ from the anterior end. The lateral cuticular wings, three on each side, commencing at the base of the cephalic cuticular inflation, extend posteriorly for a distance about one-third of the body length. The middle wing of each three is 60μ (110-120μ Seurat) wide at its middle, the point of greatest width. The other wings are about half as wide.

Male.—6-9 mm. long, measured in a straight line. Body nearly uniform in diameter, averaging 263μ and attaining its greatest width of 315μ at the point of the greatest width of the lateral wings. The narrow bursal membranes, about half the width of the body, extend from a point about 1.4 or 1.5 mm. from the caudal extremity to and including the bluntly pointed tip. Caudal extremity twisted into a fairly regular spiral, having usually three turns. Long spicule, grooved on the ventral side, 2.1 to 2.25 mm. in length, or five to six times the length of the short spicule, very slender, gradually tapering to a fine needle point. Short spicule 300-350μ long, relatively broad at its base, suddenly tapering to a fine point. The ventral surface of the short spicule is provided with a narrow wing, extending nearly to the tip. Bursa furnished with eight pairs of papillae. Of these the four pairs of preanal papillae are long and stalked; the postanal papillae, close to the tip of the tail, are very small with short stalks.

Female.—13-19 mm. long, average about 16-17 mm. Maximum width 333-450μ in the region directly anterior to the anus. The body rapidly increases in diameter from the anterior end to the region of greatest width of the lateral cuticular wings. At this point the diameter is nearly as great as in the region of the anus. It then rapidly diminishes to half as much at the end of the first third of the body, then slowly increasing, it reaches a maximum near the anus and abruptly diminishes, the body ending in a blunt point, furnished with a mucronate tip. Anus 120μ from the caudal end, 50μ in diameter. Vulva posterior of the middle, 35μ in diameter, dividing the body in the ratio of 9 to 8. The vagina extends posteriorly. Uterus bilobed, the ovaries lying at opposite extremities. Eggs 34 by 15μ, slightly flattened at the poles. Embryo well developed before oviposition.

Development indirect, the egg normally only hatching in the digestive tube of an insect, from whence the larva makes its way into the body cavity of its intermediate host, becoming encysted at

* Description taken from Foster (1).

the end of its second phase. Further development takes place after the intermediate host has been swallowed by the definite host.

Occurrence.—In the stomach and small intestine of the white-lipped peccary, wild boar, and domestic hog. Reported by Seurat (1 and 4) as occurring buried in the mucosa of the stomach of the donkey and dromedary in Algeria, 1911.

TABLE No. I.

TABLE OF OCCURRENCE: HORSE.

Number of bottle..	1	3	5	7	9	10	11	12	15	18	19	20	21	30	34	36
Strongylus																
edentatus								+	+							
equinus	+							+	+							
vulgaris	+	+	+	+	+	+	+	+	+		+	+		+	+	
Triodontophorus																
brevicauda			+													
minor	+	+	+	+	+	+	+	+	+						+	+
serratus			+	+		+	+		+				+			+
tenuicollis	+	+		+				+	+	+						+
Gyalocephalus																
capitatus	+		+	+	+	+	+	+	+				+	+	+	+
Oesophagodontus																
robustus						+										
Cylicostomum																
tetracanthum																
labratum			+	+	+	+	+			+	+		+	+		+
labiatum			+	+		+	+			+				+		
coronatum		+	+	+	+	+	+		+	+	+	+	+	+	+	+
alveatum																
**calinatum*		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
pateratum		+	+			+	+	+	+		+		+		+	+
goldi			+	+		+	+		+		+	+				
radiatum		+			+	+		+	+	+						
elongatum			+			+										
insigne			+			+	+		+							+
†*nassatum*	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
auriculatum																
calicatum		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
minutum				+		+	+		+	+	+	+	+	+	+	+
longibursatum	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+
poculatum	+			+		+		+		+				+		+
asymetricum			+			+	+		+			+				
bicoronatum			+	+		+	+		+	+	+			+	+	+
euproctus	+					+					+	+				+
ihlei						+										
ultrajectinum												+				
brevicapsulatum																
Poteriostomum																
imparidentatum						+									+	
ratzii						+						+			+	
Craterostomum																
mucronatum	+					+		+			+	+			+	
Oxyuris																
equi	+	+	+			+	+	+		+	+	+				+
Probstmayria																
vivipara						+										
Setaria																
equina																
Dictyocaulus																
arnfieldi																
Habronema																
muscae												+				+

* *calinatum* = var. *pseudocalinatum*.
† *nassatum* = var. *parvum* + *leptostomum*.

TABLE NO. I—*continued.*

TABLE OF OCCURRENCE: HORSE—*continued.*

Number of bottle..	40	41	42	43	44	45	47	53	56	57	59	60	62	O.L.142	Total
Strongylus															
edentatus.....								+	+	+	+	+			7
equinus.....								+	+	+	+	+			8
vulgaris.....	+					+		+	+		+	+			10
Triodontophorus															
brevicauda.....				+				+			+				4
minor.....	+		+	+	+	+		+		+	+		+		20
serratus.....	+					+		+			+		+		12
tenuicollis.....								+		+		+	+		11
Gyalocephalus															
capitatus.....		+	+	+	+	+							+		18
Oesophagodontus															
robustus.....															1
Cylicostomum															
tetracanthum...															0
labratum.....		+	+	+		+		+			+		+	+	18
labiatum.....			+	+	+			+						+	11
coronatum.....	+	+	+	+	+	+	+	+	+		+		+	+	26
alveatum.....								+							1
**catinatum*.....	+	+	+	+	+	+	+	+	+	+			+	+	27
guderiatum.....			+		+			+					+		13
goldi.....	+	+	+			+		+					+	+	14
radiatum.....															6
elongatum.....				+				+					+	+	6
insigne.....	+	+	+		+	+		+					+	+	13
†*nassatum*.....	+	+	+	+	+	+	+	+	+				+	+	26
auriculatum....															0
calicatum.....	+	+	+	+	+	+	+	+			+		+		25
minutum.....		+			+	+		+					+		16
longibursatum..	+	+			+	+		+					+	+	22
poculatum.....	+														8
asymetricum....								+					+	+	8
bicoronatum....	+					+		+	+		+			+	16
euproctus.....													+		6
ihlei.....													+		2
ultrajectinum...												+	+		3
brevicapsulatum.	+														1
Poteriostomum															
imparidentatum.													+		3
ratzii.....												+	+		5
Craterostomum															
mucronatum....								+					+		8
Oxyuris															
equi.....		+						+				+	+	+	15
Probstmayria															
vivipara.....		+													2
Setaria															
equina.....									+						1
Dictyocaulus															
arnfieldi.....									+						1
Habronema															
muscae.....					+	+									4

* *catinatum* = var. *pseudocatinatum*.
† *nassatum* = var. *parvum* + *leptostomum*.

TABLE No. II.

TABLE OF OCCURRENCE: MULE, DONKEY, AND ZEBRA.

	14 M.	10 M.	31 M.	58 M.		37 D.	38 D.	39 D.	49 D.	50 D.	51 D.	52 D.	54 D.	55 D.	185 D.	422 D.		P. 641 Z.	P. 642 Z.	P. 643 Z.	
Strongylus																					
edentatus				+	1		+							+			1				
equinus				+	1		+			+		+		+			4	+			1
vulgaris	+		+	+	3		+	+				+		+	+		5	+	+		2
Triodontophorus																					E
brevicauda				+	3		+	+							+		3				
minor		+	+	+	1		+	+	+	+	+		+	+	+	+	9				
serratus				+	1	+	+	+	+	+	+		+	+	+	+	10				
tenuicollis				+	1		+		+							+	3				
Gyalocephalus																					
capitatus	+			+	2	+		+		+	+	+	+				6				
Oesophagodontus																					
robustus				+	1																
Cylicostomum																					
tetracanthum						+	+		+	+	+	+	+	+	+		9	+			1
labratum	+	+	+		3	+		+	+				+	+	+		6				
labiatum	+	+			2	+	+		+		+	+	+	+			7			+	1
coronatum	+	+	+		3	+			+	+	+	+	+	+	+		8				
alveatum						+												+	+	+	3
catinatum		+	+	+	3	+	+		+		+	+	+	+	+		8				
pateratum	+		+	+	3	+	+						+	+			5				
goldi		+	+	+	3	+	+		+				+	+	+	+	7				
radiatum	+			+	2	+							+				2				
triramosum																		+		+	2
elongatum						+	+		+	+	+	+	+	+	+		9				
insigne	+	+		+	3		+								+		2			+	1
adersi				+	1	+			+	+			+	+		+	5	+		+	2
nassatum	+	+	+	+	4	+	+		+		+	+	+	+	+		8				
auriculatum						+	+	+		+	+	+	+	+	+		9				

TABLE No. II—*continued.*

TABLE OF OCCURRENCE: MULE, DONKEY, AND ZEBRA—*continued.*

	14 M.	16 M.	31 M.	58 M.		37 D.	38 D.	39 D.	49 D.	50 D.	51 D.	52 D.	54 D.	55 D.	185 D.	422 D.		P. 641 Z.	P. 642 Z.	P. 643 Z.	
Cylicostomum—contd.																					
calicatum		+	+		2	+					+		+	+	+		5				
minutum		+	+		2	+					+			+			3				
longibursatum		+	+	+	3	+			+				+				3				
poculatum		+			1	+											1				
asymetricum																					
bicoronatum		+	+		1	+			+								2				
euproctus		+	+	+	3	+	+	+									3				
ihlei		+			1	+											1				
ultrajectinum				+	1																
Poteriostomum																					
imparidentatum		+			1	+	+		+	+						+	3	+	+	+	1
ratzii		+		+	2		+									+	4			+	2
ratzii, var. *nanum*																					1
Craterostomum																					
mucronatum		+	+		2	+											1	+		+	2
Oxyuris																					
equi		+		+	2	+	+		+		+				+	+	6		+	+	2
Probstmayria																					
vivipara																			+		1
Setaria																					
equina																		+	+		2
Habronema																					
muscæ																		+	+		2
microstoma																		+	+		2
megastoma																		+	+		1
zebræ																		+	+		2
Cylindrophorynx																					
intermedia																		+	+	+	3
Grossocephalus																					
viviparus (*zebræ*)																		+	+	+	3

TABLE

TABLE OF OCCURRENCE

	Feb., 1916.	March							April					May						
Date	5	22	18	21	22	23	24	27	27	6	6	8	8	29	1	3	4	12	17	23	24
Bottle number	O.L.422	1	3	5	7	9	10	11	12	15	14	16	19	57	34	56	18	20	21	30	31
Animal	D	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H	H	H	H	H	M
Strongylus																					
edentatus																					
equinus		1														11					
vulgaris		4	2	40	9	1	3	10	3						24	20		2			4
Triodontophorus																					
brevicauda																					
minor																					
serratus	4			1	4		1	3		1									3		
tenuicollis																					
Gyalocephalus																					
capitatus		1		6	4		6													1	
Oesophagodontus																					
robustus																					
Cylicostomum																					
tetracanthum																					
labratum				2															2		
labiatum											4										
coronatum			101	115	103	114	239	∞		2	8	72	27					10	∞	51	79
alveatum																					
calinatum			1	7		28	1	5+	21	2		2						5	27	41	
plicatum				5			3														
goldi																					5
radiatum																					
elongatum				1			1														
insigne																					
adersi																					
nassatum			6	15		49	6	1	18	1	1							24	57	15	
auriculatum																					
calicatum			16	10	2	26	87	6+	1	2		7	7					24	30	3	33
minutum																		1	3	33	13
longibursatum			1			1	1	1	1	3											14
poculatum		1			1		2		4											3	
asymetricum																					
bicoronatum				2	1																1
coprocetus																					
ihlei																					
ultrajectinum																					
brevicapsulatum																					
Poteriostomum																					
imparidentatum																					
ratzii																					
Craterostomum																					
mucronatum																					
Oxyuris																					
equi					+						1										
Probstmayria																					
vivipara																					
Setaria																					
equina															+						
Dictyocaulus																					
arnfieldi															+						
Habronema																					
muscae																					

No. III.

IN THE CAECUM.

June			July										Aug.			Sept.		Oct.		Feb., 1917.	Dec.	
8 38 M	8 59 H	29 36 H	1 37 D	1 38 D	12 39 D	18 40 H	20 41 H	20 42 H	21 43 H	22 44 H	25 46 H	27 47 H	19 60 H	19 61 H	21 49 D	29 50 D	30 51 D	13 52 D	62 H	17 53 H	18 54 D	19 55 D
2 1 93	43 46										1		7 4	1 19 7		3		3 11				1 4
	11					1									1 3		25 54		1			1
		7	29				4	1	3	8	5					1	1	1				
	2 2	1 16	1 1 76			107	2 11	71	87	65	82	1			6 2	9	14	5 3 51	78			6
		3 2	5 3				1	1			14	8			1				2	19 1		
		32	2 5 4 1			+	2		1			4			16	14	2 1	1 2		20		6
	1	1 13 5	10			5 2	22	8	4	19	20 1						1		4	5		12
		2																				
																	2					
										2	1											

TABLE OF OCCURRENCE

Collected	Feb., 1916.		March							April					May						
Date	5	22	18	21	22	23	24	27	27	6	6	8	8	29	1	3	4	12	17	23	24
Bottle number	C.L.422	1	8	5	7	9	10	11	12	15	14	16	19	57	34	56	18	20	21	30	31
Animal	D	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H	H	H	H	H	M
Strongylus																					
edentatus									1	2						4					
equinus									4	2						21					
vulgaris					3				4	2		1		25		3				1	
Triodontophorus																					
brevicauda																					
minor	+	+		1	8	2	7		3	2											
serratus	+																				
tenuicollis																					
Gyalocephalus																					
capitatus				15	3	1	2	1	5	1	1				+				2	3	
Oesophagodontus																					
robustus																					
Cylicostomum																					
tetracanthum																					
labratum				1	1	1	94	8			16	5	1				34		3	10	20
labiatum				3	1		56	13			45						17			2	
coronatum			2	1	8	3				3	3					8	4		2	7	3
alveatum																					
calinatum			27	19	5	∞	75	∞	∞	∞		7	19	2	+	2	25		114	84	76
pateratum			3	1			22	12	2	1	3				+				1		1
goldi					1							200									
radiatum			+			1	3		2	3	1						1				
elongatum																					
insigne				1								1									
adersi																					
nassatum			43	28		∞	∞	50	∞	∞	30		4		+	3	18		100	9	31
auriculatum																					
calicatum			7		42	30+	40	6	1	∞		1	23		+		1		17		17
minutum					27		30	7+		6			4		+		16+		2	12	40
longibursatum									2			125	1						1		
poculatum																	1				
asymetricum												3									
bicoronatum				1	7		4	3		4			1		+	1	1			1	1
euproctus												7									
iblei												3									
ultrajectinum																					
brevicapsulatum																					
Poteriostomum																					
imparidentatum																					
rutzii												3									
Craterostomum																					
mucronatum				1								6									
Oxyuris																					
equi									1			1									
Probstmayria																					
vivipara							+														
Setaria																					
equina																					
Dictyocaulus																					
arnfieldi																					
Habronema																					
muscae																					

In bottles 16 and 37 the large number of *C. goldi* and *C. longibursatum*, as well as the general fauna

No. IV.

IN THE VENTRAL COLON.

June			July										Aug.			Sept.		Oct.		Feb., 1917.	Dec.	
8 58 M	8 59 H	29 36 H	1 37 D	1 38 D	12 39 D	18 40 H	20 41 H	20 42 H	21 48 H	22 44 H	25 46 H	27 47 H	19 60 H	19 61 H	21 49 D	29 50 D	30 51 D	13 52 D	62 H	17 53 H	18 54 D	19 55 D
3 4	35 35				1						1		52 1	10 6 2			1			4 14 4		1 1
2 3	3	2 1	6	2	8 152	5		10	1 1	5	4		1			74 15	165 60		8	2	∞ 6	∞ ∞
		28			1					1	2								1			
2																						
		10 64					1	3 2	4 6	1 3	3 180	50+			2 3	21	2 3 1	18 10 6	1 12	6 6 1	6 9 10	23 5 15
2 1		20 6	125	23		15	27	4 1	16	1 2	45				1		6	1	72 10 124	4 9	11	5 1
2 1		250	1	2	1	14	61	5	38	2 1	15				1	2 47	2 29	1 9	2 3 177	75	1 1 ∞	15 8
		27 50 5	4 130 8				4 1		3	11 2	27 5	1			4			1	3 235	1 1	3	8 1
		6	3 1	1	1	1					1									1		
			6	2 1																		
			1																2			
2			14	30			4								117		2		4			
							+															
							1				1											

Present, suggest that the labels of the ventral and the dorsal colon have been interchanged.

TABLE OF OCCURRENCE

Collected	Feb., 1916.		March							April					May						
Date	5	22	18	21	22	23	24	27	27	6	6	8	8	29	1	3	4	12	17	23	24
Bottle number	O.L.422	1	3	5	7	9	10	11	12	15	14	16	19	57	34	56	18	20	21	30	31
Animal	D	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H	H	H	H	H	M
Strongylus																					
edentatus									1												
equinus																					
vulgaris									1	8	1										
Triodontophorus																					
brevicauda				1																	
minor	6				9		6		3	16											1
serratus																					
tenuicollis	1								1	1											
Gyalocephalus																					
capitatus					2				2		1										
Oesophagodontus																					
robustus																					
Cylicostomum																					
tetracanthum																					
labratum							1					4					5		1		
labiatum											1						2				
coronatum																	1	1	1		1
alveatum																					
catinatum			2				1		27	+		6			1		4	·	3		1
pateratum															1						
goldi	7			61	· 2					7 +		34	5					120			5
radiatum									1												
elongatum																					
insigne							2														
adersi	10																				
nassatum			1				1		38	+		1					1		9		2
auriculatum																					
calicatum			3		1					+							1	1	2		
minutum							1			4 +		1					3				
longibursatum		51	3	1	1				14	7 +		81	11				4	134			14
poculatum																					
asymetricum							1	1										4			
bicoronatum		7								1							1				
euproctus		18											2					37			
ihlei												1									
ultrajectinum																		2			
brevicapsulatum																					
Poteriostomum																					
imparidentatum	10						1														
ratzii	15						2											1			
Craterostomum																					
mucronatum		10										1	1								1
Oxyuris																					
equi	10								6			1	3				23	2			
Probstmayria																					
vivipara																					
Setaria																					
equina																					
Dictyocaulus																					
arnfieldi																					
Habronema																					
muscae																	+	+			

No. V.

IN THE PELVIC FLEXURE

June			July										Aug.			Sept.		Oct.		Feb., 1917.	Dec.	
3 58 M	3 59 H	29 36 H	1 37 D	1 38 D	12 39 D	18 40 H	20 41 H	20 42 H	21 43 H	22 44 H	25 46 H	27 47 H	19 60 H	19 61 H	21 49 D	29 50 D	30 51 D	18 52 D	62 H	17 58 H	18 54 D	19 55 D
																				1		
1		1		+		1				4							11		4	1	2	
1		1		+																1		
		19																				
		5															1			1		
		1																		4		
2		3									2								1	1		
2		2		+		7	3	1			4								18	3 7	1	∞
4																						
1		4					1	9			1				8		1			5		
5		50		+				1													1	4
																			1			
1		7				1	10			1	6				2				106	2 1	1	
3		5																		3		
1		9												2								
						1																
2				+										4	1					1		
		1																		1	1	
15							4			6			25	1	13		1			4	4	

TABLE OF OCCURRENCE

Collected.....	Feb., 1916.		March							April					May						
Date.....	5	22	18	21	22	23	24	27	27	6	6	8	8	29	1	3	4	12	17	23	24
Bottle number..	O.L.422	1	3	5	7	9	10	11	12	15	14	16	19	57	34	56	18	20	21	30	31
Animal.....	D	H	H	H	H	H	H	H	H	H	M	M	H	H	H	H	H	H	H	H	M
Strongylus edentatus.....																					
equinus.....											2		2								
vulgaris.....																					
Triodontophorus brevicauda....																					
minor.....	3		3	3	7		11	10	2	5		2		4	1						
serratus.....																					
tenuicollis.....	1	39	2		35				2	22				24			1				
Gyalocephalus capitatus.....										1	2										
Oesophagodontus robustus.....							1														
Cylicostemum tetracanthum..																					
labratum.....												1									
labiatum.....							2					19					1				
coronatum....												2									38
alveatum.....																					
catinatum.....					1					1		39	9				3	1			1
pateratum.....							4														
goldi.....	1			19	9		∞	11		∞		2						130			
radiatum.....																					
elongatum.....																					
insigne.....				7			43	2		2	5										
adersi.....	5																				
nassatum.....		1		1			1		9	3	1	2	1		+		1	2			
auriculatum...																					
calicatum.....					2					1		6	3					2	1		11
minutum.....					8		1			1		12					1				1
longibursatum.		93	1	1	36		∞	∞	∞	∞		5	3		+		15	∞	15		1
poculatum.....																					
asymetricum...				2			15	1		1											
bicoronatum...		7																			
euproctus.....							9											27			
ihlei.....							1														
ultrajectinum..							7														
brevicapsulatum																					
Poteriostomum imparidentatum																					
ratzii.....	5	2					2					1			2						
															1						
Craterostomum mucronatum...							4			1								4			
Oxyuris equi.....	10				1		9	9	3				2		1						
Probstmayria vivipara.....																					
Setaria equina.....																					
Dictyocaulus arnfieldi.....																					
Habronema muscae.....																					

For bottles 16 and 37 the large number of *C. goldi* and *C. longibursatum*, as well as the general fauna

No. VI.

IN THE DORSAL COLON.

June			July										Aug.			Sept.		Oct.		Feb., 1917.	Dec.	
8 58 M	8 59 H	29 36 H	1 37 D	1 38 D	12 39 D	18 40 H	20 41 H	20 42 H	21 43 H	22 44 H	25 46 H	27 47 H	19 60 H	19 61 H	21 49 D	29 50 D	30 51 D	13 52 D	62 H	17 53 H	18 54 D	19 55 D
				2 1		1														10 1		
	14	150	1	4 ∞ 19 1	1 86						1			1	15 1		3		5 4	1 8	1	
			1																			
			1 44 28 3	10 3	1										98 12 2 1							
			37 1	1 1 3		1					4 2				2				1 35		1	∞
		2	4 96 2	1 5 50		1					17				14 1				2	1	1	4
		1	1 3			5					1 1 7								12 1		1	
1 1			1		1										1				2 2 12			
	1															1 2			1 2			
2	+			5									7	12				∞			5	

present, suggest that the labels of the ventral and the dorsal colon have been interchanged.

TABLE No. VII.

TABLE SHOWING GEOGRAPHICAL DISTRIBUTION OF THE EQUINE STRONGYLIDS.

	Egypt (Looss).	South Africa.	W. Africa (Yorke & Maplestone).	Belgian Congo (Gedoelst).	E. Africa (Blgr.).	India (Smith Blgr.).	Australia.	Canada (Ransom & Hadwen).	U.S.A. (Yorke & Maplestone).	England (Tasker & Blgr.).	Holland (Ihle).	Hungary (Kotlán).
Strongylus												
asini		° +			+							
edentatus	+	+	+		+	+		+	+	+	+	+
equinus	++	+	+		+	+		+	+	+	+	+
vulgaris	+	° +	+		+	+		+	+	+	+	+
Triodontophorus												
brevicauda		+				+		+	+	+	+	
intermedius		+	+		+	+	+	+	+	+	+	
minor	+	+	+	+								+
serratus	+	+		+	+							+
tenuicollis		+						+	+	+	+	
Gyalocephalus												
capitatus	+	+						+	+	+	+	+
Oesophagodontus												
robustus		+				+		+		+	+	
Cylicostomum												
tetracanthum	+	° +					+					+
labratum	+	+						+	+		+	+
labiatum	+	+	+			+		+	+			+
var. *digitatum*		+									+	
sagittatum												+
coronatum	+	° +	+		+	+		+	+	+	+	+
ornatum												+
alveatum	+	° +	+		+							
catinatum	+	° +				+		+				
var. *pseudocatinatum*		+	+			+			+		+	
var. *litoraureum*			+									
pateratum		+				+			+		+	+
goldi		+	+			+		+		+	+	+
mettami										+		
radiatum	+	° +	+					+				+
triramosum		° +										+
elongatum	+	° +		+				+		+	+	+
var. *kotlani*		+									+	
insigne		+	+			+		+	+	+	+	
adersi		+			+							
nassatum	+	° +	+			+		+	+	+		+
var. *parvum*		+	+			+					+	
leptostomum		+									+	+
auriculatum	+	° +		+	+							
calicatum	+	° +	+			+	+	+	+	+	+	+
minutum		+				+			+		+	+
longibursatum		+	+			+			+		+	+
hybridum												+
poculatum	+	° +	+			+	+	+	+	+	+	+
asymmetricum		+										
bicoronatum	+	° +			+			+	+	+	+	+
euproctus		+									+	
ihlei		+									+	+
ultrajectinum		+									+	
brevicapsulatum		+									+	
prionodes												+
montgomeryi					+							
Poteriostomum												
imparidentatum		+	+			+					+	
ratzii		+	+								+	+
var. *nanum*		+										
Craterostomum												
mucronatum		+									+	
acuticaudatum												+
tenuicauda					+							

[a] Previously reported by Gough.

