TREMATODES FROM INDIAN MARINE FISHES

Part II. On Some Trematodes of the Gasterostome Family Bucephalidæ (Braun, 1883) Poche, 1907, with Description of Four New Species

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Class . . . . Trematoda Rud., 1808
Order ...... Digena van Beneden, 1858.
Sub-order .. Gasterostomata Odhner, 1905.
Family .. Bucephalidæ Poche, 1907.
(Syn.: Gasterostomidaæ Braun, 1883.)

Excellent accounts of the history of the sub-order Gasterostomata and the family Bucephalidæ Poche, 1907 (Syn.: Gasterostomidaæ Braun, 1883) and of the two sub-families Bucephalidæ Nicoll, 1914 and Prosorhynchidæ Nicoll, 1914, are given by Eckmann (1932), Bhalerao (1937), Nagaty (1937) and Manter (1940).

The family was originally created by Braun in 1883 under the family name Gasterostomidae, for the genus Gasterostomum Siebold, 1848. In the same year Ziegler observed that the genus Gasterostomum Siebold, 1848, is synonymous with the genus Bucephalus Baer, 1827. In 1907, Poche
named the family Bucephalida. Fuhrmann (1932) regards Gasterostomidae Braun, 1883 as the valid family with Bucephalidae Poche, 1907, as a synonym to it. However the later authors refer it under the latter name only.

**GENUS** .. 1. Bucephalopsis (Diesing, 1855) Nicoll, 1914.
(Syn.: Prosorhynchoides Dollfus, 1927.)

*Bucephalopsis microcirrus.* n. sp.

[Text-Figs. 1, 1 (a)]

Four specimens of this gasterostome were found in the alimentary canals of two out of nearly eight specimens of a marine fish, *Sciæna belengeri* examined in the month of December 1940. All the forms except one were sexually mature. On examination it is found that they represent a new species of the genus *Bucephalopsis.*

![Fig. 1. Bucephalopsis microcirrus, n.sp](image1)

![Fig. 1 (a). Eggs (magnified)](image2)
Body very much elongate and in natural position crescent-shaped, with a flat and slightly tapering anterior end. The posterior half of the animal contains almost all the important organs. The posterior extremity is broadly rounded. Body of the living parasite is covered over by minute spines which are more closely set in the anterior region than in the posterior. Living specimens are usually covered with mucus and they present an absolutely white, transparent appearance with dark brown dots representing vitelline follicles and golden yellow specks representing eggs. Body length is 1·71 mm., width 0·12 mm. (about 1/8 body length), maximum width being in the region of the testes. Anterior sucker (S.) is oval and subterminal and is situated slightly obliquely. It measures 0·016 x 0·04 mm., and, as is usual in this genus, is surrounded by unicellular glands. The deeply staining mass of glandular material (C.G.), just posterior to the sucker on the mid-ventral side, is dense and voluminous. It probably represents the "Cytogenous organ" of Tennent (1906) and the "penetration organ" of Woodhead (1929).

Chandler (1935) observed that in the case of *Rhipidocotyle transversale* Chandler, 1935, the anterior sucker develops in the midst of this mass and vitelline follicles from its posterior part. Previous authors have recorded the presence of this material only from very young specimens but I observed it in some completely adult forms with mature eggs though its volume decreases with the advance in age of individuals. Mouth (m.) is a simple inconspicuous opening situated ventrally at a distance of 0·9 mm. from the anterior end. It is surrounded by a small, compact, muscular and globular pharynx (Ph.) which measures 0·022 x 0·03 mm. Oesophagus is a narrow, thin, straight tube running across the width of the animal, measuring about 0·075 mm. in length, posteriorly it bends to lead into the very thin-walled, ovoid intestine. The intestine (I.C.) runs in the antero-posterior direction, and is about 0·1 mm. in length and 0·055 mm. in maximum width which is in its posterior region.

Testes (T.) two, globular, post-ovarian, median, tandem, and separate. The anterior testis is slightly larger than the posterior one. It measures 0·075 x 0·06 mm. and is situated at a distance of 0·08 mm. from the ovary. The posterior one is smaller, measuring 0·065 x 0·064 mm. and is situated at a distance of 0·095 mm. from the anterior one. Cirrus sac (C.S.)
is a median, ovoid, highly developed muscular organ, measuring 0.22 mm. (about 1/8 to 1/9 body length). Anteriorly it comes to within a distance of 0.12 mm. from the posterior testes; posteriorly it extends almost to the end. It encloses at its anterior end a compact, ovoid vesicula seminalis (V.S.), 0.045 mm. in length; a well-developed elongate pars prostatica (P.Pr.) surrounded by prostrate gland cells (P.C.) and a narrow ductus ejaculatorius (D.E.). The genital tongue (G.T.) extends into the large globular genital atrium (= genital sinus) (G.A.) which opens medianally to the outside on the ventral surface, a little in front of the hind end, through an inconspicuous genital pore (G.P.). There are developed two processes (D.E.) dorsal to the genital tongue. The left dorsal genital lobe (= genital papilla) is fingerlike, double structure, smaller than the right. The right lobe is longer, thicker and tongue-shaped.

