STUDIES ON THE PARASITES OF INDIAN FISHES.*

IV. Trematoda: Monogenea, Microcotylidae.

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Contents.

Introduction.

In the course of the examination of Indian marine and estuarine food fishes for parasites, the following species of Monogenea of the family Microcotylidae were collected from the gills, and are described in this paper. The incidence of infection is given in Table I.

Table I.

Host.	No. examined.	No. infected.	Parasite.	Place.
Chirocentrus dorab	6	4	*Megamicrocotyle chirocentrus*, Gen. *et* sp. nov.	Puri.
Chorinemus tala	1	1	*Diplasiocotyle chorinemi*, sp. nov.	Mahanadi estuary.
Cybium guttatum	4	2	*Thoracocotyle ovale*, sp. nov.	Puri.
„ „	4	3	*Lithidiocotyle secundus*, sp. nov.	Puri.
Pama pama	48	30	*Microcotyle pamae*, sp. nov.	Chilka lake and Hoogly.
Polynemus indicus	6	3	*Microcotyle polynemi* MacCallum 1917.	Chilka lake, Hoogly and Mahanadi.
P. tetradactylum	30	9	„ „ „	
Stromateus cinereus	6	3	*Bicotyle stromatea*, Gen. *et* sp. nov.	Puri.

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The parasites were fixed in Bouin's fluid or Bouin-Duboscq fluid under pressure of cover slip and stained with Ehrlich's haematoxylin, which gave satisfactory results. Those on the gills of *Chorinemus tala* were picked from specimens of fish preserved in 5 per cent formalin in the field and examined in the laboratory after washing and staining as above, but the fixation was not satisfactory.

Systematic Account of the Species.

Sub-family *Microcotylinae* Monticelli, 1892.

Genus **Microcotyle** van Beneden & Hesse, 1863.

Microcotyle pamae, sp. nov.

(Text-Fig. 1, a-f.)

Body long, anterior end truncate, maximum breadth in the ovarian region (text-fig. 1*a*). Haptor long and tapering posteriorly. Clamps unequal in number on the two sides, 28-54 on one side and 34-64 on the other. Two larval specimens with two pairs of anchors have 7 and 22 pairs of clamps respectively. Ventral surface of the clamp capsule with 6-7 thin striae on either side of the middle piece.

Anterior suckers septate and oval. Pharynx spherical. Oesophagus long and thin, bifurcating into intestinal crura in front of the genital pore. In some specimens the oesophagus was red, presumably due to the blood of the host on which the parasite had fed.

Testes 8-11, globular to oval in shape. Vas deferens long, stout and sinuous, and opening into the spiny genital atrium. Spines long and curved forming a coronet with another circlet of 15-20 smaller spines at their base. Ovary convoluted. Germiduct starts at its posterior end where vitelline duct also joins it. Genito-intestinal canal present. Uterus long with one oval egg, having a spathulate appendage at its posterior end. Vagina opening midway between the ovary and the anterior end of body, armed with a circlet of recurved spines surrounded by muscle fibres. Vitellaria follicular and lateral; they extend, from the genital pore to the middle of the haptor.

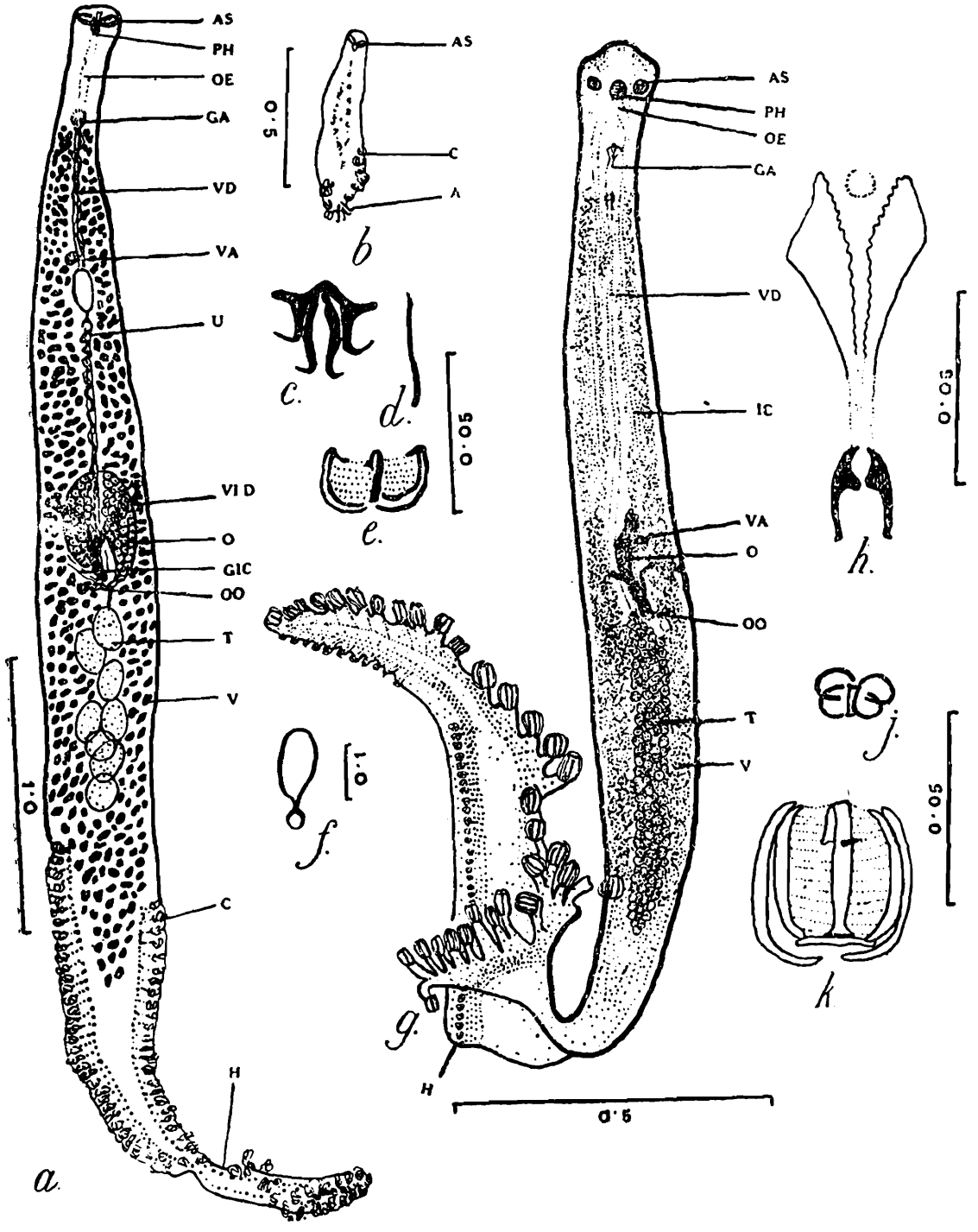
*Measurements.**—Total length, 2·17-5·06 ; breadth, 0·116-0·40, haptor, length 0·26-1·9 ; clamp, width 0·038-0·041 ; anchors, length inner pair 0·045-0·053, outer pair, 0·041 ; anterior sucker, 0·038-0·041 × 0·038-0·066 ; pharynx, 0·03-0·034 × 0·038-0·045 ; cirrus-spine, length 0·038 and 0·015 ; genital atrium diameter, 0·054-0·06 ; vagina diameter 0·038-0·044 ; testis, 0·05×0·07 ; egg, 0·087-0·1×0·152-0·18, egg filament, length 0·07.

