The Acanthocephala of North American Birds

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THE ACANTHOCEPHALA OF NORTH AMERICAN BIRDS*

H. J. VAN CLEAVE

CONTENTS

I. INTRODUCTION

Parasitologists have given little attention to the Acanthocephala parasitic in North American birds. The result has been a rather general belief that infestation with Acanthocephala in this class of vertebrates is rare. It is true that heavy infestations are more commonly found in other groups of vertebrates, but many of the

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water and shore birds carry very heavy infestations of Acanthocephala. Among the land birds, while infestation is not rare, it is usually of less frequent occurrence, and the number of parasites found in a single host individual is usually smaller. Most of the earlier records of the occurrence of Acanthocephala in North American birds ascribe the forms found to known European species. This is not surprising when one reviews the extent to which the study of Acanthocephala in birds has proceeded in Europe. Yet the mere fact that all earlier writers recognized but the one genus, Echinorhynchus, in part explains their lack of appreciation of specific characters within this group. On the whole, most of the earlier specific descriptions are little more than sufficient to permit of later workers recognizing the genus to which the species belong. This lack in specificity of earlier descriptions quite naturally lead the new world investigators to believe that the species they found on this continent were the same as the European species, since the descriptions published contained insufficient data to permit of a separation.

As indicated by the writer in an earlier paper (Van Cleave 1916 b: 228), the acanthocephalan fauna of North America is in the main a distinctive fauna with few species identical with those of the European fauna. The attempt on the part of earlier parasitologists to ascribe names of European species to forms found on this continent has, to a great extent, hindered the appreciation of this distinctness of the North American fauna, and at the same time has lead to considerable confusion regarding the geographical distribution of the genera and species of Acanthocephala. Unfortunately, many of the specimens of the older writers are not available for restudy to determine the correctness of the original determinations. However, in most cases where further study has been possible points of difference from the European species have been found too numerous to permit of including the American forms in the European species.

The writer has made an extensive study of the Acanthocephala of birds in which he has had access to the collections of the U. S. Bureau of Animal Industry, the U. S. National Museum, the Marine Hospital Service, private collections of Dr. H. B. Ward and of the

writer. Papers covering the species of several genera of Avian Acanthocephala have already been published by the writer as a result of the study of these collections. The present article deals with the descriptions of several new species and a reconsideration of some forms previously described, but here for the first time ascribed to the proper genera as recognized by more recent developments of classification of the Acanthocephala. In all cases the study has been made from cleared, stained specimens mounted in damar.

Linton (1892: 92) recorded the occurrence of *Echinorhynchus striatus* Goeze from the intestine of the black scoter, *Oidemia americana,* collected at Yellowstone Lake, Wyoming. The writer has reexamined the original material of this collection and finds that these individuals constitute an undescribed species of the genus Corynosoma. Linton (page 92) remarked that the two females constituting the extent of the infestation of one of the hosts differed from the six males from the other host individual, in the "absence of spines at the posterior end" of the former. It is true that this sexual dimorphism is characteristic of the members of the genus Corynosoma as indicated by the founder of the genus, Lühe (1904 and 1911).

Of the materials from this collection deposited in the U. S. National Museum, one entire female, a portion of a second and five of the males, have been studied by the present writer. The entire female specimen is immature but, fortunately, the fragment of a specimen is of the anterior end of a fully mature individual so that the body cavity contains well developed embryos.

II. The Genus Corynosoma Lühe, 1904

The genus Corynosoma was established by Lühe to accommodate two species of Acanthocephala parasitic in fish-eating mammals and birds. This genus is characterized by the presence of spines on the anterior end of both sexes while in addition the males bear spines around the genital opening. The body is swollen anteriorly and with its coating of spines adheres to the intestinal mucosa of the host thereby furnishing an accessory means of attachment. Posteriorly the body gradually becomes smaller.

Corynosoma constrictum nov. spec.

Plate I, Figures 1, 2 and 3

Synonym: *Echinorhynchus striatus* Goeze of Linton 1892.

SPECIFIC DEFINITION. With the characters of the genus. Body of the males 2.28 mm. to 4.3 mm. long, with a maximum diameter of from 0.5 mm. to 0.6 mm. Linton gives the measurement of a female 3.3 mm. long with a diameter of 0.8 mm. Proboscis slightly larger at base than at tip, armed with sixteen longitudinal rows of ten to twelve hooks each. Hooks near base of proboscis 0.035 to 0.041 mm. long, near middle of proboscis 0.041 to 0.047 mm. long, near tip of proboscis 0.030 to 0.041 mm. long. A constriction occurs around the body at about the anterior third (see Fig. 1). In both sexes the part of the body wall anterior to this constriction is armed with small cuticular spines about 0.030 mm. long. Each of these spines is embedded in a triangular elevation of the cuticula projecting from the general body surface. In the males there occurs in addition a group of cuticular spines surrounding the genital opening (Fig. 2). The genital spines are of the same size as those on the anterior region of the body, usually with the tip strongly recurved. Embryos in body of female 80 to 108μ long by 12 to 16μ wide (Fig. 3).

Type host *Oidemia americana,* in intestine. Type locality Yellowstone Lake, Wyoming. The cotypes of this species are deposited in the Smithsonian Institution; the males under catalog number 5449 and females under number 5439.

III. The Genus Plagiorhynchus Lühe, 1911

In the same paper mentioned above (1892:91) Linton described another species of Acanthocephala from the intestine of a gull taken at Guaymas, Mexico. To this new species, founded on the study of one male and one female, he gave the name *Echinorhynchus rectus.* The present writer has examined the female of this collection, the only specimen in the bottle of material turned over to him for study from the collections of the U. S. National Museum. Facts brought out by the reexamination of the female of this species and the study of Linton's description of the male and female clearly indicate that this species belongs in the genus Plagiorhynchus, which

up to the present time has not been recorded as occurring in North America. In the present paper the writer describes still another species belonging to the genus Plagiorhynchus.

