

TWO NEW GENERA AND SPECIES OF ACANTHOCEPHALOUS WORMS FROM VENEZUELAN FISHES.

By H. J. VAN CLEAVE,

Of the University of Illinois, Urbana, Illinois.

With the exception of the species parasitic in birds and in mammals, practically nothing is known of the acanthocephalan fauna of South America. K. M. Diesing (1851) described a number of species of these parasites from the Brazilian collections by Natterer and by Olfers which included a few species from fishes. These were briefly characterized by the enumeration of a few salient features of external morphology. The drawings accompanying these descriptions are so highly generalized that they add but little to the data available for the recognition of Diesing's species. In spite of the fact that his records indicate some interesting deviations from the conditions and structures found in the better known European and North American species, no one has yet made a successful attempt to include his forms from fishes in the modern system of classification which, for this group, has been evolved in the last quarter century.

No recent worker has published an account of having restudied or even of having recognized any of Diesing's species of Acanthocephala from Brazilian fishes. In fact, there is no published record including results of a careful study of the Acanthocephala from fresh-water fishes of any locality on the South American continent. Porta (1905) in his general catalogue of the Acanthocephala of fishes listed Diesing's species, but with no data beyond that included in the original descriptions. Recently a considerable body of evidence has been accumulating (Van Cleave 1916 *a*:228, 1918:20 and 32, 1919:234) emphasizing the distinctive features of the North American acanthocephalan fauna as contrasted with the European fauna, upon which the modern system of classification of the group has been chiefly based. It is not improbable that the incompletely described and imperfectly known novelties in Diesing's work may represent another line of independent differentiation characteristic of the Acanthocephala of the South American continent. Phylogenetically the Acanthocephala represent such an ancient group of

parasites that great diversification in isolated regions is not surprising.

Through the courtesy of Prof. A. S. Pearse I have been permitted to study an interesting collection of Acanthocephala which he secured in the course of investigations upon the fishes of Lake Valencia, Venezuela, during the summer of 1918. Though data from a fairly large number of fishes was included in this collection, but two species of these parasites were encountered. For one of these, two species of fresh-water fishes acted as definitive hosts, and for the other five species of definitive hosts were recorded. Since each of the parasites here encountered represents a hitherto undescribed genus, it seems advisable to present descriptions of them. This is especially desirable because facts brought out in the study of these new forms seem to present entirely new lines of evidence concerning the relationships of certain genera previously described, and also because it has been found necessary to create a new family for which one of these genera becomes type.

This paper forms No. 157 of the series of contributions from the Zoological Laboratory of the University of Illinois.

PANDOSENTIS, new genus.

Generic diagnosis.—With the characters of the family Neoechino-rhynchidae, except for the variation in arrangement of giant nuclei within the subcuticula. These do not always lie in the sagittal plane, as in representatives of all the other genera previously included in this family, but are frequently lateral in distribution. Parasitic as adults in the alimentary canal of fishes. Body proper small, devoid of spines. Proboscis short, cylindrical, provided with more than three circles of hooks. Boundary between root and thorn usually not sharply marked. Male genital organs in same arrangement as found in members of the genus *Gracilisentis*. Testes elliptical, contiguous. Cement gland a rounded syncytial mass immediately following the posterior testis, with its posterior boundary indented for the reception of the reservoir of the cement gland. Cement gland in only known species contains 16 giant nuclei. Central nervous system at base of proboscis receptacle. Retractors of receptacle emerge from the receptacle at its posterior extremity on dorsal and ventral surfaces. Lemnisci not as long as the proboscis receptacle.

Type species.—*Pandosentis iracundus*, new species.

PANDOSENTIS IRACUNDUS, new species.

Plate 27.

