RECORDS

of the

INDIAN MUSEUM

(A Journal of Indian Zoology)

Vol. 51, Part II

June, 1953

Edited by the Director, Zoological Survey of India

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED BY THE GOVERNMENT OF INDIA PRESS, CALCUTTA, INDIA.
1954.

STUDIES ON THE TREMATODE FAUNA OF INDIA

Part I. Subclass MONOGENEA.

By B. S. CHAUHAN, *MSc, PhD, FZS, FASc, FZSI, Assistant Superintendent, Zoological Survey of India, Calcutta.*

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I. INTRODUCTION.

Countries situated in tropical and sub-tropical regions abound in helminth fauna. India is by no means an exception to this. Therefore our trematode fauna is also very rich and varied. But, unfortunately, their studies do not seem to have received adequate attention either in proportion to the richness or in regard to the national problem of public health or welfare of animal or cattle. Comparatively speaking, the subject has received greater attention during the past twenty five to thirty years. However, although the trematode parasites form an important group in the study of helminth fauna of India but unfortunately, so far, there has been no compact publication dealing with the Indian fauna in a comprehensive way. We have volumes in the Fauna of (*formerly* British) India Series dealing with Cestodes and Nematodes, but so far no volume has been taken up for Trematodes. This greatly handicaps the work and studies specially of university post-graduate students, junior research workers and various scientific technical personnel engaged in this work in various National Research Laboratories and Research Institutes of applied research, like those dealing with fisheries, parasitology, medicine, public health, national hygiene

and sanitation, veterinary zoology, animal husbandry, etc. The need is more keenly felt, particularly after their post-war development, when the various activities have expanded or increased many-fold, but there is great national shortage of technically trained scientific personnel with requisite experience. The publication of this series has therefore been taken up by the author to meet, at least partly, this national demand. Part II of this series, dealing with Order Gasterostomata (Digenea) was the first to be completed and is in the press. That followed Part III, dealing with Subclass Aspidogastrea. Part IV, which is also in the press, is the first in the series to deal with Digenea (Prosostomata) and deals with Hemiuroidea from the Indian region. Parts dealing with other Prosostomata are expected to follow. In fact, studies with regard to Part V, dealing with Paramphistomoidea from the Indian region, is already in hand. Part I, presented herewith, deals with forms of the Subclass Monogenea recorded from the Indian region. The geographical area covered in the series includes the whole of India, Burma, Pakistan and Ceylon, *i.e.*, as it has been for the Fauna of India series.

The main object in preparing this series, has been to make it a self contained publication including all forms discovered from the region so far, give brief diagnosis of each systematic category concerned, provide diagnostic keys at every taxonomic stage, where considered necessary and include a representative diagram, if possible, of each species, described. At the beginning of each specific description, wherever considered desirable, a brief reference has been made to all those workers who have made any observations regarding it. At the end of each part, a systematic list of parasites along with their host, location and locality of record or discovery has been given. A host-parasite list has also been added. Regarding the references, attempt has been made generally to give only such important references as have been actually cited in the text, but such others also as have been considered to have any fundamental bearing on the approach to their study have been included. However, as far as the references to worms dealt with from this region in particular are concerned, an attempt has been made to make them as complete as possible.

The author does not put forth any claim that the publication is absolutely complete and perfect, but he will be obliged if his attention be drawn to omissions, or suggestions if any are kindly advanced to him, to make the series still more useful.

II. Systematic Account.

In recent years, Price (1936-43) has revised the classification of this group extensively. Sproston (1946) also brought out a large monograph on the subject after exhaustive studies. In view of these, I am not dealing with the subject at length here. Therefore for further details a reference may be made to their work if necessary.

I am also not including any general account of the group, as I have done in earlier parts of the series dealing with Gasterostomata, Aspidogastrea and Hemiuroidea, although I had already prepared it as early as 1945; because Dawes recently (1946; 1947) has dealt with the matter

fairly adequately. In fact, since 1939, I was also engaged in studies on the group, similar to those of Sproston, but due to World War II my progress could not be as expected. However, just wnen I had also made headway Sproston's monograpn appeared.

In earlier parts of this series, particularly Parts IV and II, I have attempted to deal with the evolution and inter-relationships in the Platyhelminthes and have given briefly the history of classification of the Class Trematoda. I have proposed there that following Faust and Tang (1936) and other former authors, we should revert to the earlier classification and divide the Class into three Subclasses, *viz.*, 1. *Monogenea*, 2. *Aspidogastrea* and 3. *Digenea*. If this is followed the two Suborders of *Monogenea* of Odhner (1912), *viz.*, *Monopisthocotylea* and *Polyopisthocotylea*, will have to be regarded as of the rank of Orders and not Suborders.

In Part III of this series, I have given the distinguishing features differentiating the three Subclasses, as given by Dawes (1946). The Subclass *Monogenea* could be defined somewhat as follows :—

Subclass *MONOGENEA* (Carus, 1863).

Syns. *Pectobothrii* Burmeister, 1856.
Polystomea Leuckart, 1856.
"*Monogénèses*" of von Beneden, 1858.
Crypoocoela Johnston, 1865.
Ectoparasitica Lang, 1888.
Enterocotylea Montic, 1892.
Heterocotylea Braun, 1893.
Monogenetica Haswell, 1893.
Heterocotylida Lahille, 1918.

Diagnosis of Subclass : *Trematode* Rudolphi, 1808; with characters of the Class.

Small to medium sized Trematoda. Anterior adhesive organs may be groups of gland cells opening in " head organs " or as suckers and pseudosuckers. Eyes present or absent. Mouth at or near anterior end. Pharynx is always present. Intestine usually formed of two lateral crura; separate or confluent; branched or unbranched; rarely sac-like. Chief organ of attachment, the" haptor " is posterior or lateral; may be as in Monopisthocotylea, more or less discoidal, muscular and sometimes provided with localised cuticular thickenings; with nearly always 2-16 hooklets round the margin of the larval haptor, which may persist in the adult and frequently 1-3 pairs of large hooks " anchors " more centrally placed. The secondary haptor of adults may be discoidal or in reduced form, as in some Polyopisthocotylea, with cuticular or muscular developments upon it, or may be formed of a fixed number of muscular suckers, with or without supporting sclerites or of a fixed or indefinite number of characteristically formed cuticular adhesive units " clamps " which are either located on a definite haptoral region or cotylophore or are disposed along the margins of the body proper. Animals always hermaphroditic, though the male and female systems may not mature simultaneously. Ovary nearly always pretesticular. Genital pore usually opening into a common sinus. Uterus usually short. Genito-intestinal canal present or absent. Vagina may be absent. Vitellaria

nearly always composed of minute follicles, co-extensive with intestinal crura, occurring above and below them and between their branches, usually not extending across the median region, which is occupied by the reproductive system. Excretory system double, opening dorsally by two symmetrically placed pores, at or near the level of the genital aperture. Eggs comparatively few and relatively large, frequently with polar prolongations. The life-cycle is direct, *i.e.*, the whole of life-cycle is on one host, there being incomplete metamorphosis and alternation of generations rare, present only in some *Polystoma* spp. Parasites usually of cold-blooded aquatic vertebrates or of crustaceans, semi-parasitic on them ; very rarely on cephalopods or mammals.

Odhner (1912) proposed a division of the Order Monogenea into two Suborders, (1) Monopisthocotylea and (2) Polyopisthocotylea on the basis of the absence or presence of a genitointestinal canal, *i.e.*, the tubular connection between oviduct and right (rarely left) caecum. But Fuhrmann (1928) proposed a tripartite division of the Order, (1) Monopisthodiscinea Fuhrmann, (2) Monopisthocotylinea Odhner, (3) Polyopisthocotylinea Odhner, two of the groups thus formed representing subdivisions of Odhner's Monopisthocotylea. Price (1937) thinks that there is little taxonomic advantage in this scheme and Odhner's scheme has been generally followed by later workers.

TAXONOMY AND PHYLOGENY OF MONOGENEA.

It is true, as pointed out by Dawes (1947) that a complete classification of the Subclass Monogenea has not yet been accomplished in a modern sense, although Price (1936-43) has made very substantial progress with a scheme of his own, now accepted by almost all, excepting with a few minor adjustments here and there. He has firmly established a number of superfamilies, families and lower taxonomic units. I also agree with Dawes, that it is doubtful if some of the superfamilies have any phylogenetic significance, but they are serviceable units in diagnosis and taxonomy. I (Chauhan, 1953*d*) met with the same situation in the Subclass Digenea also, while revising a group recently. I find that as far as the classification of the class Trematoda into three Subclasses, *viz.*, Monogenea, Aspidogastrea and Digenea is concerned, probably there is some phylogenetic basis, but when one comes to the further sub-division of the Subclass Digenea, into two Orders, Gasterostomata and Prosostomata, one finds that it is probably more in a way a convenient taxonomic arrangement than phylogenetic. Recently, my studies of the family Haplosplanchnidae led me to propose further sub-division of the Order Prosostomata into two new Suborders, *viz.* *Preprosostomata* and *Prosostomatida*. The Class Trematoda is obviously a group of polyphylogenic origin and it appears to me that the Gasterostomes have developed from their pre-trematode, parasitic, rhabdocoelidan Turbellarian stock, probably common or closely allied to that of ancestors of other groups of Platyhelminthes also, through a line of evolution of their own, separately or probably running parallel in the tree of evolution upto a certain stage, along with other Prosostomes ; probably under similar, ecological and environmental conditions of living and food habits. There appears to be more phylogenetic affinity in the

taxonomic units : Turbellaria, Temnocephala, Monogenea, Aspidogastrea, Digenea, Preprosostomata, Prosostomatida, etc.

As suggested by Dawes, perhaps before an ideal scheme can be propounded, we shall need to consider life-histories and growth cycles in greater detail. Probably more intensive and detailed studies will also have to be carried out of some archaic, transitory forms, representing some intermediate stages like, *Chimaericola* Brinkmann, 1942 ; *Diplozoon* Nordmann, 1832 ; *Protomicrocotyle* Johnston and Tiegs, 1922 ; *Bilateracotyle* Chauhan, 1945, etc. A closer study of relative growth rate may enable us better to assess variability in relative sizes of organs and parts within a species. We also seem to have been misled to a certain extent, while dealing with shapes and structures, like anchors or hooks, hooklets, sclerites, etc. Dawes thinks that these may be differences more indicative of the processes of growth than phylogenetic distinction. I may add that they could also represent, at least to some extent, different stages of secondary adaptation to meet similar conditions of living and food habits. Sproston (1946) has brought in another useful factor in consideration in the study of this group, *i.e.* larval characters, but as Dawes put it, in lieu of information concerning the growing trematodes, we have to depend more on the characters of the adult, which have been put to good use by Price.

Another group of special interest in the study of phylogeny of the Subclass Monogenea is the family *Discocotylidae*. The position about this has been summarised by Sproston (1946). She states that among the vere numerous modifications of structure and habit found in Discocotylida are the several separate appearances of asymmetry, which may be a sign of the phylogenetic plasticity of these forms. The asymmetry in *Anthocotyle*, for instance, is highly irregular. Some individuals have the larger anterior clamp on one side of the body and some, from the same batch of fish, may have it on the other ; while in others the anterior pair of clamps may be nearly equal in size. The family is clearly polyphylectic and represents only a tentative grouping for convenience of those genera which are probably nearest to the evolutionary stem of the superfamily though they are probably not the most primitive members. From the point of view of clamp structure, the most primitive members are thought to be represented by the Mazocraeidae and on a divergent line, the Chimericolidae—the Choricotylinae and Hexostomatidae representing the ends of two different lines of evolution.

The two Orders of the Subclass Monogenea are differentiated by the following key :—

Key to Orders of Subclass Monogenea.

Anterior end with gland-organs ; mouth without oral sucker ; paired suckers within mouth always absent ; accessory suckers outside mouth may be present ; haptor a single unit : a well developed postero-ventral disc, sometimes sucker like, with or without radial septa partitioning it into loculi, armed with 1—3 pairs of large hooks or anchors and 12—16 marginal hooklets ; genito-intestinal canal usually absent	*Monopisthocotylea.*

Anterior end nearly always devoid of adhesive gland-organs; mouth surrounded by an oral sucker or with a pair of "suckers" within mouth; haptor consisting of several units; a number of suckerlets or clamps borne on a disc-like process or on the ventral surface; Genito-intestinal canal present .. .. .. *Polyopisthocotylea.*

1. ORDER *MONOPISTHOCOTYLEA* ODHNER, 1919.

Syns. *Monocotylea* Blainville, 1828.
Tricotylea Diesing, 1850.
Calicotylea Diesing, 1850.
Tristomae Taschenberg, 1879.
Oligocotylea Monticelli, 1903.
Monopisthodiscinea Fuhrmann, 1928.
Monopisthocotylinea Fuhrmann, 1928.

The Order is defined as below :—

Diagnosis : *Monogenea;* with characters of the Subclass.

Anterior end without prohaptor or with a feeble oral sucker or a pair of anterior accessory suckers or two elongate anterolateral depressions receiving the ducts from numerous unicellular glands or frequently provided with one or more pairs of adhesive glands in the form of "head organs" receiving the ducts of the cephalic glands. Mouth not surrounded by an oral sucker. Paired cuticular suckers within mouth never present; accessory muscular suckers may be present outside mouth. Haptor a single unit; a well developed disc; sometimes sucker-like, with or without radial septa, dividing it into loculi on its ventral side but the septa never subdividing it into distinct sucker and clamps; armed generally with 1-3 pairs of large hooks or anchors, the hooks being often supported by transverse cuticular bars, and 12-16 marginal hooklets or poorly developed and leaf-like body, acting as a generalised sucker. Eyes and a vagina present or absent. Genitointestinal canal absent; except, possibly, in the Australian family, Protogyrodactylidae.

The Order contains three Superfamilies, Gyrodactyloidea Johnston and Tiegs, 1922; Capsaloidea Price, 1936; Acanthocotyloidea Sproston, 1946. Dawes (1946) does not appear to recognise the new superfamily of Sproston. Representatives of only two Superfamilies have been so far recorded from the Indian region. They can be differentiated by the following key :—

Key to Superfamilies of Order MONOPISTHOCOTYLEA.

Haptor armed with large hooks or anchors and with supporting transverse bars .. *Gyrodactyloidea.*

Haptor armed or unarmed; when armed, the large hooks or anchors lack supporting transverse bars .. *Capsaloidea.*

A. Superfamily *GYRODACTYLOIDEA* Johnston & Tiegs, 1922.

Syn. *Gyrodaclylides* Poche, 1926.

Superfamily diagnosis : *Monopisthocotylea* Odhner, 1912; with characters of the Order.

Prohaptor absent or represented by at least one pair of head or cephalic glands usually in two groups, one on either side of pharynx, their ducts opening into one or two pairs of head organs. Intestine simple, sac-like, or with two crura without or with short diverticula. Haptor discoidal or wedge-shaped, bearing one or two pairs of large hooks or anchors, almost always supported by 1-2 rarely 3 cuticular supporting transverse bars. Cirrus simple, cuticular, frequently with a complicated cuticular accessory apparatus. Vagina present or absent. Genital aperture median or sub-median. Genito or Vitello-intestinal canal rarely present. Oviparous or viviparous.

The Superfamily contains, at present, four families, *viz.* Gyrodactyidae Cobbold, 1864 ; 2. Protogyrodactylidae Johnston & Tiegs, 1922; 3. Dactylogyridae Bychowsky, 1933 and 4. Calceostomatidae Parona & Perugia, 1890. They can be differentiated by the following key :—

Key to Families of Superfamily GYRODACTYLOIDEA (after Sproston)

1. Viviparous	*Gyrodactylidae.*
Oviparous	2.
2. Vitellaria frond-like in palmate groups. Genito-intestinal canal present	*Protogyrodactylidae.*
Vitellaria not frond-like or in distinct groups. Genito-intestinal canal absent	3.
3. Anterior end expanded forming conspicuous head lappets	*Calceostomatidae.*
Anterior end not expanded to form head-lappets ..	*Dactylogyridae.*

The Superfamily is recorded to be represented so far in India by only one of these families, *viz. Dactylogyridae.*

Family DACTYLOGYRIDAE Bychowsky, 1933.

Syn. *Amphibdellidae* Carus, 1885.

The family is defined as :—

Family diagnosis : *Gyrodactyloidea* Johnston & Tiegs, 1922 with Superfamily characters.

Small, elongate worms. Anterior end with two or more pairs of head-organs ; head lappets absent ; cephalic glands lateral or distributed throughout the median preoral region. Haptor with or without accessory structures or squamodiscs ; with one or two pairs of anchors and usually 14 marginal hooklets. Ovary pretesticular, elongate, curved or globular. Vagina present or absent. Vitellaria well developed. Oviparous. Parasites of marine and freshwater fishes.

Type genus—*Dactylogyrus* Diesing, 1850.

The family contains at present four subfamilies. They are distinguished by the number of anchors and presence or absence of squamodiscs, as in the following key :—

Key to Subfamilies of Family DACTYLOGYRIDAE—

1. Haptor with one pair of anchors ..	2.
Haptor with two pairs of anchors	3.

2. Haptor with circle of heavily cuticularised tubular structures	*Bothitrematinae.*
Haptor without these subsidiary structures	*Dactylogyrinae.*
3. Haptor with a pair of accessory plaques (dorsal and ventral squamodiscs)	*Diplectaninae.*
Haptor without squamodiscs ..	*Tetraonchinae.*

Representatives of three subfamilies, *viz.* Dactylogyrinae, Diplectaninae and Tetraonchinae have been so far recorded from India.

(*a*) Subfamily *Dactylogyrinae* Bychowsky, 1933.

This monotypic subfamily was created by Bychowsky in 1933, for the genus *Dactylogyrus* Diesing. The other genera included under it are *Dogielius* Bychowsky, 1933; *Neodactylogyrus* Price, 1938 and *Paradactylogyrus* Thapar, 1948. The subfamily is defined below :—

Subfamily diagnosis : *Dactylogyridae* Bychowsky, 1933 ; with Family characters.

Haptor well developed, without accessory cuticular structures or squamodiscs and with one pair of anchors, supported by one or two cuticular transverse bars ; marginal hooklets 14 pairs. Eyes present. Intestine bifurcate and the crura confluent posteriorly. Ovary pretesticular. Testes and ovary spherical. Vagina present, with or without supporting structures.

Type genus—*Dactylogyrus* Diesing, 1850.

Price (1938) raised the two groups of species of the genus *Dactylogyrus* Diesing, 1850 to independent generic rank. He retained the forms having a single haptoral bar in the genus *Dactylogyrus* and the forms with two haptoral bars were assigned to his new genus, *Neodactylogyrus* Price, 1938.

Thapar (1948) added another genus to the family. He did not assign it to any subfamily. Chauhan (1953), however, allotted it to this subfamily.

The subfamily is recorded to be represented in India so far by two genera, *Dactylogyrus* and *Paradactylogyrus*. These genera can be differentiated as follows :—

Key to Indian Genera of Subfamily Dactylogyrinae.

Haptor without any median " onchium " ..	*Dactylogyrus.*
A single median " *onchium* " present on haptor	*Paradactylogyrus.*

(i) Genus **Dactylogyrus** (Diesing, 1850) *emend.* Price, 1938.

Generic diagnosis : *Dactylogyrinae* Bychowsky, 1933 ; with Subfamily characters.

Head organs two pairs. Eyes present. Haptor disclike, without any accessory structures like squamodiscs but with one pair of anchors, a single clamp-like supporting transverse bar and 14 marginal hooklets. Ovary pretesticular. Copulatory apparatus complicated. Vagina sometimes with cuticular supporting structures.