CHARACTERS OF THE GENUS PLAGIORHYNCHUS. Acanthocephala belonging to this genus are parasitic as adults in the alimentary canal of birds. The proboscis is cylindrical with numerous hooks arranged in radial symmetry. The body proper, which is entirely devoid of spines, is usually short, elliptical, or with a tendency toward egg-shaped. The proboscis receptacle is a double walled muscular sac attached at the base of the proboscis. In dealing with other genera of Acanthocephala the writer has found that in Arhythmorhynchus (Van Cleave 1916:a) the embryos in recently discovered American species differ in appearance from those described for European species of obviously the same genus. Here again in the genus Plagiorhynchus Lühe (1911:27) described embryos and figured one having the middle membrane with a conspicuous spherical knob at each of its two poles. This he considered characteristic of the entire genus (1911:26). The embryos of *P. formosus* (Fig. 6) are elliptical with no polar knobs. Here is evidence, in addition to that previously brought out by the writer (1916:a) and mentioned above, regarding the advisability of omitting the shape of the embryonic shells from the generic diagnosis.

Lühe (1911:26) specified the presence of six closely compacted, thickset, cement glands as characteristic of the genus Plagiorhynchus. In earlier papers (1914 and 1916) the present writer has shown that shape and number of cement glands may both vary widely among different species of the same genus. Consequently I propose that a fixed number of cement glands and the shape of the cement glands be omitted from the list of characters diagnostic of this genus. Descriptions of two species, one new, and the other newly attributed to this genus follow.

Plagiorhynchus rectus (Linton, 1892)

Plate I, Figure 7

Synonym, *Echinorhynchus rectus* Linton, 1892

Described originally from one male and one female of which the female only has been reexamined by the present writer. Body

of female 9 mm. long and 0.8 mm. in diameter. Proboscis cylindrical, 1.9 mm. long; 0.26 mm. in diameter; armed with twenty-four longitudinal rows of about twenty hooks each. In specimen examined this last number was calculated on the basis of the number of hooks on the exposed portion of the proboscis, since the tip of the proboscis is inverted. Hooks near the base of the proboscis 0.082 mm. long, with a diameter of 0.016 mm. at the point of emergence from proboscis wall; hooks near middle of proboscis 0.070 mm. long, recurved, with a diameter of 0.020 mm. at the point where the hooks curve backward; hooks near tip of proboscis 0.053 mm. long. Male 8.8 mm. long and 0.8 mm. in diameter. Testes oval, approximate, median. Female not fully mature so measurements of embryos cannot be given.

Type host, Larus (Chroicocephalus) sp. taken at Guaymas, Mexico. Type female deposited in U. S. National Museum, catalog number 5431.

Plagiorhynchus formosus nov. spec.

Plate I, Figures 4, 5 and 6

SPECIFIC DEFINITION. With the characters of the genus. Body about 10 mm. long, elliptical to slightly ovoid. Proboscis practically cylindrical, diameter about one-third of length; armed with sixteen longitudinal rows of thirteen to fourteen hooks each. Cement glands long, tubular. Hard shelled embryos inside body of female elliptical, 48 to 60μ long by 12 to 20μ in diameter.

This species is described from four mature individuals, two males and two females, in the Parasite Collection of the U. S. Bureau of Animal Industry; catalog number 4598. The writer designates one male and one female as types of the species. Descriptions of these follow.

TYPE MALE. Body elliptical with anterior and posterior extremities slightly flexed ventrally; entire length 8.5 mm.; maximum diameter 2 mm. Body proper devoid of spines. Proboscis subcylindrical, length 1.06 mm., diameter 0.33 mm., armature as mentioned in definition of species. The following table of measurements of hooks in a single row from tip to base of proboscis indicates relative size of hooks in various regions of proboscis.

Row	1	2	3	4	5	6	7	8	9	10	11	12	13	
Length in μ.....	71	77	83	83	83	83	83	83	83	77	77	77	65	Base

Proboscis receptacle cylindrical, 1.73 mm. long, 0.42 mm. in diameter, base of the receptacle rounded, with invertors of proboscis penetrating posterior extremity (Fig. 4). Brain 0.180 mm. long, in center of proboscis receptacle, between the invertors. Retinacula conspicuous at the middle of the proboscis receptacle. Lemnisci 0.192 mm. long, 0.058 mm. in diameter. Anterior and posterior testes form an oblique line of contact; each 1.15 mm. long and 0.6 mm. in diameter. Cement glands long, tubular, extending from the dorsal margin of posterior testis to region of bursa.

TYPE FEMALE. Body more nearly cylindrical than type male, 9.5 mm. long, 2 mm. in diameter. Tip of proboscis slightly inverted, size and aramture practically identical with that described for male. Body filled with developing embryos surrounding and covering almost all of internal organs. Hard shelled embryos within type female rather variable in size, 40 to 60μ long by 12 to 20μ in diameter.

Type host, the flicker, *Colaptes auratus,* in intestine. The four specimens upon which the species is founded were collected at Bowie, Maryland, October 9, 1906, by Dr. B. H. Ransom.

MORPHOLOGY. The males of this species display a phenomenal transparency of body structures so that in stained whole mounts minute internal structures are observable with the greatest ease. The proboscis in the preserved specimens is so inserted that it points ventrally at an angle of approximately 60 degrees from the chief axis of the body. At the base of the proboscis the body proper is slightly expanded to form a thickened rim. The proboscis receptacle is a cylindrical sac composed of two muscular layers. The retinacula arise in the brain as two fairly small fibres. Upon penetration of the wall of the receptacle their size increases appreciably. This increased size is maintained through the remainder of their course to their insertion upon the body wall. The means of insertion upon the wall of the body is shown in Fig. 4. The lemnisci are slightly longer than the proboscis receptacle and of smaller diameter throughout.

The two testes of the male are roughly oval, lying in the anterior region of the body. Lühe (1911:26) described six closely compacted cement glands as characteristic of the genus Plagiorhynchus. *P. formosus* appears to have six of these glands (Fig. 4), but their shape differs radically from the shape of the cement glands of *P. lanceolatus*.

The hooks upon the proboscis present a perfect pattern in their exact arrangement in alternating rows. Roots of the hooks are not distinct. The base of each hook for a length of about 0.021 mm. lies embedded in the wall of the proboscis perpendicular to its surface. The free portion of each hook is directed backward at an angle of about 110 degrees with the basal portion. The foregoing description of hooks applies to all hooks upon the proboscis except one or two hooks at the base of each row, which are simple, thornlike and one or two of those at the tip of the proboscis which differ from the remaining hooks in shape and general proportions (see Fig. 5). In all cases measurement of hooks here as in other papers by the writer the length of a hook is considered as the straight line connecting the tip of the hook with its extreme basal part.