INDEX OF SYNONYMS.

Cyathostomum..... See *Cylicostomum.*

Cylichnostomum..... „ *Cylicostomum.*

Cylicostomum—

acuticaudatum..... „ *Craterostomum acuticaudatum.*
calicatum var. *minus*..... „ *Cylicostomum minutum.*
calicatiforme..... „ „ *longibursatum.*
cymatostomum..... „ „ *pateratum.*
elongatum var. *macrobursatum*.. „ „ *elongatum* var. *Kotlani.*
mucronatum..... „ *Craterostomum mucronatum.*
nanum..... „ *Cylicostomum longibursatum.*
pseudocatinatum..... „ „ *catinatum* var. *pseudocatinatum.*
ratzii..... „ *Poteriostomum ratzii.*
tridentatum..... „ *Cylicostomum goldi.*
zebrae (Boulenger)..... „ „ *insigne.*
zebrae (Turner)..... „ *Poteriostomum imparidentatum.*

Dermofilaria irritans..... „ *Habronema muscae.*

Filaria—

equi..... „ *Setaria equina.*
megastoma..... „ *Habronema megastoma.*
microstoma..... „ „ *microstoma.*
muscae..... „ „ *muscae.*
papillosa..... „ *Setaria equina.*
stomaxeos..... „ *Habronema muscae.*

Gordius equinus..... „ *Setaria equina.*

Gyalocephalus equi..... „ *Gyalocephalus capitatus.*

Hamularia..... „ *Setaria equina.*

Hexodontostomum markusi..... „ *Poteriostomum imparidentatum.*

Oxyuris—

curvula..... „ *Oxyuris equi.*
mastigoides..... „ „

Poteriostomum pluridentatum..... „ *Poteriostomum imparidentatum.*

Pseudosclerostomum securiferum..... „ *Oesophagodontus robustus.*

Pterocephalus..... „ *Crossocephalus.*

Sclerostoma quadridentatum..... „ *Cylicostomum tetracanthum.*

Sclerostomum—

armatum..... „ *Strongylus vulgaris.*
bidentatum..... „ „ *vulgaris.*
equinum..... „ „ *equinus* and *edentatus.*
robustum..... „ *Oesophagodontus robustus.*
vulgare..... „ *Strongylus vulgaris.*

Spiroptera—

megastoma..... „ *Habronema megastoma.*
microstoma..... „ „ *microstoma.*
sexalata..... „ *Physocephalus sexalatus.*
strongylina suis labiata..... „ „ „

Strongylus—

armatus..... „ *Strongylus equinus.*
neglectus..... „ „ „
quadridentatum..... „ „ „
tenuissimus..... „ *Trichostrongylus axei.*
tetracanthus..... „ *Cylicostomum tetracanthum.*

Trichonema arcuata..... „ footnote, page 20.

Triodontus..... „ *Triodontophorus.*

Triodontophorus intermedius..... „ *Triodontophorus serratus.*

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(10) *Yorke, W., and Macfie, J. W. S.*—1920. "Strongylidae in Horses": XI. "Species found in West Africa and Jamaica." Ann. Trop. Med. Parasit., XIV, p. 165.

(11) *Yorke, W., and Macfie, J. W. S.*—1920. "Strongylidae in Horses": XII. "Cylindrophaiynx Rhodesiensis." Ann. Trop. Med. Parasit., XIV.

(12) Yorke, W., and Macfie, J. W. S.,.—1920. "Strongylidae in Horses": XIII. "Cylicostomum Triramosum." Ann. Trop. Med. Parasit., XIV, p. 175.

Vevers, G. M.—1920. "Reports on Entozoa Collected from Animals which Died in the Zoological Gardens of London during Eight Months of 1919-1920." Pro. Zool. Soc. London, 1920, p. 405.

EXPLANATION OF PLATES.

Reference Letters.

A = Anterior extremity, lateral view.
B = Head, dorsal view.
C = Posterior extremity of male, lateral view.
D = Posterior extremity of male, dorsal view.
E = Appendage of male genital cone.
F = Posterior extremity of female, lateral view.
G = Spicule.

In each case the scale is indicated beside the drawing.

Head.

c.p. = Cervical papilla.
d.g. = Dorsal gutter.
d.t. = Dorsal tooth.
e.l.c. = External leaf crown.
e.m.ca. = Extra-chitinous support of the external leaf crown.
e.p. = Excretory pore.
i.l.c. = Internal leaf crown.
l.p. = Lateral papilla.
m.ca. = Wall of mouth capsule.
m.co. = Mouth collar.
n.r. = Nerve ring.
oe. = Oesophagus.
oe.f. = Oesophageal funnel.
o.t. = Oesophageal tooth.
sm.p. = Submedian papilla.

Posterior Extremity (Male).

a.g.c. = Appendages of genital cone.
d.co. = Dermal collar.
g.c. = Genital cone.

Rays.

d. = Dorsal or posterior ray.
d_1 = External branch of dorsal ray.
d_2 = Median branch of dorsal ray.
d_3 = Internal or main branch of dorsal ray.
d.e. = External branch of dorsal ray (*Cylindropharynx*).
d.i. = Internal branch of dorsal ray (*Cylindropharynx*).
e.d. = Externo-dorsal (postero-external) ray.
e.l. = Externo-lateral (antero-external) ray.
m.l. = Medio-lateral (anterior-median) ray.
p.l. = Postero-lateral (posterior-median) ray.
l.c. = Latero-ventral ray } Anterior rays.
v.v. = Ventro-ventral ray }
pb.p. = Prebursal papilla.
d.l. = Dorsal lobe of bursa.
l.l. = Lateral lobe of bursa.

Posterior Extremity (Female).

a. = Anus.
ut. = Uterus.
v. = Vulva.
vg. = Vagina.

Plate I..... *Strongylus equinus.*
A not quite lateral view.

Plate II..... *Strongylus edentatus.*

Plate III..... *Strongylus vulgaris.*

Plate IV..... *Strongylus asini*, after Boulenger.
A, B and D × 37.

Plate V..... *Cylicostomum tetracanthum.*

Plate VI..... *Cylicostomum labratum.*

Plate VII..... *Cylicostomum ornatum*, after Kotlán.
B: Ocular, 4; objective, 7*a*.
D: Ocular, 5; objective, 3.
E: Ocular, 2; objective, 7*a*.

Plate VIII..... *Cylicostomum labiatum.*
E_1 : Genital appendage, lateral view.
E_2 : Genital appendage, ventral view.
E_3 : Genital appendage, variety *digitatum.*

Plate IX..... *Cylicostomum coronatum.*

Plate X..... *Cylicostomum hybridum*, after Kotlán.
B_1, E_1 : 4 ocular, 7*a* objective; 135 tube length.
C : 4 ocular, 3 objective.
P_1 : 4 ocular, 3 objective.
Cylicostomum sagittatum, after Kotlán.
B : 2 ocular, 4 objective.
D × 50.
E × 140.
F × 100.

Plate XI..... *Cylicostomum alveatum.*

Plate XII..... *Cylicostomum pseudocatinatum.*
E_1 : Genital cone, appendage of *C. catinatum*, after Looss.
E_2 : *C. pseudocatinatum*, after Yorke and Macfie.
E_3 : *C. catinatum* var. *literaureum*, after Yorke and Macfie.
E_4 : *C. pseudocatinatum*, after Boulenger.

Plate XIII..... *Cylicostomum pateratum.*
E_1 × 360, after Yorke and Macfie.

Plate XIV..... *Cylicostomum goldi.*

Plate XV..... *Cylicostomum radiatum.*

Plate XVI..... *Cylicostomum triramosum.*
C and D × 90, after Yorke and Macfie.
E × 360, after Yorke and Macfie.
Cylicostomum montgomeryi.
A^1 and B^1 × 360, after Boulenger.

Plate XVII..... *Cylicostomum elongatum* var. *Kotláni.*

Plate XVIII..... *Cylicostomum insigne.*

Plate XIX..... *Cylicostomum adersi.*
F_1 : Posterior extremity (female), ventral view.
E_1 × 280, after Boulenger.

Plate XX..... *Cylicostomum nassatum* var. *parvum.*

Plate XXI..... *Cylicostomum leptostomum.*

Plate XXII..... *Cylicostomum auriculatum.*

Plate XXIII..... *Cylicostomum calicatum.*

Plate XXIV..... *Cylicostomum minutum.*

Plate XXV..... *Cylicostomum longibursatum.*

Plate XXVI..... *Cylicostomum poculatum.*

Plate XXVII..... *Cylicostomum asymetricum.*

Plate XXVIII.... *Cylicostomum bicoronatum.*

Plate XXIX..... *Cylicostomum euproctus.*
C^1 : Posterior extremity, with genital cone retracted.

Plate XXX..... *Cylicostomum ihlei.*
C^1 and D^1 × 90, after Kotlán.
E^1 × 180, after Kotlán.

Plate XXXI..... *Cylicostomum ultrajectinum.*

Plate XXXII..... *Cylicostomum brevicapsulatum.*
C × 87 (× $\frac{2}{3}$), after Ihle.
D × 110 (× $\frac{2}{3}$), after Ihle.
E × 640 (× $\frac{2}{3}$), after Ihle.
Cylicostomum prionodes.
A_1 × 345, after Kotlán.
F_1 × 90, after Kotlán.

Plate XXXIII.... *Oesophagodontus robustus.*
C^1 and D^1, after Boulenger.

Plate XXXIV.... *Poteriostomum imparidentatum.*

Plate XXXV..... *Poteriostomum razzii.*

Plate XXXVI.... *Poteriostomum ratzii* var. *nanum.*

Plate XXXVII... *Oraterostomum mucronatum.*

Plate XXXVIII.. *Gyalocephalus capitatus.*
B^1 : ventral view.

Plate XXXIX.... *Triodontophorus minor.*

Plate XL..... *Triodontophorus serratus.*

Plate XLI..... *Triodontophorus brevicauda.*

Plate XLII..... *Triodontophorus tenuicollis.*

Plate XLIII..... *Cylindropharynx brevicauda.*
C, D, F.
Cylindropharynx longicauda.
C^1, F^1.
Cylindropharynx rhodesiensis.
C^2, F^2.
$F^2 \times 45$, after Yorke and Macfie.

Plate XLIV..... *Cylindropharynx intermedia.*

Plate XLV..... *Trichostrongylus axei.*
C, after Travassos, after Cobbold.
Dictyocaulus arnfieldi.

Plate XLVI..... *Ascaris zebrae*, after Sckrijabin.
a : Portion of cuticle at caudal end showing lateral and subventral papilla.
b : Dorsal lip.
c : Tail showing arrangement of papillæ.

Plate XLVII and Plate XLVIII. *Crossocephalus viviparus (zebrae).*
A : Anterior extremity, lateral view, mouth closed.
B : Anterior extremity, dorsal view, mouth everted.
B^1 : Anterior extremity, ventral view, mouth partly everted.
B^2 : Anterior extremity, ventral view, mouth closed.
H : Excretory pore.
K^1 : Head of *C. zebrae*, viewed from in front, after Yorke and Southwell.
K^2 : Head of *C. viviparus*, viewed from in front, after Gedoelst.
a : Lateral papilla.
b : Submedian papilla.
c : Papilla on middle of each lip.
d : Paired papillae.
b.m. : Muscles of mouth parts.
p.l. : Pectinated laminae.

Plate XLIX..... *Probstmayria vivipara*, after Ransom.
Fig. 1 : Lateral view of male × 54.
Fig. 2 : Lateral view of posterior end of male, showing spicules, postanal papillae, vas deferens and cloaca × 190.
Fig. 3 : Dorsal view, anterior end, showing dorsal lips with their papillae × 400.
Fig. 4 : Optical horizontal section, anterior end, showing lateral lips, the lateral organs, pharynx, and oesophagus × 400.
Fig. 5 : Lateral view of anterior end, showing lateral lip, lateral organ, dorsal and ventral lips, and papillae × 400.
Fig. 6 : Lateral view of immature form in which the genital organs are not yet developed × 54.
Fig. 7 : Lateral view of young female, showing an egg in one horn of the uterus × 54.
Fig. 8 : Lateral view of paturient female with uterus containing a well-developed embryo, a second less-developed embryo, and two eggs × 54.

Oxyuris equi.
A : Anterior extremity, larva.
b.ph. : Bulbus pharyngis.
c.ph. : Corpus pharyngis.
l.c. : Lateral cells.

Plate L..... *Setaria equina.*

Lettering to Habronema Plates.
D = Ventral view, posterior extremity, male.
G = Region of vulva of female.

Head.
l.l. = Lateral lip.
ph. = Pharynx.
sm.l. = Submedian lip.
sm.p. = Submedian papilla.
t. = Pharyngeal tooth or tridentate process.

Male.

a. = Anus.
c.p. = Unpaired papilla, situated on upper lip of cloaca.
g. = Gubernaculum.
l.s. = Left spicule.
r.s. = Right spicule.

Female.

a. = Anus.
s. = Sphincter
ut. = Uterus.
v. = Vulva.
ves. = Vestibule.

Plate LI..... *Habronema muscae.*
C = Lateral view, showing preanal and adanal papillae of right side only; and postanal papillae of right and left side.

Plate LII..... *Habronema megastoma.*

Plate LIII..... *Habronema microstoma.*
C = Lateral view, showing preanal papillae on left side only, and postanal of left and right side.

Plate LIV..... *Habronema zebrae.*
C = Showing preanal papillae of left side only, and postanal papillae of right and left side.

Plate LV..... *Physocephalus sexalatus*, after Foster.
c.cut.inf. = Cervical cuticular inflation.
c.p. = Cervical papilla.
ex.p. = Excretory pore.
lab.p. = Labial papillae.
l.b.w. = Left bursal wing.
l.c.w. = Lateral cuticular wing.
r.b.w. = Right bursal wing.

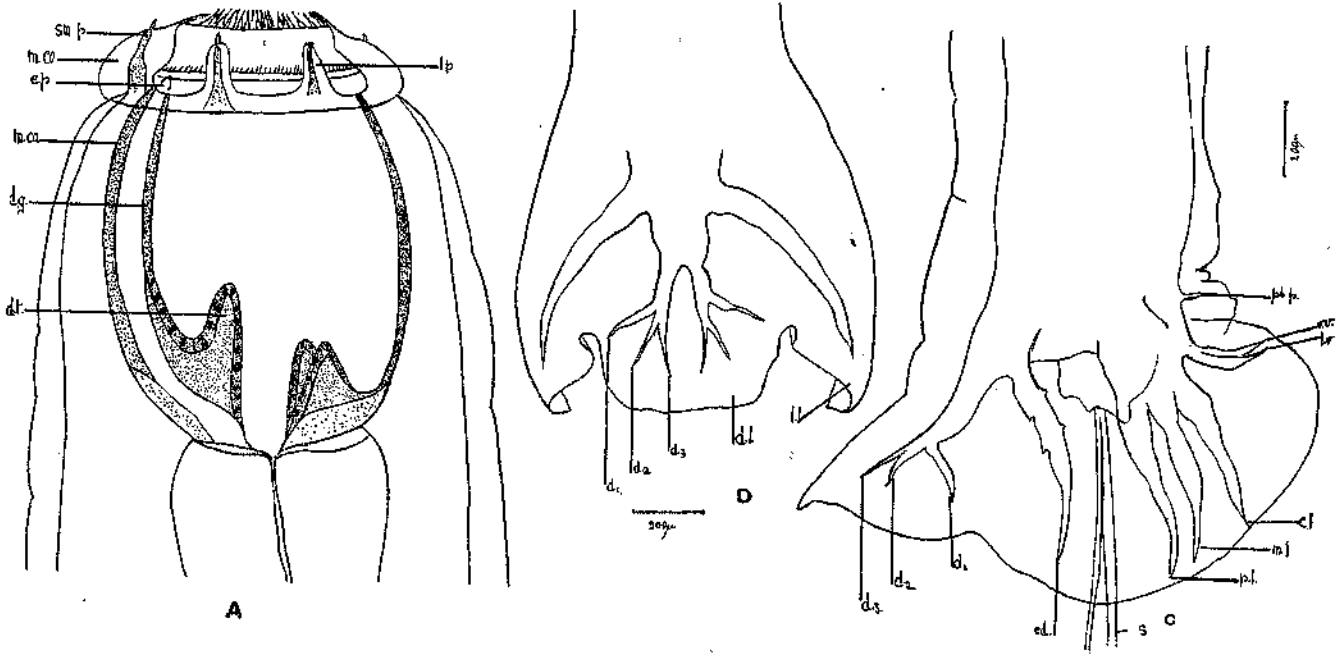


Plate I. *Strongylus equinus.*

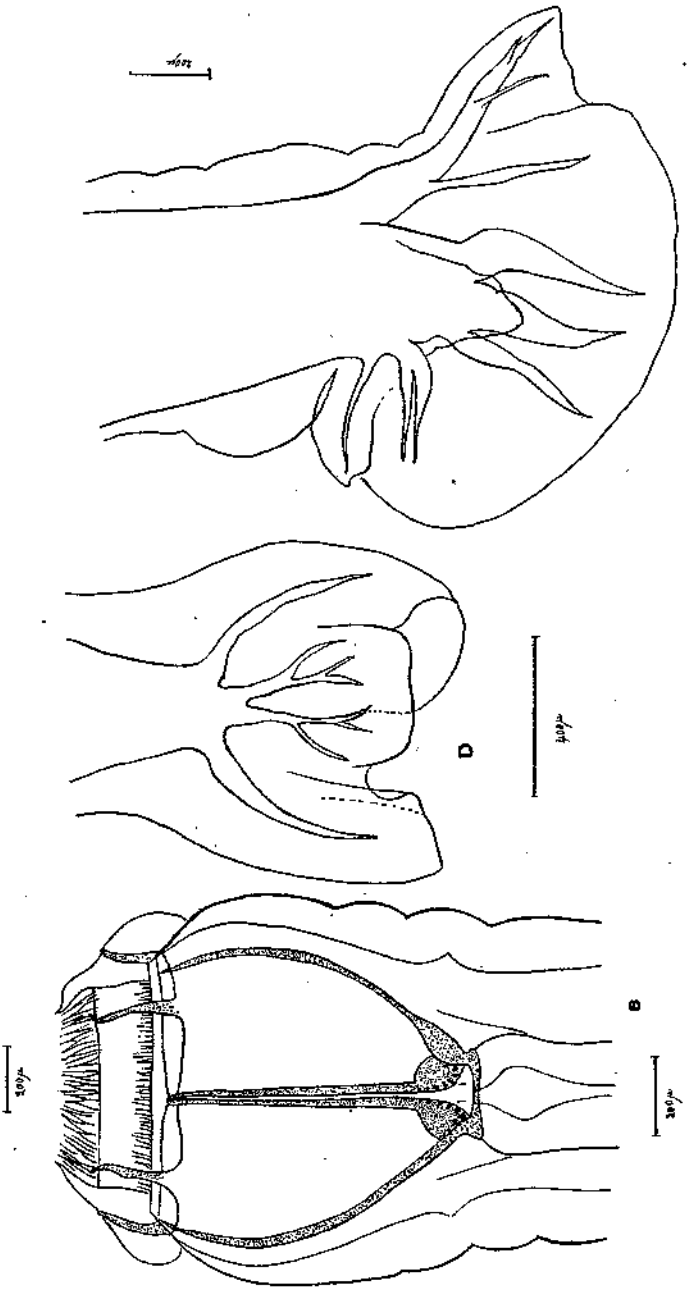
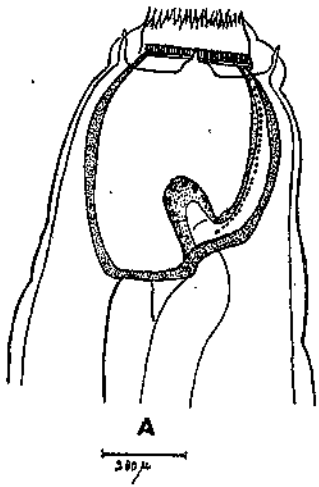
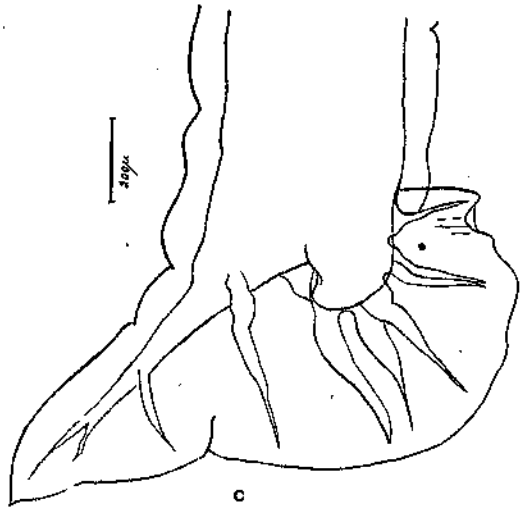


Plate VI.

Strongylus edentatus.





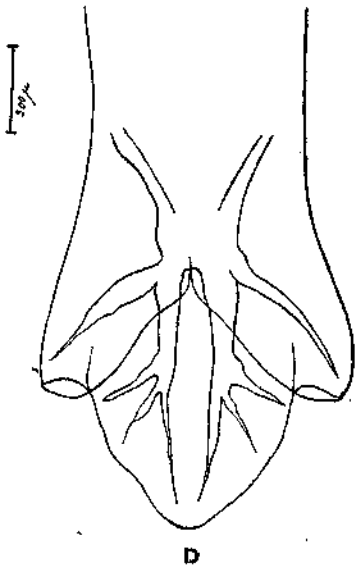
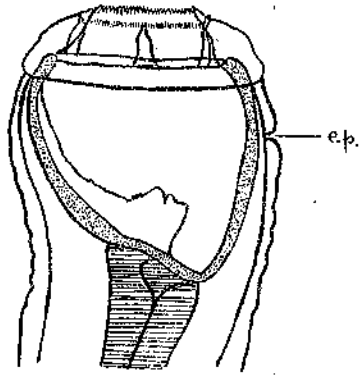
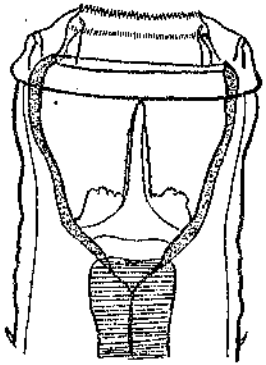


Plate III. *Strongylus vulgaris.*



A

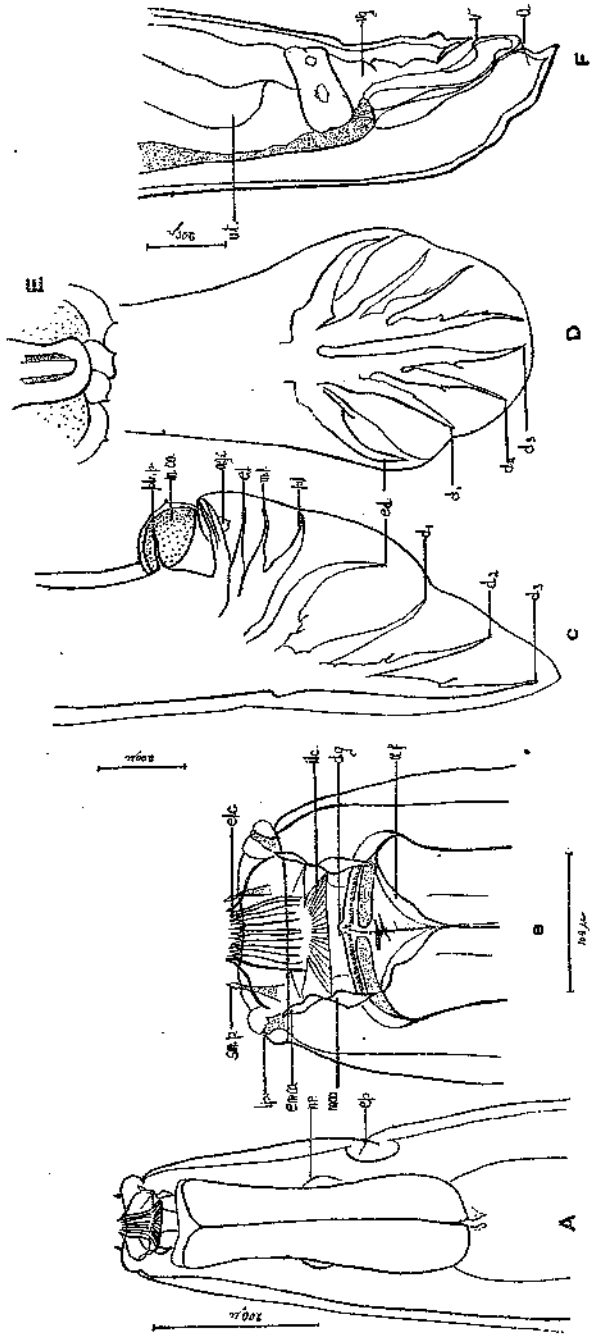


B

C

Plate IV.

