U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY—BULLETIN No. 60.

D. E. SALMON, D. V. M., Chief of Bureau.

MANSON'S EYE WORM OF CHICKENS

(*Oxyspirura Mansoni*),

WITH A GENERAL REVIEW OF NEMATODES PARASITIC IN THE EYES OF BIRDS,

AND

NOTES ON THE SPINY-SUCKERED TAPEWORMS OF CHICKENS

(*Davainea echinobothrida* (=*Tænia botrioplites*) and *D. tetragona*).

BY

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Scientific Assistant in Charge of the Zoological Laboratory, Bureau of Animal Industry.

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HEADS OF CHICKENS AFFECTED WITH MANSON'S EYE WORM.

U. S. DEPARTMENT OF AGRICULTURE.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 25, 1904.

SIR: I have the honor to submit herewith for publication the manuscript of two articles entitled, respectively, "Manson's eye worm of chickens (*Oxyspirura Mansoni*), with a general review of nematodes parasitic in the eyes of birds," and "Notes on the spiny-suckered tapeworms of chickens, *Davainea echinobothrida* (= *Tænia botrioplites*) and *D. tetragona*," by B. H. Ransom, B. Sc., A. M., scientific assistant in charge of the Zoological Laboratory of this Bureau.

The first-named paper is in two parts. The first part comprises a complete account of a parasitic nematode, the presence of which in North America has not previously been recorded. This parasite is found beneath the nictitating membrane of the eyes of chickens and peafowl, and chickens thus affected frequently exhibit a severe ophthalmia, which, if left untreated, ends in the loss of the eyes and may even lead to fatal results. The second part contains a complete summary of all the parasites allied to *Oxyspirura Mansoni* which occur in the eyes of birds.

The second article consists in a discussion of two important tapeworms of chickens. These worms, although distinctly different species, show such close anatomical similarities that they have hitherto been much confused, and indeed their specific identity seems so far never to have been clearly and precisely recognized. One of them (*Davainea echinobothrida* = *Tænia botrioplites*) is the form which frequently produces the nodular disease of the intestines, first reported for this country in 1895 by Dr. Veranus A. Moore, at that time pathologist in this Bureau; while the other (*Davainea tetragona*) produces no apparent lesions.

The economic importance of recognizing and distinguishing between the two species is evident. Upon the basis of the specific diagnoses given in this paper, the worms may be readily identified and separated from each other, the characteristic differences between the two forms being here given for the first time.

The illustrative work necessary for the articles has been done by W. S. D. Haines, the artist of this Bureau.

Very respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary.

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MANSON'S EYE WORM OF CHICKENS
(OXYSPIRURA MANSONI),

WITH A GENERAL REVIEW OF NEMATODES PARASITIC IN THE EYES OF BIRDS.

By B. H. Ransom, B. Sc., A. M.,
Scientific Assistant in Charge of Zoological Laboratory, Bureau of Animal Industry.

MANSON'S EYE WORM (OXYSPIRURA MANSONI) OF CHICKENS.

INTRODUCTION.

The attention of the Bureau of Animal Industry has recently been called to the occurrence of a parasite in the United States which has hitherto not been published for this country. The parasite in question is a round worm known as *Oxyspirura Mansoni* (=*Filaria Mansoni*=*Spiroptera Emmerezii*) and is found beneath the nictitating membrane of the eye of chickens. The worms of this species are white, small, and thread-like, measuring a little over half an inch in length, with the thickness of a fine sewing needle. The body is thickest near the middle and tapers gradually toward each end. The posterior end is the more pointed, and in the male is more or less curved ventrally, while in the female it is straight. The females are generally slightly larger than the males. The number which may be present in a subject varies from few to many; Mr. H. C. Niles, of Summerland Key, Keywest, Fla., states that he has taken nearly 200 from the eyes of a single chicken.

Fig. 1.—Manson's eye worm (*Oxyspirura Mansoni*). Male on the left and female on the right. Natural size. Original.

SYMPTOMS.

The presence of these worms in the eye is frequently borne by chickens without any apparent inconvenience. For example, the chicken mentioned above was said to be perfectly healthy and entirely without symptoms. On the other hand, it seems that considerable irritation of the ocular membranes would be produced by the movements of the worms, which are seen to be very active when the nictitating membrane is drawn away from the cornea so as to expose them to view. Apart

from the possibility of an actively irritating influence, the worms undoubtedly have an injurious effect merely from their presence as foreign bodies. It would appear in any case that the presence of these parasites in a locality so sensitive would tend to establish an inflammation, and at least be a condition predisposing to inflammation from other causes.

While the presence of the parasites, as already mentioned, is commonly borne without seeming inconvenience, such is not always the case. Distinct symptoms of irritation become evident at times. Emmerez (Emmerez & Mégnin, 1901a) observed that an affected bird shows signs of uneasiness and scratches at its eyes, which exhibit an acute inflammation accompanied by an abundant secretion of tears. The first stages of the inflammation seem to be confined almost entirely to the eye itself. The nictitating membrane, which is swollen and projects slightly beyond the eyelids at the corner of the eye, is kept in continual motion to and fro, as if to remove some foreign body. The eyelids become stuck together and a white cheesy matter, easily removed, gathers beneath them.

Further symptoms appear which seem to be due to a complication with catarrh. The tissues surrounding the eye and the infra-ocular sinuses become highly inflamed, and are reddened and swollen. (See Frontispiece.) The eyeball is likely to be involved; the cornea becomes opaque, and later the entire eyeball is destroyed and the orbital cavity is filled with a yellow purulent material. When this stage is reached the worms are no longer to be found in the eye. The nostrils may also be affected and become obstructed in the catarrhal process, and finally fatal results may follow. The bird becomes somnolent, scarcely eats, declines in strength, becomes anemic, and dies in three or four weeks.

TREATMENT.

The treatment consists in the removal of the worms, combined with the treatment of the associated catarrh. The worms may be removed either by direct mechanical means, as with small forceps, which operation is more or less dangerous and painful to the fowl, or by irrigating with a solution of bicarbonate of soda or a 1 or 2 per cent solution of creolin. The irrigation has the effect of partially dislodging the worms, which may then be removed entirely by wiping away with a soft cloth.

Further treatment is directed toward alleviation of the inflammation or the cure of the catarrh which may have been established. Irrigation of the eyes with a mildly antiseptic solution, such as a 4 per cent boric acid solution or 1 per cent creolin solution, is indicated, together with irrigation, also, of the nose and mouth if the nostrils are affected. Anointing the eyes with a mixture of lard 9 parts and iodoform 1 part.

or with carbolized vaseline, is likely to give good results in some cases. The general sanitary conditions should also be attended to and stimulating food furnished as in the treatment of simple catarrh.

Prophylaxis.—No special prophylaxis is evident, as the life history of the parasites is so far unknown (see p. 18). Certain general precautions which are likely to prevent the spread of this as well as of other parasitic diseases should, however, be taken. Affected fowls should be isolated. The chicken houses should be kept clean and disinfected frequently by the use of boiling water and whitewash, with which carbolic acid, creolin, or other disinfectant has been mixed. The yards likewise should be kept clean and free from excessive moisture. Chickens should not be allowed to drink from stagnant pools, but pure drinking water should be furnished in vessels which can be frequently cleaned.

HISTORICAL REVIEW.

We find this species first referred to by Cobbold (1879b, p. 440) in the following words:

> Here I may mention that on the 10th of April, 1878, I received a letter from Doctor Manson, of Amoy, announcing his acquaintance with a filaria infesting the eye of the fowl. On the 9th of May I also received from Doctor Manson the head of a bird showing examples of the worm. As the species is new to science I have proposed to call it *Filaria Mansoni*, after the discoverer. The male is five-eighths inch and the female three-fourths inch in length.

Magalhães (1888) was the next observer to encounter this worm, which he described from specimens collected in Brazil, five from the eye of a fowl and two from the eye of a peacock.

Seven years later (1895) he published a French translation of his original Portuguese paper. In his later paper he was able to change to a positive statement his earlier expressed belief as to the identity of the Brazilian form with *Filaria Mansoni*, having had in the meantime opportunity to study specimens collected by Manson in China.

Emmerez & Mégnin (1901a) noticed a peculiar ophthalmia among chickens on the island of Mauritius. Following the account which they have given, the disease is very contagious and frequently ends in death. It begins as an ordinary ophthalmia. The bird affected appears uneasy and scratches at its eyes, which become much inflamed and watery. The eyelids stick together and a white, cheesy matter, easily removed, gathers beneath them. At other times there is a complication of nasal catarrh, together with great inflammation and edema of the infra-ocular sinuses. In such cases the condition of the bird may be considered very serious. With its eyes almost always closed it remains in one place, eats but little and with difficulty, becomes anemic, and dies in twenty to thirty days.

One of the fowls which had begun to show symptoms of the disease was isolated, and Doctor Emmerez observed the following:

The trouble seemed to be confined to the eye itself, while the eyelids exhibited no inflammation, except that the nictitating membrane was slightly swollen and projected at the corner of the eye. It was drawn rapidly and constantly across the eye, as if to remove some foreign body. When the membrane was lifted a large number of little white slender worms in active motion were seen beneath. Doctor Emmerez was able to remove them all, to the number of about 50.

Treatment becomes very simple after the discovery of the worms. A solution of bicarbonate of soda is dropped in the eye several times a day. Under the influence of this treatment the worms come out from under the membrane, fall between and under the eyelids, and are carried outward with the tears. A fine cloth should be used to finally remove them, as they very quickly regain their position under the membrane. As an alternative, one may remove the worms with fine forceps and complete the treatment by bathing the eye with a warm 4 per cent solution of boric acid.

Taken at the start this affection offers nothing serious, but if allowed to become complicated with nasal catarrh it may prove fatal.

In addition to the above account Mégnin gives a short zoological description with figures and proposes to name the worm *Spiroptera Emmerezii*, believing it to be a new species, but the description leaves no doubt as to its identity with the previously described *Filaria Mansoni*.

In 1901 and 1902 Mr. F. C. Clark collected numerous specimens at Laughlands, Jamaica, which are preserved in the helminthological collection (Nos. 3182 and 3257) of the Bureau of Animal Industry, Department of Agriculture. The Bureau is under obligations to Mr. H. C. Niles, Keywest, Fla., for supplying a number of chickens infected with this parasite.

Attention may here be called to the fact that so far the worm has been reported only from localities on or near the seacoast. This point may prove to be of significance in the life history or it may be only a coincidence, but in any case it is worthy of remark.

ANATOMY.

EXTERNAL APPEARANCE.

The worms are white, with the customary slender threadlike form of the nematodes, and are attenuated at both ends. The attenuation is greater toward the posterior end, which is pointed, while the anterior end is rounded (fig. 1).

Males may be distinguished from females by their generally smaller size, and by the tail, which is curved ventrally (fig. 1).

The cuticula is very transparent and perfectly smooth. Magalhães (1888, 1895) describes the cuticula as finely striated transversely, but Mégnin (Emmerez & Mégnin, 1901a) remarks that there is no visible

striation of the cuticula, nor have I seen such markings in any of a large number of specimens examined.

The muscle fibers of the body wall are plainly visible through the cuticula, under low magnification, as coarse longitudinal striations, and in favorable specimens much of the internal anatomy is also apparent.

On each side of the body 350 to 400 μ from the anterior end is a very small rounded cervical papilla, scarcely discernible, provided with a short projecting hair-like process, evidently a sense organ. A pair of very small conical papillæ, each with a tiny opening, is situated near the tip of the tail in both sexes (fig. 4.)

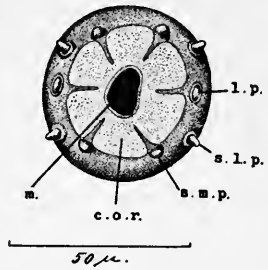

FIG. 2.—Manson's eye worm (*Oxyspirura Mansoni*). Anterior view of head: *c. o. r.*, circumoral cuticular ring; *l. p.*, lateral papilla; *m*, mouth; *s. l. p.*, sublateral papilla; *s. m. p.*, submedian papilla. Enlarged. Original.

The mouth (fig. 2, *m.*) is circular or oval, and is surrounded by a chitinous ring (figs. 2, 3, *c. o. r.*) divided into six lobes by narrow clefts extending inward from the outer edge. These clefts correspond to the lateral and submedian longitudinal lines. Projecting from the surface of the head near the outer edge of the ring and in relation with the clefts are six small papillæ (figs. 2, 3, *l. p.*, *s. m. p.*) to be distinguished only with difficulty and usually only when the head is viewed *en face* under a high power. On the sides of the head, posterior of the circle of papillæ just referred to, are four papillæ (figs. 2, 3, *s. l. p.*) which from their position may be designated sublateral papillæ, as they are located midway between the lateral and submedian lines. The sublateral papillæ measure 4 to 6 μ in length, and are slender and conical in shape. They project outward almost at right angles to the surface, and under a moderately high power are readily apparent in a lateral view of the head.

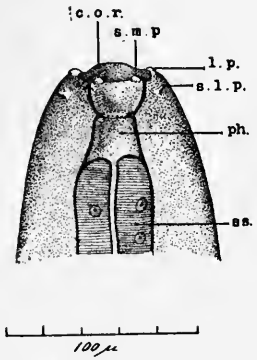

FIG. 3.—Manson's eye worm (*Oxyspirura Mansoni*). Dorsal view of head: *c. o. r.*, circumoral cuticular ring; *cs.*, esophagus; *l. p.*, lateral papilla; *ph.*, pharynx; *s. l. p.*, sublateral papilla; *s. m. p.*, submedian papilla. Enlarged. Original.

The excretory pore (fig. 5, *ex. p.*) is situated in the ventral line at about the level of the cervical papillæ; that is, 350 to 400 μ from the anterior end of the body.

Male: Cobbold (1879b) gives the length of the male as five-eighths of an inch (about 16 mm.); Magalhães (1888, 1895), 14 mm.; and Mégnin (Emmerez & Mégnin, 1901a), 12 mm. The maximum length of the speci-

mens which I have measured was 14 mm., the minimum 10 mm. Specimens of the latter length were clearly immature; 12 to 13 mm. was the usual size of mature worms. The diameter of the body is 50 μ at the anterior end, 200 to 350 μ at the middle, and 65 to 150 μ at the opening of the cloaca, which is situated 320 to 400 μ from the tip of the tail. As already mentioned, the tail is more or less curved ventrally and may describe one complete revolution of a spiral, or less. There are six pairs of genital papillæ (fig. 4) in the immediate neighborhood of the anal opening—two pairs postanal and four pairs preanal. Mégnin (Emmerez & Mégnin, 1901a) mentions but five pairs of papillæ; Magalhães (1888, 1895), on the other hand, states that there are eight pairs—three postanal and five preanal. In the considerable number of specimens which I have examined there were in no case more nor less than six pairs of genital papillæ.

FIG. 4.—Manson's eye worm (*Oxyspirura Mansoni*). Ventral view of posterior end of male, showing papillæ. Enlarged. Original.

The papillæ (fig. 4) of the first and second pair are situated a short distance on either side of the median line. The second pair is just posterior of the anus, and the first pair about 50 μ behind the second. The papillæ of the third pair, adanal rather than preanal, are almost on a line with the anal opening, and are so far distant from the median line as to be sublateral in position. The fourth pair is 30 to 40 μ, the fifth pair 60 to 70 μ, and the sixth pair 100 to 130 μ, anterior of the anus. Of any two successive pairs, the fourth and fifth pairs are generally the nearest together, while the fifth and sixth are the farthest apart (the lateral distance which separates the papillæ of the third pair from the others not considered). Passing forward from the first pair of papillæ, which are the closest together, and leaving out of consideration the third pair, the lateral distance between the papillæ of each pair gradually increases, reaching a maximum in the sixth pair, which are situated nearly on the submedian lines. The papillæ of the sixth, fifth, fourth, second, and first pairs are thus located on two converging lines which meet a short distance posterior of the anus. There is more or less asymmetry in the arrangement of the papillæ, so that the papillæ of any one pair are not always exactly opposite. Owing to this circumstance it is sometimes difficult, from a lateral view alone, to determine the exact number of papillæ and their arrangement into pairs. The spicules (fig. 6, *sp.*) are often seen extruding from the anal

opening. One of the spicules is long and slender, and the extruded portion may measure 1 mm. or more in length, while the other is short and thick and is only slightly protrusible. In no specimen examined was there any evidence of lateral cuticular membranes in relation with the tail, as described by Mégnin (Emmerez & Mégnin, 1901a).

Female: The females measure from 12 to 18 mm. in length, 50μ in diameter at the anterior end, 400 to 430 μ at the middle of the body, 210 to 280 μ at the vulva, and 90 to 100 μ at the anus. The vulva (fig. 7, *vul.*) is in the posterior part of the body, 1 to 1.4 mm. from the tip of the tail. It is an almost circular opening 40 or 50 μ in diameter, surrounded by a very prominent raised border. The anus (fig. 7) is situated 400 to 530 μ from the tip of the tail, and its location is frequently indicated by a small papilla-like swelling of the cuticula. Magalhães (1888, 1895) gives the following table of measurements of five females:

Measurements of Manson's eye worm (female).

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
Length	15.00	15.00	16.00	17.00	18.00
Diameter at anterior end	.04	.04	.04	.05	.05
Diameter a little farther back	.09	.08	.08	.07	.07
Diameter at middle third	.42	.41	.42	.41	.43
Diameter at level of vulva	.22	.22	.28	.28	.21
Diameter at level of anus	.10	.09	.10	.10	.10
Diameter at extremity of tail	.01	.01	.01	.02	.01
Diameter of mouth opening	.03	.03	.03	.03	.03
Diameter of esophagus	.05	.05	.05	.05	.05
Diameter of vulva	.06	.07	.06	.05	.05
Distance of vulva from tip of tail	1.00	1.20	1.20	1.20	1.33
Distance of anus from tip of tail	.40	.40	.40	.40	.53

INTERNAL ANATOMY.

An extensive account of the internal anatomy is deemed unnecessary for the purposes of this article, and accordingly no attempt has been made to elaborate the finer anatomical and histological details. The following discussion is therefore confined to the more general relations of internal structure.

NERVOUS SYSTEM.

A nerve ring (fig. 5, *n. r.*) surrounds the esophagus about 250 μ from the anterior end of the body. It is thus some distance anterior of the excretory pore.

In the immediate neighborhood of the nerve ring are a number of large cells with prominent nuclei, which, from their position, were interpreted by Magalhães as ganglion cells. Some of them are smaller than the rest and stand in direct relation with the fibers of the nerve

ring. The remainder are arranged in four groups, corresponding to dorsal, ventral, and lateral ganglia. The lateral groups are embedded in the substance of the lateral bands on each side of the nerve ring. The dorsal group is composed of four or five pyriform cells with processes extending to the body wall in the dorsal line. The ventral group is largest, and extends from the nerve ring to the excretory pore. In cross section it is triangular, with the apex of the triangle joining the body wall in the ventral line, while the base is closely applied to the ventral surface of the esophagus. Cells of similar appearance to the above occur in a group in each lateral band opposite the terminal portion of the intestine in both male and female.

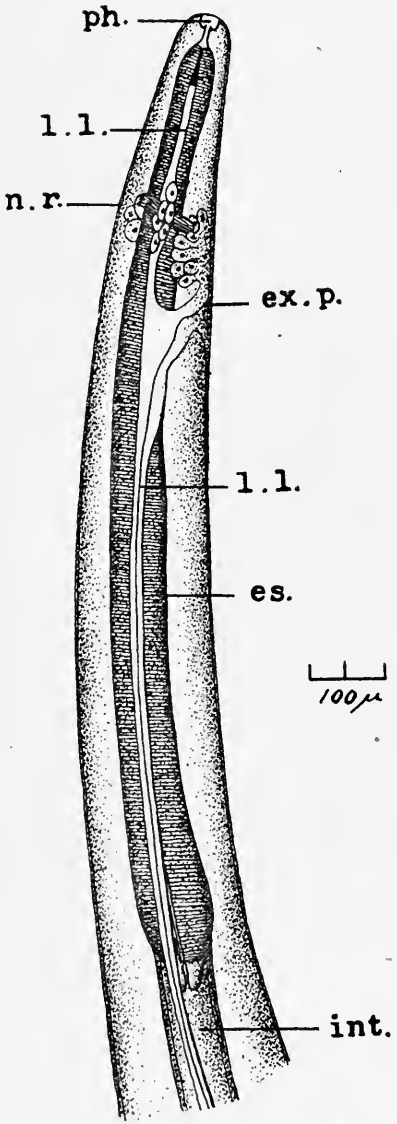

FIG. 5.—Manson's eye worm (*Oxyspirura Mansoni*). Side view of anterior end of body: *es.*, esophagus; *ex. p.*, excretory pore; *int.*, intestine; *l. l.*, lateral line; *n. r.*, nerve ring; *ph.*, pharynx. Enlarged. Original.

The following nerves were seen: A prominent ventral and a small dorsal nerve extending backward from the nerve ring in the ventral and dorsal lines, respectively, and one or two nerves extending forward from the nerve ring in each lateral band. The ventral nerve divides into two a short distance posterior of the nerve ring, and the two portions, after passing one on either side of the common excretory canal, unite again on the median line.

EXCRETORY SYSTEM.

The lateral bands (fig. 5, *l. l.*) extend the length of the body, and measure 15 to 20 μ in width. They have the usual structure, contain numerous nuclei, and through them run the longitudinal excretory canals, which unite posterior of the nerve ring, and open by the common tube thus formed at the excretory pore (fig. 5, *ex. p.*).

There appears to be a connection posteriorly between the excretory canals and the openings through the small papillæ (fig. 4), near the tip of the tail, already mentioned, but this relation could not be determined with certainty.

MUSCLE SYSTEM.

The muscles of the body wall have the well-known polymyarian arrangement.