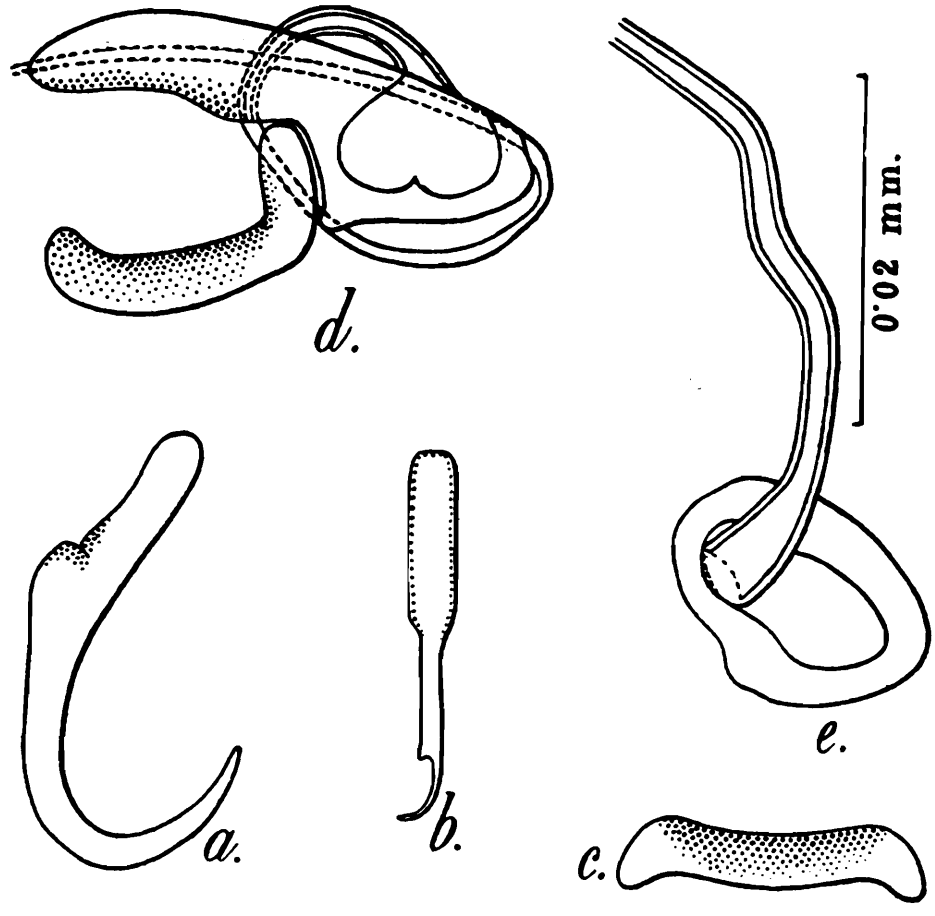
Type species—*Dactylogyrus auriculatus* (Nordmann, 1832) Diesing, 1850.

1. **Dactylogyrus moorthyi** Price, 1938.

(Text-fig. 1, *a*, *b*, *c*, *d*, *e*.)

Specific diagnosis : *Dactylogyrus* Diesing, 1850 ; with Generic characters.

Body elongate, 165 to 266μ long by 37 to 75μ wide. Haptor 22 to 44μ wide, armed with 1 pair of large hooks (anchors) 18 to 30μ long and supported by a single ox-yoke shaped bar about 18μ long and with 14 marginal hooklets 15 to 18μ long. Eyes present. Oral aperture about 35 to 45μ from anterior end of body ; pharynx globular, 15 to 18μ in diameter ; remainder of digestive tract not observed. Genital aperture about 55 to 65μ from anterior end of body. Male copulatory apparatus consisting of a long slender cirrus describing a complete loop at its proximal end and an accessory piece consisting of 2 parts, one portion finger-shaped, about 28μ long, and a crescentic portion about 20μ long. Vagina



TEXT-FIG. 1.—*Dactylogyrus moorthyi*. (*a*) Large haptoral anchor (*b*) Marginal hooklet (*c*) Haptoral bar (*d*) Male copulatory apparatus (*e*) Vagina, (after Price).

present, opening on right side of body. Gonads and vitellaria not distinctive. Eggs not observed.

Hosts.—Freshwater fishes, *Puntius puckelli* and *P. ticto*.

Location.—Gills.

Distribution.—India (Chitaldurg District, Mysore State).

Specimens.—U. S. N. M. Helm. Coll. Nos. 41144 (type) and 41145 (paratypes).

This species differs from all other species of the genus *Dactylogyrus* in the morphology of the male copulatory apparatus and in the shape of the haptoral bar.

(ii) Genus **Paradactylogyrus** Thapar, 1948.

Generic diagnosis : *Dactylogyrinae* Bychowsky, 1953 ; with Subfamily characters.

Small monogenetic forms, bearing one pair of anchors and a single anchor bar on the haptor. Besides the usual fourteen haptoral hooklets it bears a single median " onchium " There is a pair of cephalic lobes bearing the openings of several cephalic glands. The intestinal caeca unite posteriorly in front of the haptor. There is a single ovary and a single postovarial testis. The vagina is cuticularised structure and the copulatory apparatus consists of a highly cuticularised cirrus, a cirrhal thread and a horse-shoe shaped accessory piece provided with a posterior shaft. There is a single egg in the uterus. Parasites of fresh water fishes.

Genotype—*Paradactylogyrus catlarius* Thapar, 1948.

2. **Paradactylogyrus catlarius** Thapar, 1948.
(Text-fig. 2, *a, b, c, d, e, f.*)

Specific diagnosis : *Paradactylogyrus* Thapar, 1948 with Generic characters.

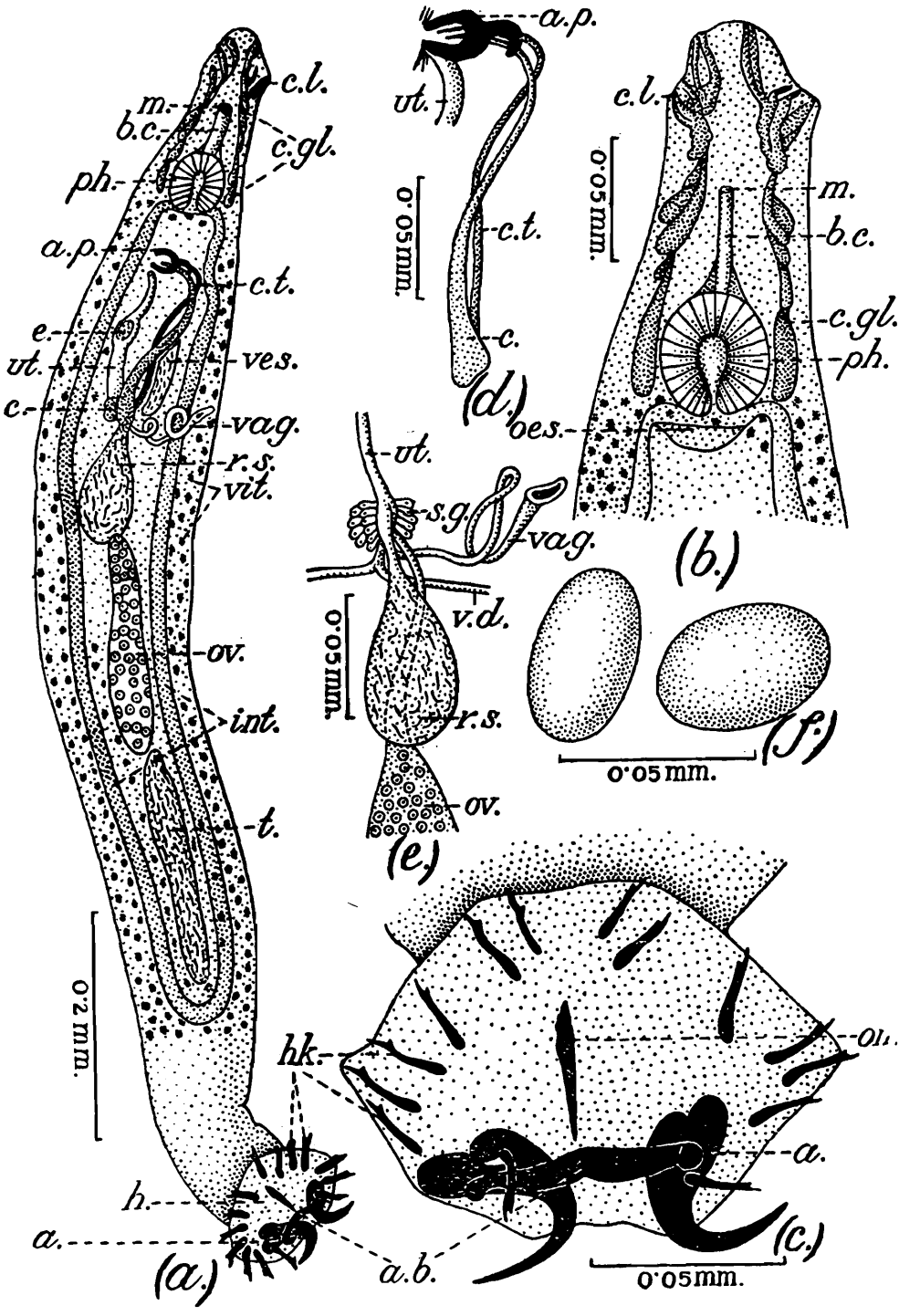
Body elongate, dorso-ventrally flattened ; length 0·75—1·01, width 0·095—0·15 (maximum). Anterior end with cephalic lobes. Integument smooth. Haptoral disc hexagonal, armed with two strong anchors, with bifid roots, and 14 small marginal hooks. Transverse cuticular bar hooked downwards at both the ends. An elongate, accessory cuticular piece " *onchium* " present in the centre of haptoral disc. Mouth ventral, subterminal. Buccal canal short. Pharynx globular, muscular. Oesophagus short, represented by a shallow outpocket behind pharynx. Intestinal caeca unite posteriorly before haptoral disc. Testis single, elongated, post-ovarial, in the posterior region of body. Vesicula seminalis pear shaped, large, dilated, near vaginal pore. Copulatory apparatus highly cuticularised consisting of an anterior horse-shoe shaped, clasper-like accessory piece, with a downwardly directed shaft, a cirrus and cirrhal thread. Cirrus very long, slender, tubular. Ovary single, elongated, sausage shaped, situated immediately behind middle, in front of testis. Receptaculum seminis large. Vagina a narrow, coiled, cuticularised duct on left side. Vitellaria numerous, small follicles, mainly extra-caecal. Uterine egg single, oval, 0·041—0·045×0·0295—0·031 (Type species).

Host.—Freshwater fish, *Catla catla.*
Location—Gills.
Locality—Lucknow.

(*b*) Subfamily—*Tetraonchinae* Monticelli, 1903 *emend* Price, 1937

Subfamily diagnosis : *Dactylogyridae* Bychowsky, 1933 ; with Family characters.

[1] All measurements in this paper are given in millimetres.



TEXT-FIG. 2.—*Paradactylogyrus catlarius* (*a*) Entire worm, ventral view (*b*) Anterior end, greatly enlarged (*c*) Haptor, ventral view (*d*) Copulatory apparatus (*e*) Ootype complex (*f*) Eggs. (after Thapar).

a., Anchor ; *a.b.*, Anchor bar ; *a.p.*, Accessory piece ; *b.c.*, Buccal canal ; *c.*, Cirrcus ; *c.gl.*, Cephalic glands ; *c.l.*, Cephalic lobes ; *c.t.*, Cirrhal thread ; *e.*, Egg ; *h.*, Haptor ; *hk.*, Hooklets ; *int.*, Intestinal caeca ; *m.*, Mouth ; *oes.*, Oesophagus ; *on.*, Onchium ; *ov.*, Ovary ; *ph.*, Pharynx ; *r.s.*, Receptaculum seminis ; *s.g.*, Shell gland ; *t.*, Testis ; *ut.*, Uterus ; *ves.*, Vesicula seminalis ; *vag.*, Vagina ; *vit.*, Vitellaria ; *v.d.*, Vetelline duct.

Body devoid of scales or spines. Eyes present or absent. Haptor without squamodiscs, but bears two pairs of anchors and 12—16 marginal hooklets. Intestine single or double. Testes usually without lobes. Ovary unlobed. Vagina present or absent.

Type genus—*Tetraonchus* Diesing, 1858.

Chauhan (1945) gave a key to 18 genera of the subfamily, considered valid. Sproston (1946) considered 20 genera under the subfamily as valid. She also gave a key to those genera, as follows :—

Key to Genera of Subfamily Tetraonchinae.

1. Haptor with 3 separate transverse bars	*Murraytrema* Price.
Haptor with 2 separate transverse bars ..	2.
Haptor with 2 articulated bars	3.
Haptor with 2 bars fused by their mid-regions ..	*Rhabdosynochus* Miz. & Blatz.
Haptor with one transverse bar	4.
Haptor without transverse bars	5.
2-A. Haptoral bars similar—	
Intestinal crura not confluent posteriorly ..	2*a*.
Intestinal crura confluent posteriorly ..	2*b*.
2a. Vagina absent ; eyes present	*Anchylodiscus* J. & T.
Vagina conspicuous on right	*Haliotrema* J. & T.
2b. Vagina on left margin ; accessory piece basally articulate with cirrus	*Cleidodiscus* Muell.
Vagina on right margin ; accessory piece never basally articulate with cirrus	*Urocleidus* Muell.
2-B. Haptoral bars dissimilar—	
Intestinal crura not confluent ; vagina on left side ..	*Ancyrocephalus* Crepl.
Intestinal crura confluent posteriorly—	
Vagina on left, in mid-lateral region	*Ancylodiscoides* Yam.
Vagina on right margin	*Tetrancistrum* Goto & Kikuc.
3. Haptoral bars similar—	
Anchor bases abnormally developed and occupying the whole of haptor area ; vagina on left	*Anchoradiscus* Miz.
Haptoral bars dissimilar	
Anchor bases normal ; vagina on left	*Anctinocleidus* Miz.
4-A. Haptoral bar butterfly-shaped, articulating directly with both pairs of anchors ; intestine unbranched and sac-like	*Tetraonchus* Dies.
B. Haptoral bar simple, articulating directly with only one pair of anchors ; intestine bifurcate. Intestinal crura not confluent ; 14 (? or 12) marginal hooks ..	4a.
Intestinal crura confluent ; 2 or 14 marginal hooks ..	4b.
4a. 3 pairs of head organs ; vagina present ; anchors similar ; 14 marginal hooks	*Amphibdelloides* Price.
1 pair of head organs ; vagina absent ; anchors dissimilar ; 14 marginal hooks	*Diplectanotrema* J. & T.
Numerous scattered head glands ; vagina absent ; anchors dissimilar ; ? 12 marginal hooks ..	*Linguadactyla* Brinkm.
4b. 2 marginal hooklets—	
4 pairs of head organs ; vagina absent	*Empleurosoma* J. & T.

2 pairs of head organs; conspicuous vagina on left margin	*Daitreosoma* J. & T.
14 marginal hooklets	
2 pairs of head organs; vagina in left mid-lateral region	*Parancyrocephaloides* Yam.
5. Intestinal crura not confluent; anchors similar; vagina in left lateral region	*Amphibdella* Chatin.
Intestinal crura confluent; anchors dissimilar; vagina in left mid-lateral region	*Ancyrocephaloides* Yam.

Genus **Ancyrocephalus** Creplin, 1839.

Generic diagnosis: *Tetraonchinae* Monticelli, 1903; with Subfamily characters.

Head organs generally 3 pairs bearing the opening of cephalic glands. Eyes present. Haptor distinctly set off from body proper. Anchors two pairs, supported by two dissimilar supporting bars. Marginal hooklets 14. Intestine bifurcate, crura not confluent posteriorly. Gonads situated near the middle of body or further back. Vagina present, opening on left side. Vitellaria usually extend into posterior third of body.

Type species—*Ancyrocephalus paradoxus* Creplin, 1839.

3. **Ancyrocephalus alatus** Chauhan, 1945.

(Text-fig. 3, *a*, *b*, *c*, *d*, *e*.)

Sproston, N. G. (1946). *Trans. zool. Soc. Lond.* **25**(4); 507

———————(1948). *Sinensia*. **19**(1—6); 77 & 79

Specific diagnosis: *Ancyrocephalus* Creplin, 1839; with Generic characters.

Body elongate, minute, 0·71—2·43×0·11—0·27. Haptor discoidal, with a dorsal and a ventral pair of anchors, each pair supported by a transverse bar. Marginal hooklets 12. Cephalic glands 7-9 on each side. Head organs three on each side. Eyes 2 pairs. Pharynx small, muscular, sub-spherical. Mouth terminal. Oesophagus very short. Intestinal caeca do not extend up to haptor, not united posteriorly. Testis single, post ovarian, elongate. Vesicula seminalis very elongate. Prostate gland well developed. Penis sac rounded with accessory elongate, cuticularised, tubular, hollow structure, pointed at its extremity, with a spiral ala and a cuticular, supporting bent rod. Ovary simple, pear shaped in the middle of body. Vagina simple. Shell gland small. Vitellaria small follicles.

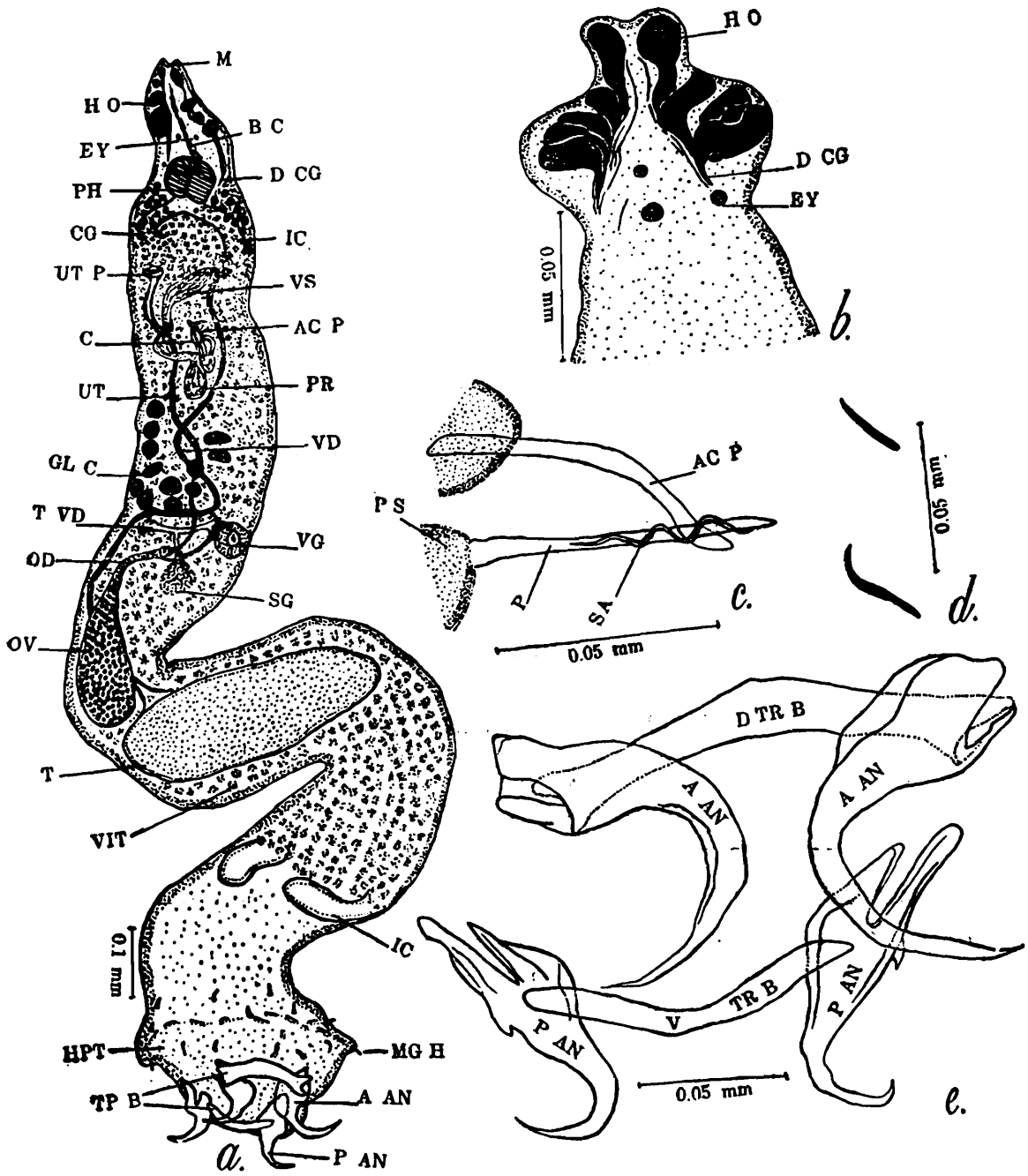
The species is characterised by the possession of three pairs of head organs, large anchors supported by cuticular transverse bars, only 12 marginal hooks; intestinal caeca not united posteriorly; two pairs of eyes and the vitellaria extending into the posterior region of body.

It differs from other species, in the general shape of body, the number of marginal hooklets, which is only 12, the structure of vesicula seminalis and penis, possessing a spiral ala and in the shape of the accessory piece.

Host.—*Muraenesox talabonoides*; *Arius fulcarius*; *Mugil parsia*; *Harpodon neherius*.

Location.—Gills.

Locality.—Bombay; Arabian Sea, Indian Ocean.



Test-fig. 3.—*Ancyrocephalus alatus* (*a*) Entire view (*b*) Anterior end, to show head organs and eyes (*c*) Dorsal and ventral pair of anchors with transverse bars (*d*) Two marginal hooklets (*e*) Penis with spiral ala, accessory piece and a portion of penis sac. (after Chauhan).

A AN., Anterior anchor; *AC P.*, Accessory piece of penis; *B C.*, Buccal cavity; *C.*, Cirrus; *CG.*, Cephalic glands; *D CG.*, Duct of cephalic glands; *D TR B.*, Dorsal transverse bar; *EY.*, Eye; *GL C.*, Gland cells; *H O.*, Head organs; *HPT.*, Haptor; *IC.*, Intestinal caecum; *M.*, Mouth; *MG H.*, Marginal hooklet; *OD.*, Oviduct; *OV.*, Ovary; *P AN.*, Posterior anchor; *PH.*, Pharynx; *PR.*, Prostate reservoir; *P.*, Penis; *PS.*, Penis sac; *SA.*, Spiral ala; *SG.*, Shell gland; *T.*, Testis; *TR B.*, Transverse bar; *T VD.*, Transverse vitelline duct; *UT.*, Uterus; *UT P.*, Uterine pore; *VD.* Vas deferens; *VG.*, Vagina; *VIT.*, Vitellaria; *VS.*, Vesicula seminalis; *V TR B.*, Ventral transverse bar.

