INSTITUT DES PARCS NATIONAUX DU CONGO BELGE | INSTITUUT DER NATIONALE PARKEN VAN BELGISCH CONGO

Exploration du Parc National Albert

MISSION G. F. DE WITTE (1933-1935)

FASCICULE 4

Exploratie van het Nationaal Albert Park

ZENDING G. F. DE WITTE (1933-1935)

AFLEVERING 4

PARASITIC NEMATODA

BY

J. H. SCHUURMANS STEKHOVEN Jr.
(Utrecht)

BRUXELLES 1937 | BRUSSEL 1937

AVIS

L'*Institut des Parcs Nationaux du Congo Belge* a commencé, en 1937, la publication des résultats scientifiques des missions envoyées aux *Parcs Nationaux*, en vue d'en faire l'exploration.

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Discours prononcé par le Duc de Brabant à l'*African Society*, à Londres, à l'occasion de la Conférence Internationale pour la Protection de la Faune et la Flore africaines.

La Protection de la Nature. Sa nécessité et ses avantages, par V. VAN STRAELEN, 1937.

I. — Mission G. F. DE WITTE (1933-1935).

Fasc. / Afl. 1. G. F. DE WITTE (Bruxelles), *Introduction* 1937

Fasc. / Afl. 2. C. ATTEMS (Vienne), *Myriopodes* 1937

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Redevoering door den Hertog van Brabant gehouden in de *African Society*, te Londen, bij de gelegenheid van de Internationale Conferentie voor de Bescherming van de Afrikaansche Fauna en Flora.

De Natuurbescherming. Haar noodzakelijkheid en haar voordeelen, door V. VAN STRAELEN, 1937.

I. — Zending G. F. DE WITTE (1933-1935).

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INTRODUCTION

Among the rich zoological collections brought home by GASTON F. DE WITTE from his mission to the Belgian Congo, made under the auspices of the « Institut des Parcs Nationaux du Congo belge », there is a series of Nematoda taken from a variety of hosts and excellently preserved in the field. This material has kindly been entrusted to me for study by Professor VAN STRAELEN, to whom I offer my thanks.

Further thanks are due to my colleagues, to Dr. S. FRECHKOP for the identifications of the mammalian hosts, to Dr. H. SCHOUTEDEN for those of the avian hosts, to Mr. G. F. DE WITTE for those of reptiles and batrachians, and to Dr. L. GILTAY for that of the fish.

The collection of *Nematoda*, though not large, includes some very interesting species, the head characters of which I could study in more detail. These, as demonstrated by SCHUURMANS STEKHOVEN and DE CONINCK in the free-living marine forms as well as those of fresh water, are of the utmost importance in showing the inter-relations of families and orders within this class. Independently of the aforementioned authors, CHITWOOD and WEHR have given for the *Spiruroidea*, one of the most important orders of parasitic Nematodes from the standpoint of phylogeny, a scheme in which they trace the relationships of the members of this order.

Fortunately the present collection includes several species of Spirurids which, by the arrangement of their head characters, throw new and unexpected light on the relationships of several genera studied also by CHITWOOD and WEHR. These findings do not diminish in the least the value of the study of CHITWOOD and WEHR, but they show how careful one must be in drawing conclusions in this field. The differences in their views and

mine result from our widely divergent starting points. CHITWOOD and WEHR are inclined to derive the Spiruroidea from a *Rhabditis*-type of Nematode, a form which lived therefore in soil or in fresh water. Their standpoint corresponds with that of STEINER, who is of the opinion that the free-living marine Nematodes may be derived from Nematodes living in the soil, and in the last instance from the prototype *Rhabditis*.

On the other hand, FILIPJEV and I think that we have to consider the free-living marine Nematodes as the most primitive types of Nematodes, from which those living in fresh water and the soil, as well as the numerous parasites, must be derived. Many recent researches seem to prove that the arrangement of the head characters (sensory papillae, sensory setae, and amphids) is decisive in showing the inter-relations not only of genera within the same family or order, but also of the orders of parasitic and free-living Nematodes. We must therefore look to the free-living marine Nematodes in our search for the origin of the parasites, and trace our lines of relationship by taking the free-living marine forms as a starting point. Nor is it pure chance, I think, that the *Spiruroidea*, of which many an parasites of aquatic animals, may serve us in the prosecution of this aim.

Atthough CHITWOOD and WEHR have gone to much trouble to study the head characters of many different genera of *Spiruroidea*, of all families within that order, the present studies prove that it is necessary to go much further in this direction. The different species of the same genus must be compared, since this comparison may enable us to draw conclusions of great importance from the point of view of relationship.

In his paper on the free-living soil-inhabiting Nematodes of the Belgian Congo, DE CONINCK comes to the conclusion that a primitive nematode has three crowns of cephalic sensory organs : a crown of six labial papillae, a second crown of six cephalic papillae or setae, and a third crown of four cephalic setae. During the course of his studies in the zoological laboratories at Utrecht, I made the suggestion to DE CONINCK that there might be a shifting of one or more of the three primitive crowns of cephalic sensory organs along the head. Following this suggestion, DE CONINCK arrived at the conclusion that such a shifting had really taken place in several groups of free-living Nematodes. For instance, in the *Choanolaimidae* and *Cyatholaimidae* among the *Chromadoroidea*, as well as in the *Enoploidea*, we commonly find, apart from a crown of six labial papillae, a second crown consisting of ten cephalic setae, respectively ten cephalic papillae. The duplication of the submedian cephalic setae or papillae of this lower crown he traces back to a fusion of the second with the third crown of cephalic sensory organs. When one considers this point of view it is clear that the partners of each couple of submedian cephalic setae or papillae, when the lower crown is composed of ten elements, must be unequal. This is in accordance with what we find in nature.

A second question arises. Is DE CONINCK right in supposing that the crown consisting of four elements has to be considered as the third crown,

or is it in reality the second crown which may be shifted so far back as to be found posterior to the crown consisting of six elements ? Again another question : should this crown of four elements not be considered as composed primarily of six elements, of which two have disappeared ? It is true that in the *Chromadoroidea* the crown of four elements is to be found posterior to that composed of six elements. But this may mean that in this case the crown has been shifted posteriorly to the crown composed of six elements. In the case of the *Araeolaimoidea*, where we have only two crowns, one of six labial papillae and one of four cephalic setae, the arrangement might be explained in two ways : we might suppose (1) that the crown of four cephalic papillae has disappeared, together with the lateral setae of the posterior crown of six elements; or (2) that the posterior crown of six elements has disappeared, leaving only the crown of four elements, which probably has been shifted posteriorly from its primitive position.

In the *Enoploidea* the crown of four elements has almost fused with the posterior crown of six elements, but lies mostly somewhat in front of the latter. The same is true for the *Choanolaimidae* and *Cyatholaimidae*. As for the *Spiruroidea*, which I consider comparatively near relatives of the *Enoploidea*, there the same phenomenon may be observed.

In discussing the relationships of the members of the *Spiruroidea*, as arranged chiefly on the basis of cephalic characters, and with reference to other supplementary characters, CHITWOOD and WEHR say literally (p. 289) : « The cephalic characters of spiruroids present a most varied and complex picture, yet the writers believe, that of the patterns represented by this group can be interpreted in terms of the pattern studied in a single genus, namely *Thelazia*. The arrangement and the number of the cephalic papillae in *Thelazia californiensis* appear to be the most generalised of any known spiruroid form of nematode. They approach in many respects the pattern represented by the hypothetical nematode head. In *Thelazia californiensis* there is an internal circle of 6 very slightly reduced papillae and an external circle of 8 well developed symmetrically spaced papillae, each papilla of the external circle being situated at the same level of the head. The oral opening is dorsoventrally elongated and lips or labial structures are entirely absent.

» Serial sections indicate that the ventrolateral papillae are actually represented by rudiments which terminate below the surface of the cuticle on the ventral side of the amphidial pouch.

» The cephalic pattern of the species of the genera *Oxyspirura* and *Rhabdochona* is very similar to that of *Thelazia californiensis*, but differs from the latter in the possession of rudiments or indications of 6 lips, and in the character of the dorsodorsal and ventroventral papillae. In the larval stage of *Oxyspirura mansoni* the circumoral membrane shows 6 distinct lobes, each lobe bearing at its tip a papilla of the internal circle (the labial papillae of other authors) while in the adult stage of this species the circumoral membrane is hexagonal in outline and is no longer lobed.

In both the larve and the adult of *Oxyspirura mansoni* the dorsodorsal and ventroventral papillae are intermediate in size between the papillae of the internal circle and the laterodorsals and lateroventrals of the external circle (the cephalic papillae) and they are located approximatively one third of the distance from the former to the latter. »

This fairly long quotation was necessary to point out some principal features. For instance, there is no doubt that the possession of lips is a primitive character in a nematode, so that on this account the genus *Oxyspirura* should stay nearer to the root of origin of the spiruroid type than the genus *Thelazia*. Secondly, a comparison of *Thelazia* with *Oxyspirura* as described by CHITWOOD and WEHR shows that in *Thelazia* there are two crowns of sensory organs, whereas in *Oxyspirura* there are three of them. Going still deeper, it is clear that in *Thelazia californiensis* the external circle is composed of 10 papillae of which two, the ventrolaterals, are rudimentary. This number, 10, is in accordance with what we find in several groups of free-living marine nematodes, such as the *Enoploidea*, and the *Cyatholaimidae* and the *Halichoanolaimidae* among the *Chromadoroidea*.

In *Oxyspirura*, however, there are 3 crowns as in most *Chromadoroidea* (a crown of labial papillae and 2 crowns of cephalic papillae). The difference from the free-living group mentioned is that both crowns of cephalic papillae are composed of 4 papillae instead of the intermediate crown (first crown of cephalic papillae) having 4, the external crown 6 components. Probably we may assume that just as in *Thelazia californiensis* the representatives of the genus *Oxyspirura* have rudimentary ventrolaterals. If further research proves this to be the case, the conformity with the chromadoroid type is even more striking. Moreover, there are reasons to assume that the *Thelazia* pattern is derived from the *Oxyspirura* pattern by a shifting of the intermediate crown of papillae in the caudal direction.

When our knowledge is limited to the forms studied by CHITWOOD and WEHR, we may say that the presence of 10 papillae in the external circle, in combination with the disappearance of the lips, leads to the assumption of secondary significance for both characters as the most likely explanation. On the other hand, we must point out that the possession of a set of 10 components in the external circle is not necessarily a secondary character. Thus, in the *Enoploidea*, where we have always a complete set of 6 lips, with 6 labial papillae and 10 cephalic setae, the latter character may perhaps be a rather old one. Yet we are only able to explain its origin and the relationships of the *Enoploidea* with other groups of free-living nematodes by deriving this type of distribution of the sensory organs from the type with 3 circles of sensory organs. This is all the more probable because the partners of each couple of sensory organs in the *Enoploidea* are generally unequal, or at most subequal and, as stated above, do not stay quite on one level.

There is a third essential feature in *Thelazia californiensis*, as CHITWOOD and WEHR have depicted it in contradiction to their text. This character apparently was misunderstood by them. They emphasize the fact that the external circle has 8 well developed papillae, symmetrically spaced, each papilla situated at the same level on the head. After consulting their own figure of *Thelazia californiensis* no one would doubt that these 8 papillae are situated at the same level, but we may be in doubt as to the equality of all 8 components. Thus, in their figure of the head of *Thelazia californiensis*, the laterodorsals are distinctly larger than the dorsodorsals. As for the lateroventrals and the ventroventrals, they differ in size, but it is not certain that the lateroventrals are larger than the ventroventrals. The reverse may be true. At any rate, I doubt the accuracy of this figure as a whole, though I am fairly sure its upper half is correctly depicted.

In their family diagnosis of the *Thelaziidae* (page 313) CHITWOOD and WEHR make this remark about the papillae : Papillae of external circle 4 or 8 in number, *not approaching in pairs*, sometimes with the dorsodorsals and ventroventrals internal to laterodorsals and lateroventrals. The words in italics prove that the authors have misunderstood the meaning of the papillae in the external circle, in case there were 8 components. Had they extended their research over more species of Thelaziids they certainly would have come to a different conclusion.