A fan-like system of fibers (figs. 6, 7) is found in the tail of both male and female in relation with the terminal portion of the intestine. Beginning close together in the neighborhood of the anus, the fibers extend in divergent lines to attach to the dorsal wall of the body.

DIGESTIVE SYSTEM.

The circular or oval mouth (fig. 2, *m.*) opens into a chitinous mouth capsule, or pharynx (figs. 3, 5, *ph.*), in which two distinct portions may be defined, anterior and posterior, the former somewhat shorter and broader than the latter, and marked off from it by a prominent irregular ridge projecting forward on the inner surface. The pharynx is triangular in cross section. Its length is 40 to 60 μ. The anterior portion measures 15 to 25 μ in length by 25 to 30 μ in width; the posterior portion 25 to 30 μ in length by 20 to 25 μ in width.

The esophagus (figs. 3, 5, *es.*), which begins at the base of the pharynx, is a thick-walled muscular organ with a narrow triradiate lumen lined by cuticula, and belongs to the filariform type. It is club-shaped, gradually increasing in size toward the posterior end. The diameter of its anterior end is about 40 μ; of its posterior end, 80 to 100 μ; and the length is about 1.5 mm. The posterior end is rounded and slightly bulbous, and at the extremity, which projects into the lumen of the intestine, prolonged into a rounded conical tip, without muscular elements and apparently composed entirely of chitin.

Except for irregular dilations the intestine (figs. 5, 6, 7, *int.*) varies little in diameter during its almost straight course from esophagus to rectum and measures in that dimension from 50 to 100 μ. Its comparatively thin wall is composed of columnar cells about 8 μ in length, covered internally by the peculiar cuticular lining of the nematode intestine. The cells (fig. 7, *x.*) forming the wall of that portion of the intestine just in front of the rectum are larger and less closely crowded than elsewhere and the wall is thicker. In a ventral view of the female this region of the intestine is seen to be sharply marked off from the rectum by a straight transverse line.

The rectum (fig. 7, *rct.*) tapers gradually toward its opening at the anus. Its wall is compact and lined inwardly by a dense layer of cuticula. It measures 100 to 120 μ in length. The fan-like system of fibers extending from its terminal portion to the dorsal wall of the body has already been mentioned.

REPRODUCTIVE SYSTEM.

Male: The testis begins anterior of the middle of the body as a slender cord, which makes a number of short loops backward and forward and gradually increases in diameter. It may extend into the anterior part of the body almost to the nerve ring. From about the middle of the body, where it has attained a size of 50 to 60 μ, its farther course backward is almost a straight line. About 1.5 mm. in front of the anus there is a constriction which marks the beginning of the terminal portion or ejaculatory duct (fig. 6, *dct. ej.*). The wall of this portion is thick, composed of tall columnar cells, and the lumen is narrow. The portion immediately anterior of the constriction, with thin walls and wide lumen, serves as a seminal vesicle (fig. 6, *v. s.*). The ejaculatory duct becomes smaller near its terminus and joins the intestine on the ventral side of the latter, 80 to 100 μ from the anal opening, to form the cloaca.

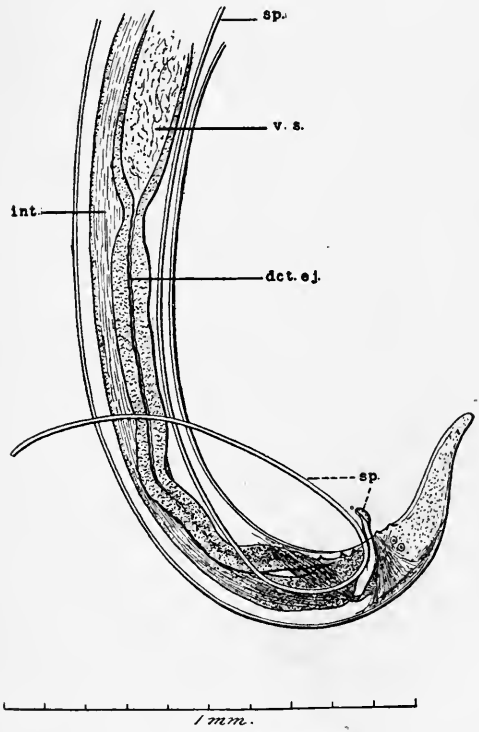

FIG. 6.—Manson's eye worm (*Oxyspirura Mansoni*). Lateral view of posterior end of male: *dct. ej.*, ejaculatory duct; *int.*, intestine; *sp.*, spicules; *v. s.*, seminal vesicle. Enlarged. Original.

The long spicule measures 3 to 3.5 mm. in length by 8 to 10 μ in diameter; the short spicule, 200 to 220 μ in length by 30 μ in maximum thickness. The spicules are hollow. There is no opening through their rounded distal ends, while their proximal ends are squarely cut off and open. The short spicule may be compared roughly to a boat. On its ventral surface it has a longitudinal depression or groove, which serves as a guide for the slender spicule. The delicate transverse striation of the spicules is not superficial but affects their entire thickness. The spicules are situated on opposite sides of the cloaca. If the long spicule is on the right side, the short spicule is on the left side, and vice versa, and this relation varies in different individuals. Each spicule is surrounded by a close-fitting sheath, which opens into the dorso-lateral side of the cloaca near its terminus. The walls of the spicule sheaths are well supplied with

longitudinal muscle fibers, and a strong bundle of muscle fibers (fig. 6) extends forward from the anterior end of each spicule attaching finally to the body wall near the ventral line.

Female: The female organs begin in the posterior portion of the worm as two slender tubes, the ovaries (fig. 7, *ov.*), which describe a number of loops in their course forward, and increasing gradually in size are transformed into two large uteri filled with eggs in various stages of development. Besides lesser loops each uterus describes a long loop, the two limbs of which extend nearly the entire length of the worm, so that in a cross section near the middle of the body each uterus is cut twice. The bend of the long loop of the uterus is in the anterior part of the body. The two uteri ultimately unite in the posterior

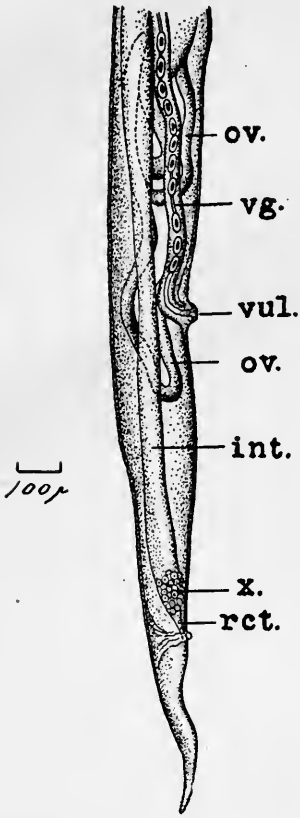

FIG. 7.—Manson's eye worm (*Oxyspirura Mansoni*). Lateral view of posterior end of female: *int.*, intestine; *ov.*, ovary; *rct.*, rectum; *vg.*, vagina; *vul.*, vulva; *x.*, cells surrounding rectum. Enlarged. Original.

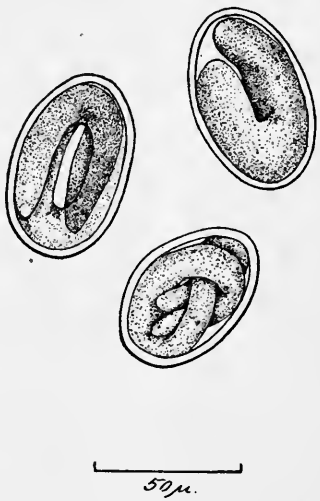

FIG. 8.—Manson's eye worm (*Oxyspirura Mansoni*). Eggs containing embryos. Enlarged. (Drawings by E. C. Stevenson.)

part of the body about 1.5 to 2 mm. in front of the vulva to form the vagina (fig. 7, *vg.*), which extends in a nearly straight course backward to the vulvar orifice. The vagina measures about 50 μ in diameter, the uteri about 100 μ in maximum diameter. The wall of the vagina increases in thickness posteriad, due to the gradual accumulation of circular muscle fibers. The eggs are forced along the narrow lumen of the vagina in a single row, but in the uterus as many as 15 or 20 may be counted in a single cross section.

Segmentation of the eggs does not begin until after the formation of the shells. At this time the eggs are much elongated, with rather square ends, and measure 24 by 12 μ. With progressing development the eggs increase in size and become more rounded, so that in the later stages, wherein the worm-like embryo is rolled up inside the shell, they are almost perfectly oval and measure 50 by 40 to 65 by 45 μ (fig. 8).

LIFE HISTORY AND DEVELOPMENT.

The life history has not been determined. Mégnin (Emmerez & Mégnin, 1901a) ventures the opinion that eggs are deposited outside the eye, since Emmerez never observed free eggs or embryos in the eye,

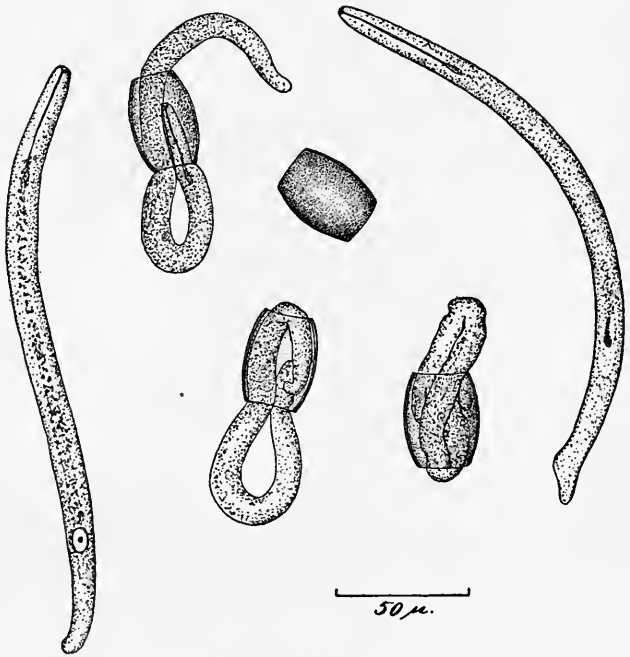

FIG. 9.—Manson's eye worm (*Oxyspirura Mansoni*). Embryos. Enlarged. Original.

and he surmises that development takes place in water. Experiments bearing upon the life history have been performed in this laboratory, but they have been almost barren of results.

On July 17, 1903, two female worms were removed from the eye of a chicken into salt solution, and on the following day were placed in water and torn into small pieces with needles, thus setting free a large number of eggs containing embryos. The embryos were kept at the temperature of the room. Two days later there was no apparent

change, but on the following day, July 21, many of the embryos had hatched.

In the hatching of the embryo (fig. 9) a small cap splits off from each pole of the egg, following a smooth even line of fracture, leaving the body of the eggshell in the form of a barrel without head or bottom. In many instances but one cap splits off. The newly hatched embryo is only slightly attenuated toward each end. The anterior end is rounded and the posterior end only very bluntly pointed. Little could be distinguished of the internal structure, which was still in a very incomplete condition of development. The cuticular lining of the filariform esophagus was distinctly evident, leading backward from a small cup-like cavity in the anterior end, indicating a rudimentary mouth capsule or pharynx. The embryos measure 225 to 250 μ long by 12 μ in maximum thickness; the esophagus has a length of about 50 μ.

The above-mentioned embryos were quiescent when they were first seen after hatching, and apparently dead, with the exception of one, which exhibited feeble movements, but it also became quiet in a short time. The embryos manifested no further signs of life and were entirely decomposed at the end of a few days.

A female worm from the same lot was also cut up on July 18 and the eggs contained were transferred to the eye of a healthy chicken. Two weeks later, August 1, the eye seemed to be slightly swollen and a small white opaque spot was apparent on the cornea; on August 6 the other eye appeared to be affected also. Careful examination of the eyes, however, failed to reveal any of the parasites. The inference is that the embryos did not develop, and that the slight affection of the eyes noted was due to other causes.

Further attempts at infection have been made, but with negative results. Eggs containing embryos were placed in the eye of a young fowl February 26, 1904. On the same date, also, eggs containing embryos were fed to a young fowl and to a full-grown hen. Both young chickens died April 4. No eye worms were found on postmortem examination. Examination of the remaining chicken to which eggs had been fed showed that eye worms were absent April 19.

These few incomplete experiments, all resulting negatively, will warrant no definite conclusions concerning the life history of *Oxyspirura Mansoni*. It seems probable, however, that it is necessary for the embryos to pass a certain period of their existence either free or in an intermediate host before they will develop to maturity. If further investigations continue to show, as all observations so far have shown, that the parasite is restricted to localities bordering on the seacoast, this fact will be of considerable significance in connection with the life history, indicating either that some marine form serves the

parasite as an intermediate host, or that certain conditions, peculiar to the seashore but yet unknown, are necessary to enable the parasite to complete the cycle of its development.

The entire question of the life history of *Oxyspirura Mansoni*, therefore, still remains to be solved.

GENERAL REVIEW OF NEMATODES PARASITIC IN THE EYES OF BIRDS.

In connection with the study of *Oxyspirura Mansoni* it was found, so far as was possible to trace in the literature, that only one other nematode ("*Filaria oculi*," p. 20) has been recorded parasitic in the eyes of birds in the United States. Taking the entire world, however, about 38 species, altogether, have been reported, collected from the eyes of about 43 different species of birds. It therefore seems very evident that a considerable number of species probably occur in the eyes of birds in the United States which have hitherto been overlooked, chiefly, it is presumed, on account of a lack of due attention by collectors of parasites to the eyes of animals examined. The fact that over half the known species are the result of the work of a single collector (Natterer) of South American birds would indicate that the eyes are much more frequently the location of nematode parasites than is commonly supposed.

Since the literature concerning the nematodes parasitic in the eyes of birds is scattered in numerous publications, mostly foreign and not generally available, it is believed that a summary of our knowledge concerning them will be found useful. Such a summary seems especially desirable, not only because these parasites are of particular interest in the present connection, but because a résumé of the forms in question may, in the first place, serve to direct attention to a neglected but important field, and, in the second place, afford a convenient and readily accessible basis of reference. The following review includes practically all the nematodes which have been reported up to the present time from the eyes of birds. The synonymy and bibliography are based upon the card catalogue of the Zoological Laboratory.

LIST OF SPECIES, WITH SYNONYMY AND SPECIFIC DIAGNOSES.

Genus **OXYSPIRURA** Drasche (in Stossich, 1897).

Generic diagnosis.—Filariidæ: Mouth without lips, surrounded by two lateral and four submedian papillæ. Pharynx present. Membranous alæ on head generally lacking. Tail usually slender and acutely pointed.

Tail of male without bursal membranes, and with papillæ. Spicules two, unequal; one long and filiform; the other short and thick. Vulva as a rule situated in the posterior part of the body, a short distance in front of the anus.

Type species.—*Oxyspirura cephaloptera* (Molin, 1860) Stossich, 1897.[a]

[a] See nematode check-list, by Stiles & Hassall (MS.).

Oxyspirura anacanthura (Molin, 1860) Stossich, 1897.

(Figs. 10, 11.)

Synonymy and Bibliography.

1860: *Spiroptera anacanthura* Molin, 1860, pp. 966–967, 993.—Diesing, 1861a, p. 678.—Linstow, 1878, p. 71.—Idem, 1889, p. 29.—Drasche, 1884a, pp. 203, 213, pl. 14, figs. 15, 16.—Stossich, 1897, p. 123 [as synonym of *Oxyspirura anacanthura*].
1860: *Spiroptera crotophagæ ani* Molin, 1860, p. 966 [as synonym of *S. anacanthura*].
1860: *Spiroptera crotophagæ majoris* Molin, 1860, p. 966 [as synonym of *S. anacanthura;* not *S. crotophagæ majoris* Molin, 1860, p. 940=*S. lanceolata* Molin].
1897: *Oxyspirura anacanthura* (Molin, 1860) Stossich, 1897, pp. 123–124, 148.

Specific diagnosis.—*Oxyspirura:* Body straight and slender, gradually attenuated toward both ends, truncated anteriorly and acutely pointed posteriorly without mucronate caudal tip. Head with two voluminous lateral cuticular membranes.[a] Mouth large, circular, surrounded by six very small membranous lobules, and four submedian papillæ. Pharynx short. Cuticula of body closely striated transversely.

Male: 8 to 10 mm. long by 0.1 mm. thick. Caudal extremity coiled in a single turn, without bursal membranes; two pairs of (?) preanal papillæ, and a variable number of asymmetrically arranged postanal papillæ, up to as many as five pairs. Spicules two, unequal; right spicule short, thick-set, with boat-shaped tip; left spicule filiform, acutely pointed, alate, five times as long as the right spicule.

Female: 11 to 13 mm. long by 0.2 mm. thick. Vulva prominent, a short distance anterior of anus.

Habitat.—Common smooth-billed ani, *Crotophaga ani;* under nictitating membrane; Brazil (Molin, 1860).—Greater ani, *Crotophaga major;* under nictitating membrane; Brazil (Molin, 1860).

Type specimens.—In Vienna Museum.

Fig. 10.—*Oxyspirura anacanthura.* Posterior end of male. × 60. (Haines del., after Drasche, 1884a, pl. 14, fig. 15.)

Fig. 11.—*Oxyspirura anacanthura.* Right spicule. × 280. (Haines del., after Drasche, 1884a, pl. 14, fig. 16.)

Molin (1860, p. 966) based this species on nine males and two females from *Crotophaga ani* collected by Natterer in 1829, and four males and six females from *C. major* collected by Natterer in 1825. All but three were well preserved and perfectly transparent. The original material was reexamined by Drasche (1884a).

[?Oxyspirura] anolabiata (Molin, 1860) Ransom, 1904.

(Fig. 12.)

Synonymy and Bibliography.

1860: *Spiroptera anolabiata* Molin, 1860, pp. 981, 992.—Linstow, 1878, p. 124.—Idem, 1889, p. 47.—Drasche, 1884a, p. 206, pl. 12, fig. 23.—Stossich, 1897, p. 51 [as synonym of *Filaria anolabiata*].
1860: *Spiroptera cracis alectoris* Molin, 1860, p. 981 [as synonym of *S. anolabiata*].
1897: *Filaria anolabiata* (Molin, 1860) Stossich, 1897, pp. 51, 149.
1904: [? *Oxyspirura*] *anolabiata* (Molin, 1860) Ransom, 1904, p. 21.

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[a] Molin (1860, p. 966) describes four membranes on the head arranged in the form of a cross, but Drasche (1884a, p. 203), who examined Molin's original material, failed to find this structure.

SPECIFIC DIAGNOSIS.—? *Oxyspirura:*

Male: Unknown.

Female: 8 to 17 mm. long by 0.4 mm. thick. Anterior end of body abruptly attenuated with truncated apex. Cuticular rings with sharply cut posterior border encircle the body. Mouth large, surrounded by six small lips or lobes, two lateral and four submedian. In relation with each lip is a finger-like process extending inward from the periphery of the head. These processes divide the annular border of the mouth into six lobes. Mouth opens into a broad short pharynx. Tail straight, abruptly conical, with blunt curved tip. Position of vulva not determined.

FIG. 12.—[?*Oxyspirura*] *anolatiata*. Lateral view of head. × 280. (Haines del., after Drasche, 1884a, pl. 12, fig. 23.)

HABITAT.—Spix curassow, *Crax fasciolata;* under nictitating membrane and free in the eye; Brazil (Molin, 1860).

TYPE SPECIMENS.—In Vienna Museum.

This species is based upon specimens of five females, collected by Natterer in 1825 and 1827. It was listed with *species inquirendæ* by Molin, on account of the lack of specimens of the male. The original material was reexamined by Drasche (1884a). It is very probable that this species belongs in the genus *Oxyspirura*. There is a striking similarity between the figure (fig. 12) given by Drasche (1884a), and the head of *Oxyspirura Mansoni* (fig. 3).

[?OXYSPIRURA] BREVIPENIS (MOLIN, 1860) STOSSICH, 1897.

(Fig. 13.)

SYNONYMY AND BIBLIOGRAPHY.

1860: *Spiroptera brevipenis* MOLIN, 1860, pp. 921, 991.—DIESING, 1861a, p. 676.—LINSTOW, 1878, p. 137.—IDEM, 1889, p. 51.—DRASCHE, 1884a, pp. 194, 212, pl. 14, fig. 14.—STOSSICH, 1897, p. 126 [as synonym of *Oxyspirura brevipenis*].

1860: *Spiroptera microdactyli margravii* MOLIN, 1860, p. 921 [as synonym of *Spiroptera brevipenis*].

1897: *Oxyspirura brevipenis* (Molin, 1860) STOSSICH, 1897, pp. 126, 150.

SPECIFIC DIAGNOSIS.—?*Oxyspirura:* Body straight, slender, filiform. Anterior extremity attenuated with truncated apex. Mouth large, orbicular, without lips or papillæ. Pharynx absent.

Male: 16 to 22 mm. long by 0.4 mm. thick. Tail coiled in two turns, bodkin-shaped with sharp point, and without bursal membranes; six pairs of preanal and six pairs of postanal papillæ, the latter inconstant in number and asymmetrical in arrangement. Spicules two, nearly equal, very short, curved, saber-like.

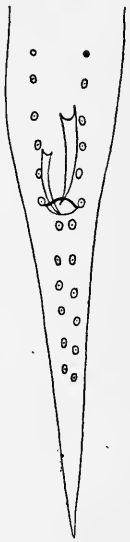

FIG. 13.—[?*Oxyspirura*] *brevipenis*. Posterior end of male. × 60. (Haines del., after Drasche, 1884a, pl. 14, fig. 14.)

Female: 11 to 27 mm. long by 0.1 to 0.5 mm. thick. Tail straight, slender, conical, with thickened tip. Anus remote from caudal tip. Vulva near anus, prominent, with swollen posterior lip.