(*c*) Subfamily Diplectaninae Monticelli, 1903.

Syn. *Lepidotreminae* Johnston & Tiegs, 1922.

Subfamily diagnosis: *Dactylogyridae* Bychowsky, 1933, with Family characters.

Body, especially posterior half (except in *Neodiplectanum*) covered with anteriorly directed scale-like spines. Cephalic glands present, opening to exterior through head organs. Eyes two pairs. Haptor

bearing paired squamodiscs, dorsal and ventral; sessile or sub-sessile; covered with concentric rows of scale-like spines or lamellae, with or without accessory hooks. Anchors two pairs, with 2, 3 or 5 supporting bars. 14 marginal hooklets probably always present. Intestine sac-like or crura without diverticula. Testis and ovary without lobes, cirrus simple or complex; vagina present.

Type genus—*Diplectanum* Diesing, 1858.

Key to Genera of Subfamily DIPLECTANINAE.

1.	Squamodiscs with concentric rows of paired lamellae and three haptoral bars	*Lamellodiscus* J. & T.
	Squamodiscs with concentric rows of scale-like spines or spine-like hooks and 2, 3 or 5 bars	2.
2.	Squamodiscs with spine-like hooks and 5 bars ..	*Lepidotrema* J. & T.
	Squamodiscs with scale-like spines and 2-3 bars ..	3.
3.	Intestine bifurcate	*Diplectanum* Dies.
	Intestine a single lobed sac	*Neodiplectanum* Miz. Blatz.

Sproston (1946) included the genus *Squamodiscus* Yamaguti, 1934 as a valid genus, in her key to the genera of the subfamily. I[1] regard it a synonym of the genus *Diplectanum* (Diesing).

Genus **Diplectanum** Diesing, 1858, *emend.* Price, 1937.

Syns. *Acleotrema* Johnston & Tiegs, 1922.
Lepidotes Johnston & Tiegs, 1922.
Squamodiscus Yamaguti, 1934.

The outstanding generic character is the squamodiscs, which are absent in *Ancyrocephalus*. Most authors regarded it as synonymous to the genus *Ancyrocephalus* but Price (1937) established its independent validity.

Generic diagnosis : *Diplectaninae* Monticelli, 1903 ; with Subfamily characters.

Squamodiscs consist of dorsal and ventral concentric rows of scale-like spines or rodlets, without groups of accessory spine-like hooks. Transverse haptoral cuticular bars three. Cirrus with ejaculatory bulb. Vagina present or absent.

Type species—*Diplectanum aequans* (Wagner, 1857), Diesing, 1858.

Syn. *Dactylogyrus aequans* Wagner, 1857.

4. **Diplectanum belengeri** (Chauhan, 1945) Chauhan, 1953.

(Text-fig. 4, *a*, *b*, *c*, *d*, *e*.)

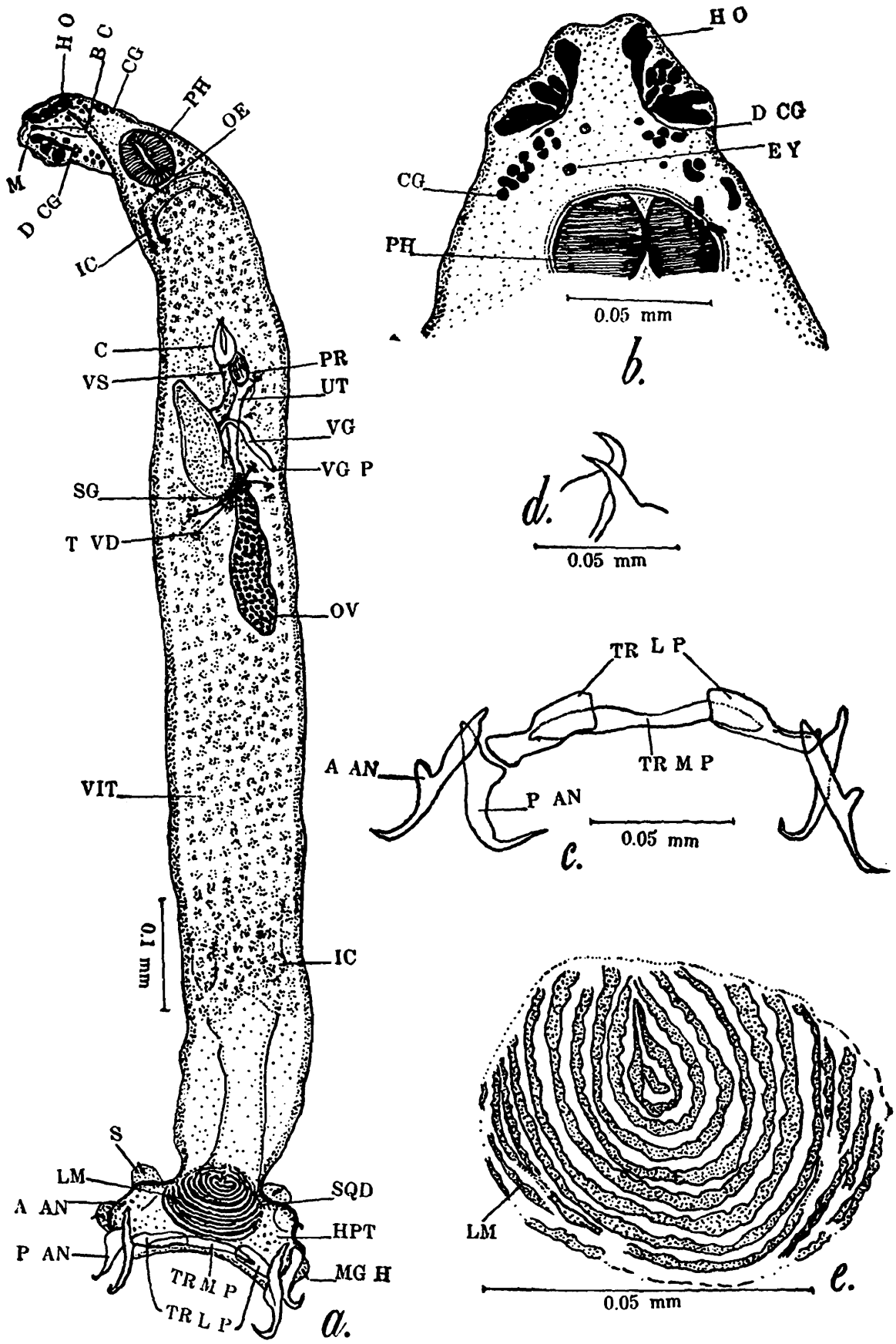
Syn. *Lamellodiscus belengeri* Chauhan, 1945.

Sproston, N. G. (1946). *Trans. zool. Soc.* Lond **25** (4) : 507.

Specific diagnosis : *Diplectanum* Diesing, 1858 ; with Generic characters.

Body elongate to oval, 0·52—1·17 × 0·11—0·225. Cephalic glands 8-9. Head organs 3 pairs. Eyes two pairs. Haptor distinct, with

[1]While this paper has been in the Press, Yamaguti (1953, p 227) himself thinks that the presence or absence of the ejaculatory bulb as well as the structure of the squamodisc in terms of hooks, rodlets or scales—distinguishing characters between the genera *Squamodiscus* and *Dipleccanum*—are of no generic importance.



Text-fig. 4.—*Diplectanum belengeri* (*a*) Entire view (*b*) Anterior end, to show head organs ; cephalic glands, their ducts and eyes (*c*) Dorsal and ventral pairs of anchors with transverse bars (*d*) Penis hooks (*e*) Squamodisc, showing concentric lamellae. (after Chauhan).

A AN., Anterior anchor ; *B C.*, Buccal cavity ; C., Cirrus ; *CG.*, Cephalic glands ; *D CG.*, Duct of cephalic glands ; *EY.*, Eye ; *H O.*, Head organs ; *HPT.*, Haptor ; *IC.*, Intestinal caecum ; *LM.*, Lamellae ; *M.*, Mouth ; *MG H.*, Marginal hooklet ; *OE.*, Oesophagus ; *OV.*, Ovary ; *P AN.*, Posterior anchor ; *PH.*, Pharynx ; *PR.*, Prostate reservoir ; S., Outgrowth on haptor ; *SG.*, Shell gland ; *SQD.*, Squamodisc ; *T VD.*, Transverse vitelline duct ; *UT.*, Uterus ; *VG.*, Vagina ; *VIT.*, Vitellaria ; *TR LP.*, Lateral piece of transverse bar ; *TR MP.*, Median piece of transverse bar ; *VG P.*, Vaginal pore. *VS.*, Vesicula seminalis.

2 pairs of anchors, one dorsal and one ventral, curved distally. Transverse cuticular bar, composite, made of three pieces. Haptor carries three pairs of foliate, round, cutaneous outgrowths, each pair bearing a marginal hook. Squamodisc consisting of concentric rows of continuous, 5-16 lamellae. Mouth terminal or sub-terminal, mid ventral. Buccal cavity small. Pharynx muscular. Oesophagus practically absent. Intestinal crura not uniting posteriorly. Gonads situated in the posterior part of anterior half. Testis single, elongate, oval. Vesicula seminalis short. Penis enclosed in a sac, simple with two hook-like structures. Ovary elongate, oval, in the middle of body. Vagina median. Shell gland small. Vitellaria small follicles.

The species is characterised by the possession of the peculiar six outgrowths on the haptor, number of marginal hooks being only six ; the peculiar but simple structure of penis, with two simple hooks, vagina being without cuticular development and the lamellae of the squamodisc being continuous.

Hosts.—Sciaena belengeri ; Sciaena carulta ; Muraenesox talabonoides.

Location.—Gills.

Locality.—Bombay, Indian Ocean.

B. Superfamily CAPSALOIDEA Price, 1936.

Superfamily diagnosis: *Monopisthocotylea* Odhner, 1912 ; with the characters of the Order.

Prohaptors absent or if present, a weakly developed oral sucker or a pseudo-sucker or two lateral suckers or glandular grooves. Heaa organs sometimes present. Intestine sac-like or if bifurcated, crura generally with median and lateral diverticula. Haptor armed or unarmed, discoidal, muscular, generally comparatively large ; usually divided ventrally by septa into sucker-like depressions or loculi, without anchors or with anchors, always without any cuticular, supporting transverse bar. Testis one or more. Cirrus without accessory structures, sometimes circular. Genital pore median or lateral. Vagina present or absent. Oviparous.

Type family—*Capsalidae* Baird, 1853.

Sproston (1946) in her key to families of the Superfamily included only four families under the Superfamily, *viz. Udonellidae* Taschenberg, 1879 ; *Microbothridae* Price, 1936 ; *Monocotylidae* Taschenberg, 1879 and *Capsalidae* Baird, 1853. She placed the family *Acanthocotylidas* Price, 1936 separately under a new Superfamily *Acanthocotyloidea* created by her for the purpose. Brinkmann (1952) seems to accept t. Dawes (1946 ; 1947), however, includes it under the Superfamily *Capsaloidea*.

These five families can be differentiated as follows :—

Key to Families of Superfamily Capsaloidea.

1.	Prohaptor a pair of anterior suckers or glandular depressions	2.
	Prohaptor not a pair of anterior suckers or glandular depressions	4.
2.	Intestine simple and sac-like ..	*Udonellidae.*
	Intestine bifurcate	3.
3.	Genital pores nearly together	*Capsalidae.*
	Genital pores not nearly together	*Acanthocotylidae.*
4.	Haptor armed with hooks	*Monocotylidae.*
	Haptor not armed with hooks ..	*Microbothriidae.*

Representatives of only two families out of these, *viz. Monocotylidae* and *Capsalidae* have been recorded, so far from, the Indian region.

(*a*) Family Monocotylidae Taschenberg, 1879.

Family diagnosis: *Capsaloidea* Price, 1936; with characters of the Superfamily.

Oval or elliptical, flattened forms. Eyes present or absent. Prohaptor, if present, an oral sucker or several pre-oral suckers or head organs. Cephalic glands present. Mouth ventral not quite terminal. Pharynx large. Oesophagus short or absent. Intestine bifurcated; crura long and simple, without lateral diverticula along the crura; crura sometimes united posteriorly. Haptor discoidal, generally divided ventrally by septa into depressed sucker-like loculi, armed usually with one pair of anchors (absent in *Empruthotrema*); marginal hooklets usually 14. Testes generally one, rarely 3 or more. Cirrus heavily cuticularised (except in *Dionchus*). Ovary curved, often embracing right intestinal crus. Vagina single or paired. Genital pores, usually near together, in median region.

Type genus *Monocotyle* Taschenberg, 1878.

Price (1938) differentiated the Subfamilies, included under the Family as follows :—

Key to Subfamilies of Family Monocotylidae.

1.	Haptor without septa	*Loimoinae.*
	Haptor with septa	2.
2.	Vagina absent	*Dionchinae.*
	Vagina present . ..	3.
3.	Vagina single .. , ...	*Monocotylinae.*
	Vagina double ..	4.
4.	With oral sucker	*Calicotylinae.*
	Without oral sucker ..	*Merizocotylinae.*

The family is so far recorded to be represented in the Indian region by a single subfamily.

Subfamily—*Loimoinae* Price, 1936.

Price (1936) separated the subfamily from other Monocotylidae on account of the character of a separate haptor and removed it from the family Udonellidae, where it was placed by Fuhrmann (1928), owing to armoured haptor and cuticularised cirrus. Manter (1944) re-examined type material of MacCallum (1917) and discovered in it a vagina, several testes, a bipartite pharynx and also that the dorsal cuticular ridges

on the haptor are file-like. He therefore transferred *Tricotyle scoliodoni* Manter (1938) from the family Calceostomatidae Parona & Perugia. (1890) to the genus, *Loimos* under the subfamily Loimoinae (Price, 1936) family Monocotylidae. The subfamily is defined as follows :—

Subfamily diagnosis : *Monocotylidae* Taschenberg, 1879 ; with Family characters.

Prohaptor as 1-3 pre-oral suckers. Testis single, in anterior half of body. Cirrus long, cuticularised. Vagina present. Genital pore median or submedian. Hoptor discoidal, aseptate but with a pair of relatively small anchors and a number of marginal hooklets, usually with a pair of dorsal ridges.

Type genus—*Loimos* MacCallum, 1917.

The subfamily contains, at present, two genera ; *Loimos* MacCallum, 1917 and *Loimosina* Manter, 1944. They can be differentiated as follows :—

Key to Genera of Subfamily LOIMOINAE Price, 1936.

Pre-oral suckers 1 or 2 pairs ; cirrus well developed. Testes several, tandem ; dorsal haptoral ridges well developed ..	*Loimos.*
Oral suckers 3 pairs ; cirrus rudimentary ; Testes single, deeply lobed ; posterior cuticular ridges on haptor inconspicuous or absent	*Loimosina.*

The subfamily is recorded so far, to be represented in the Indian region by a species of the genus *Loimos* only.

Genus **Loimos** MacCallum, 1917 *emend.* Manter, 1944.

Generic diagnosis : *Loimoinae* Price, 1936 ; with Subfamily characters.

Pre-oral suckers one or two pair, cirrus well developed. Testes several, tandem. Dorsal haptoral ridges well developed.

Type species—*Loimos salpinggoides* MacCallum, 1917.

5. Loimos secundus (Chauhan & Bhalerao, 1945) Chauhan and Bhalerao, 1945.

(Text-fig, 5, *a*, *b*. *c*.)

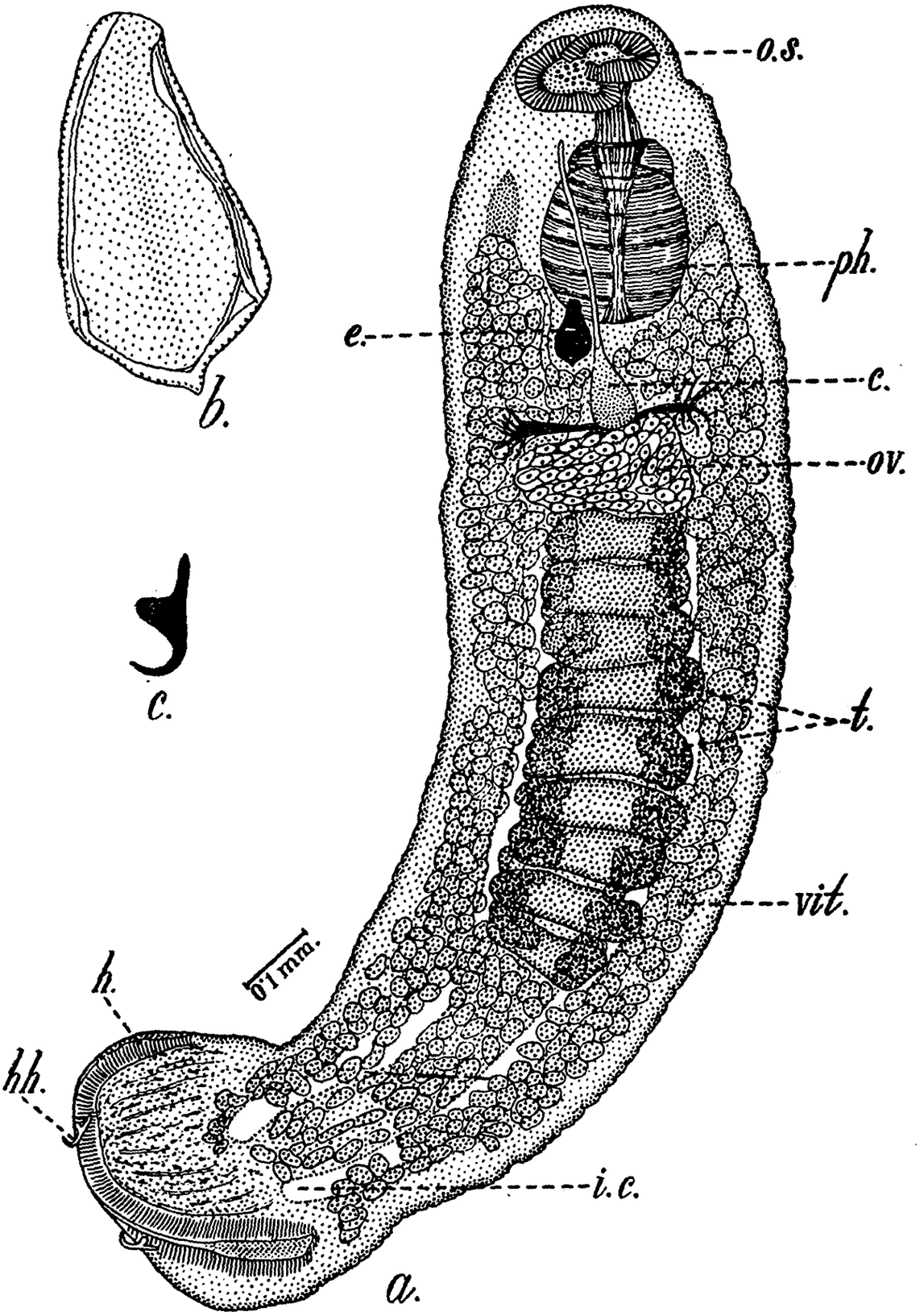
Syn. *Tricotyle secundus* Chauhan & Bhalerao, 1945.

Sproston, N. G. (1946). *Proc. zool. Soc. Lond.* **25** (4) : 508

Specific diagnosis : *Loimos* MacCallum, 1917 ; with Generic characters.

Body flat, elongate, tapering anteriorly, broadest in the middle, with a spatula-shaped posterior haptor, distinctly set off from body. Length 1·61-1·63×0·38-0·48. Head lobe constricted. Mouth subterminal, guarded by two inconspicuous sucker-like structures. Prepharynx present. Pharynx large, elongate, oval, higly muscular, with characteristic muscle bands. Intestinal crura simple, unbranched, not continuous. Haptor disc-like, without septa, bi-partite, with dorsal and ventral sucker-like semi-circular, convex, muscular, ribbed borders. It has a large, widely separated pair of hooks, with heavy, small, truncated roots. Ovary large, much branched, pre-testicular with numerous sinuous tubes, in the anterior third of body. Uterus with single conical egg, with highly cuticularised shell. Vitellaria spherical or elongate, small follicles. Vagina thick walled muscular Testes large, post-ovarian ; 9-10, median, tandem, intercrural transversely elliptical, somewhat lobed. Cirrus sac median, small, flask-shaped;

anterior end cuticularised and with a long, slender tube. Genital pore on right side, in the region of prepharynx.



Text-fig. 5.—*Loimos secundus*; (*a*) Ventral view; (*b*) Egg; (*c*) Haptoral hook. (after Chauhan and Bhalerao).