Strongylus asini. (× 37, after Boulenger.)



Cylicostomum tetracanthum.

Plate V.

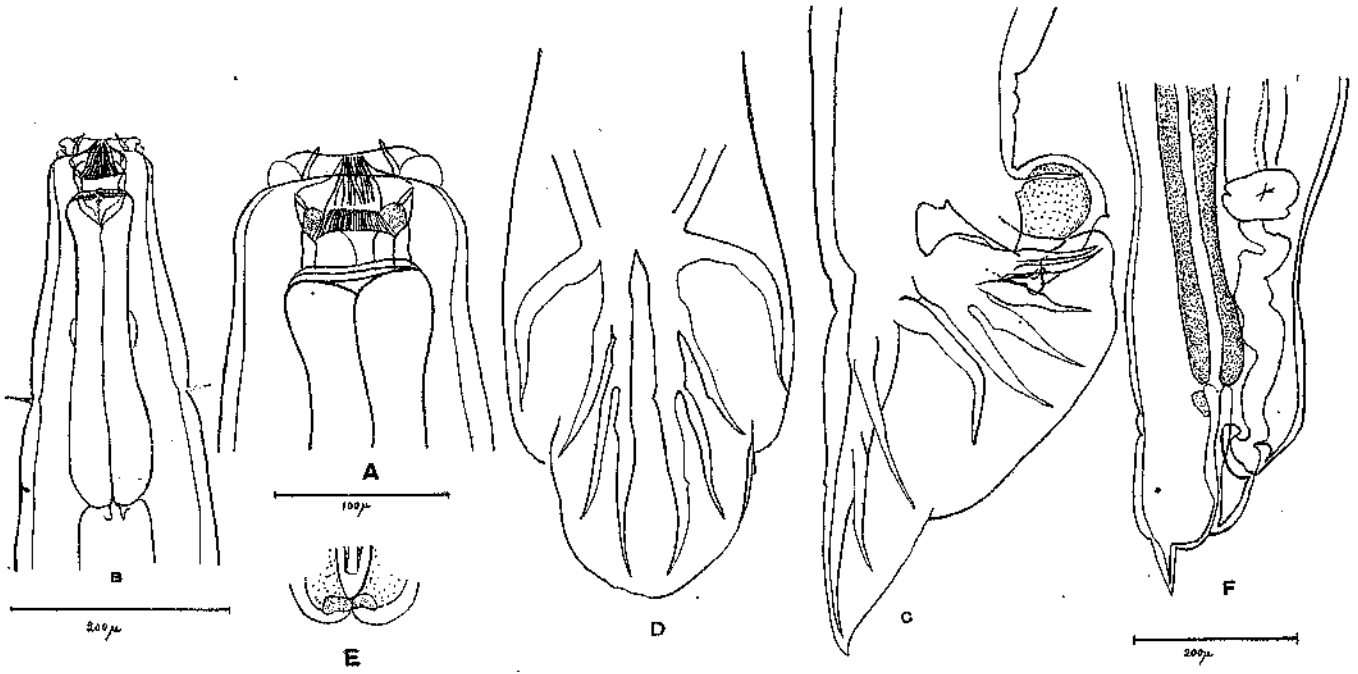
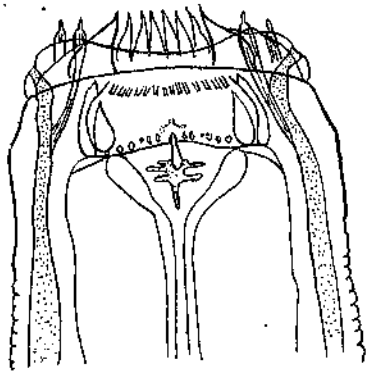


Plate VI. *Cylicostomum labratum.*



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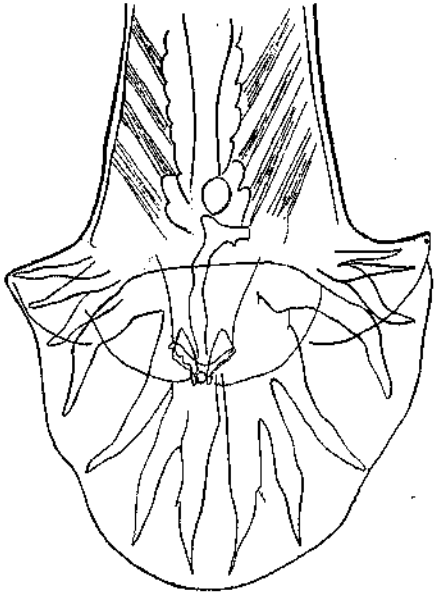
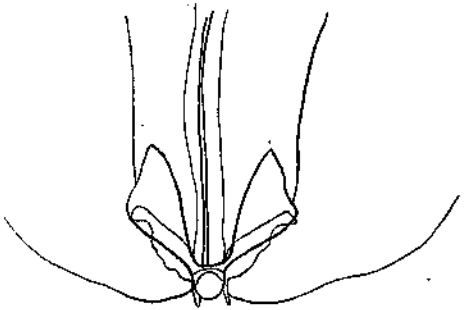


D



E

Plate VII.

Cylicostomum ornatum. (After Kotlán.)

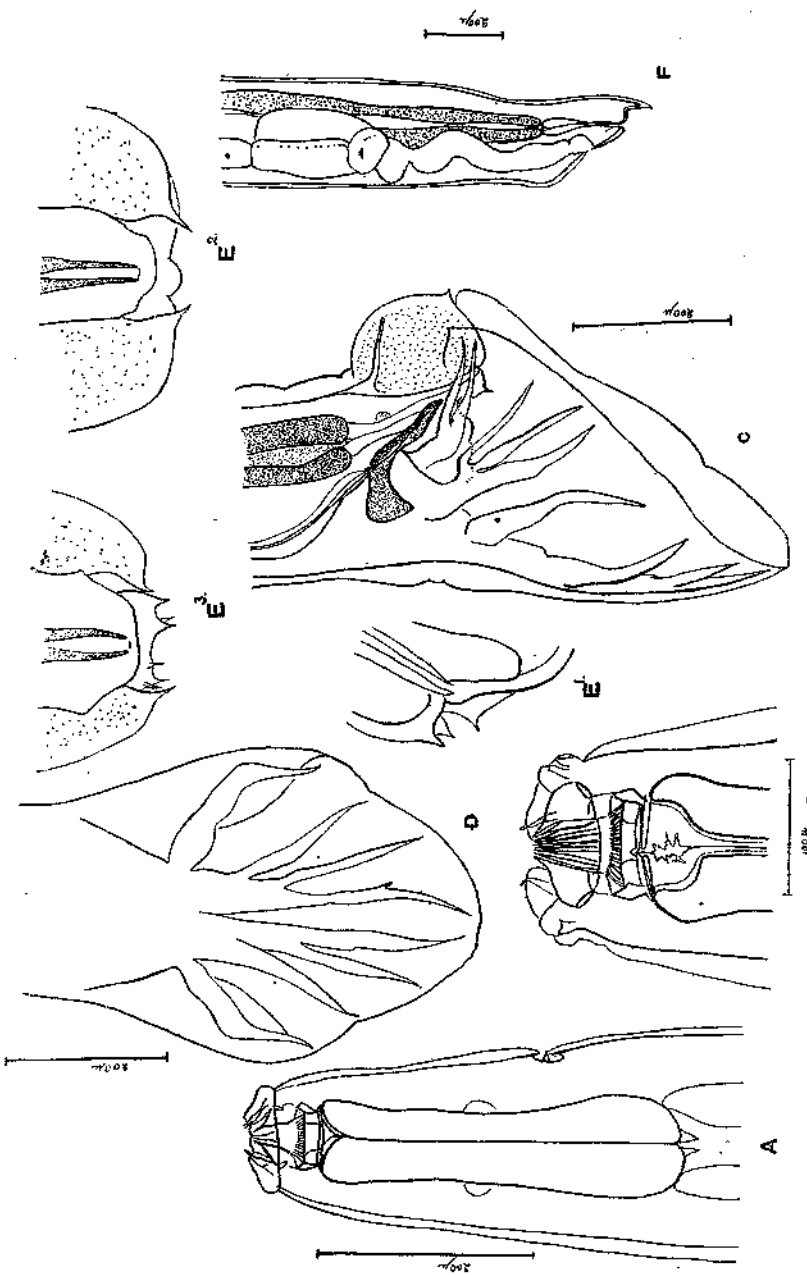


Plate VIII.

Cylicostomum labiatum.

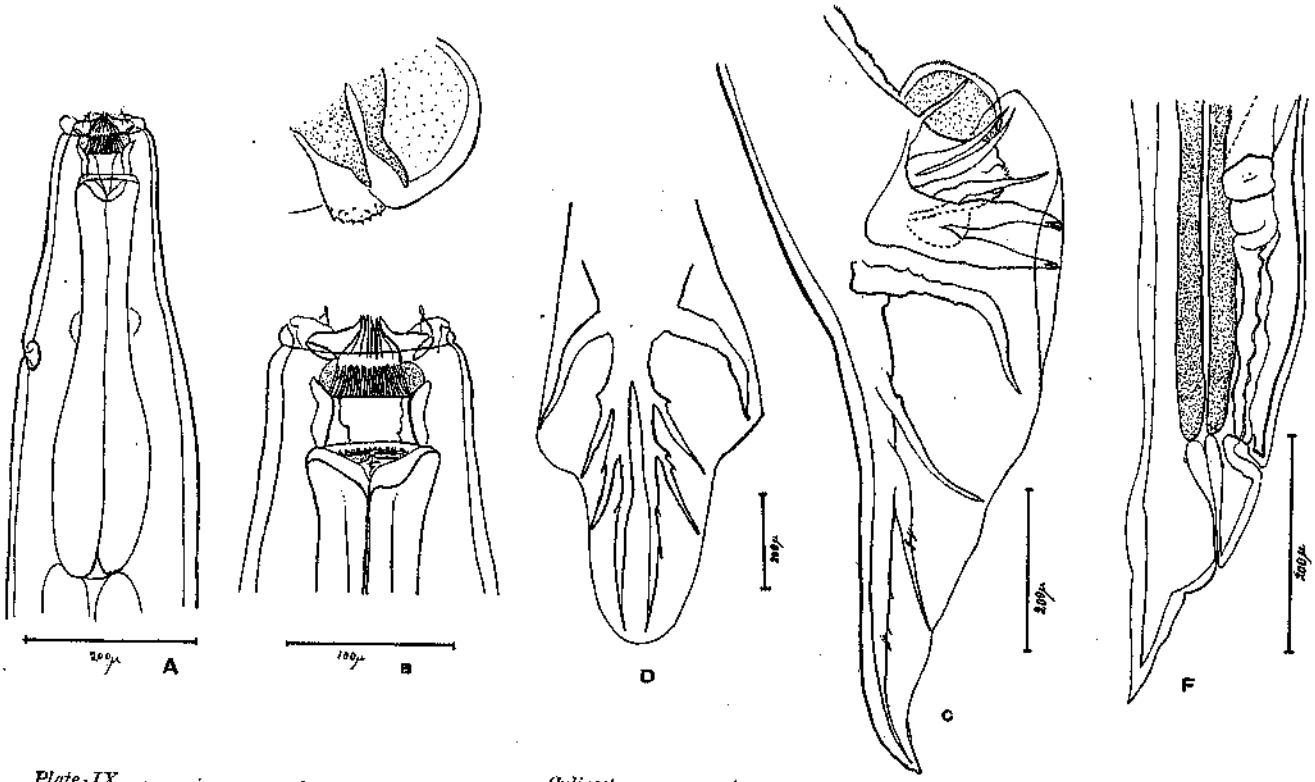
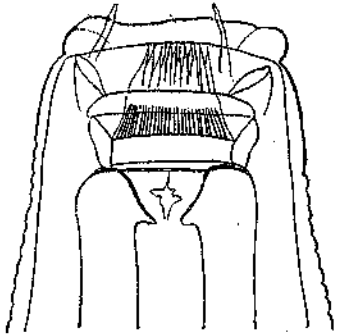
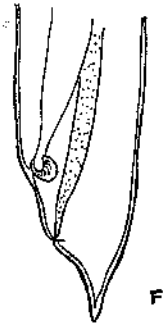
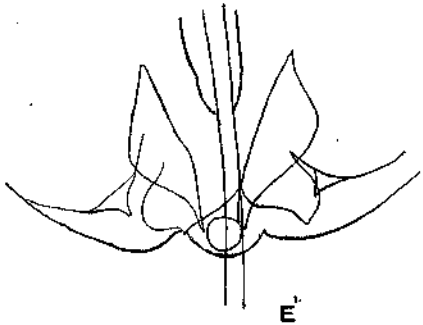
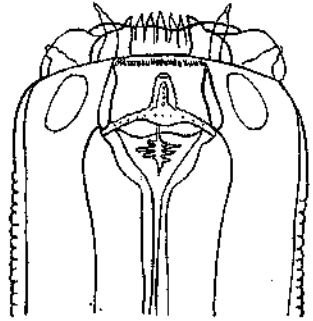


Plate IX. *Cylicostomum coronatum.*









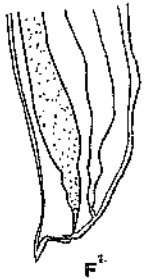


Plate X.

Cylicostomum sagittatum. (B, D, E, F., after Kotlán.)
Cylicostomum hybridum. (B¹, C¹, E¹, F¹., after Kotlán.)

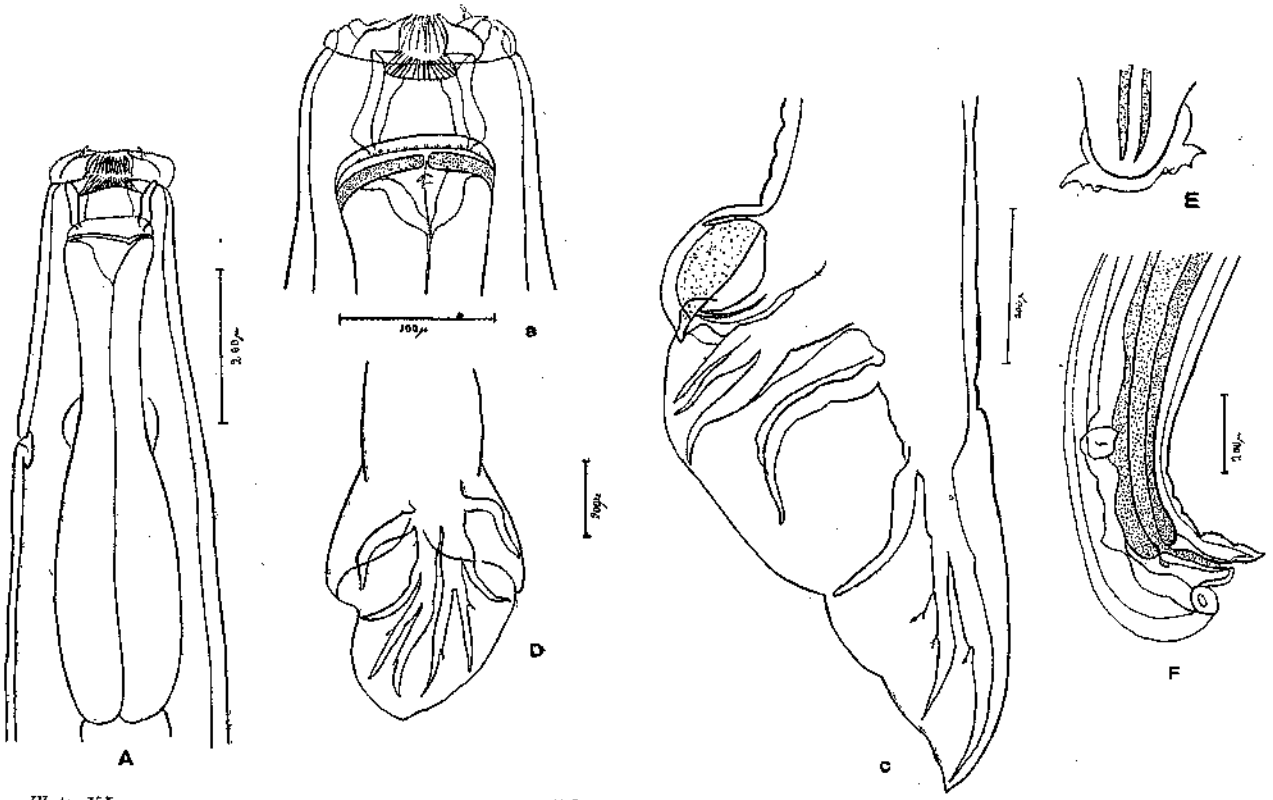


Plate XI. *Cylicostomum alveatum.*

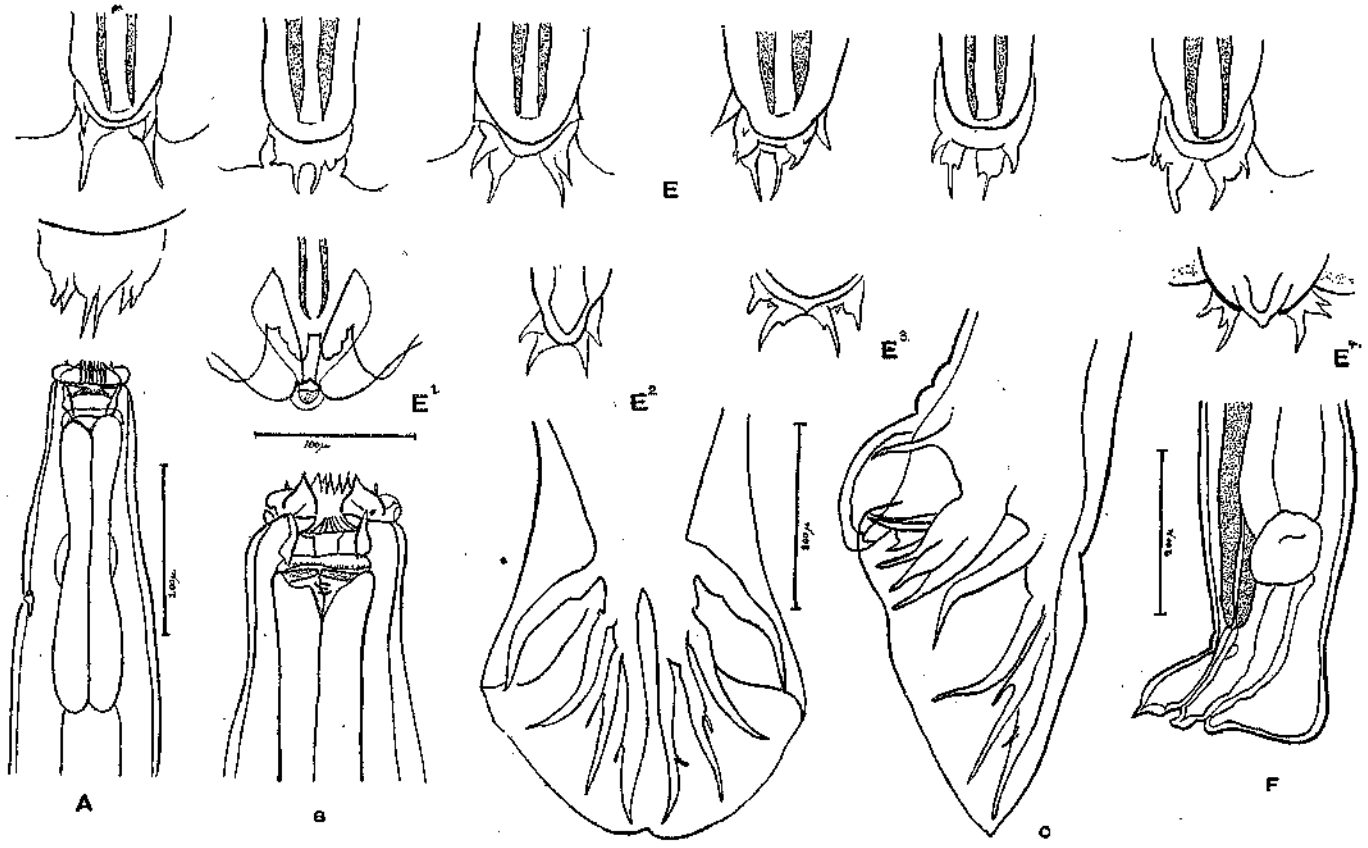


Plate XII.

Cylicostomum catinatum. (Fig. E¹. after Looss.)
Cylicastomum catinatum, var. *pseudo-catinatum.* (Figs. A, B, C, D, E. F; Fig. E² after Yorke and Macfie; Fig. E⁴ after Boulenger.)
Cylicostomum catinatum, var. *litoraureum.* (Fig. E³ after Yorke and Macfie.)