IV. The Genus Polymorphus Lühe, 1911

Acanthocephala parasitic as adults in the intestine of birds. Posterior tip of the body rather broadly truncated. Anterior end of body swollen and separated from more attenuated posterior region by a constriction. Anterior region of the body spined. Proboscis usually cylindrical, frequently smaller at base.

Polymorphus obtusus nov. spec.

Plate II, Figs. 8, 9, 10, 11, and 12

Body with a slightly enlarged anterior region. This enlargement is set off by a constriction back of which the body again assumes a diameter equal to that of the anterior enlargement, then gradually decreases in size to the posterior tip which is more or less flexed ventrally. Posterior tip terminates bluntly (Fig. 11). Females 7.7 mm. long, males 4 to 5.5 mm. long. Proboscis in all specimens examined partially inverted, armed with about sixteen longitudinal rows of hooks. Anterior body region armed with small

cuticular spines about 24μ long (Fig. 9). Embryos within body of female 60 to 80μ long and 20 to 24μ wide with one conspicuous outpocketing of the middle membrane at each pole (Fig. 10).

Type host *Anhinga anhinga* (water-turkey), in intestine. Type locality, Florida. Described from three specimens, one female and two males. Cotypes in U. S. National Museum, catalog number 2967.

Polymorphus sp?

Plate II, Fig. 13

In addition to *Polymorphus obtusus* another representative of this genus has been studied by the writer, but the single specimen, a male, is insufficient to permit of a description of the species. Record is given here with a drawing of the proboscis in order to facilitate comparison in case other specimens are found from the same host later. The host of this undescribed species in the hooded merganser, *Lophodytes cuculatus*. Specimen in the U. S. Bureau of Animal Industry Collection, catalog number 2808.

V. The Genus Centrorhynchus Lühe, 1911

Centrorhynchus spinosus Van Cleave, 1916

Plate III, Figs. 14 and 15

A single species of this genus has been described from North America. The writer (1916b) described *C. spinosus* from the intestine of the egret, *Herodias egretta*. For description see paper cited above.

VI. The Genus Mediorhynchus Van Cleave, 1916

Mediorhynchus papillosus Van Cleave

Plate III, Figs. 16, 17, 18 and 19

Mediorhynchus robustus Van Cleave, 1916

Plate IV, Figs. 20 and 21

This genus, which to the present time has been recognized only from North America, was created by the writer (Van Cleave 1916b) for three new species of Acanthocephala belonging evidently near to the genus Centrorhynchus, but having characteristics which

prevented including them in that genus. At the time the description of this genus was published the writer failed to designate which of the species should be considered as type. *M. papillosus* is hereby designated as type of the genus Mediorhynchus.

Mediorhynchus papillosus has been recorded from *Myiochanes virens* (the wood pewee) and *Porzana carolina* (the sora). *Mediorhynchus robustus* has been found in *Icteria virens* (the yellow-breasted chat).

Mediorhynchus grandis was originally included within this same genus but a more thorough study of Kostylew's articles dealing with the genus Heteroplus has convinced the writer that the species *grandis* is, in reality, a member of the genus Heteroplus. Kostylew (1913: 532) considered Heteroplus as near to the genus Gigantorhynchus from which he claimed to have separated it. On the other hand de Marvel (1905: 217) considered *Echinorhynchus otidis,* one of the species upon which Kostylew founded his genus Heteroplus, as a synonym for *E. aluconis. E. aluconis,* through the careful work of Lühe (1911), became type of the genus Centrorhynchus. At the same time *Gigantorhynchus mirabilis* de Marvel, which Kostylew claimed also belonged to his genus Heteroplus, is clearly, on the basis of de Marvel's descriptions and figures, one of the Centrorhynchidæ. De Marvel's figures show clearly the constriction of the proboscis at the line of insertion of the receptacle with the coincident differentiation of hooks on the anterior and posterior regions of the proboscis. Kostylew (1913), in describing the proboscis receptacle of Heteroplus, referred to the anterior half as being twice the diameter of the posterior half. This condition is typical of the genus Mediorhynchus and serves as an additional argument for considering the genus Heteroplus as a member of the family Centrorhynchidæ and not of the Gigantorhynchidæ.

VII. The Genus Heteroplus Kostylew, 1914

With the characteristics of the family Centrorhynchidæ. Anterior and posterior regions of the proboscis bearing widely different numbers of longitudinal rows of hooks.

Heteroplus grandis (Van Cleave, 1916)

Plate V, Figs. 27, 28 and 29

Synonym, *Mediorhynchus grandis* Van Cleave, 1916

This species, the description of which is given in Van Cleave 1916 b: 226, was described from *Quiscalus quiscula* (the purple grackle) and *Sturnella magna* (the meadow lark). More recently the writer has examined a specimen from *Corvus brachyrhynchus* (the crow) taken in Maryland which proves to belong to this same species.

Kostylew's contention that the genus Heteroplus belongs to the Gigantorhynchidæ caused the writer at the time of the description of this species to believe that its superficial and general resemblance to Heteroplus was not of great significance.

VIII. The Genus Filicollis Lühe, 1911

Filicollis botulus Van Cleave, 1916

Plate V, Figs. 30, 31, 32, 33 and 34

But a single species of this genus, *F. botulus,* has been recorded from North America. This species differs widely from *F. anatis* of Europe, especially in the shape of the proboscis of the female. Specific characteristics upon which this species was founded are given in an earlier paper (Van Cleave 1916). Since the species was described the writer has discovered younger males than he had seen at the time of the original description. Figure 30 shows the arrangement of the internal organs of one of these young males. The eider ducks, *Somateria dresseri* and *S. mollissima,* are the known hosts of the species.

IX. The Genus Arhythmorhynchus Lühe, 1911

Arhythmorhynchus uncinatus (Kaiser, 1893)

Arhythmorhynchus trichocephalus (R. Leuckart, Kaiser, 1893)

Arhythmorhynchus brevis Van Cleave, 1916

Plate IV, Figs. 22, 23 and 24

Arhythmorhynchus pumilirostris Van Cleave, 1916

Plate IV, Figs. 25 and 26

Kaiser in 1893 published a description of *Echinorhynchus uncinatus* Kaiser and *E. trichocephalus* R. Leuckart. The writer

(1916a: 172) showed that these two species belong in reality to the genus Arhythmorhynchus and in the same paper described two additional species for this genus, *A. pumilirostris* and *A. brevis,* both from the intestine of the American bittern, *Botaurus lentigenosus.*

X. Species Inquirendæ and Species of Doubted Determination

Echinorhynchus pici collaris Leidy, 1850

Leidy described and recorded the occurrence of four Acanthocephalans from North American birds, but no one of these is the present writer able to locate with any degree of certainty within the modern system of classification of the group. The description of *Echinorhynchus pici collaris* from *"Picus colaris"* is lacking in details sufficient to permit of speculation as to even the genus to which it belongs. Consequently *E. pici collaris* must be regarded as a *species inquirenda.* The other three species, given the names of known European species, probably belong to the respective genera now recognized as including the European forms.