C., Cirrus; *E.*, Egg; *h.*, Haptor; hh., Haptoral hook; *IC.*, Intestinal caecum; *O.S.*, Oral sucker; *OV.*, Ovary; ph., Pharynx; t., Testes; vit., Vitellaria.

The species is characterised by the possession of a pair of anterior suckers; well developed cirrus, with a long, cuticularised tube; 9-10.

testes ; much branched ovary ; haptor with two sucker-like borders and a pair of anchors.

The genus *Loimos* contains three species, *L. salpinggoides* MacCallum, 1917 ; *L. scoliodoni* (Manter, 1938) Manter, 1944 and *L. secundus* (Chauhan & Bhalerao, 1945) Chauhan and Bhalerao, 1945. The last species resembles *L. salpinggoides* in the possession of nine testes and probably in the shape of egg and cirrus tube, but differs from it in having a single pair of anterior suckers, absence of marginal hooklets on the haptor, the position of genital pore, the egg and in the relative position of the terminal portions of genitalia. It resembles *L. scoliodoni* in the number of anterior suckers, but differs from it in the structure of vagina, more anterior position of the genital pore, a longer cirrus-tube, absence of marginal hooklets on the haptor and in the lack of three well marked anterior lobes. The number of testes is also different, being 9-10, whereas in *L. scoliodoni* they are only five.

Taxonomic Position.

Chauhan & Bhalerao (1945) suggested the transfer of the subfamily Loimoinae from the family Monocotylidae to the family Microbothriidae, on the grounds that members of the subfamily Loimoinae differ from Monocotylids, in the total absence of septa from the haptorial disc, number of testes and in the form of ovary and anterior haptors. They more nearly resemble Microbothrids, in the anterior haptor consisting of suckers, the structure of buccal cavity and oesophagus, and in the posterior haptor being non-separate.

Sproston (1946) does not agree with this view.

Host.—Indian dog-fish, *Scoliodon sorrakowah.*

Location.—Gills.

Locality.—Rangoon, Burma.

(*b*) Family CAPSALIDAE Baird, 1853.

Syns. *Phyllinidae* Johnston, 1846.
Tristomidae Cobbold, 1877.
Encotyllabidae Monticelli, 1888.
Tristomatidae Gamble, 1896.

Family diagnosis : *Capsaloidea* Price, 1936 ; with the characters of Superfamily.

Body elliptical, oval or cordate ; flattened dorso-ventrally. Cuticle smooth or papillate or sometimes with spines along the cuticular, lateral margins and on the dorsal surface. Anterior region forming a pre-oral cephalic lobe and adhesive apparatus, subterminal or ventral, on this lobe ; consisting of a pair of suckers or glandular areas or both. Sense organs present as two pairs of papillae on cephalic lobe. Eyes two pairs. Mouth or oral aperture ventral, never surrounded by an oral sucker. Pharynx always well developed. Intestinal caeca generally with median and lateral, more or less branched diverticula. Haptor well developed, muscular, discoidal, sessile or pedunculated (in *Encotyllabinae*). Sometimes partitioned by septa to form loculi. Anchors 1 to 3 pairs. Marginal hooklets 14, probably always present. Testes two or numerous. Ovary median, pretesticular. Vagina present, single or absent. Male and

female genital pores open separately, close together, at level of pharynx or in a common genital atrium, situated laterally. Excretory pore dorso-lateral at or near level of pharynx.

Type genus—*Capsala* Bosc, 1811.

Sproston (1946) gave a modified key to Subfamilies of the Family after Price (1939) as follows :—

Key to Subfamilies of Family CAPSALIDAE.

1.	Haptor on a muscular peduncle, aseptate	*Encotyllabinae.*
	Haptor sessile, or nearly so ; septate or aseptate ..	2.
2.	Haptor septate	3.
	Haptor aseptate	4.
3.	Two testes	*Trochopodinae.*
	Numerous testes	*Capsalinae.*
4.	Two testes	*Benedeniinae.*
	Numerous testes	*Nitzschiinae.*

Species of *Capsalinae* and *Benedeniinae* only have so far been recorded from the Indian region.

(i) Subfamily *CAPSALINAE* Johnston, 1929 ; *emend.* Price, 1939.

Syns. *Tristominae* Braun, 1893.
Tristomatinae Gamble, 1896.

Subfamily diognosis : *Capsalidae* Baird, 1853 ; with Family characters.

Cephalic lobe with a pair of suckers, of about the size of pharynx, on either side. Testes very numerous. Ovary lobed. Haptor sessile, divided by septa into a central polygonal and seven subtriangular areas. Anchors generally present, spine-like. Marginal hooklets 14.

Type genus-*Capsala* Bosc, 1811.

Price (1939) differentiated the various genera included under the family by a key as follows :—

Key to Genera of Subfamily CAPSALINAE.

1.	Pharynx with a constriction ; testes usually, if not always, extending laterally to intestinal crura .	*Capsala.*
	Pharynx without a constriction ; testes confined to the area between intestinal crura	2.
2.	Posterior rays of haptor bifid distally ; anchors clawed ; dorsal marginal spines crown-shaped, in a single longitudinal row	*Capsaloides.*
	Posterior rays of haptor not bifid distally ; anchors without clawed tips ; dorsal marginal spines, when present, not crown-shaped and in numerous short rows	*Tristoma.*

Genus **Capsala** Bosc, 1811 ; *emend.* Price, 1939.

Syns. *Tricotyle* Guiart, 1938.
Tristomella Guiart, 1938.

Generic diagnosis : *Capsalinae* Johnston, 1929 ; with Subfamily characters.

Posterior rays of haptor not bifid. Anchors, when present simple, without claw-like tips. Dorsal marginal spines present or absent. Pharynx with a transverse constriction at or slightly posterior to middle. Testes numerous, usually if not always, extending laterally to intestinal crura.

Type species—*Capsala martinieri* Bosc, 1811.

Chauhan (1952) while describing a new species, *C. gouri* gave a list of species considered valid under the genus. Out of those 21, four have been recorded from the Indian region.

6. **Capsala laevis** (Verrill, 1875) ; Johnston, 1929 ; Price, 1938.

(Text-fig. 6, *a. b*).

Syns. *Tristoma laeve* Verrill, 1875.

Tristoma histiophori Bell, 1891.

Tristoma laeve var. *armata* Goto, 1899.

Bell, F. J. (1891). *Ann. Mag. nat. Hist.* (6) 6 : 534-545.

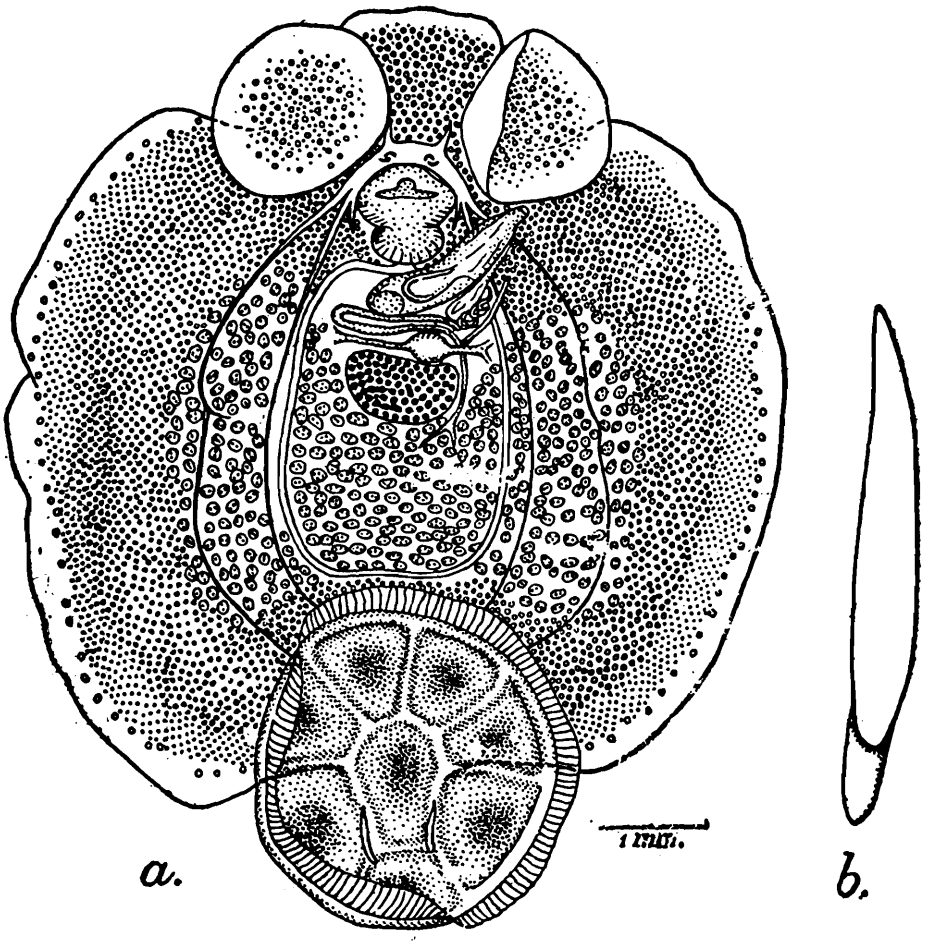
Goto, S. (1894). *J. Coll. Sci. Tokyo.* 8 : 1-273.

—— (1899). *J. Coll. Sci. Tokyo.* 12 : 263-295.

Price, E. W. (1939). *J. Wash. Acad. Sci.* 29 (2) : 79.

Sproston, N. G. (1946). *Trans. zool. Soc. Lond.* 25 (4) : 299.

Chauhan, B. S. (1952). *Rec. Indian Mus.* 49 (1) : 45-54.



TEXT-FIG. 6.—*Capsala laevis ;* (*a*) Entire worm ; (*b*) Haptoral hook (after Price).

Bell (1891) records that his species bears close resemblance to and is clearly allied to but is quite distinct from *Tristomum coccineum*. It is stated to be distinguished from it by the absence of parallel rows of body spines and by the fact that the posterior sucker projects by about one third of its diameter beyond the margin of body.

He gave the measurements of his specimens as follows :—

Breadth 12 mm., length (including suckers) 15 mm.

Breadth 11·5 mm., length (including suckers) 14 mm.

Breadth 10·0 mm., length (including suckers) 10·5 mm.

Chauhan (1952) has fully discussed the present systematic position of the species.

Host.—*Histiophorus* (sic) *brevirostris*—collections of Dr. Francis Day

Locality.—Madras, India.

7. **Capsala megacotyle** (v. Linstow, 1906) Johnston, 1929; *emend.* Price, 1938.

(Text-fig. 7, *a*, *b*).

Syns. *Tristoma megacotyle* von Linstow, 1906.

Capsala megacephala Johnston, 1929—a *lapsus* for *megacotyle*.

Tristomella megacotyle Guiart, 1938.

Linstow, O. F. B. von (1906). *Spolia zeylan.* **2**: 163-188.

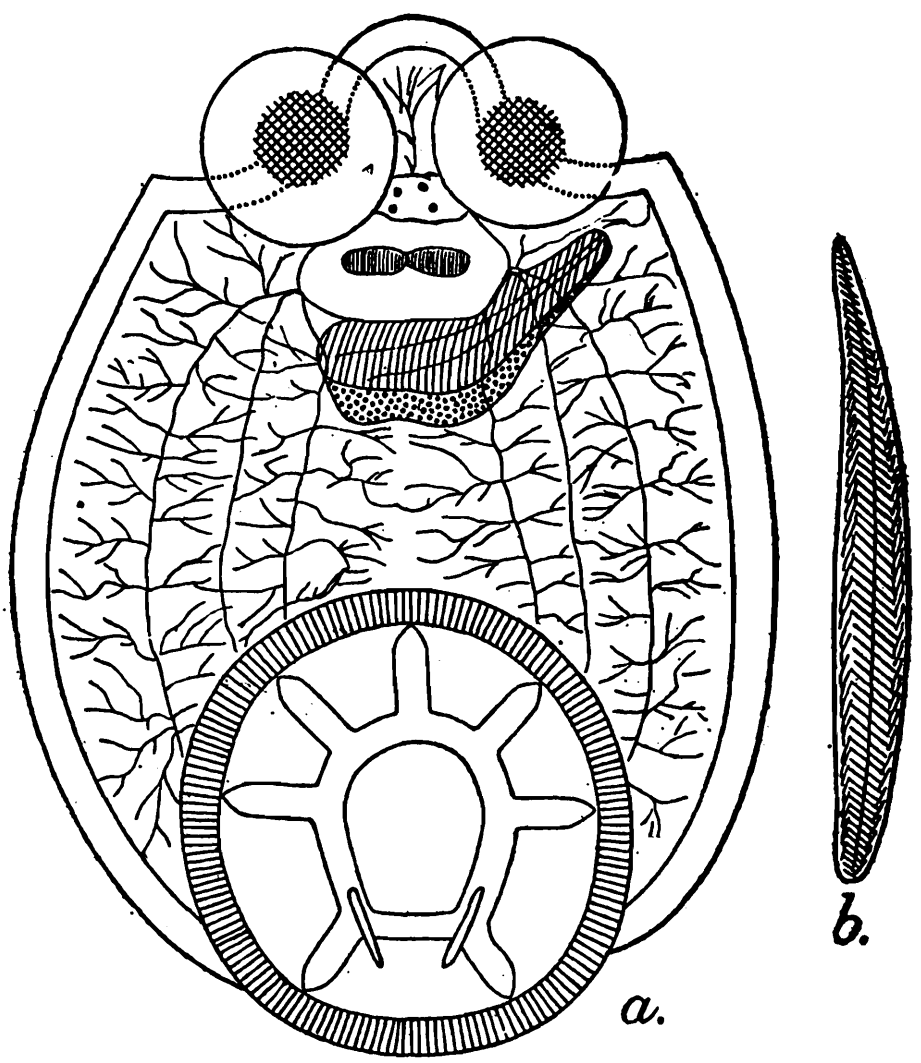
Johnston, T. H. (1929). *Trans. roy. Soc. S. Aust.* **53**: 71-78.

Guiart, J. (1938). Trematodes parasites provenant des campagnes scientifiques de S. A. S. le Prince Albert de Monaco (1886-1921) (Monogenea): 1-16.

Price, E. W. (1938). *J. Wash. Acad. Sci.* **29** (2): 79.

Sproston, N. G. (1946). *Trans. zool. Soc. Lond.* **25** (4): 300.

Chauhan, B. S. (1952). *Rec. Indian Mus.* **49** (1): 45-54.



Text-fig. 7.—*Capsala megacotyle*; (*a*) Entire worm; (*b*) Haptoral hook (after Linstow).

Linstow (1906) records the following specification of his species:—

"Length 7·5; breadth 6·0; ventral cuticle except on the sucker ann head thickly beset with circular papillae, measuring 0·31. The two

anterior suckers are equal to 1/5 of body length ; the caudal sucker has a diameter equal to ½ the body length and shows seven radial ribs, which abut upon a central roundish area produced backwards ; the sucker is bound at the periphery by a striated border ; in the posterior region of the sucker there are two straight undivided rods attenuated at the ends, 0·48 long ; these rods are always described as hooks in the definition of the genus *Tristomum*".

Chauhan (1952) has discussed its latest systematic position.

Host.—Sword fish, *Histiophorus* sp.

Location.—Body surface.

Locality.—Beruwala, Ceylon.

8. **Capsala ovalis** (Goto, 1894) Price, 1938 ; *emend.* Sproston, 1946.

(Text-fig. 8, *a*, *b*, *c*.)

Syns. *Tristomum ovale* Goto, 1894.

Tristomum ovale Setti, 1899.

Tristomum laeve var *inermis* Goto, 1899.

Capsala ovale Price, 1938.

Linstow, O. F. B. von (1906). *Spolia zeylan.* **3** : 163-188.

Johnston, T. H. (1929). *Trans. roy. Soc. S. Aust.* **53** : 71-78.

Guiart, J. (1938). Trematode Parasites Provenant des compagnes scientifiques S. A. S. le Prince albert de Monaco (1886-1921) (Monogenea) : 1-16.

Price, E. W. (1938). *J. Wash. Acad. Sci.* **29** (2) : 79.

Sproston, N. G. (1946). *Trans. zool. Soc. Lond.* **25** (4) : 300.

Chauhan, B. S. (1952). *Rec. Indian Mus.* **49** (1) : 45-54.

Linstow (1906), while describing his new species, *Tristomum megacotyle*, since regarded as *Capsala megacotyle*, stated that " a similar, though much larger species, also living upon *Histiophorus*, is *Tristomum laeve* Verrill=*T ovale* Goto ; the length of this species amounts to 13 mm. and its breadth 12 mm. ; the diameter of the anterior suckers equal to 1/7 of the body length ; the rays of the caudal sucker are narrow, its margin unstriated and the rods are expanded and irregularly laciniate at the roots. (Cf. S. Goto 1894 : Studies on the Ectoparasitic Trematodes of Japan. *J. Coll. Sci. Tokyo* **8** (1) : 241-244".

Chauhan (1952) has discussed the taxonomic position of this material.

Host.—*Histiophorus* sp.

Location.—Body surface.

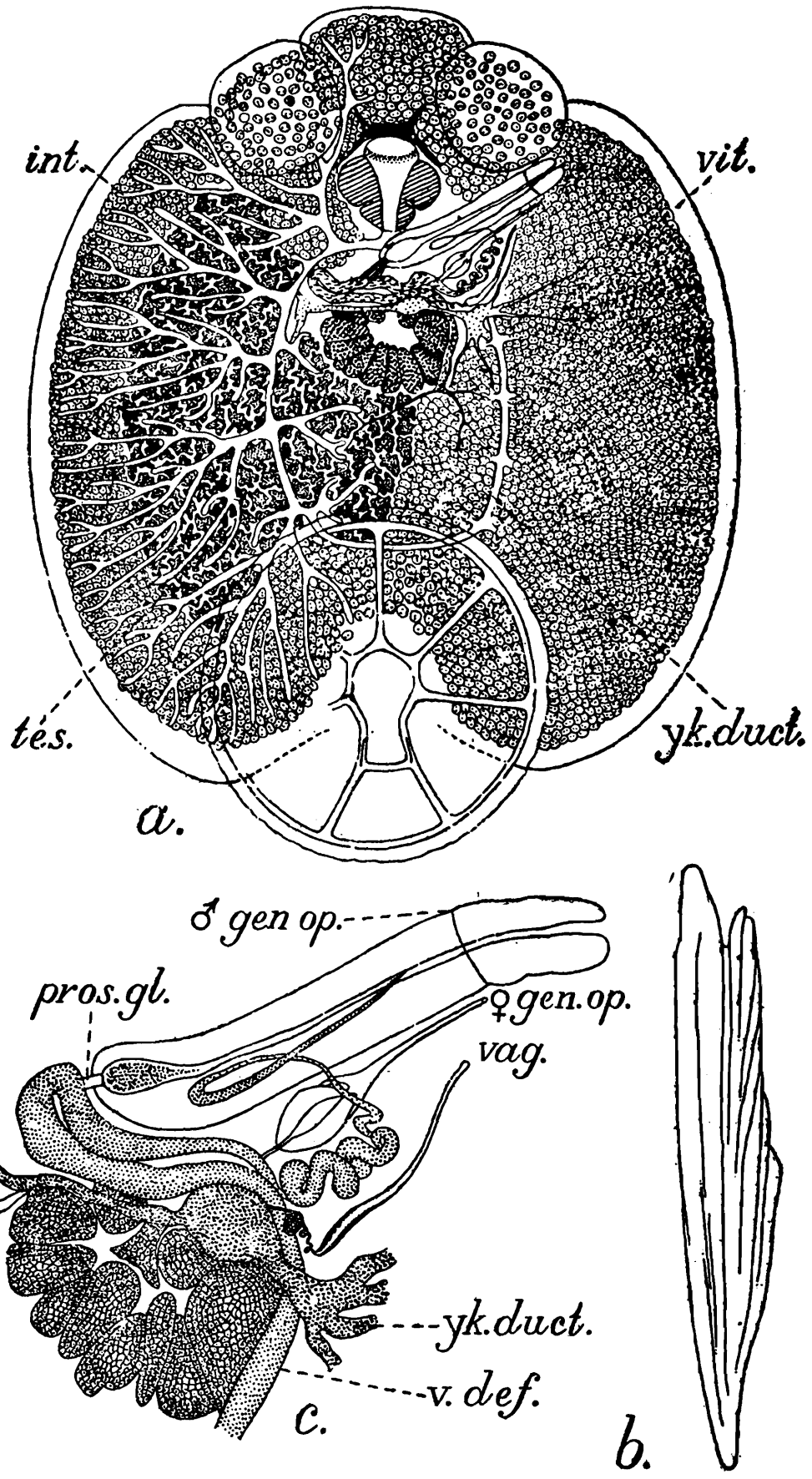
Locality.—Beruwala, Ceylon.

9. **Capsala gouri** Chauhan, 1952.