Ovary (Ov.) globular with a small protuberance on the right side, partly lying over the posterior end of the intestine. It measures 0.05 x 0.04 mm. Vitelline glands (Vit.) are composed of a few, large and round follicles, their average measurement varying from 0.013 to 0.02 mm. The follicles are arranged in two lateral, longitudinal, widely separated groups of 15 and 17 on the right and left sides respectively. They extend from half the distance between the ovary and anterior testis to a region much anterior to mouth. The average length of vitellarian extent on either side is about 0.38 mm. The two vitelline ducts (Vit.D.) are clearly noticed. The shell gland (S.G.) is situated to the extreme left border of the body, slightly posterior to the ovary. It is a compact pear-shaped body measuring 0.045 x 0.025 mm. The uterus (Ut.) does not consist of heavy coils and is longitudinal in extension. It runs by the right side of the anterior testis, takes a turn to the left of the posterior testis and finally runs on the right side of the cirrus sac as a thick metraterm (Met.) and opens into the genital atrium.

The excretory system consists of a tube (Ex.C.), extending much farther forward in the anterior region upto about 1.7 mm. from the anterior end. Posteriorly it dilates into a pear-shaped vesicle (Ex.V.) in the region below genital atrium and opens terminally by means of an excretory pore (Ex.P.).

Eggs (E.) are few, thin-shelled and oval. They measure 0.0035 x 0.0023 mm. (average).

The species described above possesses a simple sucker and thus belongs to the sub-family Bucephalinae Nicoll, 1914. The genera included in this sub-family are Dolichoenteron Ozaki, 1924, in which the ovary lies between the two testes; Bucephalus Baer, 1827, in which sucker bears tentacles;
Rhipidocotyle Diesing, 1858, in which the weak sucker bears a hood and Bucephalopsis (Diesing, 1855) Nicoll, 1914, in which the anterior end is provided with nothing but a sucker. The species described here belongs to the genus Bucephalopsis (Diesing, 1885) Nicoll, 1914.

The genus was originally created by Diesing (1855) as one of the two sub-genera of the genus Bucephalus Baer, 1827. Subsequently Nicoll (1914) raised it to the generic rank.

Eckmann (1932) published an excellent review of the group. She regarded only eight species of the genus as valid, viz., B. gracilescens (Rud., 1819); B. haimeanus (Lacaze-Duthiers, 1854); B. triglae (van Beneden, 1870); B. arcuata (Linton, 1900); B. pusilla (Stafford, 1905); B. exilis Nicoll, 1915; B. lata Ozaki, 1928 and B. elongata Ozaki, 1928.

Subsequent to Eckmann’s work, Verma (1936) described five new species of the genus, viz., B. fusiformis; B. garuai; B. magnum; B. confusus and B. minimus. Of these the last three are in the opinion of Bhalerao (1937), synonymous with B. garuai.

Bhalerao (1937) described a new species B. karvei and gave a key to the species of the genus which was an enlargement of one published by Eckmann in 1932.

Since then, following more species have been added to the genus B. scrombropsis Yamaguti, 1938; B. belonea Srivastava, 1939; B. southwelli Nagaty, 1937; B. longicirrus Nagaty, 1937; B. megacetabulus Nagaty, 1937 and B. longoviferus Manter, 1940.

Unfortunately I could not get Yamaguti’s paper in spite of my best efforts.

Srivastava (1939) is inclined to accept B. magnum Verma, 1936, as a valid species but maintains that B. confusus Verma, 1936, and B. minimum Verma, 1936, are synonymous with B. garuai Verma, 1936. Nagaty (1937) rightly regards B. confusus Verma, 1936 and B. minimum Verma, 1936 as synonymous to B. magnum Verma, 1936, and not to B. garuai Verma, 1936, as held both by Bhalerao and Srivastava. I have included B. magnum in the key.

B. tergestinum (Stossich, 1883); B. ovatus (Linton, 1900); and B. Ozakii(Ozaki, 1928) Nagaty, 1937, have been added to the list of valid species.

B. belonea Srivastava, 1939, shows close resemblance to B. southwelli Nagaty, 1937. They are also obtained from the same host.

Stafford (1904) described a species, Gasterostomum pusillum without any figure. From Stafford’s description one cannot distinguish between his
species and *B. arcuata* (Linton, 1900). Eckmann (1932) could also not separate the two in her key. Nagaty (1937) therefore considered *B. pusilla* (Stafford, 1904) as a synonym to *B. arcuata* (Linton, 1900). Manter (1940) states that more recent figures of *B. pusilla* (Stafford, 1904) by van Cleave and Mueller (1934) together with Woodhead's (1930) description show that *B. pusilla* is smaller, with larger eggs and its excretory vesicle extends much farther forward. On this authority, I have included *B. pusilla* as a valid species in my key.

