

ON A COLLECTION OF  
ACANTHOCEPHALA IN THE LIVERPOOL  
SCHOOL OF TROPICAL MEDICINE

BY

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AND

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(Received for publication 11 March, 1925)

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The examination of this small collection of Acanthocephala has led us to attempt a tentative classification of the numerous genera hitherto described. The classification is based largely on the published descriptions of various authors which, unfortunately, are sometimes incomplete in details, a knowledge of which would



have been of great assistance, since the simplified morphology of the Acanthocephala offers at best but few characters on which to base a classification, and even these are liable to variation. Our work has therefore been one of great difficulty, and the result leaves much to be desired. To classify the group satisfactorily it will be necessary to obtain a much larger collection of species than we have had at our disposal, and a more extensive knowledge of the life history of the various worms.

Amongst the somewhat unsatisfactory characters upon which it has been necessary to base classification, mention should be made of the following :—

(1) *Lemnisci*. Even in mature worms, the length of the lemnisci appears (at least in certain genera) to vary within rather wide limits ; the length also varies, of course, with age ; and, moreover, the length relative to the total length of the body varies somewhat with the state of contraction or relaxation of the worm. From a systematic point of view, therefore, account must be taken of the age of the specimen and of the degree to which it is contracted.

(2) *Testes*. In young worms the shape, size, and relative position of the testes may be quite different from what they are in the adult. Reference has been made to this fact in the description of *M. moniliformis*. The degree of contraction of the body may also alter to some extent the position of the testes in the body and their relationship to each other, and this should be taken into account in those cases in which the position of the testes is of systematic importance.

(3) *Prostatic glands*. No reliance can be placed on the appearance of the prostatic glands of young worms. In mature worms it is frequently extremely difficult to determine the number of prostatic glands, but as some authors attach great importance to it, we have been unable to avoid employing it as a diagnostic character (see ECHINORHYNCHIDAE). Moreover, our experience has convinced us that the shape and arrangement of the prostatic glands are by no means constant, and as diagnostic characters must not be pressed too far, only differences of considerable degree being significant.

(4) *Eggs*. Eggs taken from the body cavity may or may not be fully developed and therefore it is clearly unwise to describe the eggs from specimens obtained in this manner. We have frequently



observed notable differences to exist between the more and the less mature eggs in a single worm. As the characters of the eggs are occasionally of importance, however, and as usually the only eggs available for examination are those taken from the body of the worm, it is important to select for description none excepting those which appear to be mature, namely, those in which the three concentric membranes are clearly defined, and the ring of hooks on the embryo developed. As an aid to the recognition of mature eggs we may say that, so far as our experience goes, the embryos in them are of a brownish colour.

With reference to the retractibility of the proboscis, a distinction must be drawn between a retraction of the entire proboscis or 'proboscis-like structure' within the anterior part of the body, and a retraction (invagination) of the proboscis within its sheath. In this paper a reference to the proboscis as being retractile means that it is capable of being invaginated into its sheath.

As we employ certain terms in a sense in which they are not used uniformly by other authors the following definitions must be given :—

(1) *Proboscis*. The proboscis, as usually understood, signifies the process at the anterior extremity of the body which is used as an organ of fixation, and which (excepting in *Apororhynchus hemignathi*) is armed with hooks. We consider that this structure is not always morphologically identical, and therefore we propose to limit the term 'proboscis' to that part of the process at the anterior extremity of the body which lies anterior to the insertion of the proboscis-sheath, and to use the term 'proboscis-like structure' when referring to the proboscis as understood colloquially. We cannot agree with Lühe and Van Cleave (1916) in considering this unreasonable because it involves the admission that in the genus *Gigantorhynchus* there is little or no true proboscis. On the contrary, we regard it as characteristic of the genus *Gigantorhynchus* that the proboscis is reduced, and maintain that the morphology of the 'proboscis-like structure' of *G. echinodiscus*, and the forms of the hooks with which that structure is armed, afford strong support to the view that in this species the true proboscis is represented by only the one or two circles of large hooks at the anterior extremity.

(2) *Body*. We define the anterior limit of the body as being situated at the level of the insertion of the lemnisci. This is, of course,



a purely arbitrary definition which, however, we consider necessary for systematic purposes.

(3) *Neck*. Considerable importance is attached to the presence or absence of a neck in the Acanthocephala, and to the presence or absence of hooks on this neck, but there does not appear to us to be any general agreement as to what constitutes a neck, some authors using the term to indicate a zone, often devoid of hooks, at the base of the 'proboscis-like structure,' and others using it in a more restricted sense. We therefore propose to define the neck as being that part of the worm which lies between the base of the proboscis and the anterior extremity of the body, that is, between the level of the insertion of the proboscis-sheath and the level of the insertion of the lemnisci. Thus in the genus *Echinorhynchus* the proboscis, using the term in its colloquial sense, is entirely or almost entirely the true proboscis, in the genus *Gigantorhynchus* it is largely neck, whilst in the genus *Centrorhynchus* it is approximately half true proboscis and half neck.

*Classification*.—Westrumb, in 1821, briefly reviewed the earliest observations made on the Acanthocephala. The order **Acanthocephala** was established by Rudolphi, in 1809, the following being the characteristics assigned to it by him in 1819:—'Corpus teretiusculum, utriculare, elasticum. Proboscis seriatum uncinata retractilis. Individua alia mascula, alia feminea.' Rudolphi recognised one genus only, namely, *Echinorhynchus*, with the characters of the order. Diesing, in 1851, accepted Rudolphi's classification, recognising only the single genus *Echinorhynchus*, but considered the order **Acanthocephala** to be a tribe which he included in the sub-order **Aprocta**.

Cobbold, in 1879, erected the family ECHINORHYNCHIDAE to accommodate the single genus *Echinorhynchus*, but did not define its characters; and Leuckart, in 1886, used the family name ACANTHOCEPHALIDAE without stating either the characters of the family or the genera he proposed should be included in it, but apparently for the reception of the single genus *Echinorhynchus*.

The first important attempt to split up the Acanthocephala was made by Hamann, who, in 1892 and 1895, divided them into three families as follows:—

(1) ECHINORHYNCHIDAE. Body elongated, smooth. Proboscis-



sheath with double walls ; the proboscis-sheath receives the proboscis. Nerve ganglion in the proboscis-sheath, generally in its depth, centrally placed. Hooks chitinised only at their tips, and with a root-like process below.

Genus *Echinorhynchus* ; with the characters of the family.

(2) GIGANTORHYNCHIDAE. Large species with a segmented, flat, taenia-like body when alive. Hooks like those of *Taenia*, being entirely covered with chitin, and with two root-like processes. Proboscis-sheath muscular, inserted into the proboscis, and into which the proboscis cannot be retracted. Nerve ganglion situated behind the middle of the proboscis-sheath, lying laterally and eccentrically. The body cavity lined by a structureless membrane and traversed by oblique membranes. Lemnisci long coiled tubes with a central canal.

Genus *Gigantorhynchus* ; with the characters of the family.

(3) NEORHYNCHIDAE. Species which become sexually mature in the larval state. Proboscis-sheath a tube with a simple wall. In the skin, and in the lemnisci, are a few giant nuclei. Circular muscles very simply developed ; and the longitudinal muscles only present here and there.

Genus *Neorhynchus* ; with the characters of the family.

Since the publication of Hamann's classical work numerous authors have contributed to our knowledge of this interesting group of parasitic worms, amongst whom especial mention should be made of Lühe, Porta, Van Cleave, and Travassos.

The tentative classification which we propose is as follows. The species which we have had at our disposal are indicated in the body of the paper.

Phylum	NEMATHELMINTHES.
Order	ACANTHOCEPHALA.
Sub-order (1)	<b>Neoechinorhynchiea</b> , nom. nov.
Family (1)	NEOECHINORHYNCHIDAE Van Cleave, 1919.
Genera	<i>Neoechinorhynchus</i> Stiles and Hassall, 1905. <i>Tanaorhamphus</i> Ward, 1918. <i>Octospinifer</i> Van Cleave, 1919. <i>Gracilisentis</i> Van Cleave, 1919. <i>Pandosentis</i> Van Cleave, 1920.



- Family (2) QUADRIGYRIDAE Van Cleave, 1920.  
 Genus *Quadrigyryrus* Van Cleave, 1920.
- Family (3) APORORHYNCHIDAE Shipley, 1900.  
 Genus *Apororhynchus* Shipley, 1900.  
 Sub-order (2) **Gigantorhynchiea**, nom. nov.
- Family (1) GIGANTORHYNCHIDAE Hamann, 1892.  
 Genus *Gigantorhynchus* Hamann, 1892.
- Family (2) OLIGACANTHORHYNCHIDAE, nom. nov.  
 Genera *Macracanthorhynchus* Travassos, 1917.  
*Oligacanthorhynchus* Travassos, 1915.  
*Prosthenorchis* Travassos, 1915.
- Sub-order (3) **Echinorhynchiea**, nom. nov.
- Family (1) RHADINORHYNCHIDAE Travassos, 1923.  
 Genera *Rhadinorhynchus* Lühe, 1911.  
*Leptorhynchoides* Kostylev, 1924.  
*Arhythmorhynchus* Lühe, 1911.  
*Serrasentis* Van Cleave, 1923.  
*Telosentis* Van Cleave, 1923.
- Family (2) CENTRORHYNCHIDAE Van Cleave, 1916.  
 Genera *Centrorhynchus* Lühe, 1911.  
*Mediorhynchus* Van Cleave, 1916.  
*Empodius* Travassos, 1916.
- Family (3) CORYNOSOMIDAE, nom. nov.  
 Genera *Corynosoma* Lühe, 1904.  
*Bolbosoma* Porta, 1908.  
*Polymorphus* Lühe, 1911.  
*Filicollis* Lühe, 1911.  
*Tegorhynchus* Van Cleave, 1920.
- Family (4) MONILIFORMIDAE Van Cleave, 1924.  
 Genus *Moniliformis* Travassos, 1915.
- Family (5) ECHINORHYNCHIDAE Cobbold, 1879.  
 Genera *Prosthorhynchus* Kostylev, 1916.  
*Oligoterorhynchus* Monticelli, 1914.  
*Pomphorhynchus* Monticelli, 1905.  
*Acanthocephalus* Koelreuter, 1771.  
*Echinorhynchus* Zoega, 1776.