My material has allowed me to study two species of *Thelazia : T. depressa* and *T. digiticaudata*, as well as a species of *Oxyspirura*, *O. wittei*. The distribution of the papillae in the species of *Oxyspirura* was as described by CHITWOOD and WEHR. That of both species of *Thelazia* differed essentially from their description in that in both the papillae *approach in pairs* and are *unequal in size*, more distinctly so in *T. depressa* than in *T. digiticaudata*. In *depressa* the dorsodorsals and ventroventrals are distinctly smaller than the laterodorsals and lateroventrals, while each dorsodorsal is coupled with a laterodorsal, and each ventroventral with a lateroventral. Thus the pattern of the papillae approaches that of the *Enoploidea*, rather than that of the *Anguilluloidea*, to which *Rhabditis* belongs. The parasitic Spiruroids, possess more than one rather primitive character, as compared for example with the Ascaroidea — far more different from the free-living marine nematodes. Thus I am inclined to link te parasitic Spiruroids with *Enoploidea*, with their 6 lips and their internal and external circles of papillae. The latter circles consist in principle of 10 papillae, or setae, the partners of each pair being unequal either in size or in state of development. That the coupling of papillae of the submedian groups is an essential feature in the spiruroids is proved likewise by the diagram CHITWOOD and WEHR published on the relationships of the families of Spiruroidea. The assumption that *Thelazia californiensis* was to be considered as the nearest relative of the prototype of *Thelazia* proved to be false. At any rate the pattern was misinterpreted. This, however, says nothing against the beautiful work done by these authors in tracing lines of relationship in the order *Spiru-*

roidea, of which *Thelazia* undoubtedly represents one of the most primitive types, with regard to the distribution of sensory organs.

The DE WITTE collection contains another Spirurid, *Streptopharagus pigmentatus* (LINSTOW), about the cephalic pattern of which something must be said. CHITWOOD and WEHR treat of this genus immediately after *Thelazia*, together with some other genera of *Ascaropsinae*. In *Streptopharagus* the lips are rudimentary, although distinctly indicated and beset with 6 labial papillae in all. There are 8 cephalic papillae, i. c. 4 pairs, the partners of which are subequal in size. As CHITWOOD and WEHR correctly remark, the dorsodorsals and the ventroventrals are usually slightly anterior to, and smaller than the laterodorsals and the lateroventrals. The externolateral papillae are situated just between the internolateral patillae and the amphids. Here again the resemblance is unmistakable with what we find in the *Enoploidea*.

Spiroxys gedoelsti deviates from the prototype *Spiroxys contorta*, studied by CHITWOOD and WEHR in their beautiful work on the head characters of the *Spiruroidea*, in that the submedian cephalic papillae of *gedoelsti* fall outside the reach of the pseudolabia, whereas in *contorta* they are located on them. As for the amphids I am less certain; but the comparison of the two species proves again, as was stated for *Thelazia*, that a phenomenon like the capture of the cephalic papillae by the pseudolabia may be observed in the evolutionary development of the same genus.

CHITWOOD and WEHR remark that « all filariids that have been studied thus far by the writers have a cephalic pattern consisting of 8 separate and well developed papillae of the external circle, with the papillae of the internal circle either very much reduced or lacking ». For the Filariid which I have identified as *Hamatospiculum dehiscens* the same proved to be true. Here the papillae are placed 4 by 4 on lateral epaulettes, each of which embraces an amphid. The latter are situated in the mid-line of the ellipse formed by the line connecting both epaulettes. Study of the papillae and their location in detail makes it obvious that they may be grouped in 4 pairs. The partners of each pair are unequal in size and are placed on a different level.

Here again I may point to what has been sind regarding the shifting of the two crowns of cephalic papillae along the head. In the species of *Hamatospiculum*, as in the Thelaziids mentioned above, the fusing of both crowns of head sense organs is on the way, but not fully accomplished. A similar picture was found in a species which in all probability is *Dracunculus dahomensis*, although in this case the components of each couple of submedian papillae had fused. The conditions in *Philometra congolense* were less clear, and so far cannot be arranged in the same scheme.

At any rate the relations are close between Spiruroids and Filaroids, I fully agree with CHITWOOD and WEHR (page 307) when they conclude that « Spiruroidea and related groups, including the filaroids and dracunculids probably had an origin distinct from that of any other group of parasitic

Nematodes, a view which has been added support because there are no known intermediate forms between the Rhabditids and the Spiruroids ».

The existence of such intermediate forms would have been very improbable from my point of view that the rhabditids are far from primitive forms, adapted to life in damp soil. In my opinion the *Spiruroidea* as well as the *Filirioidea* have sprung from prototypes which must be sought for among the free-living marine nematodes of the Enoploid type. I am further inclined to suppose that the *Ascaroidea*, and possibly also a part of the *Oxyuroidea*, present relations with the *Monhysteroidea* among the marine formes as well as with the *Anguilluloidea* living in soil. The order *Oxyuroidea* is by no means such a natural group as as in the classification by YORKE and MAPPLESTONE, for instance.

In regard to the latter order I think BAYLIS and DAUBNEY have come nearer to truth.

This rather long introduction, which at the same time may be considered as a summary of the main results of the present paper, is necessary in order to point out the very interesting morphological problems which the nematoda present to the scientist who studies them not with the aim of controling diseases, but as a zoologist who seeks a concise view of the group as a whole.

In the systematic part I shall try to give supplementary details as to the species studied by me, and to bring together information relating particularly to the cephalic structures of the *Ascaroidea*. Several interesting forms of that group were available. It seems to me that in this group the lateral projections of the pulpa, of which each lip generally possesses a pair in the family Ascaridae, are to be considered as sense organs. They have the significance of the labial papillae in other orders of parasitic and free-living nematodes, so here we find in principle the same arrangement of labial papillae as elsewhere.

SYSTEMATICAL PART

ORDER I : ASCAROIDEA

Family ASCARIDAE

Subfamily ASCARINAE

1. — **Polydelphis anoura** (DUJARDIN)

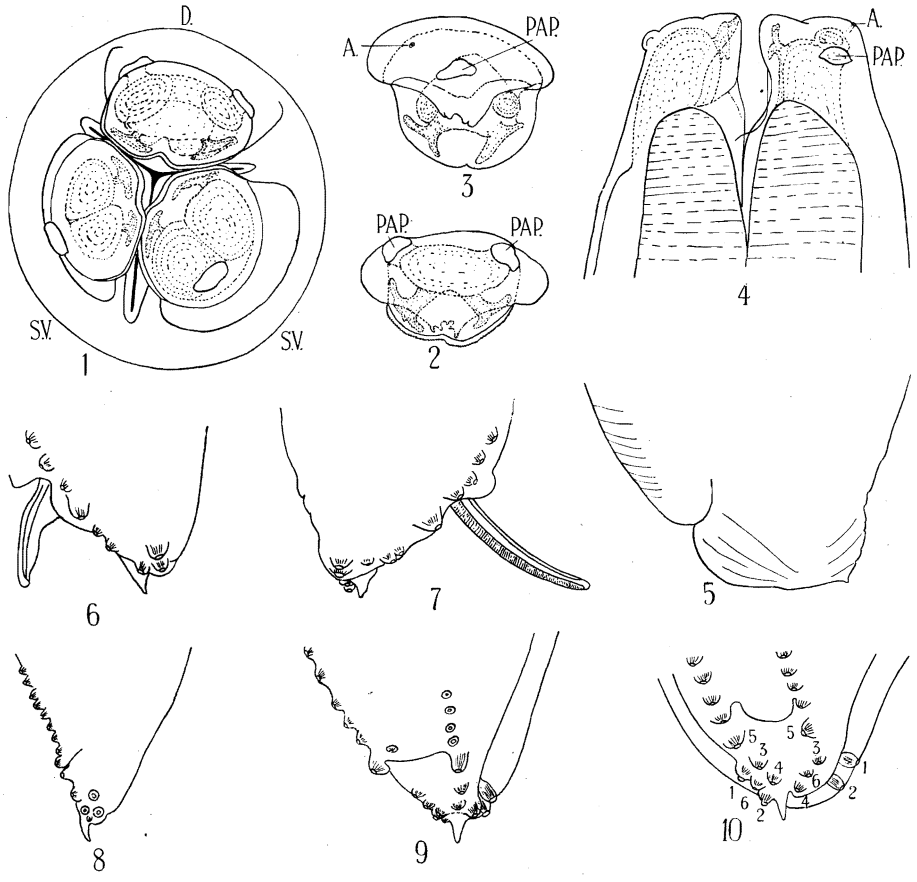
(Figs. 1-10.)

88 ♀♀, 44 ♂♂, from intestine of *Python sebae* (GMEL.), N° 1295, Rutshuru, 1,285 m., 29-V-1934.

13 ♀♀, 15 ♂♂, from same habitat, intestine of *Python sebae*, N° 1296, 29-V-1934.

Polydelphis anoura, the same species, according to BAYLIS, as *Polydelphis pythonis* (RETZIUS) of GEDOELST and RETZIUS and *Ascaris attenuata* MOLIN of STOSSICH and VON LINSTOW, was found by GEDOELST in *Python sebae* at Leopoldville. As other hosts BAYLIS gives *Python molurus*, *Bitis arietans*, *Drymobius bifossatus*, *Coluber corais*, *Zamenis constrictor* and ? *Coronella* sp. Our specimens belong, I believe, to the above-mentioned species, of which BAYLIS and DAUBNEY (1923) gave instructive figures of the head-end and of the distribution of the papillae on the male tail. BAYLIS, BAYLIS and DAUBNEY, and GEDOELST all note the presence in the male of 25 preanal papillae. In our specimens the number of preanal papillae varies between 23 and 27. The number of postanal papillae, noted as 2 by GEDOELST, is 6, according to BAYLIS. In my specimens there are 5 or 6 such papillae.

Length of a male 10.2 cm., width 3 mm.; length of a female 11.5 cm., width 3 mm., oesophagus 10 mm. long. Vulva in the same female 2.7 cm. from the anterior end, or 23.4 % of total bodylength. BAYLIS, on the other hand, said : Vulva at a little less than one-third of the total length from anterior end. 4 uteri. Body tapering strongly anteriorly, here not more than 0.5 mm. broad, stout posteriorly. In the female the caudal end of the body is obtusely rounded, with a very short spike. In the male the spike is distinctly longer and acute at tip. The postanal papillae are arranged more or less in two rows. Just posterior to the cloaca there is a pair of prominent papillae, said by BAYLIS and DAUBNEY to possess 2 terminals each followed at a certain distance by 2 closely placed papillae. Quite laterally and near the tip 2 large papillae are found. In the gap between these papillae, at



Polydelphis anoura (DUJARDIN).

FIG. 1. — Head female, top view, D. = dorsal lip, S. V. = subventral lip.
FIG. 2. — Dorsal lip of same with papillae (Pap.).
FIG. 3. — Subventral lip of the same with Papilla and Amphid (A).
FIG. 4. — Female head in lateral view with Amphid and Papilla.
FIG. 5. — Female tail.
FIG. 6-8. — Male tails in lateral view.
FIG. 9-10. — Male tails in ventral view.

each side, a sixth papilla is found. The last-mentioned 3 papillae are generally situated more or less in a triangle. The precloacal double papilla figured by BAYLIS and DAUBNEY was not present in my specimens. Spicule 65 mm. long, thus much longer than in GEDOELST's male.

The lips are rather high. When seen from the front they present a shallow emargination at the anterior border, distinctly longer than broad. At its base, on the internal border, next to the oral opening, the lip exhibits a crenulated margin. The pulpa is rather massive and prolonged anteriorly

into 2 flat horns, 1 at each side of the median indentation. At their exterior border the lips rest with a broad base on the body. Auricles obtusely rounded. Denticles of dentigerous ridges minute. Subventral lips with one papilla each on the ventral side and a very minute amphidial opening, which is not readily visible, and to be found only by careful search.

Oesophagus trifurcate, the ends of the branches often distinctly visible between the auricles.

2. — **Polydelphis quadricornis** (WEDL)

(Figs. 11-19.)

3 ♀ ♀, 1 ♂, from intestine of *Python sebae* (GMEL.), N° 290, Rutshuru, 1,285 m., 9-XII-1933.

1 ♀, from intestine of *Leptodira duchesnii* BOULENGER, N° 1097, molindi, between Kirumba and Lake Kibuga, 14-V-1934.

1 ♀, 1 ♂, 1 juv., from intestine of *Naja nigricollis* REINH., N° 304, Kaluga, 1,082 m., XII-1934.

1 ♀, from intestine of *Bitis gabonica* (DUM. and BIBR.), N° 2421, Rutshuru, 30-X-1934.

32 ♀ ♀, 22 ♂ ♂, from intestine of *Bitis arietans* (MERR.), N° 2544, Rwindi, 1,000 m., 20-XI-1934.