Specific description.—With the characters of the genus *Pandosentis*. Females about 1 to 1.5 mm. long and 0.4 mm. in maximum diameter; males about 0.6 to 1 mm. long and 0.15 to 0.25 mm. in

diameter. Body proper tapering slightly toward each extremity (fig. 6), frequently with the ventral surface slightly concave. Proboscis short, cylindrical; in most preserved specimens completely inverted and retracted within body proper by the violent action of the exceptionally highly developed inverter of the proboscis and the retractors of the receptacle. In fully extended individual the proboscis (fig. 1) measured 0.09 mm. in length and was of the same diameter. Proboscis bears 22 longitudinal rows of four hooks each. Each hook is embedded in a papilla beyond which only a small portion of the hook protrudes. Hooks of distinctive form, somewhat resembling those of *Gracilisentis*, with no distinct line of separation between thorn and root and with no sharp contrast in form of hooks in different regions of the proboscis. Total length of line connecting base of root with tip of hook when hook is in full side view, 14μ . The exposed, distal, 8μ of each hook near the base of the proboscis is bent at almost right angles to the basal portion of the hook (fig. 2), while those at the tip of the proboscis (fig. 4) are slightly less strongly bent. Wall of proboscis receptacle very delicate, composed of a single layer. Inverter of the proboscis excessively developed, filling most of the space within the receptacle (fig. 5). Central nervous system a small mass of ganglion cells crowded into the posterior extremity of the receptacle between the postero-lateral angles of the receptacle where the retractors of the receptacle emerge from the wall. Lemnisci shorter than the receptacle and usually obscured by that structure. Embryos (fig. 9) within the body cavity of the mature female 22 to 28μ long by 11μ in diameter. Testes ovoid to spheroidal, contiguous; followed immediately by a syncytial cement gland containing 16 giant nuclei.

Type host.—*Aquidens pulcher* (Gill); also taken from intestine of *Crenicichla geayi* Pellegrin. These hosts were identified by Prof. C. H. Eigenmann.

Type locality.—Maracay, Lake Valencia, Venezuela.

Cotypes deposited in the collection of the writer and in the United States National Museum.

The members of this genus are of especial interest because of the fact that they show remarkable combinations of characters, which indicate probable relationships to the two distinctly North American genera, *Gracilisentis* and *Tanaorhamphus*. In many respects the characters of *Pandosentis* stand intermediate between those of the two genera just mentioned. General body form and general topography of the internal organs of both male and female closely simulate the conditions found in *Gracilisentis*, though the number of giant nuclei in the cement gland is 16, the same as that found in *Tanaorhamphus*, as against the 12 found in *Gracilisentis*. The form of the proboscis and the number and shape of the hooks combine

characters which seem, on the whole, to stand intermediate between these two genera, as shown in the accompanying table:

Genus.	Proboscis hooks.		Nuclei in cement gland.
	Circles.	In a circle.	
<i>Gracilisentis</i>	3	12	12
<i>Pandosentis</i>	8	11	16
<i>Tanaorhamphus</i>	20	8-10	16

The lacunar system of *Pandosentis* is especially conspicuous in many individuals; in fact, the distances between the annular lacunae in the body wall are frequently little more than the diameter of a single lacuna (fig. 7). The body wall is only about 50 μ in thickness. This gives to the individuals a distinctly fragile appearance. The nuclei of the subcuticula are of the type previously described for *Gracilisentis*. The unusual irregular distribution of the dorsal subcuticular nuclei mentioned in the generic diagnosis is associated with the fact that the lacunar system is not absolutely regular in its arrangement of parts. In some portions of the body there are distinctly dorsal and ventral main canals with regular annular intercommunications between them. This is especially typical of the anterior region of the body. Figure 7 represents a portion of the dorsal lacuna and its lateral branches from the anterior extremity of the body. In other regions of the body (fig. 8) this definiteness of arrangement is replaced by irregular diagonal canals communicating with the annular lacunae. The giant nuclei of the subcuticula have definite relationships to the lacunar system. In most of the Neoechinorhynchidae the longitudinal trunks of this system are distinctly dorsal and ventral in location. In all such cases which have been observed by the writer, the giant nuclei are all located in the sagittal plane of the body. In *Pandosentis* the irregularity of the longitudinal trunks of the lacunar system is directly associated with an irregularity in arrangement of the subcuticular nuclei. Figure 8 shows one of the giant nuclei from the posterior extremity of a mature male. The irregularity of the lacunar system in this region is readily observable.