# PHYLUM NEMATHELMINTHES.

## Order ACANTHOCEPHALA.

Nemathelminthes without a gut, and with a proboscis-like structure which is usually armed with hooks.

With three sub-orders.

### KEY TO THE SUB-ORDERS OF THE ORDER ACANTHOCEPHALA.

1. Prostatic glands a single syncytial mass..... *Neoechinorhynchoidea* (1)  
     Prostatic glands not a single syncytial mass.....2
2. Proboscis reduced, not capable of being withdrawn  
     into the proboscis-sheath..... *Gigantorhynchoidea* (2)  
     Proboscis well developed and capable of being with-  
     drawn into the proboscis-sheath..... *Echinorhynchoidea* (3)

### Sub-order I. NEOECHINORHYNCHIDEA, nom. nov.

Proboscis usually short and sub-spherical. Proboscis-sheath (when present) a tube with a simple wall. Prostatic gland a single syncytial mass. Nuclei of sub-cuticle and lemnisci few and very large.

The order is divided into three families.

### KEY TO THE FAMILIES OF THE ORDER NEOECHINORHYNCHIDEA.

1. With a proboscis armed with hooks.....2  
     Without such a proboscis..... *Apororhynchidae* (3)
2. Body bearing spines on the anterior region..... *Quadrigyridae* (2)  
     Body devoid of spines..... *Neoechinorhynchidae* (1)

### Family (1) NEOECHINORHYNCHIDAE Van Cleave, 1919

Neoechinorhynchoidea of small to medium size. Wall of proboscis-sheath a single layer of muscle. Central nervous system near base of proboscis-sheath. Body devoid of spines; spines or hooks on proboscis only. Nuclei of sub-cuticle and lemnisci extremely large, normally of fixed number and definite arrangement, the sub-cuticle with five in the mid-dorsal line of the body and one in the mid-ventral line near the anterior end, and the lemnisci with two in one lemniscus and a single one in the other. Testes elliptical, usually contiguous. Prostatic gland a single syncytial mass containing relatively few



giant nuclei. Eggs where known with three membranes, and without polar capsules. Parasitic\* in fish and reptiles (turtles).

The family contains five genera.

KEY TO THE GENERA OF THE FAMILY NEOECHINORHYNCHIDAE.

1. Proboscis armed with 3 circles of hooks.....2  
    Proboscis armed with more than 3 circles of hooks.....3
2. Proboscis armed with 3 circles of 6 hooks each..... *Neoechinorhynchus* (1)  
    Proboscis armed with 3 circles of 8 hooks each..... *Octospinifer* (3)  
    Proboscis armed with 3 circles of 12 hooks each..... *Gracilisentis* (4)
3. Proboscis several times longer than wide, armed with  
    about 16 to 20 longitudinal rows each composed of  
    about 10 hooks..... *Tanaorhamphus* (2)
- Proboscis short, cylindrical, armed with about 22  
    longitudinal rows each composed of about 4 hooks... *Pandosentis* (5)

With regard to the last two genera, Van Cleave (1923) states in his key to the genera of Acanthocephala that in the genus *Tanaorhamphus* the proboscis bears 'twenty or more circles of hooks,' and in *Pandosentis* 'eight circles of hooks.' We are unable to harmonise these statements with his earlier generic definitions which we give below.

Genus (1) *Neoechinorhynchus* Stiles and Hassall, 1905.

SYNONYMS :—*Echinorhynchus* Zoega, in Müller, 1776, in part.  
*Neorhynchus* Hamann, 1892, preoccupied.  
*Eorhynchus* Van Cleave, 1914.

*Diagnosis*.—*Neoechinorhynchidae* with short, globose proboscis armed with three circles of six hooks each. Terminal hooks conspicuously larger and heavier than those of remaining rows, and the only ones which bear conspicuous reflexed root-like processes. Each root a broad, flattened disc pyriform in surface view, usually approximately parallel to surface of proboscis wall. The thorn or hook proper attached at the apical or anterior end of the root, and appreciably longer than the root. Parasitic in fish and turtles.

Type species : *N. rutili* (Müller, 1780).

A single species belonging to this genus was found in the collection. This appeared to be a new species and is briefly described below.

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\* Unless otherwise stated the hosts given in this paper are those in whose alimentary canal the adult worms are found.



*Neoechinorhynchus magnus*, sp.n.

One immature female specimen only ; host unknown. Townsville, Queensland, Northern Australia. (Dr. P. A. Maplestone).

The specimen measured 90 mm. in length, and the maximum breadth was about 1.5 mm. The body is flattened and tape-like, the anterior extremity being much narrower than the posterior extremity ; the skin is slightly corrugated.

*Proboscis*. The proboscis is small, sub-globular, and armed, as is usual in the genus, with eighteen hooks in three rows, the anterior six being larger than the rest. The hooks of the terminal circle measure in length from  $60\mu$  to  $71\mu$ , those of the middle circle  $30\mu$  to  $37\mu$ , and those of the basal circle about  $18\mu$ .

*Proboscis-sheath*. This measures 0.5 mm. in length and the greatest breadth is 0.2 mm.

*Lemnisci*. These are slightly unequal in length and measure from five to six times the length of the proboscis-sheath.

The species differs from all other species of the genus in being very much longer.

Genus (2) *Tanaorhamphus* Ward, 1918.

SYNONYM :—*Neoechinorhynchus* Stiles and Hassall, 1905, in part.

*Diagnosis*.—*Neoechinorhynchidae* of small to medium size, with cylindrical proboscis several times longer than wide. Proboscis armed with about sixteen longitudinal rows of hooks. Rows frequently incomplete and imperfect. Prostatic gland of the type characteristic of the family. Parasitic in fish.

Type species : *T. longirostris* (Van Cleave, 1913).

Genus (3) *Octospinifer* Van Cleave, 1919.

*Diagnosis*.—Proboscis short, globose, usually slightly broader than long ; provided with three circles of eight hooks each. Hooks of terminal circle not much larger or stronger than hooks of middle circle and but little longer than the root-process. Testes elliptical, in contact with each other but not joined by a broad contact-surface. Prostatic gland not in direct contact with posterior testis. The two lemnisci dissimilar in nuclear content, one possessing two giant nuclei and the other a single one. Central nervous-system located at one side of the proboscis-sheath, near its base. Parasitic in fish.

Type species : *O. macilentus* Van Cleave, 1919.



Genus (4) *Gracilisentis* Van Cleave, 1919.

SYNONYM :—*Neoechinorhynchus* Stiles and Hassall, 1905, in part.

*Diagnosis*.—Neoechinorhynchidae of small size. Body proper unarmed. Proboscis provided with three circles of twelve hooks each. Each hook ensheathed in a prominent cuticular collar which permits only a small portion of it to protrude from the surface of the proboscis. Each hook of the terminal circle provided with a conspicuous root-process several times longer than the exposed portion of the spine. Root composed of a broad flat basal area which, by gradual diminution in size anteriorly, makes an ill-defined transition from thorn to root. Basal region of terminal roots frequently slightly indented. Hooks of middle circle similar in general form to those of terminal circle, except that root-processes are shorter and less easily observed. Basal hooks without recurved roots. Parasitic in fish.

Type species : *G. gracilisentis* (Van Cleave, 1913).

Genus (5) *Pandosentis* Van Cleave, 1920.

*Diagnosis*.—Neoechinorhynchidae, with the characters of the family, except for the variation in arrangement of giant nuclei within the sub-cuticle. 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. 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. Arrangement of male genital organs as in members of the genus *Gracilisentis*. Testes elliptical, contiguous. Prostatic gland a rounded syncytial mass immediately following the posterior testis, with its posterior boundary indented for the reception of the reservoir of the prostatic gland. Prostatic gland in the only known species contains sixteen giant nuclei. Central nervous system at base of proboscis-sheath. Retractors of sheath emerge from the sheath at its posterior extremity on dorsal and ventral surfaces. Lemnisci not as long as the proboscis-sheath. Parasitic in fish.

Type species : *P. iracundus* Van Cleave, 1920.



Family (2). QUADRIGYRIDAE Van Cleave, 1920.

Neoechinorhynchidea of medium size. Anterior body region provided with cuticular spines. Proboscis-sheath enclosed by a single muscular wall. Central nervous system located near the base of the proboscis-sheath. Subcuticular nuclei in anterior region elliptical, in sagittal plane; in remainder of body a few large, branched nuclei laterally arranged. Parasitic in fish.

The family contains only a single genus.

Genus *Quadrigyryrus* Van Cleave, 1920.

*Diagnosis.*—Quadrigyridae of medium size. 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-sheath provided with a single, heavy muscular wall. Central nervous system located near posterior extremity of proboscis-sheath. Parasitic in fish.

Type species: *Q. torquatus* Van Cleave, 1920.

Family (3) APORORHYNCHIDAE Shipley, 1900.

Neoechinorhynchidea of short form with the body divided into three well-marked regions. The head (proboscis) is pitted but not armed with hooks. There is no eversible introvert, no proboscis-sheath and no armature of hooks. The sub-cuticle and lemnisci have a few giant nuclei, and the lemnisci are long and coiled. Parasitic in birds.

The family contains only a single genus.

Genus *Apororhynchus* Shipley, 1900.

SYNONYM:—*Arhynchus* Shipley, 1896.

With the characters of the family.

Type species: *A. hemignathi* Shipley, 1896.

With regard to this species, Marval (1905) writes: ' Nous nous permettrons donc, maintenant, de considérer *Arhynchus hemignathi*



comme un *Neorhynchus*, endoparasite comme tous les Acanthocéphales, sans exception, et privé de rostre soit accidentellement ce qui est probable, soit à la suite de longues modifications telles que celles qui se produisent chez l'*Echinorhynchus filicollis* et *sphaerocephalus*, lors de la transformation du rostre en bulle.'

## Sub-order II. GIGANTORHYNCHIDEA

Proboscis reduced, often composing only a small part of the proboscis-like structure; proboscis-sheath with a thick muscular wall into which the proboscis (when present) cannot be retracted, the proboscis-sheath being inserted near the anterior extremity. Neck present. Nuclei of the sub-cuticle and lemnisci relatively small and numerous. Prostatic glands not a single syncytial mass. Parasitic in mammals and birds.

The order is divided into two families.