Remarks.—This species differs from *M. archosargi*, *M. canthari* *M. labracis*, and *M. polymemi* in having an unequal number of clamps on the two sides of the haptor. All these species belong to the sub-genus *Bispina* (see page 242).

*All measurements in this paper are in millimeters.

Microcotyle polynemi MacCallum, 1917.

This species was obtained from the gills of *Polynemus indicus* and *P. tetradactylum,* obtained from the estuaries of the Matla, Hoogly and Mahanadi rivers, and Chilka lake; but not in specimens of these fish from the sea at Puri. Not more than five specimens were obtained from a single fish, which showed very low frequency of infection as seen in Table I. MacCallum (1917) first described this species from the gills of

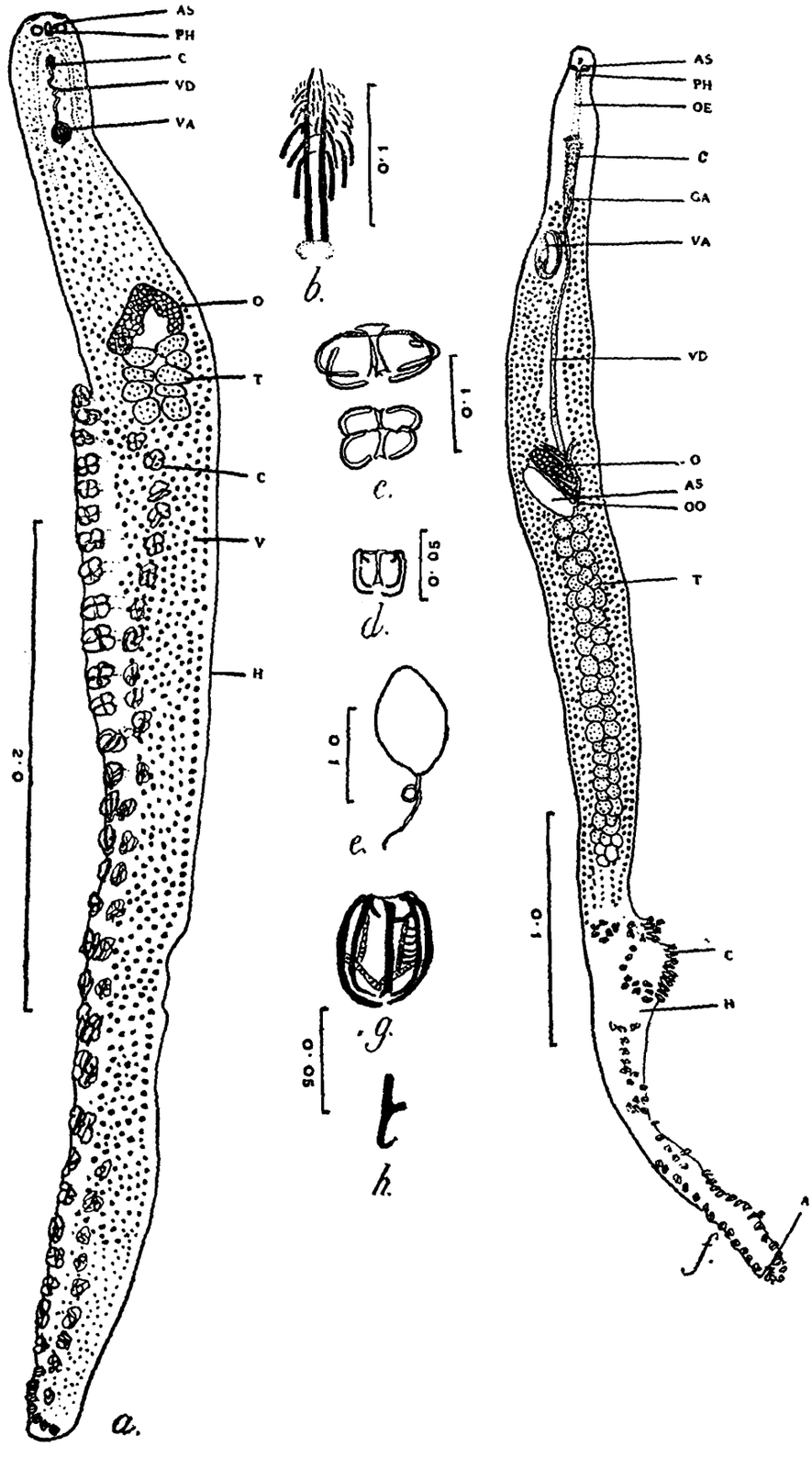


Text-fig. 1.—*Microcotyle pamae,* sp, nov.
(*a*) Complete worm, (*b*) Larval form, (*c*) Anchors of the larva, (*d*) Cirrus spine, (*e*) Clamp, (*f*) Egg.