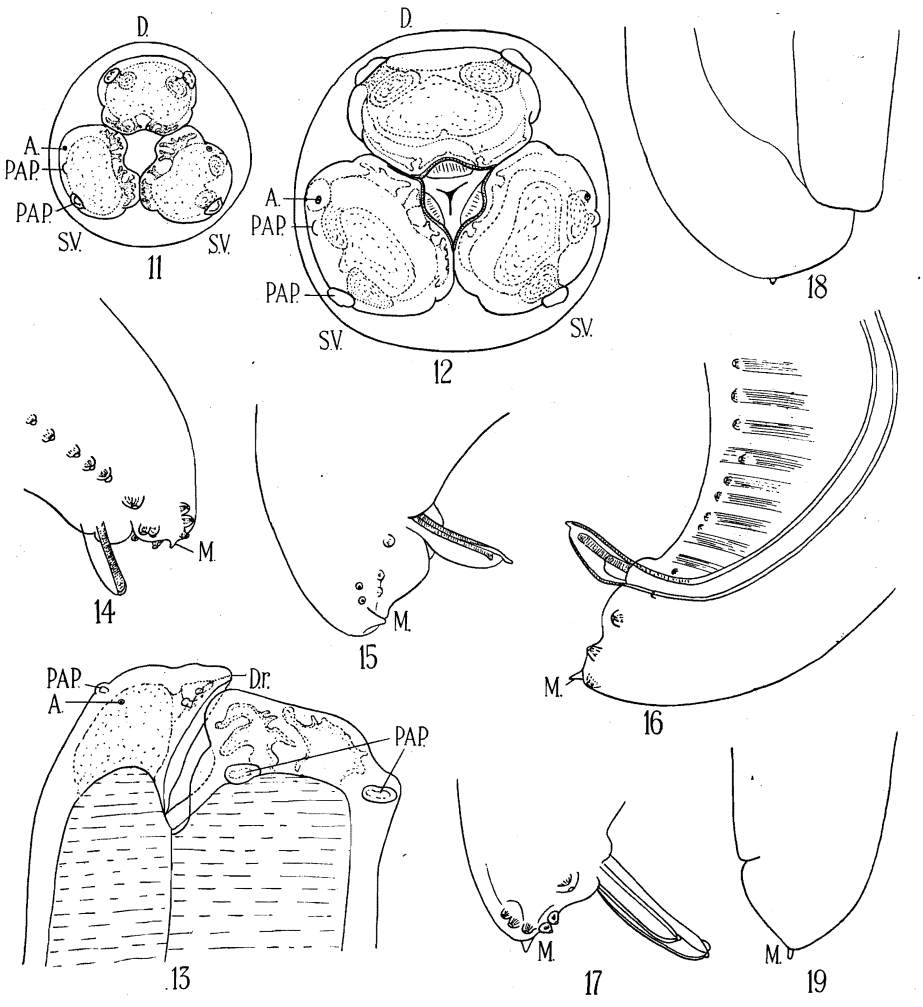
1 ♀, from intestine of *Bitis arietans* (MERR.), N° 2544, Rwindi, idem.

12 ♀ ♀, 2 ♂ ♂, from intestine of *Bitis arietans* (MERR.), N° 3951, Tshambi, 975 m., VI-1935.

As hosts for this species BAYLIS noted *Naja baje*, *Naja nigricollis*, *Bitis arietans*, *Pseudaspis cana*, *Crotalus* sp.

I have measured some specimens which have the following dimensions. Females 16 cm., width 2 mm.; vulva at 6.7 cm. from anterior end, or at 41.8 % of total body-length; vagina 6 mm.; common portion of uterus 2 mm., then branching into 6 horns. In a young female of 46 mm. the vulva was situated 22 mm. from the anterior end, or slightly in fronut of the middle. Males : 116 mm., width 1.3 mm.; 116 mm., width 1.3 mm.; 100 mm., width 2 mm.

There are 50 preanal papillae in the male. Seen from in front the lips are very typical, very much like those of *Polydelphis anoura*, but readily distinguished from that species by the polyphyllous branching of the horns, projecting in front of the pulpa inside the lips near the fore-border. On each lip there are two groups of projections, each consisting of a narrow stalk, split up at its tip into a small number of fine branches, and a broader stalk bearing at its tip numerous branches rising from a common base. Between the main stalk and the adventitious stalk there is a distinct circular white gap. The base of the lips not crenulated on the inside as in *P. anoura*. Dentigerous ridges with minute denticles. Lips more quadrangular than in *anoura*. Amphids easily discernible, almost on a level with the papillae. An interesting feature which I found in this species is the presence of lateroventral papillae on the subventral lips, apart from the ventroventrals.



Polydelphis quadricornis (WEDL).

FIG. 11. — Male head, top view (from *Bitis arietans*) lettering as in Plate I, lateral projections of pulpa more in detail.

FIG. 12. — Male head, top view (from *Bitis arietans*).

FIG. 13. — Male head, lateral view (from *Bitis arietans*), D. r. = dentigerous ridge.

FIG. 14. — Male tail, lateral view (from *Naja*).

FIG. 15-17. — Male tails (from *Bitis arietans*).

FIG. 18. — Female tail (from *Bitis arietans*).

FIG. 19. — Idem from young female out of *Bitis gabonica*.

Distribution of the head-papillae as usual. Anterior border of lips more distinctly emarginate than in *anoura*.

Female tail obtusely rounded, short, with a very short rounded terminal spike. Length of vagina 6.7 mm. Male tail with a short, terminal, acutely-tipped spike, surrounded by 5 pairs of papillae, 2 ventral and 3 lateral, of which one is minute and not easily discernible, whereas a sixth pair of large papillae is found on the prominent lips of the cloaca. 49-50 pairs of preanal papillae. Length of oesophagus 6 mm., or 1/19 of total body-length, in a male of 116 mm. This agrees with the findings of BAYLIS, who gave 1/26 to 1/28 of the total body-length. The species is apparently common in various species of snakes of which *Python sebae*, *Leptodira duchesnii*, and *Bitis gabonica* are new hosts.

Genus **OPHIDASCARIS** BAYLIS, 1921.

This genus is represented in the material at hand by several species. The differences between them are quite obvious in most instances, yet they are not easy to identify. for we lack sufficient illustrations of even the most common species.

3. — **Ophidascaris intorta** GEDOELST

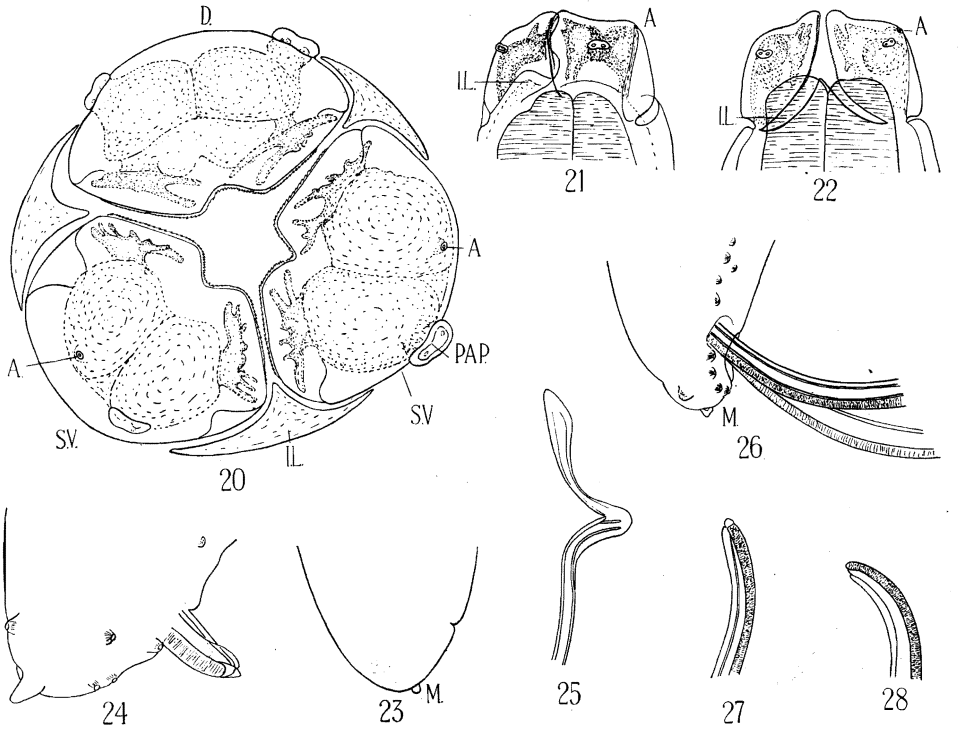
(Figs. 20-28.)

4 ♀♀, 2 ♂♂, from intestine of *Bitis gabonica* (DUM. and BIBR.), N° 2421, Rutshuru, 1,285 m., 30-X-1934.

This species of *Ophidascaris* was based on a number of unripe females from a species of *Bitis*. As one of its most characteristic features, GEDOELST stated that the vulva is found in front of the anterior third of the body. This sentence should apparently be read as : at about the anterior third of the body-length. This feature has given me the clue to the identification of the present species, in which the vulva is situated at 36 % of the body-length, reckoned from the anterior end.

The female I measured had body-length 250 mm., width 2 mm., length of oesophagus 7 mm. Length of male 200 mm., width 1.5 mm.; spicula unequal, one of them measuring 2 mm., the other only 0.8 mm. Number of preanal papillae 41-45.

Female tail, as well as that of male, circular in outline with a distinct mucron, this being distinctly longer in the male than in the female, and rounded at the tip in both sexes. In the male there are 5 pairs of postanal papillae. One pair of rather prominent papillae is situated on the dorsal side in the other male studied by me, one of the 4 subventral papillae has shifted to the lateral side. Spicules ending with a whitish knob; distally one of them presents a notch, whereas the proximal end of the other is cupshaped as in the next species.



Ophidascaris intorta (GEDOELST).

FIG. 20. — Female head, top view with interlabia I. L.
FIG. 21-22. — Female head seen from the sides.
FIG. 23. — Female tail.
FIG. 24. — Male tail, 25 proximal end of the shorter spicule of the same.
FIG. 26. — Male tail of another male, 27, 28 the distal ends of both spicules.

Head with lips marked off by long marginal grooves, as in *Ophidascaris excavata* HSUE and HOEPPLI and *Ophidascaris baylisi* ROBINSON. The ventral angles of the subventral lips project distinctly. The interlabia are distinct, not high, but pointed at their tips. From the front view, the structure of the papillae and the pulpa may be studied distinctly. The upper margins of the lips are sharply emarginate. Dentigerous ridges obvious, pulpa of each lip with two lateral projections which are very characteristic. These projections are connected with the basal pulpa of the lip by a broad base. The projections are digitate, two of the finger-like branches, particularly on the dorsal lip, pointing towards the median excavation of the anterior border of the lip. The other digitiform projections rise perpendicularly on the border of the lip, or are even directed toward the interlabia. Projections on the dorsal lip less branched than those on the subventral lips. Auricles indistinct, rather sharply pointed. Papillae as usual. Amphids prominent, on a higher level than the papillae.

4. — **Ophidascaris amucronata** n. sp.

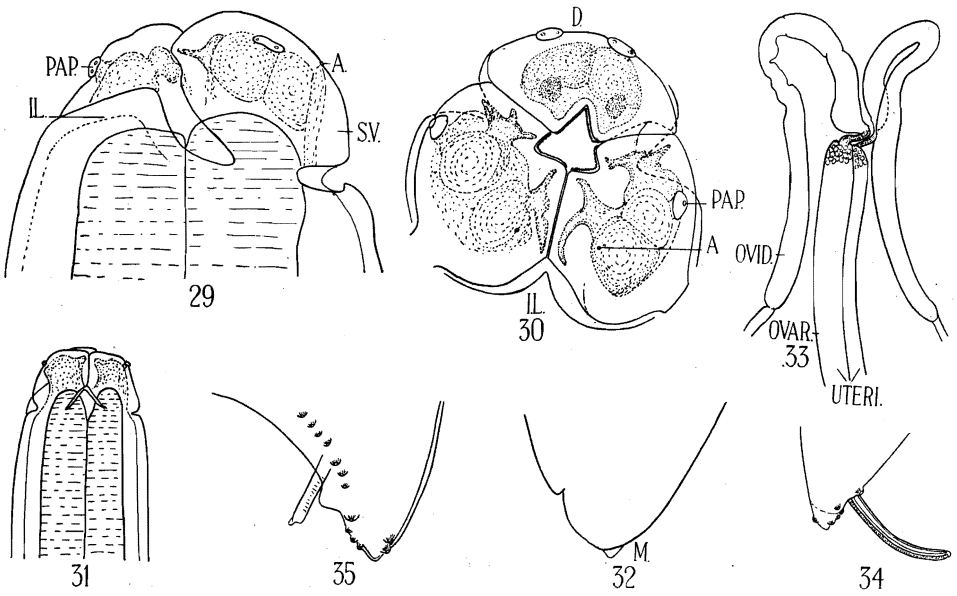
(Figs. 29-35.)