HABITAT.—*Dicholophus margravi* [=seriema, *Cariama cristata*]; under nictitating membrane; Brazil (Molin, 1860).

TYPE SPECIMENS.—In Vienna Museum.

Molin (1860, p. 921) based his description of this species on seventeen male and twenty-one female specimens, collected by Natterer in

1824, all well preserved and perfectly transparent. The original material was redescribed by Drasche (1884a).

The absence of a pharynx, and the occurrence of short, nearly equal spicules makes it very doubtful whether this species can be classed in the genus *Oxyspirura*.

Oxyspirura brevisubulata (Molin, 1860) Stossich, 1897.

Synonymy and Bibliography.

1860: *Spiroptera brevisubulata* Molin, 1860, pp. 959-960, 998.—Diesing, 1861a, p. 677.—Drasche, 1884a, pp. 201-202.—Linstow, 1889, p. 40.—Parona, 1889, p. 775.—Stossich, 1897, p. 124 [as synonym of *Oxyspirura brevisubulata*].

1860: *Spiroptera strigis* N. 16 Molin, 1860, p. 960 [as synonym of *Spiroptera brevisubulata;* not *Spiroptera strigis* Rudolphi, 1819, p. 28; not *S. strigis* N. 16 Molin, 1860, p. 939=*S. penihamata*].

1878: *Spiroptera brevissubulata* (Molin, 1860) Linstow, 1878, p. 105 [misprint for *Spiroptera brevisubulata*].

1897: *Oxyspirura brevisubulata* (Molin, 1860) Stossich, 1897, p. 124.

Specific diagnosis.—*Oxyspirura:* Body filiform, gradually attenuated anteriorly with truncated apex; two lateral cervical spines directed backward. Cuticula raised from the body between the head and cervical papillæ forming a bladder-like expansion on either side.[a] Mouth hexagonal, without lips, surrounded by two lateral and four submedian papillæ.

Male: 15 mm. long by 0.3 mm. thick. Tail coiled in two turns, short, abruptly subulate, with acute point. Bursa absent; four pairs preanal and (?) eight pairs postanal papillæ. Spicules two, unequal; right spicule short and thick; left spicule filiform and twice as long as the right.

Female: 21 mm. long by 0.5 mm. thick. Tail short, subulate, with acute point. Anus remote from caudal tip. Vulva very prominent, a short distance anterior of the anus.

Habitat.—*Strix atricapilla* [=Brazilian screech owl, *Otus choliba*]; under nictitating membrane; Brazil (Molin, 1860).

Type specimens.—In Vienna Museum.

This species is based on specimens of two males and one female, badly preserved and opaque, collected by Natterer in 1826 (Molin, 1860, p. 960). The original material was redescribed by Drasche (1884a).

Oxyspirura cephaloptera (Molin, 1860) Stossich, 1897.

(Figs. 14, 15.)

Synonymy and Bibliography.

1860: *Spiroptera cephaloptera* Molin, 1860, pp. 956-957, 994, 997—Diesing, 1861a, p. 686 [as synonym of *Cheilospirura cephaloptera*].—Linstow, 1878, pp. 73, 97.—Idem, 1889, p. 30.—Drasche, 1884a, p. 213 [as synonym of *Cheilospirura cephaloptera*].—Stossich, 1897, p. 124 [as synonym of *Oxyspirura cephaloptera*].

1860: *Spiroptera momoti brasiliensis* Molin, 1860, p. 957 [as synonym of *S. cephaloptera*].

1860: *Spiroptera orioli* N. 642 Molin, 1860, p. 957 [as synonym of *S. cephaloptera*].

1861: *Cheilospirura cephaloptera* (Molin, 1860) Diesing, 1861a, p. 686.—Drasche, 1884a, p. 212, pl. 11, fig. 22, pl. 14, fig. 17.—Stossich, 1897, p. 124 [as synonym of *Oxyspirura cephaloptera*].

1897: *Oxyspirura cephaloptera* (Molin, 1860) Stossich, 1897, pp. 124-125, 145, 147.

Specific diagnosis.—*Oxyspirura:* Body gradually attenuated anteriorly, with rounded apex; tail awl-shaped, drawn out into a slender acute point. Cuticula

[a] Drasche (1884a, p. 202), who examined Molin's original material, failed to find the four membranous ala on the head mentioned by the latter author.

densely striated transversely. Head with membranous alæ dilated and rounded anteriorly. Mouth hexagonal surrounded by a membranous border, and two lateral and four submedian papillæ. Lips absent.[a]

Male: 13 to 15 mm. long by 0.2 mm. thick. Tail coiled twice. Bursa absent; seven pairs preanal and six pairs postanal papillæ, the latter more or less inconstant and asymmetrical. Spicules two, unequal; right spicule short, thick, navicular, with blunt rounded tip; left spicule filiform, pointed, alate, five times as long as the right.

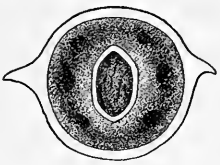

FIG. 14.—*Oxyspirura cephaloptera.* Anterior view of head. ×470. (Haines del., after Drasche, 1884a, pl. 11, fig. 22.)

Female: 10 to 13 mm. long by 0.3 mm. thick. Anus remote from tip of tail. Position of vulva not determined.

HABITAT.—*Momotus brasiliensis* [=motmot, *Momotus momota*]; under nictitating membrane; Brazil (Molin, 1860).—Orange-backed troupial, *Icterus croconotus;* under nictitating membrane; Brazil (Molin, 1860).

TYPE SPECIMENS.—In Vienna Museum.

The original description (Molin, 1860, pp. 956–957) is based on three males well preserved, and eight females badly preserved, collected by Natterer from *Momotus brasiliensis* in 1834, and two males well preserved and a fragment collected by Natterer from *Icterus croconotus* in 1824. The original material was reexamined by Drasche (1884a).

[? OXYSPIRURA] HETEROCLITA (MOLIN, 1860) RANSOM, 1904.

SYNONYMY AND BIBLIOGRAPHY.

1860: *Spiroptera heteroclita* MOLIN, 1860, pp. 944–945, 992.—DIESING, 1861a, p. 677.—LINSTOW, 1878, p. 124.—STOSSICH, 1897, pp. 115, 149.

1860: *Spiroptera cracis* MOLIN, 1860, p. 944 [as synonym of *S. heteroclita;* not *S. cracis* N. of Molin, 1860, p. 983, as synonym of *S. tenuicauda*].

1904: [? *Oxyspirura*] *heteroclita* (Molin, 1860) RANSOM, 1904, p. 24.

SPECIFIC DIAGNOSIS.—? *Oxyspirura:* Body attenuated anteriorly with truncated apex. Cuticula finely striated transversely. Mouth orbicular, large, without lips.

Male: 12 mm. long by 0.3 mm. thick. Head without membranes. Tail awl-shaped, sharply pointed, curved into a hook, without bursal membranes. Two pairs postanal papillæ. Spicules two, unequal; short spicule thick with curved point; long spicule filiform, half as long as body.

Female: 15 mm. long by 0.4 mm. thick. Head with four short, semilunar membranes, arranged in the form of a cross. Tail gradually attenuated, awl-shaped, with obtuse apex. Anus remote from tip. Position of vulva not determined.

HABITAT.—*Crax urumutum* [=urumutu, *Nothocrax urumutum*]; under nictitating membrane; Brazil (Molin, 1860).

TYPE SPECIMENS.—In Vienna Museum.

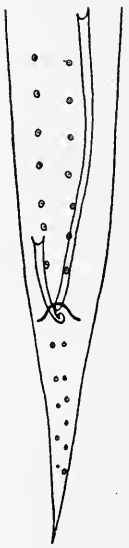

FIG. 15.—*Oxyspirura cephaloptera.* Posterior end of male. × 120. (Haines del., after Drasche, 1884a, pl. 14, fig. 17.)

This species is based on one male and one female, well preserved, collected by Natterer in 1834 (Molin, 1860, p. 945). So far as may be determined from Molin's incomplete description this species seems to belong in *Oxyspirura.*

[a] According to Drasche (1884a, p. 212); but Molin (1860, p. 956) mentions two large rounded lips.

Oxyspirura Mansoni (Cobbold, 1879) Ransom, 1904.

(Figs. 1–9.)

Synonymy and Bibliography.

1879: *Filaria Mansoni* Cobbold, 1879b, pp. 440–441 [not *Filaria Mansoni* Huber, 1896, pp. 604, 620, used as synonym of *F. sanguinis hominis* and of *Trichina cystica* Salisbury.—Simon, 1897, p. 97, copies Huber, 1896, p. 604].—Idem, 1880k, p. 131.—Magalhaes, 1888, pp. 5–12, figs. 1–6.—Idem 1895, pp. 241–244.—Neumann, 1888, p. 648.—Idem, 1892 [French ed.], p. 735.—Idem, 1892 [Eng., ed.], p. 759.—Linstow, 1889, p. 46.—Railliet, 1893, p. 533.—Stossich, 1897, pp. 35, 149.—Gedoelst, 1903a, p. 47.—Idem, 1903a, p. 90 [as synonym of *Spiroptera Mansoni*].

1901: *Spiroptera Emmerezii* Emmerez & Mégnin, 1901a, pp. 933–935, figs. A–E.

1903: *Spiroptera Mansoni* (Cobbold, 1879) Gedoelst, 1903, pp. 90, 103.

1903: *Spiroptera Emmerezi* (Emmerez & Mégnin, 1901) Gedoelst, 1903, p. 48.—Idem, 1903a, p. 90 [as synonym of *Spiroptera Mansoni*].

1904: *Oxyspirura Mansoni* (Cobbold, 1879) Ransom, 1904, pp. 7–20, 25.

Specific diagnosis.—*Oxyspirura:* Body attenuated at both ends, anterior end rounded, posterior end pointed. Cuticula smooth. Membranous appendages absent in both sexes. A pair of small cervical papillæ 350 to 400 μ from anterior end, and a pair of small papillæ near tip of tail in both sexes. Mouth circular, surrounded by a six-lobed chitinous ring; two lateral and four submedian papillæ in relation with the clefts between the lobes of ring; four sublateral papillæ slightly more posterior. Excretory pore in ventral line at about the level of cervical papillæ. Nerve ring between excretory pore and anterior end of body, about 250 μ from latter. Pharynx 40 to 60 μ long; the shorter, wider, anterior portion, 15 to 25 μ long by 25 to 30 μ wide, separated by a slight constriction from the longer narrower posterior portion, 25 to 30 μ long by 20 to 25 μ wide. Esophagus club-shaped, about 1.5 mm. long. Intestine almost straight.

Male: 10 to 16 mm. long by 0.35 mm. thick. Tail curved ventrally. Bursal membranes lacking. Cloacal opening 320 to 400 μ from tip of tail. Two pairs postanal and four pairs preanal papillæ. Spicules two, unequal; one long and slender, 3 to 3.5 mm. long by 8 to 10 μ in diameter; the other short and thick, 200 to 220 μ long by 30 μ in diameter.

Female: 12 to 18 mm. long by 0.43 thick. Anus 400 to 530 μ from tip of tail. Vulva in posterior part of body, 1 to 1.4 mm. from tip of tail. Uterus and ovary double; vagina measures 1.5 to 2 mm. long. Eggs oval, 50 by 40 μ to 65 by 45 μ in diameter.

Life history.—Unknown. Embryos hatch in two or three days after eggs are deposited, measure 225 to 250 μ in length by 12 μ in thickness, with esophagus 50 μ long.

Habitat.—Chicken, *Gallus domesticus;* under nictitating membrane; Amoy, China (Cobbold, 1879b); Rio de Janeiro, Brazil (Magalhães, 1888); Mauritius (Emmerez & Mégnin, 1901a); Laughlands, Jamaica, and Key West, Fla. (Ransom, 1904).—Peafowl, *Pavo cristatus;* under nictitating membrane; Rio de Janeiro, Brazil (Magalhães, 1888).

Type specimens.—[?]. Above diagnosis based on B. A. I. specimens Nos. 3182 and 3257.

This species is based on specimens of both sexes collected by Manson from chickens at Amoy, China (Cobbold, 1879b), but not described except as to length. Specimens collected and described by Magalhães (1888) in Brazil from chickens and peacock have been compared (Magalhães, 1895) with specimens collected by Manson and found to be of the same species as the latter.

Oxyspirura ophthalmica (Linstow, 1903) Ransom, 1904.

(Figs. 16–18.)

Synonymy and Bibliography.

1903: *Cheilospirura ophthalmica* Linstow, 1903, p. 111, pl. 5, figs. 7–9.
1904: *Oxyspirura ophthalmica* (Linstow, 1903) Ransom, 1904, p. 26.

Specific diagnosis.—*Oxyspirura:* Cuticula finely striated transversely. Mouth surrounded by two lateral and four submedian papillæ. Pharynx short and

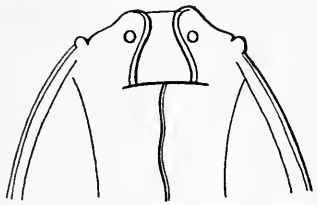

Fig. 16.—*Oxyspirura ophthalmica.* Head. Enlarged. (Haines del., after Linstow, 1903, pl. 5. fig. 7.)

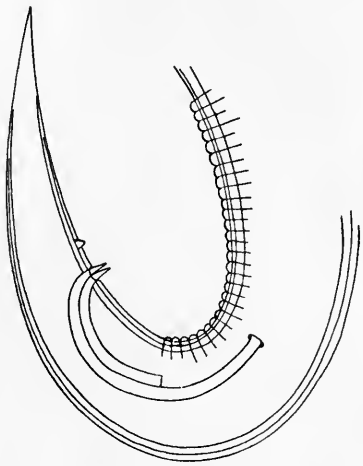

Fig. 17.—*Oxyspirura ophthalmica.* Posterior end of male. Side view. Enlarged. (Haines del., after Linstow, 1903, pl. 5, fig. 8.)

Fig. 18.—*Oxyspirura ophthalmica.* Transverse section through the lateral field of body wall. Enlarged. (Haines del., after Linstow, 1903, pl. 5, fig. 9.)

widened posteriorly. Esophagus, in male $\frac{1}{15}$, in female $\frac{1}{21}$, the length of the body, is thickened behind and broader than the beginning of the intestine. Nerve ring 0.21 to 0.22 mm. from the anterior end. Lateral fields 0.042 mm. broad, i. e., about $\frac{1}{24}$ the circumference of the body; each contains an excretory vessel, 0.0028 mm. in diameter, visible through the cuticula. Excretory pore in ventral line 0.40 mm. from the anterior end in the male, 0.44 mm. in the female.

Male: 14.4 mm. long by 0.31 mm. in width. The conical, finely pointed tail equals $\frac{1}{52}$ of the entire body length. The two unequal spicules measure 0.18 and 0.29 mm. in length. One pair of preanal papillæ, and about twenty-six pairs of postanal papillæ decreasing gradually in size toward the anus are present. Testicle occupies only about the posterior $\frac{1}{4}$ of the body.

Female: 21 mm. long by 0.53 mm. in width. Tail conical, equal in length to $\frac{1}{53}$ of the entire body. Uteri occupy the posterior $\frac{4}{5}$ of the body. Vulva near posterior end, dividing the body in the ratio of 102 to 5. Vagina runs anteriorly from vulva; 0.4 mm. from the latter divides into two uteri. Eggs thick-shelled, 0.039 mm. long by 0.026 mm. broad; cleavage takes place in the uterus.

Habitat.—Indian bustard-quail, *Turnix taigoor;* eye; Siam (Linstow, 1903).

Type specimens.—? In collection Linstow.

This species is based on specimens received from A. E. Shipley by Linstow (1903, p. 111).

Linstow classified the species under discussion in the genus *Cheilospirura*, evidently because of the similarity between it and *Oxyspirura cephaloptera* (= *Cheilospirura cephaloptera*). Such an arrangement seems, however, entirely untenable, unless it be also held that *cephaloptera*, one of the original species of *Oxyspirura*, is the type species

of *Cheilospirura*, with which genus it was listed by Diesing. In the original publication of the genus, Diesing (1861a, pp. 683–686), without definitely designating a type, defines the group as consisting of *Spiropteræ spec. bilabiatæ* Molin, and includes eight species, the last of which in the list is a *species inquirenda*, and the next to the last *cephaloptera*.

Since the chief character upon which Diesing founded the genus is the presence of two lips, it is not only desirable but practically imperative, other things being equal, to confine the choice of a type to such species as present this character. Although Molin (1860) mentions two large rounded lips, Drasche (1884a), who made a study of the material upon which Molin based the original description, states that the species *cephaloptera* is without lips. Of the six remaining species, five are characterized by the possession of two lips. One of the latter should therefore be selected as type rather than *cephaloptera* which seems to be without lips.

Unless *cephaloptera* be taken as type of *Cheilospirura*, which has been shown to be virtually out of the question, the inclusion of *Oxyspirura* in *Cheilospirura* would result in grouping together forms which, according to present generally accepted ideas, vary too widely to rank in the same genus, and I therefore prefer to recognize two distinct genera. The species *ophthalmica*, as well as the species *siamensis*, of Linstow, I have accordingly transferred to the genus *Oxyspirura*.

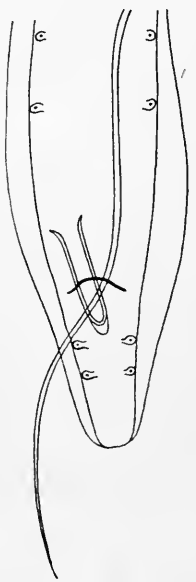

FIG. 20.—[?*Oxyspirura*] *papillosa*. Posterior end of male. × 120. (Haines del., after Drasche, 1884a, pl. 13, fig. 7.)

[?OXYSPIRURA] PAPILLOSA (MOLIN, 1860) RANSOM, 1904.

(Figs. 19, 20.)

SYNONYMY AND BIBLIOGRAPHY.

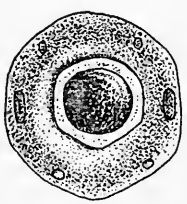

FIG. 19.—[?*Oxyspirura*] *papillosa*. Anterior view of head. × 280. (Haines del., after Drasche, 1884a, pl. 12, fig. 20.)

1860: *Spiroptera papillosa* MOLIN, 1860, pp. 929–930, 998.—DIESING, 1861a, p. 676.—LINSTOW, 1878, pp. 110, 115.—IDEM, 1889, p. 41.—DRASCHE, 1884a, p. 195, pl. 12, fig. 20; pl. 13, fig. 7.—STOSSICH, 1897, pp. 95, 141.

1860: *Spiroptera falconis leptopodis* MOLIN, 1860, p. 930 [as synonym of *S. papillosa*].

1860: *Spiroptera falconis gyrfal vcalis* MOLIN, 1860, p. 930 [as synonym of *S. papillosa*].

1860: *Spiroptera falconis* MOLIN, 1860, p. 930; *S. falconis* N. 872 MOLIN, 1860, p. 930 [as synonyms of *S. papillosa;* not *S. falconis* Rudolphi, 1819, pp. 28, 254–255; not *S. falconis* N. 698, *S. falconis* N. 11 Molin, 1860, p. 494, as synonyms of *Dispharagus rectus* Molin].

1904: [?*Oxyspirura*] *papillosa* (Molin, 1860) RANSOM, 1904, p. 27.

SPECIFIC DIAGNOSIS.—?*Oxyspirura:* Anterior end of body abruptly attenuated with very obtuse rounded apex. Surface of body crenated with dense cuticular annulations. Neck armed with rows of very delicate spines directed backward, each row

corresponding to a cuticular ring. Mouth large, orbicular, with tumid border. Lips absent; two lateral and four submedian head papillæ.

Male: 8 to 20 mm. long by 0.3 mm. thick. Tail of male more attenuated than anterior end, with very obtuse rounded tip, only slightly curved; four pairs of small preanal papillæ situated far forward (according to Molin, seven pairs of preanal papillæ) and two pairs of postanal papillæ. Spicules two, unequal; right spicule very short and broad with blunt point; left spicule six times as long as the right, slender, filiform, alate.

Female: 15 to 26 mm. long by 0.3 to 0.5 mm. thick. Tail gradually attenuated with rounded obtuse tip. Anus remote from caudal tip, prominent, with bilabiate tumid border. Vulva in anterior part of body not far posterior of the mouth.

Habitat.—*Falco destructor* [=harpy eagle, *Thrasaetus harpyia*]; under nictitating membrane; Brazil (Molin, 1860).—*Falco gracilis*[=gray crane hawk, *Geranospizias cærulescens*]; under nictitating membrane; Brazil (Molin, 1860).

Type specimens.—In Vienna Museum.

This species is based on specimens described by Molin (1860, p. 930) and reexamined by Drasche (1884a, p. 195). Of these, 5 females were collected by Natterer in 1833, 6 females in 1834, and 8 males and 12 females in 1833, all from *Falco destructor*, and 2 males and 1 female in 1826 from *Falco gracilis*. The characters given agree in the main with those typical of *Oxyspirura*, and the species may be referred provisionally to that genus.

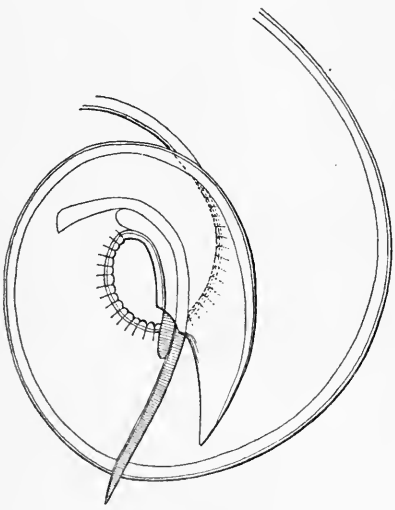

Fig. 21.—*Oxyspirura siamensis*. Posterior end of male. Side view. Enlarged. (Haines del., after Linstow, 1903, pl. 5, fig. 10.)