Text-fig. 1.—*Megamicrocotyle chirocentrus*, gen. *et.* sp. nov.
(*g*) Complete worm, (*h*) Cirrus, (*j*) Smaller clamp, (*k*) Larger clamp.

Polynemus auratus from Batavia.—The present record shows a new host species of the same genus for this parastite, and also extends its geographical distribution.

Measurements of the specimens are given below. MacCallum's data are given in parenthesis.



Text-fig. 2.—*Diplasiocotyle chorinemi*, sp. nov.

(*a*) Complete worm, (*b*) Cirrus spines, (*c*) Larger clamps, (*d*) Smaller clamp, (*e*) Egg.

Text-fig. 2.—*Lithidiocotyle secundus*, sp. nov.

(*f*) Complete worm, (*g*) Clamp, (*h*) Anchor.

Length, 4·9-6·6 (10·0) ; breadth, 0·43-0·45 (1·0) ; haptor length 1·5-2·8 ; clamp, 0·045 × 0·053, 62-60 pairs ; anterior sucker 0·087-0·116×0·043-0·048; pharynx diameter 0·03-0·043 ; cirrus spine length 0·079 ; testis diameter 0·082, 38-50 follicles.

Pathology and breeding.—The two species of *Microcotyle* dealt with above were found in small numbers, not exceeding five, and attached to and between the gill filaments. They feed on the blood of the fish as seen in *M. pamae,* but in no case was there any deterioration in the size or distortion in the form of the gill or any other pathological effect. It is probable, however, that the parasite may increase in number very rapidly if kept in confined waters, to the extent of proving fatal to the fish especially in marine aquaria as reported by Brown (1929), MacCallum (1915, 1918), Nigrelli (1940) and Sproston (1946). No control methods have so far been tried.

The parasites collected in February and March in the river Hoogly were with eggs when the temperature of the water varied between 22-29°C. In *M. polynemi* there were 4-6 eggs in the uterus in the month of April.

Genus **Diplasiocoyle** Sanders, 1944.

Diplasiocotyle chorinemi, sp. nov.

(Text-Fig. 2, a-e.)

Parasite very long, haptor relatively wider and nearly 2-3 times the length of the main part of the body. Anterior end rounded with two semi-lunar suckers at the sides. 32-41 pairs of clamps of which the posterior 6-10 pairs are smaller in size than the anterior ones. Ratio of width of larger to smaller clamps nearly 2·5 : 1. Anchors absent. Anterior suckers spherical. Pharynx oval. Oesophagus short.

Testes 12-16 in number, oval to irregular in shape, situated in the posterior part of the body, extending a little in the haptoral region. Vas deferens stout and sinuous. Genital atrium spinous with two long central spines around which are circles of curved spines. Anterior spines smaller. Ovary convoluted. Vagina unarmed, with muscular dorsal opening. Eggs oval with long coiled filament at the posterior end. Vitellaria follicular extending from the vaginal pore to the end of the haptor.

Measurements.—Total length, 4·7-10·0 ; width, 0·45-0·48 ; haptor 2·46-6·65×0·58-0·81 ; clamp width, larger pair 0·087-0·106, smaller pair 0·034-0·038 ; anterior sucker, 0·022×0·022 ; pharynx, 0·022-0·034 × 0·034-0·041 ; testis, 0·038 ×0·057-0·064 ; cirrus spines : long spine 0·095-0·115, smaller spine 0·02-0·03 ; egg, 0·114-0·125×0·076-0·106 ; egg filament, 0·136-0·152.

Remarks.—This species resembles *D. centrodonti* (Brown) and *D. sargi* (Parona & Perugia) only in the ratio of the width of the clamp, but they differ in other respects. (See Table II.) The small suckers at the anterior end, the very long haptor and the spines of the genital atrium, differentiate the new species from all the other known species of the genus *Diplasiocotyle.*

Genus **Bicotyle** Gen. nov.

Bicotyle stromatea, sp. nov.

(Text-Figs. 3, a-f.)

Body fusiform, anterior quarter of the body long and thin. Haptor triangular, nearly a third of the total length. Two rows of clamps unequal in size and number. Large clamps 10-17 in number on the left side. Anterior clamps bigger than posterior clamps in this row. Smaller clamps 35-40 in number on the right side. Clamps microcotylid in structure.

Anterior suckers spherical, aseptate, on either side of oval muscular pharynx. Oesophagus long and thin bifurcating into intestinal crura in front of genital atrium. Caeca having dark pigment granules. Vitellaria follicular, extending from vaginal pore to the end of haptor.

Testes spherical, many, post ovarial, extending into the haptor. Vas deferens long, thin and sinuous. Genital atrium armed with 12-15 spines, with curved tips, arising from a circular muscular cushion. Ovary long and convoluted, pointing posteriorly. The common vitelline duct and the germi duct join to form the ootype, from which the long uterus proceeds anteriorly. Genito-intestinal canal present. Eggs fusiform, and filamented at both poles. Vaginal opening dorsal, behind the genital pore. Its terminal part surrounded by four long corrugated cuticular plates which give a crinkled appearance to the opening which is surrounded by muscles.