### KEY TO THE FAMILIES OF THE SUB-ORDER GIGANTORHYNCHIDEA.

- Proboscis greatly reduced, represented by only one or two transverse rows of large hooks at the anterior extremity of the proboscis-like structure. Neck armed with numerous small hooks..... *Gigantorhynchidae* (1)
- Proboscis sub-spherical, armed with 5 or 6 transverse rows of hooks. Neck unarmed..... *Oligacanthorhynchidae* (2)

### Family (1) GIGANTORHYNCHIDAE Hamann, 1892.

Gigantorhynchidea of large size. Body apparently segmented. Proboscis rudimentary, represented by one or two transverse rows of hooks. Hooks with double roots. Neck armed with numerous small hooks. Lemnisci filiform, with numerous nuclei. Testes ellipsoidal, elongated, situated posteriorly. Prostatic glands sub-spherical. Parasitic in mammals.

The family contains only a single genus.

Genus *Gigantorhynchus* Hamann, 1892.

SYNONYM:—*Echinorhynchus* Zoega, 1776, in part.

With the characters of the family.

Type species: *G. echinodiscus* (Diesing, 1851).



## Family (2) OLIGACANTHORHYNCHIDAE, nom. nov.

Gigantorhynchiea of small to large size. Body more or less rugose. Proboscis sub-spherical or nail-like, armed with five or six transverse rows of hooks. Hooks (excepting those at the base) with double roots. Neck short, unarmed. Testes ellipsoidal or cylindrical. Prostatic glands eight, ellipsoidal or nail-like. Parasitic in mammals and birds.

The family contains three genera.

## KEY TO THE GENERA OF THE FAMILY OLIGACANTHORHYNCHIDAE.

1. Sexual dimorphism well marked; females very large and spirally coiled, males small, comma-shaped. Lemnisci relatively short and flat. Testes situated some distance anterior to the prostatic glands. Genital organs of the male occupying two-thirds of the body cavity..... *Macracanthorhynchus* (1)
- Sexual dimorphism not well-marked. Lemnisci narrow and cylindrical..... 2
2. Genital organs of the male situated posteriorly and occupying about a quarter of the body cavity..... *Oligacanthorhynchus* (2)
- Genital organs of the male occupying two-thirds or more of the body cavity..... *Prosthenorchis* (3)

Genus (1) *Macracanthorhynchus* Travassos, 1917.

SYNONYMS :—*Echinorhynchus* Zoega, 1776, in part.

*Gigantorhynchus* Hamann, 1892, in part.

*Diagnosis*.—Sexual dimorphism well-marked; females very large and spirally coiled, males small, comma-shaped. Proboscis very large. Lemnisci rather short and flat, extending backwards to the anterior testis. Genital organs of the male occupying two-thirds of the body cavity. Testes long, cylindrical. Parasitic in mammals.

Type species: *M. hirudinaceus* (Pallas, 1781).

A single species belonging to this genus was found in the collection, namely :—

*Macracanthorhynchus hirudinaceus* (Pallas, 1781).

SYNONYMS :—*Taenia haeruca* Pallas, 1766, preoccupied, in part.

*Taenia hirudinacea* Pallas, 1781.

*Echinorhynchus gigas* Bloch, 1782.

*Gigantorhynchus gigas* of Hamann, 1892.

*Gigantorhynchus hirudinaceus* of Porta, 1908.

Six females and five males; host unknown. Hong Kong, January, 1914 (Dr. Bell). Also one male and one female; host unknown. Kindly lent by A. W. Noel Pillers, F.R.C.V.S., D.V.S.M.



The largest female measured 532 mm. in length, and 9 mm. in greatest breadth. The largest male measured 80 mm. in length, and 6 mm. in greatest breadth.

Genus (2) *Oligacanthorhynchus* Travassos, 1915.

SYNONYMS :—*Echinorhynchus* Zoega, 1776, in part.  
*Gigantorhynchus* Hamann, 1892, in part.  
*Hamania* Travassos, 1915.  
*Hamanniella* Travassos, 1915.

*Diagnosis*.—Sexual dimorphism not well-marked. Lemnisci filiform or cylindrical, long, with numerous nuclei. Genital organs of the male situated posteriorly and occupying about a quarter of the body cavity. Testes ellipsoidal. Parasitic in mammals (marsupials and edentates) and birds.

Type species : *O. spira* (Diesing, 1851).

In place of the genus *Oligacanthorhynchus*, Travassos recognises two genera, namely, *Oligacanthorhynchus* and *Hamanniella*, which are very closely allied but, according to Travassos, may be distinguished as follows :—

Prostatic glands ellipsoidal, in pairs.	Parasitic in birds.....	<i>Oligacanthorhynchus</i>
Prostatic glands nail-like, condensed.	Parasitic in marsupials	
and edentates.....		<i>Hamanniella</i>

The distinction based on the shape of the prostatic glands appears to us to be difficult to make out, and is not clearly shown in at any rate one of Travassos' figures, and therefore we have included both genera in a single genus for which the name *Oligacanthorhynchus* appears to have priority.

A single species belonging to this genus was found in the collection, namely :—

*Oligacanthorhynchus microcephalus* (Rud., 1819).

SYNONYMS :—*Echinorhynchus microcephalus* Rud., 1819.  
*Hamania microcephala* Travassos, 1915.  
*Hamanniella microcephala* Travassos, 1915.

One male specimen from the intestine of *Didelphis marsupialis*. British Guiana, 1912 (Dr. Minett).



Unfortunately the proboscis is missing, and consequently a definite identification is not possible. The incomplete worm measured about 35 mm. in length. Our specimen agrees in general with Travassos' figure of the male of this species, excepting that the lemnisci are, relatively, extremely long (about 17 mm.) and extend to the testes. Our specimen is young and consequently much shorter than the fully-developed specimen figured by Travassos, the length of which is given as 150 mm. to 200 mm.; this fact probably accounts for the apparent difference in the length of the lemnisci in the two specimens.

Genus (3) *Prosthenorchis* Travassos, 1915.

SYNONYMS :—*Oncicola* Travassos, 1916.

*Pardalis* Travassos, 1917, preoccupied.

*Echinopardalis* Travassos, 1918.

*Diagnosis*.—Oligacanthorhynchidae of small to medium size. Sexual dimorphism not well-marked. Body rugose. Proboscis sub-spherical, armed with five or six transverse rows of hooks. Testes situated in the middle third of the body or more anteriorly; genital organs of the male occupying two-thirds or more of the body cavity. Ejaculatory canal very long. Parasitic in mammals and birds.

Type species: *P. spirula* (Olfers, in Rudolphi, 1819).

In place of the genus *Prosthenorchis*, Travassos recognises three genera, namely *Oncicola*, *Echinopardalis*, and *Prosthenorchis*, which are very closely allied but, according to Travassos, may be distinguished as follows :—

1. Testes small, round. Prostatic glands large, condensed,  
situated just behind the testes..... *Oncicola*  
Testes larger, ellipsoidal. Prostatic glands not unusually  
large.....2
2. Prostatic glands ovoid, in pairs..... *Echinopardalis*  
Prostatic glands ellipsoidal, not in pairs..... *Prosthenorchis*

Some of Travassos' figures, however, do not fully support these distinctions, and therefore we have included all three in a single genus for which the name *Prosthenorchis* has priority.

Two species belonging to this genus were found in the collection, namely :—



*Prosthenorchis spirula* (Olfers, in Rud., 1819).

SYNONYMS :—*Echinorhynchus spirula* Olfers, in Rud., 1819.  
*Echinorhynchus elegans* Diesing, 1851.  
*Prosthenorchis elegans* Travassos, 1915.

Nine specimens, including two males, from the intestine of monkeys ; species and locality unknown.

In Travassos' figure of the male of *P. elegans*, the worm is shown to be short and broad, the lemnisci overlap the anterior testis, the two testes strongly overlap, and the prostatic glands are compacted into a single oval mass immediately behind them. In his figure of *P. spirula*, the entire worm is shown elongated, the lemnisci, although long, extend only half-way to the anterior testis, the two testes do not overlap but are situated one behind the other in the middle third of the body, and the prostatic glands are placed single file one behind the other, forming a long cylindrical mass.

Our male specimens show characters intermediate between the two above species ; thus, the body is relatively long, the lemnisci overlap the anterior testis, the testes are slightly separated, lying one in front of the other, and the prostatic glands in one male form a compact mass as in *P. elegans*, but in the other, the anterior glands are drawn out as in *P. spirula*, whilst the posterior glands are compacted as in *P. elegans*.

For the above reasons we consider *P. elegans* is indistinguishable from *P. spirula*.

It may be noted that in our specimens the eggs were similar in shape and size to those figured by Travassos for both the above species, and that the average measurements of ten eggs were  $78\mu$  by  $47\mu$ .

*Prosthenorchis pardalis* (Westrumb, 1821).

SYNONYMS :—*Echinorhynchus pardalis* Westrumb, 1821.  
*Echinorhynchus ovatus* Leidy, 1850.  
*Echinorhynchus campanulatus* Diesing, 1851.  
*Echinorhynchus oncicola* v. Ihering, 1902.  
*Oncicola oncicola* Travassos, 1916.  
*Pardalis pardalis* Travassos, 1917.  
*Echinopardalis pardalis* Travassos, 1918.

Numerous specimens, males and females, from the intestine of *Felis pardus*. Freetown, Sierra Leone, 10.III.1923 (Professor B. Blacklock and Dr. S. Adler).



*Size.* The females measured from 7 mm. to 14 mm. in length, and from 1.2 mm. to 1.8 mm. in breadth; only one of the females, viz., the longest, was gravid. The males varied in length from 8 mm. to 15 mm., and in breadth from 1.3 mm. to 1.8 mm.; only the larger males were mature. Travassos states that *Echinopardalis pardalis* has the following measurements: female, 30 mm. to 40 mm. by 1 mm. to 2.5 mm.; male, 30 mm. by 1 mm. to 1.5 mm. Our specimens are therefore much smaller than Travassos' specimens of *E. pardalis* and correspond more closely in length to his *Oncicola onicola* which measures as follows:—female, 10 mm. to 13 mm. by 3 mm. to 4 mm.; male, 9 mm. to 11 mm. by 2.5 mm. to 3 mm.

Diesing's specimens of *E. campanulatus* measured 6 mm. to 35 mm. in length, and from 2 mm. to 6 mm. in breadth.