(Text-fig. 9, *a*, *b*, *c* ; 10, *a*, *b*.)

Chauhan, B. S. (1952). *Rec. Indian Mus.* **49**(1) : 49-53.

Specific diagnosis : *Capsala* Bosc, 1811 ; with Generic characters.



TEXT-FIG. 8.—*Capsala ovalis* ; (*a*) Entire worm (ventral view), testes represented only on one side ; (*b*) Haptoral hook, x 70 diam ; (*c*) Central portion of the genital organs ; viewed as a transparent object from the ventral side, x 29 diam (after Goto).

int., Intestine ; *pros. gl.*, Prostate gland ; *tes.*, Testes ; *vag.*, Vagina ; *v. def.*, Vas deferens ; *vit.*, Vitellaria ; *yk. duct.*, Yolk duct ; ♂ *gen. op.*, male genital opening ; ♀ *gen. op.*, Female genital opening.

Body elongately oval, slightly tapering anteriorly. Anterior lobe of body separated from the median by a slight constriction, where the anterior suckers are attached. Ventral papillae absent. Length 3·30

×1·55 (maximum). Lateral margin entire, with a single row of dorsal marginal chitinous spines ; not crown shaped, simple, 5—6 cuspid. Anterior suckers oval, 0·4 diameter, about one eighth of body length. Posterior sucker circular, projecting about one third its length, about one third of body length, provided with marginal striated membrane ; divided into septal regions by six ridges ; its ventral surface papillate. Pair of hooks on haptor one. Mouth subterminal. Pharynx constricted. Oesophagus very short. Intestinal crura with numerous dendritic branches on outerside, continuous posteriorly. Genital opening on left side of pharynx. Cirrus pouch club-shaped. Penis long and thick. Ovary median and situated at hinder end of anterior third of body, oval, compact, without lobes. Uterus short. Vitellaria mostly confined to lateral margins. Vaginal opening on the left. Receptaculum seminis globular. Testes small, globular, numerous, confined to mid-region between intestinal crura.

The species, *C. gouri* is unique in having a combination of some characters of all the three genera of the subfamily. It resembles *Capsala* in having the pharynx distinctly constricted and also in the shape of the anchors. It agrees with *Capsaloides* and *Tristoma* in having the testes entirely between the intestinal crura. It further resembles *Capsaloides* in probably having the posterior rays of haptor bifid distally and in having the dorsal marginal spines in a definite single longitudinal row. It resembles *Tristomum* in having anchors without clawed tips.

Price (1938) gave a list of 16 species as valid under the genus. Of the 21 species considered valid by Chauhan (1952), three are recorded from the Indian region viz. *C. megacotyle*, *C. laevis* and *C. ovalis*.

The species, *C. gouri* differs from *C. megacotyle* in the relative shape, ratio of the anterior and posterior suckers to the body length ; number of ribs on the posterior sucker and shape of cuticular rods on the posterior sucker. Specimens of *C. laevis* of Linstow, 1906, appear to differ from *C. gouri* in the ratio of the suckers and in the nature of the margin of the posterior sucker being unstriated, the rods being expanded and irregularly laciniate at the roots and in the shape of bars. *C. histiophori* Bell (syn. of *C. laevis*) differs from *C. gouri* in that its posterior sucker projects by about one third of its diameter beyond the margin of body and the parallel rows of cuticular corpuscles are absent.

C. gouri is particularly characterised in having a constricted pharynx, testes being confined between the intestinal crura, posterior sucker with a striated fringe, the posterior pairs of ribs on the posterior sucker having a tendency for bifurcation and in the shape of the anchors, being simple curved rods and the marginal spines being in a definite longitudinal row with typical shape of *Capsala* spines.

Host.—Marine fish, *Thynnus thunnina* C. *et.* V.

Location.—Operculum.

Locality.—Bombay, India.

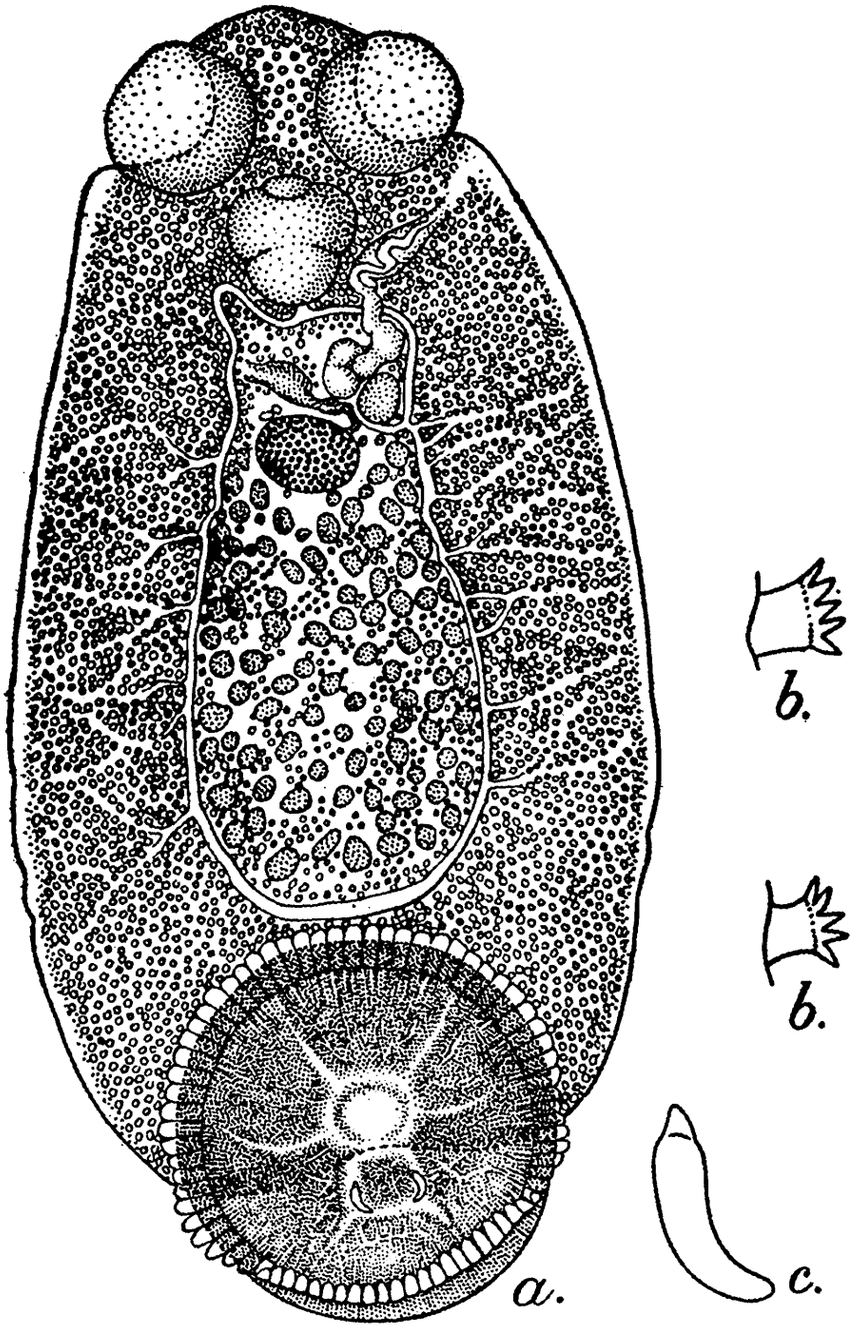
(ii) Subfamily *BENEDENIINAE* Johnston, 1931.

Syns. *Tristominae* Braun, 1893.
Ancyrocotylinae Monticelli, 1903.

Subfamily diagnosis : *Capsalidae* Baird, 1853 ; with Family characters.

Prohaptor: glandular areas, a pair of sucker or both. Haptor discoidal, aseptate, more or less sessile. Anchors 3 pairs in linear series. Marginal hooklets 14. Testes two, symmetrical. Glands of Goto present, immediately posterior to testes or absent.

Type genus—*Benedenia* Diesing, 1858.



Text-fig. 9.—*Capsala gouri*; (*a*) Entire worm, ventral view, x 50; (*b*) Dorsal marginal spines, x 600; (*c*) Haptoral hook, x 300 (after Chauhan).

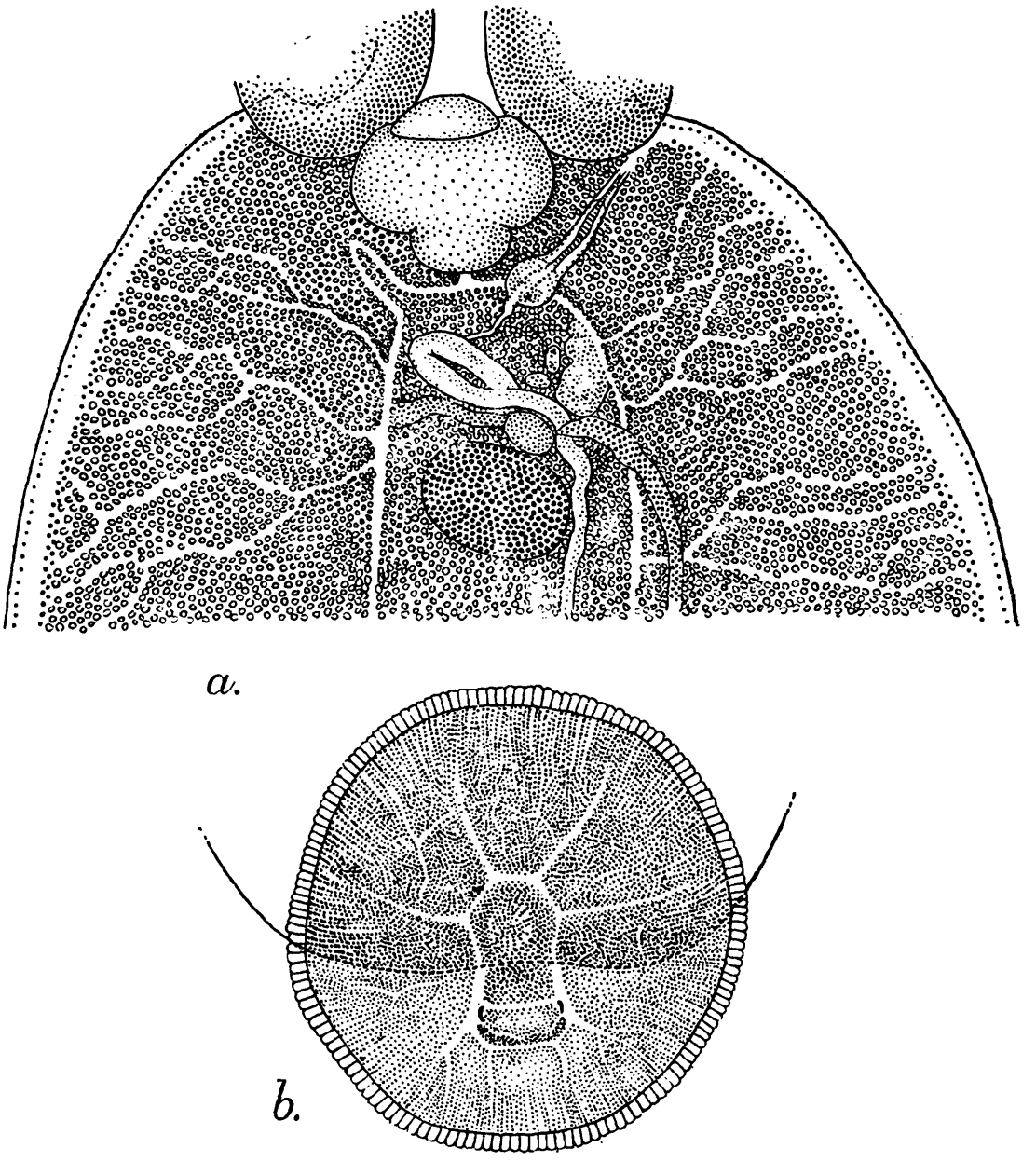
Sproston (1946) gives a key to genera of the subfamily. She also includes various subgenera of Johnston (1929) which following Price, I am deleting, as descriptions of some later species appear to cut across the subgeneric limits.

Key to Genera of Subfamily Benedeniinae.

1. Intestinal crura unbranched .. .. .. *Ancyrocotyle.*
   Intestinal crura with lateral and median branches .. 2.

2. Anterior end with glandular areas only ..	*Entobdella.*
Anterior end with suckers or both suckers and glandular areas ..	3.
3. Anterior end with suckers only	*Benedenia.*
Anterior end with suckers and a pre-oral lobe with glandular areas	*Pseudobenedenia.*

Out of these four genera, *Benedenia* Diesing, 1858; *Entobdella* Blainville, 1818; *Pseudobenedenia* Johnston, 1931 and *Ancyrocotyle* Parona & Monticelli, 1903, a species of only the first genus has so far been recorded from Indian region.



TEXT-FIG. 10.—*Capsala gouri*; (*a*) Anterior portion, enlarged, showing genital organs, x 50; (*b*) Haptor showing haptoral rays, x 30 (after Chauhan).

Genus—**Benedenia** Diesing, 1858.

Generic diagnosis : *Benedeniinae* Jahnston, 1931 ; with Subfamily characters.

Anterior end or prohaptor, with a pair of sucker-like discs ; may or may not be connected by a pre-oral lobe. Vagina present or absent. Ovary pre-testicular, separated from testes by only a narrow band of vitelline

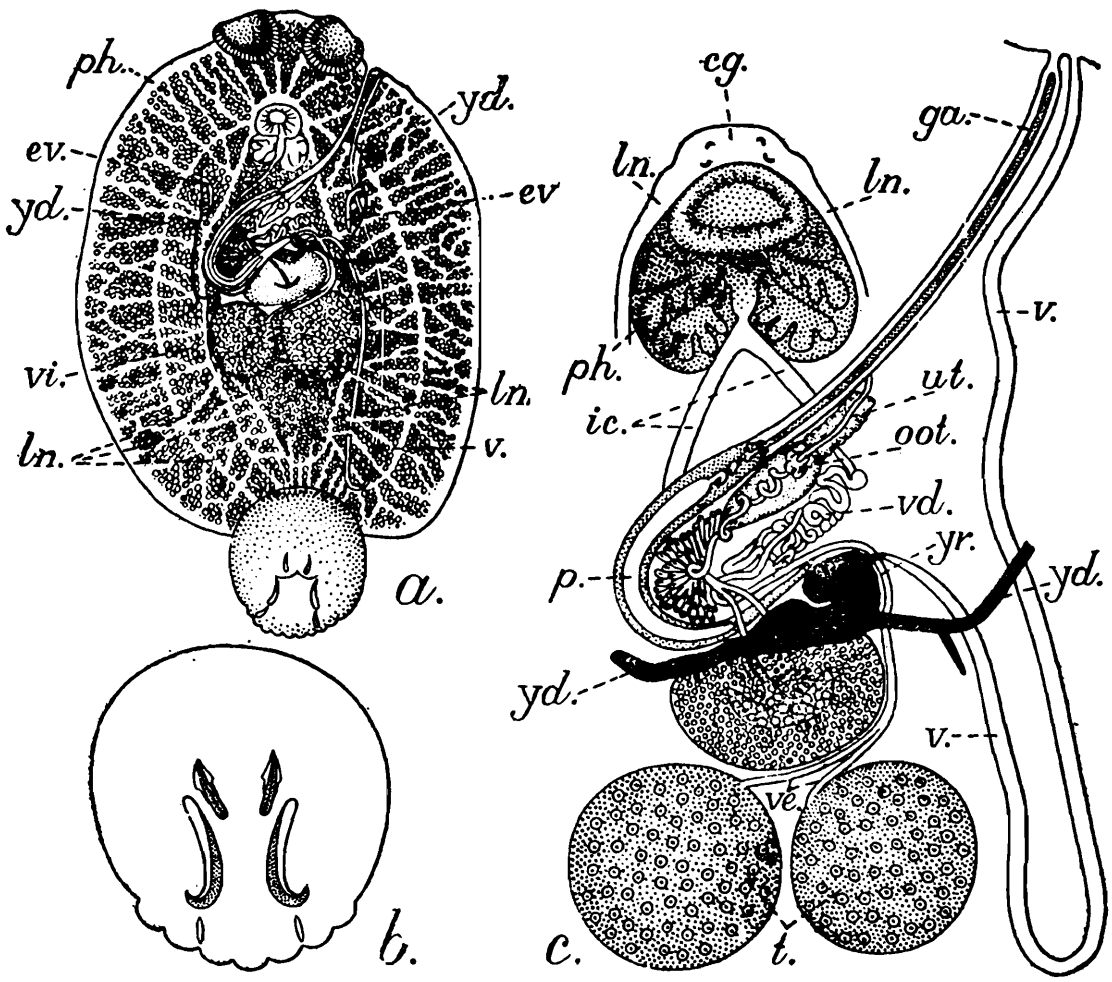
follicles. Testes two, symmetrical. Vas deferens generally not forming a preovarian loop. Haptor discoidal, aseptate with three pairs of dissimilar anchors and 14 marginal hooklets.

Type species – *Benedenia sciaenae* (van Beneden, 1852) Odhner 1905.

10. **Benedenia macrocolpa** (Lühe, 1906) Johnston, 1939.

(Test-fig. 11, *a*, *b*, *c*.)

Syns. *Epibdella* (*Benedenia*) *macrocolpa* Linstow, 1960.
Epibdella macrocolpa MacCallum, 1927.
Benedenia macrocolpa Meserve, 1938.
Benedenia (*Benedeniella*) *macrocolpa* Johnston, 1959.



Text-fig. 11.—*Benedenia macrocolpa* ; (*a*) Entire worm, ventral view ; (*b*) Haptor with three pairs of hooks ; (*c*) Genital organs, magnified (after Linstow).

cg., Cerebral ganglion with the two pairs of eyes ; *ev.*, Excretory vesicle ; *ga.*, Genital atrium ; *ic.*, Intestinal caeca ; *ln.*, Longitudinal nerve ; *oot.*, Ootype ; *ov.*, Ovary ; *p.*, Penis ; *ph.*, Pharynx ; *te.*, Testis ; *ut.*, Uterus ; *v.*, Vagina ; *ve.*, Vasa efferentia ; *vi.*, Vitellarium ; *yd.*, Yolk ducts ; *yr.*, Yolk reservoir.

Specific diagnosis : *Benedenia* Diesing, 1858 ; with Generic characters.

Body oval, flattened, 9–10 × 5–7 Anterior sucker circular, diameter about 1·0. Posterior sucker oval, 2·1—2·4 × 2·3—2.6, with three pairs of hooks and with 4 pairs of notches on the posterior surface. Mouth subterminal. Oesophagus absent. Eyes two pairs. Genital opening on the left lateral edge, near anterior end, by the side of anterior sucker. Vagina present. Testes large, paired, irregularly round, symmetrical. Ovary large, elliptical, situated just in front of testes. Vitellaria small follicles, extend from anterior end, between two suckers, to about the

end of posterior sucker. Vagina exceedingly long (hence the specific name *macrocolpa*). Vasa efferentia relatively long. Penis long. Genital atrium very long.

Host.—*Rhinoptera javanica* Mull. & Henle.

Location.—Skin.

Locality.—Kalpitiya and Dutch Bay, Ceylon.

2. Order POLYOPISTHOCOTYLEA Odhner, 1 12.

Syns. *Polycotyla Blainville*, 1828.
Octobothrii Blanchard, 1847.
Eupolycolylea Diesing, 1850.
Polycotylea Diesing, 1850, *partim.*
Polystomida Vogt, 1851.
Octobothria Troschel, 1853.
Polystomeae Taschenberg, 1879.
Polyopisthocotylinea Odhner of Fuhrmann, 1928.

Diagnosis of Order : *Monogenea* (Carus, 1863) ; with characters of the Subclass.

Prohaptor, an oral sucker or a pair of cuticular buccal suckers, within mouth or two ventral grooves or bothria. Cephalic glands seldom well developed. Eyes rarely present. Haptor consists of separate adhesive units, supported by cuticular sclerites. Suckers or clamps, with or without hooks, borne on a disc-like process or on ventral surface. Genito-intestinal canal present. Vagina present or absent.

Price (1936) divided the order into two superfamilies : *Polystomatoidea* Price, 1936 and *Diclidophoroidea* Price, 1936, mainly on the basis of presence or absence of suckers in the buccal cavity.

Sproston (1946) adds another superfamily, *Avielloidea* Sproston, 1946, to the Order. She includes in her this new superfamily forms having anterior end with Gyrodactyloid-like head organs and haptor with 6 muscular suckers and 4 large anchors, arising centrally on the stalked haptor. Dawes (1946 ; 1947) does not mention about this arrangement but Brinkmann (1952) seems to accept it.