Measurements.—Total length, 6·85-7·84 ; breadth, 1·01-1·96 ; haptor, 2·61-3·26×1·63-1·96 ; anterior sucker, 0·041-0·045 ; pharynx, 0·09-0·1 × 0·152-0·188 ; clamps, left side, anterior 0·174-0·21×0·217-0·29, posterior 0·087×0·087, right side 0·027×0·116 ; testicular mass, 2·04-2·28×1·06 ; cirrus spine, 0·017×0·002 ; vaginal opening, diameter, 0·038.

Generic diagnosis.—Microcotylinae, clamps on either side of the haptor unequal in size and number; genital pore armed with 12-15 spines; vagina armed or unarmed ; testes and vitellaria extending into the haptor ; ovary convoluted.

Type species.—B. stromatea, sp. nov. other species *B. reticulata* (Goto)

Genus **Megamicrocotyle** Gen. nov.

Megamicrocotyle chirccentrus, sp. nov.

(Text-Fig. 1, g-k.)

Body long, anterior end truncate, posteriorly thinner to broaden again at the beginning of the haptor, and tapering at the posterior end. Anchors absent. Clamps unequal in size and number on the two sides. Bigger clamps pedunculate, 26-36 in number ; peduncles in the anterior one-third of the haptor longer than in the posterior part. Clamps typically microcotylid in structure. Smaller clamps sessile, 43-56 in number with their lateral bars more rounded.

Anterior suckers spherical and muscular. Pharynx spherical, situated between the two suckers. Gland cells present near the anterior end of the body. Oesophagus small dividing into two long intestinal crura, extending into the haptor.

Testes globular, 40-58 in number, arranged in three to four longitudinal rows. Vas deferens long and straight, opening in the genital atrium. Base of the atrium with two hooks, and the distal end with four cuticular triangular structures undulated on the inner margin. Genital pore circular. Ovary long, recurved and tapering at the posterior end. Germiduct anteriorly curved and joining with the common vitelline duct. Vagina small, unarmed, surrounded by circular muscle fibres, and opening dorsally lateral to the ovary. Receptaculum seminis small and spherical. Eggs elliptical, drawn into filaments at both poles. Vitellaria extending from the cirrus to the haptor.

Measurements.—Total length, 2·05-2·4 ; breadth, 0·11-0·145 ; haptor 0·065-1·04×0·33 ; pharynx, diameter 0·019 ; anterior sucker, diameter 0·019 ; clamps, large 0·03-0·034×0·038-0·041, small 0·0076×0·015-0·019 genital atrial hook, 0·022 long ; egg, 0·10×0·076 ; egg filament, 0·114.

Generic diagnosis.—Microcotylinae, with two types of clamps, one larger and pedunculate on right side, and the other small and sessile on the left side. Basic structure of the clamp microcotylid in type. Genital atrium with two curved hooks and four triangular undulated plates. Testes spherical, 40-58 in number. Ovary convoluted. Vagina unarmed. situated in the ovarian region. Anterior suckers spherical. Anchors absent.

Type species *M. chirocentrus*, sp. nov. (only species).

Sub-family : *GASTROCOTYLINAE* Sproston, 1946.

Genus **Thoracocotyle** MacCallum, 1913.

Thoracocotyle ovale, sp. nov.

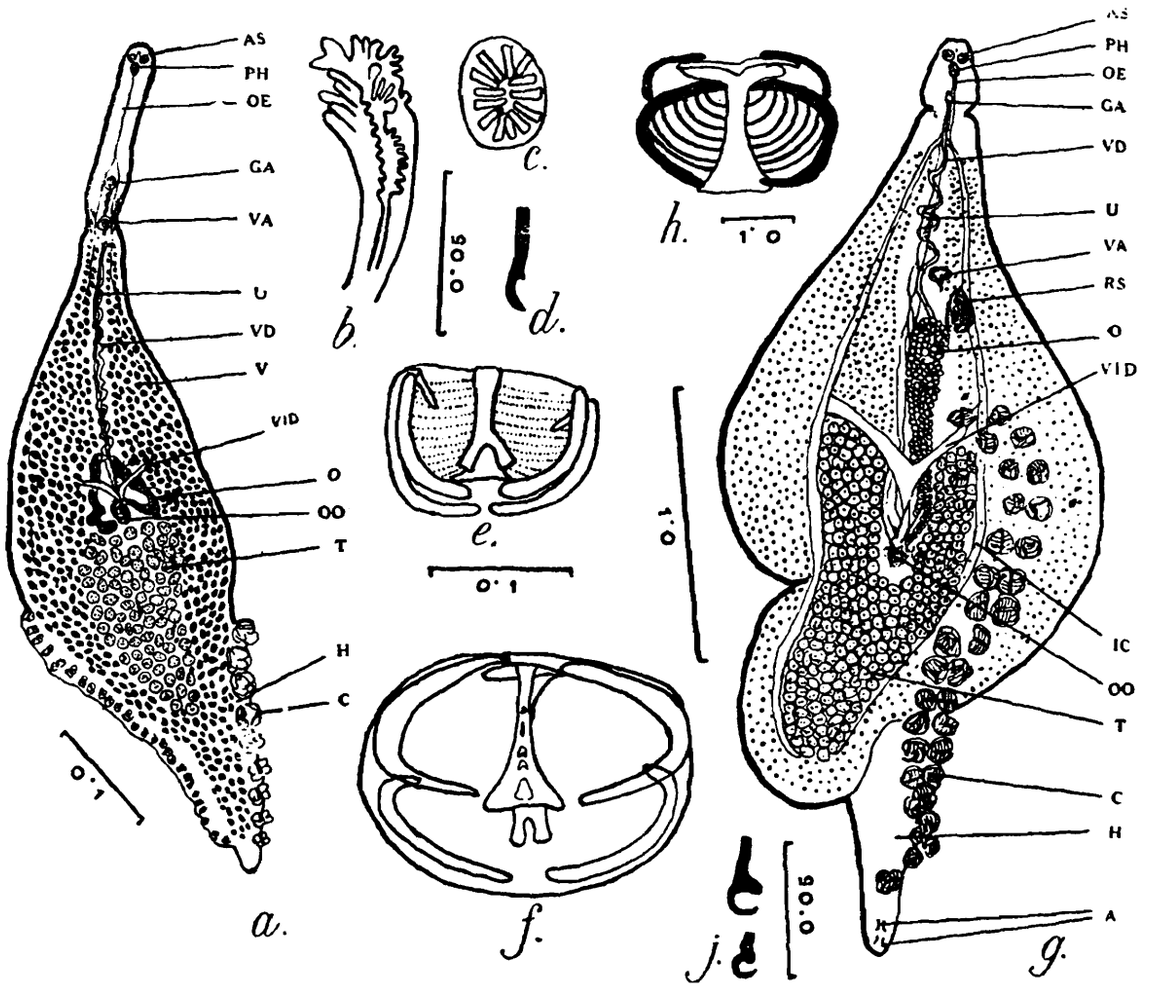
(Text-Fig. 3, g, h & j.)