*Shape of body.* Our specimens varied within fairly wide limits; all were slightly curved, some being cylindrical and tapering at each end, whilst others were more club-shaped, the broad end being anterior. The latter included specimens which were obviously shrunk. The skin, in the majority of the specimens, was smooth and ringed, but in others it was definitely wrinkled or rugose. Our specimens possess a peculiar collar-like structure identical with that figured by Diesing for his *E. campanulatus*. Travassos states that one of the differences between *O. onicola* and *E. pardalis* is that the former possesses a 'neck' and the latter does not; but at the same time he gives Diesing's *E. campanulatus* as a synonym of *E. pardalis*.

*Proboscis-sheath.* The muscular wall of the proboscis-sheath is very thick and, when viewed in certain positions, resembles the letter 'J.' The central nervous system is situated eccentrically, slightly posterior to the middle, and close to the end of the short limb of the muscular 'J.' The anterior ends of the muscular portion of the proboscis-sheath are connected with the proboscis by non-muscular strands.

*Lemnisci.* The lemnisci are very long, extending to the posterior third of the body, and often reaching nearly to the posterior extremity. In this character the specimens resemble *O. onicola*.

*Testes.* These lie near the middle of the body excepting in one or two specimens in which they are situated immediately behind the proboscis-sheath. The relative position of the testes is perhaps



to some extent dependent, firstly on the body contraction, and secondly on the contraction of the muscles attached to the proboscis-sheath, which tends to move the sheath posteriorly. The testes lie one in front of the other and are about twice as long as broad; the largest testis measured 0.97 mm. by 0.46 mm. In *E. pardalis* the testes measure 2 mm. to 3 mm. in length by 0.5 mm. in breadth, whilst in *O. onicola* they measure 0.8 mm. to 1 mm. in diameter.

The testes in our specimens thus resemble those of *O. onicola* in length, they are intermediate between those of *E. pardalis* and *O. onicola* in shape and appearance, whilst they resemble those of both species as regards their position.

*Eggs.* The eggs in our specimens averaged about  $65\mu$  by  $45\mu$ . Travassos gives the size of the egg of *E. pardalis* as  $53\mu$  to  $63\mu$  by  $38\mu$  to  $42\mu$ , and that of *O. onicola* as  $99\mu$  by  $71\mu$  to  $75\mu$ . The eggs of our specimens thus resemble more closely those of *E. pardalis*.

It will be clear then that our specimens resemble *Oncicola onicola* in some characters and *Echinopardalis pardalis* in others, and the facts cited above lead us to the conclusion that the two forms are identical, *Oncicola onicola* being merely the contracted form of *Echinopardalis pardalis*.

### Sub-order III. ECHINORHYNCHIDEA

Proboscis well-developed; proboscis-sheath with double walls (except in the genus *Mediorhynchus*) into which the proboscis can be retracted. Nuclei of the sub-cuticle and lemnisci relatively small and numerous, or with few large, finely dendritic nuclei. Prostatic glands not a single syncytial mass.

The order is divided into four families.

#### KEY TO THE FAMILIES OF THE SUB-ORDER ECHINORHYNCHIDEA.

1. Proboscis long, armed with numerous hooks which are stronger on the ventral than on the dorsal aspect..... *Rhadinorhynchidae* (1)  
     Proboscis armed with hooks arranged radially and symmetrically.....2
2. Proboscis sheath inserted near the middle of the proboscis-like structure, that is, the neck is armed with spines..... *Centrorhynchidae* (2)  
     Proboscis sheath inserted at the base of the proboscis; neck absent or unarmed.....3
3. Anterior region of body, in males at least, clothed with cuticular spines..... *Corynosomidae* (3)  
     Anterior region of body without spines.....4
4. Body moniliform..... *Moniliformidae* (4)  
     Body not moniliform..... *Echinorhynchidae* (5)



## Family (1) RHADINORHYNCHIDAE Travassos, 1923.

Echinorhynchiea of small to medium size. The anterior region of the body armed with scattered cuticular spines (except in the genus *Leptorhynchoides*). Proboscis long (at least twice as long as broad, and often much longer), usually bent ventrally, and armed with numerous hooks which are stronger on the ventral than on the dorsal aspect. Basal portion of proboscis often without hooks. Neck absent. Proboscis-sheath long. Central nervous system near the middle of the proboscis-sheath. Eggs with or without polar capsules. Parasitic in fish, reptiles and birds.

The family contains five genera.

## KEY TO THE GENERA OF THE FAMILY RHADINORHYNCHIDAE.

1. Body not armed with spines..... *Leptorhynchoides* (2)  
Body armed with spines.....2
  2. Body with ventral transverse rows of spines..... *Serrasentis* (4)  
Body without ventral transverse rows of spines.....3
  3. Posterior extremity of the body in both sexes armed with  
a few scattered cuticular spines..... *Telosentis* (5)  
Posterior extremity unarmed.....4
  4. Body covered anteriorly with scattered, powerful spines ;  
not differentiated into two structurally distinct  
portions. Proboscis sub-cylindrical, hooks on dorsal  
and ventral aspects not differing notably in size, but  
more in a varied formation of their roots..... *Rhadinorhynchus* (1)
- Body with anterior region sharply differentiated  
structurally. Proboscis spindle-shaped, hooks on  
dorsal and ventral aspects differing distinctly in size..... *Arhythmorhynchus* (3)

Genus (1). *Rhadinorhynchus* Lühe, 1911.

SYNONYMS :—*Polyacanthorhynchus* Travassos, 1918.

*Echinosoma* Porta, 1907, preoccupied, in part.

*Diagnosis.*—Rhadinorhynchidae with very long, cylindrical proboscis, and very long lemnisci. Anterior portion of body not structurally differentiated from the rest. Body armed at the anterior end with large, scattered, cuticular spines, but without ventral transverse rows of body spines. Parasitic in fish and reptiles.

Type species : *R. pristis* (Rudolphi, 1802).

A single species belonging to this genus was found in the collection, namely :—



*Rhadinorhynchus pristis* (Rudolphi, 1802).

SYNONYM :—*Echinorhynchus pristis* Rudolphi, 1802.

Four males from the intestine of *Thynnus vulgaris*. Locality unknown.

Genus (2). *Leptorhynchoides* Kostylev, 1924.

*Diagnosis*.—Rhadinorhynchidae with very long, slightly club-shaped proboscis, and very long lemnisci. Body not armed with spines; nuclei dendritic. Parasitic in fish.

Type species: *L. plagicephalus* (Westrumb, 1821).

Genus (3). *Arhythmorhynchus* Lühe, 1911.

*Diagnosis*.—Rhadinorhynchidae with a long spindle-shaped proboscis; without ventral transverse rows of body spines. Lemnisci slightly longer than proboscis-sheath. Anterior region of body sharply differentiated from posterior region in structure of body wall; nuclei present in the sub-cuticle of anterior region only. Parasitic in birds.

Type species: *A. frassoni* (Molin, 1858).

Genus (4). *Serrasentis* Van Cleave, 1923.

SYNONYMS :—*Echinogaster* Monticelli, 1905, preoccupied.

*Echinosoma* Porta, 1907, preoccupied.

*Lepidosoma* Porta, 1907, preoccupied.

*Diagnosis*.—Rhadinorhynchidae with ventral transverse rows of body spines. Lemnisci very long. Parasitic in fish.

Type species: *S. socialis* (Leidy, 1851).

A single species belonging to this genus was found in the collection, namely :—

*Serrasentis socialis* (Leidy, 1851).

SYNONYMS :—*Echinorhynchus socialis* Leidy, 1851, not Leidy, 1856.

*Echinorhynchus sagittifer* Linton, 1889.

*Echinogaster* (species not stated) Monticelli, 1905.

*Echinosoma sagittifer* of Porta, 1907.

*Echinogaster sagittifer* of Lühe, 1912.

Thirty-five specimens found encysted in the body cavity of *Platycephalus fuscus* ('Flathead'). Townsville, Queensland, Australia, 12.1.1921 (Dr. P. A. Maplestone).



All the specimens were adult but immature; they varied in length from about 3 mm. to 8 mm., and the maximum breadth was about 0.6 mm. The specimens agreed in general with Linton's description of *E. sagittifer*, but the following points of difference were noted:—(1) the number of hooks on the proboscis, counted antero-posteriorly, varied from about sixteen to eighteen, and there were about twenty-four such rows; (2) the number of ventral transverse rows of body spines varied from about fourteen to sixteen. There is no neck. The lemnisci arise at the base of the proboscis, and are very long, extending a little beyond the middle of the body. Central nervous system situated about the middle of the proboscis-sheath.

Van Cleave (1918) re-described the species and later (1923) erected the genus. In his description he states that the number of spines in the ventral transverse rows varied from six to twenty-four; this presumably means on each side as stated by Linton. In our specimens the first row contained about forty-five, the number decreasing in posterior rows.

Genus (5). *Telosentis* Van Cleave, 1923.

*Diagnosis*.—Rhadinorhynchidae with the posterior extremity of the body adjacent to the genital orifice armed in both sexes with a few scattered cuticular spines. Genital orifice sub-terminal. Parasitic in fish.

Type species: *T. molini* Van Cleave, 1923.

Family (2). CENTRORHYNCHIDAE Van Cleave, 1916.

Echinorhynchidea of small to medium size. Proboscis-sheath inserted near the middle of the proboscis-like structure; that is to say, the neck is armed with spines. Hooks on the proboscis distinct in type from, and usually larger than, those on the neck. Central nervous system situated near the middle of the proboscis-sheath. Eggs where known without polar capsules. Parasitic in birds.

The family contains three genera.

KEY TO THE GENERA OF THE FAMILY CENTRORHYNCHIDAE.

1. With three prostatic glands..... *Centrorhynchus* (1)  
     With eight prostatic glands.....2
2. Proboscis-sheath with a single wall..... *Mediorhynchus* (2)  
     Proboscis-sheath with a double wall..... *Empodius* (3)



Van Cleave (1924) states 'that the names *Heteroplus* and *Mediorhynchus* have been applied to the identical generic concept,' and that, moreover, the generic name *Empodius* is a synonym of *Mediorhynchus*, and has been recognised as such by its author Travassos. As the prior name *Heteroplus* is preoccupied, the valid name for the genus becomes *Mediorhynchus*.