The new species described in this paper differs from all the known species of the genus in its very elongated shape, having a width equal to \( \frac{1}{2} \) body length and in the anterior extension of the excretory vessel, which extends almost to the anterior end. Though it is a very long form its cirrus sac is comparatively very small. The extension of vitellaria anterior to intestine and pharynx, the position of the ovary at the posterior end of elongated intestine, the clear space between the ovary and anterior testis and between the two testes, a short and oval cirrus sac are characteristics which separate it from all the known forms.

**Host** ... *Sciaena belengeri*.
**Location** ... Alimentary canal.
**Locality** ... West Coast of India, Bombay.

There are now 22 valid species in this genus and with a view to facilitate their identification a key is given below:

_A Key to the Species of the Genus Bucephalopsis (Diesing, 1855)_

Nicoll, 1914

1. Excretory bladder Y-shaped ... ... ... ... ... 2
   Excretory bladder tubular ... ... ... ... ... 3

2. Vitelline follicles bilobed, large, uterine coils extend on both sides of the body upto near the anterior extremity, ovary anterior to pharynx ... *B. garuai* Verma, 1936.
   Vitelline follicles round, small, uterine coils lie mostly in the posterior half of the body and principally on the left side, ovary near equatorial line ... *B. magnum* Verma, 1936.

3. Vitelline glands compact ... ... ... ... ... ... 4
   Vitelline glands extending like a band along the sides of the body ... ... ... ... ... ... 11
4. Testes lying on opposite sides of the pharynx. *B. haimeanus* (Lacaze-Duthiers, 1854)
   Testes lying on the same side of pharynx

5. Cirrus sac half or more than half the body length
   Cirrus sac less than half the body length

6. Pharynx at or about the posterior third, ovary in the anterior third, anterior to pharynx, vitellaria in the anterior region. *B. karvei* (Bhalerao, 1937).
   Pharynx in the anterior third, ovary at about the middle, posterior to pharynx, vitellaria slightly above the middle of the body. *B. longicirrus* (Nagaty, 1937).

7. Vitellaria slightly above the middle of body, ovary in the region of vitellaria. Pharynx at about the middle of body. *B. tergestinum* (Stossich, 1883).
   Vitellaria confined nearly to the anterior extremity, ovary situated posterior to vitellaria. Pharynx in or about the posterior half

   Ovary situated in the anterior half or about the middle of body

   Anterior testis situated at the level of intestinal sac, ovary in or about the region of intestine


11. Body more or less round, ovary lying near the right side of the body and far removed from testes. *B. lata* Ozaki, 1928.
    Body elongate or oval, ovary lies close to the testes
12. Vitellaria lie in or about the middle of body ........ 13
   Vitellaria lie in the anterior part of body ........ 17

   Pharynx at middle of body ........ 14

14. Excretory vesicle extending to or near about pharynx ........ 15
   Excretory vesicle extending much farther forward ........ 16

15. Uterus extending anteriorly usually only to the anterior edge of ovary, rarely up to the anterior edge of vitellaria, cirrus sac always extending beyond posterior border of posterior testis and sometimes reaching to pharynx (at times about \( \frac{1}{2} \) body length) .... B. arcuata (Linton, 1900).
   Uterus extending anteriorly between vitellaria far forward almost to the anterior sucker, cirrus sac \( \frac{1}{3} \) to \( \frac{1}{2} \) body length ........ B. longoviferus (Manter, 1940).

16. Very elongate narrow form, cirrus sac smaller, \( \frac{1}{6} \) body length, does not extend anteriorly up to posterior testis. Intestine elongate. Uterus does not extend anteriorly anterior to ovary. Gonads widely separated .... B. microcirrus n.sp.
   Small broad and oval form, cirrus sac larger, at times being \( \frac{1}{2} \) body length, always extending beyond posterior border of posterior testis and sometimes reaching to pharynx. Intestine sac-like. Uterus extends anteriorly anterior to ovary, gonads not widely separated .... B. pusilla (Stafford, 1904).

17. Cirrus sac reaching the level of testes ........ 18
   Cirrus sac not reaching up to posterior testis .... B. elongata Ozaki, 1928.

18. Pharynx between first and middle third of body ........ 19
   Pharynx posterior to or near mid-body ........ 20

19. Ovary posterior to pharynx, intestine saccular .... (Type species) ........ B. gracilescens (Rud., 1819).
   Ovary near pharynx. Intestine elongate .... B. ovatus (Linton, 1900).
20. Ovary in the anterior half of the body .... 21
   Ovary in the posterior half of the body..... B. triglaæ
   (van Beneden, 1870).

21. Cirrus sac extending forward upto the level of the anterior end of the oesophagus beyond pharynx. Anterior testis is comparatively much smaller..... B. belonea (Srivastava, 1939).

   Cirrus sac not extending beyond pharynx, testes almost equal..... B. southwelli (Nagaty, 1937).