Body oval, anterior portion cylindrical. Haptor elliptical with 16-19 pairs of clamps extending up to the ovary. Two pairs of sickle shaped anchors at the posterior end, the anterior pair being the longer. Circular anterior suckers with oval pharynx behind them. Oesophagus long, bifurcating into two intestinal crura a little behind the genital opening. 13-20 pairs of clamps, consisting of a longer dorsal and a more curved ventral pair of lateral arcuate bars. Middle-piece anchor shaped. Ventral wall of clamp capsule with 7-8 pairs of curved thickenings. The middle pairs of clamps being bigger than anterior or posterior pairs.

Testes spherical, inter-crural and numerous. Vas deferens long and sinuous, opening into the pyriform muscular cirrus. Genital opening cuticularized. Ovary long and curved, tapering posteriorly at its junction with the common vitelline duct. Uterus long and straight with 3-8 fusiform filamented eggs. Vaginal opening muscular and

anterior to the ovary. Receptaculum seminis oval, on the outer side of the anterior part of the ovary. Vitellaria extra-crural and not extending into the haptor.

Measurements.—Total length, 2·47-4·45 ; breadth, 0·43-2·03 ; haptor length, 1·26-3·19 ; clamps, anterior and posterior pairs, width 0·072-0·095, middle pair width 0·114-0·145 ; anchors length, anterior pair 0·022, posterior pair 0·015 ; anterior sucker, diameter 0·03-0·041 ; pharynx, 0·026-0·038×0·038-0·057 ; testis diameter, 0·072-0·145 ; receptaculum seminis, 0·116-0·145×0·217 ; cirrus, length 0·038 ; egg, 0·11–×0·045 egg filament, 0·19 and 0·133.



Text-fig. 3.—*Bicotyle stromatei*, gen. *et.* sp. nov.
(*a*) Complete worm, (*b*) Vagina, side view, (*c*) Cirrus, (*d*) Cirrus hook, (*e*) Smaller clamp, (*f*) Larger clamp.

Text-fig. 3.—*Thoracocotyle ovale* sp. nov.
(*g*) Complete worm (*h*) Clamp, (*j*) Anchors.

Remarks.—This species resembles *T crocea* MacCallum, 1913 in the number and structure of the clamps, but differs in the position of the genital organs. The haptor extends anteriorly beyond the ovary in *T crocea*, but in the new species it ends at the middle of the ovary. From *T. coryphaenae* Yamaguti, 1938, it differs in the number of clamps, testes and the shape of the body. *T. paradoxina* Meserve, 1938 has only 28 pairs of clamps and the haptor is laterally extended.

Four species of *Thoracocotyle* are now known including the one described here.

Genus **Lithidiocotyle** Sproston, 1946.

Lithidiocotyle secundus, sp. nov.

(Text-Fig. 2, f-h.)

Body of parasite long and thin, tapering at both ends, greatest width being in the ovarian region. Haptor about one third of the total length with 50-55 pairs of pedunculated clamps, and a pair of clamps at the posterior end. Clamp with two pairs of lateral curved bars and a middle piece in addition to four accessory bars, two of which are oblique and the other two vertical. Six rib-like thickenings between the middle-piece and the outer bars, which are present on one side only.

Anterior suckers oval and bilocular. Pharynx small and oval. Oesophagus bifurcating into intestinal crura in front of the cirrus. Crura without caeca, extending into haptor.

Testes, 48-60 spherical masses situated in the posterior half of the body without extending into haptor. Vas deferens long and sinuous, opening at the base of spiny eversible cirrus. Cirrus spines numerous, long and curved at the tip. Ovary curved and lateral with, oval receptaculum seminis behind it. Ootype posterior to ovary. Uterus long and dorsal to vas deferens. Vaginal opening oval surrounded by circular muscle fibres, lateral or central in position. Vitelline follicles lateral, extending from behind the cirrus to the beginning of the haptor.

Measurements.—Total length, 2·175-3·963 ; breadth, 0·145-0·377 ; haptor, 0·899-1·711 × 0·145-0·29 ; clamp, 0·06×0·03-0·038 ; anchor, total length 0·03-0·041, root 0·019, point 0·007-0·011 ; anterior sucker, 0·034-0·038×0·019-0·026 ; pharynx, 0·034-0·038×0·038 ; testis, 0·057-0·068×0·053-0·076 ; ovary, 0·21×0·07 ; cirrus, 0·114-0·152×0·03 ; cirrus spine, 0·022 long ; vagina, 0·045-0·083×0·03-0·07 ; vagina from anterior end, 0·507-1·16.