In suggesting this synonymy, Van Cleave has apparently disregarded one of the characteristics of his genus *Mediorhynchus*, namely, that 'the wall of the proboscis receptacle is composed of a single muscular layer instead of two layers' (a feature which is well shown in his figure accompanying his description of the type species *M. papillosus*), for in the genera *Heteroplus* and *Empodius* the proboscis-sheath has a double wall. Again, on comparing the figures given by Van Cleave of the proboscis-like structure of *M. papillosus*, the type species of the genus *Mediorhynchus*, and of *M. grandis*, which was subsequently placed by him in the genus *Heteroplus*, there is seen to be an important difference, the number of longitudinal rows of hooks on the neck being in *M. papillosus* about the same as on the proboscis proper (in this respect resembling species of the genus *Centrorhynchus*), whereas in *M. grandis* they are much more numerous.

Having regard to these two important differences we are unable to accept without further explanation Van Cleave's suggested synonymy, and we therefore recognise in this paper two genera in place of his *Mediorhynchus*.

With regard to the genus *Micracanthorhynchus* Travassos, 1917, Van Cleave maintains that it is a synonym of his *Mediorhynchus*. He bases this conclusion on a re-examination of Rudolphi's type of *E. micracanthus*, a species which Travassos states is closely related to *M. emberizae*, the type species of the genus *Micracanthorhynchus*. Van Cleave has figured the anterior extremity of *E. micracanthus*, and from this figure it appears probable that the species should be referred to the genus *Empodius*.\*

#### Genus (I). *Centrorhynchus* Lühe, 1911.

SYNONYMS :—*Paradoxites* Lindemann, 1865.

*Chentrosoma* Monticelli, 1905, in part.

*Diagnosis*.—*Centrorhynchidae* having a proboscis-sheath with double walls. Proboscis and neck bearing approximately equal

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\* See Addendum to this paper, p. 182.



numbers of longitudinal rows of hooks. Prostatic glands three (Van Cleave), long and tubular.

Type species: *C. aluconis* (Müller, 1780 or 1784).

A single species belonging to this genus was found in the collection, namely:—

*Centrorhynchus asturinus* (Johnston, 1913).

SYNONYM:—*Gigantorhynchus asturinus* Johnston, 1913.

One male and one female from the intestine of the sparrow-hawk (*Accipiter cirrocephalus*). Townsville, Queensland, Northern Australia (Dr. P. A. Maplestone).

The male measured 18 mm. in length, and the maximum breadth was 0.6 mm. The female measured 25 mm. in length, and the maximum breadth was 0.8 mm. The body is slightly curved and cylindrical; in both specimens there was a small constriction which, in the male, was situated immediately behind the testes, and in the female a little way behind the ends of the lemnisci. The cuticle is smooth. The proboscis-like structure measures 0.85 mm. by 0.25 mm.; it is armed with numerous hooks radially arranged in about forty antero-posterior rows of about thirty hooks each. The hooks on that portion of the proboscis anterior to the insertion of the sheath are larger than the rest, and have long rectangular roots. The neck is marked off from the commencement of the body proper by a slight constriction.

*Proboscis-sheath.* The sheath arises a little anterior to the middle of the proboscis-like structure; it measures about 1.3 mm. in length, and the maximum breadth is about 0.25 mm. The central nervous system lies a little posterior to the middle of the sheath.

*Lemnisci.* These organs extend backwards to a level a little posterior to the proboscis-sheath.

*Testes.* The testes are oval, lie one in front of the other, and are in apposition. They lie immediately behind the proboscis-sheath. Each testis measures about 0.9 mm. in length and 0.28 mm. in breadth.

*Prostatic glands.* These commence immediately behind the testes and are cylindrical and extremely long.

*Female.* The posterior extremity of the female is produced into a short, blunt, conical protuberance.



*Eggs.* These measure about  $55\mu$  by  $22\mu$ , and are without polar capsules.

Johnston's original description (1913) was based on the examination of a few specimens from *Astur novae-hollandiae* obtained in the neighbourhood of Townsville. He pointed out that the specimens were very much coiled, and we presume he had difficulty in examining them fully because he subsequently published an emended description (1918).

In addition to the two well-preserved specimens described above, we have at our disposal a few other specimens of this species from the same locality, obtained from the intestine of a white goshawk (*Astur novae-hollandiae*). These specimens were very much coiled, as were Johnston's. An examination of these coiled specimens showed clearly that they were morphologically identical with the specimens from *Accipiter cirrocephalus*, but were a little longer and narrower.

We have also examined three male and seven female specimens of the same species from the intestine of a grey goshawk (*Astur clarus*) obtained in the neighbourhood of Townsville, 3.6.1912 (Dr. P. A. Maplestone). The largest female specimen measures 60 mm. in length and 1 mm. in breadth. The terminal papilla noted above is absent, the specimen being distended with eggs.

Also one male and two females, all immature, from the intestine of a brown hawk (*Hieracidea orientalis*) obtained in the neighbourhood of Townsville, 19.6.1913 (Dr. P. A. Maplestone). The only point in these specimens calling for comment is the relative position of the testes which are situated a little in front of the middle of the worm. The prostatic glands are rudimentary. These differences are probably due to the worm being immature.

There seems to be little doubt but that all the forms examined by us are specimens of *Centrorhynchus asturinus* (Johnston, 1913). If this surmise is correct, then Johnston's description can be somewhat amplified by details observed in the better preserved specimens, especially with regard to the number and character of the hooks on the proboscis.



Genus (2). *Mediorhynchus* Van Cleave, 1916.

*Diagnosis*.—Centrorhynchidae having a proboscis-sheath with a single wall. Longitudinal rows of hooks on the proboscis and neck similar in number. Prostatic glands eight, rounded or pear-shaped.

Type species : *M. papillosus* Van Cleave, 1916.

Genus (3). *Empodius* Travassos, 1916.

SYNONYMS :—*Heteroplus* Kostylev, 1914, preoccupied.  
*Micracanthorhynchus* Travassos, 1917.

*Diagnosis*.—Centrorhynchidae having a proboscis-sheath with a double wall. Proboscis and neck bearing different numbers of longitudinal rows of hooks, those on the neck being the more numerous. Prostatic glands eight, rounded or pear-shaped.

Type species : *E. empodius* Skrjabin, 1913.

A single species belonging to this genus was found in the collection, namely :—

*Empodius segmentatus* (Marval, 1902).

Four females from the intestine of a guinea fowl (*Numida ptilorhynchus*). Transvaal, 1907 (G. Arnold). Also three males and five females from the intestine of a guinea fowl (*Numida ptilorhynchus*). Upper Shire, Nyasaland, 1911 (Professor R. Newstead and Dr. Davey).

The males measured from 62 mm. to 74 mm. in length, and the greatest breadth was 2.3 mm. ; the number of pseudo-segments varied from fifty-eight to seventy-three. The females measured from 65 mm. to 90 mm. in length, and the greatest breadth was 2.3 mm. ; the number of pseudo-segments varied from sixty-three to eighty-eight. The body is tape-like and flattened laterally, and the pseudo-segments extend practically to both extremities ; the body is broadest anteriorly and tapers gradually and continuously towards the posterior extremity. In the female the posterior extremity is bluntly rounded, but in the male, when the bursa is retracted, there are at the posterior extremity two conspicuous lateral folds.

*Proboscis*. In the majority of our specimens the proboscis is retracted and the anterior extremity of the worm is quite rounded.



In some specimens the proboscis lies slightly ventrally, whilst in others it is median. When the proboscis is completely protruded it is continuous with the anterior part of the body, from which it can only be distinguished by the presence of large hooks. In this condition it is evident that two distinct types of hooks are present on the anterior part of the worm, namely, a few large hooks situated anteriorly, on the proboscis, and a large number of small hooks situated more posteriorly, on the neck. When the proboscis is retracted, as it is in most of our specimens, the cuticle at the anterior extremity is invaginated and consequently the small hooks are more or less hidden, the number visible depending on the degree of retraction.

The proboscis is small and bluntly conical; it measures about 0.25 mm. in length, and its diameter across the base is about 0.4 mm. It is armed with about twenty antero-posterior rows each composed of four hooks; the hooks measure about  $45\mu$  to  $55\mu$ , and have large root-like processes. On the neck are at least forty antero-posterior rows each composed of about four hooks; the hooks are very delicate, slender, and decrease in size posteriorly, the anterior hooks measuring about  $26\mu$  to  $40\mu$  in length. These small hooks have no root-like processes.

*Proboscis-sheath.* The proboscis-sheath has double walls and arises at the base of the proboscis proper; it is slightly curved and tapers a little posteriorly. It measures about 1.2 mm. in length, and its greatest breadth is 0.4 mm. The central nervous system is situated about the middle of the sheath.

*Lemnisci.* These measure about 3 mm. to 4 mm. by 0.3 mm.

*Testes.* The position of the testes varies slightly, but in all our specimens they lie in the posterior quarter of the worm. They are separated from each other by a short interval. Each testis is an elongated oval body measuring from 2.7 mm. to 3.8 mm. in length and in greatest breadth from 0.9 to 1.1 mm.

*Prostatic glands.* These lie a little distance behind the testes, and consist of eight more or less elongated bodies, loosely compacted together. In one male they extended over 7 mm. of the body length, but in another over only 3.9 mm.

*Eggs.* The average size of ten eggs was  $87\mu$  by  $50\mu$ .

In 1902, Marval described a worm from *Numida ptilorhynchus*



to which he gave the name *Echinorhynchus segmentatus*. Of this worm he had only a single specimen, the sex of which was not determined, and the proboscis of which was missing. His description, therefore, was necessarily incomplete, but considering the facts that the worm came from the same host as our specimens, that its body was divided into a similar number of pseudo-segments, and that the eggs were alike, we have little hesitation in concluding that it was probably of the same species as our specimens, and accordingly we have adopted Marval's specific name. From our more abundant and complete specimens we have been able to supplement Marval's earlier description.

Family (3). CORYNOSOMIDAE nom. nov.

Echinorhynchidea of small to rather large size. Anterior region of the body in the males, and (except perhaps in some species of *Filicollis*) in the females also, clothed with closely-set cuticular spines which extend backwards as a mantle for a variable distance. Proboscis armed with hooks arranged radially and symmetrically, i.e., without any distinction in size between those situated dorsally and those situated ventrally. Neck, when present, without spines. Eggs either with or without polar capsules. Parasitic in cetacea, birds and fish.

The family contains five genera.

KEY TO THE GENERA OF THE FAMILY CORYNOSOMIDAE.