In working out the morphology of this species nearly 100 specimens were studied. Of these only three or four had the proboscis sufficiently protruded to make a study of the hooks and their arrangement possible. Inversion of the proboscis is due to the action of the strongly developed inverter of the proboscis, which, in this species, is one of the most conspicuous structures in the anterior region of the body. It is conspicuous even in toto mounts, and in the extended proboscis occupies much of the interior of that organ. There are three conspicuously large nuclei in this inverter muscle (fig. 5).

The retracted proboscis and the inverter leave little room for other structures within the interior of the proboscis receptacle. The form and structure of this last-mentioned organ differ considerably from those of other members of this same family. The posterior end of the receptacle is bluntly truncated, and from the dorsal and ventral margins of this posterior surface the retractors of the receptacle emerge (fig. 5). The central nervous system, a single ganglionic mass, lies against the posterior wall of the receptacle between the points of emergence of the retractors. The ganglion is about 60μ in diameter. In other species of Neoechinorhynchidae the wall of the receptacle is composed of a single heavy muscular layer, the fibers of which are directed perpendicularly to the surface of the receptacle. In *Pandosentis iracundus* the wall of the receptacle is extremely thin and devoid of any conspicuous development of musculature. The dorsal and ventral retractors of the receptacle extend through the body cavity to the dorsal and ventral surfaces of the body wall, respectively, and find their insertion in the immediate vicinity of the giant nuclei of the subcuticula.

Seven species of fish were found to harbor Acanthocephala in the immediate vicinity where *Pandosentis iracundus* was found, yet only two host species are recorded for this parasite. Of these two, *Aquidens pulcher* (Gill) was much the more heavily parasitized. Though all of the collections of this species were made within the limits of one week none of the females taken from *Aquidens pulcher* contained fully formed hard shelled embryos such as were found in some of the individuals from the much less heavily parasitized host, *Crenicichla geayi*.

QUADRIGYRUS, new genus.

Generic diagnosis.—Acanthocephala of medium size parasitic in the alimentary canal of fishes. Proboscis armed with four circles of hooks. Anterior surface of body usually provided with four circles of cuticular spines. Subcuticular nuclei of two types; those of anterior part of body ovoid giant nuclei, dorsal and ventral in location; those in remainder of body a large, central elongated mass, from which heavy lateral projections are given off, usually lateral in distribution. Proboscis receptacle provided with a single heavy muscular wall. Central nervous system located at posterior extremity of proboscis receptacle.

Type species.—*Quadrigyruus torquatus*, new species.

QUADRIGYRUS TORQUATUS, new species.

Plate 28.

Specific description.—Preserved individuals long, cylindrical, with a short globose proboscis; gravid females frequently showing an ovoid enlargement of the anterior extremity. Mature females 10 to

20 mm. long and 0.9 to 1.25 mm. in maximum diameter. Mature males about 8 to 10 mm. long, with a maximum diameter of about 0.6 mm. Anterior region of body provided with four circles of cuticular spines which are approximately 24μ in length. Proboscis provided with four circles of five hooks each, those of terminal and second circle similar in appearance and size and fairly sharply differentiated from those of third and basal circles. Terminal hooks 94 to 106μ long, with a root 47 to 53μ long; those of second circle 76 to 100μ long, with a root 47 to 53μ long; those of third circle 53 to 59μ long, with a root 24 to 30μ long; basal hooks, 41 to 47μ long, with inconspicuous roots 12 to 24μ in length. Lacunar system an irregular system of branching canals. Subcuticular nuclei of two types; those in anterior extremity ovoid giant nuclei; those in posterior part of body, each in the form of a central elongated mass, from which short lateral branches are given off. Anterior nuclei, one dorsal and one ventral. Remaining nuclei lateral in arrangement, usually one upon the left and two upon the right side of the body. Proboscis receptacle inclosed by a single muscular wall. Central nervous system a single ganglion, near posterior end of receptacle. Testes elliptical to spindle shaped, usually considerably separated from each other. Cement gland a long compact mass containing a few large nuclei. Female genital orifice on ventral surface of the body a short distance from the posterior tip (fig. 19). Posterior extremity of body beyond genital orifice of distinctly smaller diameter than remainder of body.