7 ♀♀, 7 ♂♂, from *Python sebae* (GMEL.), N° 1295, Rutshuru, 1,285 m., 29-V-1934.
2 ♂♂, from *Bitis arietans* (MERR.), N° 2544, Rwindi, 1,000 m., 20-XI-34.

This new species may be distinguished from the nearly related *Ophidascaris radiosa* (SCHNEIDER), described below, by the absence of a distinct mucron at the apex of the male tail. The tail of the female is bluntly triangular. From the allied *Ophidascaris filaria* it may be distinguished by the arrangement of the postanal papillae and by the lesser number of preanal papillae — about 40 in *filaria* and not more than 23 in *amucronata*.

Dimensions of some of the specimens :

♀, length 190 mm., width 2.5 mm.
♀, lenght 150 mm., width 1.5 mm., vulva 50 mm. from posterior end (66 %).
♀, length 136 mm., width ?, vulva 40 mm. from posterior end (70.6 %).
♂, length 149 mm., width 1 mm., oesophagus 8 mm. long.



Ophidascaris amucronata n. sp.

FIG. 29. — Female head, side view, I. L. = interlabia.
FIG. 30. — Female head oblique top view,
FIG. 31. — Male head, side view.
FIG. 32. — Female tail.
FIG. 33. — ♀, genital apparatus with ovar. = ovaries, ovid. = oviduct, and uteri.
FIG. 34-35. — Two male tails.

In the males there are 21-23 preanal papillae, not quite in a single row, but more zigzag, so that here and there they give the impression of a double row.

Lips more deeply excavated than in *Ophidascaris intorta*, the marginal grooves in general deeper and more prolonged than in *intorta*. The lips are rather low and broad, resting on a narrow base. Auricles indistinct, broadly rounded. Interlabia rounded at the tip. Lateral projections of the pulpa of the lips irregularly digitate, the digiti few, not branched as in *intorta*. These projections were not seen on the dorsal lip, where the papillae are nearer the middle than in the other species. Subventral lips with papillae and very minute, rather indistinct amphids, not much higher than the papillae. Dentigerous ridges prominent. Uteri convergent, separated from the comparatively wide oviducts by muscular constrictions. Female tail almost circular in outline, with a triangular, bluntly rounded mucron. Male tail obtusely rounded, without distinct mucron. The pairs of postanal papillae are 6 in number : 3 subventral, almost contiguous and in a row; 2 lateral contiguous papillae nearer to the dorsal side; and a sixth papilla, much larger, just posterior to the lower lip of the cloacal aperture. Apex of the spicula with a fine point. In one of the other males there is a seventh postanal papilla outside the row of three papillae.

5. — **Ophidascaris radiosa** (SCHNEIDER)

(Figs. 36-41.)

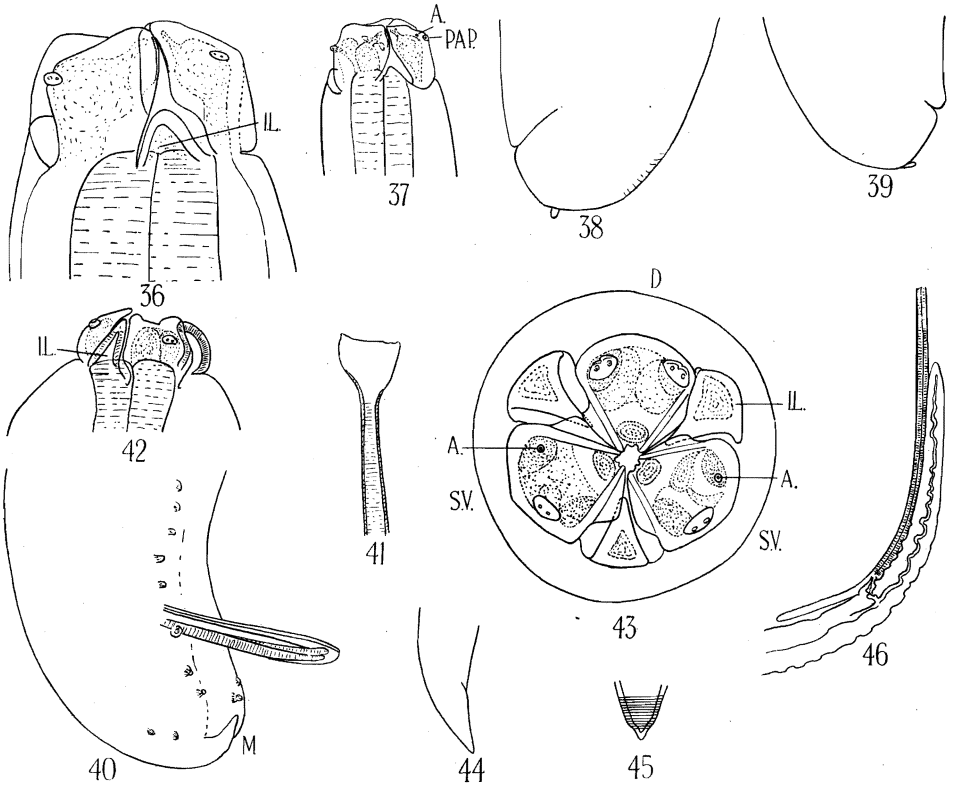
12 ♀ ♀, 1 ♂, from *Bitis gabonica* (DUM. and BIBR.), N° 2421, Ruthshuru, 30-X-1934.

The present specimens are referred to this species with some doubt. I am not quite sure that the specimen identified by BAYLIS as *O. radiosa* agreed in the shape of the lateral projections of the pulpa of the lips with SCHNEIDER's figure, which apparently was accurate. In other respects SCHNEIDER's description is so short that it will always be rather difficult to interpret, although we may be rather sure that it was a species of the genus *Ophidascaris*. Finally there is a difficulty as regards the host cited by him, *Echidna rhinocerotis* SCHLEGEL.

I have separated these specimens from those placed under *O. amucronata*, with which they show many points of agreement, because there is a very distinct terminal mucron in the male sex, as well as the female. The number of preanal papillae could not be determined accurately, but is somewhere between 15 and 18, as far as I was able to find out.

One of the females gave the following measurements : length 13.6 cm., width 0.8 mm., vulva 33 mm. from posterior end (79.4 %). Length of male 10.8 cm., width 1 mm. BAYLIS's female measured 107 mm. × 0.85 mm.; vulva situated in posterior third at 70 %.

My specimens agree with that of BAYLIS in having the dorsal lip rather square, whereas the subventral lips show prominent projections of their



Ophidascaris radiosa (SCHNEIDER) ?

FIG. 36. — Female head side view, 37 idem with the amphids.
FIG. 38-39. — Female tails.
FIG. 40. — Male tail.
FIG. 41. — Proximal end of spicula.

Contracaecum microcephalum (RUD).

FIG. 42. — Female head side view.
FIG. 43. — Female head top view.
FIG. 44-45. — Tips of female tails.
FIG. 46. — Intestine with intestinal caecum and oesophageal diverticulum.

ventrolateral sides. The lateral projections of the pulpa do not rise directly as filiform threads from the core of the lip, but are connected with a broad-based lobe, more as in *amucronata*. They show a closer resemblance with the figure of SCHNEIDER than with that of BAYLIS. Dentigerous ridges, as SCHNEIDER stated, at some distance from the edge of the lip. Base of lips with well marked grooves, which however are not such deep running incisions as in the figure of BAYLIS. Interlabia short with rounded edges.

Labial papillae as usual; amphids at a level with the papillae. Tail circular in outline, with distinct mucron in both male and female.

In the subventral region of the male there are 2 papillae, as in the figure of SCHNEIDER, and also two other papillae on the lateral border, rather difficult to see.

Family HETEROCHEILIDAE

Subfamily ANISAKINAE

6. — **Contracaecum microcephalum** (RUDOLPHI)

(Figs. 42-46.)

5 ♀ ♀, from stomach of *Nycticorax nycticorax* (L.), N° 273. Locality.

Three of the females were 20, 21, and 28 mm. long.

The same species was studied and described by GEDOELST under the name *Kathleena arcuata* GEDOELST from the stomach of a bird identified only as « grand héron bleu-gris », at Leopoldville.

YORKE and MAPLESTONE mentioned the latter species as a synonym of *Contracaecum microcephalum*, and this is undoubtedly true. MÖNNIG however considers *Contracaecum arcuatum* (GEDOELST) as a synonym of *C. spiculigerum* RUD. That it belongs in the genus *Contracaecum* is easily determined by the study of its alimentary canal (Fig. 46), which is typical. In combination with the interlabia and the absence of dentigerous ridges, this makes generic identification easy enough.

GEDOELST gave a rather extended description of the species, especially of the male. In asmuch as my study has provided some new and important details, concerning especially the structure of the head, I am able to give a redescription of these parts. This is necessary for a better understanding of the head-structure.

As GEDOELST stated correctly, the whole lip-complex — there are 3 lips and 3 interlabia is twice as broad as long. This so-called head is 5/8 times as wide as the body posterior to the head. The interlabia were described by GEDOELST as possessing a free portion, curving inward, its tip bearing a shallow incision. Despite careful search, I was unable to observe this incision, which, moreover, is not conspicuous in Gedoelst's Figure 2*a*. It may of course have escaped my attention, since the tips of the intermediate lips are generally covered by the lateral flanges of the principal lips, as shown in Fig. 43. Seen from the side, the interlabia have the same shape and the same thick, transversely striated linings visible in GEDOELST's Figure 2*b*. In top view the tips of the interlabia do not exceed 2/3 of the length of the main lips. The latter, three in number as in all Ascarids, are broad near the base. Along each side a thick cuticular lining

runs upward to the tip, where it projects slightly as a cuticular bar. Thus the anterior border of each lip is trisinuate. The oral opening is formed by the combined sinuate slits of the upper end of the three lips. This figure deviates slightly again from GEDOELST'S figure, where no median crests are to be seen in Figure 2*a*, depicting the head in top view. The lateral flanges mentioned above are attached to the longitudinal bar-like structures lining the lips on both sides. The flanges of adjacent lips mostly meet, and thus cover the tips of the interlabia. The main lips, 2 subventral and one subdorsal, possess a pulpa subdivided into two regions. The uppermost, more or less bean-shaped portion is separated from the basal portion by a transverse bar, correctly figured in GEDOELST'S Figure 2*a*. The cephalic sense-organs are located at the lower end of this basal portion of the pulpa, the dorsal lip presenting 2 double papillae, whereas each subventral lip has one double papilla, placed asymmetrically, and an amphid.

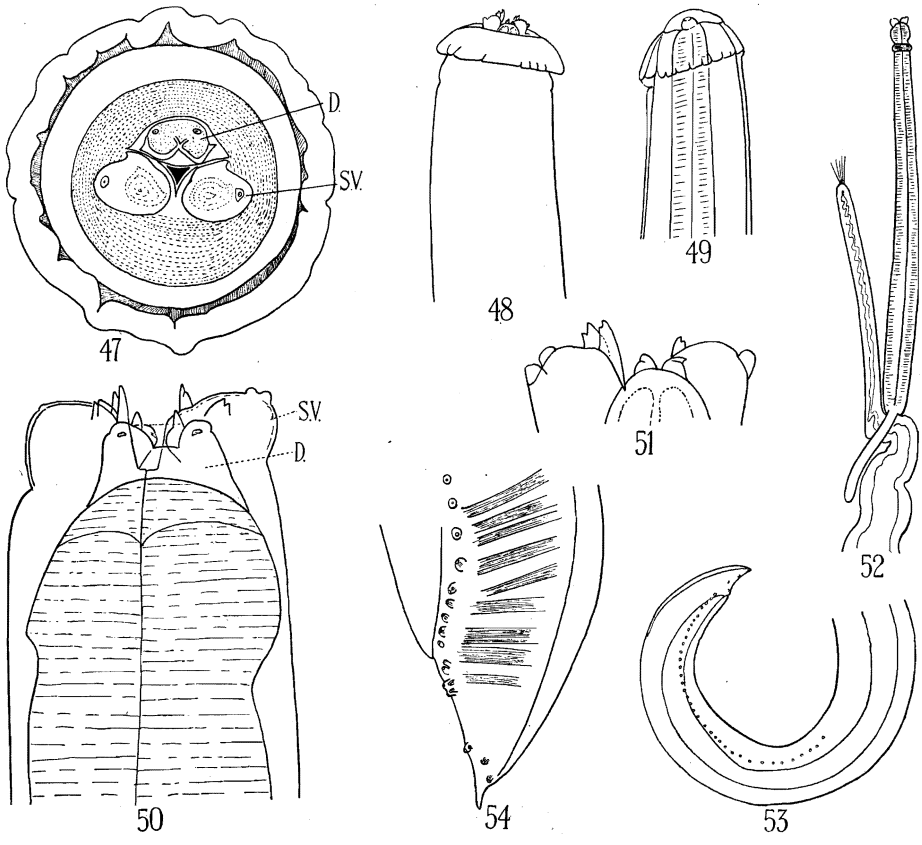
In the subventral view of Figure 42 the amphid is not depicted, but here the bases of the flanges are to be seen distinctly as projections at the upper end of the basal portion of the pulpa. The tail of the females mentioned above was short and conical.