Remarks.—This species differs from *L. acanthophallus* (MacCallum & MacCallum, 1913), the only other species of the genus, in the structure of the accessory piece of the clamp, the presence of anchors on the haptor, and in the smaller size of the body and the oral sucker.

TAXONOMIC POSITION OF THE GENERA

The family Microcotylidae was created by Taschenberg (1879) to include *Microcotyle*, *Axine*, *Aspidogaster* and *Cotylapsis*. Monticelli (1892) divided the family into Microcotylinae for *Microcotyle*, and Axiniae for *Axine*, *Pseudaxine* and *Gastrocotyle*. Price (1943) placed *Gastrocotyle* in a new family Gastrocotylidae, and included it along with Microcotylidae in the super-family Diclidophoroidea. Sproston (1946) reduced Gastrocotylidae to sub-family status in Microcotylidae and placed *Axine* and its allies under Micocotylinae.

The sub-family Microcotylinae is here confined only to those genera in which the haptor is bilaterally symmetrical or asymmetrical and the morphological posterior end is at the posterior end of the body.

Axine, Hetraxine and *Axinoides* are placed in the sub-family Axininae Monticelli, 1892 which is revived here because of the morphological differences between the haptors of *Microcotyle* and *Axine.*

Sproston (1946) included the following genera in the sub-family Microcotylinae (besides the three genera now placed in *Axininae*)—*Pyragraphorus, Cemocotyle, Microcotyle, Gotocotyla,* and *Lintaxine. Microcotyloides, Gonoplasius* and *Diplasiocotyle* were placed as addenda to *Microcotyle.* I have now added two new genera *Bicotyle* and *Megamicrocotyle.* The inter-relationship of these genera is discussed, and a key for their identification is given below.

Pyragraphorus Sproston, 1946 and *Cemocotyle* Sproston, 1946 have some clamps modified in which the sclerites are elongated, and not curved as in other genera. *Gonoplasius* Sanders, 1944 is made synonymus with *Microcotyle,* because the former differs from the latter only in possessing the gland cells in the buccal region, a character which is not of any generic importance. *Gotocotyla* Ishi, 1936 retains anchors in the adult stage. *Microcotyloides* Fuji, 1944 is characterised by the presence of prostatic bulb in connection with the male genitalia.

In the above genera the haptor is bilaterally symmetrical and the clamps are of the same size. *Diplasiocotyle* Sanders, 1944 is similar to *Microcotyle* in all characters except that the clamps decrease or increase in size antero-posteriorly. *Microcotyle centrodonti, M. sargi* and *M. sebastis* have the anterior pair of clamps bigger than the posterior pair as in *Diplasiocotyle johnstoni* Sanders. In *M. macroura* and *M. trachini* the median pair of clamps are bigger than the anterior or the posterior pairs. Because of the similarity of the haptor of these species of *Microcotyle* to *Diplasiocotyle* they are transferred to the latter genus. The number and size of the clamps and the nature of the genital atrium and the vagina are given in Table II.

TABLE II.

Species.	Genital atrium.	Vagina.	No. of clamps.	Width of clamps in microns size.	Ratio of clamp.
D. centrodonti (Brown, 1929)	unarmed	unarmed	63—80	80 & 30	2·6
D. chorinemi sp. nov.	armed	unarmed	32—42	87—95 & 34—38	·25
D. johnstoni (Sanders, 1944)	armed	unarmed	8—10	375—425 & 25	17·48
D. macroura (MacCallum & MacCallum, 1913).	unarmed	unarmed	25	120, 330 40	8·5
D. sargi (Par. & Per., 1889)	armed	armed	60—70	78 & 28	2·7
D. sebastis (Goto, 1894)	armed	unarmed	29—31	128 & 68	1·8
D. trachini (Par. & Per. 1889)	unarmed	unarmed	8—10	126 & 42	3·0

In *Bicotyle* the haptor is symmetrical but the clamps on the two sides are unequal in number and size, due to their unequal growth-potentials. *Microcotyle reticulata* Goto, 1894, found on *Stromateus argentius* in Japan,

is also transferred to this genus. It has 23 clamps on one side and 42 clamps on the other side, but the vagina is unarmed. Now there are two species under *Bicotyle* which differ from one another in the size and number of their clamps.

The asymmetry in the growth of the clamps as seen in *Bicotyle* goes a step further in *Megamicrocotyle*, where the haptor is also asymmetrical, and the vagina is situated near the ovary, unlike the other genera, in which it is near the genital atrium.

Lintaxine Sproston, 1946, is not recognised here and is placed as *gen. inq.* in Microcotylinae.

Microcotyle is now left with only those species in which the clamps are equal in size. In only seven species is the number of clamps on the two sides unequal. They are, *M. carangis* (syn. *Gonoplasius carangis* Sanders), *M. caudata*, *M. heteracantha*, *M. pamae*, *M. sciaenae*, *M. scorpis* and *M. seriola*. All the species of *Microcotyle* are divided into sub-genera based on the characters of the cirrus and vagina. Eighteen species could not be included in these sub-genera because of inadequate descriptions.