Type host.—*Hoplias malabaricus* (Bloch). Also taken from the following hosts: *Symbranchus marmoratus* Bloch, *Crenicichla gayi* Pellegrin, *Gephyrocharax valenciae* Eigenmann, and *Astyanax bimaculatus* (Linnaeus). Identified by Prof. C. H. Eigenmann.

Type locality.—Maracay, Lake Valencia, Venezuela. Also taken at Isla del Buro, Venezuela.

Cotypes in the collection of the writer and in the United States National Museum.

The description of this species is based upon a study of numerous individuals from various hosts, all collected during the month of August, 1918. They represent widely different conditions of maturity, ranging from fully mature individuals to much smaller specimens, in which the sexual products are not yet differentiated. This diversity of conditions has offered exceptional opportunity for the complete study of the finer features of the morphology from stained toto-mounts, for many structures, partially obscured in the gravid females, have been readily demonstrable even in these same individuals after the general nature of the structures had been determined from a study of smaller, less fully developed specimens.

The degree of infestations of individual hosts varied widely. Even in *Hoplias malabaricus*, the type host of this species, infestations ranged from a single parasite to more than 50 individuals in the same host specimen. No extremely heavy infestations were encountered.

The position of the genus *Quadrigyrus* in the classification of the Acanthocephala is not easily determined. This is true in spite of the fact that characteristics commonly considered as of value in establishing generic relationships are clearly observable in members of this genus. The difficulty arises from the fact that these characters appear in combinations which have not been observed previously in other genera. In the genera and families of Acanthocephala created by Hamann (1892), and in the later work by Lühe (1911), certain groups of characters seemed so commonly associated that groups rather than individual characters have come to be considered by taxonomists as immutable units forming the basis of a natural classification. The early families were based on a single genus each and the genera were frequently monotypical, consequently it is not surprising that the addition of new facts regarding Acanthocephala from other parts of the world should bring together new groupings of characters different from those of the genera and families included in the narrowly restricted regions considered by the early workers.

Thus, the presence of a single muscular wall surrounding the receptacle of the proboscis was considered as peculiar to the Neoechinorhynchidae until the present writer (1916a) described several species of Centrorhynchidae belonging to the genus *Mediorhynchus*, each of which displayed a single-walled receptacle. Now, with the discovery of the genus *Quadrigyrus*, another addition is made to the forms having a single-walled proboscis receptacle, and this character may no longer be in itself considered as diagnostic for the Neoechinorhynchidae.

In the following discussion of relationships the writer has followed the current usage of including the subfamily Rhadinorhynchinae within the family Echinorhynchidae. As it stands, this family has little homogeneity, representing a residual group from which the other families have been detached in much the same manner as its type genus, *Echinorhynchus*, represented at one time the only genus recognized among the Acanthocephala. Many of the species attributed to *Echinorhynchus* have remained there because of insufficient data to enable later workers to recognize the genus to which the species properly belong. A number of slightly related genera still remaining in this family present characteristic differences of what seem to be of family significance. Conservatism has prevented workers in this group from creating new families for these single genera, many of

which are only imperfectly known. It is believed that the relationships of the forms now considered as belonging to the Echinorhynchidae may be better understood and more intelligently dealt with when greater numbers of genera have been discovered through researches upon the parasites of regions which have been practically unstudied.