(?) *Echinorhynchus caudatus* Zeder of Leidy 1887

This species, which Leidy recorded from *Elanoides forficatus* and from *Scotiaptex nebulosa,* has been considered by the present writer (1916b: 222) as belonging to the family Centrorhynchidæ, though the original description is insufficient to permit of a closer determination. It is extremely improbable that Leidy's determination of this species is correct.

(?) *Echinorhynchus striatus* Goeze of Leidy 1856

From the intestine of *Mycteria americana* (*"Tantalus loculator"*), the wood ibis, Leidy recorded the occurrence of *Echinorhynchus striatus* Goeze. Lühe (1911) was unable to place Goeze's *E. striatus* in his revised system of classification. It seems improbable that Leidy was dealing with the species which Goeze described from central Europe. Many points of detail have caused the present writer to consider the form which Leidy recorded as probably one of the species of Arhythmorhynchus. Its relations to other species of this genus cannot be determined.

(?) *Echinorhynchus hystrix* Bremser of Leidy 1887

Leidy's report of *Echinorhynchus hystrix* from *Anhinga anhinga* (the water turkey) gives some ground for attributing the genus Corynosoma as parasitic upon that species of bird, though here again the specific identity with the European form is to be seriously doubted.

XI. Distribution of the Acanthocephala of Birds

It seems worth while to call attention to the fact that in the collections from birds examined by the writer the occurrence of two different species of Acanthocephala within the same host individual has never been observed. Furthermore there is no positive case on record wherein two different genera of Acanthocephala have been found in the same species of North American bird. The case of *Anhinga anhinga* seems to be an exception to this last statement. From this host the writer has described species of Polymorphus while Leidy has described what seems to be a species of Corynosoma. However in general body form these two genera resemble one another closely enough to confuse the casual observer. On this basis the apparent exception to the general condition may not be a real one.

De Marval, in his significant monographic contribution to the study of Avian Acanthocephala, has unfortunately failed to furnish us with any considerable body of data upon the geographical distribution of the species with which he worked. Evidently many of his records are compilations from earlier writers. In his treatment of each species of Acanthocephala he has given a host list, but offers no information as to the locality from which the hosts were taken. A study of his data shows that he has recorded the occurrence of Acanthocephala in more than forty families of birds representing eleven of the seventeen orders of birds recognized in North America and in addition some families not represented in the North American fauna.

In the collections available to the writer these parasites have been found in but seven orders, and a total of but ten families of birds. Beyond this Leidy's reports indicate the presence of Acanthocephala in at least three additional families. It is a noteworthy

fact that the geographical distribution of the species known to North America is restricted almost exclusively to the eastern part of the continent. In the opinion of the writer this apparent localization of infestation is probably due to the fact that records from the West are wanting rather than that the actual distribution is so narrowly limited. Much of the materials studied by the writer has been the result of the careful work of Mr. Albert Hassall.

XII. Distribution of Genera of Acanthocephala in Families of European and North American Birds:

Family of birds acting as host	Genera of Acanthocephala reported from Central Europe (Lühe 1911)	North America
Colymbidæ	Filicollis	
Laridæ	Filicollis	Plagiorhynchus
Anhingidæ		Polymorphus
		?Corynosoma
Anatidæ	Polymorphus	Polymorphus
	Filicollis	Filicollis
	Corynosoma	Corynosoma
	?Centrorhynchus?	
Ciconiidæ		?E. striatus?
Ardeidæ	Filicollis	Centrorhynchus
	?Arhythmorhynchus?	Arhythmorhynchus
Rallidæ	Polymorphus	Mediorhynchus
	Filicollis	
Scolopacidæ	Plagiorhynchus	
	Arhythmorhynchus	
	Filicollis	
Charadriidæ	Plagiorhynchus	
	Polymorphus	
Buteonidæ		?E. caudatus?
Falconidæ	Centrorhynchus	
Strigidæ		?E. caudatus?
Picidæ		Plagiorhynchus
		?E. pici collaris?
Tyrannidæ		Mediorhynchus
Corvidæ		Plagiorhynchus
		Heteroplus
Icteridæ		Heteroplus
Mniotiltidæ		Mediorhynchus

In the above table genera and species marked with a question mark (?) are of questioned original determination or are *species inquirendæ*. It is quite a striking fact that in only the family Anatidæ and probably the Ardeidæ are any of the same genera of Acanthocephala found in both North America and Europe.

Lühe (1911), in his register of the Acanthocephala and parasitic flatworms from central European hosts recorded the occurrence of Acanthocephala from hosts representing but eight families of birds. The accompanying table based upon Lühe's data and records of the writer shows in striking manner the differences between the types of hosts characteristic of the various genera in Europe and North America. To the writer this table furnishes still farther evidence of the independence of the acanthocephalan fauna of the two continents. In the majority of cases even the genera of these parasites have found hosts in entirely different Families and even Orders of birds.

XIII. Genera of Acanthocephala with the Orders of Birds From Which Taken

GENUS OF ACANTHOCEPHALA	ORDER OF BIRDS SERVING AS HOST	
	CENTRAL EUROPE (Lühe)	NORTH AMERICA
Arhythmorhynchus	Limicolæ	Herodiones
Centrorhynchus	Raptores	Herodiones
	Anseres	
Corynosoma	Anseres	Anseres
		?Steganapodes
Filicollis	Anseres	Anseres
	Pygopodes	
	Longipennes	
	Herodiones	
	Paludicolæ	
	Limicolæ	
Heteroplus		Passeres
Mediorhynchus		Passeres
		Paludicolæ
Plagiorhynchus	Limicolæ	Pici
		Longipennes
		Passeres
Polymorphus	Limicolæ	Steganapodes
	Anseres	Anseres
	Paludicolæ	

A comparison of infestation within the *Orders* of birds furnishes a contrast between the two continents even more striking than that found in the comparison of the Families of birds. The accompanying table shows among other things, that Corynosoma, Filicollis and Polymorphus are the only genera having hosts within the same orders of birds on the two continents.