**Genus** .. 2. *Rhipidocotyle* Diesing, 1858.
   (Syn.: *Nannænteron* Ozaki, 1924).

**(*a*) Rhipidocotyle ligulum, n.sp.**
   [Text-Figs. 2, 2 (a), 2 (b)]

Specimens of this gasterostome were found, in winter of 1940, in the alimentary canal of the marine fish, *Arius falcarius*. The degree of infection was poor.

Living worms are white, translucent, delicate forms covered over by mucilaginous secretion all over their body. Their vitellaria and eggs appear golden yellow in colour.

**Fig. 2**
*Rhipidocotyle ligulum* n.sp. (Lettering as in Fig. 1)

*Fig. 2 (a)* Hood (magnified)  
*Fig. 2 (b)* Eggs (enlarged)
Body thin, narrow and elongate. Anterior part of the body narrow, and both the extremities rounded. Most of the organs are confined to the posterior cylindrical half of the body. The anterior flat half contains a few vitellarian follicles, excretory vessel and the anterior organs of attachment. The worms assume various shapes during stages of preservation. Body is covered over with minute spines which are more numerous in the anterior region. Most of them are lost in the process of staining and mounting. Length 2.68 mm.; width 0.21 mm. (about 1/13 body length) maximum being at the level of testes. Anterior sucker (S.) muscular, subterminal measuring 0.12 \times 0.075 mm. A prominent but feebly muscular hood or cephalic disc (H.) is present on the sucker. It is crescent-shaped without any papillae and measures 0.08 \times 0.03 mm. No mid-ventral notch was observed on the disc. The glandular mass of the "Cytogenous organ" (C.G.) is very small. Mouth (m.) is a small, indistinct opening situated ventrally at a distance of 1.35 mm. from the anterior end. It opens into a small compact but muscular pharynx (Ph.) measuring 0.04 \times 0.02 mm. It is a sub-spherical structure. Oesophagus (Oes.) is narrow and very small; horizontal in extension, measuring about 0.03 mm. It is immediately followed by a narrow, long and very thin-walled intestine (I.C.) running in the antero-posterior axis. Its length is about 0.31 mm. (\frac{1}{3} body length), with maximum width being in the posterior third of the organ.

Gonads spaced, situated posterior to the intestine. Ovary (Ov.) is elongate, pear-shaped, smooth, pre-testicular, situated in such a manner that its longer axis is horizontal, just posterior and lateral to the intestine, to its left with the tapering end pointing towards the alimentary canal. It measures 0.085 \times 0.045 mm. Mehlis's gland is situated midway between the testes. Vitelline follicles (Vit.) large, round in outline, about 21 on the right side and 13 on the left, forming two separated, lateral, distinct, longitudinal bands extending from a distance of about 1.13 mm. from the anterior end to a distance about 0.8 mm. (right) and 0.10 mm. (left) from the posterior extremity. The number of follicles and their extension is more on the right side than on the left. The follicles on the left side start a little later and extend up to ovary; whereas those on the right extend even beyond the anterior testis. Size of the follicles varies from 0.01 to 0.03 mm. Vitelline ducts (Vit.D.) are distinct. Uterus (Ut.) is not much coiled but is heavily laden with eggs. It runs alongside the length of the animal, not extending anterior to ovary and posterior to genital atrium. It is observed from near the pointed end of the ovary running obliquely, horizontal in between the testes, by the right side of the cirrus sac and finally the feeble metraterm (Met.) opens into the genital atrium (G.A.). Eggs (E.) very small numerous, ovid, broadly rounded at each end measuring 0.0035 \times 0.0017 mm. (average).
Testes (T.) two, post ovarian, separate, obliquely tandem. The anterior testis is pointed like the ovary and is situated behind it, on the left side at a distance of 0.88 mm. from it. It measures 0.07 × 0.06 mm. The posterior testis is globular, slightly smaller than the anterior, measuring 0.06 × 0.06 mm. and is situated to the right at a distance of 0.08 mm. from the anterior testis. Cirrus sac (C.S.) is very elongated and narrow measuring 0.53 mm. in length (1/5 body length) and 0.08 mm. in width, the maximum being in the region of genital lobes. It is situated to the left and extends anteriorly to a distance 0.09 mm. from the posterior testis and posteriorly about 0.12 mm. before the posterior end. It encloses anteriorly a small but compact longitudinally oval vesicula seminalis (V.S.) 0.05 × 0.02 mm. It is followed by a poorly developed long and sinuous pars prostatica (P.Pr.). The prostrate gland cells (P.C.) surrounding the pars prostatica are well developed. The genital atrium (G.A.) is big and contains the genitai tongue (G.T.) and the two more or less ventral and dorsal genital lobes or papillae (D.P.). The left lobe is slender and small and the dorsal is massive in structure filling almost the whole genital sinus. Ductus ejaculatorius (D.E.) is a very narrow tube. Genital pore (G.P.) is median, ventral and is placed some distance anterior to the posterior end of the body.