7. — **Cloeoascaris spinicollis** BAYLIS

(Figs. 47-54.)

22 ♀ ♀ and 16 ♂ ♂ from the stomach of *Cercopithecus leucampyx kandti* MATSCHIE, 46.

A female measured 30 mm. and was 1 mm. broad, whereas a male measured 35 mm. × 0.8 mm. The latter was thus distinctly slenderer than the female. The genus *Cloeoascaris* may be distinguished at once by its cervical collar, which bears distinct though shallow incisions at its lower end. The lips project in front of the collar, and in front of the lips are to be seen the characteristic teeth, most of them bicuspid. The dorsal lip has a single undivided tooth at each side of the median line. On the subventral lips are a long bicuspid and a short, similarly bicuspid tooth with rounded median edges. As seen from the top the head may be compared with a wide caldera of a volcano, the collar forming the caldera wall. In the center of the caldera the secondary crater arises, in the form of the oral cone formed by the three lips, which surround the oral pit. In the space between the cervical collar and the lips minute spines are found. The subventral lips are more or less oval, each bearing a papilla, and with a lateral flange on the side with which it touches the dorsal lip. Dorsal lip with 2 papillae and 2 flaps directed toward the oral opening. The intestinal tract of one of the specimens, which I have prepared, has, just as in *Contracaecum*, an oesophageal appendix as welle as an intestinal caecum.



Cloeoascaris spinicollis BAYLIS.

FIG. 47. — Female head in top view.

FIG. 48. — Female head in side view.

FIG. 49. — Male head in side view.

FIG. 50. — Optical section trough female head with denticles on dorsal and subventral lips.

FIG. 51. — Distribution of denticles.

FIG. 52. — Female intestine with oesophagus, oesophageal diverticle and intestinal caecum.

FIG. 53-54. — Male tails.

In the male I found 36 preanal papillae. Slightly posterior to the anal opening there is a rather large double papilla, and between this papilla and the acute tip of the tail 3 pairs of smaller papillae. *Cloeoascaris spinicollis* was found by BAYLIS in *Lutra* sp. and *Atylax* sp.

Subfamily CROSSOPHORINAE

8. — **Crossophorus collaris** HEMPRICH and EHRENBERG

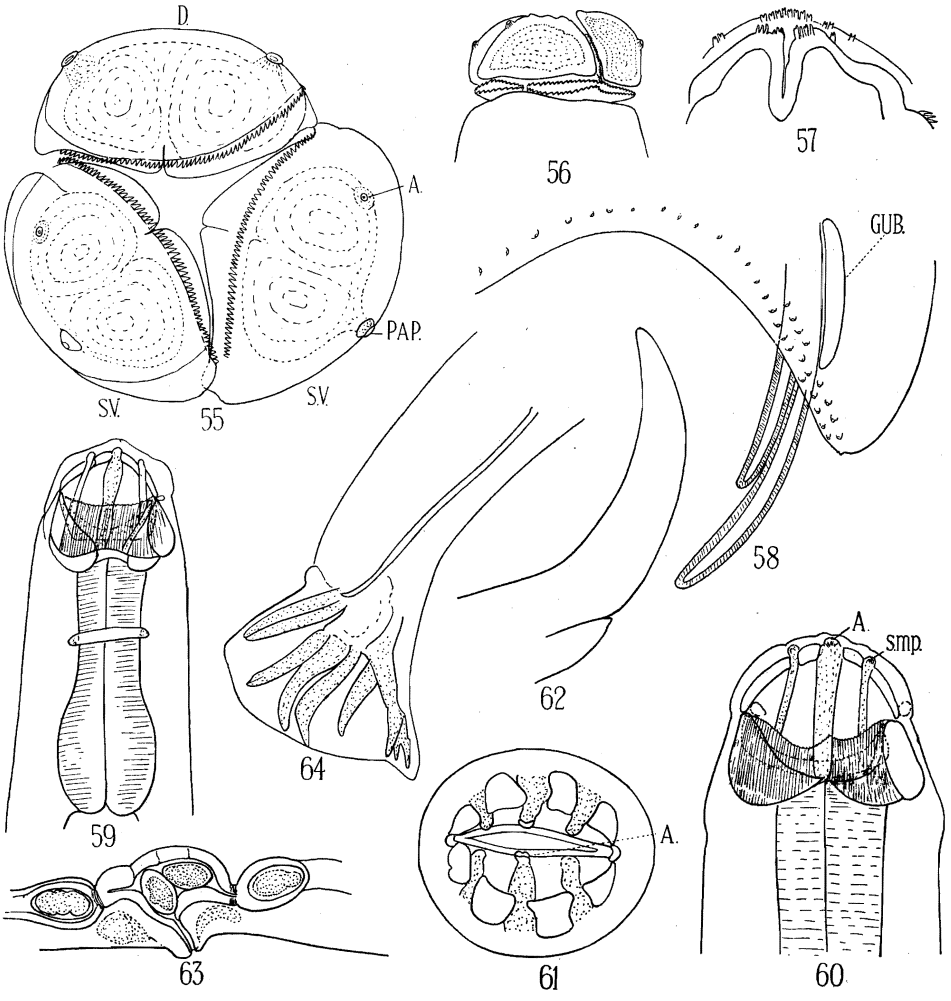
(Figs. 55-58.)

21 ♀♀, 3 ♂♂, from *Dendrohyrax*, N° 83, Nayrusambo, 2,000 m., 29-VI-1934.
8 ♀♀, 3 ♂♂, from *Dendrohyrax*, N° 84, Nayrusambo, 29-VI-1934.
7 ♀♀, 8 ♂♂, from *Dendrohyrax*, N° 107, Nayrusambo, 2-VII-1934.
29 ♀♀, 16 ♂♂, from *Dendrohyrax*, N° 85, Mushomangabo (Volc. Nyamuregira), 2,075 m., 2-VII-1934.
30 ♀♀, 18 ♂♂, from *Dendrohyrax*, N° 86, Mushomangabo, 2-VII-1934.
53 ♀♀, 45 ♂♂, 1 juv., from *Dendrohyrax*, N° 87, Mushomangabo, 2-VII-1934.
3 ♀♀, from *Dendrohyrax*, N° 113, Bitashimwa, 1,950 m., 2-VIII-1934.
13 ♀♀, 9 ♂♂, from *Dendrohyrax*, N° 117, Birambi, foot of mt. Mushavura (Ruanda), 2,325 m., 2-VIII-1934.
14 ♀♀, 8 ♂♂, from *Dendrohyrax*, 181, Bishakishaki, 2,100 m., Kamatembe River.

The hosts of all these specimens — 178 ♀♀, 110 ♂♂, and 1 juv. — were Thyraxes of one race, *D. arborens adolfi-friederici* BRAUER.

Crossophorus collaris may be recognized at once by the double row of fimbriae projecting from a constriction of the body at the base of the lips. The upper row passes around the base of each lip on its inner surface and runs along the edge of the interior oral opening. As seen from the top the lips do not bear two papillae each, as YORKE and MAPLESTONE stated. The arrangement of the cephalic senseorgans is just as in other ascarids. The dorsal lip has two papillae, whereas both subventral lips have only one papilla each. The so-called second papilla must apparently be considered an amphid, which is much smaller than the double papilla situated at the other end of the lip. Seen from the top the lips have the outline, more or less, of half-moons, especially the subventral lips. Toward the center of the head they are distinctly fleshy, with a bifurcate pulpa, both branches parallel and blunt at ends. The incision a the upper end is both narrow and shallow. Toward the sides the lips broaden to pointed flaps. Dentigerous ridges present but interrupted, the separate parts found at the tops of each side of the incision and near the base. Thus the combs are symmetrically placed.

Except for the confusion between papillae and amphids on the subventral lips, our specimens agree rather well with the description given by BAYLIS for the same species, based on material collected at Dodoma in Tanganyika Territory, from *Procavia* sp. MÖNNIG has given also a rather extensive description of the same species taken from *Procavia capensis*. Transvaal.



Crossophorus collaris HEMPRICH and EHRENBERG.

FIG. 55. — Male head in top view.
FIG. 56. — Female head in side view.
FIG. 57. — Upper border of lip with « combs ».
FIG. 58. — Male tail gith gubernaculum (gub.).

Kalicephalus obliquus (DAUBNEY).

FIG. 59. — Female head in side view.
FIG. 60. — Male head in side view, sm. p. = submedian papilla.
FIG. 61. — Female head in top view.
FIG. 62. — Female tail.
FIG. 63. — Vulva, with divergent uteri.
FIG. 65. — Male tail.

ORDER II STRONGYLOIDEA

Family DIAPHANOCEPHALIDAE

9. — **Kalicephalus obliquus** (DAUBNEY)

(Figs. 59-65.)

1 ♀, from *Bitis arietans*, N° 2951, Tshambi, 975 m., VI-1935.

1 ♂, from *Leptodira duchesnii* BOULENGER, N° 1097, Molindi (riv.) Kirumba-Lake Kibuga, (Figs. 66-73.)

ORTLEPP's specimen come from *Bitis gabonica*, South Africa. DAUBNEY's type was obtained from the same host.

The female listed above had the following dimensions : length 8.66 mm., width 0.28 mm.

FILIPJEV's formula :

	Mouth capsule.				
0	160	500	5500	8260	8.66 mm. V = 63.5 %.
160		260	280	100	

The male measured : length 6.22 mm., maximal width 0.20 mm. :

FILIPJEV's formula :

0	100	420	M	6020	6.22 mm.
120		160	200	180	

Female and male are both smaller than the type specimens described by DAUBNEY, but fall within the range of variation of specimens tentatively referred to this same species by ORTLEPP, which came from a colubrine snake of Northern Nigeria. ORTLEPP's females varied in length from 7.5 to 15 mm., with a maximum thichness of 0.55 mm.; and his males were 6 to 11 mm. long, with maximum thickness 0.28 mm. I am quite sure that ORTLEPP's specimens and mine are conspecific. According to DAUBNEY the head shows a very pronounced tilt toward the dorsal side, which as shown by DAUBNEY's Plate III, fig. 6, is due to the curvature of the median lateral ribs supporting the buccal cavity. When this rib is not curved, as in te case of DAUBNEY's female — due probably to the influence of the fixative — the tilt will not be visible, as with the present specimen.

In the species of the genus *Kalicephalus* there is a very strong framework supporting the buccal capsule at both sides, strengthened by longitudinal bars serving as guides to the nerves and the parenchyma ending in the circumoral papillae. The chitinous ledge is perforated at the spots where

the parenchymatous strands pass through it. Basal half of buccal capsule strengthened on dorsal and ventral sides. Laterally its cuticularisation is striated longitudinally. The duct of the dorsal oesophageal gland opens at the brink of the caudal half of the capsule. Oral opening a transverse slit. The amphids are surrounded by cuticularized caps, and thus easy to distinguish from the 4 submedian papillae. Capsule of male head relatively broader than that of female. Vulva somewhat behind the middle of the body, leading into a thick-walled genital atrium, the lumen of which can be closed off at each side from the uterine branches by means of a sphincter. Vulvar papillae prominent.

The female tail was said to be acutely conical by DAUBNEY, who did not figure it. In the present female I should call it elongate conical, tapering gently to the tip.

Male with typical caudal bursa. Dorsal ray trifurcate at ist tip, with a thicker and comparatively long externo-dorsal branch at the base; lateral ray tripartite to the base; externo-lateral ray curved ventrally. Ventral ray bipartite, not reaching to the borders of the bursa. Spicules 0.55 mm. long.