XIV. Key to the Genera and Species of Acanthocephala of North American Birds

1 (12) Acanthocephala with body proper devoid of spines..... 2

2 (5) Proboscis receptacle inserted at base of proboscis..... ..... Genus PLAGIORHYNCHUS.. 3

3 (4) Twenty-four longitudinal rows of hooks..... ..... *Plagiorhynchus rectus.* Linton

4 (3) Sixteen longitudinal rows of hooks..... ..... *Plagiorhynchus formosus* nov. spec.

5 (2) Proboscis receptacle inserted at or near middle of proboscis. Proboscis hooks anterior to and posterior to insertion conspicuously unlike 6

6 (7) Invertors of proboscis extending through posterior tip of proboscis receptacle and continuing as retractors for receptacle..... .....Genus CENTRORHYNCHUS

Centrorhynchus spinosus Van C., only known species in North America.

7 (6) Invertors of proboscis passing through wall of proboscis receptacle near its middle or at least considerable distance anterior to the posterior end 8

8 (9) Anterior and posterior regions of proboscis bearing different numbers of longitudinal rows of hooks.....Genus HETEROPLUS

Twelve longitudinal rows of hooks on the interior region of proboscis, about thirty on posterior. *Heteroplus grandis* (Van. C.) only known species in North America.

9 (8) Anterior and posterior regions of proboscis bearing the same number of longitudinal rows of hooks. Genus MEDIORHYNCHUS..10

10 (11) Proboscis not covered with conspicuous papillæ in which hooks are embedded. Body usually robust, forms with twenty-four longitudinal rows of hooks on proboscis. Embryos 38μ by 16μ..... .....*Mediorhynchus robustus* Van C.

11 (10) Proboscis hooks not conspicuous; embedded in conspicuous papillæ. Eighteen longitudinal rows of hooks. Embryos 38μ to 47μ by 18μ to 24μ.....*Mediorhynchus papillosus* Van C.

12 (1) Body proper bearing spines, at least in restricted regions.....13

13 (14) Body spines on anterior region of the body and also surrounding genital opening.....Genus CORYNOSOMA, males

But one species, *Corynosoma constrictum* nov. spec., known to North America.

14 (13) With no cuticular spines around the genital opening.....15

15 (26) Anterior end of the body decidedly larger than posterior end.....16

16 (23) Anterior and posterior regions of the body of distinctly different histological structure.....Genus ARHYTHMORHYNCHUS..17

17 (18) Hooks on mid-ventral surface of proboscis conspicuously larger than on any other part of proboscis.....
.....*Arhythmorhynchus trichocephalus* (R. Leuckart)

18 (17) Hooks on ventral surface of proboscis not conspicuously larger than on any other surfaces.....19

19 (20) Longest hooks more than 100μ long.....
.....*Arhythmorhynchus uncinatus* (Kaiser)

20 (19) Longest hooks not more than 50μ long.....21

21 (22) Proboscis with sixteen longitudinal rows of hooks. Embryos 65 to 80μ long, 18μ wide....*Arhythmorhynchus pumilirostris* Van C.

22 (21) Proboscis with eighteen longitudinal rows of hooks. Embryos 76 to 100μ long, 24 to 30μ wide....*Arhythmorhynchus brevis* Van C.

23 (16) Anterior end of body larger than posterior end, but body wall of same histological structure throughout.....24

24 (25) Anterior region of body set off from posterior region by conspicuous constriction. Proboscis cylindrical, or frequently tapering slightly toward base.....Genus POLYMORPHUS

Polymorphus obtusus nov. spec. only species described from North America.

25 (24) Anterior region of body distinctly swollen, but not separated from posterior by a constriction. Proboscis spindle shaped.....
..... Genus CORYNOSOMA, females

Corynosoma constrictum nov. spec., only known species from North America.

26 (15) Body sac-like or sausage shaped, not conspicuously swollen at anterior end. Proboscis spherical or ovate, followed by a neck fully as long as the proboscis and sharply set off from the body proper.
.....Genus FILICOLLIS

Filicollis botulus Van C. is the only species known to North America.

XV. Summary

1. This article contains the results of a study of the Acanthocephala parasitic in birds from the U. S. Government collections and the private collections of Professor H. B. Ward and of the writer.

2. *Echinorhynchus striatus* taken by Linton from *Oidemia americana* belongs to the genus Corynosoma and here is described as *Corynosoma constrictum* nov. spec.

3. *Echinorhynchus rectus* Linton, 1892 is shown to belong to the genus Plagiorhynchus. *P. formosus* nov. spec. from *Colaptes auratus* is described. These two species constitute the first record of species of Plagiorhynchus in North America.

4. *Polymorphus obtusus* nov. spec. is described from *Anhinga anhinga.*

5. *Polymorphus species?* is recorded from *Lophodytes cucullatus.*

6. *Mediorhynchus papillosus* Van C., 1916 is designated as type of the genus Mediorhynchus.

7. The genus Heteroplus is one of the Centrorhynchidæ (not of the Gigantorhynchidæ as maintained by Kostylew, its creator).

8. *Mediorhynchus grandis* Van C., 1916 is shown to belong to the genus Heteroplus.

9. *Corvus brachyrhynchus* is cited as a new host for *Heteroplus grandis* (Van C.).

10. Among North American birds the occurrence of two different species of Acanthocephala within the same host individual has never been recorded.

11. There is no positive case on record of the occurrence of two different genera of Acanthocephala within the same species of North American bird.

12. Tables are given to show the comparison of acanthocephalan infestation in the families and orders of birds of central Europe and of North America.

13. A key to all described species of Acanthocephala from North American birds is given.

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XVII. Explanation of Plates

All figures excepting Figure 7 are drawn by the aid of a camera lucida from stained specimens mounted in xylol damar. The magnification is indicated by the projected scale accompanying each drawing.

Abbreviations Used

b. bursa copulatorix
br. brain.
c.g. cement glands
e. egg masses
ins. insertion of proboscis receptacle
i.p. invertors of proboscis
l. lemniscus
p.r. proboscis receptacle
r. retinacula
r.p. retractors of proboscis receptacle
t.a. anterior testis
t.p. posterior testis

Plate I.

Figs. 1 to 3, *Corynosoma constrictum* nov. spec.