Excretory system (Ex.C.) is tubular. The tube extends anteriorly to a distance 0.29 mm. from the anterior end and posteriorly the bladder expands in the region of the genital atrium and opens terminally on the posterior end by an excretory pore (Ex.P.).

This species conspicuously differs from the other species of the genus in elongated shape of the body, general topography of the organs and the structure of its cirrus sac, structure of the genital complex, extent of excretary tube and vitelline follicles. Size and number of eggs are also very characteristic.

**Host** . . *Arius falcarius.*  
**LOCATION . .** Alimentary canal.  
**LOCALITY . .** West coast of India, Bombay.

(b) *Rhipidocotyle apapillosum, n.sp.*

[Text-Figs. 3, 3 (a), 3 (b)]

Only two specimens of this gasterostome were found in the alimentary canal of one out of six specimens of a marine fish, *Clupea* sp., examined from the western coast of India, during the winter season of 1940. Unfortunately one of them was spoiled during staining.
The worms when alive are dull white, translucent minute forms and show a great deal of contractability. The body is hook-shaped in preserved specimen.

*Rhipidocotyle apapillosum* n.sp. (Lettering as in Fig. 1)

**Fig. 3 (a)** Hood (enlarged)  
**Fig. 3 (b)** Eggs (enlarged)

Size of the body small, shape elongate, comparatively narrow. Its length is 1.51 mm., width 0.18 mm. (1/8 body length), maximum being in the region of the posterior testis. Anterior third of body slender, tapering and flat. The posterior two-thirds contains all the important organs and is cylindrical, thick and wide. The posterior end is broadly tapering round and flat. Anterior sucker (*S.*) sub-terminal, weakly muscular and measures 0.095 × 0.085 mm. Hood or cephalic disc (*H.*) in living specimens slightly wider than the anterior end of the body. It has a dorsal pad-like structure with a semi-circular anterior edge and the posterior edge is prominently notched mid-ventrally so as to divide it into two lateral lobes with rounded edges. The disc measures 0.09 × 0.06 mm. No “Cytogenous organ” was observed in this species.

Mouth (*m.*) is small and ventral situated at a distance of 0.92 mm. from the anterior end. It leads into a sucker-like, spherical pharynx measuring 0.03 mm. in diameter. Oesophagus (*Oes.*) small. Intestine (*I.C.*) sacular, extending posteriorly upto nearly the middle of the anterior testis. It measures 0.12 mm. (about 1/12 body length).

Gonads contiguous, crowded together almost at the same level. Ovary (*Ov.*) small, sub-spherical, by the left side of the intestine. It is anterior to
anterior testis and slightly overlaps it. It measures $0.05 \times 0.04$ mm. The vitellaria (Vit.) are in two, lateral, separated longitudinal groups of follicles, extending from the level of the anterior testis to a distance 0.62 mm. from anterior end. Posteriorly the follicles terminate at a distance of 0.45 mm. from the posterior end. The extent of vitelline follicles is slightly more on the left side than on the right, being 0.45 mm. on the right and 0.46 mm. on the left. The follicles are small, round and their average measurement is 0.015 mm. Their number is 14 on the right and 16 on the left side. Uterus (Ut.) does not extend beyond the anterior limit of vitellaria. Eggs (E.) are minute, few, oval in shape, ovary thin-walled, measuring $0.0125 \times 0.0083$ mm. (average).

Testes (T.) two, obliquely tandem, contiguous and oval in shape. The anterior testis is slightly smaller and is situated somewhat in the plane of mid axis of body, in the posterior region of intestine, partly below ovary, with its longitudinal axis lying horizontally. It measures $0.05 \times 0.07$ mm. The posterior testis is situated to the left, in contact with the anterior one, with its longitudinal axis lying in the antero-posterior direction. It measures $0.09 \times 0.07$ mm. Cirrus sac (C.S.) extends forward almost to the anterior end of the posterior testis, measuring 0.36 mm. It contains anteriorly an ovoid vesicula seminalis (V.S.) extending in the horizontal plane to the right of the body, measuring $0.065 \times 0.03$ mm. posterior to it is a long straight, somewhat poorly developed pars prostatica (P.Pr.) with tall prostrate gland cells (P.C.), opening into the genital atrium (G.A.) by means of ductus ejaculatorius (D.E.). Genital tongue (G.T.) is not very conspicuous, the left genital lobe or papilla is a slender fingerlike process but the right one is a big spoon-shaped papillated structure with convexity on the outer side. Genital pore (G.P.) is sub-terminal and inconspicuous.

Excretory vesicle (Ex.C.) is tubular, the bladder extending anteriorly to a distance 0.10 mm. from the anterior end. Excretory pore (Ex.P.) is terminal.

This species is distinguished from the other species of the genus by its smaller size, totally different general topography of the organs, extent of uterus and the size and structure of the cirrus sac.

It can be distinguished from the other species described in this paper, in the shape and size of the alimentary canal, extent of uterus, and the position of gonads. The cirrus sac is also comparatively very large in this species.