I. *Microcotyle* sub-genus nov.—Cirrus armed, vagina unarmed. It includes the following species :—

M. aigoi Ishii & Sawada, 1938.

M. angelichthys MacCallum, 1913.

M. a. townsendi MacCallum, 1916.

M. bassensis Murray, 1931.

M. branchiostegi Yamaguti, 1937.

M. caudata Goto, 1894.

M. centropristes MacCallum, 1915.

M. cephalus Azim, 1937.

M. cepolae Yamaguti, 1937.

M. chiri Goto, 1894.

M. chrysophryi van Beneden & Hesse, 1863.

M. ditrematis Yamaguti, 1940.

M. donavani van Beneden & Hesse, 1863.

M. elegans Goto, 1894.

M. eriensis Bengham & Hunter, 1936.

M. erythrini van Beneden & Hesse, 1863.

M. furcata Linton, 1940.

M. fusiformis Goto, 1894.

M. gotoi Yamaguti 1934.

M. heteracantha Manter, 1938.

M. hiatulae Goto, 1899.

M. inada Ishii & Sawada, 1938.

M. longicauda Goto, 1899.

M. mormyri Lorenz, 1878.

M. mouwoi Ishii & Sawada, 1938.

M. mugilis Vogt, 1878.

M. pomacanthi MacCallum, 1915.

M. pomatomi Goto, 1899.

M. poronoti MacCallum, 1915.

M. priacanthi Meserve, 1938.

M. salpae Par. & Per., 1890.

M. sciaenae Goto, 1894.

M. spinicirrus MacCallum, 1918.

M. stenotomi Goto, 1899.

M. suzuki Ishii & Sawada, 1938.

M. tanago Yamaguti, 1940.

M. toba Ishii & Sawada, 1938.

M. truncata Goto, 1894.

M. victoriae Woolcock, 1936.

II. *Bispina* sub-genus nov.—Cirrus and vagina armed.

It includes the following species :—

M. archosargi MacCallum, 1913.
M. canthari van Beneden & Hesse, 1863.
M. labracis van Beneden & Hesse, 1863.
M. polynemi MacCallum, 1917.
M. pamae sp. nov.

III. *Vaginaespina* sub-genus nov.—Cirrus unarmed, vagina armed.

It includes the following species :—

M. alcedinis Par. & Per., 1890.
M. baumi Sprehn, 1929.
M. ichimidai Ishii & Sawada, 1938.
M. pagrosomi Murray, 1931.

IV. *Aspina* sub-genus nov.—Cirrus and vagina unarmed.

It includes the following species :—

M. acanthogobii Yamaguti, 1940.
M. australis Murray, 1931.
M. pogoniae MacCallum, 1913.
M. sciaenicola Murray, 1932.
M. seriolae Yamaguti, 1940.
M. sillaginae Woolcock, 1936.
M. spari Yamaguti, 1937.
M. tai Yamaguti, 1938.
M. virgatarum Tubangui, 1931.

In the following species the cirrus is armed, but no information about the vagina is given :—

M. agnostomi Sanders, 1945.
M. arripis Sanders, 1945.
M. australiensis MacCallum, 1921.
M. carangis (Sanders, 1944).
M. eueides MacCallum & MacCallum, 1913.
M. helotes Sanders, 1944.
M. odacis Sanders, 1945.
M. aparasillaginae Sanders, 1945.
M. pentapodi Sanders, 1944.
M. pancerii Sonsino, 1891.
M. scorpis Sanders, 1944.
M. temnodontis Sanders, 1945.

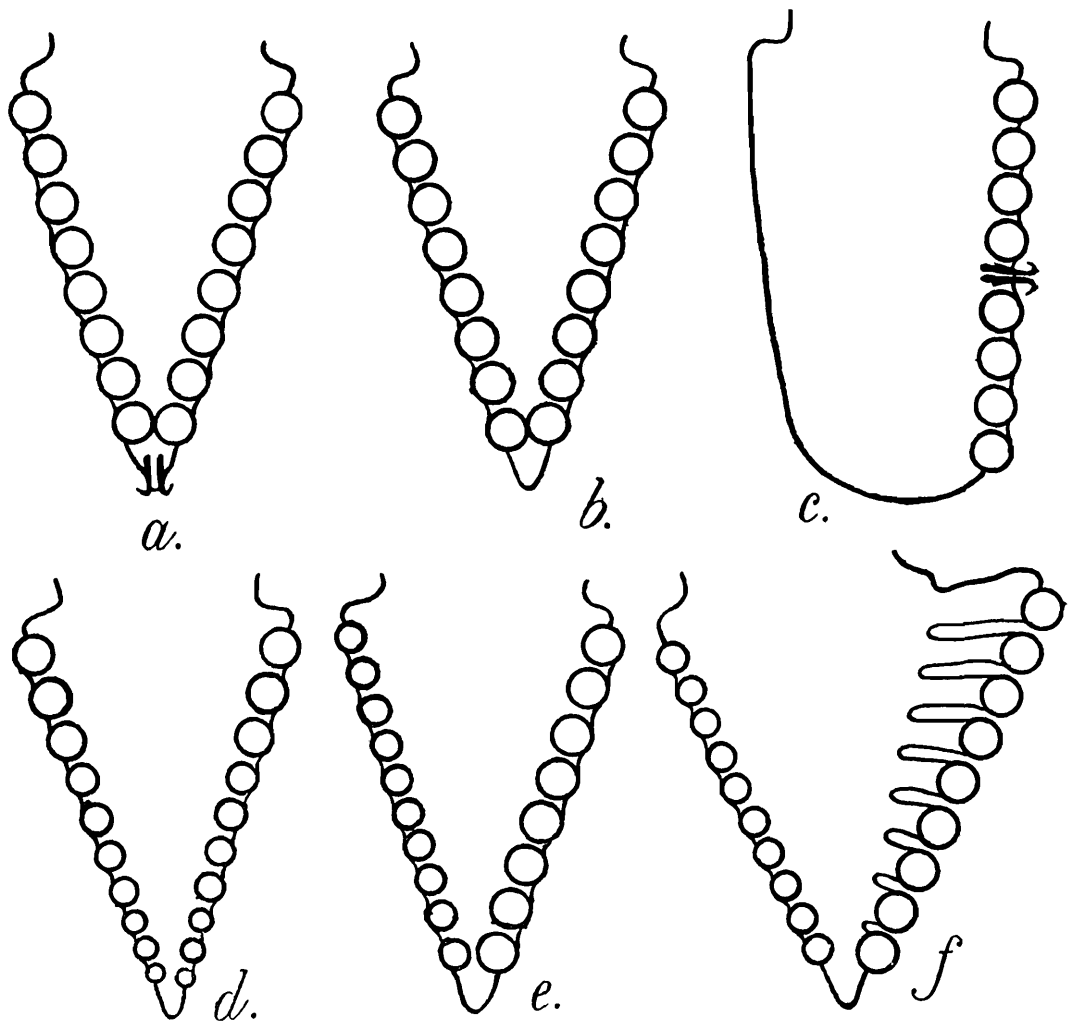
M. gerres Sanders, 1944 : has armed cirrus but no information is given about the vagina.