Fig. 1. Entire male showing general body shape and arrangement of internal organs.

Fig. 2. Posterior tip of male showing cuticular spines.

Fig. 3. Embryo from body of mature female.

Figs. 4 to 6, *Plagiorhynchus formosus* nov. spec.

Fig. 4. Entire male showing general body form and arrangement of internal organs.

Fig. 5. Profile of the proboscis of same individual as shown in Fig. 4.

Fig. 6. Embryo from body of mature female.

Fig. 7. *Plagiorhynchus rectus* (Linton). Drawing copied from Linton 1892.

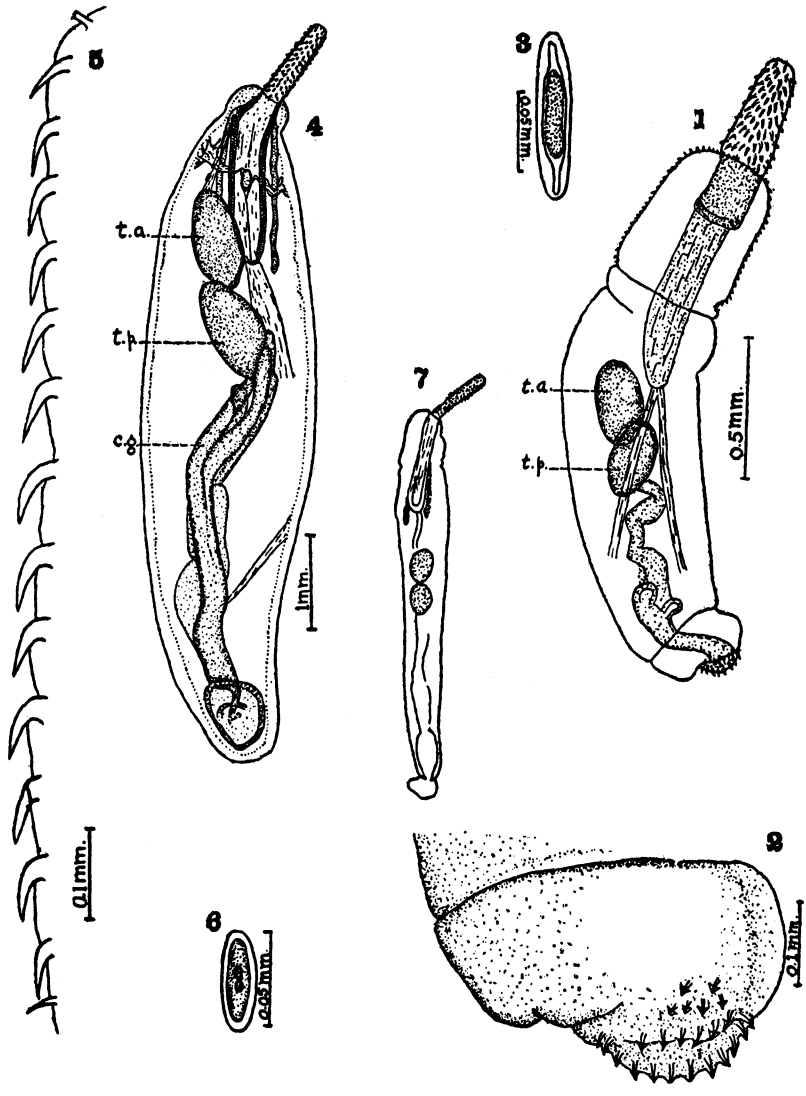

PLATE I.

H. J. Van Cleave, del.

PLATE II.

Figs. 8 to 12. *Polymorphus obtusus* nov. spec.

Fig. 8. Entire male, poorly preserved specimen, internal organs very indistinct.

Fig. 9. Cuticular spines in profile, from anterior region of body.

Fig. 10. Embryo from body cavity of female.

Fig. 11. Posterior extremity of type female showing characteristic bluntness upon basis of which the specific name is given.

Fig. 12. Profile of proboscis hooks.

Fig. 13. *Polymorphus species?* from *Lophodytes cucullatus.*

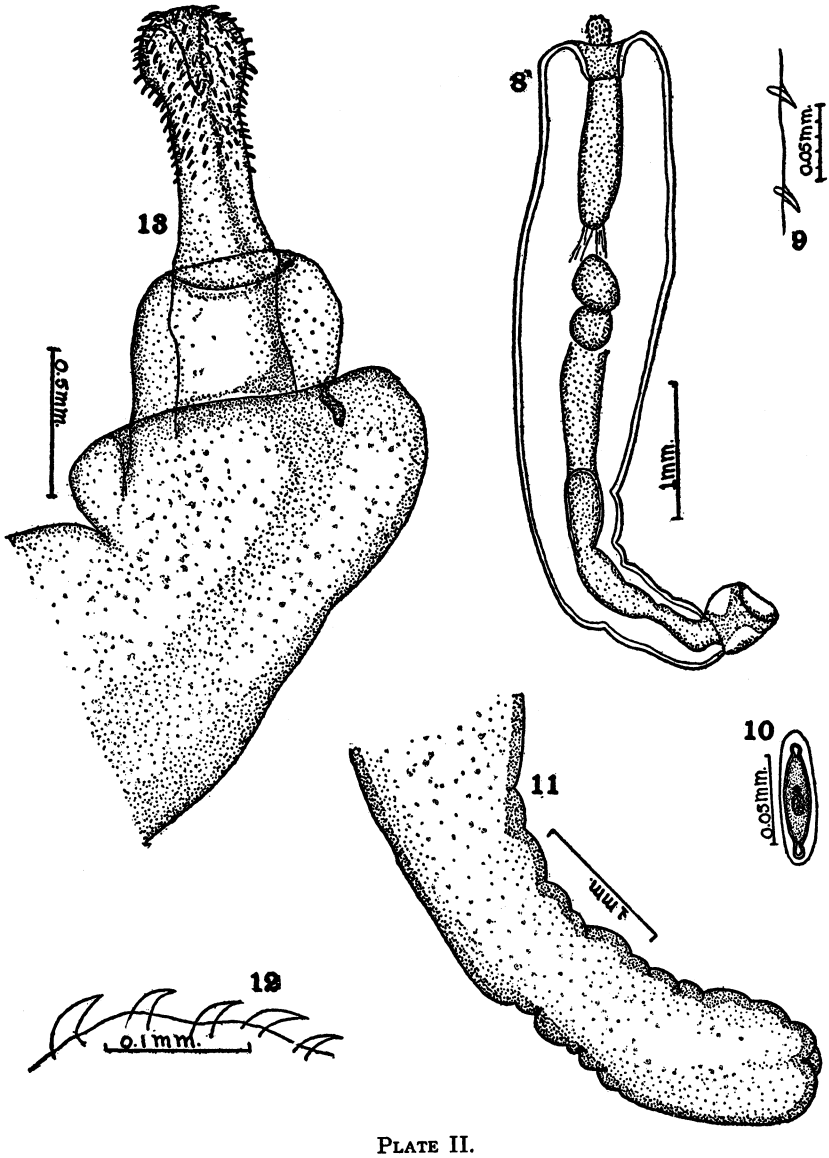

PLATE II.