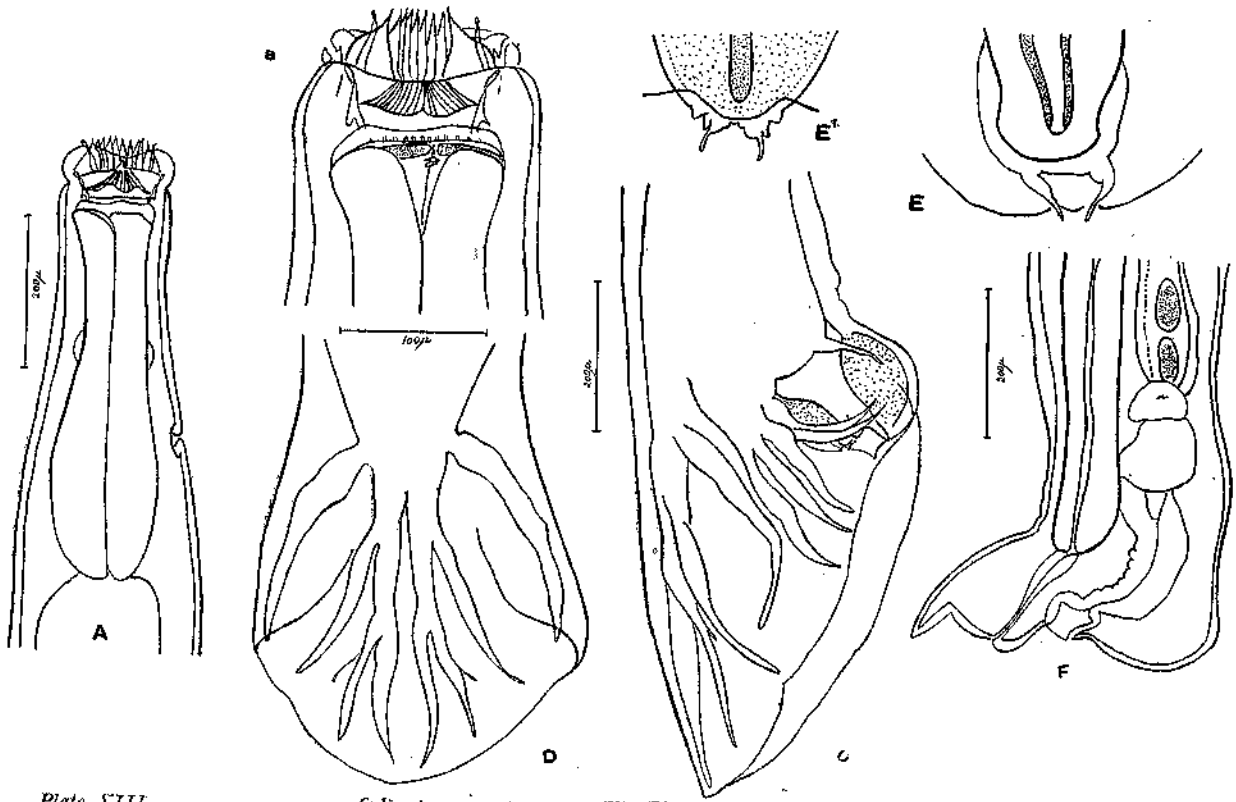


Plate XIII.

Cylicostomum pateratum. (Fig. E¹ after Yorke and Maofie.)

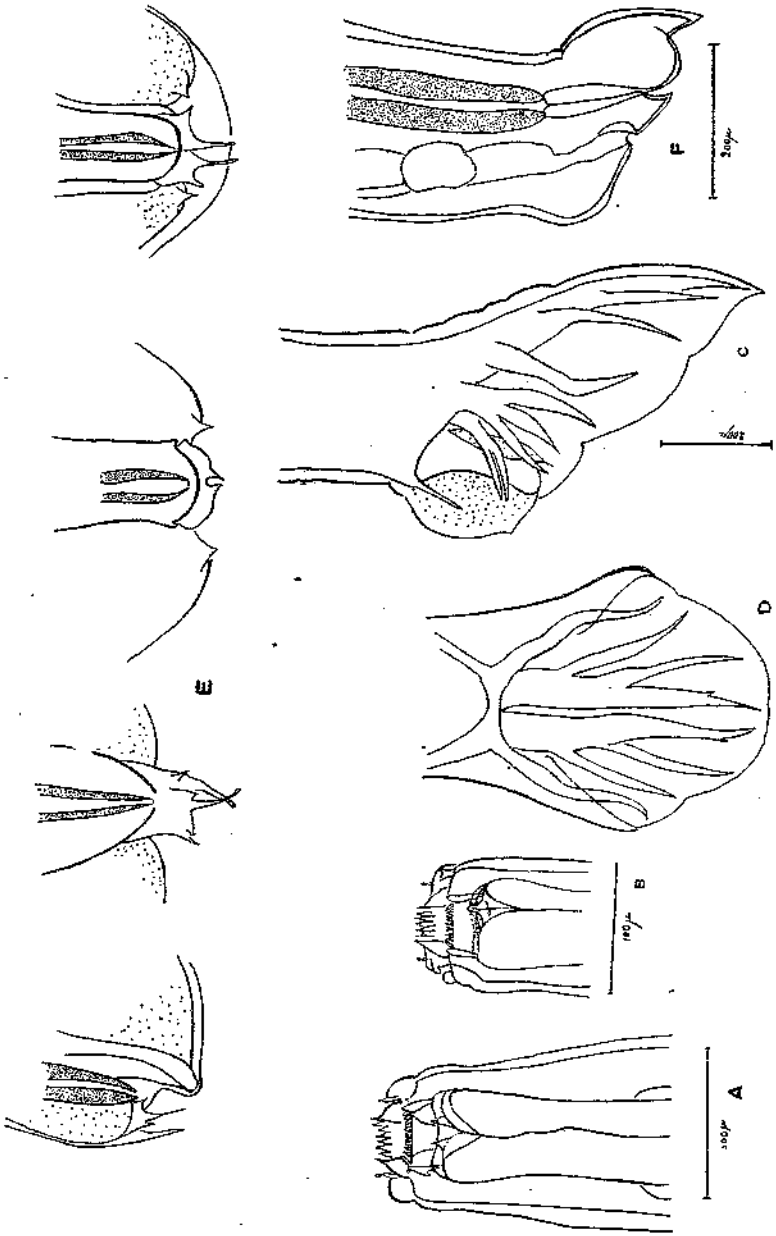


Plate XIV.

Cyliocotamum goldi.

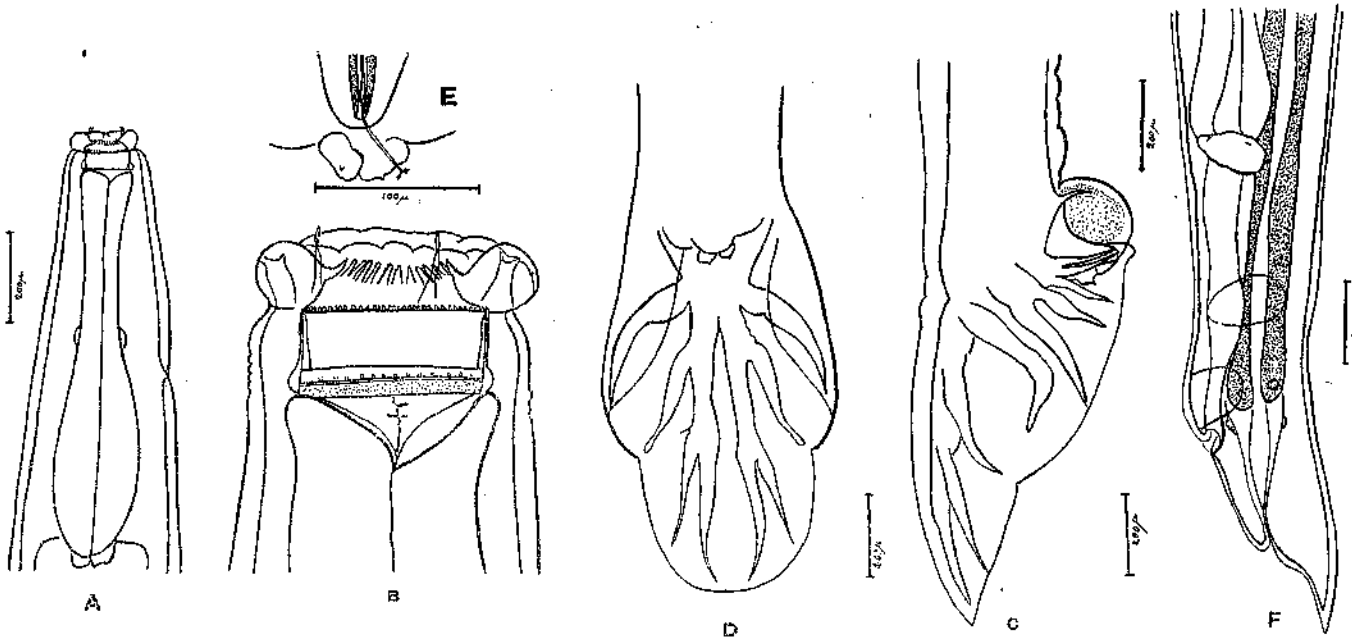


Plate XV.

Cylicostomum radiatum.

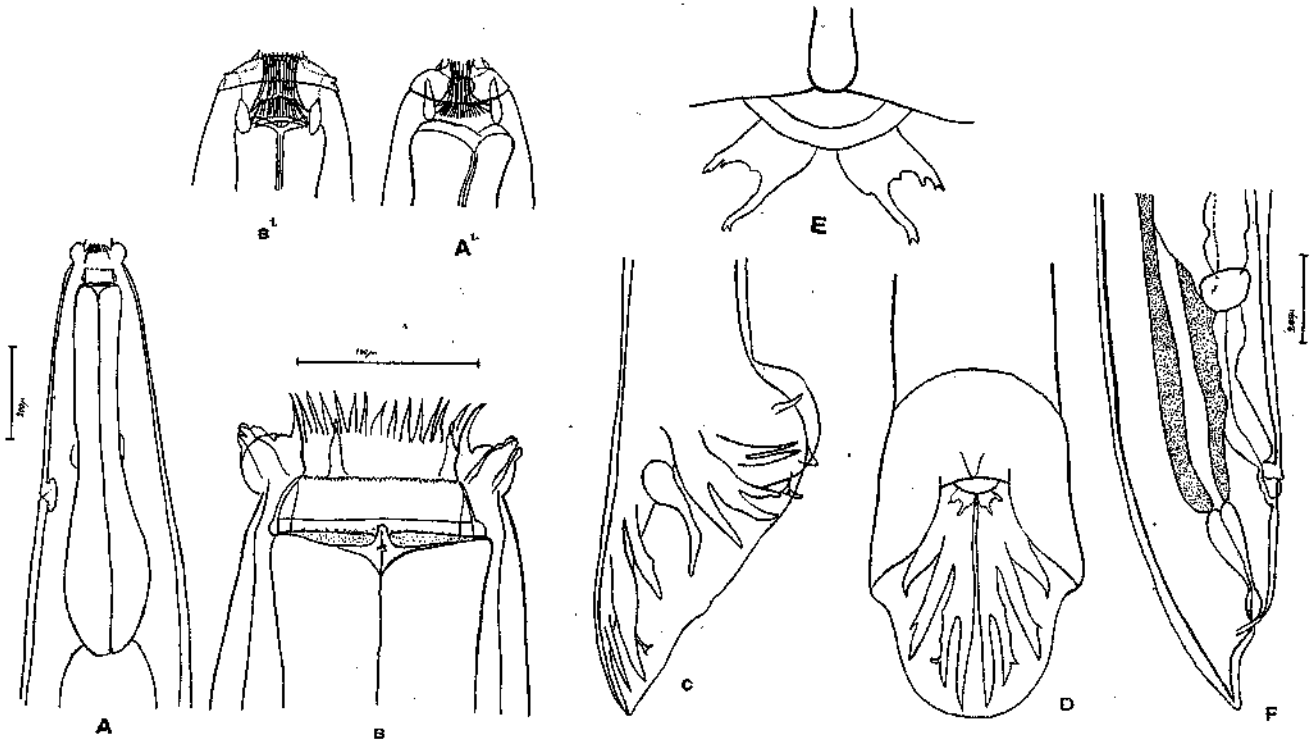


Plate XVI. *Cylicostomum triramosum.* (Figs. A, B, C, D, E. F. Fig. E. × 200. Figs. C, D × 50 after Yorke and Macfie.)
Cylicostomum montgomeryi. (Figs. A^1, B^1, after Boulenger.)

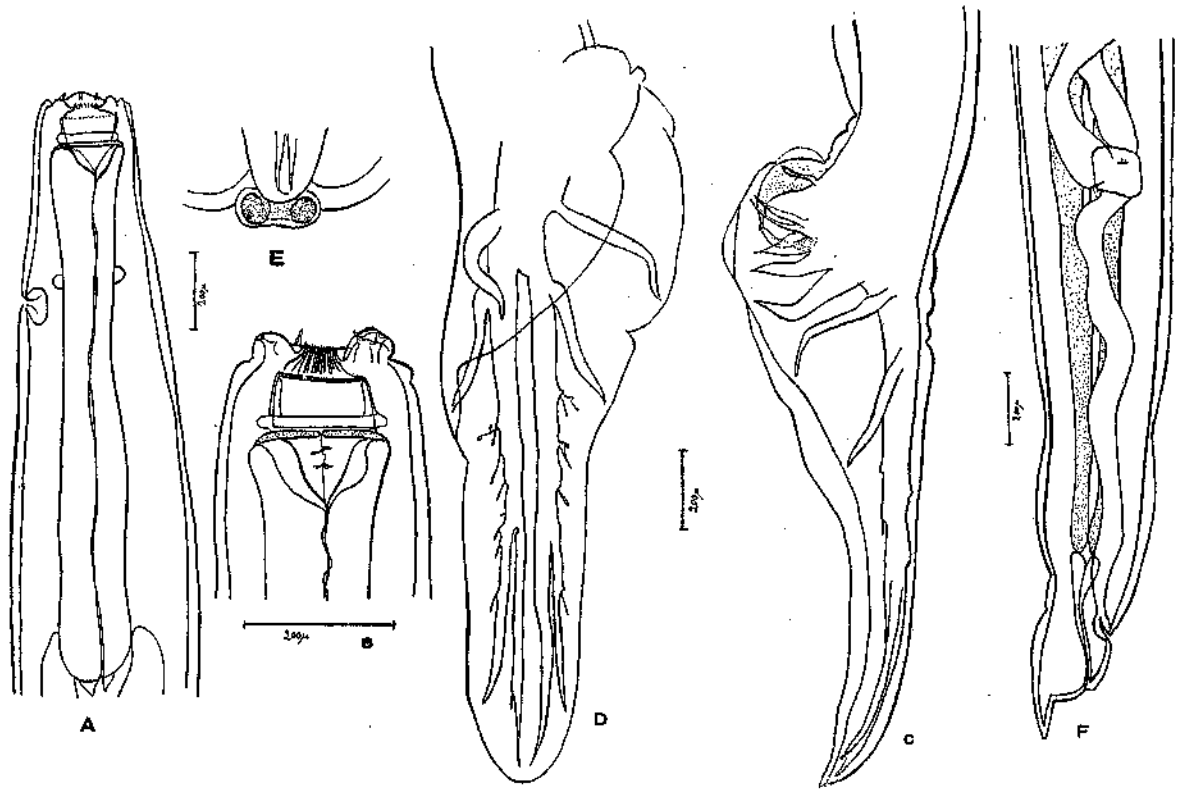


Plate XVII. *Cylicostomum elongatum* var. *kotlani.*

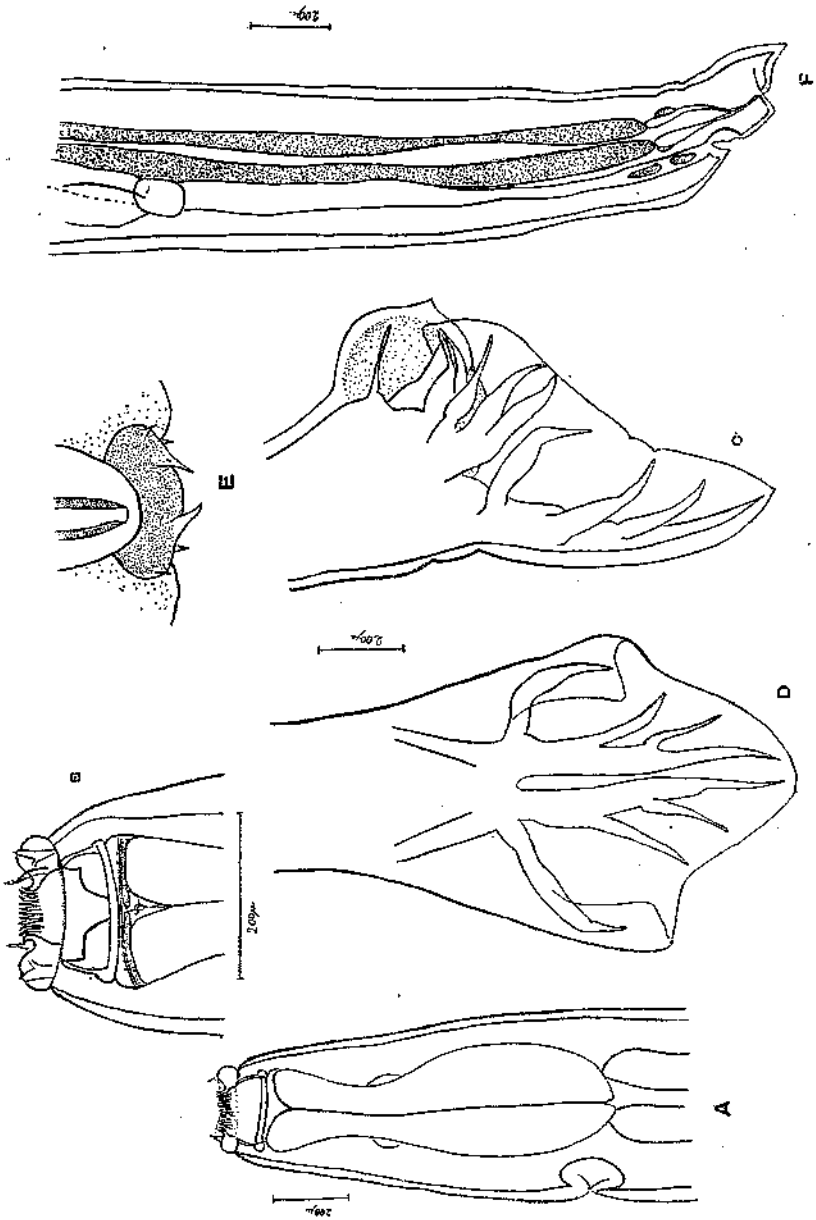


Plate XVIII.

Cylicostomum insigne.

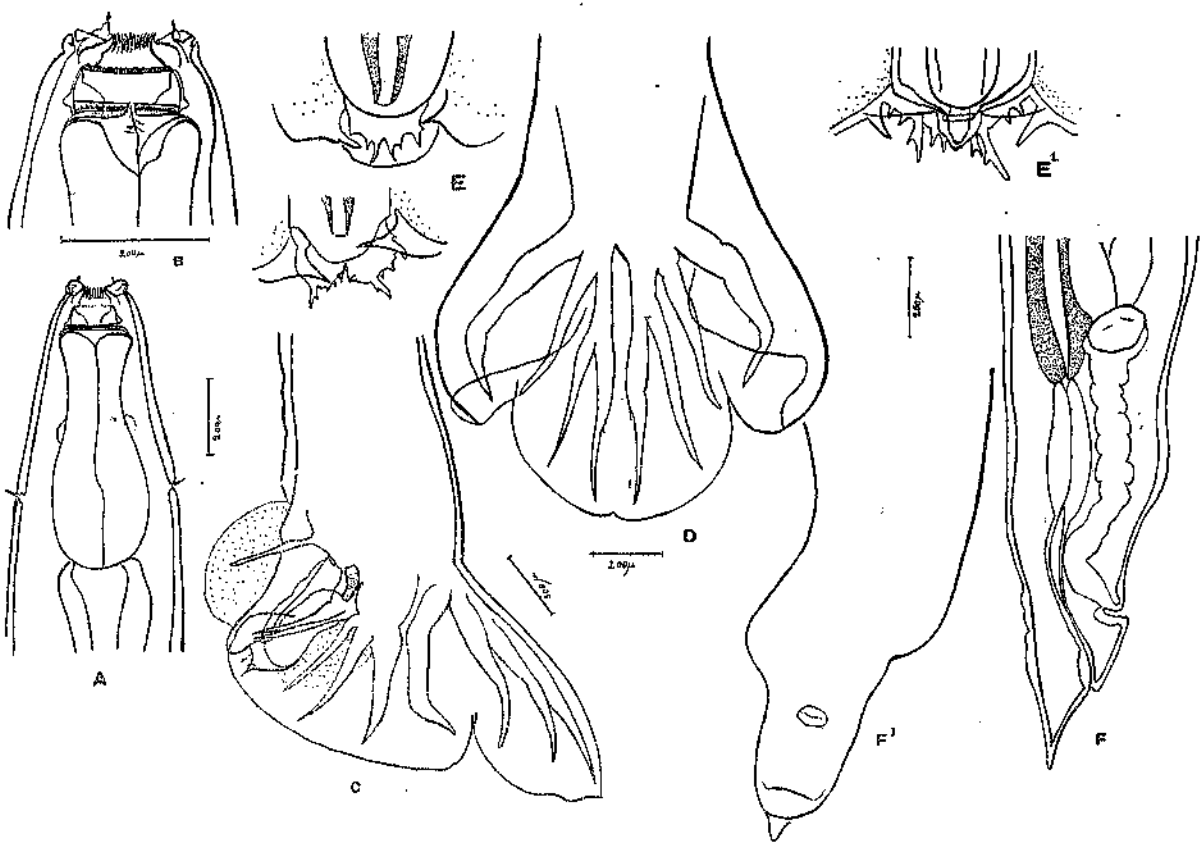


Plate XIX. *Cylicostomum adersi.* (Fig. E¹ after Boulenger.)

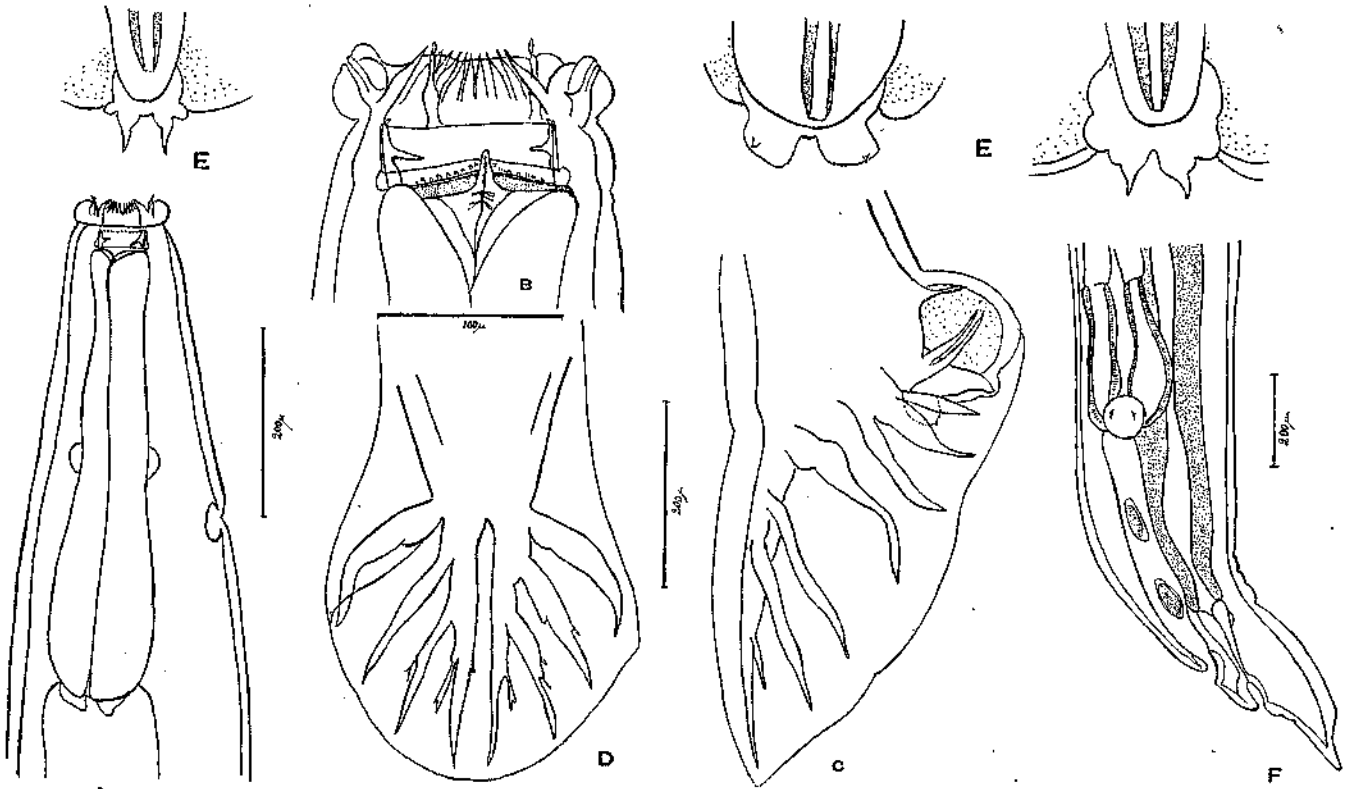


Plate XX.