ORDER III SPIRUROIDEA

Family THELAZIIDEA

10. — **Thelazia depressa** BAYLIS

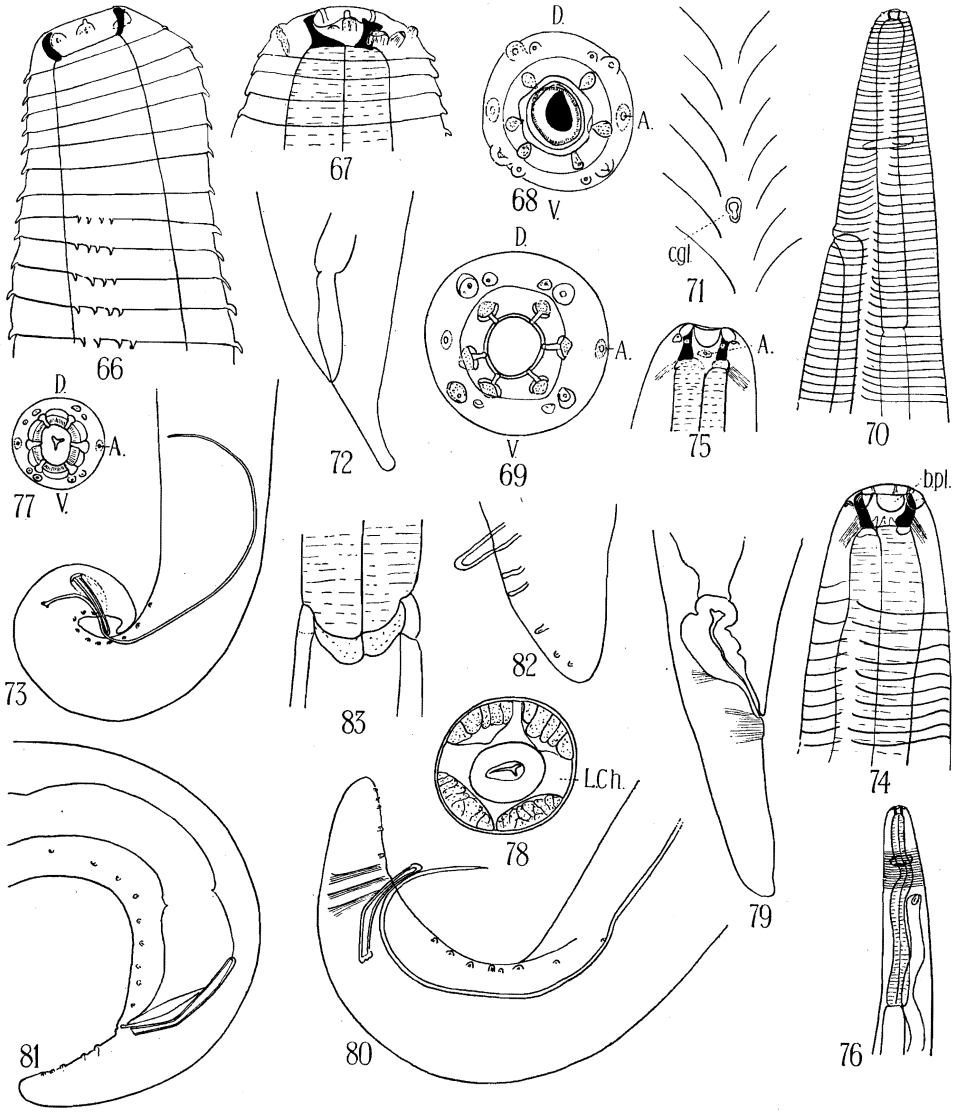
(FIGS. 66-73.)

6 ♀ ♀, 3 ♂ ♂, from the head of *Buteo rufofuscus augur* (RÜPPELL), N° 256, Mugunga (Lake), 1,500 m., 31-I--3-II-1934.

9 ♀ ♀, 6 ♂ ♂, from the eye of the same host, N° 766, Bitashimwa, 1,950 m., 4-VIII-1934.

A female measured by me was 20 mm. long, 0.7 mm. broad. A male measured 16 mm. × 0.7 mm.

The cuticle of this species in rather characteristic, roughly ringed. The rings are provided with a single row of teeth, directed backward and projecting distinctty at the sides. Lateral fields clearly delimited by a narrow interruption of the rings, which turn upward just here. In these lateral fields the cervical glands open, surrounded by 8-shaped rings. The body tapers slightly in front; and the tail in both sexes is rather short, conical at its base. It soon tapers to a prolonged point, with slight swelling at tip. The male shows two very unequal spicula, one serving as a gubernaculum for the other. Gubernaculum nail-shaped, straight, pointed at tip, hardly more than 1 ½ times as long as anal diameter, and surrounded by strong musculature. The second spiculum is very slender, 11 times as long as anal diameter. 10 pairs of preanal papillae observed, but no postanal.



Thelazia depressa BAYLIS.

FIG. 66. — Male head, side view.
FIG. 67. — Female head, side view.
FIG. 68. — Female head, top view.
FIG. 69. — Male head, top view.
FIG. 70. — Anterior portion of female body.
FIG. 71. — Cervical gland of female (c. gl.).
FIG. 72. — Female tail.
FIG. 73. — Male taile.

Thelazia digiticaudata n. sp.

FIG. 74. — Male head, side view, b. pl., buccal plates.
FIG. 75. — Idem with distinct amphids.
FIG. 76. — Anterior portion of female body.
FIG. 77. — Male head, top view.
FIG. 78. — Male, optical section through oesophagus.
FIG. 79. — Female tail.
FIG. 80-82. — Male tails.
FIG. 83. — Junction of oesophagus and intestine.

Vulva near the posterior end of the muscular portion of oesophagus. Head bluntly rounded anteriorly; oral opening terminal surrounded by a strong chitinous ring, through which the papillae of the inner circle project to the outer rim. From the top one looks right into the opening of the muscular oesophagus, its lumen being almost circular.

Papillae of the exterior circle 8 in number, the ventroventrals as well as the dorsodorsals distinctly larger and slightty more to the rear than the laterodorsals and lateroventrals. The arrangement shows distinctly that the exterior circle is really the result of the fusion of two crowns of papillae, as explained in my introduction. Amphids distinct, papilla-like.

Thelazia depressa was first described by BAYLIS from males and females taken from *Mungos fasciatus* at Morogoro, Tanganyika Territory. In size our specimens agree fairly well with those of BAYLIS, since his male measured 14 mm., and his female 21 mm. However, BAYLIS did not interpret the papillae correctly, for he said that 2 of them (apparently the amphids) were lateral, and 4 submedian, the latter being apparently double papillae. Their true nature escaped him because be did not decapitate a specimen.

The shape of the tail in BAYLIS's specimens leaves no doubt as to the specific agreement of my material. Yet he gave a different arrangement of preanal and postanal papillae.

There are, as he says, about 15 pairs : four postanal, close together; one pair adanal; and about 10 preanal, in regular series. Immediately in front of the cloaca, according to BAYLIS, there is an unpaired ventral papilla. I could only observe the 10 preanal papillae.

Thelazia depressa was also mentioned by BAYLIS (1934) from *Necrosyrtes monachus* in Tanganyika Territory, and be had a number of additional examples from the orbital cavity of *Sarcogyps calvus* from Chiengmai, Siam. Thus this species appears to have a wide geographic distribution.

11. — **Thelazia digiticaudata** new species

(Figs. 74-83.)

4 ♂♂, 2 ♀♀, from the eye of *Halcyon chelicuti* (STANLEY), N° 575, Molindi, 1,000 m., between Molindi and Lake Kibuga, 10-V-1934.

From *T. depressa* this species may be distinguished at once by the fact that its skin is much less roughly ringed and lacks the large spines, although the annulation is similarly interrupted in the lateral fields. The tail is likewise diagnostic, finger-shaped and blunt in the female, and more or less conical in the male, which has postanal papillae. Length of a male : 8.5 mm.; a female measures 11.5 mm. × 0.5 mm. Vulva in the female just posterior to the cervical glands, which again open just posterior to the nerve-ring.

Oral opening strengthened by a thick chitinous ring, prolongated on the external surface of the head by 6 chitinous plates, bordered at each side

by a papilla of the inner circle. Papillae of the exterior circle 8 in number, the partners of each couple almost on a level, differing little in size. Here again the dorsodorsals and the ventroventrals are slightly larger than the dorsolaterals and the ventrolaterals, the partners of each couple approaching each other. Opening of the oesophagus tripartite. Amphids distinct. Buccal capsule short, its walls parallel, not diverging as in *T. depressa*. Male tail with 5 pairs of postanal papillae in two groups, a proximal group of 2 longstalked papillae and a distal group of 3 pairs of rather fine papillae. Preanally 8 or 9 pairs of papillae are to be found. Gubernaculum short, bluntly pointed at the end, not straight but edged. Spiculum at least 8 times as long as the anal diameter, slender, and finely pointed at tip..

The present species shows a great resemblance to *Thelazia campanulata* (MOLIN), from which it differs in the following particulars (1). It is smaller, the female of *campanulata* measuring, according to TRAVASSOS, 23 × 0.6 mm., the male 17 × 0.4 mm. (2). The buccal cavity in *digiticaudata* has parallel sides, whereas the walls are distinctly divergent in *campanulata* (3). The female tail tapers distinctly in *campanulata*, while preserving almost the same width throughout in the present species (4). The number of pre- and postanal papillae is different in the male. *T. campanulata* has the same two groups of postanal papillae, but its caudal group consists of 2 pairs only. In the preanal region of *campanulata* there are not more than 7 pairs (5). The gubernaculum is evenly curved in *campanulata*, not hooked as in *digiticaudata*.

Zoogeographically, I think that the type localities are too far apart, in in the Congo and in Brazil, for their identity to be possible.

In passing, I may express my surprise that even in recent publications, with the exception of that by CHITWOOD and WEHR, authors continue to write that there are 4 submedian and 2 lateral cephalic papillaa. This we read in the paper by TRAWASSOS, the monograph of YORKE and MAPLESTONE, and that of CRAM on bird parasites. It is almost incomprehensible that no one has realized that there are 4 pairs of submedian papillae, except CHITWOOD and WEHR, and finally BAYLIS, who remarked that the 4 submedian papillae in *T. depressa* were apparently double. That the amphids were taken for lateral papillae in a minor error.

12. — **Oxyspirura wittei** new species

(Figs. 84-87.)

2 ♀ ♀, from the orbital cavity of *Dioptrornis tornensis* (HARTERTJ, N° 391, Molindi, 1,000 m., between Kirumba and Lake Kibuga, 10-V-1934.

Length of females 6.5 and 7 mm., width of both 300 micra.

This species has a cylindrical buccal cavity with comparatively tender cuticularized sides, length of the capsule twice the width of its lumen. There are 6 inconspicuous lips, each with a distinct labial papilla, visible

only when the head is viewed from the top. 4 pairs of submedian papillae, the lateroventrals and laterodorsals distinctly smaller than dorsodorsals and ventrodorsals, and distinctly more cephalad in position. This gives an impression of how the shifting of the second crown of papillae may take place along the head in a caudal direction. Amphids distinct, with a conspicuous amphibial pouch. The vulva is situated in front of the anus at a distance of 2 ½ tot 3 anal diameters. In the vulvar sphincter 2 vulvar glands are visible. Tail conical, pointed at tip, 2 ½ to 3 times as long as anal diameter.

CRAM (1927) mentions *Oxyspirura mansoni* from the Belgian Congo, but the figures she gives of this species, after RANSOM, are rather confusing. Thus the front view of the head resembles closely that of a species of *Thelazia*, with six festoons as in *T. digiticaudata*. Comparison of the top-head views of *O. mansoni* in the figure CRAM gave and those of CHITWOOD and WEHR (figures 7*b* and 7*c*, of larva and adult respectively) shows at once that RANSOM's specimens and those of CHITWOOD and WEHR had nothing in common with regard to head-characters. In this respect my specimens agree fairly well with the larva of *Oxyspirura mansoni* as depicted by CHITWOOD and WEHR. Apparently my females are rather young.

RANSOM's figure of the female tail of *mansoni* gives the impression of extreme slenderness, much more so than in the present species. Moreover, the distance between vulva and anus in *mansoni* as depicted by RANSOM, is much greater than in my specimens. So I doubt if they are conspecific with *Oxyspirura mansoni* as described by RANSOM.

There remains the mention of *O. mansoni* from the Belgian Congo by GEDOELST (1916). I have sought in vain for references to the paper in which GEDOELST published his findings, so thus far the record seems questionable.

Subfamily ASCAROPSINAE

13. — **Streptopharagus pigmentatus** (LINSTOW)

Syn. : **Streptopharagus armatus** MÖNNIGNEC Blanc.