No information about the cirrus or vagina is given for the following species :—

M. atrynetri Pearse, 1951.
M. draconsis Briot, 1904.
M. incomparabilis MacCallum, 1917.
M. peprili Pearse, 1951.
M. lichiae Ariola, 1899.

In conclusion, it may be stated that there is a graded asymmetry of the clamps and the haptor, from the basic Microcotylid pattern, in

which *Gotocotyla* represents the primitive form. The probable relationships of the various genera of Microcotylinae are given in Text Fig. 4, and a key to their identification is given below :



Text-fig. 4.—Diagrammatic arrangement of the clamps on the haptor of (*a*) *Gotocotyla*, (*b*) *Microcotyle*, (*c*) *Axine*, (*d*) *Diplasiocotyle*, (*e*) *Bicotyle*, (*f*) *Megamicrocotyle*.

Key to the genera of Microcotylinae.

1. Outer sclerites of the clamps elongated or modified.	2.
1. Clamp sclerites of normal pattern	3.
2. Haptor bifid and set off from the body, anchors absent.	*Pyragraphorus* Sproston, 1946.
2. Unilateral extension of haptor bearing modified clamps, anchors present.	*Cemocotyle* Sproston, 1946.
3. Clamps of equal size on either side of haptor	4.
3. Clamps unequal in size	6.
4. Vagina mid-dorsal	5.
4. Vagina opening laterally on right margin	*Microcotyloides* Fujii, 1944.
5. Anchors absent in adult	*Microcotyle* van Beneden & Hesse, 1863.
5. Anchors present in adult	*Gotocotyla* Ishii, 1936.
6. Clamps decrease in size antero-posteriorly, haptor symmetrical.	*Diplasiocotyle* Sanders, 1944.
6. Clamps on one side smaller than on the other, haptor symmetrical.	*Bicotyle* gen. nov.
6. Clamps on one side smaller than on the other, hapter asymmetrical.	*Megemicrocotyle* gen. nov.

The sub-family Gastrocotylinae contains *Gastrocotyle* van Beneden & Hesse, 1963, *Pseudaxine* Par. & Per., 1890, *Thoracocotyle* MacCallum, 1913, *Lithidiocotyle* Sproston, 1946, and *Pricea* Chauhan, 1945. Sproston (1946) separated *Lithidiocotyle* and *Pricea* on the basis of the absence of anchors in the former genus and the presence of the body hooks in the latter genus. But anchors are present in *L. secundus*, sp. nov. and the body hooks are not present in all the species of *Pricea* (Ramlingam, 1952). In view of the above, the following characters are suggested to differentiate the two genera. In *Lithidiocotyle* the cirrus is long with many spines and the vagina is smooth, whereas in *Pricea* the cirrus has 10-15 spines only and the vagina has a U shaped spine at its base.

Sanders (1947) has described a new genus *Pseudomicrocotyle* and placed it in Microcotylidae, without assigning it to any subfamily. The clamp has three main pieces hooked at the distal end and five accessory sclerites. To one of the main pieces "eight closely set hooklets are attached" These are similar to the rib-like thickenings in the clamp capsule of *Thoracocotyle*, *Pricea* and *Lithidiocotyle*. The clamp is formed on the Gastrocotylid pattern. A pair of anchors is also present at the end of the haptor. These characters assign the genus to *Gastrocotylinae*.

Summary.

Six new species and two new genera of the family Microcotylidae are described. They are, *Microcotyle pamae*, sp. nov., *Diplasiocotyle chorinemi*, sp. nov., *Bicotyle stromatea*, Gen. et. sp. nov., *Megamicrocotyle chirocentrus*, Gen. et. sp. nov., *Thoracocotyle ovale*, sp. nov., and *Lithidiocotyle secundus*, sp. nov. *Microcotyle polynemi* MacCallum, 1917 is recorded from a new host.

The sub-family Axininae Monticelli, 1892 is revised to include *Axine*.

The species of Microcotyle are divided in four new sub-genera ; *Microcytyle*, *Bispina*, *Vaginaespina*, and *Aspina*.

Pseudomicrocotyle Sanders, 1944 is placed in the sub-family Gastrocotylinae.

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Key to lettering :—

A—Anchor.	OO—Ootype.
AS—Anterior sucker.	PH—Pharynx.
C—Clamp.	RS—Receptaculum seminis.
GA—Genital aperture.	T—Testis.
GIC—Genito-intestinal canal.	U—Uterus.
H—Haptor.	V—Vitellaria.
IC—Intestinal caeca.	VA—Vagina.
O—Ovary.	VD—Vas deferens.
OE—Oesophagus.	VID—Vitellineduct.

The scales along with the figures are in millimeters.