Oxyspirura siamensis (Linstow, 1903) Ransom, 1904.

(Fig. 21.)

Synonymy and Bibliography.

1903: *Cheilospirura siamensis* Linstow, 1903, p. 112, pl. 5, fig. 10.

1804: *Oxyspirura siamensis* (Linstow, 1903) Ransom, 1904, p. 28.

Specific diagnosis.—*Oxyspirura:* Cuticula very finely striated transversely. Pharynx small. Esophagus, in male $\frac{1}{11}$, in female $\frac{1}{13}$, of the entire body length, is widened behind to a diameter somewhat greater than that of the intestine. Nerve ring situated $\frac{28}{100}$, excretory pore $\frac{61}{100}$, of the length of the esophagus from the anterior end of the body. Posterior portion of esophagus separated from remainder by a constriction. Tail conical. Sexual organs lie in posterior half of body in both sexes.

Male: 8.9 mm. long by 0.26 mm. broad. Tail, curved ventrally, equals $\frac{1}{34}$ of the entire body length. Two unequal spicules 0.47 and 0.25 mm. long. About twenty-eight pairs preanal papillæ becoming gradually smaller anteriorly.

Female: 9.8 mm. long by 0.46 mm. broad. Tail equals $\frac{1}{37}$ of the entire body length. Vulva opens a short distance anterior of anus, 0.62 mm. from tip of tail. Vagina runs anteriorly from vulva and 0.26 mm. from latter divides into two uteri.

Habitat.—*Centropus siamensis* [=Indian ground cuckoo, *Centropus sinensis*]; probably from the eye; Siam (Linstow, 1903).

Type specimens.—? In collection Linstow.

This species is based on specimens received by Linstow (1903) from A. E. Shipley. I have placed this species in *Oxyspirura* for reasons given in the discussion of *Oxyspirura ophthalmica* (see p. 26).

[? Oxyspirura] stereura (Rudolphi, 1819) Ransom, 1904.

Synonymy and Bibliography.

1819: *Spiroptera stereura* Rudolphi, 1819, pp. 23, 237, 555.—Westrumb, 1821, p. 69.—Rayer, 1843, p. 145.—Gurlt, 1845a, p. 246.—Dujardin, 1845a, pp. 52, 93.—Diesing, 1851a, p. 212.—Idem, 1861a, p. 678.—Molin, 1860, pp. 967, 999.—Schneider, 1866, pp. 78, 108 [as probably belonging in *Ceratospira*].—Linstow, 1878, p. 113.—Stossich, 1889, p. 183.—Idem, 1897, pp. 119-120, 142.
1904: [? *Oxyspirura*] *stereura* (Rudolphi, 1819) Ransom, 1904, p. 29.

Specific diagnosis.—? *Oxyspirura:* Body slightly curved, thick, attenuated anteriorly with truncated apex. Cuticula annulated with numerous small campanuliform folds. Head without membranous appendages. Mouth orbicular without lips.

Male: 12 to 15 mm. long by 0.8 mm. thick. Tail coiled once spirally, without bursal membranes. Tip extended into a short appendage with knob-like end. Spicules two, unequal; short spicule, styloid with very acute point; long spicule, filiform. More than four pairs of preanal papillæ (Schneider, 1866, p. 108).

Female: 12 to 17 mm. long by 1 mm. thick; 2 lateral cervical spines. Tail acutely conical, tip prolonged into a styloid appendage, with rounded knob-like extremity. Anus at base of appendage. (?) Vulva in anterior part of body.

Habitat.—*Falco nævius* [=*Aquila nævia*=spotted eagle, *Aquila maculata*]; under nictitating membrane and in auditory meatus; Vienna (Rudolphi, 1819); orbit; Croatia (Stossich, 1889).

Type specimens.—? In Berlin or Vienna Museum.

This species is based on 1 male and 1 female specimen from the collection of the Vienna Museum (Rudolphi, 1819, p. 237). Specimens of 2 males and 4 females in the same collection were examined by Molin (1860, p. 967) and Rudolphi's original description added to. The characters given seem to warrant a provisional classification in the genus *Oxyspirura.*

Oxyspirura sygmoidea (Molin, 1860) Stossich, 1897.

(Fig. 22.)

Synonymy and Bibliography.

1851: *Spiroptera anthuris* Rudolphi, 1819, of Diesing, 1851a, p. 215 [in part].—Molin, 1860, p. 920 [in part; as synonym of *Spiroptera sygmoidea*].
1860: *Spiroptera sygmoidea* Molin, 1860, pp. 920, 995.—Diesing, 1861a, p. 676.—Drasche, 1884a, pp. 194, 213, pl. 13, fig. 3.—Stossich, 1897, p. 125 [as synonym of *Oxyspirura sygmoidea*].
1878: *Spiroptera sygmoides* Linstow, 1878, p. 100 [misprint for *Spiroptera sygmoidea*].—Idem, 1889, p. 38.
1878: *Filaria anthuris* Linstow, 1878, p. 100 [not *Filaria anthuris* (Rud.) Schneider, 1866, p. 96].
1897: *Oxyspirura sygmoidea* (Molin, 1860) Stossich, 1897, pp. 125, 146.

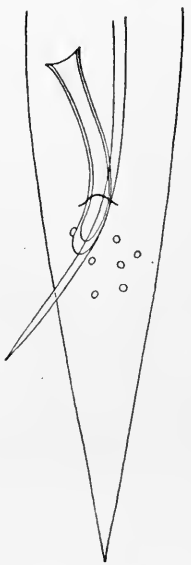

Fig. 22.—*Oxyspirura sygmoidea.* Posterior end of male. ×120. (Haines del., after Drasche, 1884a, pl. 13, fig. 3.)

Specific diagnosis.—*Oxyspirura:* Body sygmoidal, attenuated at both ends, truncated anteriorly, slender and acutely pointed posteriorly. Cuticula finely striated transversely. Mouth large, orbicular, without lips; four submedian head-papillæ.

Male: 11 mm. long by 0.4 mm. thick. Tail coiled in two turns, without bursa, four pairs postanal papillæ; papillæ of third pair (counting from behind) laterad of the others. Preanal papillæ apparently absent. Spicules two, unequal; right spicule short, thick, somewhat curved, with very blunt point; left spicule, filiform, pointed, alate, $2\frac{1}{2}$ times as long as the right.

Female: 11 to 15 mm. long by 0.5 mm. thick. Anus a transverse slit, some distance from tip of tail. Position of vulva not determined.

HABITAT.—Rook, *Corvus frugilegus;* orbital cavity; Vienna (Diesing, 1851a).

TYPE SPECIMENS.—In Vienna Museum.

This species is based on 1 male and 3 females, specimens perfectly transparent (Molin, 1860, p. 920). The original material was reexamined by Drasche (1884a, p. 194).

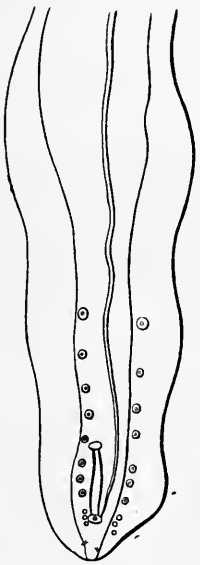

FIG. 23.—*Ceratospira vesiculosa.* Posterior end of male. × 50. (Haines del., after Schneider, 1866, p. 109.)

GENUS **CERATOSPIRA** SCHNEIDER, 1866.

GENERIC DIAGNOSIS.—Filariidæ: Mouth surrounded by papillæ. Pharynx present. Tail of male with bursa and ten or more papillæ. Spicules two, unequal. Vulva in anterior part of body. Viviparous.

TYPE SPECIES.—*Ceratospira vesiculosa* Schneider, 1866.

CERATOSPIRA VESICULOSA SCHNEIDER, 1866.

(Fig. 23.)

SYNONYMY AND BIBLIOGRAPHY.

1866: *Ceratospira vesiculosa* SCHNEIDER, 1866, p. 109, 1 fig.—LINSTOW, 1878, p. 68.

SPECIFIC DIAGNOSIS.—*Ceratospira:* Head rounded, with (?) papillæ. Mouth opens into a short pharynx. Cuticula marked by widely separated annulations with sharp projecting edges.

Male: 20 mm. long. Tail rolled spirally. Bursa present with thick vesicular borders. Papillæ asymmetrical, eleven on one side, twelve on the other; one pair posterior of the anus near the tip of the tail; three pairs forming a group on either side of the anus. The remaining, 7 on one side and 8 on the other, are situated at unequal intervals in front of the anus. Spicules two, unequal; one very short, cornet-shaped, the other very slender, over 3 mm. long.

Female: ? Length (specimen incomplete). Tail rounded. Vulva in anterior part of body, near the end of the esophagus. Vagina runs posteriad from vulva. Viviparous.

HABITAT.—*Psittacus sinensis* [= red-sided eclectus, *Eclectus pectoralis*]; orbital cavity; zoological garden, Berlin (Schneider, 1866).

TYPE SPECIMENS—? In Berlin Museum.

CERATOSPIRA OPHTHALMICA (LINSTOW, 1898) RANSOM, 1904.

(Figs. 24, 25.)

SYNONYMY AND BIBLIOGRAPHY.

1898: *Ancyracanthus ophthalmicus* LINSTOW, 1898, pp. 285–286, pl. 22, figs. 11–12.
1904: *Ceratospira ophthalmica* (Linstow, 1898) RANSOM, 1904, p. 30.

SPECIFIC DIAGNOSIS.—*Ceratospira:* Head with a circle of six papillæ; pharynx wide, squarely cut off behind. Tip of tail rounded in both sexes. Cuticula marked by

transverse rings 0.013 mm. wide, with swollen posterior edges. The musculature is weakly developed.

Male: 14.6 mm. long by 0.39 mm. thick. Esophagus $\frac{1}{18}$, tail $\frac{1}{370}$, of the body length. Posterior end of body curved hook-like, and furnished with a broad bursa. Nine to ten preanal papillæ on each side. Postanal papillæ small, four on each side. Spicules unequal; right spicule short and broad, 0.264 mm. long; left spicule long and slender, measuring 0.968 mm. in length.

Female: 18 mm. long by 0.47 mm. thick. Oesophagus $\frac{1}{23}$, tail $\frac{1}{154}$ of the body length. Vulva near anterior end of body, dividing the body into two parts in the ratio of 1 to 45. The ends of the ovaries lie close together at the junction of the third and fourth fifths of the body. From this point one ovary runs forward, the other backward. Eggs very numerous, 0.023 mm. long by 0.016 mm. wide.

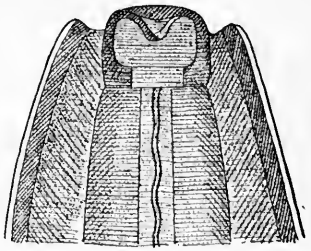

FIG. 24.—*Ceratospira ophthalmica.* Anterior end. Enlarged, (Haines del., after Linstow, 1898, pl. 22, fig. 11.)

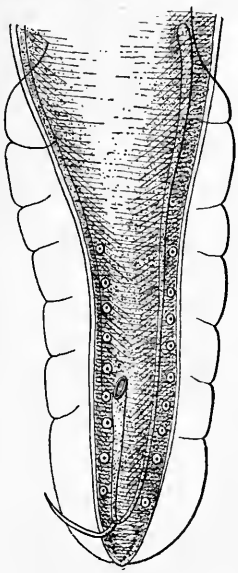

FIG. 25.—*Ceratospira ophthalmica.* Posterior end of male. Ventral view. Enlarged. (Haines del., after Linstow, 1898, pl. 22, fig. 12.)

HABITAT.—*Carpophaga brenchleyi* [= Brenchley fruit pigeon, *Zonœnas brenchleyi*]; orbital cavity; Bismarck Archipelago (Linstow, 1898).

TYPE SPECIMENS.—No. 3364, Berlin Museum.

Linstow (1898) classed this species in *Ancyracanthus*, but the characters as given seem to correspond more closely to *Ceratospira*, to which genus I have transferred it.

GENUS **FILARIA** MÜLLER, 1787.

GENERIC DIAGNOSIS.—Filariidæ: Body very slender and much elongated. Musculature polymyarian. Mouth with or without lips. Tail of male usually possesses four preanal papillæ and a variable number of postanal papillæ and is in some species furnished with a bursa. Spicules two, unequal. Vulva in anterior part of body, near the head.

TYPE SPECIES.—*Filaria martis* Gmelin, 1790, or *F. falconis* Gmelin, 1790.[a]

FILARIA ABBREVIATA RUDOLPHI, 1819.

SYNONYMY AND BIBLIOGRAPHY.

1819: *Filaria abbreviata* RUDOLPHI, 1819, pp. 4-5, 210, 555.—WESTRUMB, 1821, p. 72.—NORDMANN, 1832, p. 17.—ALESSANDRINI, 1838, p. 12.—DUJARDIN, 1845a, p. 52.—GURLT, 1845a, pp. 246, 259.—CREPLIN, 1846b, pp. 155, 159, 160, 161, 162, 164, 172.—DIESING, 1851a, p. 268.—IDEM, 1851a, p. 226 [in part; as synonym of *Spiroptera philomelæ* Diesing].—IDEM, 1861a, p. 702.—MOLIN, 1858, pp. 396-397.—IDEM, 1858, p. 425 [considers *F. myotheræ chrysopygæ* from under skin near the eye of *Myothera chrysopyga* possibly identical with *F. abbreviata*].—WALTER, 1866, p. 74, pl. 1, fig. 6.—LINSTOW, 1878, pp. 80, 84, 86, 90, 91, 92, 95, 97.—IDEM, 1883, p. 286.—IDEM, 1886, p. 11.—STOSSICH, 1897, pp. 57, 143, 144, 145, 147.—MÜHLING, 1898, p. 50.

1819: *Filaria turdorum* RUDOLPHI, 1819, p. 9 [as doubtful species and possible synonym of *F. motacillarum;* no description; specimens not seen by Rudolphi; abdomen of *Turdus pilaris* and of *T. viscivorus*].—DIESING, 1851a, p. 268 [as synonym of *F. abbreviata*].—MOLIN, 1858, p. 397 [as synonym of *F. abbreviata*].—STOSSICH, 1897, p. 57 [as synonym of *F. abbreviata*].

[a] See nematode check-list by Stiles & Hassall (MS.).

1819: *Filaria motacillarum* RUDOLPHI, 1819, p. 9 [as doubtful species and possible synonym of *F. turdorum;* no description; specimens not seen by Rudolphi; abdomen of *Motacilla rubecula* and of *Motacilla œnanthe;* about the ears, cheeks, and neck of *Motacilla philomela*].—DIESING, 1851a, p. 268 [in part, exclusive of specimens from *Sylvia philomela;* as synonym of *F. abbreviata*].—MOLIN, 1858, p. 397 [follows Diesing, 1851a].—STOSSICH, 1897, p. 57 [as synonym of *F. abbreviata*].

1819: *Filaria motacillæ* RUDOLPHI, 1819, pp. 635-636 [as doubtful species and synonym of *F. motacillarum;* abdomen of *Muscicapa* N. 144, Brazil].—DIESING, 1851a, p. 268 [as synonym of *F. abbreviata*].—MOLIN, 1858, p. 397 [as synonym of *F. abbreviata*].—STOSSICH, 1897, p. 57 [as synonym of *F. abbreviata*].

1851: *Spiroptera philomelæ* DIESING, 1851a, p. 226.—LINSTOW, 1878, pp. 87, 92.

1888: *Filaria abreviata* MAGALHÃES, 1888, p. 11 [misprint for *Filaria abbreviata*].

1897: *Filaria philomelæ* DIESING of STOSSICH, 1897, p. 57 [error for *Spiroptera philomelæ;* as synonym of *F. abbreviata*].

SPECIFIC DIAGNOSIS.—*Filaria:* Body elongated, armed with deciduous spines arranged in longitudinal series; anterior extremity abruptly attenuated, truncated; posterior extremity thicker. Mouth without papillæ; infundibuliform pharynx supplied with six tooth-like organs, three on the dorsal and three on the inferior surface.

Male: 12 to 25 mm. long by 0.5 mm. thick. Caudal extremity curved, truncated. Spicules two, unequal; short spicule ensiform; long spicule twisted spirally.

Female: 30 to 50 mm. long by 0.5 to 1 mm. thick. Caudal extremity straight, obtuse.

HABITAT.—*Motacilla stapazina* [=Russet wheatear, *Saxicola rufa*]; orbital cavity; ? Europe (Rudolphi, 1819).—*Motacilla melanocephala* [=Sardinian warbler, *Melizophilus melanocephalus*); abdomen; ? Europe (Diesing, 1851a).—*Sylvia rubecula* [=robin redbreast, *Erithacus rubecula*]; abdomen; ? Europe (Diesing, 1851a).—*Sturnus pyrrhocephalus* [=scarlet-headed marsh bird, *Amblyrhamphus holosericeus*]; abdomen; Brazil (Molin, 1858).—*Thryothorus polyglottus* [=Brazilian short-billed marsh wren, *Cistothorus polyglottus*]; abdomen; Brazil (Molin, 1858).—*Tanagra jacapa* [=Jacapa tanager, *Ramphocelus jacapa*]; kidney; Brazil (Molin, 1858).—Red oven bird, *Furnarius rufus;* abdomen and kidneys; Brazil (Molin, 1858).—Pale-footed oven bird, *Furnarius leucopus;* abdomen; Brazil (Molin, 1858).

In the following hosts parasites have been found which have been identified provisionally as *Filaria abbreviata:* White wagtail, *Motacilla alba;* thoracic cavity; Europe (Walter, 1866).—Fieldfare, *Turdus pilaris;* abdomen; ? Europe (Rudolphi, 1819).—Mistletoe thrush, *Turdus viscivorus;* abdomen; ? Europe (Rudolphi, 1819).—*Motacilla rubecula* [=robin redbreast, *Erithacus rubecula*]; abdomen; ? Europe (Rudolphi 1819).—*Motacilla œnanthe* [=wheatear, *Saxicola œnanthe*]; abdomen; ? Europe (Rudolphi, 1819).—*Motacilla philomela* [=thrush nightingale, *Aedon luscinia*]; about the ears, cheeks, and neck; ? Europe (Rudolphi, 1819).—*Muscicapa* sp. [=probably some species of Tyrannidæ]; abdomen; Brazil (Rudolphi, 1819).—*Falco nævius* [=spotted eagle, *Aquila maculata*]; eyes and nares; ? Europe (Rudolphi, 1819).—*Saxicola* sp.; body cavity; Turkestan (Linstow, 1883).

TYPE SPECIMENS.—? In Berlin Museum.

The above description is taken from that given by Molin (1858, p. 396). Rudolphi's (1819, p. 210) original description based on 3 specimens, females, from the orbit of *Motacilla stapazina*, gives the length as 16 to 18 mm.; body of uniform thickness; head slender, obtuse; mouth orbicular; tail rounded; intestine of uniform thickness, dark yellow in color. A few remarks are made also concerning the female organs, but no distinctive characters are given.

Rudolphi (1819, p. 555) also describes briefly some worms from the collection of the Vienna Museum, said to have been taken from the ears and around the eyes of *Falco nævius.* These worms were apparently

of the same species as those from *Motacilla stapazina*. It seemed, however, doubtful to Rudolphi that birds so different should harbor the same species of parasite, and he therefore inclined to the belief that some error had been made in the identification of the one or the other host. He places the worms from *Falco nævius* in his list of doubtful forms. Subsequent authors have, however, generally included them with *Filaria abbreviata*. There were a number of males present, measuring 12 to 14 mm. in length, with a tail coiled once spirally, terminating in a very short point; spicule recurved. The females had a tail with a very short depressed tip.

[?Filaria] armata Gescheidt, 1833.

Synonymy and Bibliography.

1833: *Filaria armata* Gescheidt, 1833a, pp. 442–444, 445.—Idem [1834a, p. 55].—Rayer, 1843, pp. 145–146, 148, 149 [includes translation of Gescheidt, 1833a, pp. 442–444].—Creplin, 1846b, pp. 160, 163, 172.—Diesing, 1851a, p. 275.—Idem, 1861a, p. 703.—Molin, 1858, pp. 404, 448.—Leuckart, 1876, v. 2, Lief. 3, p. 627.—Linstow, 1878, p. 112.—Stossich, 1897, pp. 60, 140.

Specific diagnosis.—? *Filaria: Species inquirenda.*

Male: Unknown.

Female: Body 7 mm. long by 1 mm. thick, slightly broader at the tail. Head with four nodular spines. Tail obtuse, rounded, with short, blunt mucronate tip.

Habitat.—*Falco lagopus* [=rough-legged hawk, *Archibuteo lagopus*]; vitreous body of eye; ? Europe (Gescheidt, 1833a).

Type specimens.—The single specimen on which the species is based is probably not in existence.

? Filaria attenuata Rudolphi, 1802.

Linstow (1879, p. 315), in a list of parasites collected by Doctor von Hering, Stuttgart, mentions a worm from the eyes of the black crow, *Corvus corone*, considered possibly identical with *Filaria attenuata*. The specimens were very poorly preserved.

To this species Shipley (1903, p. 605) also refers provisionally a roundworm collected by Hawker in the Soudan from the orbit of an eagle owl (*Bubo* sp.). The species named, however, can scarcely come into consideration in this connection.

The original *Filaria attenuata* Rudolphi, 1802, came from crows, and though later Rudolphi assigned worms from hawks and falcons to the same species, Molin (1858, pp. 375–376, 394–395) has shown that the latter are a distinctly different species from the former, and that *F. attenuata* probably does not occur in the latter group of birds.

[?Filaria] bonasiæ Rayer, 1843.

Synonymy and Bibliography.

1832: *Filaria* sp. Nordmann, 1832, pp. 16–17.—Gescheidt, 1833a, p. 423.—Gurlt, 1845a, p. 263.—Creplin, 1846b, p. 175.