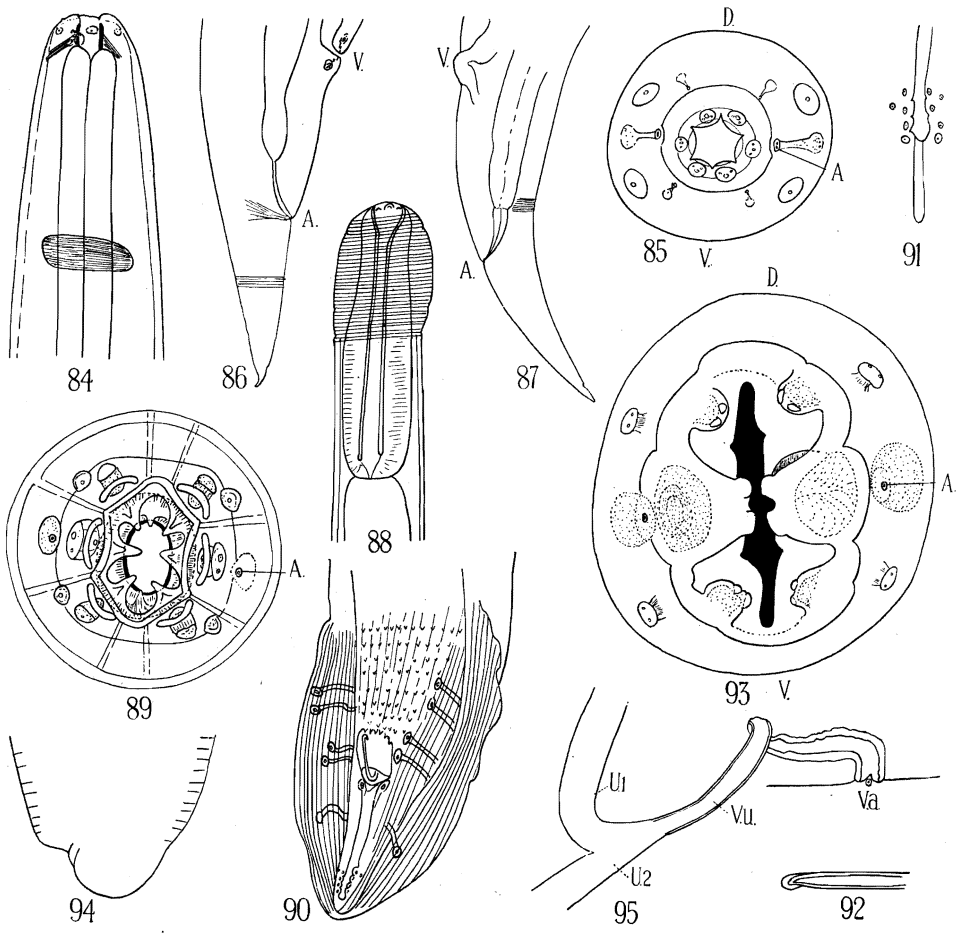
(Figs. 88-92.)

2 ♂♂, 1 ♀, from intestine of *Cercopithecus leucampyx schoutedeni* SCHWARZ, N° 185, Kamatembe, 2,200 m., 6-23-I-1935.

The males measured 27 and 28 mm. × 1 mm., the female 55 × 1.5 mm.

CHITWOOD and WEHR refer the genus *Streptopharagus* BLANC to the subfamily *Ascaropsinae* of ALICATA and MACINTOSH (1933). This subfamily, with the subfamilies *Spirocercinae*, *Thelaziinae*, and some others, they place in the family *Thelaziidae*, a classification which I think correct. In this I shall follow them.

The male cephalic portion, here depicted, is distinctly swollen and marked off by a faint constriction. Its cuticle is distinctly striated trans-



Oxyspirura wittei n. sp.

FIG. 84. — Female head, side view.
FIG. 85. — Idem, top view.
FIG. 86-87. — Female tails with anus (A.) and vagina (V.).

Streptopharagus pigmentatus (LINSTOW).

FIG. 88. — Male head, side view.
FIG. 89. — Idem, top view.
FIG. 90. — Male tail.
FIG. 91. — End of groove of bursa with small papillae.
FIG. 92. — Tip of spiculum.

Spiroxys gedoelsti n. sp.

FIG. 93. — Top view of female head.
FIG. 94. — Female tail.
FIG. 95. — Vagina (V. a.), Vulva (V. u.) and uteri (U. 1 and U. 2).

versely. Head end blunty rouded. Seen from the top the oral opening is hexangular, surrounded by 6 lobed lips, each with a single median papilla. MÖNNIG (1923) apparently oversaw the lateral labial papillae. Into the lumen of the buccal cavity pointed teeth project. 6 of them are situated just opposite the mid-line of each of the lips, whereas at a lower level 2 other teeth are to be seen, one dorsal, the other ventral. The exterior circle of head-papillae is composed of 8 elements. The dorsodorsals and ventroventrals — just as described by CHITWOOD and WEHR — are usually slightly anterior to, and smaller than the laterodorsals and lateroventrals. In my belief the laterodorsals and the ventrodorsals have shifted along the head until they lay behind the level of the ventroventrals and the dorsodorsals. Thus the genus *Streptopharagus* is a further step in the way leading from *Oxyspirura*, where the first crown of head-papillae has not yet reached the level of the second crown, through a stage represenfed by *Thelazia*. In other respects, as in the disappearance of the lips, *Thelazia* is less primitive than *Streptopharagus*; but in the latter genus the first and second crown of head-papillae have almost fused to a single crown of 8 papillae arranged in 4 pairs. The partners show traces of their origin by their unequal size. In *Streptopharagus* the first crown has reached a level posterior to that of the second crown. That is, I think, another strong argument in favour of the arrangement by CHITWOOD and WEHR, who placed the *Ascaropsinae* in close proximity to the *Thelaziinae*.

There seems to be a in *S. pigmentatus* a couple of laterolateral cephalic papillae midway between the laterolateral labial papillay and the amphids. This would be a very primitive feature indeed.

In *Streptopharagus pigmentatus* the oesophagus is lined with strong cuticularisations. I did not observe, however, the half-turn of a spiral which should be typical of this genus. Posterior portion of the muscular oesophagus distinctly swollen.

The male has a distinct bursa copulatrix, in that the tail is provided with lateral alae, which project sidewards and even surround the tip of the tail. Transverse rows of minute spines are seen in front of the cloaca. 2 spicules, a short one apparently serving as a gubernaculum for the longer spicule, the tip of the latter being sharply pointed, while that of the shorter one is blunt. There are 4 pairs of preanal stalked papillae, a couple of sessile papillae just posterior to the cloaca first seen by SANDGROUND (1933) overseen by MÖNNIG (1923), a pair of stalked papillae midway between anal opening and tip of tail, and 10 minute papillae along the borders of the ventral groove just in front of the tail-end.

Streptopharagus pigmentatus has a wide geographical distribution and was taken in various host-species. MOENING found this species, although identified as *Streptopharagus armatus* BLANC in *Cercopithecus pygerythrus* and *Papio porcarius* in Transvaal, SANDGROUND in *Cercopithecus dianae* (ex Liberia), in *G. pygerythrus* and *C. leucampyx* (ex Rhodesia), *C. albogularis* (ex Tanganyika) and *Papio porcarius* (ex Rhodesia). Recently (1933) the

same author mentions it from *Hylobates leucogenys* and *Macacus* sp. from Lei Chau. Tonkin. According to SANDGROUND (Harvard African Expedition) it occurs also in the African Primates *Papio hamadryas* and *Macacus* sp.

Family GNATHOSTOMIDAE

Subfamily SPIROXYINAE

14. — **Spiroxys gedoelsti** new species

(Figs. 93-95.)

2 ♀ ♀, from the stomach of *Bitis arietans* (MERR.), N° 1182, Ndcko Katanda, 950 m., IV-1934.

Most of the species of the genus *Spiroxys* are parasites of chelonians. Recently, however, some have been reported from other hosts, such as *S. japonica* MORISHITA in *Rana nigromaculata*, *Rana japonica*, and *Rana rugosa*; and *S. alleghaniensis* WALTON from *Cryptobranchus alleghaniensis*. My new species came from a snake, and is named in honor of the helminthologist GEDOELST, a pioneer in the study of parasites in the Belgian Congo.

These females of *S. gedoelsti* measured 33 and 35 mm., the width of the second specimen 1.5 mm. Vulva 14 mm. from caudal extremity.

The oesophagus is composed of a muscular part, 1.6 mm. long, and a glandular part 3.9 mm. long, both together measuring 5.5 mm. Genital apparatus with a comparatively long vagina and two divergent uteri. The tail is very short and obtusely rounded. The head portion is short. I have studied it only in front view, where the 3-lobed pseudolabia are to be seen distinctly. Each lobe bears 2 papillary outgrowths, those on the median lobes, which meet each other in the mid-line, being the largest. These overshadow the longitudinal oral slit. At the basis of these lobes the amphids are to be seen, situated outside the line of demarcation of the pseudolabia. The same applies to the 4 submedian papillae of double origin.

ORDER III FILARIOIDEA

Family FILARIIDAE

Subfamily DICHEILONEMATINAE

15. — **Hamatospiculum dehiscens** (SCHNEIDER)

(Figs. 91-101.)

4 ♂ ♂, 3 ♀ ♀, from under the skin of the head of *Cinnyris afer graneri* NEUMANN, N° 721, [Kabara, Mikeno, 3,200 m., 15-23-VII-1934].

In the present paper the classification of the *Filarioidea* by EVERETT WEHR (1935) is adopted. WEHR placed both *Hastospiculum* SKRJABIN and

Parhamatospiculum SKRJABIN and PETROW in the synonymy of *Hamatospiculum*. This I think is justified by a thorough comparison of CHITWOOD's excellent figures of species of *Hastopiculum*, a genus thus far believed to be confined to reptiles, with those given here of a bird-parasite like *Filaria* (*Hamatospiculum*) *dehiscens* SCHNEIDER.

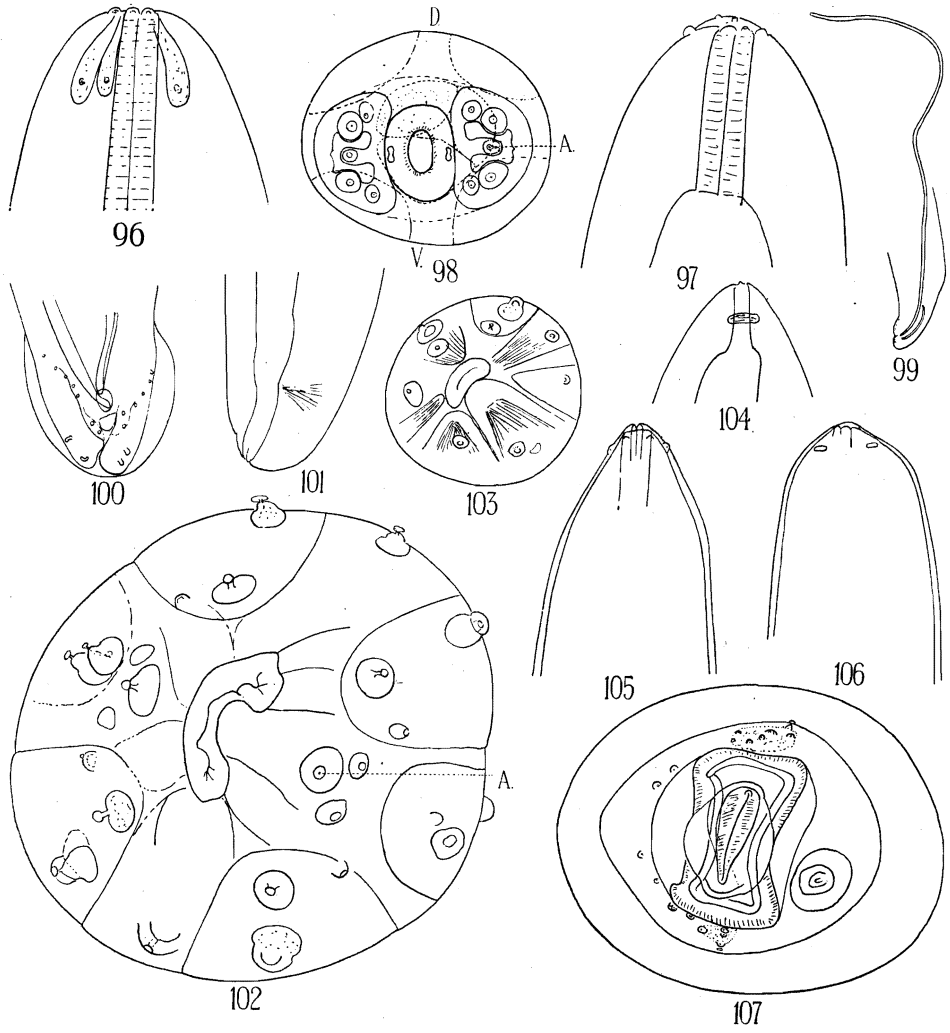
The present material exhibits very distinctly the epaulette-like structures typical of the *Dicheilonematinae*, also the pair of blunt, lateral, lip-like projections which arise from the outer surface of the cuticular elevation around the month. The oral opening is elongated dorsoventrally. The epaulettes are trifid, shaped like a letter M with its legs pointing toward the sides of the body. 8 papillae in all are to be seen, in the interpretation of CHITWOOD and WEHR they are the dorsoventrals, ventroventrals, laterodorsals, and lateroventrals. According to my view the two crowns of head-papillae are in process of fusion into one. That two crowns have contributed to the pattern described is distinctly indicated by the difference in size between dorsodorsals and ventroventrals and between laterodorsals and lateroventrals, as well as by the fact that the two groups of lateral papillae do not remain at the same level as the dorsodorsals and dorsoventrals. A comparison of this pattern with that of the Spiruroids here described shows that the *Filarioidea* and *Spiruroidea* are closely allied, and may well have a common ancestry.