1. Proboscis covered by a thick hyaline membrane beyond which the hooks protrude only a short distance. Central nervous system at anterior end of proboscis-sheath..... *Tegorhynchus* (5)  
     Proboscis not covered by such a membrane. Central nervous system at, or posterior to, middle of proboscis-sheath.....2
2. Body proper dilated into a bulb anteriorly..... *Bolbosoma* (2)  
     Body proper not so dilated.....3
3. Proboscis bent ventrally at an angle with the axis of the body. Spines on the anterior part of the body extending backwards much further ventrally than dorsally..... *Corynosoma* (1)  
     Proboscis not bent ventrally. Spines on the anterior part of the body not extending backwards much further ventrally than dorsally.....4
4. Body sac-like, not notably thickened anteriorly. Prostatic glands irregularly egg-shaped..... *Filicollis* (4)  
     Anterior region of body thickened. Prostatic glands tubular... *Polymorphus* (3)



Genus (1). *Corynosoma* Lühe, 1904.

*Diagnosis.*—Corynosomidae of small to medium size. Body club-shaped, the anterior end thickened but not separated from the posterior part. Spines on anterior part of body extending much further backwards ventrally than dorsally. Genital opening in the male armed with hooks. Proboscis bent ventrally, often spindle-shaped and unarmed at the base. Central nervous system near the middle of the proboscis-sheath. Lemnisci short. Eggs with polar capsules. Parasitic in birds.

Type species: *C. strumosum* (Rudolphi, 1802).

Genus (2). *Bolbosoma* Porta, 1908.

SYNONYM:—*Bolborhynchus* Porta, 1906, preoccupied.

*Diagnosis.*—Corynosomidae of rather large size. Body proper dilated anteriorly, a little behind the proboscis, into a bulb. Spines on the anterior part of the body not extending posterior to the dilation. Proboscis short, sub-cylindrical, unarmed at its base. Neck absent. Central nervous system near the middle of the proboscis-sheath. Eggs long and narrow, with polar capsules. Parasitic in cetacea.

Type species: *B. capitatus* (v. Linstow, 1880).

Genus (3). *Polymorphus* Lühe, 1911.

*Diagnosis.*—Corynosomidae of small size. Body thickened anteriorly, sometimes narrowed immediately behind the spine-bearing region. Spines on the anterior part of the body not extending backwards much further ventrally than dorsally. Genital opening in the male unarmed. Proboscis sub-cylindrical, often unarmed at the base. Central nervous system in the posterior third of the proboscis-sheath. Lemnisci of moderate length. Prostatic glands tubular. Eggs spindle-shaped, with polar capsules. Parasitic in birds.

Type species: *P. minutus* (Zed., 1800).

A single species belonging to this genus was found in the collection, namely:—



*Polymorphus minutus* (Zed., 1800).

Four females from the intestine of *Anas* sp., Egypt.

The specimens measured about 4 mm. to 6 mm. in length, and the greatest breadth was 1.3 mm.

The body is short and broad, tapering towards the posterior extremity, which is bluntly rounded. In one female the diameter of the anterior part was 1.3 mm., and that of the posterior part was 0.66 mm. Van Cleave states that in the genus *Polymorphus* the 'anterior end of the body is swollen and separated from the more attenuated posterior region by a constriction.' In our specimens this constriction, although clearly present in one specimen, was not obvious in the others, but neither is it shown in Van Cleave's figure of the male *P. obtusus*. The cuticle is smooth, but at the extreme anterior end it is closely beset with minute spines about 18  $\mu$  long; those on the ventral surface extend rather further back than those on the dorsal surface, but they do not extend beyond the anterior fifth of the worm, whilst the dorsal spines cover only about 0.4 mm. of the anterior dorsal surface.

*Proboscis*. The proboscis is situated somewhat ventrally and although bent slightly ventrally it is almost in line with the body. It is sub-cylindrical, slightly narrowed both anteriorly and posteriorly, and unarmed at the base. There is no neck. The length of the proboscis is about 0.5 to 0.6 mm., and its greatest breadth 0.3 mm. The proboscis is armed with numerous large hooks radially arranged and distributed in about sixteen antero-posterior rows each composed of about nine or ten hooks. The largest hooks are situated in the middle of the proboscis, measure about 70  $\mu$  in length, and have long rectangular root-like processes.

*Proboscis-sheath*. The sheath is curved in the form of an arc; it measures about 1.3 mm. in length and its greatest breadth is about 0.2 mm. The central nervous system lies a little posterior to the middle of the proboscis-sheath.

*Lemnisci*. The lemnisci are slightly longer than the proboscis-sheath, and arise at the base of the proboscis.

*Eggs*. The eggs in the body cavity are long and narrow and vary in size and appearance according to the degree of maturity. The fully mature egg measured about 120  $\mu$  by 30  $\mu$  (average of 10) and polar capsules were not seen. The embryo within it is cylindrical,



about  $60\ \mu$  by  $17\ \mu$ , with rounded ends ; it is of a light brown colour and its surface presents a pitted or shagreen appearance. The eggs, immediately before becoming mature, show one or two polar capsules at each end, and the contained embryo is transparent. Some eggs thus resemble Lühe's figure of the egg of *P. minutus*, whilst others resemble Marval's figure of the egg of *E. anatis*.

Genus (4). *Filicollis* Lühe, 1911.

*Diagnosis*.—Corynosomidae of medium size. Body sac-like, anterior part not notably thickened, armed with spines anteriorly which do not extend much further backwards ventrally than dorsally. In the male the spines are well-developed, but in the gravid female they may be very small and well-nigh unrecognisable. Genital opening unarmed. Proboscis spherical or ovate ; in the female the proboscis may be bulbular and bear hooks only on its anterior extremity. Neck long and unarmed. Central nervous system in the posterior third of the proboscis-sheath. Prostatic glands irregularly egg-shaped. Eggs with or without polar capsules. Parasitic in birds.

Type species : *F. anatis* (Schrank, 1788).

Genus (5). *Tegorhynchus* Van Cleave, 1920.

*Diagnosis*.—Corynosomidae of small size. Posterior extremity of body unarmed ; in the female, terminating in two short, blunt papillae. Proboscis covered by a thick hyaline membrane beyond which the hooks protrude only a short distance. Central nervous system at the anterior extremity of the proboscis-sheath. Lemnisci long, about half the length of the body. Prostatic glands elongated. Parasitic in fish.

Type species : *T. brevis* Van Cleave, 1920.

Family (4). MONILIFORMIDAE Van Cleave, 1924.

Echinorhynchidea of medium to large size. Body without spines, and divided into a large number of pseudo-segments. Neck absent. Proboscis well developed, sub-cylindrical, armed with numerous hooks which are small and have only a single, posteriorly directed root. Lemnisci filiform, long, with numerous nuclei. Testes ellip-



soidal, situated quite posteriorly. Prostatic glands eight, almost spherical, compressed. Parasitic in rodents and insectivores.

The family contains only a single genus.

Genus *Moniliformis* Travassos, 1915.

SYNONYMS :—*Echinorhynchus* Zoega, 1776, in part.  
*Gigantorhynchus* Hamann, 1892, in part.  
*Hormorhynchus* Ward, 1917.

With the characters of the family.

Type species : *M. moniliformis* (Bremser, 1811).

Two species belonging to this genus were found in the collection, namely :—

*Moniliformis moniliformis* (Bremser, 1811).

SYNONYMS :—*Echinorhynchus moniliformis* Bremser, 1811.  
*Gigantorhynchus moniliformis* of Railliet *et al.*  
*Hormorhynchus moniliformis* of Ward, 1917.  
*Echinorhynchus cestodiformis* von Linstow, 1904.  
*Gigantorhynchus cestodiformis* of Porta.  
*Moniliformis cestodiformis* of Travassos.

A very large number of specimens were examined, from rats (*Rattus rattus* and *Rattus norvegicus*), collected in Liverpool, West Africa (Freetown and Accra), South America (Manaos), and Australia (Townsville). Also one specimen from man (British Honduras), and numerous specimens from *Cricetomys gambianus* (Accra). An examination of the above specimens led us to the conclusion that they were all of the same species and we give below a general account of its characters.

The males varied in length from 5.5 mm. to 86 mm., and the females from 7 mm. to 239 mm. In worms, from a single host, the size often varied within very wide limits, some being large and fully mature, whilst others were small and incompletely developed.

*Shape.* In very small and immature worms the body is sub-cylindrical and decidedly broader at the anterior extremity than it is posteriorly. In fully-developed worms, however, the body is flat, tape-like and, excepting at the two extremities, marked out into a large but variable number of pseudo-segments ; the posterior end is somewhat broader than the anterior end.

*Proboscis.* Relatively short, cylindrical, with a broadly rounded end. Length, 0.5 mm. to 0.67 mm., greatest breadth about 0.2 mm.



Armed with twelve to sixteen (usually twelve) antero-posterior rows each composed of ten to twelve (usually eleven) hooks. The arrangement of the hooks is not quite regular. Hooks in the middle third of the proboscis about  $25\mu$  to  $30\mu$  in length; with a single root. The size, shape, and armature of the proboscis are similar in the worms regardless of their size. The proboscis was occasionally found retracted within the sheath, and frequently the entire proboscis was invaginated into the anterior extremity of the worm.

There is no neck, but the proximal end of the proboscis is devoid of hooks.

*Proboscis-sheath.* Large, with a double muscular wall, arising at the base of the proboscis. Length, 0.5 mm. to 1.3 mm.; greatest breadth, 0.22 mm. to 0.42 mm.

*Lemnisci.* Length, 2.4 mm. to 8.76 mm. Narrow, with a few large nuclei. Often very unequal. Lemnisci largest in the largest specimens.

*Testes.* Situated in the posterior part of the worm where they sometimes cause a slight swelling of the body; placed close together, the one anterior to the other. In the smallest immature worm examined by us they were sub-spherical and measured respectively  $44\mu$  and  $63\mu$  in diameter. In all the other specimens they were oval and usually elongated, in length varying from  $201\mu$  to 4 mm., and in greatest breadth from  $120\mu$  to 0.96 mm.; as a rule, in fully-developed worms they measured about 2 mm. to 2.5 mm. by 0.4 mm. In one specimen only a single testis was present.

*Prostatic glands.* Situated a little behind the posterior testis. There are, apparently, eight glands which are compacted together into a single oval mass and are usually individually indistinguishable. The mass of prostatic glands in mature worms varied in length from 0.45 mm. to 3.6 mm., and in greatest breadth from 0.25 mm. to 1.1 mm. In the smallest, immature specimens, the prostatic glands were almost unrecognisable.