The presence of four circles of proboscis hooks in *Quadrigyurus* is a rather significant feature in that it marks a transition between the condition of three circles characteristic of many species of the Neochinorhynchidae and the condition of many circles such as are characteristically found in the genus *Rhadinorhynchus* and many others. Lühe (1904: 191) has called attention to the fact that in members of the genus *Neoechinorhynchus* the hooks usually considered as belonging to the terminal circle do not all occur at the same level upon the surface of the proboscis, but rather represent two alternating series or circles of three hooks each, but slightly separated one from the other. Phylogenetically it seems probable that a condition such as that mentioned by Lühe, and the fusion of two circles at the base of the proboscis (Van Cleave, 1919: 238), as in *Pomphorhynchus bulbocollis*, may represent either an early step in the diversification which has resulted in the development of the highly armed, elongated proboscis from a simple type, or may, on the other hand, represent a late stage in the regressive simplification of the elongated type of proboscis toward the simple ovoid type. These two possibilities of interpretation are mentioned here because of the fact that investigators have apparently been agreed in defining the simplicity of the Neoechinorhynchidae as primitive when there is just as much reason for believing that it is a simplicity derived from a regressive evolution. Regardless of the interpretation that is put into the evidence it nevertheless holds that the four circles of hooks on the proboscis of *Quadrigyurus* represents a condition intermediate between the fixed three circles characteristic of many Neoechinorhynchidae and the many circles found in most of the other Acanthocephala. In this degree *Quadrigyurus* represents a transitional form linking the Neoechinorhynchidae with the other genera.

To the present time members of the subfamily Rhadinorhynchinae have comprised the only Acanthocephala possessing body spines which occur as adults in fishes. This would suggest a probable relationship between the Rhadinorhynchinae and members of the genus *Quadrigyurus*. In details of structure the body spines in the two instances differ considerably. Those of *Quadrigyurus* have a less conspicuous cuticular elevation surrounding each spine, and at the base of each there is a distinctly granular area which renders the boundary between the base of the spine and the subcuticula rather indistinct in

toto-mounts. In young individuals (fig. 10) the spines are easily observable, but in many of the fully mature specimens the body spines can be demonstrated in toto-mounts only with greatest difficulty. In fact, in some individuals they seem to be wanting and their place marked only by a roughening of the body surface. This condition is not peculiar to members of this genus, for the same thing has been noted by the writer in describing mature females of *Filicollis botulus* (Van Cleave, 1916: 132).

The subcuticular nuclei of *Quadrigyrus* are unique, both in form and in arrangement. Ovoid or elliptical giant nuclei of fixed number and arrangements are characteristic of the Neoechinorhynchidae. Finely dendritic nuclei are characteristic of *Echinorhynchus thecatus* and what seem to be very minute scattered nuclei have been frequently described in the subcuticula of various genera of Acanthocephala. In *Quadrigyrus* nuclei of two distinctly different types occur. In the anterior region of the body a single elliptical giant nucleus is to be found in the subcuticula on the ventral surface of the body, and directly opposite it on the dorsal surface of the body there is another one just like it. The remainder of the subcuticular layer contains a few large nuclei laterally arranged. Each of these consists of an elongated central mass, from which a small number of short heavy projections are given off. These branches follow the canals of the lacunar system for a short distance and end abruptly or in a short pointed projection. These nuclei last described are different from any that have heretofore been recorded from any acanthocephalan.

From the foregoing discussion it will be seen that the genus *Quadrigyrus* has certain definite points in common with the Neoechinorhynchidae, on the one hand, and with the Rhadinorhynchinae, on the other. These relationships are briefly recapitulated in the following table:

Name.	Body spines.	Wall of proboscis receptacle.	Location of brain.	Circles of hooks.
Neoechinorhynchidae ...	Wanting.....	Single ..	Base of receptacle	3+
<i>Quadrigyrus torquatus</i>	Four circles....	...do...	Near base of receptacle.	4
Rhadinorhynchinae.....	Many circles.	Double.	Middle of receptacle....	Many.

Even this partial summary of comparisons will show that it is impossible to include *Quadrigyrus* in either of the two groups mentioned above; and since its affinities with other Acanthocephala are much less obvious it becomes necessary to create for this genus a new family, which takes the name Quadrigyridae and of which the genus *Quadrigyrus* becomes type.

QUADRIGYRIDAE, new family.

Acanthocephala of medium size parasitic as adults in the alimentary canal of fishes. Anterior body region provided with cuticular spines. Proboscis receptacle enclosed by a single muscular wall. Central nervous system located near the base of the receptacle. Subcuticular nuclei in anterior region elliptical, in sagittal plane; in remainder of body a few large, branched nuclei, laterally arranged.

SUMMARY.

1. A collection of Acanthocephala taken by Prof. A. S. Pearse from fishes of Lake Valencia, Venezuela, contains two new species, each of which represents a new genus and one of them a new family.