Cylicostomum nassatum var. *parvum*.

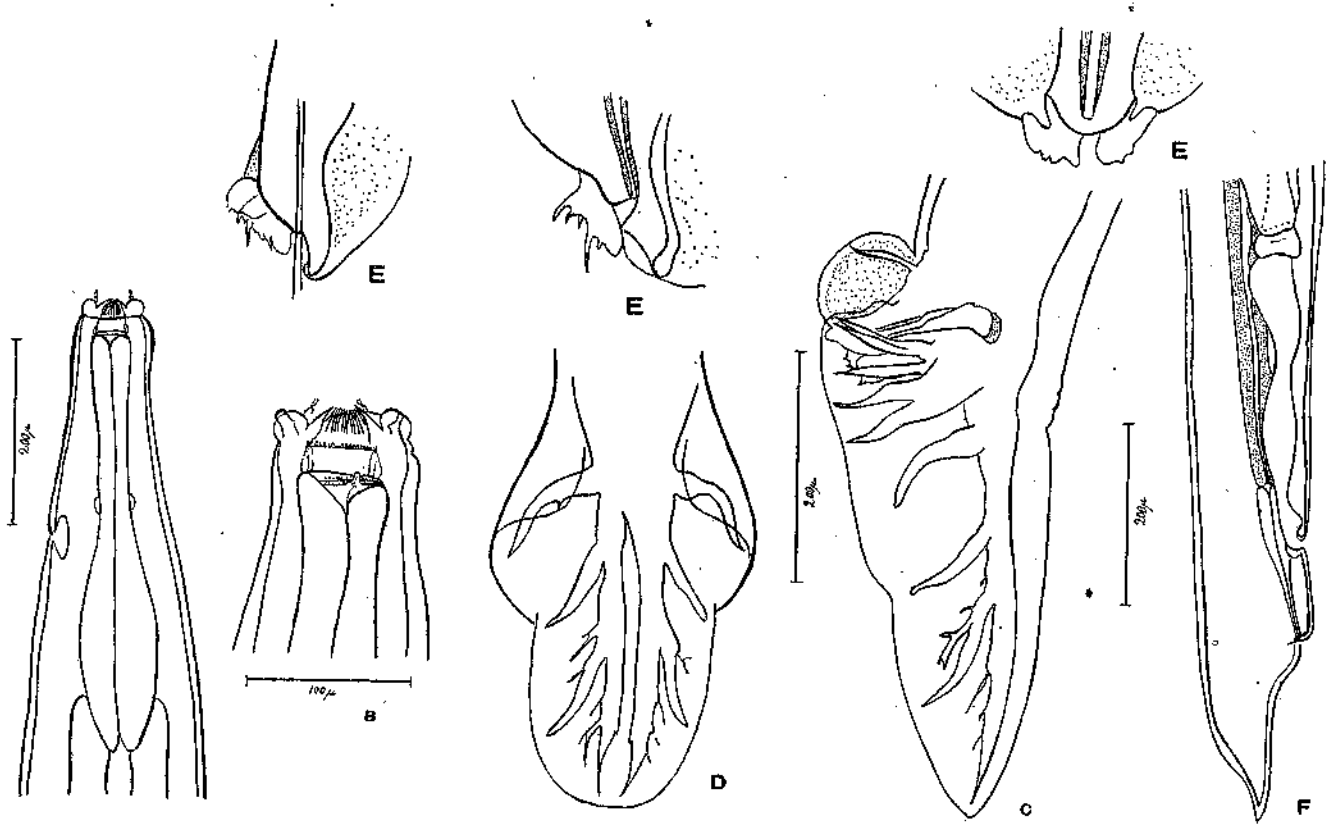


Plate XXI. *Cylicostomum leptostomum.*

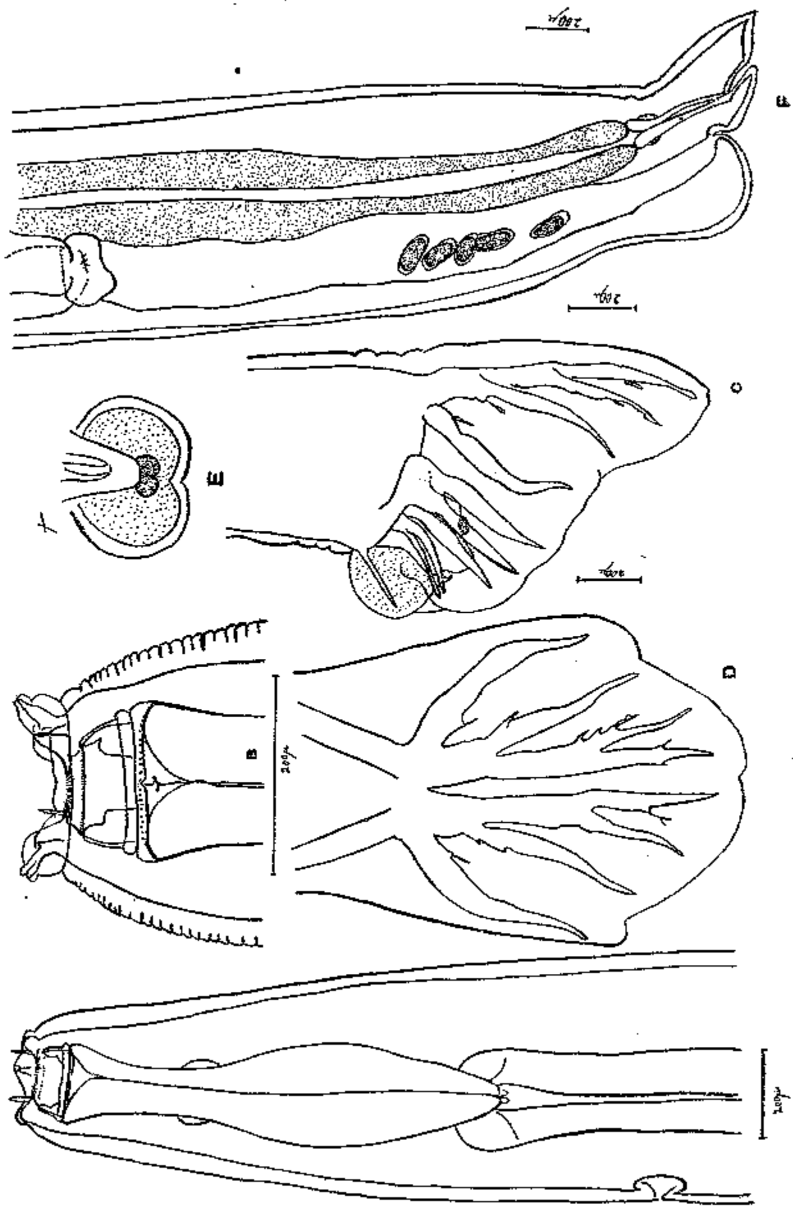
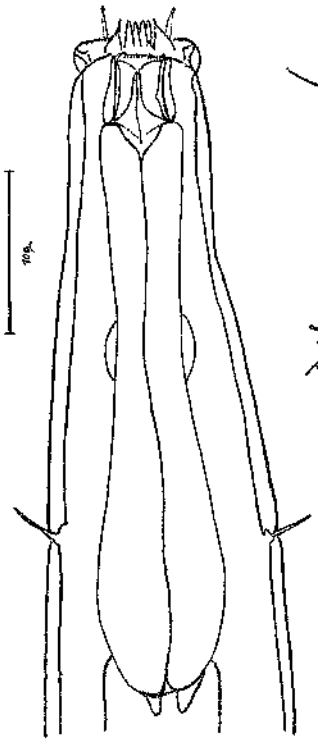
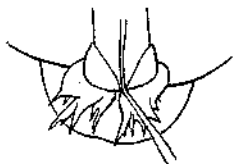


Plate XXII.

Cylicostomum auriculatum.



B

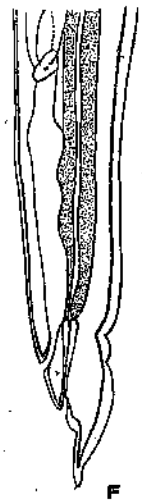


E

E

D

C



F

Plate XXIII. *Cylicostomum calicatum.*

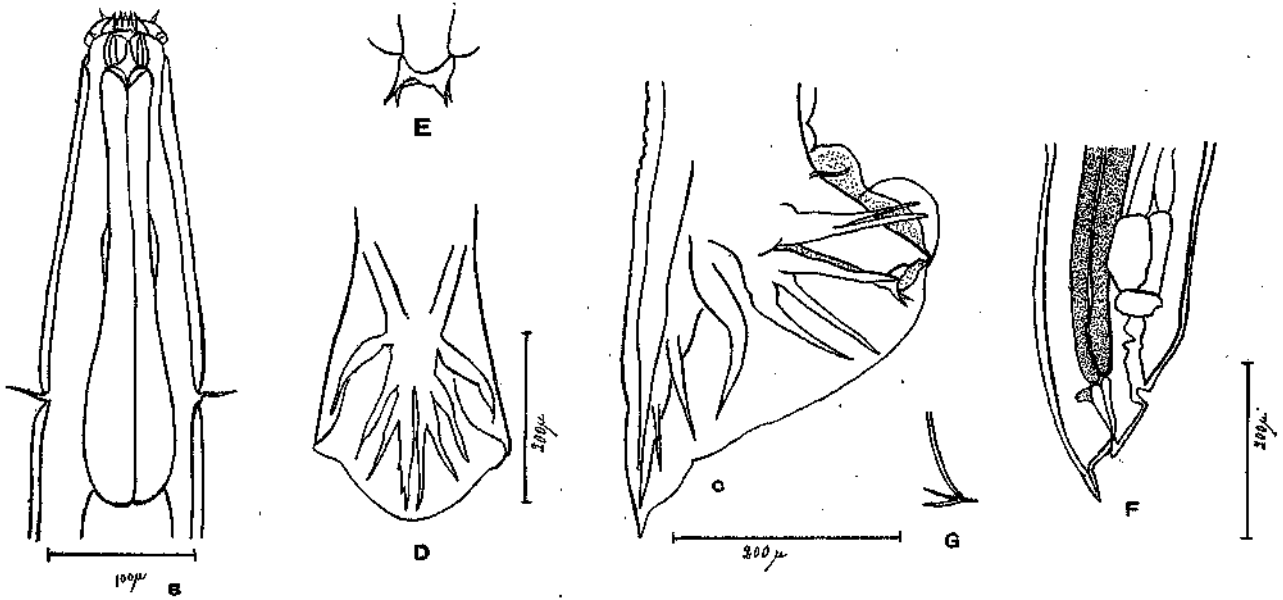


Plate XXIV. *Cylicostomum minutum.*

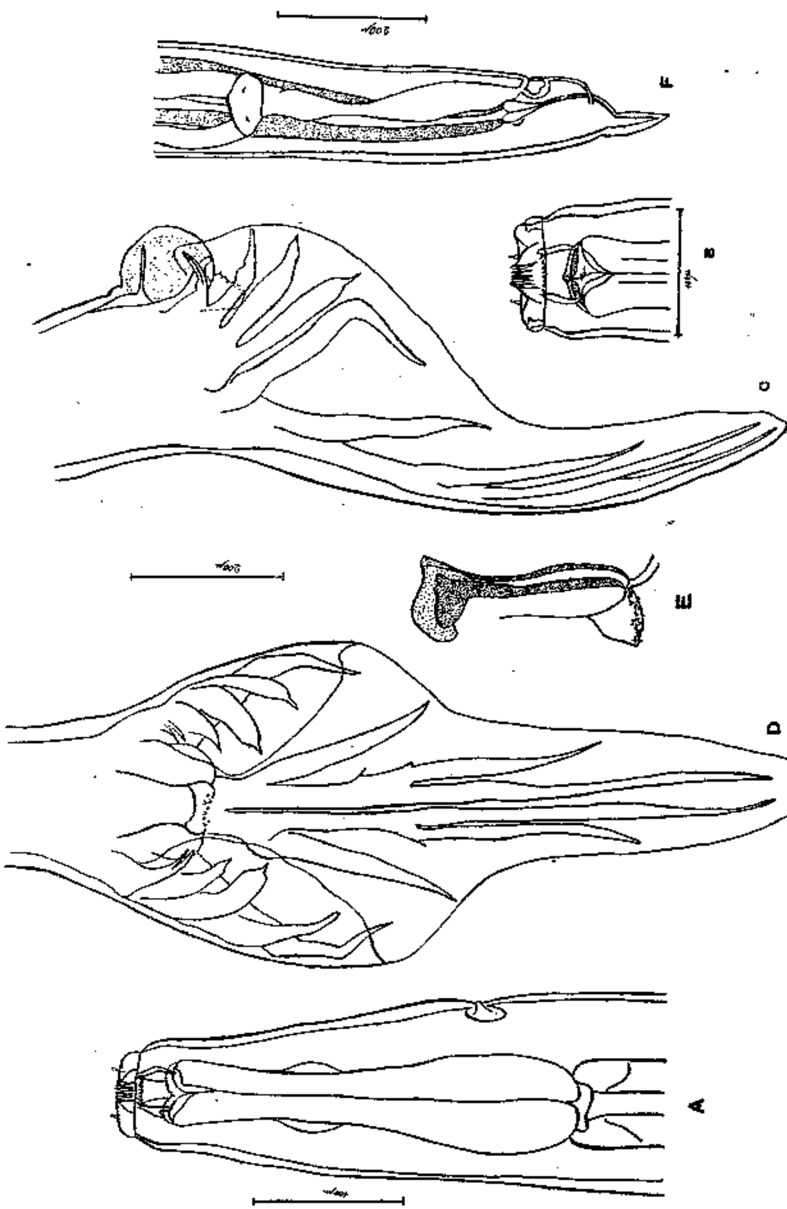


Plate XXV.

Cylicostomum longibursatum.

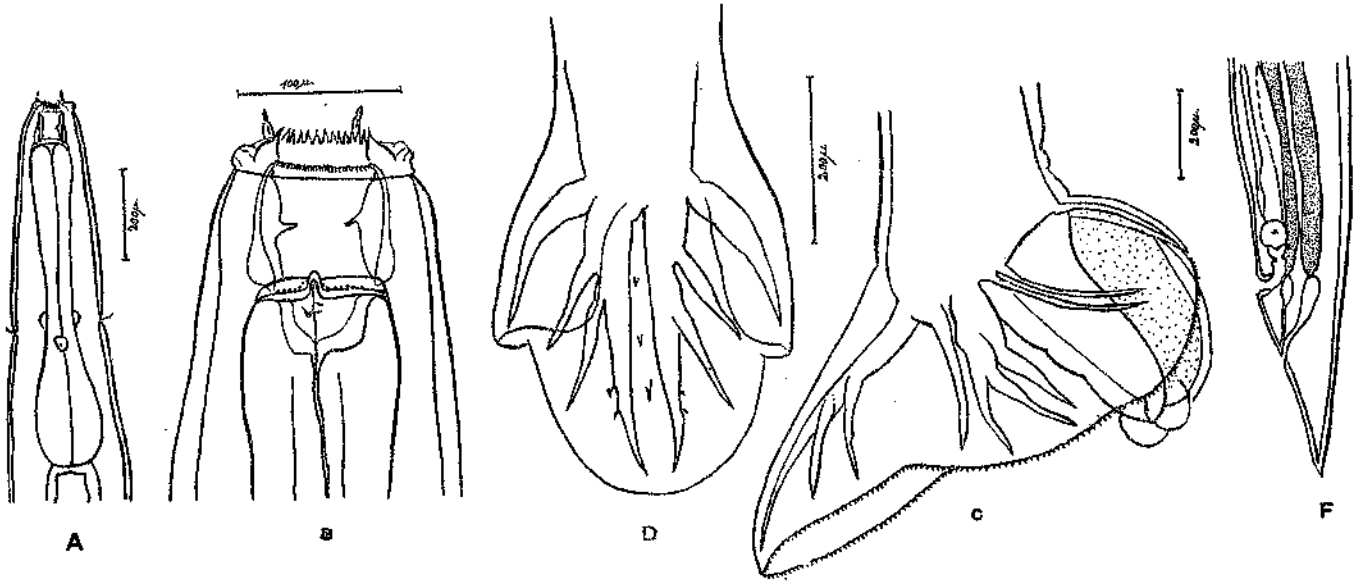


Plate XXVI.

Cylicostomum poculatum.

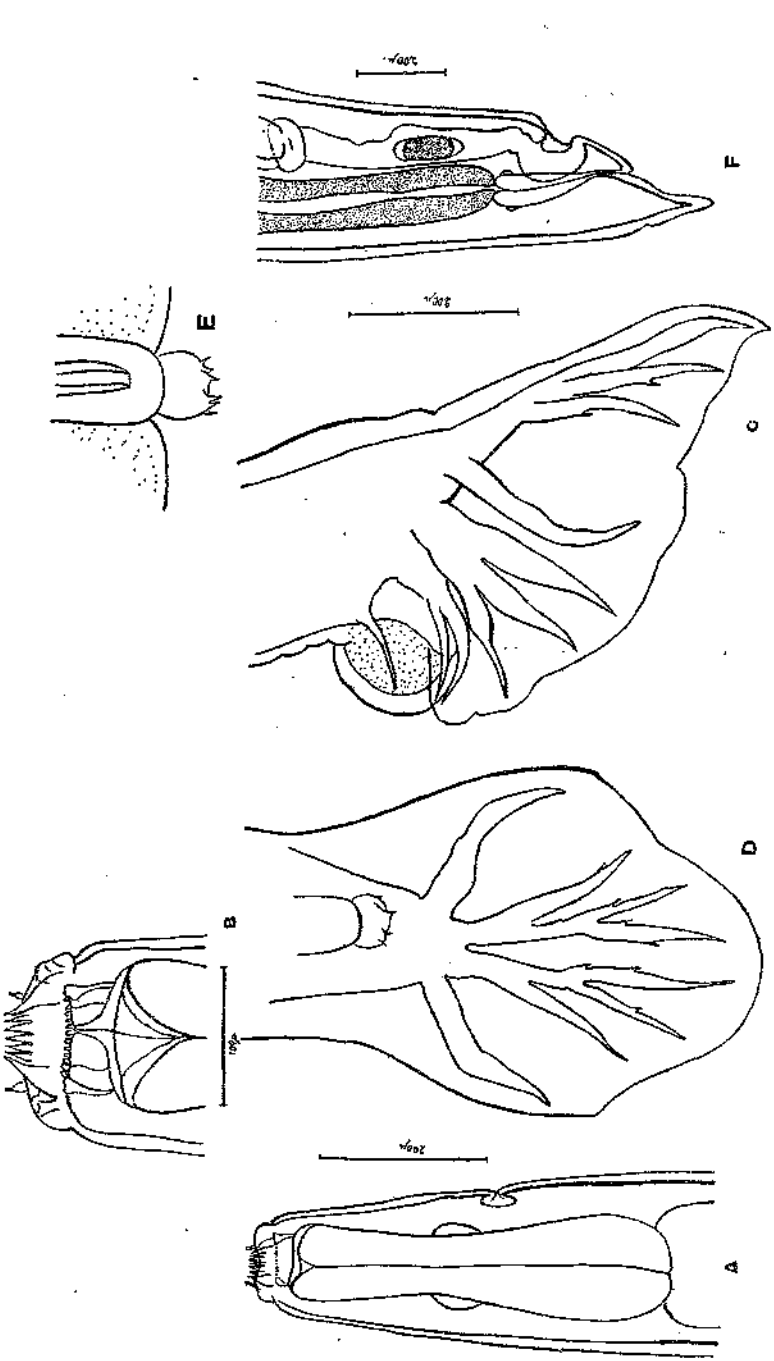


Plate XXVII.

Cylicocotomum asymetrivum.

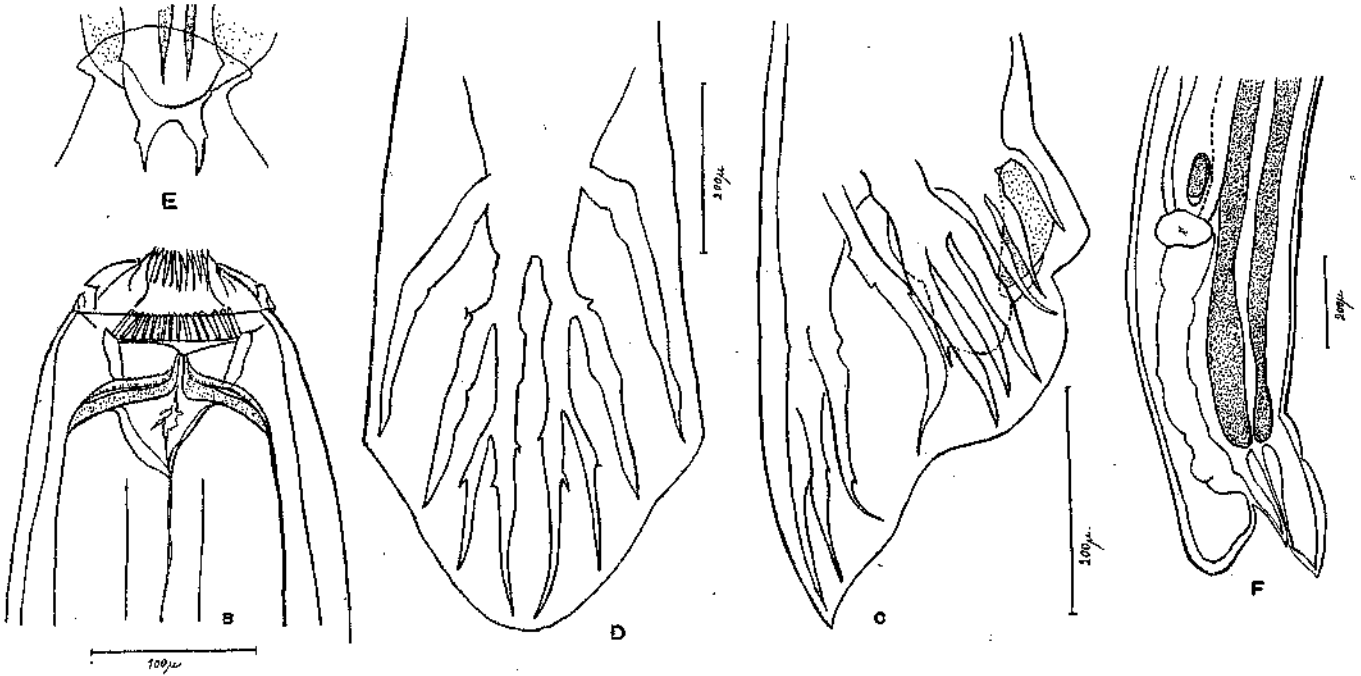


Plate XXVIII. *Cylicostomum bicoronatum.*

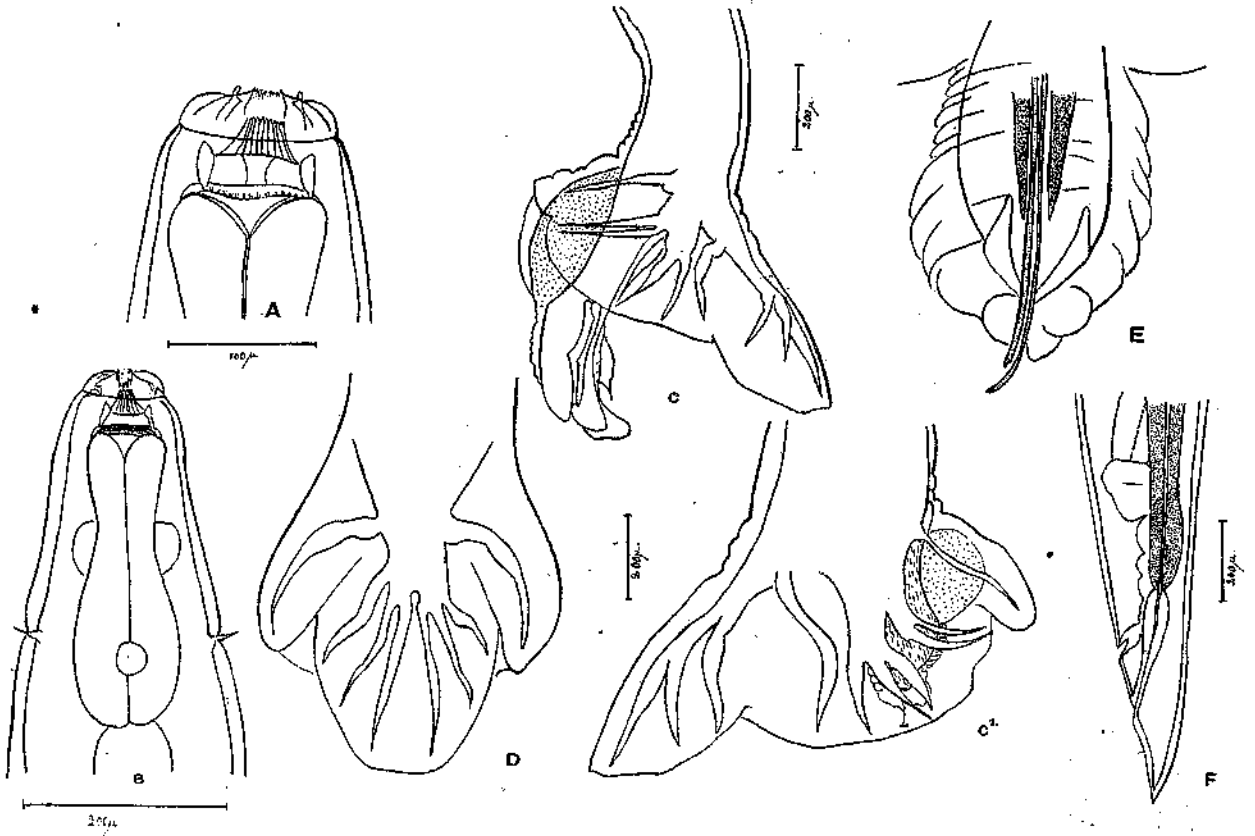
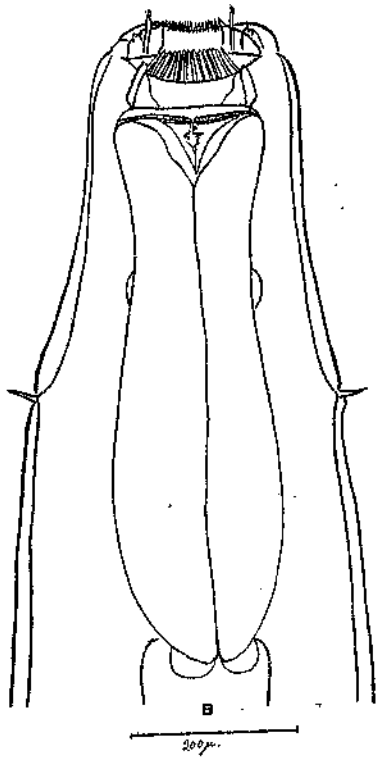
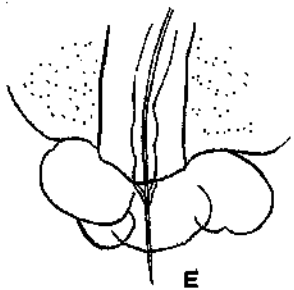
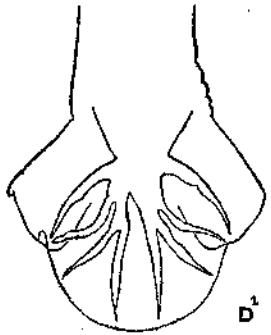