*Eggs.* Rather variable in size and appearance. When fully mature the outer shell is slightly wrinkled and the enclosed embryo brown or dark-coloured. There are no polar capsules. In thirty eggs (ten from each of three females) measured by us, the length varied from  $109\mu$  to  $137\mu$ , average  $123\mu$ , and the greatest breadth from



57 $\mu$  to 63 $\mu$ , average 60.5 $\mu$ . Both larger and smaller eggs were, however, seen in other worms examined. It may be noted here that the smallest female examined by us in which there were eggs of the mature form (but not fully developed), measured only 13 mm. in length. In the same host we observed very much larger females (some 47 mm. long) which were without eggs.

The species is extremely variable in size, both in a single host and in different hosts. The proboscis is, however, remarkably constant in size. There seems to be no justification for dividing up the species on account of the variations in size which it exhibits.

Van Cleave (1924) states that he has examined von Linstow's type specimen of *M. cestodiformis* and that he has discovered no points of difference between this species and *M. moniliformis*. On account of the small size of the proboscis in *Hormorhynchus clarki* Ward, 1917, we are of opinion, however, that this species is probably distinct.

#### *Moniliformis erinacei*, sp.n.

One male and one female from the small intestine of a hedgehog (*Erinaceus europaeus*). Accra, Gold Coast, West Africa (Dr. J. W. S. Macfie).

The male measured about 85 mm. in length by 1.6 mm. in maximum breadth; the female measured about 110 mm. in length by 1.5 mm. in maximum breadth. The entire body, with the exception of the anterior and posterior extremities, is divided up into about 100 obvious pseudo-segments.

*Proboscis.* The proboscis measured about 0.4 to 0.5 mm. in length by about 0.2 mm. in maximum breadth. It is armed with numerous hooks arranged radially and distributed in eighteen antero-posterior rows each composed of seven to eight hooks, decreasing in size posteriorly. Each hook is short and stout, the largest measuring about 30 $\mu$  in length.

A pseudo-neck is present, which, when the proboscis is partly retracted, forms a prominent ruff or frill.

*Proboscis-sheath.* Its length is about 0.8 mm., and its greatest breadth 0.3 mm.

*Lemnisci.* The lemnisci are long, cylindrical, and relatively



narrow ; they measure 7 mm. to 8 mm. in length, and in greatest breadth 0.2 mm.

*Testes.* The testes are situated quite at the posterior extremity of the body ; they are large oval bodies measuring about 5 mm. in length and 1.3 mm. in breadth.

*Prostatic glands.* These form a somewhat compact mass immediately posterior to the testes.

*Eggs.* These resemble those figured by von Linstow, and measure (average of 10)  $92\mu$  by  $51\mu$ .

This worm agrees closely with von Linstow's description of *Echinorhynchus cestodiformis*, excepting that in the type specimens, which were from Nigerian hedgehogs, the lemnisci measured, in length, 1.7 mm. only, whilst in the specimens from the Gold Coast they measured from 7 mm. to 8 mm. Van Cleave (1924), however, has recently examined the type specimen of *M. cestodiformis* and has stated that it does not differ in any respect from *M. moniliformis*, and, therefore, the species described above, which differs from *M. moniliformis* in several respects, such as the size and armature of the proboscis and the dimensions of the eggs, must be regarded as a new species.

#### Family (5). ECHINORHYNCHIDAE Cobbold, 1879.

Echinorhynchidea of small to medium size. Body and neck (when present) without spines. Proboscis armed with hooks arranged radially and symmetrically. Eggs with or without polar capsules. Parasitic in mammals, birds, amphibians, and fish.

This family contains a heterogeneous group of species from which, during recent years, a number have been separated as distinct genera, leaving, however, a residue of species, not yet susceptible of more exact classification, in the original genus *Echinorhynchus*.

The genus *Plagiorhynchus* we regard as only another name for *Echinorhynchus*, the species referred to it appearing to be distinct only in the length of the lemnisci, and in that they occur in birds, characters which we do not consider to be of generic importance.

The family contains five genera.



## KEY TO THE GENERA OF THE FAMILY ECHINORHYNCHIDAE.

1. With three prostatic glands..... *Prosthorhynchus* (1)  
     With four prostatic glands..... *Oligoterorhynchus* (2)  
     With six prostatic glands..... 2
2. Neck very long, expanded at its anterior extremity into a  
     sub-spherical bulla..... *Pomphorhynchus* (3)  
     Neck short or absent, without a bulla..... 3
3. Central nervous system at the posterior extremity of the  
     proboscis-sheath..... *Acanthocephalus* (4)  
     Central nervous system near the middle of the proboscis-  
     sheath..... *Echinorhynchus* (5)

Genus (1). *Prosthorhynchus* Kostylev, 1916.

*Diagnosis.*—We have not been able to consult Kostylev's description of this genus, but according to Van Cleave (1923) the following appear to be its chief characteristics. Body without spines. Without giant nuclei. Proboscis very long, cylindrical or clavate, armed with hooks which are arranged radially and symmetrically. Neck short, unarmed. Proboscis-sheath sac-like, with double walls. Prostatic glands three, long and tubular. Parasitic in birds.

Type species : ?

Genus (2). *Oligoterorhynchus* Monticelli, 1914.

*Diagnosis.*—Echinorhynchidae of medium size. Proboscis sub-cylindrical, small, armed with numerous hooks. Base of proboscis unarmed. Neck absent. Lemnisci a little longer than the proboscis-sheath. Testes oval, situated in the middle third of the body. Prostatic glands four, long, sac-like, narrow. Parasitic in birds.

Type species : *O. campylurus* (Nitzsch, 1866).

Genus (3). *Pomphorhynchus* Monticelli, 1905.

*Diagnosis.*—Echinorhynchidae of small to medium size. Proboscis sub-cylindrical. Neck very long, cylindrical, excepting at its anterior extremity where in some species it expands into a sub-spherical bulla. Central nervous system at the posterior end of the proboscis-sheath. Parasitic in fish.

Type species : *P. laevis* (Zoega, 1776).



Genus (4). *Acanthocephalus* Koelreuter, 1771.

SYNONYM :—*Echinorhynchus* Zoega, 1776, in part.

*Diagnosis*.—Echinorhynchidae of small to large size. Proboscis short, ovate or cylindrical. Neck very short. Central nervous system at the posterior extremity of the proboscis-sheath. Parasitic in amphibians and fish.

Type species : *A. anguillae* (Müller, 1780).

A single species belonging to this genus was found in the collection, namely :—

*Acanthocephalus bufonis* (Shiple, 1903).

SYNONYM :—*Echinorhynchus bufonis* Shipley, 1903.

Three females and one male from the intestine of a toad. Hong Kong (Dr. Bell).

The male specimen measured 9 mm. in length, and the maximum breadth was 1.5 mm. ; the females measured from 20 mm. to 25 mm. in length, and the maximum breadth (near the anterior end) was 1.5 mm. to 1.8 mm.

*Body* cylindrical, slightly thickened anteriorly and tapering a little posteriorly, the posterior extremity being bluntly rounded. The body is curved, especially in the female, and the skin is smooth.

*Proboscis*. This organ is cylindrical and is situated asymmetrically as pointed out by Shipley ; length 0.5 mm. to 0.6 mm. ; breadth 0.3 mm. It is armed with eighteen to twenty antero-posterior rows each composed of six to eight hooks. The hooks are strongly geniculated at their base and in the middle of the proboscis measure  $80\mu$  to  $90\mu$  in length. The roots resemble those described by Lühe as present in *E. ranae*, i.e., they have no lateral wing-like expansions.

*Proboscis-sheath*. This measures about 1 mm. in length and 0.4 mm. in breadth, and is inserted at the base of the proboscis. Neck absent, or extremely short. The central nervous system lies at the posterior extremity of the proboscis-sheath.

*Lemnisci*. These are about twice as long as the proboscis-sheath and are rather broad.

*Testes*. These are situated at the beginning of the posterior half of the body ; they measure 0.6 mm. in length by 0.5 mm. in



breadth, and, in the single specimen examined, they lie one in front of the other and are in apposition.

*Prostatic glands.* These glands are elongated and extend to the posterior margin of the posterior testis.

*Eggs.* The eggs in the body cavity measured about  $75\mu$  by  $26\mu$ .

The specimens, therefore, agree with Shipley's description excepting as regards size. They differ from *E. ranae* in (1) the greater length of the lemnisci, and (2) the greater breadth of the eggs.

Genus (5). *Echinorhynchus* Zoega, 1776.

SYNONYM :—*Plagiorhynchus* Lühe, 1911.

*Diagnosis* :—Echinorhynchidae of small to large size. Proboscis long, sub-cylindrical, armed with numerous circles of alternating hooks. Hooks of almost uniform size excepting those of the few basal rows which are much reduced. Neck very short or absent. Central nervous system near the middle of the proboscis-sheath. Parasitic in mammals, birds, and fish.

Type species : *E. gadi* Zoega, 1776.

The following species found in the collection are referred to this genus :—

*Echinorhynchus bazae*, sp.n.

One male and two females from the intestine of a crested hawk (*Baza subcristata*). Townsville, Queensland, Northern Australia, 8.12.1913 (Dr. P. A. Maplestone).

The male measured 33 mm. in length, and the greatest breadth was 2 mm. Both females were incomplete, the fragments measuring 45 mm. and 50 mm. in length respectively, and about 2 mm. in breadth. Body rugose, without spines.

*Proboscis.* The proboscis is short and broad, slightly constricted about the middle, broadest in the basal half, with a rounded anterior extremity. In the male it measured 0.9 mm. by 0.64 mm., and in the females 1.2 mm. by 0.7 mm. The hooks, which extend to the base of the proboscis, are arranged radially in about thirty-eight to forty-one antero-posterior rows each composed of twelve or thirteen hooks. The hooks on the distal two-thirds are larger than the rest and have long rectangular root-like processes ; the larger (anterior) hooks measure about  $90\mu$  in length.



*Proboscis-sheath.* The proboscis-sheath is inserted at the base of the proboscis. There is no neck. In the male the sheath measured 1.4 mm. by 0.76 mm., and in the females 1.78 mm. by 0.7 mm. The central nervous system lies about the middle of the sheath.

*Lemnisci.* These are slightly more than twice the length of the proboscis-sheath.