2. *Pandosentis*, new genus, is described and *P. iracundus*, new species, is designated as type. *Aquidens pulcher* is the type host.

3. The relationships of the genus *Pandosentis* are discussed.

4. *Quadrigyryus*, new genus, is described and *Q. torquatus*, new species, is designated as type. *Hoplias malabaricus* is the type host.

5. The relationships of the genus *Quadrigyryus* are discussed and a new family, the Quadrigyridae, is established with *Quadrigyryus* as the type genus.

LITERATURE CITED.

- DIESING, K. M. 1851. Systema Helminthium. Vidobonae, 1850-1851.
- GRAYBILL, H. W. 1902. Some points in the structure of the Acanthocephala. Trans. Amer. Micros. Soc., vol. 23, pp. 191-200.
- HAMANN, O. 1892. Das System der Acanthocephalen. Zool. Anz., vol. 15, pp. 195-197.
- LÜHE, M. 1904-1905. Geschichte und Ergebnisse der Echinorhynchen-Forschung bis auf Westrumb (1821). Zool. Ann., vol. 1, pp. 139-353.
1911. Acanthocephalen. Die Süßwasserfauna Deutschlands, Heft 16. Jena.
- PORTA, A. 1905. Gli Echinorinchi dei Pesci. Arch. Zoologico, vol. 2, pp. 149-214.
- VAN CLEAVE, H. J. 1913. The genus *Neorhynchus* in North America. Zool. Anz., vol. 43, pp. 177-190.
1916. *Filicollis botulus* n. sp., with notes on the characteristics of the genus. Trans. Amer. Micros. Soc., vol. 35, pp. 131-134.
- 1916a. Acanthocephala of the genera *Centrorhynchus* and *Mediorhynchus* (new genus) from North American birds. Trans. Amer. Micros. Soc., vol. 35, pp. 221-232.
1918. Acanthocephala of North American Birds. Trans. Amer. Micros. Soc., vol. 37, pp. 19-48.
- 1918a. Acanthocephala of the subfamily Rhadinorhynchinae from American fish. Jour. Parasitol., vol. 5, pp. 17-24.
1919. Acanthocephala from the Illinois River, with descriptions of species and a synopsis of the family Neoechinorhynchidae. Bull. Ill. Nat. Hist. Survey, vol. 13, Art. 8, pp. 225-257.

EXPLANATION OF PLATES.

All figures were drawn from hematoxylin stained permanent mounts with the aid of a camera lucida.

SYMBOLS.

<i>a</i> , annular lacuna.	<i>g</i> , genital opening.
<i>a r</i> , retractor of anterior region of body.	<i>i</i> , inverter of proboscis.
<i>b</i> , central nervous system.	<i>l</i> , lemniscus.
<i>c</i> , cement gland.	<i>n</i> , subcuticular nucleus.
<i>d</i> , dorsal lacuna.	<i>r</i> , proboscis receptacle.
<i>d r</i> , dorsal retractor of receptacle.	<i>s</i> , body spine.
<i>e</i> , egg mass.	<i>t</i> , testis.
	<i>v r</i> , ventral retractor of receptacle.

PLATE 27.

Pandosentis iracundus, new species.

The scales indicating magnification of figs. 1, 5, 7, and 8 have a value of 0.05 mm.; of fig. 6, 0.1 mm.; of remaining figures on this plate, 0.01 mm.

Fig. 1.—Fully extended proboscis of a mature male from intestine of *Aquidens pulcher*.

2.—Lateral view of a hook from near base of proboscis of a mature female.

3.—Lateral view of a hook from near middle of proboscis.

4.—Lateral view of a hook from tip of proboscis.

5.—Optical section through anterior region of a young female showing proboscis receptacle and associated structures.

6.—Optical section of a mature male with proboscis inverted.

7.—A portion of lacunar system in dorsal anterior region of a male, showing irregularity in the dorsal lacuna.

8.—A portion of lacunar system from posterior region of same individual as shown in fig. 7, showing irregularities of lacunar system in the region of a subcuticular giant nucleus.