<table>
<thead>
<tr>
<th>Host</th>
<th>Clupea sp.</th>
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<tbody>
<tr>
<td>Location</td>
<td>Alimentary canal.</td>
</tr>
<tr>
<td>Locality</td>
<td>West coast of India, Bombay.</td>
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(c) *Rhipidocotyle septapapillata* Krull, 1934

Some specimens of *Rhipidocotyle septapapillata* Krull, 1934, were obtained from the intestine of a marine fish, *Chrysophrys berda* from Bombay in January 1941. The specimens were very much longer than those obtained by Krull in Virginia from *Fundulus diaphanus*, the rest of the anatomy was practically identical.

The genus *Rhipidocotyle* was created by Diesing in 1858. Eckmann (1932) after a critical review of the group regards the following five as the valid species of the genus. They are *R. galeatum* (Rudolphi, 1819) type species; *R. baculum* (Linton, 1905); *R. papillosum* (Woodhead, 1929); *R. pentagonum* (Ozaki, 1924) and (?) *Gasterostomum* sp. Linton, 1910 (from *Mycteroperca bonaci*, from Tortugas, Florida); but she gives a key only to four species excluding *Gasterostomum* sp. Linton, 1910, probably because its description is inadequate.

Manter (1940 a) describes *Prosorhynchus atlanticus* from the same host and the same locality and thinks it as the same species as *Gasterostomum* sp., 1910. If therefore, Linton’s species belongs to the genus *Prosorhynchus* it should be excluded from the genus *Rhipidocotyle*.

Since then, the following species have been added to the genus, viz., *R. septapapillata* Krull, 1934; *R. transversale* Chandler, 1935; *R. elongatum* MacFarlane, 1936; *R. khalili* Nagaty, 1937; *R. eckmanni* Nagaty, 1937; *R. longleyi* Manter, 1934; *R. nagatyi* Manter, 1940; *R. barracuda* Manter, 1940; and *R. adbaculum* Manter, 1940. Two more new species, *R. ligulum* and *R. apapillosum* have been added to the genus in this paper.

Miss F. Eckmann’s (1932) key to the species of the genus has been adopted and enlarged below to include all valid species of the genus including the two described in this paper.

**A Key to the Species of the Genus *Rhipidocotyle* Diesing, 1858**

(*Syn. Nannoenteron* Ozaki, 1924)

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<table>
<thead>
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<tbody>
<tr>
<td>1. Hood or cephalic disc with papillae</td>
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<td>2</td>
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<tr>
<td></td>
<td>Hood or cephalic disc without papillae</td>
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<tr>
<td>2. The number of papillae on the hood, 3-5</td>
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<td>3</td>
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<td></td>
<td>The number of papillae on the hood more than 5</td>
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<tr>
<td>3. The number of papillae on the hood five</td>
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<td>4</td>
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<td></td>
<td>The number of papillae on the hood three....<em>R. khalili</em> (Nagaty, 1937).</td>
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</table>
4. Papillae elongate, fine. Pharynx behind the middle of body. (Type species.) R. galeatum (Rudolphi, 1819).

Papillae-star shaped. Pharynx at or anterior to the middle of body.............R. pentagonum (Ozaki, 1924).

5. The number of papillae on the hood fifteen........R. papillosum (Woodhead, 1929).

The number of papillae on the hood seven ........ 6

6. Cirrus sac comparatively small, pear shaped, not extending anteriorly up to testes........R. septapapillata Krull, 1934.

Cirrus sac extending from anterior border of posterior testis to the posterior end of the body........R. longleyi Manter, 1934.

7. Vitellaria arranged laterally in two distinct groups ..... 8

Vitellaria arranged transversely just posterior to anterior sucker; and not separated into two distinct groups ........R. transversale (Chandler, 1935).

8. A conspicuous distinctly pentagonal hood or cephalic disc. 9

Cephalic disc or hood not pentagonal ........ 10

9. Pre-oral portion of body narrow. Vitellaria extending only to a short distance anterior to midbody. Ventral indentation of cephalic disc broader, lacks markedly longitudinal coils of uterus and has larger eggs........

........R. barracudae Manter, 1940.

Pre-oral portion of body not narrowed, vitellaria extend anteriorly to somewhat less than half-way to anterior sucker in the anterior half of the body. Coils of the uterus chiefly longitudinal........R. nagatyi Manter, 1940.

10. Two sets of vitelline follicles, one on either side, occupying a central position in the third quarter of the body.

........R. eckmanni Nagaty, 1937.

The vitelline glands of two sets of follicles lateral ........ 11

11. Cirrus sac not reaching up to posterior testis ........ 12

Cirrus sac reaching up to or beyond posterior testis ........ 13

12. Cephalic disc with a dorsal and two lateral lobes, vitellaria not extending posterior to pharynx, ovary and testis.
Uterine coils extend up to pharynx. Gonads in contact or not far apart. Intestine short, sac like......

......R. abdaculum Manter, 1940.