1843: *Filaria bonasiæ* Rayer, 1843, p. 149.—Dujardin, 1845a, p. 56.—Diesing, 1851a, p. 282.—Molin, 1858, pp. 426, 442.—Linstow, 1878, p. 120.—Stossich, 1897, pp. 62, 119.

1851: *Filaria tetraonis bonasiæ* Diesing, 1851a, p. 282 [as synonym of *Filaria bonasiæ*].—Molin, 1858, p. 426 [as synonym of *F. bonasiæ*].

SPECIFIC DIAGNOSIS.—? *Filaria: Species inquirenda.* Length 10 to 12 mm.; color white.

HABITAT.—*Tetrao bonasia* [=hazel hen, *Tetrastes bonasia*]; posterior chamber of eye; Gulf of Finland (Nordmann, 1832).

TYPE SPECIMENS.—Probably not in existence.

FIG. 26.—[?*Filaria*] *campanulata.* Female. Natural size. (Haines del., after Molin, 1858, pl. 2, fig. 5.)

Reported but once; a single specimen collected.

[?FILARIA] CAMPANULATA MOLIN, 1858.

(Figs. 26–28.)

SYNONYMY AND BIBLIOGRAPHY.

1858: *Filaria companulata* MOLIN, 1858, pp. 392-393, 448, pl. 2, figs. 5-7.—DIESING, 1861a, p. 702.—LINSTOW, 1878, p. 116.—STOSSICH, 1897, pp. 63, 141.

1858: *Filaria falconis magnirostris* MOLIN, 1858, p. 392 [as synonym of *F. campanulata*].

SPECIFIC DIAGNOSIS.—? *Filaria:*

Male: Unknown.

Female: 15 mm. long by 0.5 mm. thick. Anterior extremity of body attenuated, obtuse. Surface of body annulated; annulations campaniform, imbricated. Tail nearly straight, pointed. Vulva in anterior portion of body.

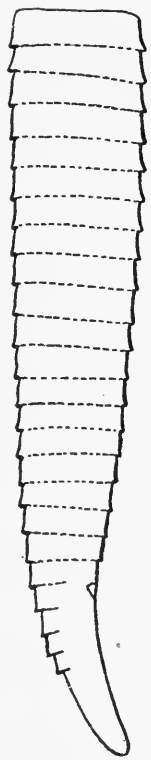

FIG. 28.—[?*Filaria*] *campanulata.* Posterior end of female. Enlarged. (Haines del., after Molin, 1858, pl. 2, fig. 7.)

HABITAT.—*Falco magnirostris* [=large-billed hawk, *Rupornis magnirostris*]; under nictitating membrane; Brazil (Molin, 1858).

TYPE SPECIMENS.—In Vienna Museum.

This species is based upon a single specimen collected by Natterer in Brazil, and was placed in the genus *Filaria* by Molin (1858, p. 393) on account of the position of the vulva.

FIG. 27.—[?*Filaria*] *campanulata.* Anterior end of female. Enlarged. (Haines del., after Molin, 1858, pl. 2, fig. 6.)

FILARIA CIRRURA LEIDY, 1886.

SYNONYMY AND BIBLIOGRAPHY.

1886: *Filaria cirrura* LEIDY, 1886, p. 309.—LINSTOW, 1889, p. 37.—STOSSICH, 1897, p. 64.

SPECIFIC DIAGNOSIS.—*Filaria:* Body cylindrical, nearly equal, cephalic end conical, rounded truncate, smooth; mouth a minute funnel-like orifice without papillæ or internal armature.

Male: 10 mm. long by 0.375 mm. thick. Caudal end closely rolled inward, conical, blunt, without alæ or papillæ; penal spiculæ strongly curved, with the points projecting from the prominent genital aperture situated above the tail end.

Female: 16 mm. long by 0.5 mm. thick. Caudal end slightly curved or nearly straight, conical, obtusely rounded, without appendages. [Vulva about 0.4 mm. from the cephalic end.]

HABITAT.—*Quiscalus major* [=boat-tailed grackle, *Megaquiscalus major*]; orbit; Florida (Leidy, 1886).

TYPE SPECIMENS.—In Helminthological Collection, U. S. National Museum, No. 66.

The above diagnosis comprises the original description of Leidy (1886) which was based upon specimens of 4 females and 2 males. After examining the original material I am able to add one item to Leidy's diagnosis, namely, the position of the vulva.

[? Filaria] dendrocolaptis procurvi lacrymalis Molin, 1858.

Synonymy and Bibliography.

1858: *Filaria dendrocolaptis procurvi lacrymalis* Molin, 1858, pp. 425, 443.
1858: *Filaria dendrocolaptis* Molin, 1858, p. 425 [as synonym of *Filaria dendrocolaptis procurvi lacrymalis;* not *F. dendrocolaptis* Molin, 1858, p. 399=*Filaria quadriverrucosa* Molin, 1858, p. 398].
1879: *Filaria dendrocolapti procurvi* Linstow, 1878, p. 80.
1897: *Filaria dendrocolaptis procurvi* Stossich, 1897, pp. 67, 147.

Specific diagnosis.—? *Filaria: Species inquirenda.* Ten mm. long by 0.5 mm. thick. Anterior extremity of body pointed. Surface of body thickly striated transversely. Posterior extremity thickened, curved. Mouth without lips.

Habitat.—*Dendrocolaptes procurvus* [=curve-bill woodhewer, *Xiphorhynchus procurvus*]; eye; Brazil (Molin, 1858).

Type specimens.—In Vienna Museum.

This form is listed among *species inquirendæ* by Molin (1858, p. 425). The sex of the single specimen examined by him could not be determined.

[? Filaria] myotheræ campanisonæ Molin, 1858.

Synonymy and Bibliography.

1858: *Filaria myotheræ campanisonæ* Molin, 1858, pp. 425, 444.—Linstow, 1878, p. 81.—Stossich, 1897, pp. 74, 144.
1858: *Filaria turdi* Molin, 1858, p. 425 [as synonym of *F. myotheræ campanisonæ;* not *F. turdi* Molin, 1858, p. 396, as synonym of *F. filiformis;* not *F. turdi* Molin, 1858, p. 423, as synonym of *F. turdi olivascentis* (*palpebralis*); not *F. turdi* n. sp. Linstow, 1877, pp. 173-174].

Specific diagnosis.—? *Filaria: Species inquirenda.*

Male: Unknown.

Female: 25 mm. long by 0.5 mm. thick. Anterior end of body attenuated, posterior end thickened.

Habitat.—*Myothera campanisona* [=short-tailed ant thrush, *Chamæza brevicauda*]; eye; Brazil (Molin, 1858).

Type specimens.—In Vienna Museum.

Only a single opaque specimen of this species was examined by Molin (1858).

Filaria obtuso-caudata Rudolphi, 1819.

(Figs. 29, 30.)

Synonymy and Bibliography.

1819: *Filaria obtuso-caudata* Rudolphi, 1819, p. 634 [not *Filaria obtusocaudata* Schneider, 1866, p. 101=*Filaria Schneideri* Stossich, 1897].—Dujardin, 1845a, p. 55.—Gurlt, 1845a, p. 250.—Creplin, 1846b, pp. 155, 160, 161, 172.—Diesing, 1851a, p. 277.—Idem, 1861a, p. 710 [as synonym of *Monopetalonema obtuse-caudatum*].—Molin, 1858, pp. 413-414, 442, 443, 447.—Linstow, 1878, pp. 74, 75.—Idem, 1879, pp. 315, 327.—Parona, 1889, p. 762, fig. 4.—Stossich, 1897, pp. 37, 144, 148, 149.
1819: *Filaria collurionis subcutanea* Rudolphi, 1819, pp. 8, 217 [in part; under skin of *Lanius minor* and *L. pomeranus*].—Diesing, 1851a, p. 274 [as synonym of *F. nodulosa*].—Molin, 1858, p. 413 [as synonym of *F. obtuso-caudata*].—Dujardin, 1845a, p. 52 [in part].—Parona, 1889, p. 762 [as synonym of *F. obtuso-caudata*].
1851: *Filaria nodulosa* Rudolphi, 1820 of Diesing, 1851a, pp. 274-275 [in part; under skin of *Lanius minor* and *L. pomeranus*].—Molin, 1858, p. 413 [as synonym of *F. obtuso-caudata*].—Diesing, 1861a, p. 710 [as synonym of *Monopetalonema obtuse-caudatum*].—Parona, 1889, p. 762 [as synonym of *F. obtuso-caudata*].

1858: *Filaria tetraonis* Molin, 1858, p. 413 [as synonym of *F. obtuso-caudata;* not *F. tetraonis* Molin, 1858, p. 427=*F. perdicis dentatæ*].
1861: *Monopetalonema obtuse-caudatum* (Rudolphi, 1819) Diesing, 1861a, p. 710.—Stossich, 1897, p. 37 [as synonym of *Filaria obtuso-caudata*].
1879: *Monopetatonema obtus* [*ecaudatum*] Linstow, 1878, p. 74 [misprint for *Monopetalonema obtusecaudatum;* as synonym of *Filaria obtuso-caudata*].
1883: ? *Filaria obtuso-caudata* Linstow, 1883, pp. 284-285.—Idem, 1886, p. 10.

Specific diagnosis.—*Filaria:* Anterior end of body obtuse, with 8 nodules; posterior end gradually attenuated. Mouth bilabiate with unarmed truncate conical lips.

Fig. 29.—*Filaria obtuso-caudata.* Posterior end of male. Enlarged. (Haines del., after Parona, 1889, p. 762, fig. 4.)

Male: 20 to 37 mm. long by 0.5 mm. thick. Tail curved, with a slender 5-ribbed membrane on each side. Spicules two, unequal, very straight and slender; long spicule 2.5 to 3 mm. long; short spicule 0.36 mm. long.

Female: 30 to 125 mm. long by 0.5 to 1 mm. thick. Tail straight, obtuse. Position of vulva not determined.

Habitat.—*Picus lineatus* [=lineated woodpecker, *Ceophlœus lineatus*]; thoracic cavity; Brazil (Rudolphi, 1819).—*Picus flavescens* [=black and yellow woodpecker, *Celeus flavescens*]; subcutaneous connective tissue of neck; Brazil (Diesing, 1851a); under skin of neck and superorbital region, and in walls of esophagus; Brazil (Molin, 1858).—*Picus robustus* [=Brazilian ivory-billed woodpecker, *Campephilus robustus*]; muscles of neck; Brazil (Diesing, 1851a).—*Picus passerinus* [=sparrow woodpecker, *Veniliornis passerinus*]; orbital cavity; ? Brazil (Diesing, 1851a); under skin of neck; Brazil (Molin, 1858).—*Picus aurulentus* [=Brazilian green woodpecker, *Chloronerpes aurulentus*]; muscles of neck; Brazil (Diesing, 1851a; Molin, 1858); under skin of neck; Brazil (Molin, 1858).—*Picus leucolæmus* [=white-throated green woodpecker, *Chloronerpes leucolæmus*]; subcutaneous connective tissue of neck; Brazil (Diesing, 1851a).—*Picus jumana* [=Jumana woodpecker, *Celeus jumana*]; muscles and subcutaneous connective tissue of neck; Brazil (Diesing, 1851a); under skin of and in tumor of neck; Brazil (Molin, 1858).—*Picus rubricollis* [=red-necked ivory-billed woodpecker, *Campephilus rubricollis*]; muscles of neck; Brazil (Diesing, 1851a); under skin of neck; Brazil (Molin, 1858).—Lesser gray shrike, *Lanius minor;* under skin; ? Europe (Rudolphi, 1819).—*Lanius pomeranus* [=pomerine shrike, *Lanius senator,* or rufous shrike, *Lanius rutilus*]; under skin; ? Europe (Rudolphi, 1819).—*Lanius rufus* [=rufous shrike, *Lanius rutilus*]; under skin near eye; ? Europe (Linstow, 1879).—*Lanius* sp.; under skin in occipital region; Abyssinia (Parona, 1889).

Fig. 30.—*Filaria obtuso-caudata.* Anterior end of male. Enlarged. (Haines del., after Parona, 1889, p. 762, fig. 4.)

In the following host a parasite was found which was identified provisionally as *Filaria obtuso-caudata.*—*Lanius* sp.; ? location; Turkestan (Linstow, 1883).—*Perdix leucostricta* [=stellated partridge, *Odontophorus stellatus*]; wing muscles; Brazil (Molin, 1858).

Type Specimens.—? In Vienna or Berlin Museum.

This species is based on a single specimen of female collected from the thoracic cavity of *Picus lineatus* by Natterer in Brazil. Rudolphi (1819, p. 634) described this specimen as slender, gradually attenuated posteriorly, with rather acute head, apex of tail very obtuse and short. Length, 20 mm. (15 lines). Mouth orbicular, unarmed. Two unequal spicules. Diesing (1851a, p. 277) enlarged slightly upon Rudolphi's

original description and added a number of hosts. The description and list of hosts was still further extended by Molin (1858, pp. 413–414) and a part of *Filaria nodulosa* Rudolphi of Diesing (1851a), transferred to the species under discussion. Diesing (1861a, p. 710) placed this form in the genus *Monopetalonema*. Linstow (1879, 1883, 1886) and Parona (1889) have added one or two points to our incomplete knowledge of the anatomy of this form, and record new hosts and localities.

Filaria oculi of "C. W. W.," 1891.

"C. W. W." (1891, p. 290) mentions a nematode found in the interior chamber of the eye of a parrot. No microscopic examination was made.

Filaria papilloso-annulata Molin, 1858.

Synonymy and Bibliography.

1851: *Filaria attenuata* Rudolphi of Diesing, 1851a, p. 266 [in part; from the orbit of *Falco swainsonii*, Brazil[1]].

1858: *Filaria papilloso-annulata* Molin, 1858, pp. 399–400, 448.—Diesing, 1861a, p. 702.—Linstow, 1878, p. 118.—Stossich, 1897, pp. 75, 141.

1858: *Filaria attenuata falconis picti* Molin, 1858, p. 400 [as synonym of *F. papilloso-annulata;* not *F. attenuata falconis picti* Molin, 1858, p. 392, as synonym of *F. verrucosa*.]

Specific diagnosis.—*Filaria:*

Male: Unknown.

Female: 50 mm. long by 1 mm. thick. Anterior end of body obtusely attenuated, closely annulated as far as the vulva. Mouth surrounded by eight papillæ. Posterior end of body thickened, with very acute caudal tip.

Habitat.—*Falco swainsonii* [=Vigors hawk, *Gampsonyx swainsoni*]; in posterior region of orbit; Brazil (Diesing, 1851a).

Type specimens.—In Vienna Museum.

This species is based upon two female specimens (Molin, 1858, p. 400) collected by Natterer, the same apparently as those from the orbit of *Falco swainsonii* mentioned by Diesing (1851a) and identified by him as *Filaria attenuata*.

[? Filaria] sylviæ Diesing, 1851.

Synonymy and Bibliography.

1832: *Filaria* sp. Nordmann, 1832, p. 17.

1851: *Filaria sylviæ* Nordmann of Diesing 1851a, p. 281 [not *F. sylviæ* Molin, 1858, p. 425, as synonym of *F. myotheræ chrysopygæ*].—Molin, 1858, pp. 423, 447.—Linstow, 1878, p. 86.—Stossich, 1897, pp. 82, 143.

Specific diagnosis.—?*Filaria: Species inquirenda.*

Length, 37.5 mm.

Habitat.—*Sylvia abietina* [=chiffchaff, *Phylloscopus minor*]; orbital cavity; Germany (Nordmann, 1832.)

Type specimens.—Probably not in existence.

Reported but once. A single specimen collected by Doctor Gloger in Breslau (Nordmann, 1832, p. 17).

[? Filaria] tinami variegati Molin, 1858.

Synonymy and Bibliography.

1858: *Filaria tinami variegati* (*palpebralis*) Molin, 1858, pp. 427, 441.
1858: *Filaria tinami variegati* Molin, 1858, p. 427 [as synonym of *F. tinami variegati* (*palpebralis*)].—Linstow, 1878, p. 125.—Stossich, 1897, p. 83.
1858: ? *Filaria labiotruncata* Molin, 1858, p. 427 [as possible synonym of *F. tinami variegati* (*palpebralis*)].

Specific diagnosis.—? *Filaria: Species inquirenda.*

No description.

Habitat.—*Tinamus variegatus* [=variegated tinamou, *Crypturus variegatus*]; under nictitating membrane; Brazil (Molin, 1858).

Type specimens.—In Vienna Museum.

Molin (1858, p. 427) examined a single specimen collected by Natterer in poor state of preservation, which seemed to be a female belonging to *Filaria labiotruncata*, but he separated it from the latter on account of the difference in habitat.

[? Filaria] turdi olivascentis (palpebralis) Molin, 1858.

Synonymy and Bibliography.

1858: *Filaria turdi olivascentis* (*palpebralis*) Molin, 1858, pp. 423, 446.
1858: *Filaria turdi* Molin, 1858, p. 423 [not *F. turdi* Molin, 1858, p. 396 = *F. filiformis;* not *F. turdi* Molin, 1858, p. 425 = *F. myotherœ campanisonœ;* not *F. turdi* Linstow, 1877, pp. 173–174.]
1878: *Filaria turdi olivascentis* Linstow, 1878, p. 90.—Stossich, 1897, pp. 85, 143.

Specific diagnosis.—? *Filaria: Species inquirenda.* No description.

Habitat.—*Turdus olivascens* [identity of host unknown; this name not found in ornithological literature]; under nictitating membrane; Brazil (Molin, 1858).

Type specimens.—In Vienna Museum.

Molin (1858) remarks that the two specimens of this form collected by Natterer were in too bad condition to be studied.

Genus **SPIROPTERA**[a] Rudolphi, 1819.

Generic diagnosis.—Filariidæ: Scarcely distinguishable from *Filaria*. Body generally shorter and thicker. Vulva usually at a considerable distance from anterior end of body. Tail of male rolled spirally and furnished with lateral membranes.

Type species.—Probably *Spiroptera euryoptera* Rudolphi, 1819.[b]

? Spiroptera caprimulgi Molin, 1860.

Shipley (1903, p. 606) mentions a worm from the orbit of a "Night jar" (*Caprimulgus europæus* or *C. ægyptius*) collected by R. M. Hawker in the Soudan, and refers it provisionally to *Spiroptera caprimulgi* Molin, a species based upon a single specimen collected in Brazil from the stomach walls of *Caprimulgus megalurus* and listed among *species inquirendæ* by the latter author.

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[a] As will be shown in a forthcoming check list of the nematodes by Stiles and Hassall, the name *Acuaria* Bremser, 1811, must replace the name *Spiroptera*, as the latter is simply the genus *Acuaria* renamed. Since the generic relationship of each of the three species, *caprimulgi* of Shipley, *feai*, and *tenuicauda*, is very doubtful, I have, in order to avoid a multiplication of names, retained in the present paper the name *Spiroptera*, with which the species in question were originally listed.

[b] See nematode check-list by Stiles & Hassall (MS.).

[? Spiroptera] Feai Stossich, 1897.

Synonymy and Bibliography.

1889: *Spiroptera* sp. Parona, 1889, pp. 775, 779.—Stossich, 1897, p. 114 [as synonym of *S. Feai* Stossich)].
1897: *Spiroptera Feai* Stossich, 1897, pp. 114, 142.

Specific diagnosis.—? *Spiroptera:*

Male: Unknown.

Female: 16 mm. long by 1 mm. thick. Head rounded, with two conical papillæ. Caudal extremity very obtuse, not pointed.

Habitat.—Burmese hawk-owl, *Ninox scutulata;* orbital cavity, behind the eyeball; Burma (Parona, 1889).

Type specimens.—[?]

This species is based on Parona's (1889) description of material collected by Leonardo Fea in Burma. On account of our incomplete knowledge of the anatomy of this form its classification in the genus *Spiroptera* may be considered only provisional.

[? Spiroptera] tenuicauda Molin, 1860.

(Fig. 31.)

Synonymy and Bibliography.

1860: *Spiroptera tenuicauda* Molin, 1860, pp. 983-984, 991, 992.—Linstow, 1878, pp. 124, 146.—Idem, 1889, p. 53.—Drasche, 1884a, p. 207, pl. 12, fig. 17.—Stossich, 1897, pp. 88-89, 149.
1860: *Spiroptera eiconiæ maguari* Molin, 1860, p. 983 [as synonym of *Spiroptera tenuicauda;* not *S. eiconiæ maguari* Molin, 1860, p. 932=*S. exeisa;* not *S. eiconiæ maguari* Molin, 1860, p. 486 =*Dispharagus longevaginatus*].
1860: *Spiroptera cracis* N. of Molin, 1860, p. 983 [as synonym of *S. tenuicauda;* not *S. cracis* Molin, 1860, p. 944=*S. heteroclita*].

Specific diagnosis.—? *Spiroptera:*

Male: Unknown.

Female: 8 to 19 mm. long by 0.2 mm. thick. Body slender, increasing in thickness anteriorly, posteriorly gradually attenuated. Anterior end coiled in a single turn, apex truncated. Head with two membranous alæ,[a] lips absent, mouth opening hexagonal, two lateral and four submedian papillæ. Pharynx absent. Esophagus ends in a bulb with dental apparatus. Tail straight, slender, acutely conical, with very acute tip. Anus remote from caudal tip. Position of vulva not determined.

Fig. 31.—[?*Spiroptera*] *tenuicauda.* Anterior view of head. × 280. (Haines del., after Drasche, 1884a, pl. 12, fig. 17.)

Habitat.—*Ciconia maguari* [= South American stork, *Euxenura maguari*]; proventriculus; Brazil (Molin, 1860).—*Crax tomentosa* [=Brazilian mitua, *Mitua tomentosa*]; under nictitating membrane; Brazil (Molin, 1860).

Type specimens.—In Vienna Museum.