Forms belonging only to the superfamilies Polystomatoidea and Diclidophoroidea have so far been recorded from the Indian region. These two superfamilies can be differentiated as follows :—

Key to Superfamilies of Order POLYOPISTHOCOTYLEA

Anterior end of body usually with an oral sucker, never paired buccal suckers. Haptor with three pairs of cup-like suckers (except in *Sphyranura*)	*Polystomatoidea.*
Anterior end of body with a pair of small suckers opening into the oral cavity. Haptor with few or many pairs of suckers or clamps, each organ supported by a number of cuticular pieces or sclerites	*Diclidophoroidea.*

A. Superfamily *POLYSTOMATOIDEA* Price, 1936.

The Superfamily is defined by Price (1939) as follows :—

Superfamily diagnosis : *Polyopisthocotylea* Odhner, 1912 ; with characters of the Order.

Anterior haptor in the form of an oral sucker, terminal or slightly subterminal. Posterior haptor more or less disc-like, usually with 3 pairs of well developed cup-like suckers (1 pair in *Sphyranura*), with or without appendix-like projection, bearing a pair of small suckers and 1 to 3 pairs of hooks ; suckers of haptor proper provided with a single hook each, large in Onchocotylidæ and small in Polystomatidæ. Alimentary tract consisting of short prepharynx, bulbous pharynx, short esophagus, and intestinal branches with or without diverticula or anastomoses. Eyes usually absent. Male and female genital apertures opening to exterior through common opening, situated ventrally. Testis single or multiple, postovarial. Vagina double, usually opening laterally. Parasites of amphibians, reptiles and fishes, rarely in eyes of mammals.

Type family.—*Polystomatidæ* Gamble, 1896.

The Superfamily includes two families, *Polystomatidæ* Gamble, 1899 and *Hexabothriidæ* Price, 1942 (Syn. *Onchocotylidæ* Monticelli, 1903), which according to Sproston (1946) can be differentiated as follows :—

Key to Families of Superfamily Polystomatoidea.

Haptor with an appendix-like prolongation ; suckers with a large hook-like sclerite ..	*Hexabothriidæ.*
Haptor without an appendix-like prolongation ; suckers without a large hook-like sclerite	*Polystomatidae.*

Family POLYSTOMATIDAE Gamble, 1896.

Syns. *Polystomidae* Carus, 1863.
Dicotylidæ Monticelli, 1903.
Sphyranuridae Poche, 1926.

Family diagnosis : P*olystomatoidea* Price, 1936 ; with Superfamily characters.

Anterior haptor in the form of a more or less well developed oral sucker ; posterior haptor disc-like (bilobed in *Sphyranura*), bearing 1 to 3 pairs of cup-like suckers, with or without large hooks, and with 16 larval hooklets. Intestine consisting of 2 branches, sometimes united posteriorly, with or without diverticula. Eyes usually absent in adults. Common genital aperture ventral, median ; cirrus usually with coronet of hooks. Testis single or multiple. Ovary small, dextral or sinistral, pretesticular. Vagina present or absent. Parasitic in mouth, pharynx, esophagus and urinary bladder of reptiles and amphibians and, rarely, in eyes of aquatic mammals.

Type genus—*Polystoma* Zeder, 1800.

The Family contains two Subfamilies, *Polystomatinæ* Gamble, 1896. and *Sphyranurinæ* Price, 1939 (Syn. *Dicotylinæ* Monticelli, 1903). They can be differentiated as follows.—

Key to Subfamilies of Family Polystomatidae Gamble, 1896.

Haptor with 6 suckers	*Polystomatinae.*
Haptor with 2 suckers ..	*Sphyranurinae.*

Subfamily *POLYSTOMATINAE* Gamble, 1896.

Syn. *Polystominae* Pratt, 1900.

Subfamily diagnosis : *Polystominatidæ* Gamble, 1896 ; with Family characters.

Haptor with 6 cup-like suckers. Eyes present or absent. Testes one, two or many. Vaginæ, when present, with ventro-lateral openings.

Type genus—*Polystoma* Zeder, 1800.

Kaw (1950) described a new genus, *Eupolystoma*. He modified the key of Price (1939) to the genera of the Subfamily to accommodate his new genus, as below :—

Key to Genera of Subfamily POLYSTOMATINAE.

1.	Vaginæ absent	*Oculotrema*.
	Vaginæ present ..	2.
2.	Uterus postovarial	3.
	Uterus preovarial	4.
3.	Testes lateral, two	*Diplorchis*.
	Testes median, numerous (rarely one) ..	*Parapolystoma*.
4.	Testis single ; uterus short, usually containing one egg at a time ..	5.
	Testes numerous ; uterus relatively long, containing many eggs	7.
5.	Haptor without large hooks	*Neopolystoma*.
	Haptor with large hooks	6.
6.	Haptor with one pair of large hooks	*Polystomoidella*.
	Haptor with two pairs of large hooks	*Polystomoides*.
7.	Haptor with one pair of large hooks ..	*Polystoma*.
	Haptor without large hooks . ..	*Eupolystoma*.

(i) Genus **Polystomoides** Ward, 1917

Ward (1917) created *Polystomoides*, as a subgenus of *Polystoma* Zedar, 1800 to separate those North American polystomes which differed from the European forms in having a short uterus, with only one egg. Stunkard (1924) raised it to generic rank. Price (1939) redefined it.

Generic diagnosis : *Polystomatinae* Gamble, 1896 ; with Subfamily characters.

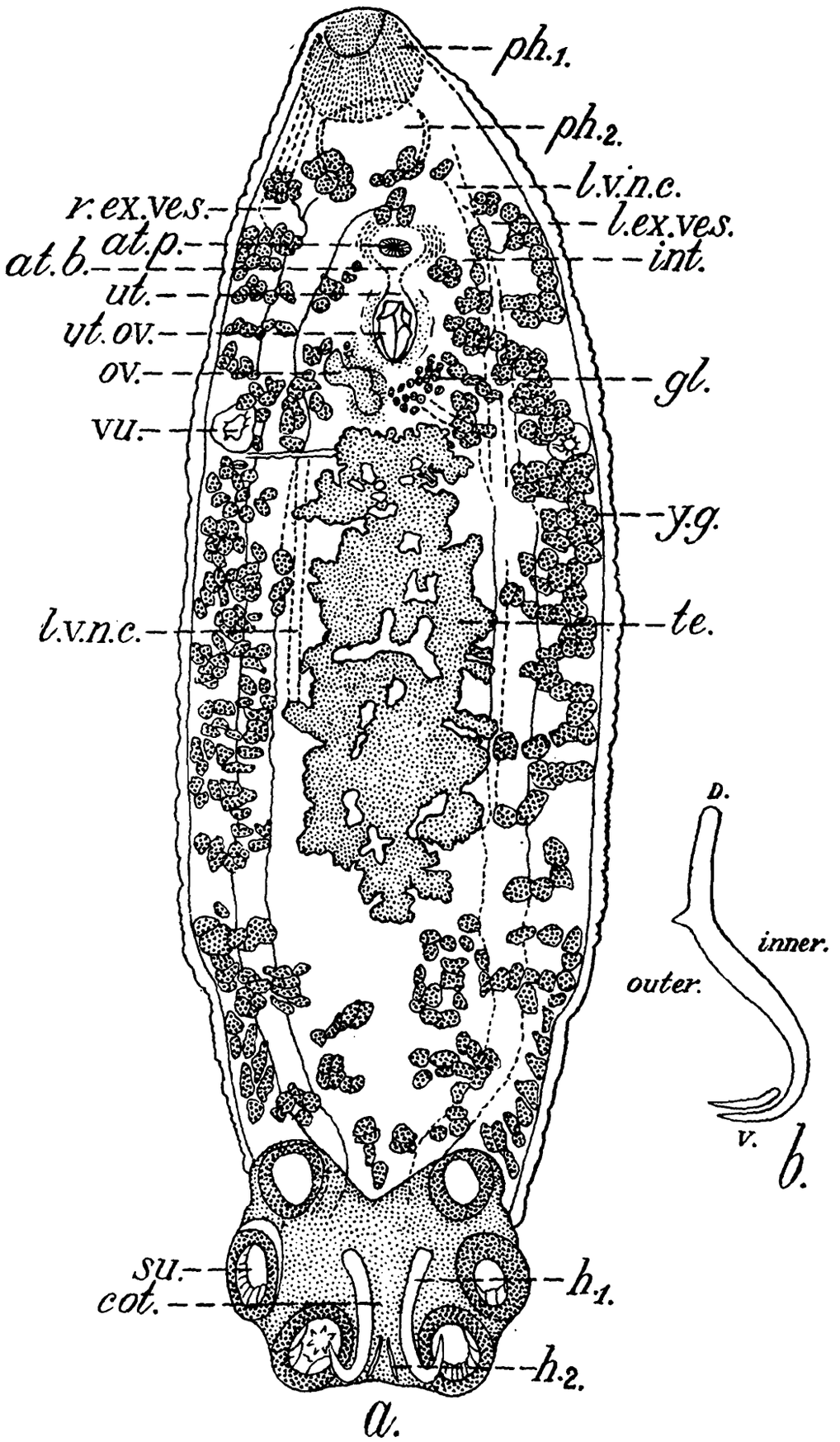
Haptor with 2 pairs of large hooks or anchors, outer pair larger than inner. Eyes absent in adults. Testis single. Uterus preovarian, short, usually containing one egg at a time. Vitellaria extend into posterior part of body. Vaginæ present. Parasitic in mouth, oesophagus and nasal passages usually and in urinary bladder, rarely of freshwater tortoises.

Type species—*Polystomoides coronatum* (Leidy, 1888) Ozaki, 1935.

11. **Polystomoides kachugae**, (Stewart, 1914) Fukui & Ogata, 1936.

(Text-figs. 12, *a*, *b* ; 13, *a*, *b*.)

Syn. *Polystomum kachugæ* Stewart, 1914.



Text-fig. 12.—*Polystomum kachugae* ; (*a*) ventral view, x 30 ; (*b*) A spine of the atria circlet, with the point of a second spine, × 1000 (after Stewart).

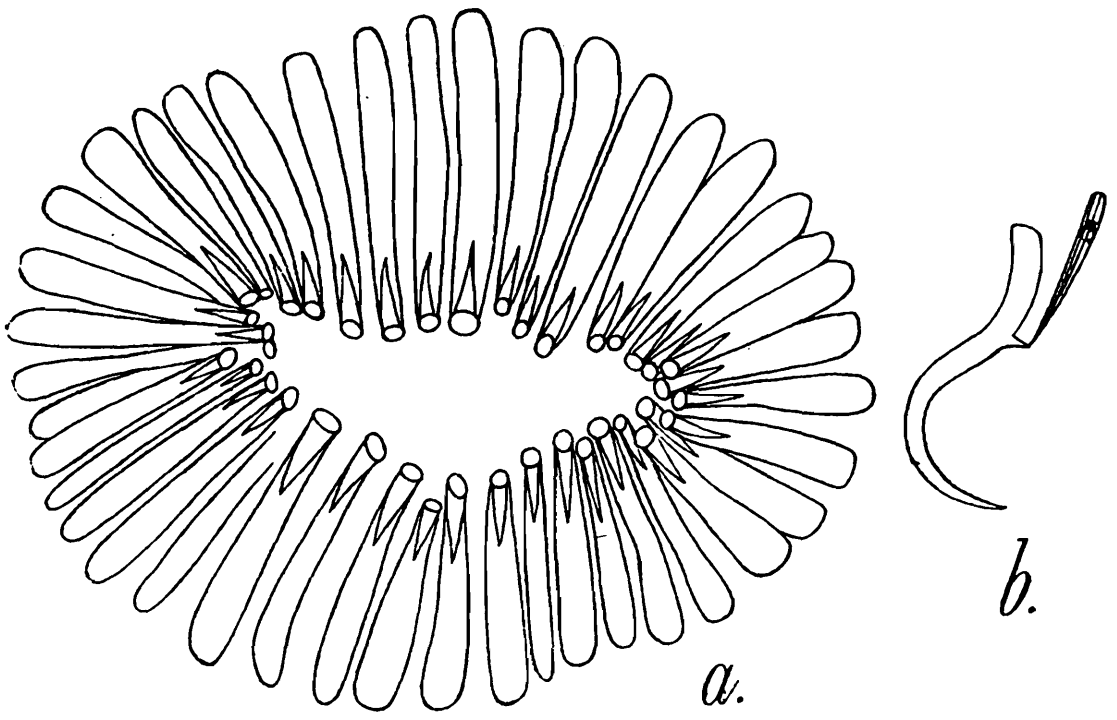
at. b., Atrial bulb ; *at p.*, Atrial pore ; *cot.*, Cotylophore ; *d.*, Dorsal ; *gl.*, Gland innominate ; h. $_1$, h. $_2$, Hook ; *int.*, Intestine ; *ov.*, Ovary ; *l.v.n.c.*, Lateral ventral nerve cord ; ph.$_1$., ph.$_2$., Pharynx ; *r. ex. ves.*, Right excretory vesicle ; *l.ex. ves.*, Left excretory vesicle ; *su.*, Sucker., *te.*, Testis ; *ut.*, Uterus ; *ut. ov.*, Uterine Ovum ; *v.*, Ventral ; *vu.*, Vulva ; *y.g.*, Yolk gland.

Stewart, F. H. (1914). *Rec. Indian Mus.* **10**(3) : 195-205.
Stunkard, H. W. (1916). *J. Parasit.* **3**(22) : 22.
——— (1917). *Illinois biol. Monogr.* **3** : 297-309.
Srivastava, H. D. (1930). *Proc. Indian Sci. Congr.* **3**(6) : 69.
Fukui, T. & Ogata, T. (1936). *Zool Mag., Tokyo* **48** : 765-770.
—— (1939). *Vol. Jub.* pro. Prof. S. Yoshida **2** : 200.
Price, E. W. (1939). *Proc. helm. Soc. Wash* **6**(2) : 84.
Dawes, B. (1946). *The trematoda : 148.*
Sproston, N. G. (1946). *Trans. Zool. Soc. Lond.* **25**(4) : 351.

Stewart (1914) described the species as *Polystomum kachugæ*. Fukui & Ogata (1936) assigned the species to its present taxonomic position.

Specific diagnosis (after Stewart's description)—*Polystomoides* Ward, 1917 ; with Generic characters.

Body elongate, bluntly pointed at the head, length 6·5, width about 2·0 maximum. Mouth subterminal. Eyes absent. Cotylophore 1·33 in breadth, bearing six cup-shaped suckers and two pairs of hooks, situated between the posterior pair of suckers ; one pair large, sabre-shaped, the other short, simply curved. First pharynx, muscular, spherical ; second pharynx identical with first, lying dorsal and posterior to it. Oesophagus short, muscular. Intestine bifurcate, caeca unbranched, extending posteriorly in the region of haptor. Testis single,



TEXT-FIG. 13.—*Polystomum kachugae* ; (*a*) The circlet of atrial hooks as seen from the ventral surface, x 650 ; (*b*) Single atrial spine, lateral view (after Stewart).

broad, flat, lobulated, lying in median third of body. Vesicula seminalis present. Penis a short, protrusible, muscular tube. Genital atrium cavity enclosed in a muscular bulb, divided by a diaphragm into a dorsal male atrium and a flattened ventral female atrium ; the former opening into the latter, which in its turn opens to exterior. Diaphragm armed with a circle of forty spines, appearing ventrally straight truncated rods but laterally as S-shaped hooks, sharp pointed at the projecting extremity. Ovary situated on the right, in one side and on the left in

second specimen. It is curved, sausage-shaped, fundus somewhat bulbous. Oviduct a narrow canal. Uterus oval, containing a single ovum. Vaginæ two. Vitelline glands extend from level of posterior border of second pharynx to anterior margin of cotylophore. Genito-intestinal canal present. Excretory pore a fine pore, on dorsal surface.

Host—*Kachuga lineata* (Gray).
Location—Urinary bladder.
Locality—Lucknow.

(ii) Genus **Eupolystoma** Kaw, 1950.

Generic diagnosis : *Polystomotinæ* Gamble, 1896 ; with Subfamily characters.

Haptor without large hooks ; larval hooks present. Gonads post equatorial ; testes median post-ovarial and follicular. Uterus long and preovarial, containing many eggs. Vaginæ present. Genital hooks present. Parasitic in the urinary bladder of amphibian.

Type species—*Eupolystoma rajai* Kaw, 1950.

12. **Eupolystoma rajai** Kaw, 1950.
(Text-fig. 14 *a*, *b*, *c*, *d*, *e*, *f*, *g*.).

Specific diagnosis, *Eupolystoma* Kaw. : 1950 ; with Generic characters.

Body oval, 2·4-3·22×0·98-1·4. Prohaptor sucker-like. Eyes absent. Haptor discoidal, broader than long, bearing three pairs of cup-like suckers. Large haptoral hooks absent, but 16 small, marginal hooks present on haptor, on ventral side. Mouth subterminal ; prepharynx funnel-like. Pharynx globular. Oesophagus almost absent. Intestinal caeca unite posteriorly, just in front of haptor. Gonads post-equatorial, inter-caecal, just in front of union of intestinal cæcum. Testes numerous, follicular, median, post-ovarian. Vas deferens long, narrow. Vesicula seminalis a narrow tube. Cirrus armed with genital coronet of eight hooks. Ovary sinistral, elongated, more or less comma-shaped. Genito-intestinal canal a small duct. Vitelline follicles scattered throughout body. Vaginæ present. Uterus greatly developed, inter-cæcal. Genital atrium thick-walled, globular. Genital pore median, lying ventral to intestinal bifurcation. Eggs numerous, oval thin-walled, 157-170×81-99μ, with well developed embryoes.

Host—*Rana* sp.
Location—Urinary bladder.
Locality—Punch, Kashmir.

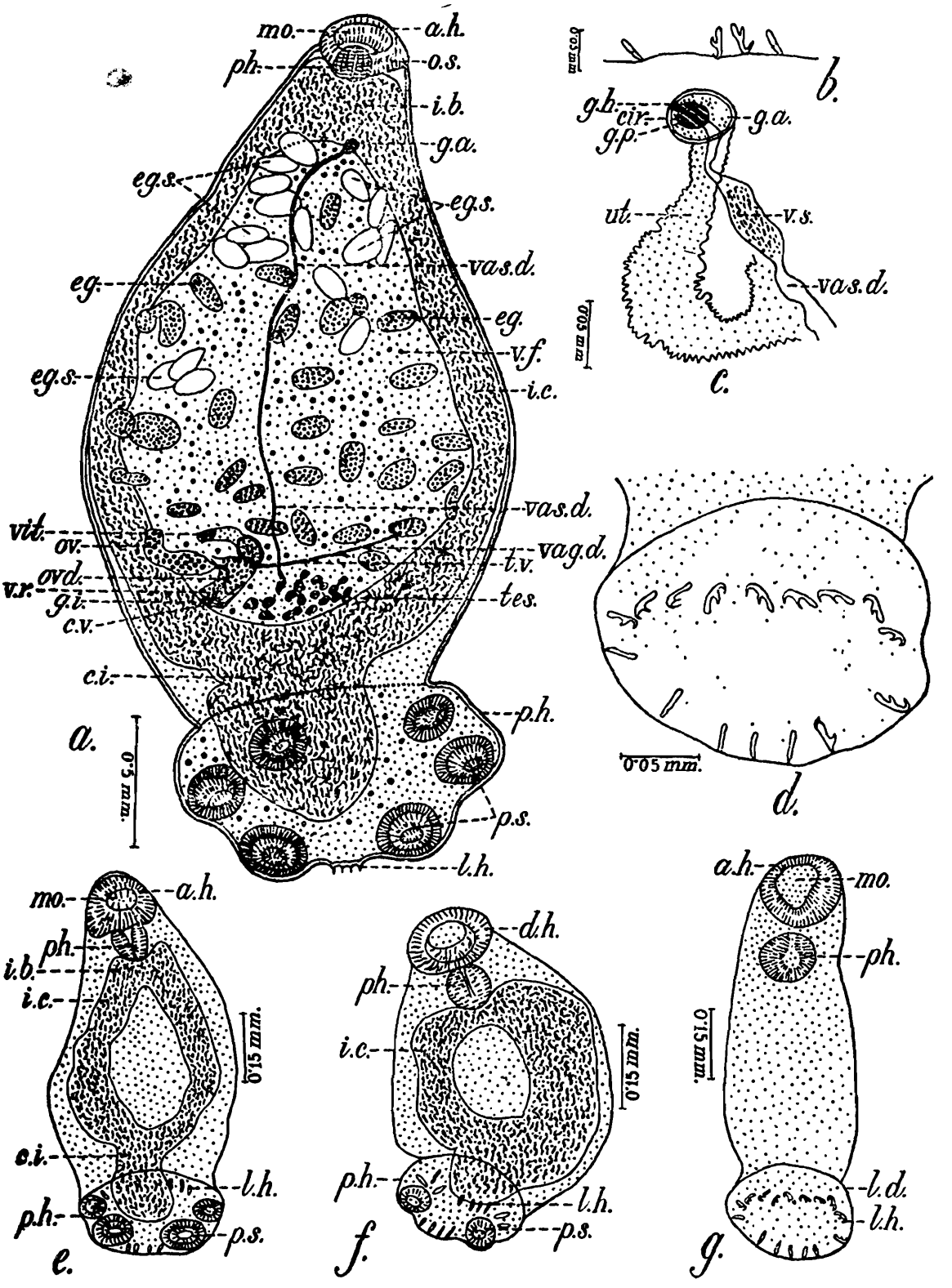
2. Superfamily DICLIDOPHOROIDEA Price, 1936.
Syn. *Dactylocotyloidea* Brinkmann, 1942.