9.—An embryo from the body cavity of a gravid female.

PLATE 28.

Quadrigyrus torquatus, new species.

The scales indicating magnification of figs. 11 to 15, inclusive, have a value of 0.01 mm.; all others on this plate have a value of 0.1 mm.

Fig. 10.—Fully extended proboscis and anterior region of body of a young male showing arrangement of proboscis hooks and body spines.

11.—Hook from basal circle of proboscis of young female.

12.—Hook from third circle of proboscis, same individual.

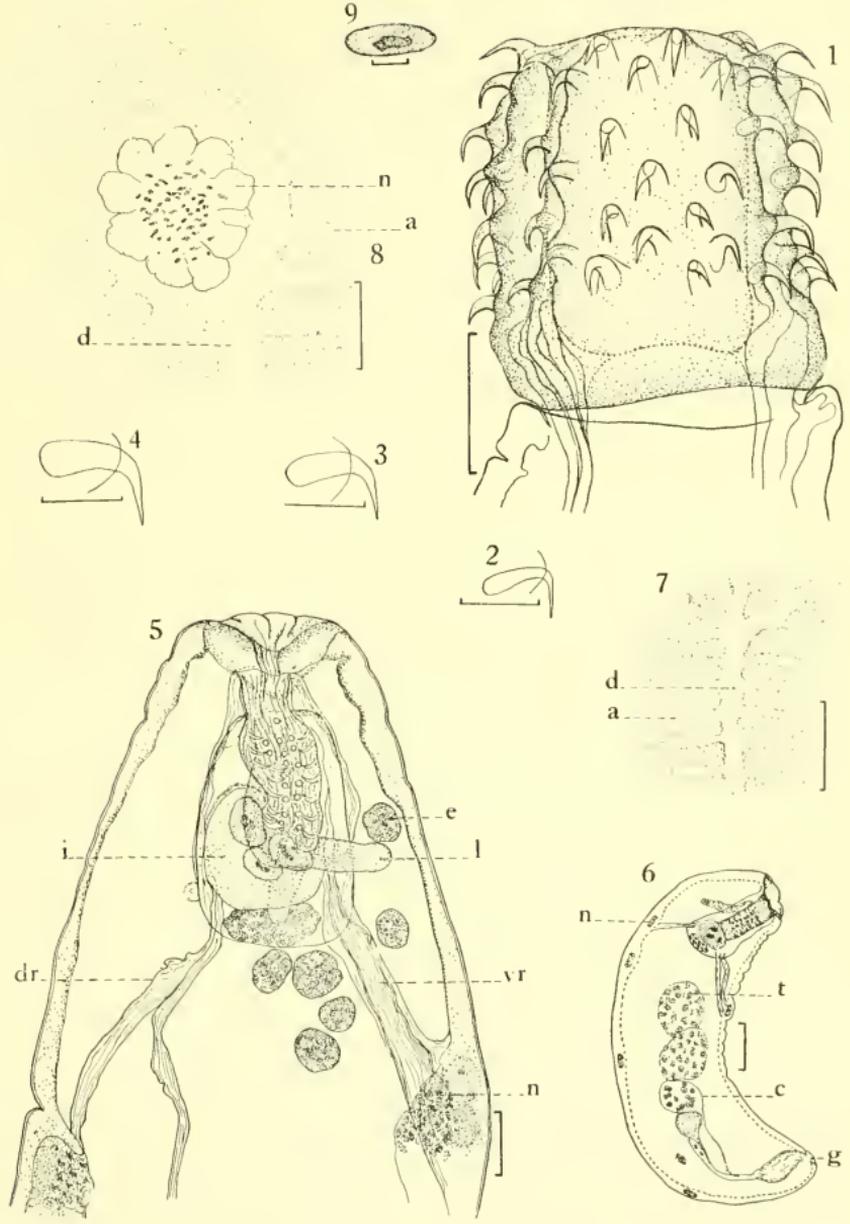
13.—Hook from second circle of proboscis, same individual.

14.—Hook from terminal circle of proboscis, same individual.

15.—Longitudinal section of an embryo from the body cavity of a gravid female.