This species is based on specimens of two females collected by Natterer in 1831 from the proventriculus of *Ciconia maguari*, and two females and a fragment from under the nictitating membrane of *Crax tomentosa*, also collected by Natterer in 1831. Molin (1860, p. 984), considers it probable that the forms from *Ciconia* are of a different species from those from *Crax*, but since he saw no males from either

[a] According to Molin (1860, p. 983), membranous appendages are lacking. Drasche (1884a, p. 20), who reexamined Molin's material, found alæ on the head.

host, the great similarity in the females did not justify him, he believed, in creating two species.

Drasche (1884a, p. 207), who reexamined the original material, does not state whether he examined specimens from both hosts or from but one. He doubts that the species belongs in the genus *Spiroptera*.

Genus **APROCTA** Linstow, 1883.

Generic diagnosis.—Filariidæ: Body rounded at both ends. Head attenuated. Mouth without lips. Esophagus short. Anus lacking. Lateral fields very broad and thin, without excretory vessels. Excretory pore lacking. Caudal extremity without papillæ, or with a single unpaired papilla near posterior end.

Type species.—*Aprocta cylindrica* Linstow, 1883.

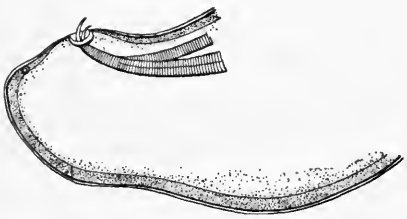

Fig. 32.—*Aprocta cylindrica*. Posterior end of male. Enlarged. (Haines del., after Linstow, 1883, pl. 7, fig. 21.)

Aprocta cylindrica Linstow, 1883.

(Fig. 32.)

Synonymy and Bibliography.

1883: *Aprocta cylindrica* Linstow, 1883, pp. 289–290, pl. 7, fig. 21.—Idem, 1889, p. 35.—Idem, 1901, p. 188.

Specific diagnosis.—*Aprocta:* Head rounded without lips or papillæ. Tail rounded in both sexes. Esophagus short; measures $\frac{1}{15}$ of the length of the body. Anus absent. Musculature meromyarian. Lateral fields very broad and thin.

Male: 16 mm. long by 0.54 mm. thick. Genital opening prominent; one pair postanal papillæ. Tip of tail prolonged into short appendage. Spicules two, almost equal, short, curved, 0.31 mm. and 0.28 mm. in length.

Female: 27 mm. long by 0.9 mm. wide. Eggs elliptical, 0.026 by 0.01 mm.

Habitat.—*Petrœca cyanea* [=blue rock thrush, *Petrophila cyanus*]; orbital cavity; Turkestan (Linstow, 1883).

Type specimens.—[?].

Aprocta ophthalmophaga Stossich, 1902.

Synonomy and Bibliography.

1902: *Aprocta ophthalmophaga* Stossich, 1902, p. 73.

Specific diagnosis.—*Aprocta:* Body thick, cylindrical, attenuated at both ends. Head (lacking in all specimens studied).

Male: 20 to 24 mm. long. Tail coiled spirally, with rounded tip, lacking bursa and papillæ. Cloacal opening salient; spicules two, of equal length, short, with hook-like points.

Female: 40 mm. long. Caudal extremity broad and rounded. Vulva prominent near cephalic extremity. Eggs elliptical, with thick yellowish shell.

Habitat.—Falcon, *Falco* sp.; behind eyeball; Abyssinia (Stossich, 1902).

Type specimens.—In Collection Parona.

This species is based upon a number of specimens collected by Doctor Traverso in November, 1885.

Aprocta orbitalis Linstow, 1901.

(Figs. 33, 34.)

Synonymy and Bibliography.

1901: *Aprocta orbitalis* Linstow, 1901, p. 188, pl. 8, figs. 10, 11.

Specific diagnosis.—*Aprocta:* Anterior end of body rounded, somewhat conical, without papillæ. Esophagus short, anus absent, lateral fields very thin and broad, each equal to $\frac{1}{6}$ of the periphery of the body. Excretory vessels and pore lacking.

Male: 21 mm. long by 1.03 mm. thick. Esophagus $\frac{1}{25}$ the body length. Tail coiled into a double spiral. Tip prolonged into a short appendage with rounded extremity. Appendage measures $\frac{1}{69}$ of the body length. Spicules two, short, 0.40 and 0.47 mm. in length. Genital opening rather prominent. Papillæ absent.

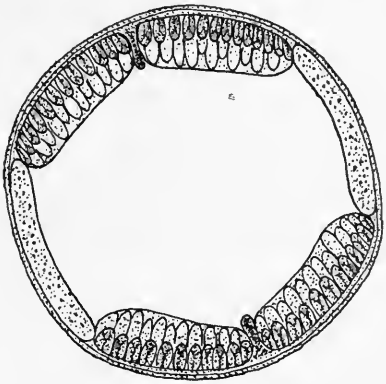

Fig. 33.—*Aprocta orbitalis.* Cross section. Enlarged. (Haines del., after Linstow, 1901, pl. 8, fig. 10.)

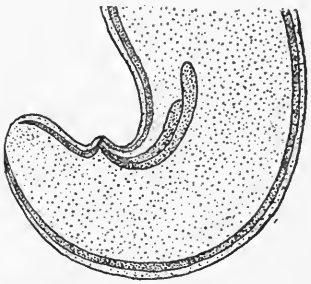

Fig. 34.—*Aprocta orbitalis.* Posterior end of male. Enlarged. (Haines del., after Linstow, 1901, pl. 8, fig. 11.)

Female: 38 mm. long by 1.26 mm. thick. Esophagus $\frac{1}{39}$ of the body length. Vulva rather prominent, anterior, 0.79 to 1.03 mm. from the cephalic extremity. Eggs thick-shelled, oldest contain worm-like embryos and measure 0.055 mm. long by 0.036 mm. thick.

Habitat.—*Falco fuscoater* [=black kite, *Milvus korschun*]; orbit; ? locality (Linstow, 1901).

Type specimens.—In Breslau Collection.

Genus **PHYSALOPTERA** Rudolphi, 1819.

Generic diagnosis.—Filariidæ: Mouth with two equal lips, each with three papillæ on the outer surface, and each armed with teeth at the extremity and usually also on the internal surface. There are usually present cuticular expansions of variable form behind the lips. Posterior extremity of male is lanceolate, spoon-like, surrounded by a vesicular border. Two varieties of papillæ: A series of external pedunculate papillæ, four on each side, in the anal region, serving as supporting ribs for the bursa; and internal papillæ, almost always sessile; frequently an unpaired papilla in front of the anus. Spicules two, unequal. Female with two ovaries; vulva in anterior part of body. Oviparous.

Type species.—*Physaloptera clausa* Rudolphi, 1819.[a]

[a] See nematode check-list by Stiles & Hassall (MS.).

PHYSALOPTERA ACUTICAUDA MOLIN, 1860.

(Figs. 35, 36.)

SYNONYMY AND BIBLIOGRAPHY.

1851: *Physaloptera alata* RUDOLPHI of DIESING, 1851a, p. 234 [in part].—MOLIN, 1860, p. 661 [in part; as synonym of *P. acuticauda*].

1860: *Physaloptera acuticauda* MOLIN, 1860, pp. 661–663, 669, 670.—LINSTOW, 1878, pp. 110, 114, 115, 116, 117, 118.—IDEM, 1889, p. 41.—IDEM, 1901, p. 413.—DRASCHE, 1883b, p. 127, pl. 8, figs. 4, 5.—STOSSICH, 1889, pp. 46, 56, pl. 2, fig. 14, pl. 3, fig. 33.

SPECIFIC DIAGNOSIS.—*Physaloptera:* Body filiform, more attenuated posteriorly. Well-developed membranous expansions on the head. Mouth bilabiate, anterior border of lips semicircular. Each lip furnished with a large pointed outer tooth and three small inner teeth.

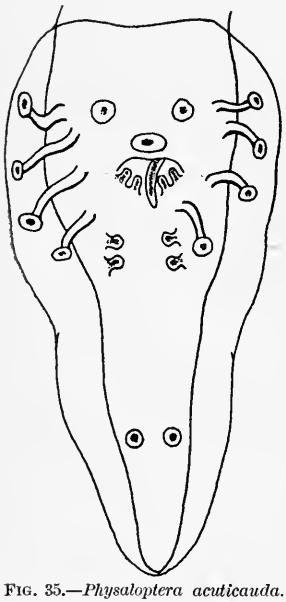

FIG. 35.—*Physaloptera acuticauda.* Posterior end of male. × 80. (Hainesdel., after Drasche, 1883b, pl. 8, fig. 4.)

Male: 20 to 32 mm. long by 0.8 mm. thick. Tail curved, with long semilanceolate bursal membranes; four pairs of rib-like papillæ supporting the bursal membrane on either side, two postanal and two preanal; near the median line five pairs of sessile postanal papillæ, two just posterior of the anal opening, two slightly farther back, and the remaining pair at about two-thirds of the distance from the anus to the tip of the tail; one pair of preanal papillæ not far from the median line a short distance in front of the anus, and a single median unpaired papilla just anterior of the anal opening; spicules two, unequal, one of them very long and filiform.

Female: 20 to 43 mm. long by 0.8 to 1.2 mm. thick. Tail long and conical, with rather acute tip. Anus some distance from tip of tail. Vulva in anterior part of body.

HABITAT.—Falcon, *Falco* sp.; gizzard.—*Falco cachinans* [=laughing falcon, *Herpetotheres cachinnans*]; esophagus and gizzard.—*Falco gracilis* [=gray crane-hawk, *Geranospizias cærulescens*]; esophagus and gizzard.—*Falco swainonii* [=Vigors hawk, *Gampsonyx swainsoni*]; esophagus.—*Falco rutilans* [=brown buzzard, *Heterospizias meridionalis*]; gizzard.—*Falco ornatus* [=Brazilian crested eagle, *Spizaetus mauduyti*]; esophagus and gizzard.—*Falco palustris* [=long-winged harrier, *Circus maculosus*]; esophagus and gizzard.—*Falco coronatus* [=crowned harpy, *Harpyhaliaëtus coronatus*]; orbital cavity, free in occipital region and in gizzard.—*Falco urubutinga* [=South American black hawk, *Urubitinga urubitinga*]; gizzard.—*Falco dispar* [=long-tailed kite, *Elanus leucurus*]; gizzard.—*Falco atricapillus* [=Vieillot hawk, *Spiziaster melanoleucus*]; mouth, esophagus, and gizzard.—*Falco cayennensis* [=Cayenne falcon, *Leptodon cayennensis*]; gizzard.—*Falco unicinctus* [=one banded buzzard, *Parabuteo unicinctus*]; esophagus and gizzard.—*Falco minutus* [=South American sharp-shinned hawk, *Accipiter tinus*]; gizzard. All the above hosts were first reported by Molin (1860) from Brazil.—Black-winged kite, *Elanus cæruleus*; stomach; Lake Nyassa, Africa (Linstow, 1901).

FIG. 36.—*Physaloptera acuticauda.* Inner view of lip. × 165. (Haines del., after Drasche, 1883b, pl. 8, fig. 5.)

TYPE SPECIMENS.—In Vienna Museum.

Drasche (1883b) has restudied the original material.

PHYSALOPTERA SP. PARONA, 1885.

(Fig. 37.)

SYNONYMY AND BIBLIOGRAPHY.

1885: *Physaloptera* sp. PARONA, 1885, pp. 438–439, pl. 7, fig. 22.—LINSTOW, 1889, p. 53.

SPECIFIC DIAGNOSIS.—*Physaloptera:*

Male: Unknown.

Female: 32 mm. long. Head with wing-like appendages and two or more papillæ or lips.

HABITAT.—Sacred ibis, *Ibis æthiopica;* orbital cavity; Abyssinia (Parona, 1885).

TYPE SPECIMENS.—[?]

One specimen collected by P. Magretti in March, 1882.

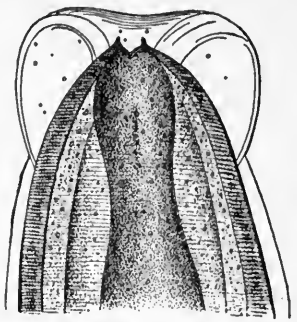

FIG. 37.—*Physaloptera* sp. Anterior end of female, showing wing-like appendages and lips. × 75. (Haines del., after Parona, 1885, pl. 7, fig. 22.)

GENUS **SYNGAMUS** SIEBOLD, 1836.

GENERIC DIAGNOSIS.—Strongylidæ: Head thick. Mouth large, followed by a chitinous pharyngeal capsule.

Male: Truncated posteriorly with fan-like bursa and two spicules.

Female: With a double ovary. Vulva usually anterior of the middle of the body. Copulation is permanent in many species.

HABITAT.—Usual habitat is the trachea and bronchi of birds and mammals.

TYPE SPECIES.—*Syngamus trachealis* Siebold, 1836.

SYNGAMUS LARI (BLANCHARD, 1849) STOSSICH, 1899.

(Figs. 38–40.)

SYNONYMY AND BIBLIOGRAPHY.

1829: *Nematoideum lari ridibundi* CREPLIN, 1829b, p. 36.—IDEM [1846a, p. 140].—DIESING, 1851a, p. 321 [as synonym of *Strongylus lari ridibundi*].—LINSTOW, 1878, p. 168.

1837: *Strongylus* sp. SIEBOLD, 1837, p. 68.—CREPLIN, 1851b, p. 289 [=*Nematoideum lari ridibundi* Creplin, 1829 =*Cyathostoma lari* Blanchard, 1849].

1849: *Cyathostoma lari* BLANCHARD, 1849a, pp. 183–185, pl. 7, fig. 5.—IDEM in CUVIER [? date] (zoophytes), pl. 25, figs. 6, 6*a*, 6*b*.—DIESING, 1851a, p. 306 [as synonym of *Sclerostomum cyathostomum*].—IDEM, 1861a, p. 717 [as synonym of *Sclerostomum cyathostomum*].—GERVAIS & VAN BENEDEN, 1859b, p. 106.—MOLIN, 1861, p. 561 [as synonym of *Sclerostomum lari* Molin].—RAILLIET, 1898, p. 402.—STOSSICH, 1899, p. 100 [as synonym of *Syngamus lari*].

1851: *Sclerostomum cyathostomum* DIESING, 1851a, pp. 306–307.—IDEM, 1861a, pp. 717–718.—MOLIN, 1861, p. 561 [as synonym of *Sclerostomum lari* Molin].—LINSTOW, 1878, p. 167.—PARONA, 1894, p. 235.—MÜHLING, 1898, p. 48.—STOSSICH, 1899, p. 100 [as synonym of *Syngamus lari*].

1851: *Strongylus lari ridibundi* DIESING, 1851a, p. 321.—IDEM, 1861a, p. 718 [as probable synonym of *Sclerostomum cyathostomum*].—MÜHLING, 1898, p. 48 [as synonym of *Sclerostomum cyathostomum*].

1861: *Sclerostomum lari* (Blanchard, 1849) MOLIN, 1861, p. 561.—STOSSICH, 1899, p. 100 [as synonym of *Syngamus lari*].

1899: *Syngamus lari* (Blanchard, 1849) STOSSICH, 1899, pp. 100–101.

SPECIFIC DIAGNOSIS.—*Syngamus:* Body, red in color, attenuated anteriorly. Mouth opens into a pharyngeal capsule, which is marked in front by an annulation. Esophagus is thick and muscular, and increases gradually in diameter posteriorly. Intestine rather sinuous, with thin delicate walls, dark in color.

Male: 6 to 8 mm. long (Siebold, 1837, p. 68). Body ends abruptly behind; membranous fan-like bursa with six rays, of which the middle ones are the most marked; two spicules of equal length. Testicle a single very wide tube sinuous anteriorly.

Female: 6 to 8 mm. long (Creplin, 1829b, p. 36); 10 mm. long by 0.5 to 0.7 mm. thick (Siebold, 1837, p. 68); 10 to 13 mm. long by about 1 mm. thick (Blanchard, 1849a, p. 183). Body becomes gradually thicker in the anterior third, then continues of equal thickness to the posterior extremity. Tail with slender conical tip. Cuticula finely striated. Esophagus equals about one-fifteenth of the length of the body. Ovaries two, widening into capacious uteri, which unite to form a vagina of about 2 mm. in length. The latter gradually decrease in diameter toward the vulva, a large prominent opening, with salient lips, situated slightly posterior of the middle of the body.

HABITAT.—Black-headed gull, *Larus ridibundus;* nasal cavity; ? Europe (Creplin, 1829); orbital cavity; Sicily (Blanchard, 1849).—Lesser black-backed gull, *Larus fuscus;* infra-orbital cells; ? Europe (Siebold, 1837).—Gulls, *Larus* sp.; nasal fossæ; Belgium (Gervais & Van Beneden, 1859).

TYPE SPECIMENS.—[?]

FIG. 38.—*Syngamus lari.* Female. Enlarged about 12 times. (Haines del., after Blanchard, in Cuvier [?date] (zoophytes), pl. 25, fig. 6 a.)

FIG. 39.—*Syngamus lari.* Anterior end of female. Much enlarged. (Haines del., after Blanchard, in Cuvier [?date] (zoophytes), pl. 25, fig. 6 a.)

Creplin (1829, p. 36) is the first to mention this form, reporting the discovery of a single female, found by Schilling in 1826 in the nasal cavity of *Larus ridibundus.*

FIG. 40.—*Syngamus lari.* Vulva. Enlarged. (Haines del., after Blanchard, in Cuvier [?date] (zoophytes), pl. 25, fig. 6 b.)

Siebold (1837, p. 68) reported a number of males and females found by him in the infraorbital cells of *Larus fuscus.* Blanchard (1849a, p. 183) collected five females from the orbit of *Larus ridibundus* and gives a

description of the female. Gervais & Van Beneden (1859b, p. 106) found three females and two males in the nasal fossæ of birds of the genus *Larus* from Belgium, and gave a short description of the male.

?Genus ASCARIS.

Ascaris leptoptera Rudolphi of Rayer, 1843; not Rudolphi, 1810.

Rayer (1843, pp. 146, 148, 149, pl. 4, figs. 7–10) mentions and figures a worm from beneath the palpebral conjunctiva of *Emberiza pecoris* [=*Molothrus ater*], which he identifies as *Ascaris leptoptera*, a species described by Rudolphi from the esophagus and stomach of a lion. No description is given, and the figures are not sufficiently distinctive to enable one to identify the form in question. From the figures, the head is seen to possess lateral alæ, and the tail has a slender acutely pointed tip. Most authors have referred this form provisionally to *Spiroptera leptoptera* Rudolphi, 1819, a parasite of falcons, but such an arrangement seems hardly warranted by the facts in the case.

COMPENDIUM OF NEMATODES PARASITIC IN THE EYES OF BIRDS ARRANGED ACCORDING TO HOSTS.

I am much indebted to Mr. H. C. Oberholser of the Biological Survey, U. S. Department of Agriculture, for his generous assistance in determining the present-used scientific and common names of the hosts here listed, and arranging them into orders and families.

The star (*) signifies that the parasite so indicated has been reported from the eye of the host with which it is listed.

Order CRYPTURIFORMES.

Family Tinamidæ.

Crypturus variegatus (Latham). Variegated tinamou.
* [? *Filaria*] *tinami variegati*, p. 38.

Order CICONIIFORMES.

Family Ciconiidæ.

Euxenura maguari (Temminck). South American stork.
[? *Spiroptera*] *tenuicauda*, p. 39.

Family Ibididæ.

Ibis æthiopica (Latham). Sacred ibis.
**Physaloptera* sp., p. 43.

Order FALCONIFORMES.

Family Falconidæ.

Accipiter tinus (Latham). South American sharp-shinned hawk.
Physaloptera acuticauda, p. 42.
Aquila maculata (Gmelin). Spotted eagle.
*[?*Oxyspirura*] *stereura*, p. 29.
*?*Filaria abbreviata*, p. 31.

Archibuteo lagopus (Gmelin). Rough-legged hawk.
*[?*Filaria*] *armata*, p. 33.
Circus maculosus (Vieillot). Long-winged harrier.
Physaloptera acuticauda, p. 42.
Elanus cæruleus (Desfontaines). Black-winged kite.
Physaloptera acuticauda, p. 42.
Elanus leucurus (Vieillot). White-tailed kite.
Physaloptera acuticauda, p. 42.
Falco sp. Falcon.
**Aprocta ophthalmophaga*, p. 40.
Falco sp. Falcon.
Physaloptera acuticauda, p. 42.
Gampsonyx swainsoni (Vigors). Vigors hawk.
**Filaria papilloso-annulata*, p. 37.
Physaloptera acuticauda, p. 42.
Geranospizias cærulescens (Vieillot). Gray crane-hawk.
*[?*Oxyspirura*] *papillosa*, p. 27.
Physaloptera acuticauda, p. 42.
Harpyhaliaetus coronatus (Vieillot). Crowned harpy.
* *Physaloptera acuticauda*, p. 42.
Heterospizias meridionalis (Latham). Brown buzzard.
Physaloptera acuticauda, p. 42.
Leptodon cayennensis (Gmelin). Cayenne falcon.
Physaloptera acuticauda, p. 42.
Milvus korschun (Gmelin). Black kite.
* *Aprocta orbitalis*, p. 41.
Parabuteo unicinctus (Temminck). One-banded buzzard.
Physaloptera acuticauda, p. 42.
Rupornis magnirostris (Gmelin). Large-billed hawk.
* [? *Filaria*] *campanulata*, p. 34.
Spizaetus mauduyti (Daudin). Brazilian crested eagle.
Physaloptera acuticauda, p. 42.
Spiziaster melanoleucus (Vieillot). Vieillot hawk.
Physaloptera acuticauda, p. 42.
Thrasaetus harpyia (Linnæus). Harpy eagle.
* [? *Oxyspirura*] *papillosa*, p. 27.
Urubitinga urubitinga (Gmelin). South American black hawk.
Physaloptera acuticauda, p. 42.