Price (1943) who created the superfamily in (1936) defines it as follows :—

Superfamily diagnosis : *Polypisthocotylea* Odhner, 1912 ; with characters of the Order.

Anterior haptor in the form of two lateral, oval or circular suckers opening into the oral cavity. Posterior haptor variable in shape and position, usually at the posterior end of body, sometimes ventral or lateral, usually provided with two rows of suckers or clamp-like adhesive organs having a complicated, heavily cuticularized, rib-like supporting structure ; posterior tip of haptor often terminating in a tongue-like structure or " languette " or "lappet", armed with one to three pairs of hooks. Digestive system consisting of a prepharynx serving as an oral cavity,

a bulbous pharynx, a short oesophagus, and an intestine consisting,except in *Diplozoon*, of two principal branches provided with numerous median and lateral diverticula. Eyes absent in adults. Male and female genital



TEXT-FIG. 14.—*Eupolystoma rajai* ; (*a*) Entire, dorsal view ; (*b*) Larval hooks of adult ; (*c*) Distal portion of genital ducts ; (*d*) Larval disc ; (*e*) Third stage larva ; (*f*) Second stage larva ; (*g*) First stage larva (after Kaw).

a.h. or dh., Anterior haptor ; *ci.*, Fused intestine ; *cir.*, Cirrus ; *c. v.*, Common vitelline duct ; *eg.*, Egg ; *eg. s.*, Egg-shell ; *g. a.*, Genital atrium ; *g. h.*, Genital hook ; *g. i.*, Genito-intestinal canal ; *g. p.*, Genital pore ; *i. b.*, Intestinal bifurcation ; *i. c.*, Intestinal crus ; *l. d.*, Larval disc., *l. h.*, Larval hook ; *mo.*, Mouth ; *o. s.*, Oral sucker ; *oc.*, Ovary ; *ovd.*, Oviduct ; *ph.*, Pharynx ; *p. h.*, Postrior haptor ; *p.s.*, Posterior sucker (Haptoral sucker) ; *tes.*, Testes ; *t. v.*, Transverse vitelline duct ; *ut.*, Uterus ; *vag. d.*, Vaginal duct ; *vas. d.*, Vas deferens ; *v. f.*, Vitelline follicle ; *v.r.*, Vitelline receptacle, *v.s.*, Vesicula seminalis ; *vit.*, Vitellaria.

apertures usually opening to exterior through a common pore situated ventrally. Cirrus armed or unarmed. Testes usually numerous, postovarial, occasionally preovarial. Ovary elongate, folded. Vaginæ present or absent, usually opening dorsally. Parasites of fishes or of crustaceans parasitic on fishes.

Type family—*Diclidophoridæ* Fuhrmann, 1928.

Key to Families of Superfamily DICLIDOPHOROIDEA.

1.	Skeleton of clamps symmetrical ..	2.
	Skeleton of clamps asymmetrical ..	5.
2.	Spring double, formed by the shoulders between the ventral and dorsal loops of capsule skeleton ; dorsal loop complete ; tendon cuticularised only at distal end	*Mazorcæidæ.*
	Spring three-fold ; tendon completely cuticularised ; both loops incomplete in median line ; exceptional in circumoral sucker, replacing the pair of suckers within the mouth ..	*Chimæricolidæ.*
	Spring single, formed by the completely cuticularised tendon ; dorsal loop of capsule skeleton vestigial	3.
3.	Numerous clamps on haptor	4.
	Eight or fewer, clamps on haptor	*Discocotylidæ.*
4.	Main spring simple, one piece ; three paired and symmetrical lateral cuticular long bars supporting each clamp on the haptor, simple without any accessory structures	*Microcotylidæ.*
	Main spring may be a composite piece, with accessory pieces ; three paired and symmetrical, lateral cuticular long bars, supporting each clamp structure on the haptor, may be supported by an additonal transverse bar and usually with other transverse rib-like, lightly cuticularized, fine structures in wall of clamp-capsule	*Gastrocotylidæ.*
5.	Haptoral sclerites reduced to three dissimilar pieces embedded in lateral margin and partition of muscular sucker ..	*Hexostomatidæ.*
	Haptoral sclerites well developed ; muscles shifted towards the medial margin of the clamp-capsule	*Diclidophoridæ.*

Species belonging only to four of these families have so far, been recorded from the Indian region which are dealt with below.

(a) Family DICLIDOPHORIDAE Fuhrmann, 1928.

Syns. *Choricotylidæ* Rees & Llewellyn, 1941.

Dactylocotylidæ Brinkmann, 1942.

Family diagnosis (after Price, 1943) : *Diclidophoroidea* Price, 1936 ; with Superfamily characters.

Haptor terminal, usually bearing four pairs of cup-like adhesive structures having a complicated, heavily cuticularised frame of the type indicated for the family by Price (1943). Cirrus usually armed with a circle of curved hooks, which are crescentic in cross section. Seminal receptacle usually, if not always, present. Vaginæ usually absent.

Type genus—*Diclidophora* Diesing, 1850.

Price (1943) sub-divided the family into two subfamilies, which were differentiated as follows :—

Key to Subfamilies of Family DICLIDOPHORIDAE.

Haptoral sucker clamp or pincerlike	*Diclidophorinæ* Cerfontaine, 1895.
Haptoral sucker cup-like	*Cyclocotylinæ* Price, 1943.

Subfamily *CYCLOCOTYLINAE* Price, 1943.

Syns. *Choricotylidæ* Llewellyn, 1941.
Choricotylinæ Sproston, 1946.

Price (1943) while creating the new subfamily defined it as follows :—

Subfamily diagnosis : *Diclidophoridae* Fuhrmann, 1928 ; with Family characters.

Haptor with four pairs of sessile, sub-sessile or pedunculated, cup-like suckers, each provided with a heavily cuticularised framework of the kind typical of the family. Cirrus armed (except in *Cyclocotyloides*) with hooks as in Diclidophorinæ. Vaginæ usually absent.

Type genus—*Cyclocotyla* Otto, 1823.

Key to Genera of Subfamily CYCLOCOTYLINE.

1. Cirrus hooks absent	*Cyclocotyloides* Price, 1943
Cirrus hooks present	**2.**
2. Vaginæ present	**3.**
Vaginæ absent	**4.**
3. Vagina single, dorso-lateral	*Echinopelma* Raecke, 1945
Vaginæ two, lateral ..	*Diclidophoropsis* Gallien 1937.
4. Frame work of anterior pair of haptoral suckers orientated inversely as compared with those of posterior 3 pairs	*Heterobothrium* Cerfontaine, 1895.
Framework of all 4 pairs of haptoral suckers with the same relative orientation	**5.**
5. Testes both pre-and post-ovarial	*Cyclobothrium* Cerfontaine, 1895.
Testes entirely post-ovarial	**6.**
6. Posterior pair of suckers sessile and widely removed from anterior 3 pairs of pedunculated suckers	*Pedocotyle* MacCallum, 1913.
Posterior pair of suckers either sub-sessile or pedunculated and not separated from other pairs	**7.**
7. Vitellaria extending into haptor	*Cyclocotyla* Otto, 1823.
Vitellaria not extending into haptor	*Neoheterobothrium* Price, 1943.

Genus **Cyclocotyla** OTTO, 1823.

Syns. *Cyclostoma* Otto, 1823, *non* Lamarck, 1799.
Octostoma Otto, 1823, *non* Kuhn, 1829.
Choricotyle Beneden & Hesse, 1863.
Mesocotyle Parona & Perugia, 1889.

The genus, *Cyclocotyla* Otto (1823) was revived by Price (1943). Sproston (1946) does not agree with this contention. Dawes (1946; 1947) however, accepts classification of Price. I have followed Price and Dawes provisionally, pending the clarification of the status of the generic name.

Generic diagnosis—*Cyclocotylinae* Price, 1943; with Subfamily characters.

Haptor distinctly set off from body proper; suckers either subsessile or pedunculated, more or less equally spaced. Genital atrium non-muscular. Cirrus armed. Testes post-ovarial. Vaginae absent. Vitellaria extending into haptor.

Type species—*Cyclocotyla bellones* Otto, 1823.

Price (1943) gave a complete list of species of this genus. Chauhan (1945) described a new species, *C. multaetesticulae* from India and gave a key to species, which clearly indicates the taxonomic position of his species, under the genus, as shown below.—

Key to Species of Genus Cyclocotyla.

1. Vaginae two, opening near the zone of the genital atrium	*C. taschenbergii* (Parona and Perugia, 1889) Price, 1943.
Vaginae absent ..	2.
2. Body proper (not including the haptor) clearly divisible into two regions	3.
Body proper not divisible into two regions	4.
3. Anterior part of body demarcated from posterior by distinct shoulders ..	*C. bellones* Otto, 1823, (Type species)
	C. charcoti (Dollfus, 1942) Price, 1943.
Two regions of the body merge imperceptibly into one another	*C. smaris* (Ijima, in Goto, 1894) Price, 1943.
4. Peduncles of unequal length ..	5.
Peduncles of equal length ..	7.
5. Penis with 10 or 13 hooks ..	*C. prionti* (MacCallum, 1917) Price, 1943.
Penis with eight hooks	6.
6. Body proper oval, anterior end obtuse, peduncles comparatively short and robust ..	*C. labracis* (Cerfontaine, 1895) Price, 1943.
Body proper lanceolate, anterior end rather narrow, peduncles comparatively longer and slender	8.
7. Three anterior pairs of peduncles of equal size and relatively large, posterior pair relatively small, with smaller suckers ..	8.
Peduncles progressively shorter in antero-posterior succession	9.
8. Larger, with 25 testes and 12 cirrus hooks ..	*C. neomaenis* (MacCallum, 1917) Price, 1943.
Smaller, with 56 to 65 testes and 13 cirrus hooks ..	*C. caulolatali* (Meserve, 1938) Price, 1943.

9. Origin of the anterior-most peduncles contiguous	*C. pagelli* (Gallien, 1937) Price, 1943.
Origin of the anterior-most pair of peduncles separated by the width of the body, *i.e.*, haptor not distinctly set off from body proper	10.
10. Body ovate, peduncles of the posterior-most pair of haptoral suckers reach the haptoral disc separately, languette present, number of testes about 30	*C. chrysophryi* (Beneden and Hesse, 1863) Price, 1943.
Body elongate, posterior-most pair of haptoral suckers pedunculated but the two peduncles unite posteriorly into a single median stem, joining the haptor, languette absent, number of testes more than 30	*C. multaetesticulae* Chauhan 1945.

13. **Cyclocotyla multaetesticulae** Chauhan, 1945.

(Text-fig. 15, *a*, *b*, *c*.).

Syn. *Choricotyle multaetesticulae* (Chauhan, 1945) Sproston, 1946.

Sproston, N. G. (1946). *Trans zool. Soc. Lond* **25**(4) : 491.

Specific diagnosis : *Cyclocotyla* Otto, 1823 ; with Generic characters.

Body elongate, 2·83 × 0·13. Haptor palmate, carrying four pairs of pedunculated suckers. Peduncles long and thick. Suckers cup-like, almost equal in size ; clamp structure typically of Diclidophorid type, Languette absent. Mouth subterminal, transversely oval. Anterior suckers two, oval, muscular, opening into buccal cavity. Pharynx muscular, spherical. Oesophagus narrow. Intestinal caeca branched laterally, on outer side, uniting posteriorly, running practically to the end of haptor. Testes about 150, small, follicular, intercaecal, post-ovarian. Vas deferens ventral to receptaculum seminis. Vesicula seminalis at the base of cirrus. Cirrus provided anteriorly with a crown of eight, inwardly curved hooks. Genital pore situated half way between pharynx and intestinal bifurcation. Ovary small, median, pre-equatorial. Receptaculum seminis massive. Vitelline follicles numerous, relatively large, extending from the level, slightly below genital pore to posterior end of body, and into the haptor.

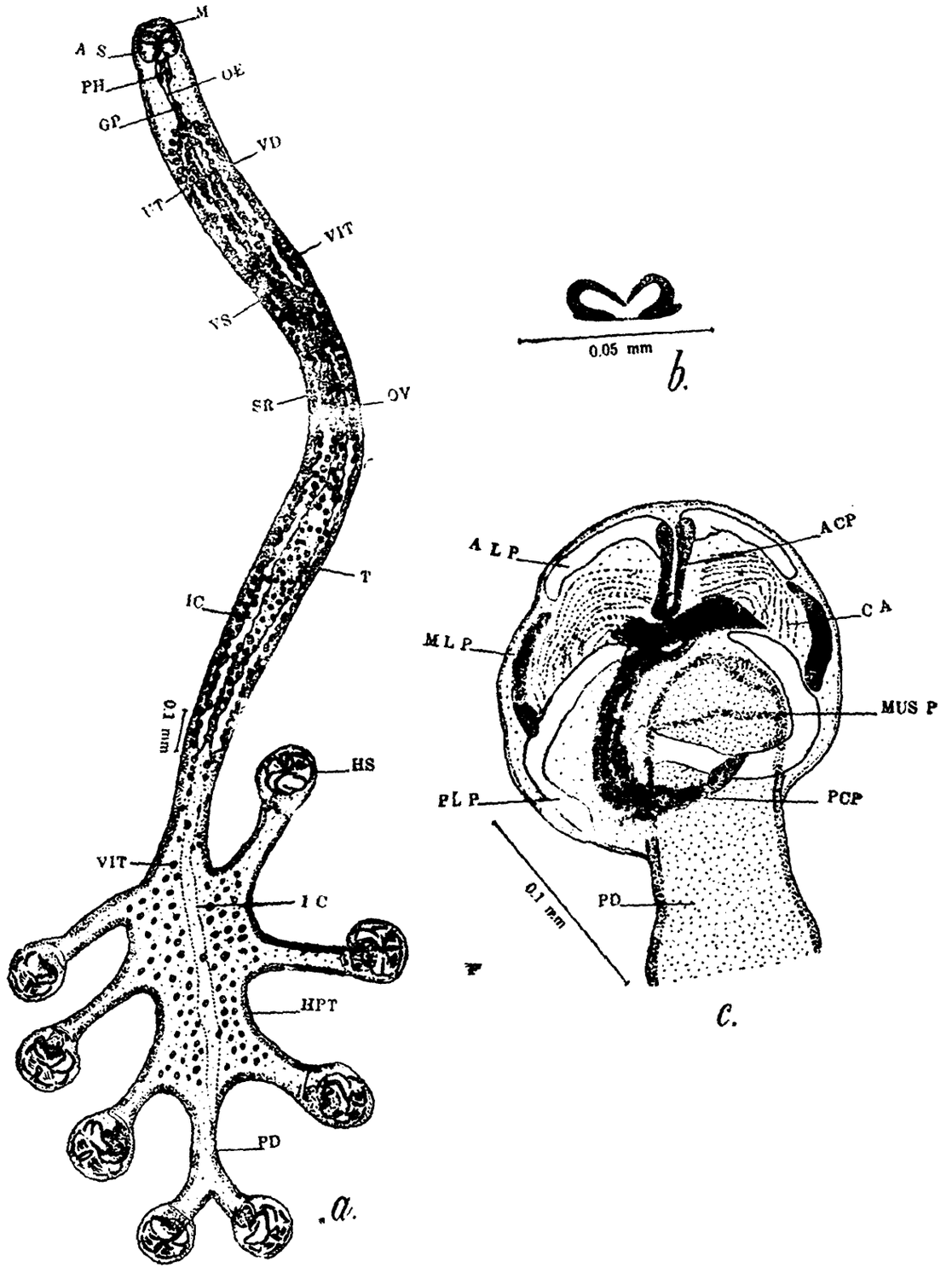
Chauhan (1945) characterised his species in having the haptor distinctly set off from the body ; vitellaria extending into the haptor ; vagina being absent ; testes, being post-ovarial and cirrus armed.

Sproston (1946) states that the species is distinguished in the key given by Chauhan as having vitellaria and a united intestinal caecum entering haptor ; the subequal clamps being borne on long stalks ; those of posterior pair being united for more than half their length and eight hooks in the genital corona.

Host.—*Pellona* sp.

Location.—Gills.

Locality.—Bombay ; Arabian Sea, Indian Ocean.



Text-fig. 15.—*Cyclocotyla multaetesticulae*; (*a*) Entire view; (*b*) Two of the cirrus hook; (*c*) Haptoral sucker, showing arrangement of the cuticular pieces of its framework (after Chauhan).

A C P., Anterior central piece; *A LP.*, Anterior lateral piece; *AS.*, Anterior suckers; *CA.*, Rodlets of concentric arcs; *GP.*, Genital pore; *HS.*, Haptoral sucker; *HPT.*, Haptor; *IC.*, Intestin l caecum; *M.*, Mouth; *MLP.*, Median lateral piece; *MUS. P.*, Muscle pad; OV., Ovary; *P CP.*, Posterior central piece; *PD.*, Peduncle; *PLP.*, Posterior lateral piece; *PH.*, Pharynx; *SR.*, Receptaculum seminis; *T.*, Testis; *UT.*, Uterus; *VD.*, Vas deferens; *VS.*, Vesicula seminalis; *VIT.*, Vitallaria.

(*b*) Family Mazocraeidae Price, 1936.

Syns. *Octocotylidae* Beneden & Hesse, 1863.

Octobothriidae Taschenberg, 1879.

Octobothridae Monticelli, 1888.

Mazocriidae Southwell & Kirshner, 1937.

Family diagnosis : *Diclidophoroidea* Price, 1936 ; with Superfamily characters.

Haptor generally with 4 pairs of clamp-like suckers, equally spaced out along the lateral regions of an indistinct cotylophore or of postero-lateral regions of body. Clamp-skeleton relatively simple, of most generalised type, consisting of a single dorsal and a ventral loop with forked tips which articulate with a straight basal piece, sometimes having a rudimentary piece attached to it. The scoop or U-shaped middle piece perforated to receive T-shaped cuticularised distal end of tendon. Terminal lappet—vestige of larval haptor—with 2-3 pairs of dissimilar hooklets. Larval hooklets may persist between the pair of anchors or just above them. Genital pore armed usually with 2 types of hooks, the lateral pair being larger than others and alate at the base. Testes generally numerous, wide follicles or sometimes a single, elongate and lobed mass between the intestinal crura. Vagina, when present, single and opening mid—dorsally, rarely Y-shaped and opening laterally. Ovary elongate, folded vermiform, situated near the anterior end of testis or testes. Vitellaria lateral and follicular.

Type genus—*Mazocraës* Hermann, 1782.

Key to Genera of Family MAZOCRAEIDAE.

1.	Haptor with two pairs of small, accessory suckers	*Ophiocotyle* Beneden & Hesse, 1863 ; *gen. inq.*
	Haptor without small, accessory suckers	2.
2.	Haptor symmetrical, bearing lateral rows of four clamps	3.
	Haptor asymmetrical, with one row of four clamps and a single smaller one on the other side : genital hooks 16 small and 2 larger laterals	*Grubea*, Diesing, 1858.
3.	Genital hooks, only the large lateral pair present ; vagina opening mid-dorsally ; ovary extends to end of body	*Mazocraeoides* Price, 1936.
	Genital hooks, slightly larger lateral pair and smaller hooks in two transverse rows ; vagina opening mid-dorsally ; ovary in anterior half, anterior to testes	*Mazocraës* Hermann 1782.
	Genital hooks, large lateral pair and smaller hooks in two vertical rows ; ovary in mid-body, anterior to testes	4.
4.	Vagina absent ; clamps like those of *Mazocraës* (typical)	*Kuhnia* Sproston, 1945.
	Vagina double, opening laterally ; clamps atypical	*Neomazocräes* Price 1948.

(i) Genus **Mazocraës** Hermann, 1782.

Syns. *Octostoma* Kuhn, 1782.
Octobothrium Leuckart, 1827.
Octocotyle Diesing, 1850.
Octoplectanum Diesing, 1858.
Glossocotyle Beneden & Hesse, 1863.
Octobothrium (*Octocotyle*) of St. Remy, 1891.

Generic diagnosis : *Mazocraeidae* Price, 1936 ; with Family character .

Body narrow, tapering to bluntly rounded either end ; haptor slightly wider than body, almost triangular, into which the diverticulate

intestinal crura extend, accompanied by the vitellaria. Clamps symmetrically arranged in lateral rows of four each side, on short pedicles which decrease in length backwards—the posterior clamps may be slightly smaller than the anterior, especially in younger worms. Typically two pairs of dissimilar anchors present, but the inner smaller pair may be lost in older worms—large anchors with bifid roots and recurved tip: these are borne on a short terminal lappet. Genital pore transversely elongate with 12 bipartite hooklets : with two lateral larger hooks and an anterior and posterior transverse row of a few (4-5) hooks each. The long, wide vas deferens apparently acts as a vesicula seminalis. The testes composed of numerous ill-defined transverse follicles which do not extend to the haptor : fill the region between the crura, in the posterior half of body. Ovary anterior to testes on the left side, vermiform and curved towards the descending oviduct. Genito-intestinal canal as long as ovary, opening into the right intestinal crus. Vagina opening on the dorsal side in the median line just posterior to the intestinal bifurcation, unarmed, and leading directly to a coiled receptaculum seminis vaginae. Eggs usually with two polar filaments. Parasites of gills of Clupeoid fishes.