Plate XXIX. *Cyliocotonum cuproctus.*







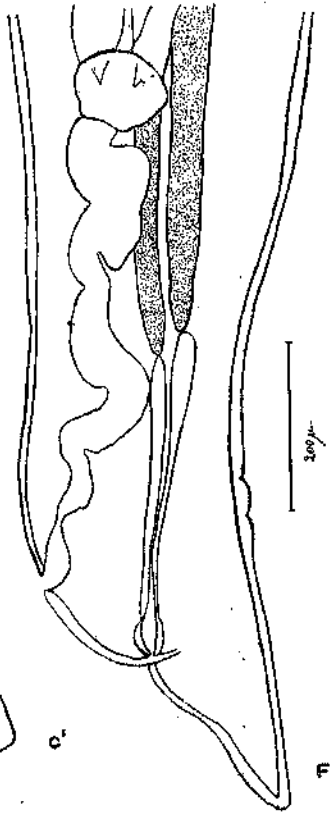


Plate XXX.

Cyllicostomum ihlei. (Figs. C¹, D¹, E¹ after Kotlán.)

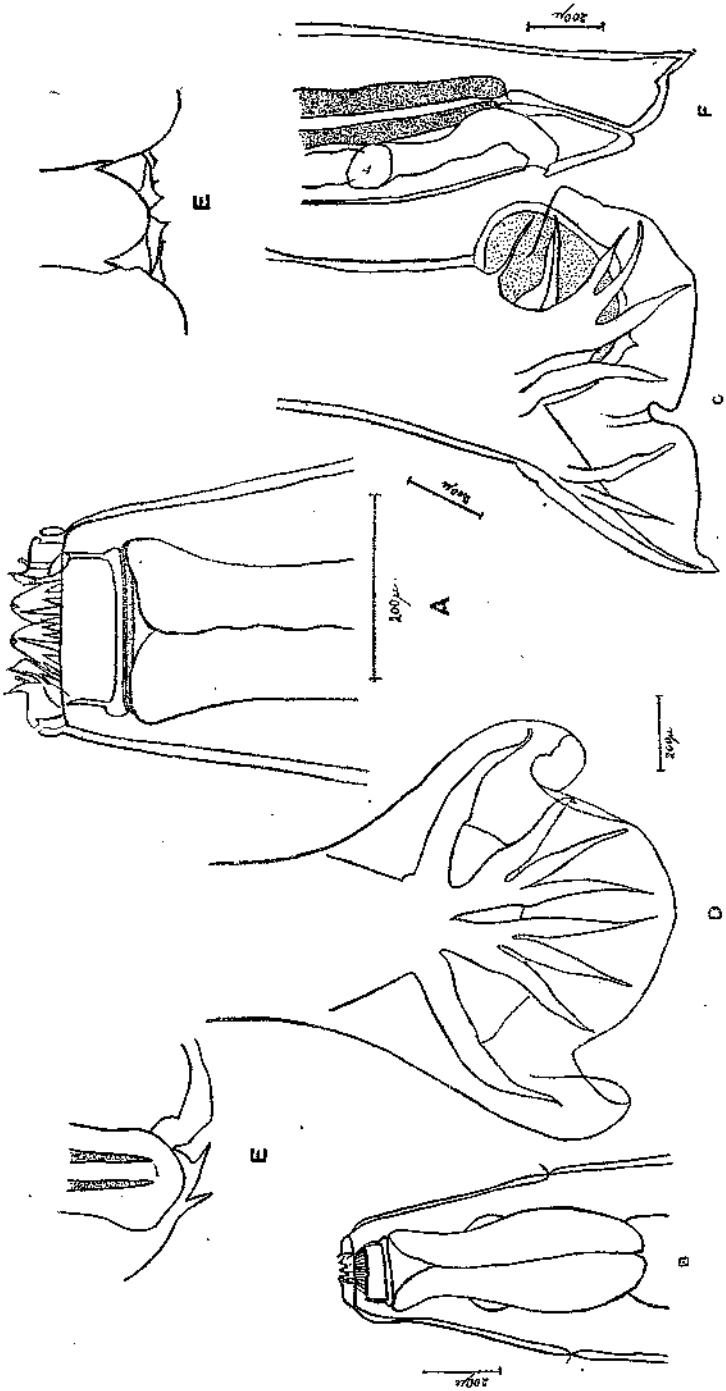


Plate XXXI.

Cyclicostomum ultrajectinum.

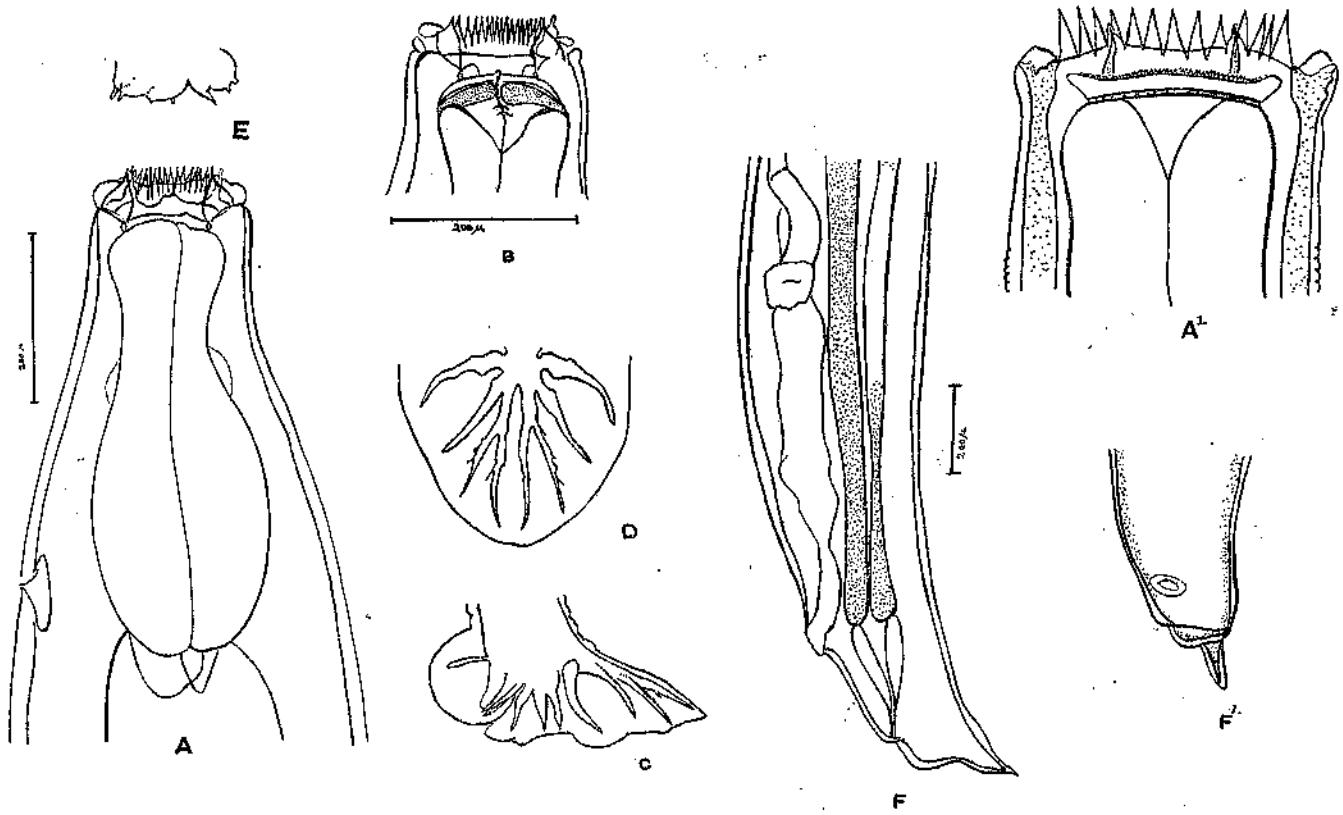
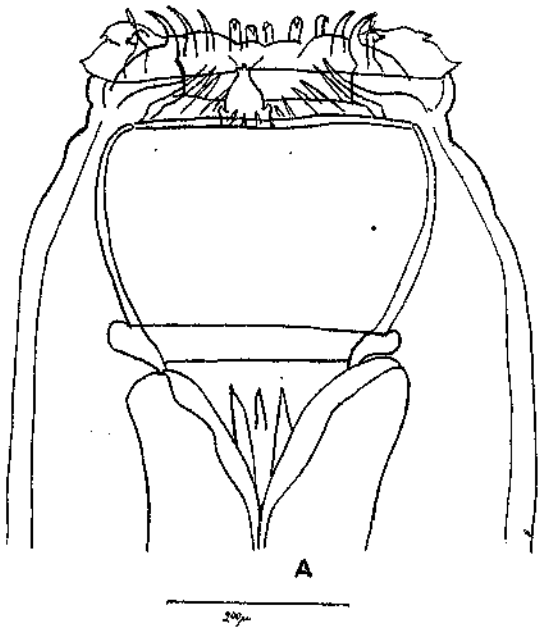


Plate. XXXVII.

Cylicostomum brevicapsulatum. (Figs. C, D, and E after Ihle.)
Cylicostomum prionodes. (Figs. A¹ and F¹ after Kotlán).



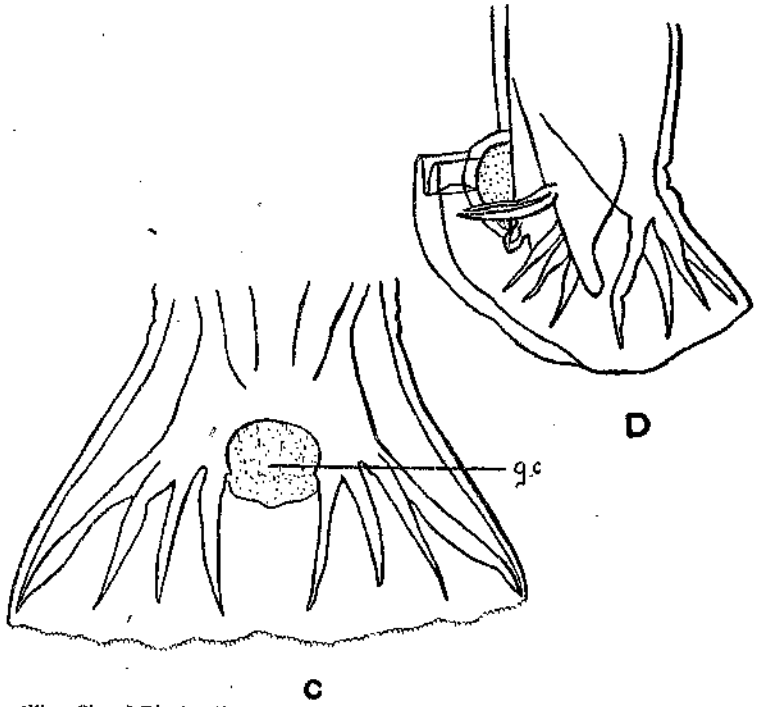


Plate XXXIII. *Oesophagodontus robustus.* (Figs. C¹ and D¹ after Boulenger.)

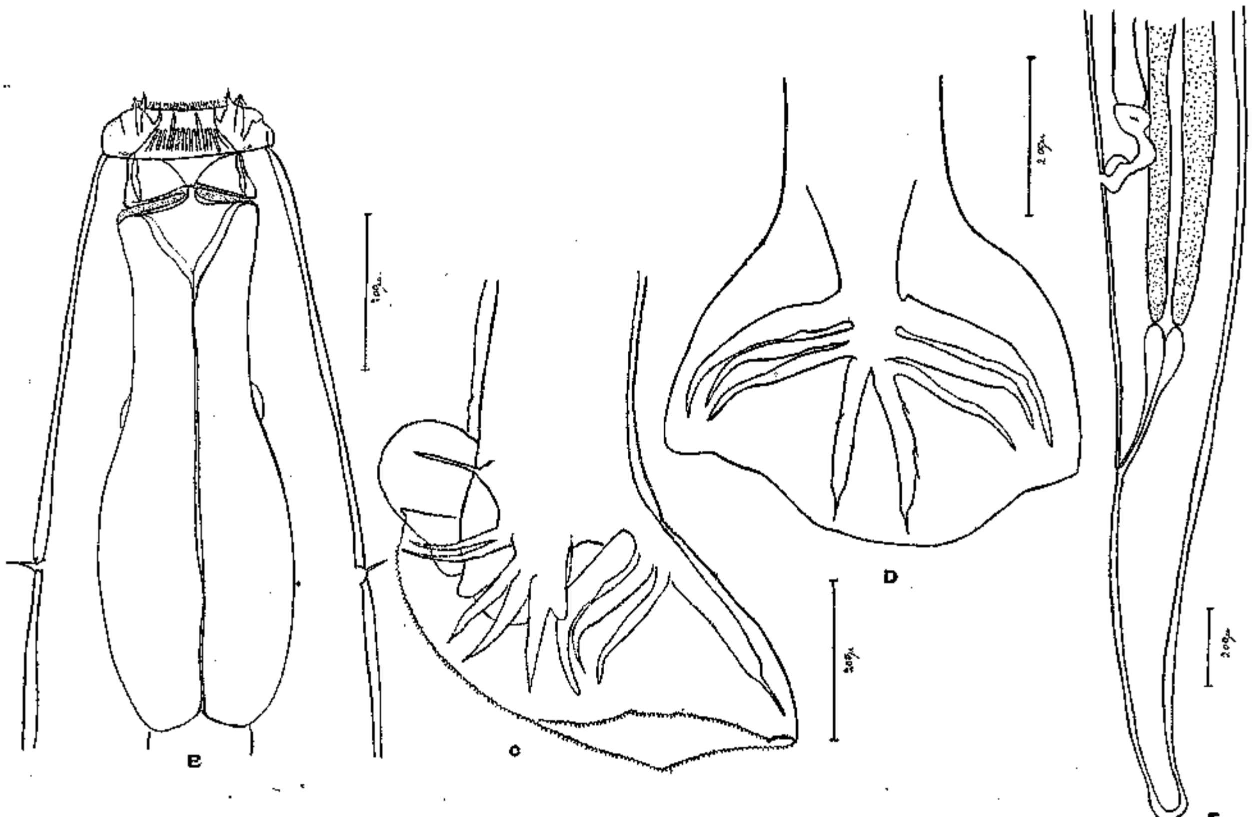


Plate XXXIV. *Poteriostomum imparidentatum.*

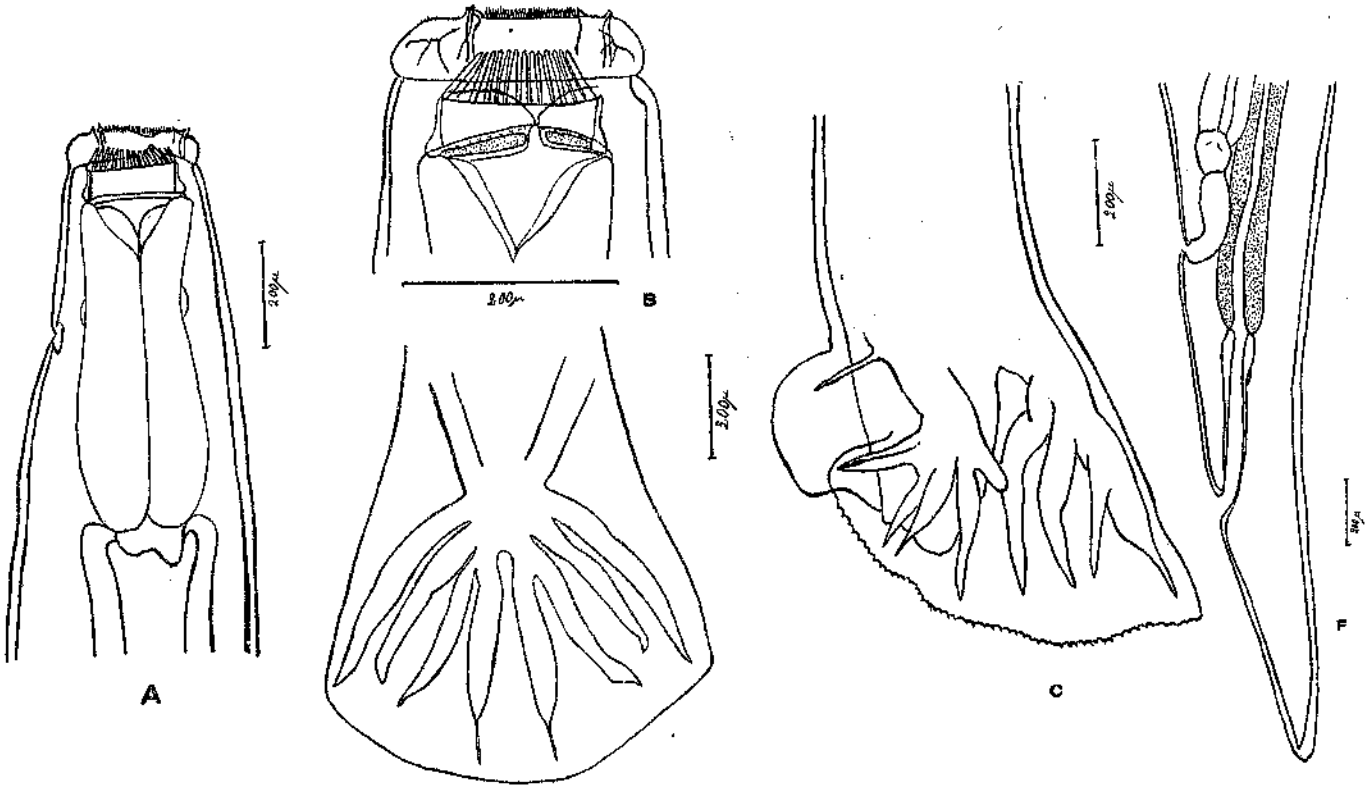
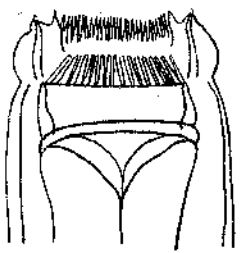
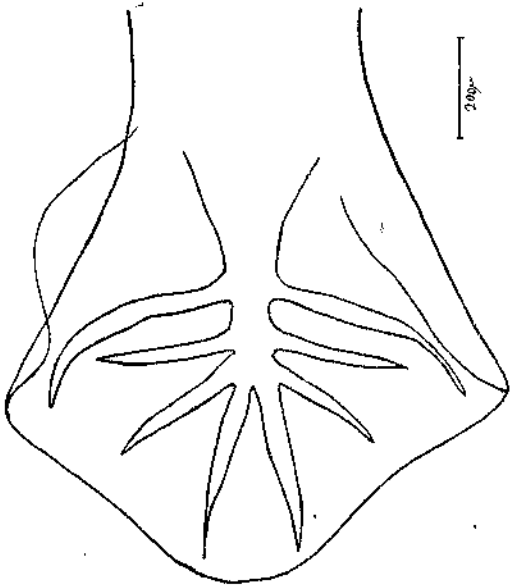


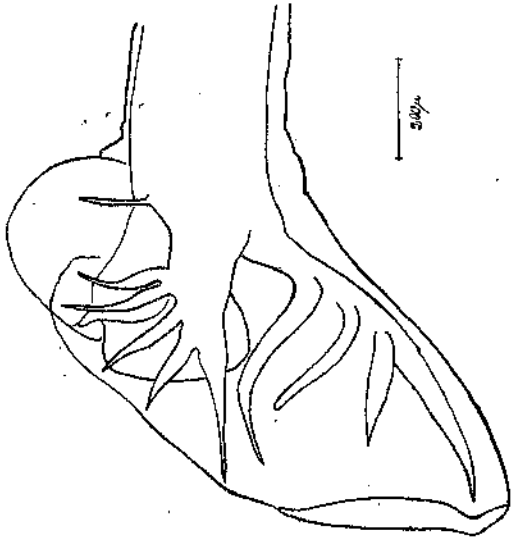
Plate XXXV. *Pteriostomum ratzii.*



A



D



C

Plate XXXVI.