Cephalic disc with no lobes. Vitellaria extend posterior to pharynx, ovary and even up to anterior testis. Gonads spaced apart. Uterine coils do not extend beyond the ovary and up to pharynx. Intestine elongated......

......R. ligulum n.sp.

13. Gonads contiguous. Sirrus sac extends beyond posterior testis

Gonads separate, cirrus sac does not extend beyond posterior testis.......................R. elongatum MacFarlane, 1936.

14. Larger, elongate, narrow form. Ovary situated behind pharynx, at a distance from it, vitellarian follicles 14–16, extending beyond pharynx in the anterior region to a distance about ¼ from anterior end. Anterior sucker smaller. Intestine elongate..............R. apapillosum n.sp.

Smaller, broad form. Ovary situated immediately behind pharynx and in contact with pharynx anteriorly and anterior testis posteriorly. Vitelline follicles ten in number and on the sides of the pharynx which is in the middle of the body; usually not extending in the anterior half beyond pharynx. Anterior sucker comparatively bigger. Intestine saccular..............R. baculum (Linton, 1905).

R. ligulum and R. apapillosum n.spp., are the first members of the genus Rhipidocotyle to be described from India.


Syn.: Pseudoprosorhynchus Yamaguti, 1938.

(a) Neidhartia microrhyncha n.sp.

[(Text-Figs. 4, 4 (a), 4 (b), 4 (c) and 4 (d)]

Five specimens of this parasite were found in the alimentary canal of three out of seven specimens of a marine fish Psettodes erumei examined in the month of November 1939, at Bombay. All the organs are quite well developed except that none of the specimens contains mature eggs. Specific characters observed are so strikingly distinctive that they leave no doubt regarding the validity of the species.
The body of the parasite is very much elongate, wide and truncated, with both the extremities tapering and broadly rounded. It measures 1.39-2.93 mm. in length and 0.23-0.4 mm. in maximum width, which is in the region of pharynx and gonads. Living worms are absolutely white, thin and translucent. The cuticle is covered over by prominent triangular spines which are more closely set in the anterior region. The anterior end possesses a well-developed muscular organ, a rhynchus or rostellum (R.) measuring 0.144-0.23 mm. in length and 0.07-0.106 mm. in maximum width. The anterior portion of this organ is broad, pointed and is provided with two highly muscular elevated muscle bands or ridges and the posterior end is narrow and conical in shape. Internally the organ seems to possess a sheath in which it lies.

Most of the important organs of the body are confined to the posterior half of the body of the animal. Mouth (m.) is a simple ventral opening.
situated at a distance of 0.91–1.84 mm. from the anterior end. It is followed by a small, compact, oval or globular, muscular pharynx (Ph.) measuring 0.06 × 0.03–0.10–0.11 mm. The position of pharynx in relation to gonads is a very variable feature. It is found that in one case (Fig. 4) it is situated at the level of the ovary, much anterior to the posterior testis and the posterior edge of the anterior testis. In the other (Fig. 4a) it is at the level of the posterior testis, much posterior to ovary and anterior testis. In Fig. 4b it is observed to be overlapping the anterior testis and ovary, anterior to posterior testis. In Fig. 4c it moves still forward to the posterior testis, much posterior to anterior testis and ovary. Fig. 4d denotes a condition where it lies completely anterior to the gonads. The position of mouth and pharynx in relation to the body and cirrus sac of the parasite is a much less variable feature. Both the pharynx and mouth are usually confined to the second third of the body and are always much anterior to cirrus sac; the distance between the two organs varying from 0.124–0.56 mm. O eso phagus (Oes.) is very small. The intestine (I.C.) has a saccular, thin-walled single caecum, running in the antero-posterior direction. Its shape is a much variable character, being elongate to oval. It measures 0.34–0.8 mm. in length.

Gonads are always situated much anterior to the cirrus sac in or about the neighbourhood of the pharynx and mouth. The two testes (T.) are slightly oval or spherical bodies situated one behind the other or obliquely tandem. The anterior testis is a comparatively smaller organ than the posterior one and is situated at a distance of 0.71–1.65 mm. from anterior end. It is round in shape and measures 0.062 × 0.062–0.08 × 0.09 mm. The posterior testis is oval, larger and measures 0.075 × 0.062–0.1 × 0.12 mm. The distance between the two testes varies from 0.2 to 0.18 mm.; they are sometimes separated only by the ovary. The posterior testis is separated from the cirrus sac by a distance of 0.07–0.37 mm. The two vasa efferentia (V.E.) from the sides of the two testes join to form the median vas deferens (V.D.) which is seen to enter the vesicula seminalis (V.S.) in the anterior extremity of the cirrus sac. Cirrus sac (C.S.) is an elongated organ, situated at the posterior end of the body, to the left side. It is comparatively a small structure 1/8 to 1/9 the body length. It measures 0.175–0.33 mm. in length; the maximum width being 0.05–0.07 mm. in the region of cirrus and 0.068–0.13 mm. in the region of genital atrium (G.A.A.). Vesicula seminalis is ovoid in shape and is poorly developed. Pars prostatica (P.Pr.) are composed of two kidney-shaped elongate muscular lobes. Prostrate gland cells are poorly developed. The genital tongue and genital lobes or papillæ are distinct. Genital atrium or sinus
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is a very prominent organ, oval in shape. It opens to the exterior subterminally on the ventral side by a distinct genital pore.