H. J. Van Cleave, del.

PLATE III.

Figs. 14 and 15. *Centrorhynchus spinosus* Van Cleave.

Fig. 14. General body form of type female.

Fig. 15. Profile of dorsal surface of proboscis shown in Fig. 14.

Figs. 16 to 19. *Mediorhynchus papillosus* Van Cleave.

Fig. 16. Entire male showing general body form and arrangement of organs.

Fig. 17. Proboscis and anterior body region of type male.

Fig. 18. Profile dorsal surface of proboscis, same individual as shown in Fig. 17.

Fig. 19. Embryos from body cavity of fully mature female.

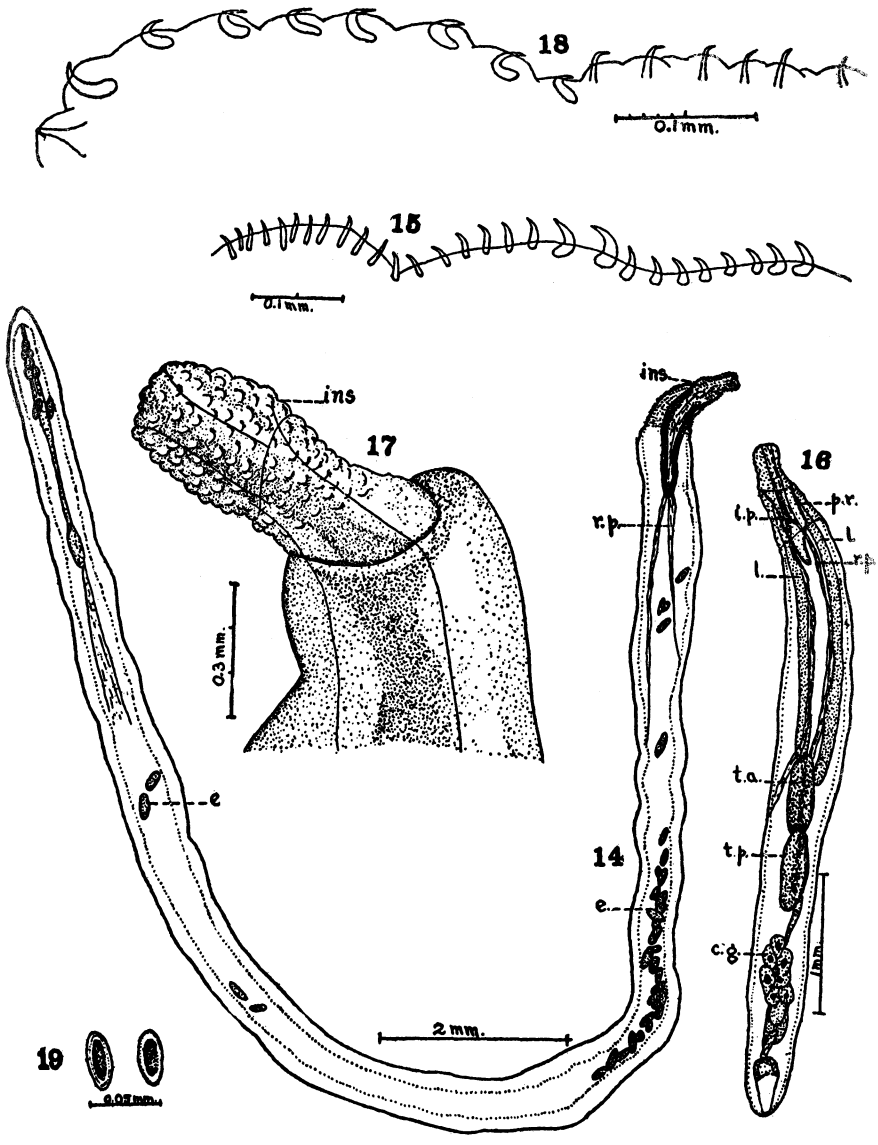

PLATE III.

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PLATE IV.

Figs. 20 and 21. *Mediorhynchus robustus* Van Cleave.

Fig. 20. Male in optical section showing body form and arrangement of organs.

Fig. 21. Embryos from body cavity of mature female.

Figs. 22 to 24. *Arhythmorhynchus brevis* Van Cleave.

Fig. 22. Body of entire male.

Fig. 23. Proboscis and anterior region of body of a male.

Fig. 24. Embryos from body cavity of mature female.

Figs. 25 and 26. *Arhythmorhynchus pumilirostris* Van Cleave.

Fig. 25. Entire male.

Fig. 26. Embryo from body of mature female.