Poteriostomum ratzii var. *nanum.*

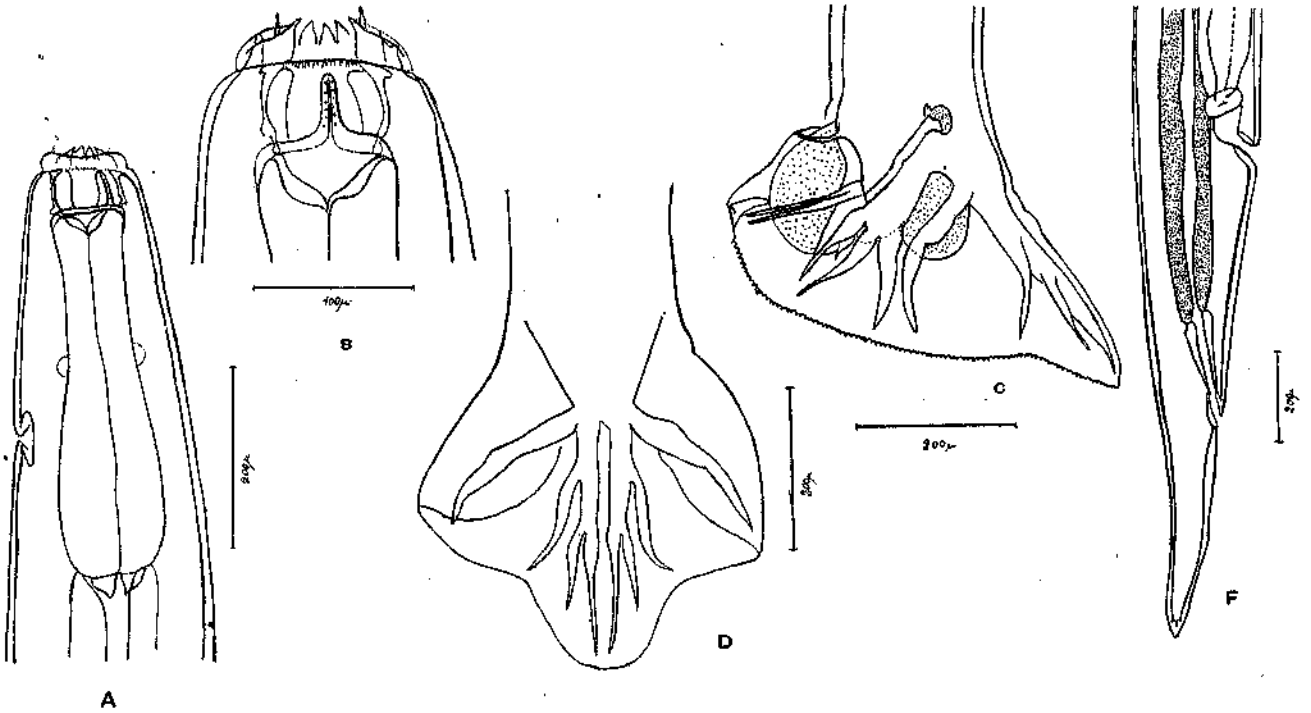
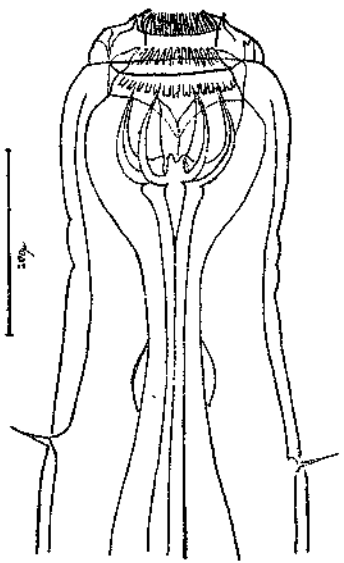


Plate XXXVII. *Craterostomum mucronatum.*



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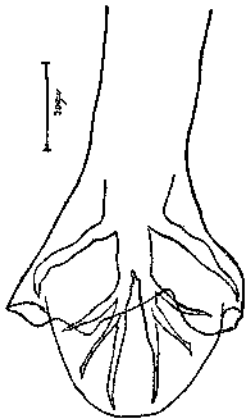
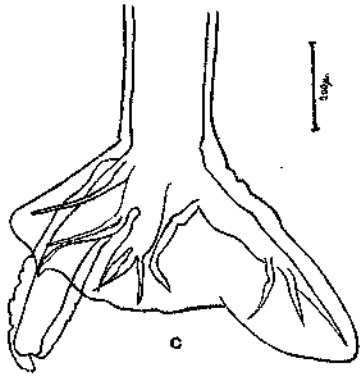


D



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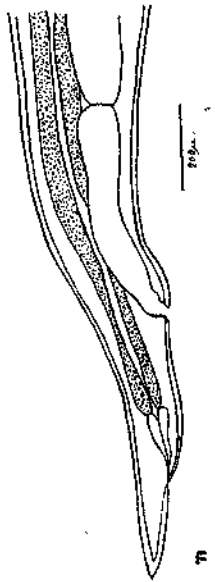


E

Plate XXXVIII. *Gyalocephalus capitatus.*

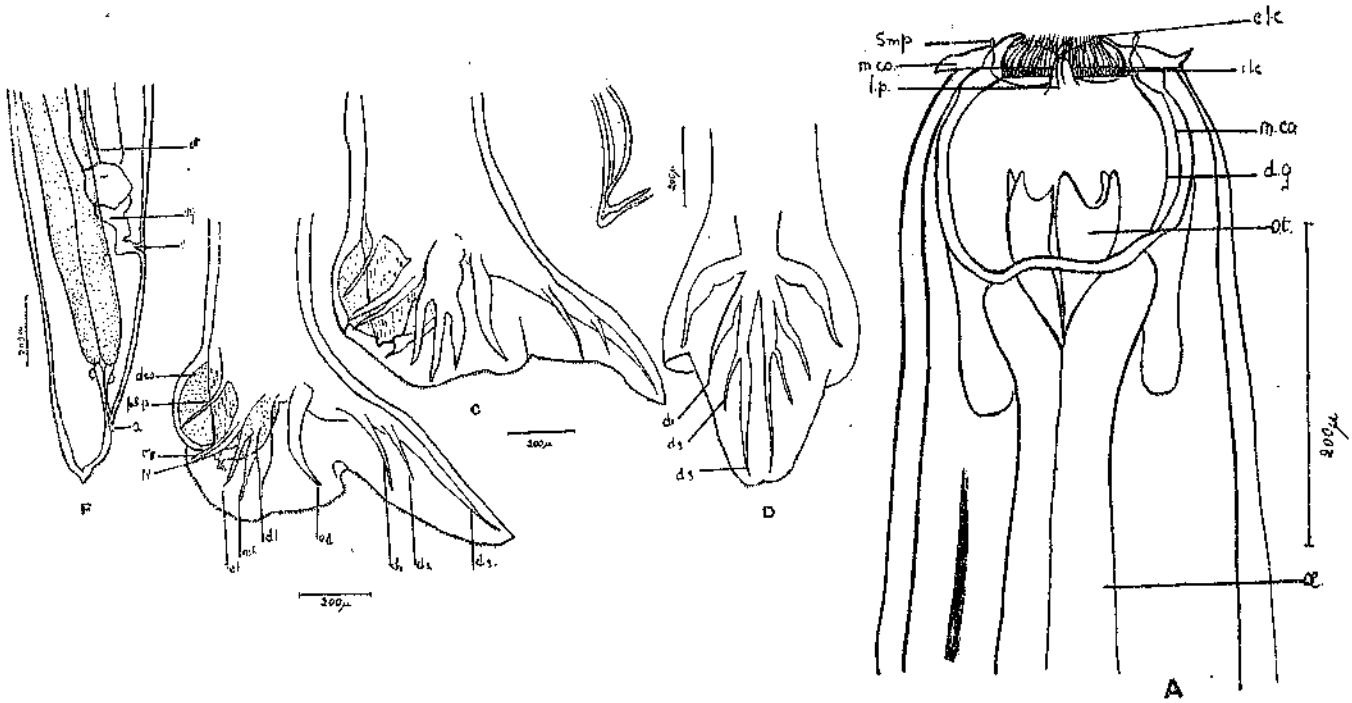


Plate XXXIX.

Priodontophorus minor.

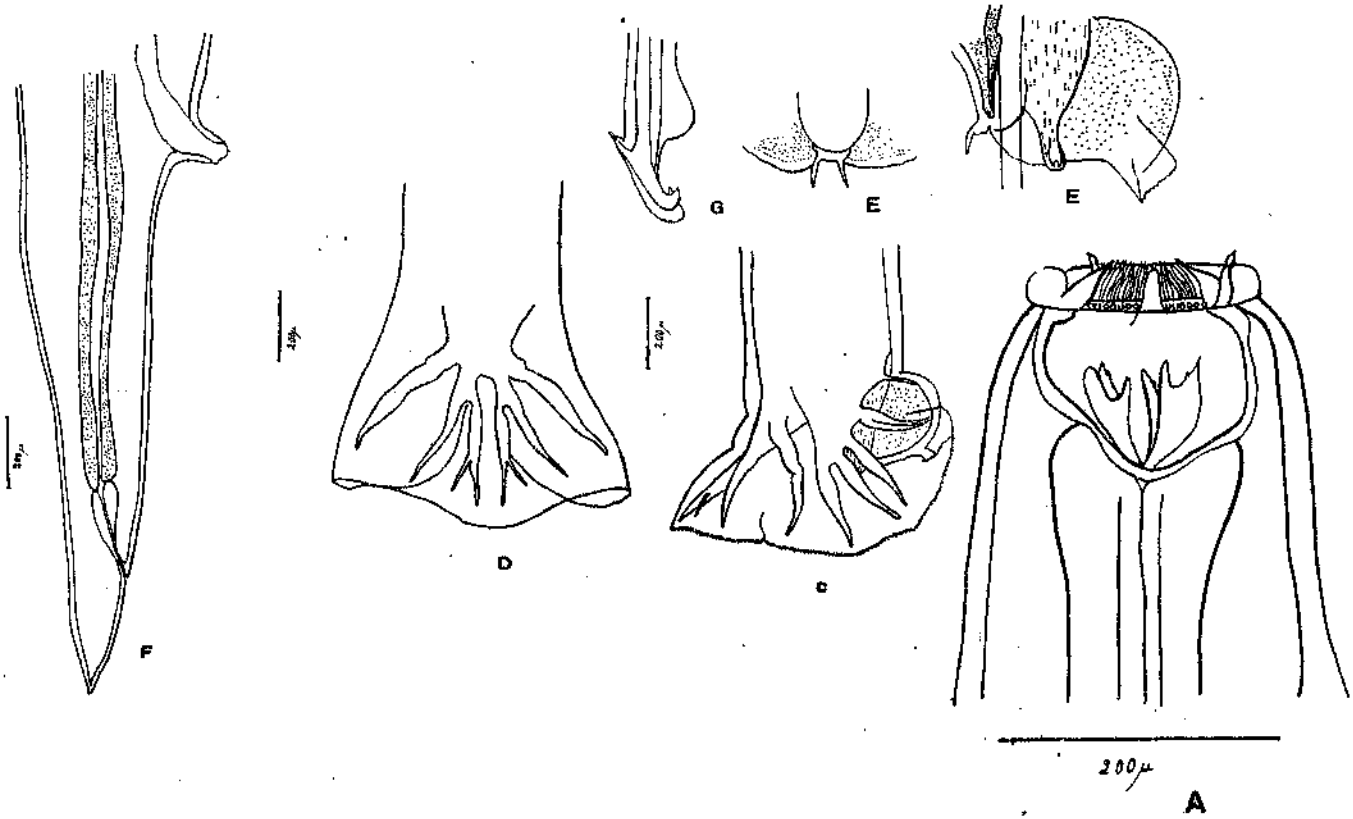


Plate XL. *Triodontophorus serratus.*

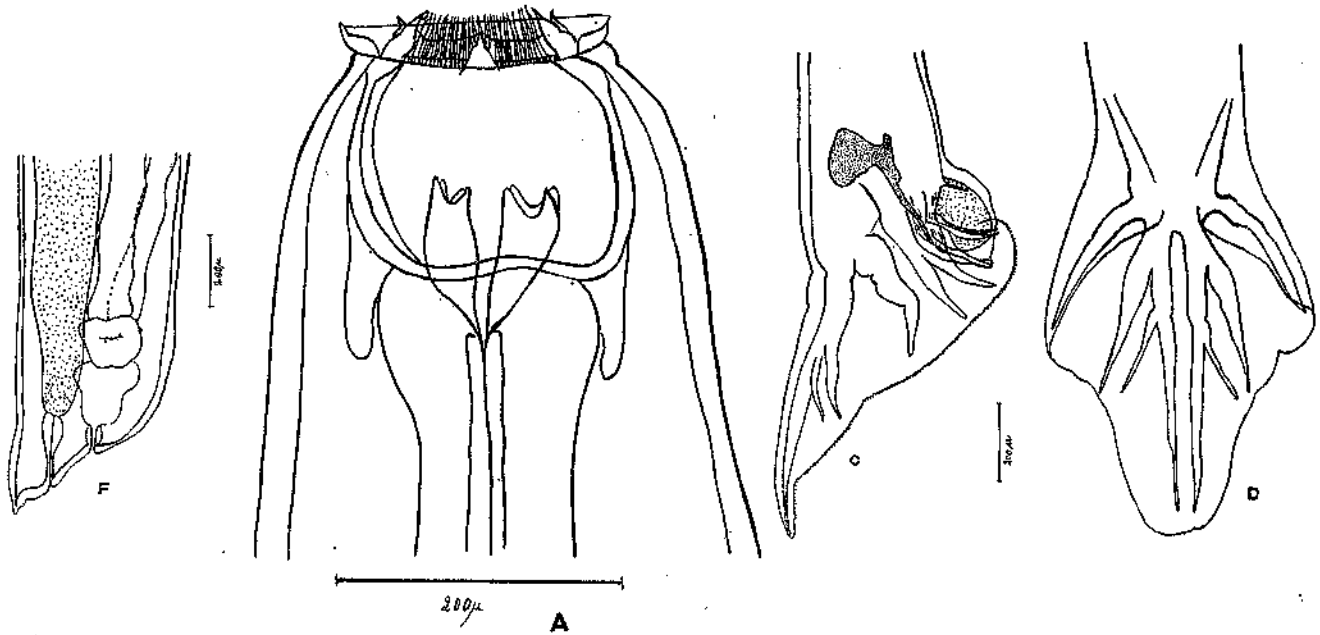


Plate XLI.

Triodontophorus brevicauda.

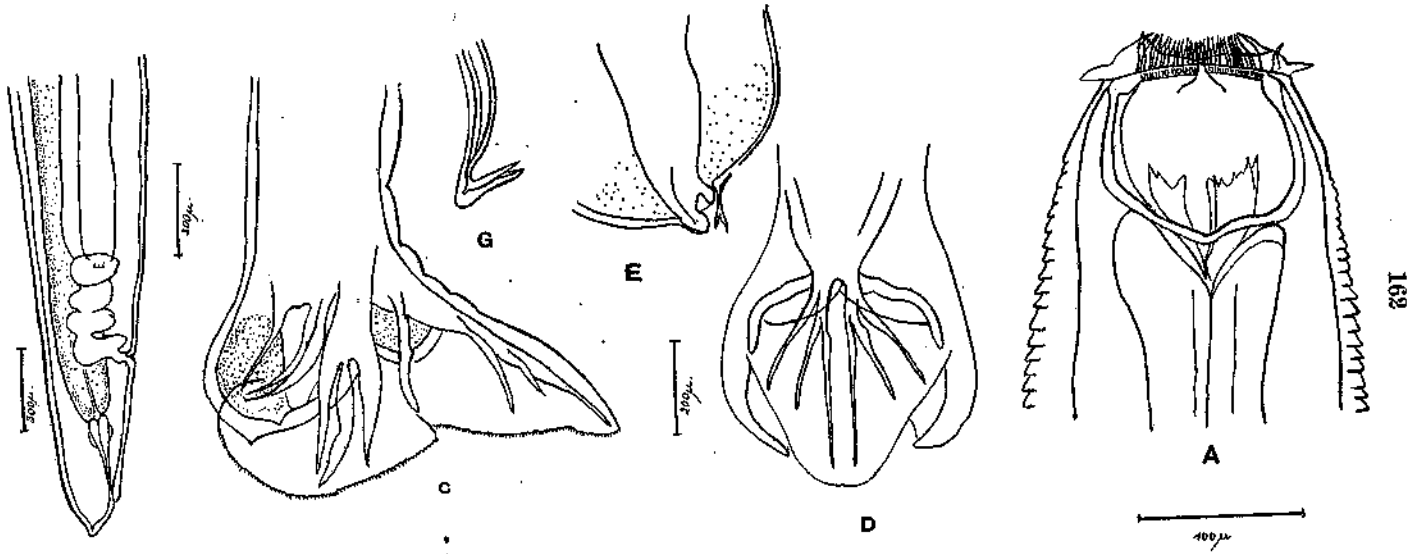
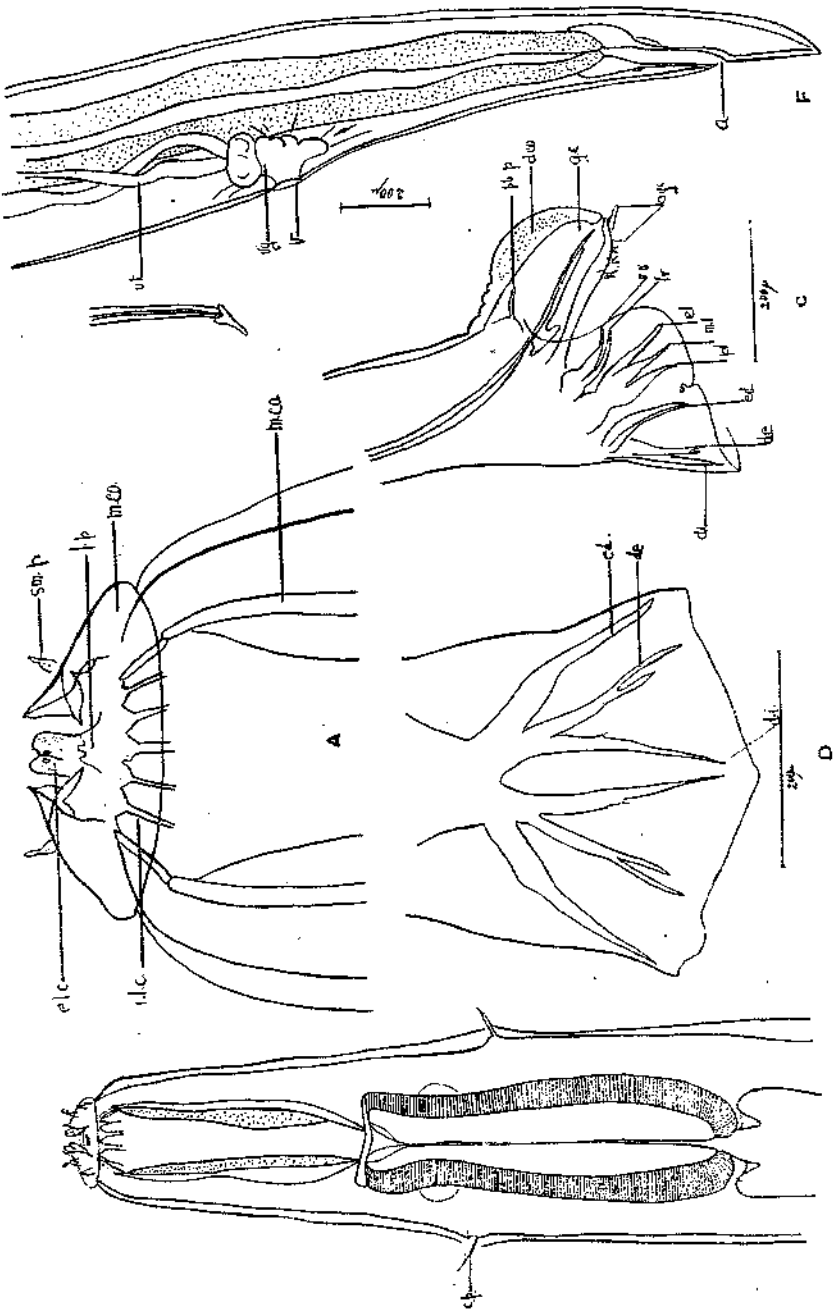


Plate XLII.

Triodontophorus tenuicollis.

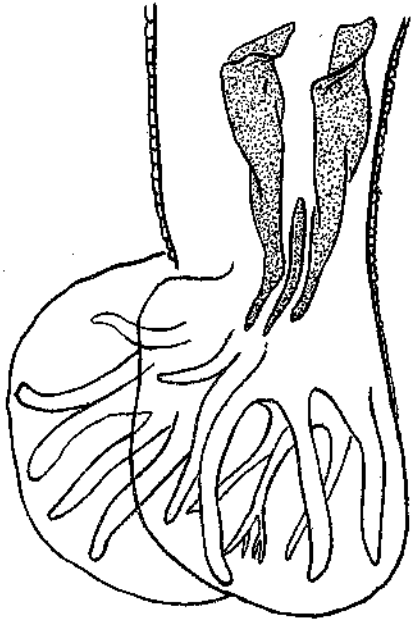
Plate XLIII.

Cylindropharynx brevicauda. (Figs. C, D, F.)
Cylindropharynx longicauda. (Figs. C¹, F¹.)
Cylindropharynx rhodesiensis. (Figs. C² and F². Fig. F² after Yorke and Maefie.)

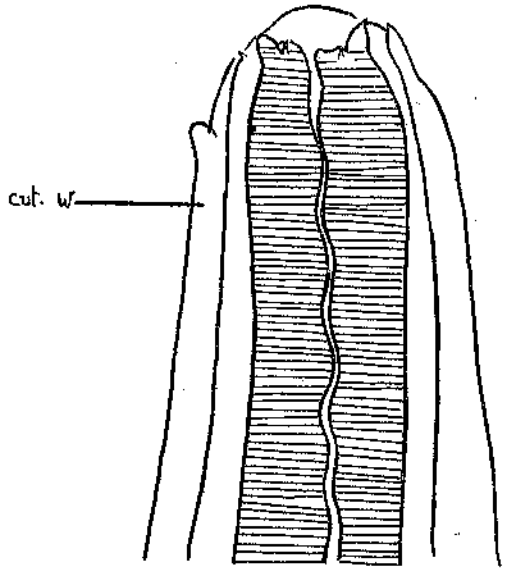


Cylindropharyngx intermedia, n. sp.

Plate XLIX.



C



A

100 μ

D

Plate XLV.

Trichostrongylus axei. (Fig C after Travassos after Cobbold.)
Dictyocaulus arnfieldi. (Figs. A + D.)