Order GALLIFORMES.

Family Turnicidæ.

Turnix taigoor (Sykes). Indian bustard-quail.
* *Oxyspirura ophthalmica*, p. 26.

Family Cracidæ.

Crax fasciolata (Spix). Spix curassow.
*[? *Oxyspirura*] *anolabiata*, p. 21.
Mitua tomentosa (Spix). Brazilian mitua.
* [?*Spiroptera*] *tenuicauda*, p. 39.
Nothocrax urumutum (Spix). Urumutu.
* [? *Oxyspirura*] *heteroclita*, p. 24.

Family PHASIANIDÆ.

Gallus domesticus. Chicken.
* *Oxyspirura Mansoni*, pp. 7–20, 25.
Pavo cristatus (Linnæus). Peafowl.
* *Oxyspirura Mansoni*, pp. 7–20, 25.

Family TETRAONIDÆ.

Odontophorus stellatus (Gould). Stellated partridge.
Filaria obtusocaudata, p. 35.
Tetrastes bonasia (Linnæus). Hazel hen.
* [? *Filaria*] *bonasiæ*, p. 33.

ORDER GRUIFORMES.

Family CARIAMIDÆ.

Cariama cristata (Linnæus). Seriema.
*[?*Oxyspirura*] *brevipenis*, p. 22.

ORDER CHARADRIIFORMES.

Family LARIDÆ.

Larus fuscus Linnæus. Lesser black-backed gull.
Syngamus lari, p. 43.
Larus ridibundus Linnæus. Black-headed gull.
* *Syngamus lari*, p. 43.
Larus spp. Gulls.
Syngamus lari, p. 43.

Family TRERONIDÆ.

Zonœnas brenchleyi (Gray). Brenchley fruit pigeon.
* *Ceratospira ophthalmica*, p. 30.

ORDER CUCULIFORMES.

Family CUCULIDÆ.

Centropus sinensis (Stephens). Indian ground cuckoo.
* *Oxyspirura siamensis*, p. 28.
Crotophaga ani (Linnæus). Common smooth-billed ani.
* *Oxyspirura anacanthura*, p. 21.
Crotophaga major (Gmelin). Greater ani.
* *Oxyspirura anacanthura*, p. 21.

Family PSITTACIDÆ.

Eclectus pectoralis (Müller). Red-sided eclectus.
* *Ceratospira vesiculosa*, p. 30.
? Genus. ? Species. Parrot.
* *Filaria oculi*, p. 37.

ORDER CORACIIFORMES.

Family PICIDÆ.

Campephilus robustus (Lichtenstein). Brazilian ivory-billed woodpecker.
Filaria obtusocaudata, p. 35.
Campephilus rubricollis (Boddaert). Red-necked ivory-billed woodpecker.
Filaria obtusocaudata, p. 35.

Celeus flavescens (Gmelin). Black and yellow woodpecker.
Filaria obtusocaudata, p. 35.
Celeus jumana (Spix). Jumana woodpecker.
Filaria obtusocaudata, p. 35.
Ceophlœus lineatus (Linnæus). Lineated woodpecker.
Filaria obtusocaudata, p. 35.
Chloronerpes aurulentus (Temminck). Brazilian green woodpecker.
Filaria obtusocaudata, p. 35.
Chloronerpes leucolœmus (Malherbe). White-throated green woodpecker.
Filaria obtusocaudata, p. 35.
Veniliornis passerinus (Linnæus). Sparrow woodpecker.
**Filaria obtusocaudata*, p. 35.

Family MOMOTIDÆ.

Momotus momota (Linnæus). Motmot.
**Oxyspirura cephaloptera*, p. 23.

Family STRIGIDÆ.

Ninox scutulata (Raffles). Burmese hawk owl.
*[? *Spiroptera*] *Feai*, p. 39.
Otus choliba (Vieillot). Brazilian screech owl.
**Oxyspirura brevisubulata*, p. 23.

Family ASIONIDÆ.

Asio (=*Bubo* sp.) Eagle owl.
*? *Filaria attenuata*, p. 33.

Family CAPRIMULGIDÆ.

Caprimulgus europæus Linnæus, or *C. ægyptius* Lichtenstein. Nightjar.
*? *Spiroptera caprimulgi*, p. 38.

ORDER PASSERIFORMES.

Family DENDROCOLAPTIDÆ.

Xiphorhynchus procurvus (Temminck). Curve-bill woodhewer.
* [? *Filaria*] *dendrocolaptis procurvi lacrymalis*, p. 35.

Family FURNARIIDÆ.

Furnarius leucopus Swainson. Pale-footed oven-bird.
Filaria abbreviata, p. 31.
Furnarius rufus (Gmelin). Red oven-bird.
Filaria abbreviata, p. 31.

Family FORMICARIIDÆ.

Chamæza brevicauda (Vieillot). Short-tailed ant-thrush.
* [? *Filaria*] *myotherœ companisonœ*, p. 35.

? Family TYRANNIDÆ.

Muscicapa sp. [= ? genus. ? species.]
? *Filaria abbreviata*, p. 31.

Family TURDIDÆ.

Aedon luscinia (Linnæus). Thrush nightingale.
? *Filaria abbreviata*, p. 31.
Erithacus rubecula (Linnæus). Robin redbreast.
Filaria abbreviata, p. 31.
Petrophila cyanus Linnæus. Blue rock-thrush.
* *Aprocta cylindrica*, p. 40.
Saxicola œnanthe (Linnæus). Wheatear.
? *Filaria abbreviata*, p. 31.
Saxicola rufa (Stephens). Russet wheatear.
* *Filaria abbreviata*, p. 31.
Saxicola sp.
? *Filaria abbreviata*, p. 31.
Turdus olivascens (doubtful form; name not found in ornithological literature).
* [? *Filaria*] *turdi olivascentis palpebralis*, p. 38.
Turdus pilaris Linnæus. Fieldfare.
? *Filaria abbreviata*, p. 31.
Turdus viscivorus Linnæus. Mistletoe thrush.
? *Filaria abbreviata*, p. 31.

Family SYLVIIDÆ.

Melizophilus melanocephalus (Gmelin). Sardinian warbler.
Filaria abbreviata, p. 31.
Phylloscopus minor (Forster). Chiffchaff.
* [? *Filaria*] *sylviæ*, p. 37.

Family TROGLODYTIDÆ.

Cistothorus polyglottus (Vieillot). Brazilian short-billed marsh wren.
Filaria abbreviata, p. 31.

Family CORVIDÆ.

Corvus corone Linnæus. Black crow.
*? *Filaria attenuata*, p. 33.
Corvus frugilegus Linnæus. Rook.
* *Oxyspirura sygmoidea*, p. 29.

Family LANIIDÆ.

Lanius minor Gmelin. Lesser gray shrike.
Filaria obtusocaudata, p. 35.
Lanius senator Linnæus. Pomerine shrike.
Filaria obtusocaudata, p. 35.
Lanius rutilus Latham. Rufous shrike.
Filaria obtusocaudata, p. 35.
Lanius sp.
Filaria obtusocaudata, p. 35.
Lanius sp.
? *Filaria obtusocaudata*, p. 35.

Family MOTACILLIDÆ.

Motacilla alba Linnæus. White wagtail.
? *Filaria abbreviata*, p. 31.

Family ICTERIDÆ.

Amblyrhamphus holosericeus (Scopoli). Scarlet-headed marsh-bird.
Filaria abbreviata, p. 31.

Icterus croconotus Gray. Orange-backed troupial.
**Oxyspirura cephaloptera*, p. 23.
Megaquiscalus major (Vieillot). Boat-tailed grackle.
**Filaria cirrura*, p. 34.
Molothrus ater (Boddaert). Cowbird.
**Ascaris leptoptera* of Rayer, p. 45.

Family TANAGRIDÆ.

Ramphocelus jacapa (Linnæus). Jacapa tanager.
Filaria abbreviata, p. 31.

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NOTES ON THE SPINY-SUCKERED TAPEWORMS OF CHICKENS

(DAVAINEA ECHINOBOTHRIDA (=TÆNIA BOTRIOPLITES) AND D. TETRAGONA).

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Authors generally have looked upon *Tænia botrioplites* Piana, 1881, a spiny-suckered tapeworm producing tubercle-like nodules in the intestines of chickens, as synonymous with the worm very incompletely described by Molin (1858, 1861) under the name of *Tænia tetragona*. *Tænia echinobothrida* Mégnin 1880 has also been considered by some (Stiles, 1896, p. 52) to belong to the same species, but more commonly (Blanchard, 1891t, pp. 433, 436; Railliet, 1893, pp. 306–307) recognized as distinct from *tetragona*, while *botrioplites* has been looked upon as a synonym of *tetragona*.

As will be shown in this paper my own observations have led me to conclusions in regard to these forms somewhat different from any yet presented. In view of the fact that one of the worms is responsible for a serious disease of chickens, while the other, with which it has been much confused in the past on account of its great similarity in structure, appears to be comparatively harmless, I believe a detailed discussion of my investigations, which seem to clear up a number of obscure points, will not be without value and interest.

GENERAL DISCUSSION AND HISTORICAL VIEW.

In connection with the present discussion a rather extensive consideration of the worms in question from the historical standpoint is necessary, and to this purpose I have quoted liberally from the comprehensive review given by Stiles (1896). That author (1896, p. 50) comments as follows on the original description of *Tænia tetragona* Molin, 1858:

> Like most of Molin's descriptions, this diagnosis gives us but little information concerning the parasite he had before him. It should be noticed, however, that he (probably erroneously) describes the rostellum as unarmed, the neck as short (a character of little or no value), the posterior segments subquadrate and imbricate, the genital pores as unilateral, the length of the worm as 12 mm. to 90 mm., breadth as 2 mm. In other words, there is neither a single distinctive character nor a collection of characters given in this diagnosis. In his second paper (1861, pp. 254–255,

pl. 7, figs. 5–8) Molin repeats this diagnosis, gives four figures of the worm which are almost useless except fig. 7, in which the genital pores are figured in the middle of the lateral margin, and in which some irregularly shaped masses are drawn, which evidently represent egg capsules. He also adds three observations to the effect that he collected 42 specimens from one chicken, of which number only 2 were mature, the others being very small. He describes a mosaic structure of the segment caused by egg capsules, each of which contains from 5 to 20 ova. Although the rostellum is unarmed, the form differs in organization from the other unarmed forms. These are all the characters ever given by Molin to the species, and it must, indeed, be admitted that they are not sufficient to determine any worm with certainty. Molin's diagnosis, without the type specimens, is therefore useless.

In addition to what Stiles has given it may be noted that in Molin's fig. 7 the genital pore in one of the segments is shown at the middle of the lateral margin; in the other two slightly in front of the middle. It may also be stated here that a portion of Molin's original material, presented by the Vienna Museum to the Bureau of Animal Industry, is preserved in the Helminthological Collection of the latter, No. 1389. An examination of this material, however, so far as any positive results regarding *T. tetragona* were concerned, proved disappointing. Only a few small fragments were present, evidently representing some of the forty small specimens mentioned by Molin, and these were identical with *Hymenolepis carioca* (Magalhães, 1898). Neither of the two large worms of which Molin speaks and chiefly upon which he seems to have based his diagnosis was present. If still in existence they probably remain with the rest of the material in the Vienna Museum, and from these only may the identity of Molin's species be determined with absolute certainty.

Stiles (1896, p. 50) continues his discussion as follows:

As far as any original observations are concerned Molin's species *T. tetragona* then rested for a number of years. In 1880 Mégnin (1880, p. 119) mentioned *T. echinobothrida* * * *. In 1881 two parasites of chickens, very similar to if not identical with *T. tetragona*, were described as new. Mégnin described and figured *T. echinobothrida* as a new species with the characters given in the diagnosis above [Stiles, 1896, p. 49]. A careful study of both figures and description shows that the most important characters at present to be considered are the hooks upon the rostellum, said to be about 100 in number, 8 μ long, the rows of hooks upon the suckers (6–7 rows), those of the middle row being the largest; genital pores irregularly alternate; eggs 90 μ in diameter, spherical, arranged in groups of 6–7 in roundish egg capsules.

In March of the same year (1881) Piana (1882, pp. 387–391, 1 pl.) presented a paper before the *Accademia delle Scienze di Bologna*, in which he described as a new species *T. bothrioplitis* [*Tænia botrioplites* Piana, 1881, pp. 84–85], a cestode which he found causing serious damage to poultry, producing tubercles in the intestine. The chief zoological characters taken as a basis for the species are as follows:

Head, 0.35 mm. in diameter; retractile hemispherical rostellum armed with hooks (number not given, but evidently ca. 200, form shown in drawing); suckers with seven or eight concentric rows of hooks (form as per drawing), hooks not all of same size; neck very long, containing ovoid calcareous corpuscles; genital pores unilateral, situated somewhat below (distally) the middle of the lateral margin; cirrus short, pyriform; eggs in egg sacs.

* * * Piana was acquainted with Mégnin's paper, but separated his form from Mégnin's species chiefly on account of the form of the hooks on the suckers, the number of the hooks on the rostellum, and the arrangement of the genital pores. Krabbe (1882, pp. 361–362, pl. 2, figs. 55–60) published as *Tænia tetragona* Molin some cestodes which Fedschenko had found in chickens in Turkestan. He admits the total inadequacy of Molin's figures and descriptions, but determines his specimens as *T. tetragona* on account of the egg capsules. The characters given are as follows:

Length to 250 mm.; breadth, 1.6 mm.; posterior segments, 1.2 mm. long by 1.6 mm. broad. Head provided with a short and broad retractile rostellum, surrounded by about 200 hooks arranged in a double row; hooks measured 6 μ long from the apex of the prong to the end of the dorsal root; ventral root 11 μ long; suckers surrounded by several rows of * * * [variable unstable hooks similar to those of *T. australis*.] Genital pores unilateral; cirrus smooth, 21 μ long by 8 μ thick. Eggs arranged in egg sacs, 10–12 ova in a group, 40 to ca. 90 groups in a segment.

Since Krabbe's paper, authors have as a rule accepted *T. tetragona* as a good species. Blanchard (1891, pp. 433, 436) recognized *D. echinobothrida* as a distinct species; recognized *D. tetragona* (Molin) as valid, and made *T. bothrioplitis* a synonym of *D. tetragona*. Grassi & Rovelli (1892, p. 84) claim to have recognized both *T. tetragona* Molin and *T. bothrioplitis* Piana, and state that they have found both forms; *T. echinobothrida* Mégnin they did not find, but they think it is possibly identical with *T. bothrioplitis* Piana. Railliet (1893, pp. 306–307) has followed Blanchard (1891).

From the above it is questionable whether Molin's specific name *tetragona* can be retained unless the originals can be found and redescribed, for the description given by Molin is unrecognizable without the types. It might possibly be retained upon the ground that it is impossible to show that *T. tetragona* of present authors is not identical with *T. tetragona* Molin. I refrain temporarily from suppressing the name, as I hope the types may be reexamined. Krabbe's description of *T. tetragona* can hardly be taken into consideration in this question, as there is nothing to show that his specimens are identical with Molin's forms, and as Krabbe himself admits the uselessness of Molin's description and figures. The differences between the species described by these three authors (Mégnin, Piana, and Krabbe) are very slight and can for the most part be explained by contraction, insufficiency of material, and lack of details. The description of the hooks of the suckers of *T. echinobothrida* (as being so simple) should, I believe, be taken with reserve. The hooks are very small and not easily studied. The fact that the genital pores are described as irregularly alternate by Mégnin and unilateral by Piana and Krabbe is not, in my opinion, a serious difference in this genus. This opinion, radical as it may appear, is based upon the following observations:

The worms which Doctor Moore found producing a nodular disease in chickens give rise to the same pathological conditions as the form described by Piana, and agree with Piana's species in regard to the armed rostellum, the form and size of the hooks, both on the rostellum and suckers, and in almost every other character mentioned by Piana. The genital pores vary in different specimens. In some specimens they are entirely unilateral; in other specimens all but one or two may be on the same side of the worm, in fact it is often necessary to mount the entire strobila before it is possible to find an alternating pore; in still other specimens the pores are extremely irregular. The specimens with irregularly alternate genital pores agree in all other respects, so far as I can see, with Piana's form. The only difference between these specimens and Mégnin's description appears to be (1) the number of hooks upon the rostellum (Mégnin estimates them at about 100, the American form possesses *ca.* 200–208); (2) the form of the hooks on the suckers (in Mégnin's form the largest hooks are in the center row, in the American form the largest

hooks are those of the external row). This latter point of difference should not be given too much weight, as Mégnin evidently made no microtome sections, and this point could hardly be established definitely otherwise.

In short, I incline to the belief that *tetragona*, *echinobothrida*, and *bothrioplitis* all represent one and the same species.

I have had opportunity to examine a large amount of tapeworm material collected from chickens in various parts of the United States,

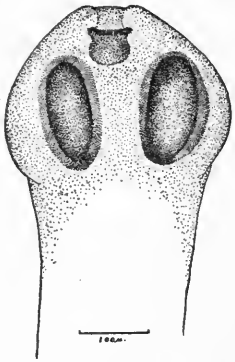

FIG. 41.—Head of *Davainea tetragona*. Enlarged. Original.

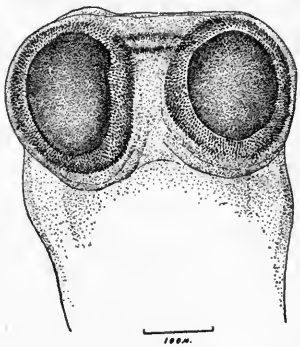

FIG. 42.—Head of *Davainea echinobothrida* Enlarged. Original.

and so far have found five distinct species—*Hymenolepis carioca*, *Choanotænia infundibuliformis*, *Davainea cesticillus*, and two spiny-suckered forms. The last are fairly common and occasionally occur

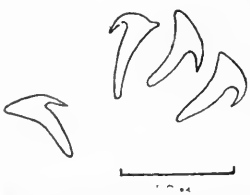

FIG. 43.—Hooks from the rostellum of *Davainea tetragona*. Enlarged. Original.

FIG. 44.—Hooks from the rostellum of *Davainea echinobothrida*. Enlarged. Original.

together in the same host. They are very similar to each other in size and general appearance, possessing, besides armed suckers, hooks on the rostellum, and numerous egg capsules. They show, however, certain distinct anatomical differences and, what is important, differ

very materially in their effects upon their hosts. One of them is the form found by Moore (1895) producing nodules in the intestines of chickens, and considered by Stiles (1896) identical with *T. botrioplites* Piana as well as with *T. echinobothrida* Mégnin and *T. tetragona* Molin of Krabbe. There can scarcely be any question as to the identity of this form with the European species *botrioplites*. Not only does it and the intestinal lesions produced by it agree perfectly with Piana's description, as Stiles has remarked, but it also agrees with specimens [B. A. I. Collection No. 1069] which I have examined of tapeworms collected from chickens in Genoa and identified by Parona as *T. botrioplitis*. With these specimens is a piece of intestine showing the characteristic nodules. There is also perfect correspondence with the descriptions of the worms producing similar lesions found by Rátz (1898) and other European authors. This species is characterized in

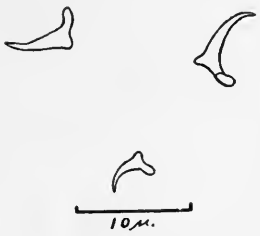

FIG. 45.—Hooks from the suckers of *Davainea tetragona*. Enlarged. Original.

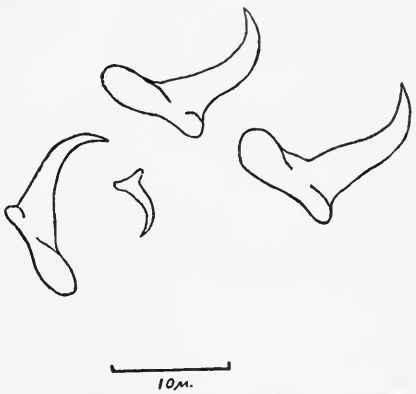

FIG. 46.—Hooks from the suckers of *Davainea echinobothrida*. Enlarged. Original.

part by the possession on the rostellum of a double row of about 200 hooks, 10 to 13 μ long (extreme length as measured in isolated hooks), and on the suckers a number of rows of hooks of variable size, the smallest 6 μ and the largest 12 to 15 μ in extreme length. The genital pores of this species, usually irregularly alternate, are situated behind the middle of the lateral margin of the segments, and the cirrus pouch is large, measuring 130 to 180 μ in length. In contracted specimens the neck is very thickset, and the head in general is exactly similar in appearance to Mégnin's figure of the head of *T. echinobothrida* (Mégnin, 1881, pl. 5, fig. 2).

The other species of spiny-suckered worm occurring in American chickens possesses a less conspicuous rostellum than the first form. It is armed with a single crown of about 100 hooks, which measure in extreme length 6 to 8 μ, and acetabular hooks 3 to 8 μ long. The genital pores are generally unilateral, and are situated in front of or

at the middle of the lateral margin of the segments. The cirrus pouch is small, measuring 75 to 100 μ in length. This species also shows an important difference from the other in that it does not seem to produce nodules in the intestine of its host, so far at least as my observations go. This is probably to be explained by the smaller size

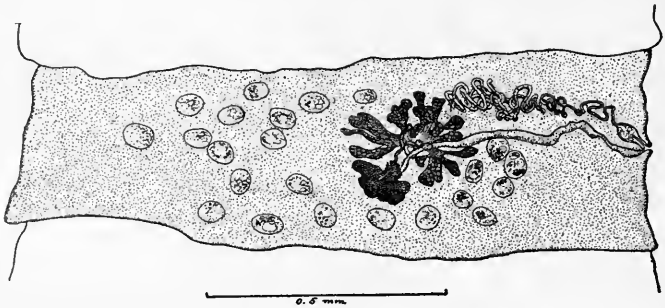

FIG. 47.—Segment of *Davainea tetragona* showing the reproductive organs. Enlarged. Original.

of the hooks. It may also be remarked here that nodules are not always to be found associated with the presence of the former species; cases are frequently seen in which the adult worms occur without apparent intestinal lesions. It is especially in association with the presence of young worms that nodules are found.