Length of a female 60 mm., width 1 mm. Length of a male 23 mm., its width 0.75 mm.; other males measures 27, 29, and 30 mm.

The head, seen from the top, presents an oral aperture — mentioned above — elongated in dorsoventral direction, the oral cavity being supported by strong cuticular linings and bearing a halter-shaped denticle at each side of its upper end. Epaulettes with three legs, of which the two exterior ones are fused, each with two submedian papillae, while the middle leg is provided with the amphid. Oesophagus composed of a short, narrow, straight-sided portion, encircled by the nerve ring, this first section being followed by a much longer portion which is at least three times thicker. In lateral view the anterior portion of the head, just behind the papillae, contains three sac-like structures apparently glandular, like those found in the genus *Diplotriaena*.

In the females I found no genital aperture, so they appeared not to be mature. Here the anal apertures were subterminal. Males had distinct, though not very prominent alae on tail-end, not mentioned by SCHNEIDER. I think, nevertheless, that the present material is correctly identified, because the distribution of the papillae is identical with that of *Filaria dehiscens* SCHNEIDER, and the other features of that species likewise apply to my examples.

In my specimens there are 4-5 pairs of preanal papillae, running in slanting rows to both sides of the body. Immediately caudad of the anal aperture, near the mildine, 2 pairs of somewhat larger papillae are observed; and on each of the wings, more widely separated than they, are 2 stalked



Hamatospiculum dehiscens (SCHNEIDER).

FIG. 96. — Male head, side view.
FIG. 97. — Idem, with both parts of oesophagus.
FIG. 98. — Idem, top view.
FIG. 99. — Male tail.
FIG. 100. — End of male tail, much enlarged.
FIG. 101. — Female tail.

Philometra congolense n. sp.

FIG. 102. — Head top view, animal moulting ?
FIG. 103. — Idem, not moulting.
FIG. 104-106. — Side views of some heads.
FIG. 107. — Anal aperture and surroundings.

papillae. The wings do not quite fuse in the middle at the posterior end. Spicules very unequal, the shorter and broader one ending in a blunt, slightly rounded tip and serving apparently as a gubernaculum for the other, which is at least ten times longer.

In YORKE and MAPLESTONE's excellent monograph I have sought in vain for *Filaria dehiscens* SCHNEIDER. This is surprising, since SCHNEIDER himself stated that his *Filaria nodosa* RUD., *Filaria dehiscens* SCHNEIDER, and *Filaria insignis* SCHNEIDER are allied species. A comparison of my figure of the male tail with that of SCHNEIDER shows that his specimens and mine belong to the same species. The geographic distribution — SCHNEIDER's specimens having come from *Strix striata* in Dongola, Anglo-Egyptian Sudan — also favours this assumption. Thus, apart from *Hamatospiculum brasilianum* STOSSICH, of which *Filaria insignis* SCHNEIDER 1866 (not of LEIDY 1858) is regarded as a synonym by SKRJABIN, *Hamatospiculum dehiscens* (SCHNEIDER) and recently (SANDGROUND 1933) *Hamatospiculum pertenuialatum* SANDGROUND among bird parasites are brought to this genus. I have wonderd whether *dehiscens* and *brasilianum* might not be conspecific, since they have so many points in common. However, when the figure of the male extremity by SKRJABIN is compared with mine, it seems that the pattern of the caudal papillae is different in my specimens. Moreover, there is a distinct difference in the shape of the oral opening which is quite circular and minute in *H. brasilianum*, according to SKRJABIN, but large and distinctly elongate in *H. dehiscens*.

Family **DRACUNCULIDAE**

16. — **Philometra congolense** new species

(Figs. 102-107.)

2 juv. from stomach of fish [*Clarias* sp.], N° 2248, Molindi (riv.) between Kirumba and Lake Kibuga, 1,000 m., 9-V-1934. Length of a juv. specimens 130 mm., width of the same 1 mm.

It is with some hesitation that I place this species in the genus *Philometra*, which should have the head swollen at its anterior end. This is not the case in my specimens, where the head is bluntly coneshaped to more or less truncate. The distribution of the circumoral papillae, moreover, gives me much trouble; and thus far I have not been able to decide this question satisfactorily. This is readily understandable, because I had to do with unripe specimens, and it may be that this swelling does not come into existence until after the last exuvium. The oral opening leads directly into the oesophagus without any intervening buccal cavity, and is surrounded by fleshy borders, the whole being elongate oval. At a certain distance from the oral opening one finds a crown of papillae, arranged in groups, 6 of thum in all. Of these, the submedian groups consist of 2 unequal papillae

each, probably to be identified with dorsodorsals, ventroventrals, latero-dorsals, and lateroventrals, according to the nomenclature of CHITWOOD and WEHR. This arrangement would indicate that these papillae belong to the exterior circle of CHITWOOD and WEHR, or according to my version that there has been a fusion of both crowns. In the lateral fields there are two groups, apparently of 3 papillae each, among them the amphids. I consider the larger papillae between the 2 others to be the amphids. Thus far the situation is easily understood, through this pattern diverges from that known in other Filarioids. The main difficulty lies in the interpretation of the other papillae depicted in Figure 102. It may be that one or another papilla, situated just at the cut-edge of the head as removed, may have escaped my attention; but even so the interpretation remains doubtful. I am inclined to consider the possibility that the animal in question was just moulting, and that the subjacent papillae were already formed. Here however we have to do with 8 groups of papillae, of which te lateral groups are easily discerned. The groups of lateral sense-organs, again, are composed apparently of 3 components, 2 papillae and 1 amphid. The interpretation of the 6 submedian papillae remains difficult, and I shall leave it until more material is available. Cloaca terminal, bordered by lips. Dorsally and ventrally from it, on a sharply delimited elevation, a group of papillae is located. A peculiar papilla-like wart is found at the right lateral border of this terminal opening, while another isolated papilla is placed at the lower border of the cloacal shield.

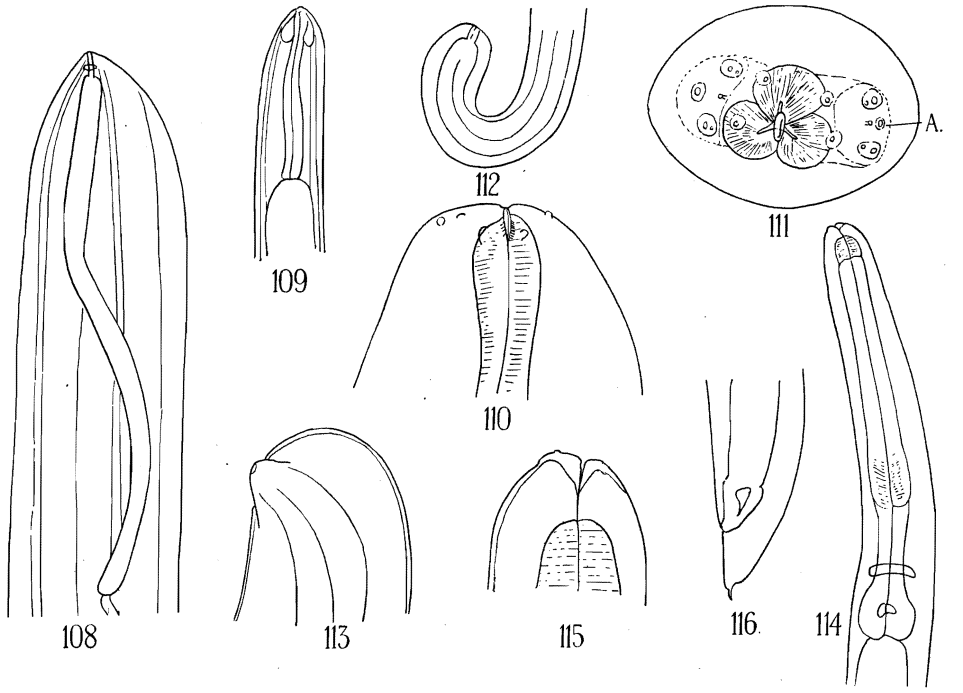
17. — **Dracunculus dahomensis** NEUMANN

(Figs. 108-113.)

4 ♀ ♀, from a serpent, *Psammophis sibilans* (L.), N° 1114, Vitshumbi, Lake Edward, 925 m., III-1934.

With a certain hesitation I retain this species in the genus *Dracunculus*, on the supposition that it may be identical with *D. dahomensis*. I have considered the possibility of its belonging to the genus *Capillaria* of the *Trichiuroidea* but the peculiar skin-structure of that order is absent, and the distribution of sense-organs on the head fits well for the *Filarioidea*.

My specimens measured 60, 75, 130, and 160 mm. None of them was sexually mature. One was decapitated and its head studied in front view. Apparently in the course of shedding its skin, this example exhibed a typical Filaria-like pattern of heach sense-organs. There is a minute slit-like oral opening, leading almost directly into the tripartite oesophagus, composed of three muscular columns. The comparatively short muscular portion ofthe oesophagus, surrounded by the nerve ring, is followed by a longer glandular part. The sense-organs are arranged in two groups, situated on faintly indicated epaulette-like shields, just as in other Filarioids. The amphids are situated at both ends of the line uniting the centres of the elliptical oral shield. Furthermore, each epaulette includes two double papillae, sub-



Dracunculus dahomensis NEUMANN.

FIG. 108. — Headportion of body openen with oesophagus and intestine.
FIG. 109. — Head, side view.
FIG. 110. — Idem, stronger magnification.
FIG. 111. — Head top view.
FIG. 112-113. — Two tails.

Aplectana congolense n. sp.

FIG. 114. — Anterior portion of body.
FIG. 115. — Head, stronger magnification.
FIG. 116. — Tip of tail.

median in position and homologous with the paired papillae in the Spiruroids. The components of each double papilla are subequal, the dorsodorsals and ventroventrals apparently larger than the lateroventrals and laterodorsals. Apart from these sense-organs which could be identified easily, some other organs were located, apparently situated at a somewhat lower level. If this supposition holds, the specimen decapitated was just moulting, and we must regard the sense-organs mentioned above as belonging to the next larval skin. There are new amphids situated on the same line as the others, but slightly nearer the center of the head, and also 4 submedian papillae, the partners of which could not be detected. 4 longitudinal muscular bands unite the cuticula with the muscular oesophagus. The

lateral chords are multinuclear. The obsolete anal aperture is subterminal. The caudal end of the body is blunt. Since other particulars are lacking and no male is available, the relationships of this species with other Filarioids are difficult to trace. Most probably it is a species of *Dracunculus*, and then referable to *D. dahomensis*; or else a species of *Filaria* which can only be accurately named when more material becomes available.

ORDER IV OXYUROIDEA

Family OXYURIDAE

Subfamily COSMOCERCINAE

18. — **Aplectana congolense** new species

(FIGS. 114-116.)

3 ♀ ♀, from body cavity of *Phrynobatrachus graneri* (NIEDEN), Kitondo, near Gandjo, 2,000 m., 7-23-I-1935.

Length of one female 14 mm. FILIPJEV's formula of another female :

$$\frac{0 \quad 600 \quad 6200 \quad 11600}{440} \text{ 11 mm. } V = 53\,\%.$$

Unfortunately only females are available; but they show some features not seen in orther species of *Aplectana*, so far as known, although the present species undoubtedly belongs to that genus. Such is the peculiar tripartite oesophagus with its indication of an anterior bulb, as in the representatives of *Rhabditis*. There are three lips with indistinct papillae, the exact number of which could not be counted. Pharyngeal portion of oesophagus distinctly marked off from the remainder. Posterior bulb distinct, witk the usual valves. Tail short, conical with a sharply pointed apex. Vulva midway between posterior end of oesophagus and anal opening; ovaries double.

Brussels, 26 July 1936.

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