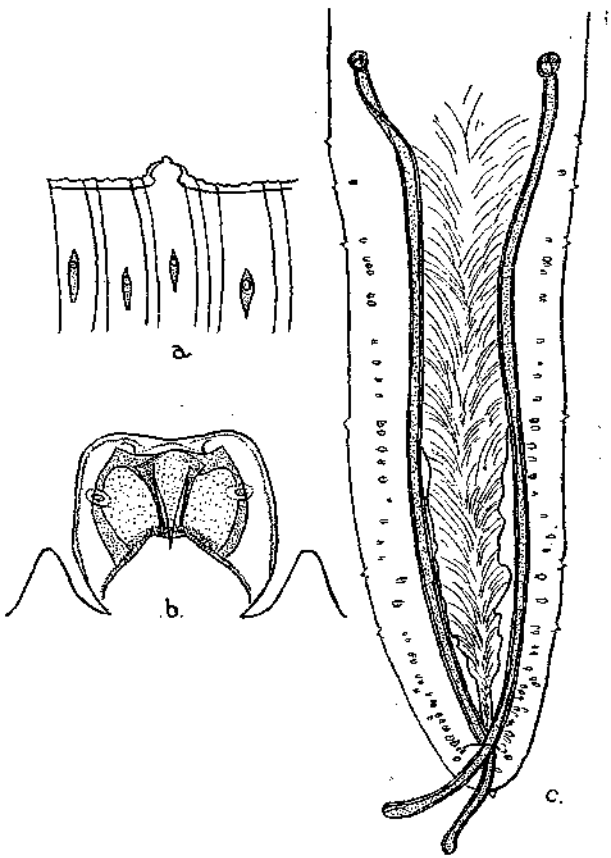


Plate XLVI. *Ascaris zebrae.*

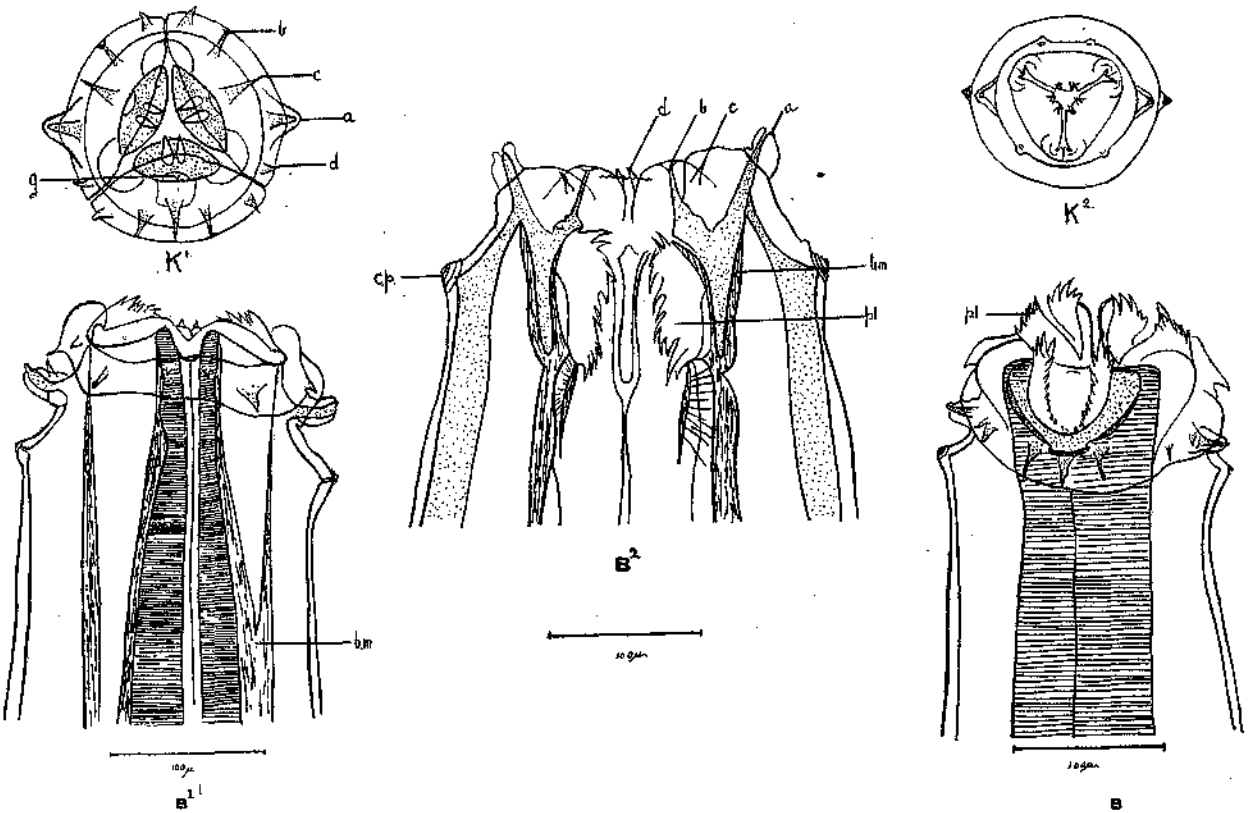


Plate XLVII.

Crossocephalus zebrae.
(Fig. K¹ after Yorke and Southwell. Fig. K² after Gedoelst.)

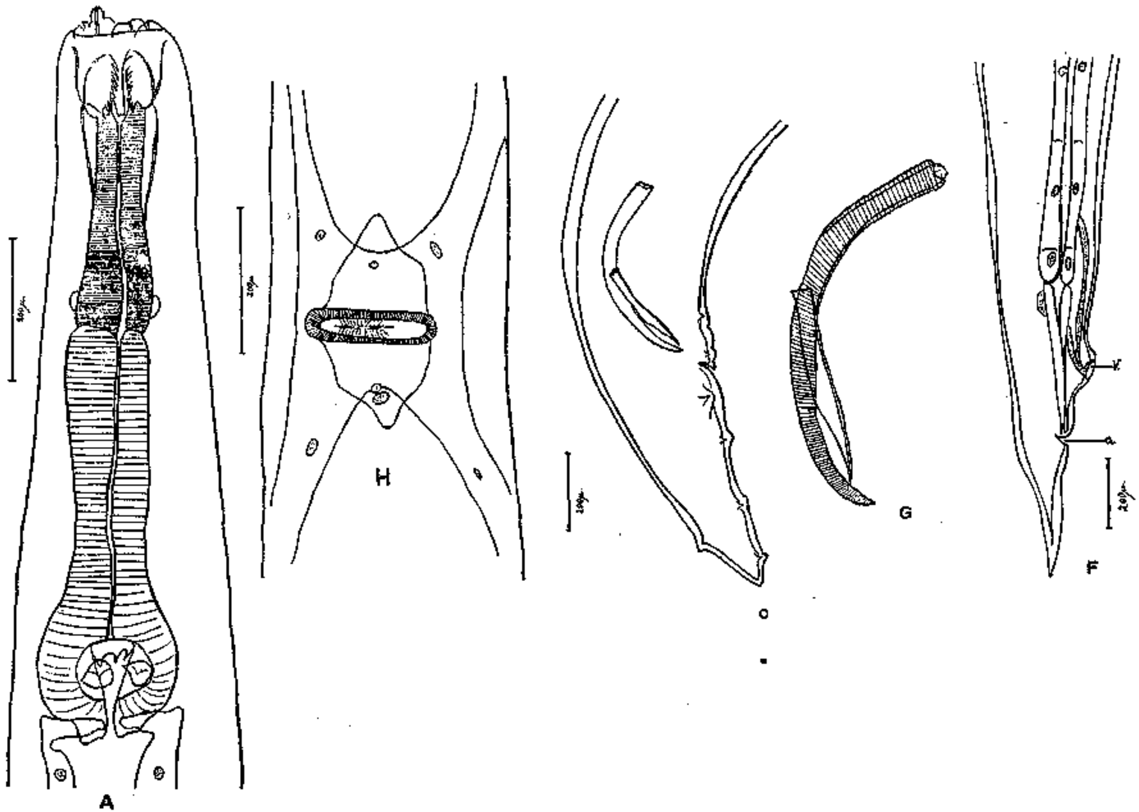
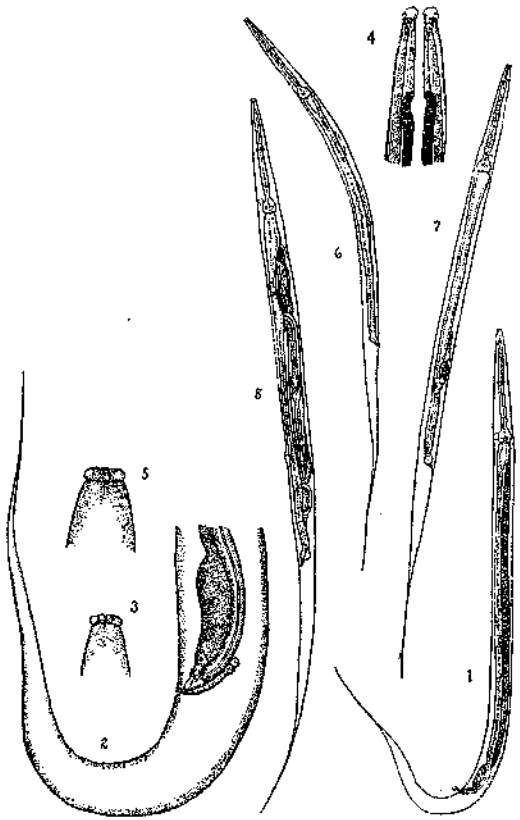


Plate XLVIII. *Crossocephalus zebrae.*



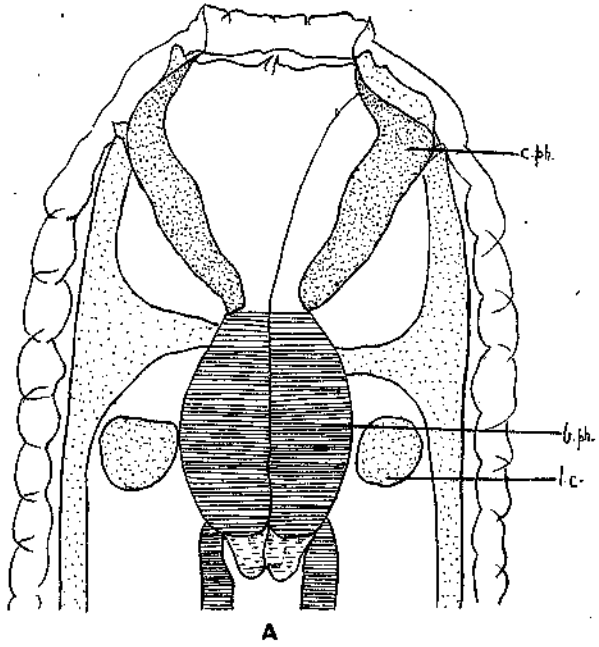
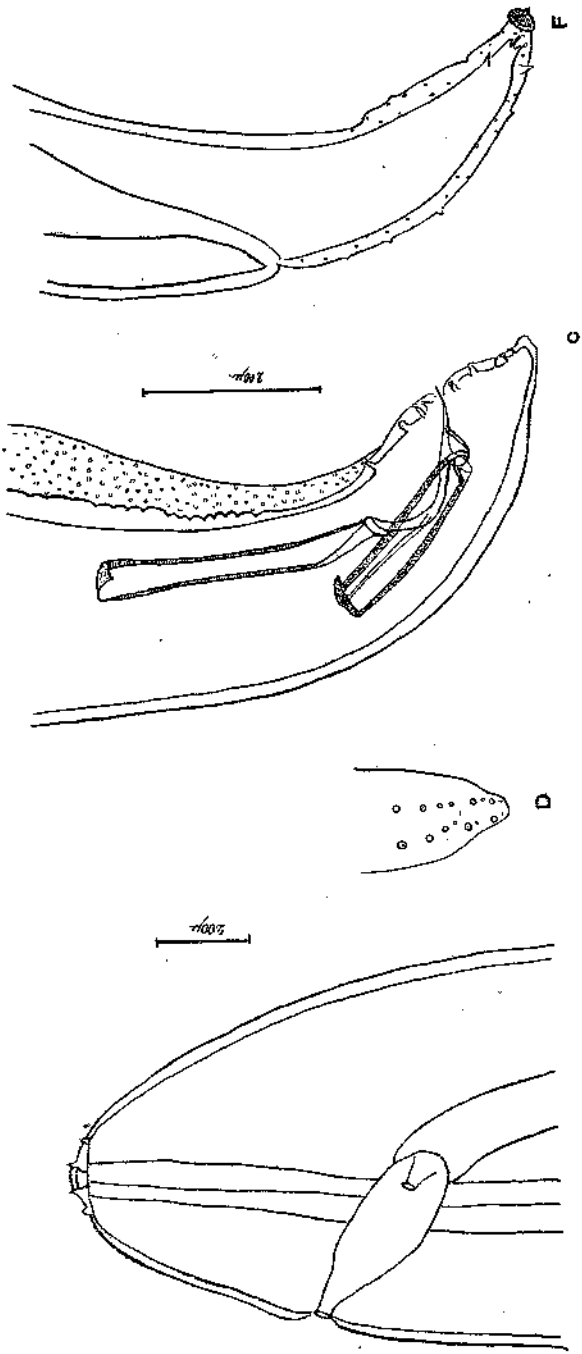


Plate XLIX.

Probstmayria vivipara. (Figs. 1–8 after Ransom.)
Oxyuris equi. (Fig. A.)



Setaria equina.

Plate I.

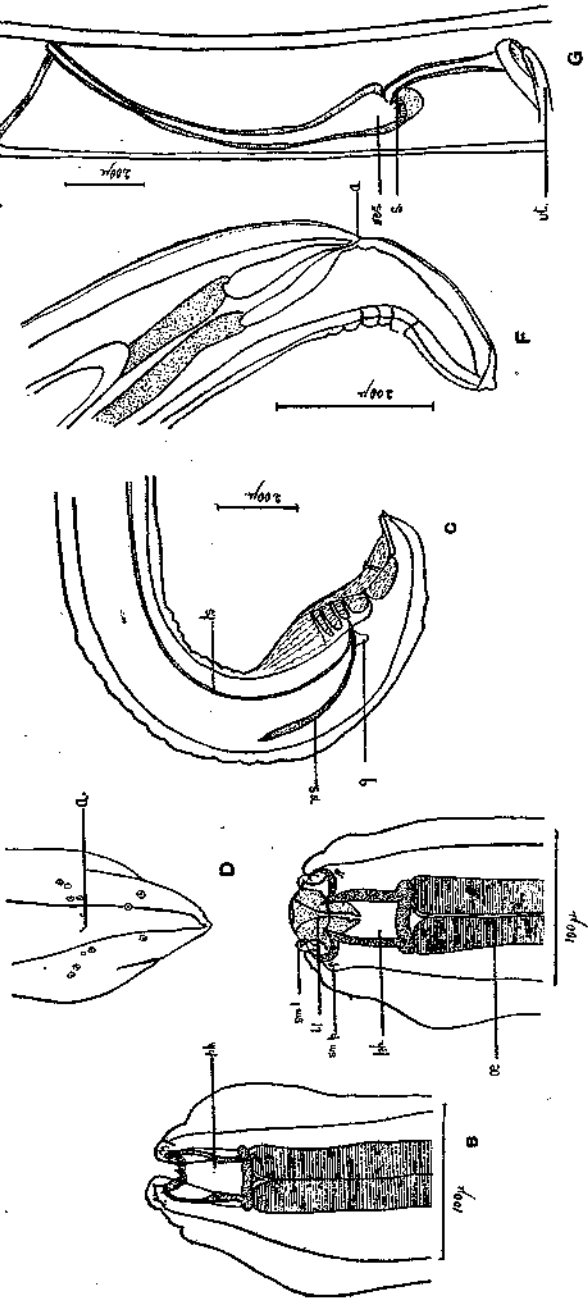
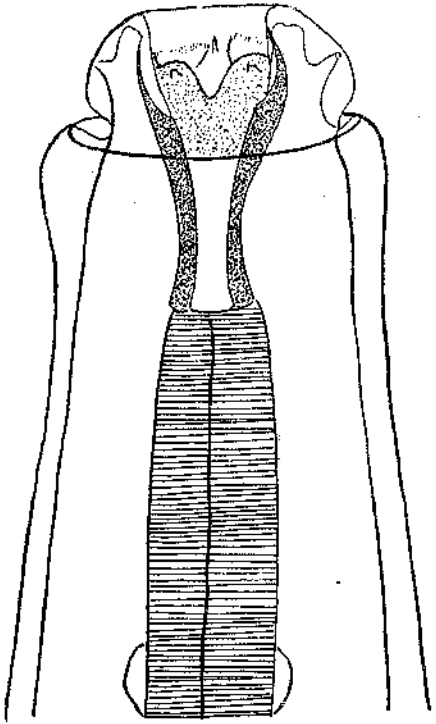
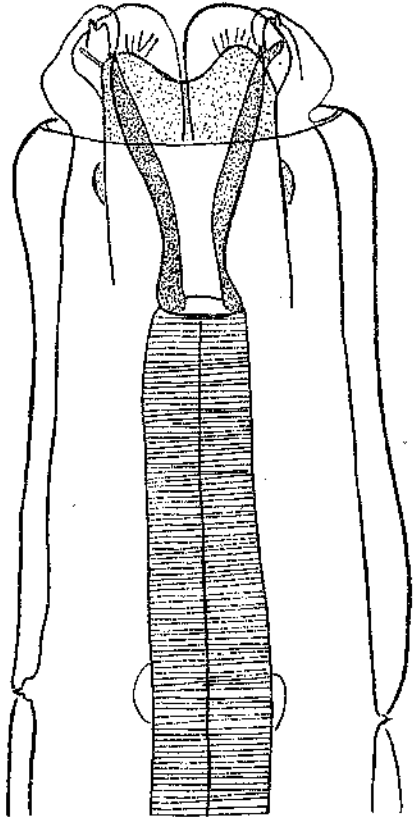


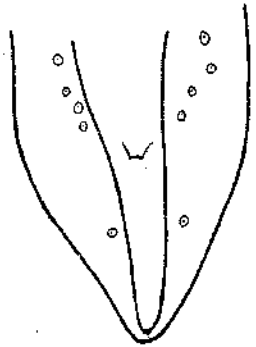
Plate LI. *Habronema muscae.*



A



B



D

Plate LII.

Habronema megastoma.

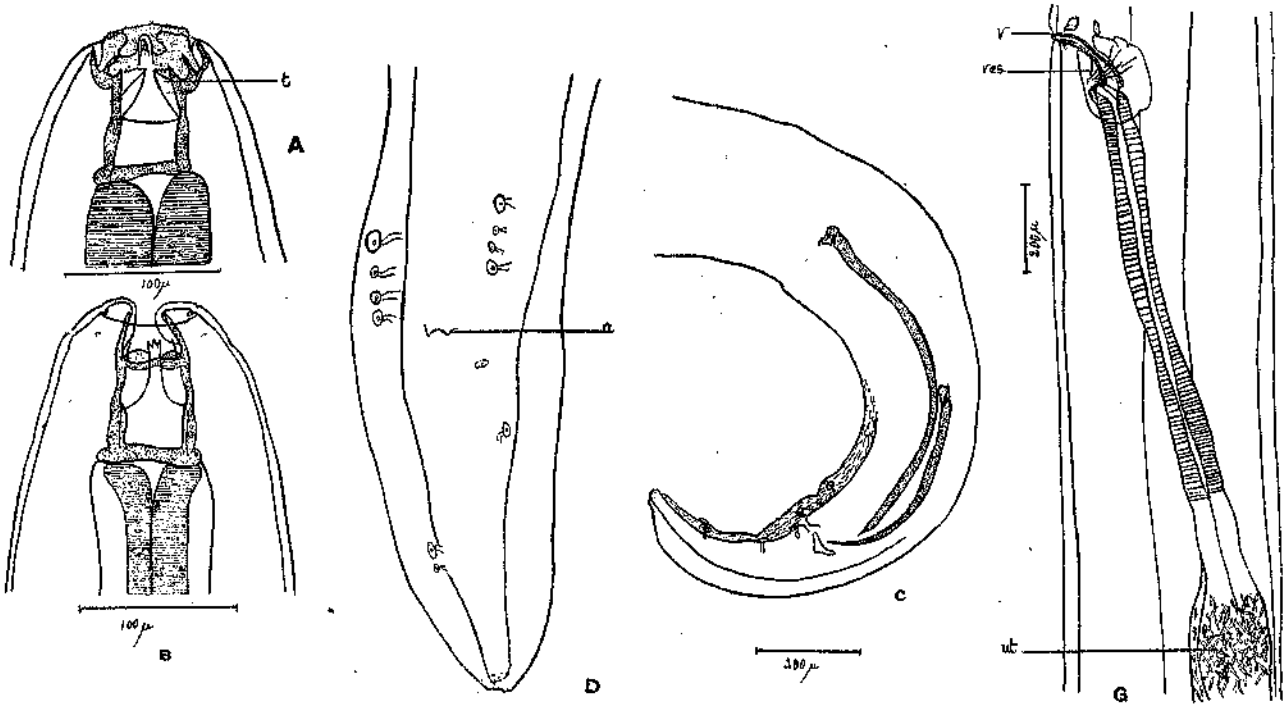


Plate LIII. *Hadronema microstoma.*

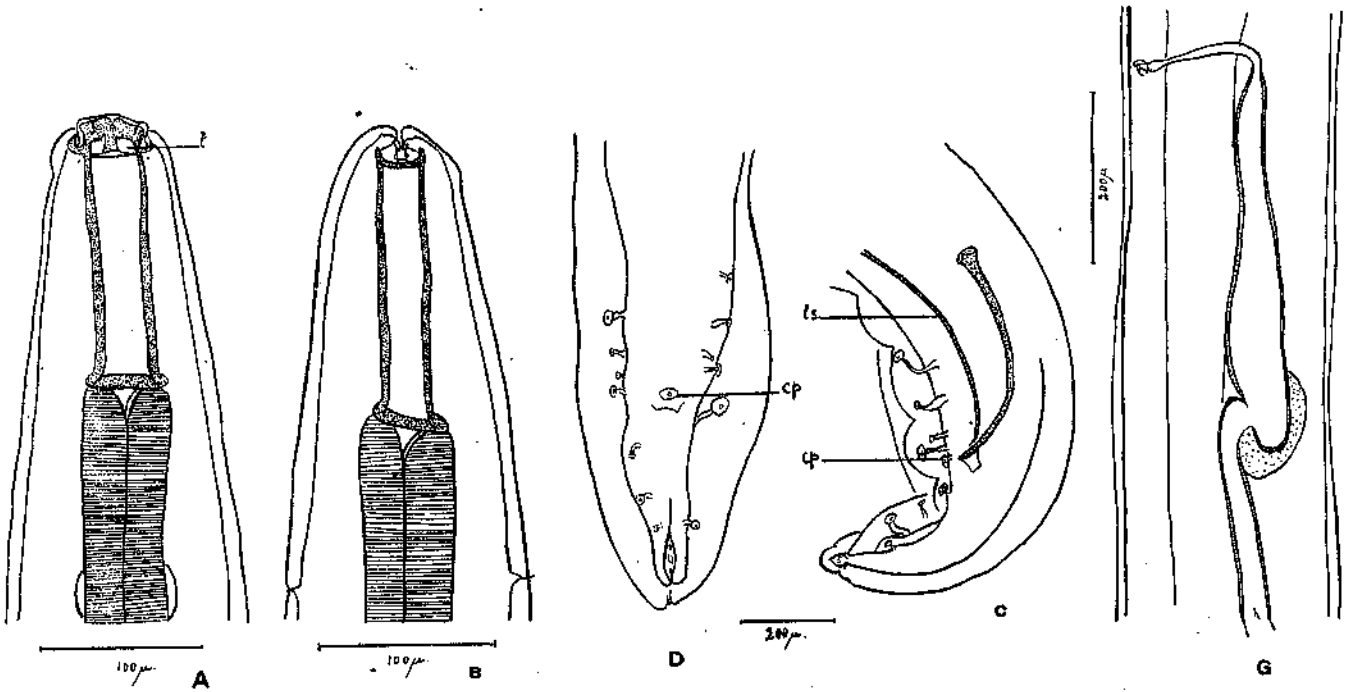
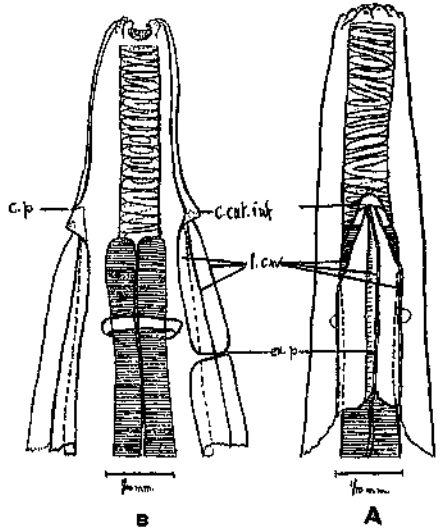
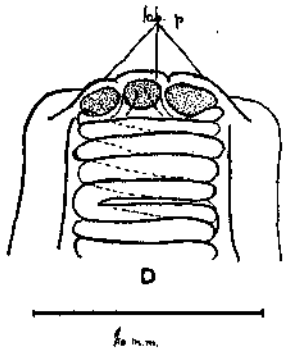


Plate LIV. *Habronema zebra*, n. sp.





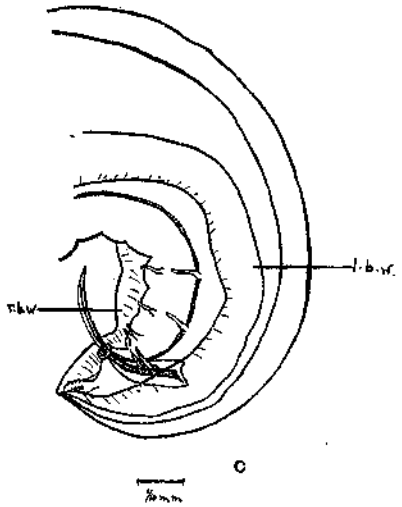


Plate LV. *Physocephalus sexalatus.* (After Foster.)