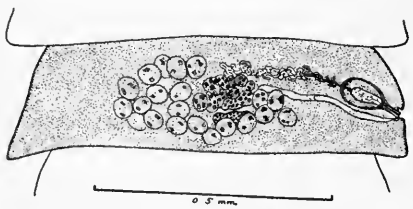

FIG. 48.—Segment of *Davainea echinobothrida* showing the reproductive organs. Enlarged. Original.

Although Mégnin's description of *T. echinobothrida* leaves much to be desired, I believe it is sufficiently distinct, all things considered and making allowances for possible errors of interpretation by Mégnin, to enable us to state with tolerable certainty that *T. echinobothrida* and *T. botrioplites* are one and the same form. It further seems evident that Krabbe (1882) based his description of *T. tetragona* partly on specimens of *echinobothrida* and partly on specimens of the small-hooked form. The details concerning the head: 200 hooks arranged in a double row on the rostellum; the hooks 6 μ long from the apex of the prong to the end of the dorsal root; ventral root 11 μ long, certainly correspond more nearly to the former species, while the unilateral arrangement of the genital pores agrees more closely with the normal condition in the latter. Krabbe's drawings of segments also suggest the latter species in that the genital pore in both drawings is farther anterior than is normal in *echinobothrida*, and the cirrus pouch is much too small for *echinobothrida*, although, to judge from the scale of magnification given by Krabbe, slightly larger than is usual in the small-hooked species.

The extensive description and numerous figures, which Filippi (1892a, pp. 75–78, figs. 1–4; 1892c, pp. 249–294, pls. 1–10) gives of a chicken tapeworm identified by him as *Tænia bothrioplitis*, show very clearly that the specimens which he studied did not belong to the species named, but to the small-hooked species, *Davainea tetragona*. Returning now to Molin's description of *T. tetragona*, we have the following possibilities to consider in connection with the question of the identity of the worms studied by him: (1) Are they identical with *T. echinobothrida* Mégnin? (2) Are they identical with the small-hooked species mentioned in this paper? (3) Were specimens of both species present in Molin's material? (4) Were specimens of neither species under discussion but of a similar species present? (5) In addition to specimens of one or both of the forms under discussion, or of a similar species, were specimens of still other species present?

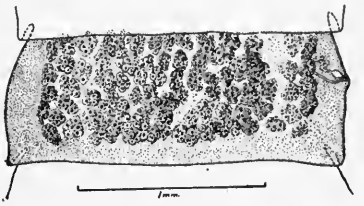

FIG. 49.—Gravid segment of *Davainea tetragona* Enlarged. Original.

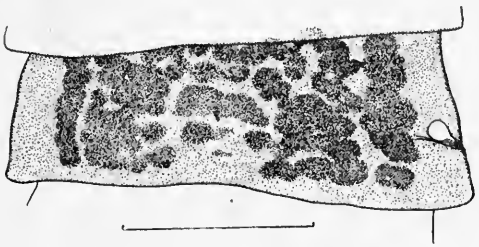

FIG. 50.—Gravid segment of *Davainea echinobothrida*. Enlarged. Original.

The last possibility has already been shown to be true by the fact that the original material upon which Molin based his species contained specimens of *Hymenolepis carioca*. It seems not improbable, moreover, that he actually based his description and drawing (1861, pl. 7, fig. 6) of the head of *T. tetragona* on specimens of *H. carioca*, in which the head is small, globose, and unarmed.[a]

[a] In a former paper (Ransom, 1902) I stated that in a head sectioned in situ with a piece of intestine the suckers were armed with small hooks. All other specimens of the head of *H. carioca* which I have seen showed no traces of hooks either on the suckers or on the rostellum. It was then my opinion that in the latter, hooks had probably been present at one time, but on account of their unstable nature had been lost. Further study has, however, since shown that the hooks seen upon the head in question are the same as those of the small-hooked tapeworm discussed in this paper. This one head, therefore, belonged to the small-hooked species of spiny-suckered tapeworm, and, consequently, so far as our present knowledge goes, the head of *H. carioca* is never armed. The only possible evidence to the contrary we now possess is the statement of Magalhães (1898, p. 450) that he believed he saw in one specimen what appeared to be little spines on the surface of the scolex near the inner posterior borders of the suckers. He was, however, doubtful on this point, and, moreover, found no trace of hooks on any other specimens examined.

Concerning the possibility, first, that the original *T. tetragona* is identical with *T. echinobothrida*, there is nothing to show absolutely, with our present knowledge, and without further examination of the type material, that such is not the case. Since, however, the genital pores are described as unilateral and since their position is indicated at or in front of the middle of the lateral margin in Molin's figure 7, the second possibility that Molin had before him specimens of the spiny-suckered worm, with small hooks, seems more probable.

With regard to the third possibility that specimens of both species were present in Molin's material, it may be said that in such case the small-hooked species should bear the name *tetragona*, since the other form was eliminated by Mégnin when he applied to it the name of *echinobothrida*.

The fourth possibility scarcely needs to be considered at present.

FIG. 51.—Cirrus sac of *Davainea tetragona*. Enlarged. Original.

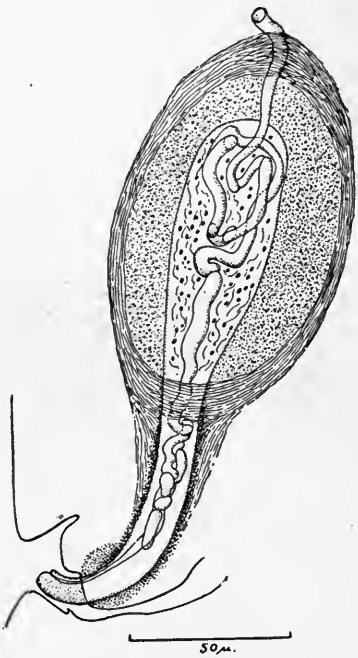

FIG. 52.—Cirrus sac of *Davainea echinobothrida*. Enlarged. Original.

So far as we know only two (unless *D. paraechinobothrida* Magalhães represent a third) species of tapeworm agreeing at all with Molin's diagnosis occur in chickens, and unless on examination of his type-specimens it is found that the original *tetragona* is different from either, one of them should be so designated.

Not only, then, does the small-hooked species correspond rather better than the large-hooked species to Molin's original diagnosis, but the latter, as already said, has been eliminated as *echinobothrida*, and so far as any present knowledge goes can not come into consideration. Until it be shown, therefore, on further examination of the type-specimens that *echinobothrida* is identical with the original *tetragona*, or

that neither of the forms under discussion is represented in the original material, we are not only fully justified in a provisional identification of the small-hooked form as *tetragona*, but in view of the apparent facts in the case we have left practically no alternative.

It may be noticed here that Magalhães (1898, pp. 442–443, 444) has mentioned a tapeworm of Brazilian chickens which he would identify with *Davainea echinobothrida* were it not for the fact that it possesses unilateral genital pores, but on that account he would separate it under the name *D. paraechinobothrida*. Whether in reality this form represents a distinct species, or whether it is identical with *D. tetragona*, or whether, perhaps, it should be considered only a variation of *echinobothrida* can only be decided when further details of its anatomy are known. The occurrence of *D. tetragona* in Brazilian chickens is established by specimens of this species in the Helminthological Collection of the Bureau of Animal Industry, No. 1388. These specimens, presented by the Vienna Museum, were labeled "*Tænia* sp. Intest. *Gallus gallinaceus dom.* Brasilien (Natterer)."

The specific characters of *D. tetragona* and *D. echinobothrida* are given in the following diagnoses:

SPECIFIC DIAGNOSES OF DAVAINEA TETRAGONA AND D. ECHINOBOTHRIDA.

Davainea tetragona (Molin, 1858) Blanchard, 1891.

(Figs. 41, 43, 45, 47, 49, 51.)

Synonomy and Bibliography

1858: *Tænia tetragona* Molin, 1858, p. 139 [a portion of the original material, B. A. I. No. 1389, consists of *Hymenolepis carioca*].—Idem, 1861, pp. 254–255, pl. 7, figs. 5–8.—Polonio, 1860, p. 222.—Diesing, 1863b, p. 402.—Krabbe, 1869, p. 341.—Idem, 1882, pp. 361–362, pl. 2, figs. 55–60 [in part].—Piana, 1882, p. 393.—Railliet, 1886, p. 268.—Idem, 1893, p. 306 [as synonym of *Davainea tetragona*].—Neumann, 1888, p. 429.—Idem, 1892, [French ed.], p. 465.—Idem, 1892 [Eng. ed.], p. 478.—Grassi & Rovelli, 1892a, pp. 84, 85.—Dolley, 1894a, p. 1017.—Mosler & Peiper, 1894, p. 40.—Braun, 1895b, pp. 194–195 [in part].—Schneidemühl, 1895, p. 290.—Stiles, 1896, pp. 49, 50, 51 52 [as synonym of *Davainea tetragona*].—Stossich, 1895, p. 43 [as synonym of *Davainea tetragona*].—Idem, 1898, p. 110 [as synonym of *D. tetragona*].—Holzberg, 1898a, pp. 154, 155–174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 185, 186, 187, pl. 10, figs. 2–7, pl. 11, figs. 15–22.

1891: *Davainea tetragona* Blanchard, 1891t, p. 436, fig. 15 [in part].—Idem, 1899d, pp. 211, 215, 216, 217 [in part].—Railliet, 1893, pp. 305, 306 [in part].—Morell, 1895, pp. 95, 99, 100.—Stossich, 1895, p. 43 [in part].—Stiles, 1896, pp. 10, 12, 15, 46, 49, 50, C., pl. 17, figs. 219–227, pl. 18, figs. 228–235 [in part].—Diamare, 1898a, pp. 480–483.—Stossich, 1898, p. 110 [in part].—Holzberg, 1898a, p. 174.—Lühe, 1900, p. 92.—Parona, C., 1901, p. 6.—Gedoelst, 1903a, p. 32.

1892: *Tænia botrioplitis* of Filippi, 1892a, pp. 75–78, pl. 1, figs. 1–4 [not *Tænia botrioplites* Piana, 1881].

1892: *Tænia bothrioplitis* of Filippi, 1892c, pp. 249–294, pls. 1–10 [not *Tænia botrioplites* Piana, 1881].

1898: *Davainaea tetragona* Diamare, 1898, pp. 480–483 [misprint for *Davainea tetragona*].

1898: *Davainea paraechinobothrida* [? synonym of *Davainea tetragona*] Magalhães, 1898, pp. 443, 444.—Blanchard, 1899a, p. 217.

1901: *Tænia* (*Davainea*) *tetragona* Vaullegeard, 1901, p. 108.

Specific diagnosis.—*Davainea:* 10 to 250 mm. long by 1 to 4 mm. broad, these dimensions varying with age and state of contraction. Head (fig. 41) 175 to 350 μ in diameter, with retractile rostellum 50 to 70 μ in diameter, armed with a crown of about 100 hooks arranged in a single row. Suckers oval, 50 to 90 μ in diameter, armed with 8 to 10 rows of hooks. Rostellar hooks (fig. 43) 6 to 8 μ long through longest axis, hammer-shaped, with long ventral root and short dorsal root, prong

short and recurved. Acetabular hooks (fig. 45) of various sizes, from 3 to 8 μ, measured through longest axis, with long, thorn-like prong, dorsal root very short, ventral root longer than dorsal root, but shorter than prong. Neck usually long and slender. Segments (figs. 47, 49) trapezoidal and imbricate, edge of strobila serrate. Ultimate segments usually longer than broad, bell-shaped. Genital pores unilateral, situated at or in front of the middle of the lateral margin, frequently marked by a papilla. Male and female canals pass on the dorsal side of the nerve and excretory vessels.

Male genitalia (figs. 47, 51): Testes 20 to 30 in median field surrounding the female glands, most of them lying on the aporose side of the latter. Vas deferens lies in anterior third of segment, begins near the median line, and extends in a much convoluted course laterally to the base of the cirrus pouch, which it enters and after a few coils in the basal portion of the latter becomes transformed into the cirrus. Cirrus pouch (fig. 51) pyriform, 75 to 100 μ in length. Basal portion surrounded by a prominent layer of longitudinal muscular fibers, neck with a thick layer of transverse fibers. Cirrus without apparent spines.

Female genitalia (figs. 47, 49): Ovary in middle of segment. Yolk gland posterior of ovary, irregularly reniform, slightly longer in its transverse axis, about 100 μ in diameter. Shell gland prominent, 50 μ in diameter, immediately in front of yolk gland. Vagina begins at the genital pore posterior of opening of cirrus pouch, at first very slender, but at a distance of 15 to 25 μ swells out into a thin-walled tube, functioning as a seminal receptacle, which extends transversely across the segment and joins the oviduct on the dorsal side of the ovary near the median line. The oviduct after being joined in the shell gland by the vitelloduct proceeds forward and ends on the dorsal side of the ovary. A definite and persistent uterus is not developed. The eggs as they pass from the distal end of the oviduct become embedded in a fibrous and granular mass, which gradually fills up most of the segment. This mass divides into 50 to 100 portions to form egg capsules (fig. 49), each surrounded by a membrane and containing 6 to 12 or more eggs. The egg is surrounded by three envelopes, an inner, close to the onchosphere; a middle, folded; and a smooth outer envelope. The onchosphere measures 10 to 14 μ in diameter, the outer envelope from 25 to 50 μ.

LIFE HISTORY: Unknown.

HOST: Chickens.

PATHOLOGICAL EFFECTS: So far as known, very slight.

GEOGRAPHICAL DISTRIBUTION: Europe; Asia; North and South America.

DAVAINEA ECHINOBOTHRIDA (MÉGNIN, 1880) BLANCHARD, 1891.

(Figs. 42, 44, 46, 48, 50, 52.)

SYNONYMY AND BIBLIOGRAPHY.

1880: *Tænia infundibuliformis* [in part] of MÉGNIN, 1880, pp. 395, 396.—IDEM, 1880, p. 716.—IDEM, 1881, pp. 125–126.—STILES, 1896, p. 49 [as synonym of *Davainea echinobothrida*].

1881: *Tænia echinobothrida* MÉGNIN, 1880, pp. 119, 120.—IDEM, 1881, pp. 35–38; pl. 5, figs. 1–11.—PIANA 1882, pp. 391–392.—RAILLIET, 1886, p. 267.—IDEM, 1893, p. 306 [as synonym of *Davainea echinobothrida*].—NEUMANN, 1888, p. 430.—IDEM, 1892 [French ed.], p. 466.—IDEM, 1892 [Eng. ed.], pp. 479–480.—GRASSI & ROVELLI, 1892a, pp. 84, 85 [as possible synonym of *Tænia bothrioplitis*].—DOLLEY, 1894a, p. 1014.—MORELL, 1895, p. 96.—STILES, 1896, pp. 49, 50, 51, 52 [as synonym of *Davainea echinobothrida*].

1881: *Tænia echinobotrida* MÉGNIN, 1881, p. 44 [misprint for *Tænia echinobothrida*].—PERRONCITO, 1886, p. 245 [misprint].

1881: *Tænia botrioplites* PIANA, 1881, pp. 84–85 [misprint for *Tænia botrioplites*].

1882: *Tænia botrioplitis* PIANA, 1882, pp. 387–395, 1 pl.—PERRONCITO, 1882, p. 211.—IDEM [? 1901], p. 268.—STOSSICH, 1889, p. 30.—IDEM, 1891, p. 114.—PASQUALE, 1890, p. 909.—FILIPPI, 1892c, p. 250.—SCAGLIOSI, 1896, pp. 538–545, pl. 10, figs. 1–2.

1882: *Tænia tetragona* MOLIN of KRABBE, 1882, pp. 361–362, pl. 2, figs. 55–60 [in part].—BRAUN, 1895a, pp. 194, 195 [in part].

1886: *Tænia bothrioplitis* RAILLIET, 1886, p. 267 [orthographic emendation of *botrioplitis*].—NEUMANN, 1888, pp. 429–430.—IDEM, 1892 [French ed.], p. 466.—IDEM, 1892 [Eng. ed.], p. 479.—GRASSI & ROVELLI, 1892a, pp. 84, 85, 89–90.—MOORE, 1895, pp. 2, 3.—MORELL, 1895, pp. 95, 96, 97, 98, 99, 100.—STILES, 1896, pp. 16, 49, 51, 52 [as synonym of *Davainea tetragona*].—STIEDA, 1900, p. 435.—PERRONCITO [? 1901], p. 268 [as synonym of *Tænia tetragona botrioplitis*].—HOLZBERG, 1898a, p. 154 [as synonym of *Tænia tetragona*].

1886: *Tenia botrioplitis* PERRONCITO, 1886, p. 245 [misprint for *Tænia botrioplitis*].

1891: *Davainea echinobothrida* BLANCHARD, 1891t, p. 433, fig. 9.—IDEM, 1899d, pp. 214, 216, 217.—RAILLIET, 1893, pp. 305, 306.—MOORE, 1895, p. 3.—STILES, 1896, pp. 10, 46, 49, 50, C., pl. 17, figs. 217–218.—MAGALHÃES, 1898, p. 442.—GEDOELST, 1903a, p. 32.

1891: *Davainea tetragona* BLANCHARD, 1891t, p. 436, fig. 15 [in part].—IDEM, 1899d, pp. 211, 215, 216, 217 [in part].—RAILLIET, 1893, pp. 305, 306 [in part].—MOORE, 1895, p. 3.—STOSSICH, 1895, p. 43 [in part].—IDEM, 1898, p. 110 [in part].—STILES, 1896, pp. 10, 12, 15, 46, 49, 50, C., pl. 17, figs. 219–227; pl. 18, figs. 228–235 [in part].—RÁTZ, 1898, pp. 69–73, figs. 2–4.—IDEM, 1900, pp. 232–233.—MINGAZZINI, 1900, pp. 134, 151, 152, 154, fig. 10.—PERRONCITO [? 1901], p. 268 [as synonym of *Tænia tetragona botrioplitis*].

1891: *Tænia bothriolites* BLANCHARD, 1891t, p. 436 [orthographic emendation of *botrioplites;* as synonym of *Davainea tetragona*].—IDEM, 1899d, p. 215 [as synonym of *Davainea tetragona*].—RAILLIET, 1893, p. 306 [as synonym of *Davainea tetragona*].—STOSSICH, 1895, p. 43 [as synonym of *Davainea tetragona*].—IDEM, 1898, p. 110 [as synonym of *Davainea tetragona*].—STILES, 1896, pp. 49, 51 [as synonym of *Davainea tetragona*].

1894: *Tænia botryoplitis* DOLLEY, 1894a, p. 1013 [misprint for *Tænia botrioplitis*].

1896: [*Tænia*] *botriophilitis* SCAGLIOSI, 1896, p. 539 [misprint for *botrioplitis*].

1898: *Davainea bothrioplitis* MAGALHÃES, 1898, pp. 442, 443, 444.

1898: *Davainea paraechinobothrida* [? synonym of *Davainea echinobothrida*] MAGALHÃES, 1898, pp.443, 444.—BLANCHARD, 1899d, p. 217.

[? 1901]: *Tænia tetragona botrioplitis* PERRONCITO [? 1901], p. 268.

SPECIFIC DIAGNOSIS.—*Davainea:* Length to 250 μ; width 1 to 4 mm. Head (fig. 42) 250 to 450, μ in diameter with retractile rostellum 100 to 150 μ in diameter, armed with a crown of about 200 hooks arranged in two ranks. Suckers round or oval, 90 to 200 μ in diameter, armed with 8 to 10 rows of hooks. Rostellar hooks (fig. 44) similar in type to those of *D. tetragona* but larger, measuring 10 to 13 μ in length. Acetabular hooks (fig. 46) likewise similar to those of *D. tetragona* but also larger, the largest measuring from 12 to 15 μ over all and the smallest 6 μ. Neck generally thicker and shorter than that of *D. tetragona*, frequently equal in width to the head. Strobila resembling that of *tetragona*, but with serrate border more pronounced. Ultimate segments in preserved specimens differ also from those of *tetragona*, being less elongate and frequently marked by a median constriction. Owing to this constriction the adjacent borders of the most posterior segments pull apart in the median line and remain joined only toward the sides, giving rise to a median series of openings through the posterior portion of the strobila. Genital pores irregularly alternate, or sometimes almost entirely unilateral, situated posterior of the middle of the lateral margin (figs. 48, 50). Male and female canals pass on the dorsal side of the nerve and excretory vessels.

Male genitalia (figs. 48, 52): Testes 20 to 30, arranged in median field as in *tetragona*. Vas deferens similar to that of *tetragona*. Cirrus pouch (fig. 52) flask-shaped, 130 to 180 μ in length. Basal portion globular or ovoid, surrounded by a thick layer (10 μ) of longitudinal muscle fibers, inside of which is a thick layer (15 to 20 μ) of transverse fibers. Neck of pouch measures 50 to 75 μ in length by 15 to 20 μ in diameter, surrounded by a layer of transverse fibers, thickened at the distal end of the pouch to form a sphincter. According to Mégnin the cirrus is armed with minute spines.

Female genitalia (figs. 48, 50): Female organs as in *D. tetragona*. Eggs similar in size and structure.

LIFE HISTORY: Unknown. According to Piana (1882) its supposed larva occurs in snails.

HOST: Chickens.

PATHOLOGICAL EFFECTS: Produces a nodular disease of the small intestine.

GEOGRAPHICAL DISTRIBUTION: Europe; Asia; Africa (Pasquale, 1890); North and South America.

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