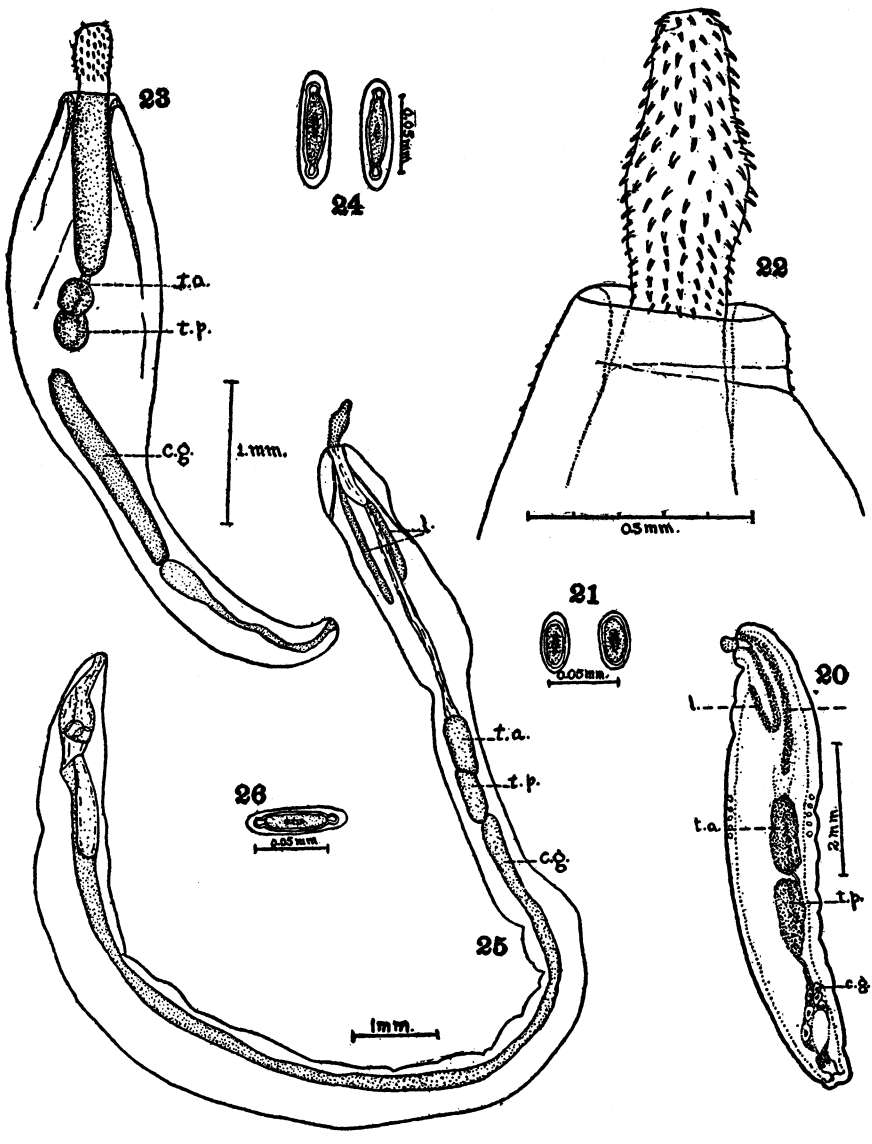

PLATE IV.

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PLATE V.

Figs. 27 to 29. *Heteroplus grandis* (Van Cleave).

Fig. 27. Proboscis partly invaginated, but showing the hook arrangement typical for the genus.

Fig. 28. Embryos from body of mature female.

Fig. 29. Profile of dorsal surface of proboscis.

Figs. 30 to 34. *Filicollis botulus* Van Cleave.

Fig. 30. Entire male showing general body form and arrangement of organs.

Fig. 31. Cuticular spines from anterior region of body.

Fig. 32. Mature female showing general body form.

Fig. 33. Embryo from body cavity of mature female.

Fig. 34. Profile, ventral surface, of proboscis of female.

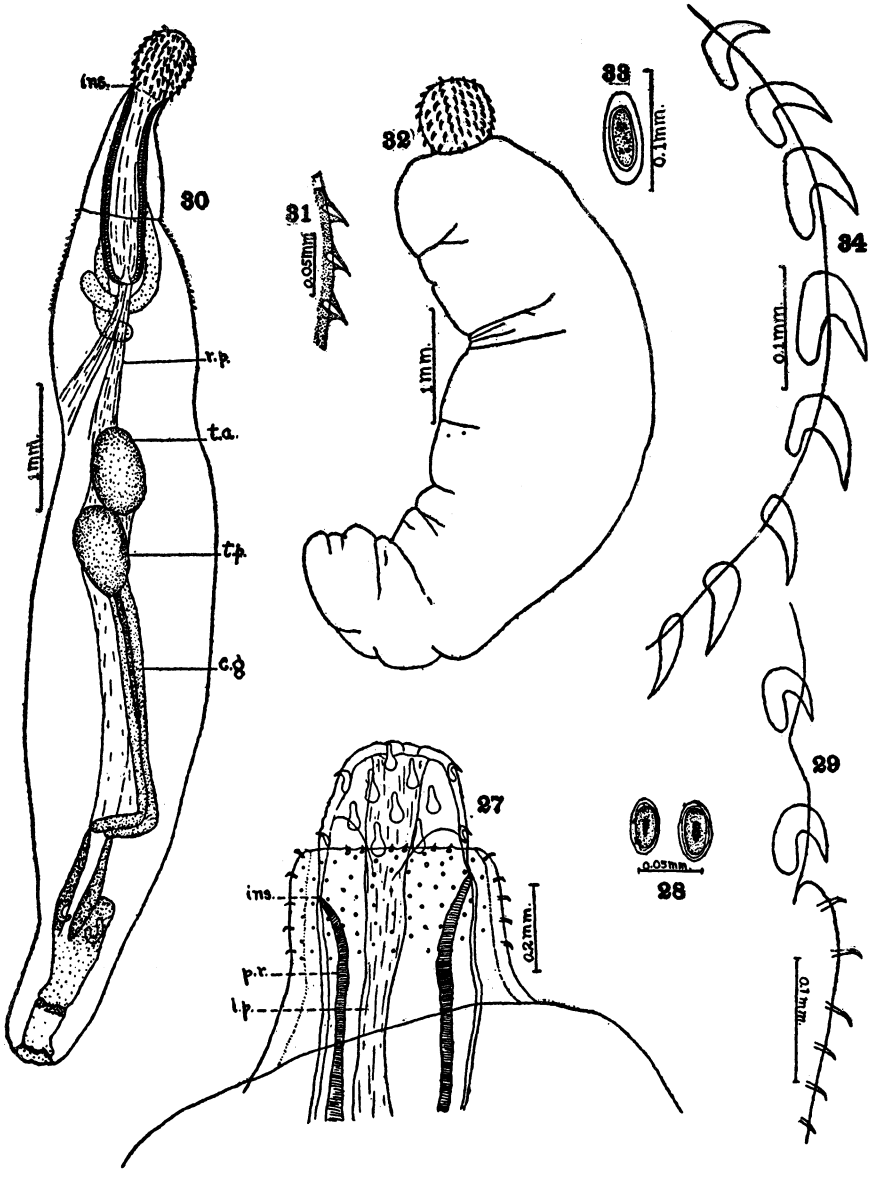

PLATE V.

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