*Testes.* The testes are situated just posterior to the proboscis-sheath, lie obliquely one in front of the other, and measure about 1.5 mm. by 0.66 mm.

*Prostatic glands.* There are, apparently, six very long cylindrical prostatic glands terminating immediately behind the posterior testis.

*Eggs.* These measure  $78\mu$  by  $41\mu$ ; they have no polar capsules.

*Echinorhynchus bulbocaudatus*, sp.n.

Very numerous specimens from a bush pheasant (*Centropus phasianus*). Townsville, Queensland, Northern Australia.

The females measured about 58 mm. in length, and in greatest breadth about 1.1 mm. The male (we had only one adult at our disposal) measured about 26 mm. in length, and the greatest breadth was 0.9 mm. The cuticle is smooth. The worms are long and cylindrical. In the female the terminal 3 mm. is oval and dilated, and the body ends in a point.

*Proboscis.* The shape of the proboscis varies from oval to sub-spherical. It is small and arises somewhat obliquely. The proboscis is separated from the body by a short neck (about 0.2 mm. long), which is devoid of hooks. When the proboscis is partly retracted, as it is in most of our specimens, the anterior portion of the body overhangs its base and the cuticle is folded so as to resemble a frill or ruff. The proboscis measures about 0.5 mm. to 0.7 mm. in length, and 0.4 mm. to 0.5 mm. in greatest breadth. It is armed with numerous hooks, arranged radially and distributed in about twenty-eight antero-posterior rows, each composed of about nine hooks. The hooks in the fourth and fifth rows are the largest and measure about  $45\mu$  in length. Each hook is provided with a conspicuous, long, rectangular root, slightly hollowed out at its posterior margin.

*Proboscis-sheath.* This arises a little anterior to the base of the proboscis-like structure, that is, there is a short neck which is unarmed. In the male the proboscis-sheath measured 1.46 mm.



by 0.24 mm., and in the female 1.5 mm. to 1.6 mm. by 0.27 mm. The central nervous system lies in the anterior half of the sheath.

*Lemnisci.* These are rather more than twice the length of the proboscis-sheath and are massive; in the male they overlap the anterior testis.

*Testes.* These are situated obliquely one behind the other and they overlap; they lie about 0.7 mm. behind the proboscis-sheath. Each testis measures about 1 mm. by 0.6 mm. In an immature specimen, however, the testes were well separated from each other, and were situated more posteriorly.

*Prostatic glands.* These are, apparently, six in number, long and tubular, extending to the posterior testis.

*Eggs.* These measure about  $60\mu$  by  $30\mu$  and are without polar capsules.

*Echinorhynchus clavula* Dujardin, 1845, *nec* Hamann.

Three females and one male from the body cavity of a sea bream (*Sparus berda*). Townsville, Queensland, Northern Australia, 8.II.1920 (Dr. P. A. Maplestone). Also two males and one female from the intestine of a 'yellow tail' (*Trachurus declivis*), Australia, 8.II.1920 (Dr. P. A. Maplestone).

*Echinorhynchus gadi* Zoega, 1776.

SYNONYM:—*Echinorhynchus acus* Rud., 1802 (according to Lühe, 1911).

Four females and one male from the intestine of a haddock. Townsville, Queensland, Northern Australia (Dr. P. A. Maplestone). Also one gravid female from the intestine of a pollack (*Gadus pollachius*). Port Erin, Isle of Man (Dr. Annett). Also very numerous males and females from a codling, North Sea, October, 1922 (Professor James Johnstone).

Lühe gives the size of the eggs as  $76\mu$  by  $13\mu$ , but in our specimens they were larger and measured  $107\mu$  by  $24\mu$  (average of 10).

*Echinorhynchus truttae* Schrank, 1788.

SYNONYM:—*Echinorhynchus fusaeformis* Zeder, 1803.

Six females and six males from a trout, 11.I.1923 (A. W. Noel Pillers, F.R.C.V.S.). The females varied in length from about 11 mm. to 19 mm. They are broadest near the anterior extremity,



the maximum breadth being 1.2 mm. The largest male measured 10 mm. in length, and had a maximum breadth of 0.86 mm.

Lühe gives the size of the egg as  $100\mu$  to  $110\mu$  in length by  $23\mu$  to  $24\mu$  in breadth; v. Linstow states that they measure  $136\mu$  to  $140\mu$  by  $23\mu$  to  $26\mu$ . The average of ten eggs in the body cavity of one of our females was  $137\mu$  by  $26\mu$ .

Three females and four males from the body cavity of a sea bream (*Sparus berda*), 20.9.1920.

Three females and one male from the intestine of a fish ('grunter'). Townsville, Queensland, Northern Australia, 3.10.1920 (Dr. P. A. Maplestone). In these specimens the lemnisci extended slightly beyond the extremity of the proboscis-sheath.

Genus. *Lueheia* Trav., 1919 (?).

Travassos recently (1923) described under the name *Lueheia lueheia* a species of *Acanthocephala* obtained from *Thamnophilus severus* and *T. guttatus* with the following characters:—'Body broad, thick, fusiform, having large folds, milky-white in colour, measuring about 7 mm. in the case of the male and 12 mm. in the female in length, by 1.2 to 1.8 mm. in greatest breadth; proboscis slightly globose, not invaginable in the adult, but retractile into the extremity of the body, measuring about 0.43 to 0.52 mm. in length by 0.38 to 0.46 in greatest breadth, furnished with 22 to 24 longitudinal rows of eight or nine hooks each; the hooks increase in size from the head to the more enlarged part; from thence, as far as the base, they grow progressively smaller; these hooks are comparatively strong, and of three chief types, the anterior hooks are delicate, those in the middle are very strong and U-shaped, and finally, those at the base are falcated.

*Measurement of hooks:—*

Specimen.	Base.	Lamina.
1	0.037 mm.	0.034 mm.
2	0.037 mm.	0.042 mm.
3	0.054 mm.	0.045 mm.
4	0.068 mm.	0.059 mm.
5	0.071 mm.	0.059 mm.
6	0.048 mm.	0.054 mm.
7	—	0.048 mm.
8	—	0.048 mm.



Neck absent; sheath of proboscis club-shaped, measuring about 0.78 to 1 mm. in length by 0.26 to 0.27 mm. in greatest breadth; lemnisci six in number, cylindrical, straight in the female, curved in the male, measuring more or less 1.9 to 2.8 mm. in length; testes ellipsoid, situated some distance from the sheath but in contact with, or partly over-lapping, the lemnisci, measuring about 0.7 by 0.3 mm.; prostatic glands in contact with the nearest testis, elongated, voluminous, measuring about 1.3 mm. in length; deferent canals showing symmetrical extensions to the level of the nearest third of the prostatic glands, and joining up at the level of the most remote third, to form a voluminous seminal vesicle, in the shape of a very thick Y which straightens out to form the ejaculatory canal. The ejaculatory canal and the ducts of the prostatic glands measure about 0.7 mm. in length; the copulative pouch is comparatively small; eggs bearing bacilliform nuclei and without polar capsules, measuring, in the median plane, 0.078 to 0.075 mm. in length by 0.028 to 0.31 mm. in greatest breadth; small egg-ejector 1 to 1.5 mm. long.

*Habitat.* Small intestine of *Thamnophilus severus* and *Th. guttatus*.

Specimens in the Oswaldo Cruz Institute, No. 1888, Angra dos Reis, Rio.

This species is very closely related to *L. inscripta* W., from which it is distinguished by a proboscis with a greater number of longitudinal rows of hooks, and a greater number of hooks in each row, the hooks themselves being also larger.

'The walls of the body appear less rugose, and in this species there is a difference in the structure of the peripheral stratum near the middle of the walls of the body, where it is clear in comparison with Westrumb's species, a difference appreciable even in specimens prepared whole. The differences in the male genital organs, which are not placed within strictly defined limits, can scarcely be observed in the very young male specimen of *L. inscripta*. It is interesting to note that while the two species exist side-by-side in the neighbourhood of Angra dos Reis, yet *inscripta* is rare and generally found as isolated specimens; the other is common and found in large numbers in every carrier.'

We have, unfortunately, been unable to obtain Travassos's



description of the genus *Lueheia* and no figures of *Lueheia lueheia* are given. Travassos apparently places the genus in the sub-family CENTRORHYNCHIDAE.

The somewhat reduced proboscis, which in the adult is not retractile within its sheath, are characters which ally the species to the OLIGACANTHORHYNCHIDAE, and especially to the genus *Oligacanthorhynchus* or the genus *Prosthenorchis*, but on the other hand the body is small, the proboscis bears numerous hooks and the worm is found in birds, characters which suggest affinities with the *Echinorhynchidea*.

The species *L. lueheia* is, however, unique in possessing six lemnisci instead of two. Until we know whether the proboscis sheath has a single or a double wall, where the sheath arises and how many prostatic glands are present, it is impossible to classify the genus satisfactorily, but in any case the presence of six lemnisci is a character sufficiently striking to identify the species; although there is, of course, the possibility (amounting, in this case, to probability) that the number '6' occurring in the description of the lemnisci is really a misprint for '2.'

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#### ADDENDUM

Whilst this paper was in page proof Travassos' supplement to the Revision of the Family Gigantorhynchidae (1924) has come to hand.

In this paper he includes the genera *Micracanthorhynchus* Travassos, 1916; *Empodius* Travassos, 1916 = *Heteroplus* Kostylev, 1914, n.p.; *Mediorhynchus* Van Cleave, 1916 = *Micracanthorhynchus* Travassos, 1917, in the family *Gigantorhynchidae*, and he defines the genera *Empodius* and *Mediorhynchus* as follows:—

*Empodius*. Proboscis armed with four transverse series of relatively large hooks and about fourteen longitudinal series of hooks with two hooks in each series. Neck sharply differentiated and armed with hooks having simple roots. Sheath of the proboscis not invaginable. Eggs with concentric membranes. Intestine of birds.

*Mediorhynchus*. Proboscis armed with from ten to twelve



transverse series of relatively small hooks and with about twenty longitudinal series of hooks, with five or six hooks in each series. Neck well differentiated and armed with small simple hooks. Hooks of the proboscis and neck situated in the centres of papilliform projections. Sheath of proboscis slightly developed. Proboscis not invaginable. Eggs with concentric membranes. Intestine of birds.

We agree that the two genera are distinguishable, but as we have found the proboscis invaginable in *E. segmentatus* we refer them to the Sub-order **Echinorhynchidea**.

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