The ovary (Ov.) is a small oval or spherical organ, intertesticular or situated to the left of the body in the plane of cirrus sac. It is usually in continuation with the anterior testis, to its posterior side or sometimes in between the two testes. It is usually smaller than the testes and measures 0.37 x 0.37-0.08 x 0.05 mm. Shell gland (S.G.) is a round structure situated in continuation of the anterior testis, on its anterior side and measuring 0.031-0.06 mm. Laurer’s canal (L.C.) is present. The vitelline glands (Vit.) are composed of two longitudinal strands of vitelline follicles arranged laterally one on each side, probably coming together at the anterior end. They extend forward anteriorly to a distance 0.47-0.8 mm. from the anterior end and posteriorly upto or slightly posterior to ovary. The follicles are elongately oval, granular bodies and number about 16-17 on right and 15 on the left side. Sometimes they are situated asymmetrically. The follicles are observed to extend slightly anterior to the posterior end of the intestinal cæcum; but in no case they extend upto the rhynchus. Vitelline ducts (Vit.D.) are clear.

The uterus (Ut.) consists of a few very narrow, thin coils. The coils are longitudinal in disposition and the terminal portion, metraterm (Met.), opens into the genital atrium. No mature ova were observed.

The excretory organ (Ex.C.) is a simple bladder running dorsal to the alimentary canal and terminating slightly posterior to the blind end of the intestinal cæcum. In some specimens it was also observed to extend slightly anterior to it; but it always terminates much posterior to the rhynchus. The bladder has a tendency to swell into a bulb-like swelling posteriorly and opens terminally through an excretory pore (Ex.P.).

The species described above possesses a rhynchus and thus belongs to the sub-family Prosorhynchinae Nicoll, 1914. The genera included in this sub-family are characterised by having the anterior adhesive organ in the form of a rhynchus. The rhynchus is simple in the genus Prosorhynchus Odhner, 1905, and Neidhartia Nagaty, 1937, but is provided with tentacles in Aleicornis MacCallum, 1917. The rhynchus of Mordvikovia Pigulewsky, 1931, has “cuticular folds” on it. The genera Prosorhynchus Odhner, 1905, and Neidhartia Nagaty, 1937, can be distinguished from each other by the position of the ovary. Neidhartia further differs from all the other genera included in the sub-family except Dollfusrema Eckmann, 1932, in having the ovary intertesticular at opposite side of testes, on the left side. The rest of them have it anterior to the anterior testis on
the right side. *Dollfustrema* differs from *Neidhartia* in the anterior end being provided with a triple-row, ring of large spines.

The new species described above under this subfamily belongs to the genus *Neidhartia* Nagaty, 1937. The genus was created by Nagaty in 1937 to include his two new species *N. neidharti* Nagaty, 1937, and *N. ghardage* Nagaty, 1937. Manter (1940) observes that the genus *Pseudoprosorhynchus* Yamaguti, 1938, seems to be a synonym of *Neidhartia*. This genus was created by Yamaguti in 1938, to accommodate his new species *P. synodi* from the small intestine of *Synodus japonicus*.

The two species of Nagaty are from the same host and the same locality. Their anatomy is also not very much different. Perhaps they may prove to be identical on further study.

The new species differs from the two species of the genus in the very elongate form of the body, relatively small size of the rhynchus and cirrus sac; the dilation of the excretory bladder near the posterior end and more anterior position of pharynx and gonads. The number of vitelline follicles is much more and they also do not extend to the rhynchus. The intestinal sac also extends much anterior to the anterior testis, in the anterior part of the body. The cirrus sac is 1/3 body length in Nagaty's specimens, but in the present species it is much smaller, only 1/8 to 1/9 body length and its anterior part is not closely related to the beginning of the alimentary canal, the posterior testis and the ovary. Excretory bladder is comparatively a small structure.

HOST .. *Psettodes erumei*.

LOCATION .. Alimentary canal.

LOCALITY .. West coast of India, Bombay.

*(b) Neidhartia neidharti* Nagaty, 1937

A single specimen of this parasite was obtained from the small intestine of a marine fish, *Belone* sp. in December 1939, at Bombay. The rhynchus of this specimen is comparatively smaller than that of Nagaty's specimen. The rest of the internal anatomy of the worm is practically identical.

It is for the first time that species of this genus also are being recorded from India.


(Syn.: *Gotonius* Ozaki, 1924: *Skrajabiniella* Issaitschikow, 1928.)
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Proisorhynchus sp.

A few specimens belonging to this genus were obtained from a marine fish, Serranus lanceolatus, from the west coast of India, in 1940. Specific identity could not be established owing to bad state of preservation of the material.

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