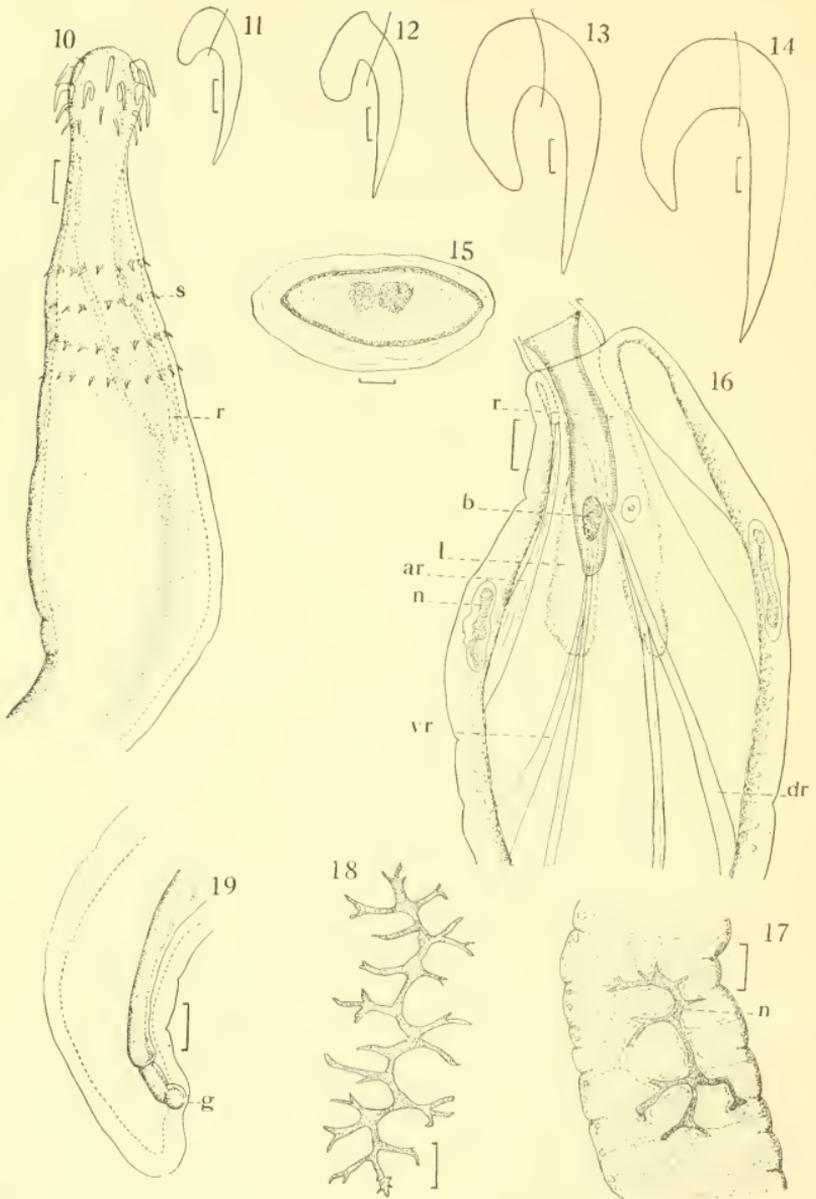
FIG. 16.—Optical section through anterior extremity of a young male, showing details of the receptacle and its associated structures.

- 17.—A portion of the body wall in the region of one of the lateral nuclei, showing the relation between the size of the nucleus and the width of the animal and the relations of the nucleus to the lacunar system. From a young male.
- 18.—A nucleus similar to the one shown in preceding figure but from a larger, older female.
- 19.—Posterior extremity of a young female in optical section, showing sub-terminal location of genital opening.



PANDOSENTIS IRACUNDUS, A NEW SPECIES OF ACANTHOCEPHALOUS WORMS.

FOR EXPLANATION OF PLATE SEE PAGE 465.



QUADRIGYRUS TORQUATUS, A NEW SPECIES OF ACANTHOCEPHALOUS WORMS.

FOR EXPLANATION OF PLATE SEE PAGES 465 AND 466.