Type species—*Mazocräes alosae* Hermann, 1782.

14. **Mazocräes orientalis** Chauhan, 1950.

(Text-fig. 16, *a*, *b*, *c*, *d*.)

Specific diagnosis : *Mazocräes* Hermann, 1782 ; with Generic characters.

Body flat, narrow, elongate, 1·15×0·15 (type). Mouth terminal. Anterior suckers paired, oval, obliquely placed, lined by refractile prismatic muscle fibres. Pharynx spherical, comparatively large, situated just behind anterior suckers. Prepharynx absent. Oesophagus thin, elongate. Intestinal crura extend nearly up to posterior end of body. Haptor somewhat triangular, continuous with body, carrying spatulate, terminal lappet, bearing at posterior end a pair of unequal hooks, which have bifid roots and recurved tips. Haptor bears four pairs of oval clamps, symmetrically arranged in lateral rows of four on each side, with short and stout retractile peduncles, decreasing slightly in length backwards. Clamps of almost equal size ; clamp—sclerite structure characteristic. Testes consist of eight oval follicles, arranged irregularly, somewhat in a double row medially, in middle third of body Ovary elongate, oval, anterior to testes, to the left. Vitellaria extend from the region near about intestinal bifurcation almost up to haptor. Vitelline follicles irregularly shaped, densely placed ; irregularly scattered. Genital pore oval, situated midway between pharynx and oesophageal bifurcation, armed with five pairs of hooks, with curved tips, arranged in two discontinuous rows.

The species is broadly distinguished by its pattern of the frame-work of clamps on the haptor ; shape and arrangement of genital hooks ; number of terminal hooks on posterior lappet of haptor and structure of lappet.

Host—A clupeid fish, *Dussumieria* sp.

Location—Gills.

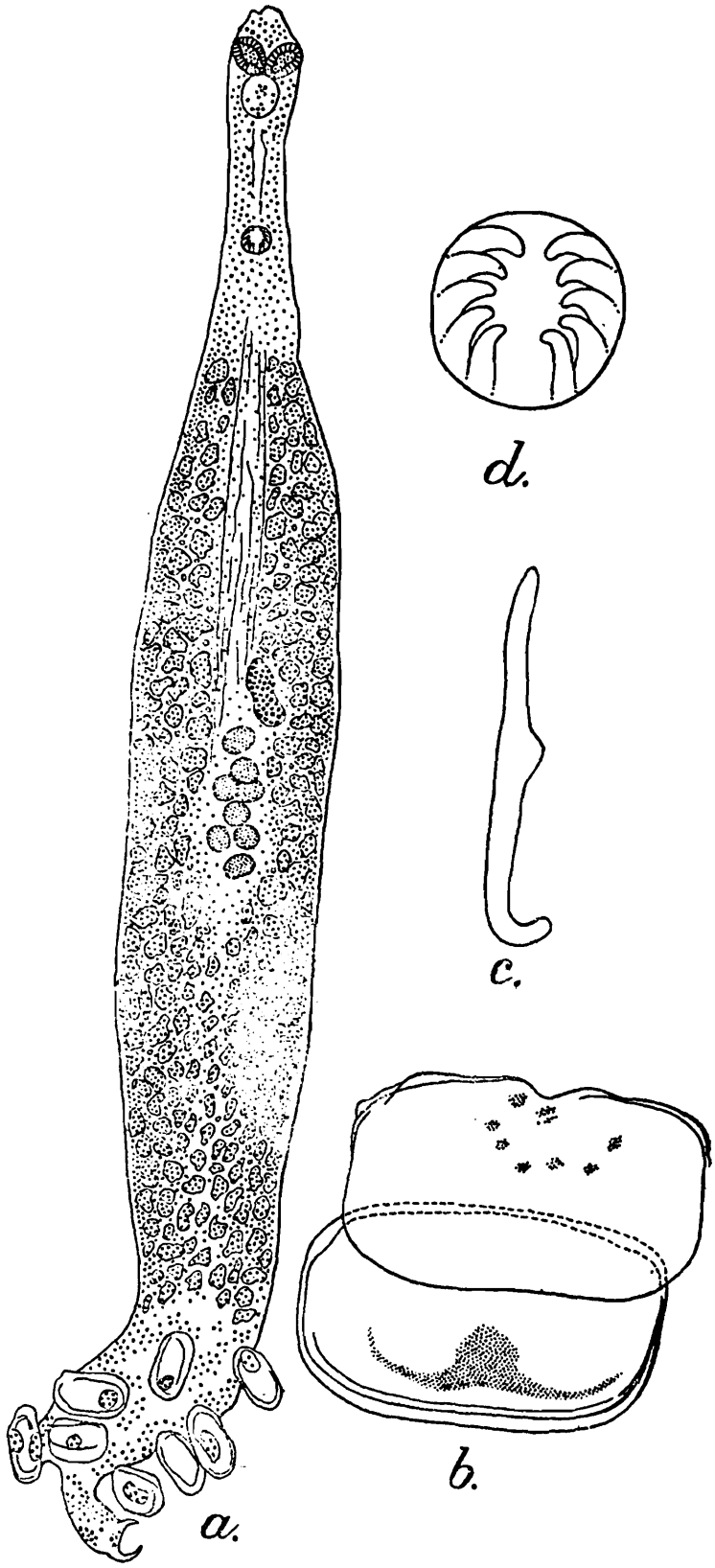
Locality—Puri, Bay of Bengal.

(ii) Genus **Mazocraeoides** Price, 1936. *emend.*

Syn. *Pseudoctocotyla* Yamaguti, 1936.

Generic diagnosis : *Mazocraeidae* Price, 1936 ; with Family characters.

Body broad, flattened. Haptor not differentiated as a separate organ ; clamps arranged on the margin of body proper, the anterior pair may be anterior to middle of body. Terminal lappet short, bearing



TEXT-FIG. 16.—*Mazocräes orientalis* ; (*a*) Entire specimen, ventral view, x 125 ; (*b*) Cuticular framework of the clamp on the posterior haptor, x 693 ; (*c*) One of the hooks of the terminal lappet of posterior haptor, x 693 ; (*d*) Genital atrium, showing cuticularised spines, x 700 (after Chauhan).

2-3 pairs of small hooks or anchors. Intestinal crura richly branched and along with vitellaria extend up to the posterior end of body. Ovary looped, sometimes extending to posterior third of body, sometimes posterior to testes. Testes follicular or a compact ovoid mass, in the median field usually, on left. Vagina single, dorsal, may be ending blindly. Genital pore with numerous small hooks, or with a single large pair, with alate spines at their bases. Eggs large, thick-shelled, without polar filaments.

Type species—*Mazrocraeoides georgei* Price, 1936.

15. **Mazocraeoides prashadi** Chauhan, 1952.

(Text-fig. 17, *a*, *b*, *c*.)

Specific diagnosis : *Mazocraeoides* Price, 1936 : with Generic characters.

Body lanceolate, flattened, 0·5×0·14 (type). Clamps four pairs on either side of posterior half of body proper. Clamp sclerites typical. Clamps pedunculated with retractile pedicels. Only two pairs of recurved terminal hooks at posterior end of body; the outer pair being larger. Mouth terminal. Prepharynx long, vestibular. Pharynx elliptical, compact, muscular. Oesophagus short. Intestinal may extend to the posterior end of body. Anterior or buccal suckers, one pair, oval. Genital sucker very prominent, highly muscular, bulb-like, situated just behind intestinal bifurcation; genital corona armed with a double row of five recurved hooks and an extra pair of comparatively long hooks, inserted between first and second pair. Testis single, elongately oval. Vas deferens massive. Ovary elongate. Vitellaria very dense, extending broadly along lateral region from genital sucker to posterior end.

The genus contains three species: *M. georgei* Price, 1936 (type), *M. dorosomatis* (Yamaguti, 1938) Sproston, 1946 and *M. prashadi* Chauhan, 1952.

Chauhan (1950) states that *M. prashadi* differs from the type species in having only two pairs of posterior hooks, in the shape of testis and clamps; details of the framework of clamps in the genital sucker abutting against the intestinal bifurcation and being very prominent, muscular and differing in its structure.

M. prashadi differs from *M. dorosomatis*, in the shape of body; very different structure of genital sucker; pattern of cuticular framework of clamp and the number of posterior pairs of hooks.

Host—A Clupeid fish.

Location—Body surface.

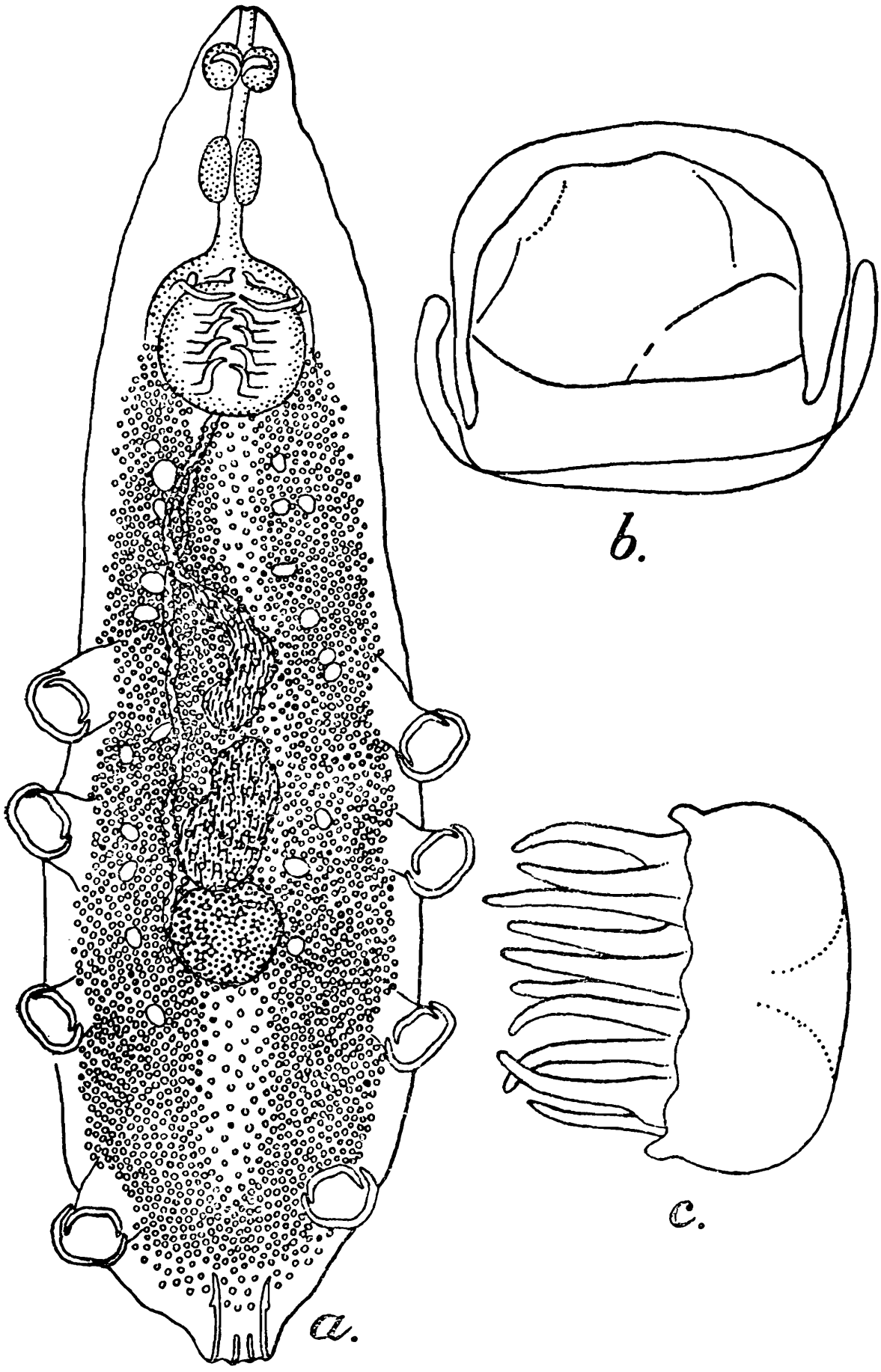
Locality—Puri, Bay of Bengal.

(*c*) Family Discocotylidae Price, 1936.

Family diagnosis : *Diclidophoroidea* Price, 1936 : Superfamily characters.

Body or haptor only sometimes asymmetrical. Haptor terminal, usually linguiform, with 3-4, usually 4 pairs of clamp-like suckers and with 1-3 pairs of terminal hooks. Clamp structure distinctive; ventral loop complete and often with articulations; dorsal loop incomplete

represented by two inwardly directed arms; middle piece usually not well developed farther than posterior rim, which is in at least two parts,



TEXT-FIG. 17.—*Mazocraeoides prashadi*; (*a*) entire worm, ventral view; (*b*) frame-work of posterior sucker; (*c*) genital sucker, showing genital spines (after Chauhan).

though it may carry accessory sclerites as in some Gastrocotylidae. Tendon always well cuticularised and forming a single median spring. Terminal lappet or languette often present, bearing 1-3 disimilar, pairs of hooklets. Lateral vaginae present or absent.

Type genus—*Discocotyle* Diesing, 1850.

Taxonomic position of subfamilies and genera included in the family.

Price (1943) included under the family three subfamilies: Anthocotylinae Price, 1936; Discocotylinae Price, 1936 and Vallisinae Price, 1943. Sproston (1946) reinstates the subfamily Plectanocotylinae Monticelli, 1903 in this family. Dawes (1946) creates under the family a new subfamily, Chimaericolinae for the genus *Chimaericola* Brinkmann, 1942. He regards the family Chimaericolidae of Brinkmann (1942) as synonymous to his new subfamily.

The family Chimaericolidae was created by Brinkmann (1942) for *Octobothrium leptogaster* Leuckart, 1830, an archaic form of very uncertain position. Diesing (1850) placed this species first under the genus *Discocotyle* as *sp. inq.* and later (1858) renamed it under *Placoplectanum*. Parona and Perugia (1892) mentioned it as *Octocotyle* (*Octobothrium*). Price (1943) places it under the genus, *Neoheterobothrium* (Fam Diclidophoridae).

Brinkmann* placed his new family along with Onchocotylidae (=Hexabothriidae) in superfamily Polystomatoidea, on account of the absence of mouth-suckers and their replacement by a weak circumoral sucker as in typical Polystomatoidea. He pointed out that it is clearly a transitory family between the two superfamilies, Polystomatoidea and Diclidophoroidea, approaching the latter in the form of haptor and clamps, though having the vaginal pattern of the former. It is an archaic form of great interest, probably an intermediate connecting link between the two superfamilies of the order Polyopisthocotylea, and I concur with Sproston (1946) that on account of similarity of its clamp skeleton with that of other Diclidophoroidea and the appearance of Discocotylid fancies in relation to several organs, it may be placed in the superfamily Diclidophoroidea but in a separate and independent family, near to Discocotylidae.

Dawes also does not mention subfamily Vallisinae of Price (1943) but mentions the genus *Vallisia* under the subfamily, Discocotylinae. There also appears to be divergence of opinion regarding family assignment of the genus *Grubea* Diesing, 1858. Price (1943) does not include it under the family Discocotylidae. Sproston (1946) mentions it under the family Mazocraeidae. Dawes (1946; 1947) puts it under the family Discocotylidae (subfamily: Discocotylinae). I am inclined to follow Sproston and Price.

Key to Subfamilies of Family Discocotylidae.

1. Three pairs of clamps; vaginae absent	*Plectanocotylinae.*
Four pairs of clamps; vaginae generally present ..	2.
2. Clamps of the anterior most pair very large, the remaining ones very small	*Anthocotylinae.*
Clamps of the anterior most pair not markedly larger than the others	3.

* Brinkmann (1952) creates a new superfamily, *C. chimaericoloidea* for his family.

3. Testes pre-ovarial ; body asymmetrical ; cirrus armed	*Vallisinae.*
Testes post-ovarial ; body symmetrical ; cirrus armed ..	*Discocotylinae.*

(i) Subfamily *DISCOCOTYLINAE* Price, 1936.

Subfamily diagnosis : *Discocotylidae* Price, 1936 ; with Family characters.

Mature individuals sometimes fused in the form of " X " (*Diplozoon*). Body symmetrical. Haptor bears 4 pairs of equally developed clamp-like suckers and a short terminal lappet with only one pair of bent, crook-shaped hooks near its posterior tip. Testes lobed, follicular or a compact mass, post-ovarial. Terminal male genitalia, an unarmed cirrus or sucker. Vaginae present or absent ; if present, either, Y-shaped with two marginal pores or single and ventral. Eggs with or without filaments.

Typegenus—*Discocotyle* Diesing, 1850.

Key to Genera of Subfamily DISCOTYLINAE.

1. Mature individuals fused in pairs, in the form of " X "	*Diplozoon* Nordmann, 1832.
Mature individuals, separate . .	2.
2. Genital sucker present ; testis single, extensively lobed ; vagina absent	*Octomacrum* Mueller, 1934.
Genital sucker absent ; testes follicular ; vagina present, Y-shaped	*Discocotyle* Diesing, 1850.

Genus **Diplozoon** Nordmann, 1832.

Syns. *Diplozoum* (Nordmann, 1832) of Burmeister, 1835.
Diporpa Dujardin, 1845.

Generic diagnosis : *Discocotylinae* Price, 1936 ; Subfamily characters.

Mature individuals and late larval stages fused in the form " X " Haptor rectangular, concave ventrally, bearing 4 pairs of clamp-like suckers, set close together, along the postero-lateral margins, symmetrically, in thick capsules. Ventral capsule wall shows papilla-like process within the area, bounded by ventral loop and a pair of crook-shaped, recurved hooks, on the ventral side, near posterior end ; the other pair of hooks may be needle-like. Intestine not bifurcated, but with numerous lateral, branched diverticula. Testis single, rounded with crenulate margins, posterior to ovary, lying partly in haptor, at posterior end of body proper. Ovary elongate, looped, pretesticular. Genital pores encircled by a genital sucker (gonotype), all close together, in posterior half, united with complementary pore of the uniting worm ; on maturity gonotyl fuses with the dorsal papilla bearing the vaginal pore of the other individual ; corresponding change occurring in the inverse sense so that the male duct of each individual is contiguous with the female duct of the other. Vitellaria massive, with numerous, large follicles, preovarial, filling available space in the anterior part of body, between intestinal meshes, in front of the point of union of the two individuals. Vagina absent or single, lateral on ventral side. Eggs oval, with a very long and much coiled filament at the anopercular pole. Parasites on gills of freshwater fishes.

Type species—*Diplozoon paradoxum* Nordmann, 1832.

The genus contains, at present, four species ; *D. paradoxum* Nordmann, 1832 ; *D. nipponicum* Goto, 1891 ; *D. indicum* Dayal, 1941 and *D. kashmirensis* Kaw, 1950. Out of these the latter two have been recorded from India. Kaw (1950) gave a key to species of the genus, as below.

Key to Species of Genus Diplozoon.

1. Intestine bifurcates into two branches behind the place of the union of two individuals and the branches unite posterior to testis ..	2.
Intestine runs as a single tube without branching behind the place of the union of two individuals and gives out lateral branches posterior to testis	*D. paradoxum.*
2. Testis lobed and lies midway between the crossing of individuals and the posterior margin of the body	3.
Testis smooth and lies more near the crossing of individuals than the posterior margin of the body	*D. indicum.*
3. A pair of sticky glands present at the entrance of the mouth	*D. nipponicum.*
No sticky glands present at the entrance of the mouth	*D. kashmirensis.*

16. **Diplozoon indicum** Dayal, 1941.

(Text-figs. 18 ; 19, *a*, *b*, *c*, *d*, *e*.)

Dayal (1941) gave the following distinguishing characters of the species :

1. The union of the two individuals takes place behind the fore end of the posterior third of the body.

2. A pair of anterior suckers, one on each side of the mouth.

3. Four pairs of posterior suckers, the anterior pair of suckers is the largest, while those that follow are smaller than the preceding one, the last pair is the smallest.

4. Mouth a triangular opening on the ventral side, prepharynx and pharynx present, intestine tubular and gives out dichotomously branched caeca anterior to the place of union of the two individuals, behind the place of union the intestine branches in two caeca which unite again posterior to testis. Behind the testis the intestine extends as a simple tube upto the posterior end of the second hind sucker.

5. Testis round or oval and lies in a sac anterior to the first pair of posterior suckers.

6. Ovary in the form of a long band which bends twice on itself thus forming an inverted overlapping double U.

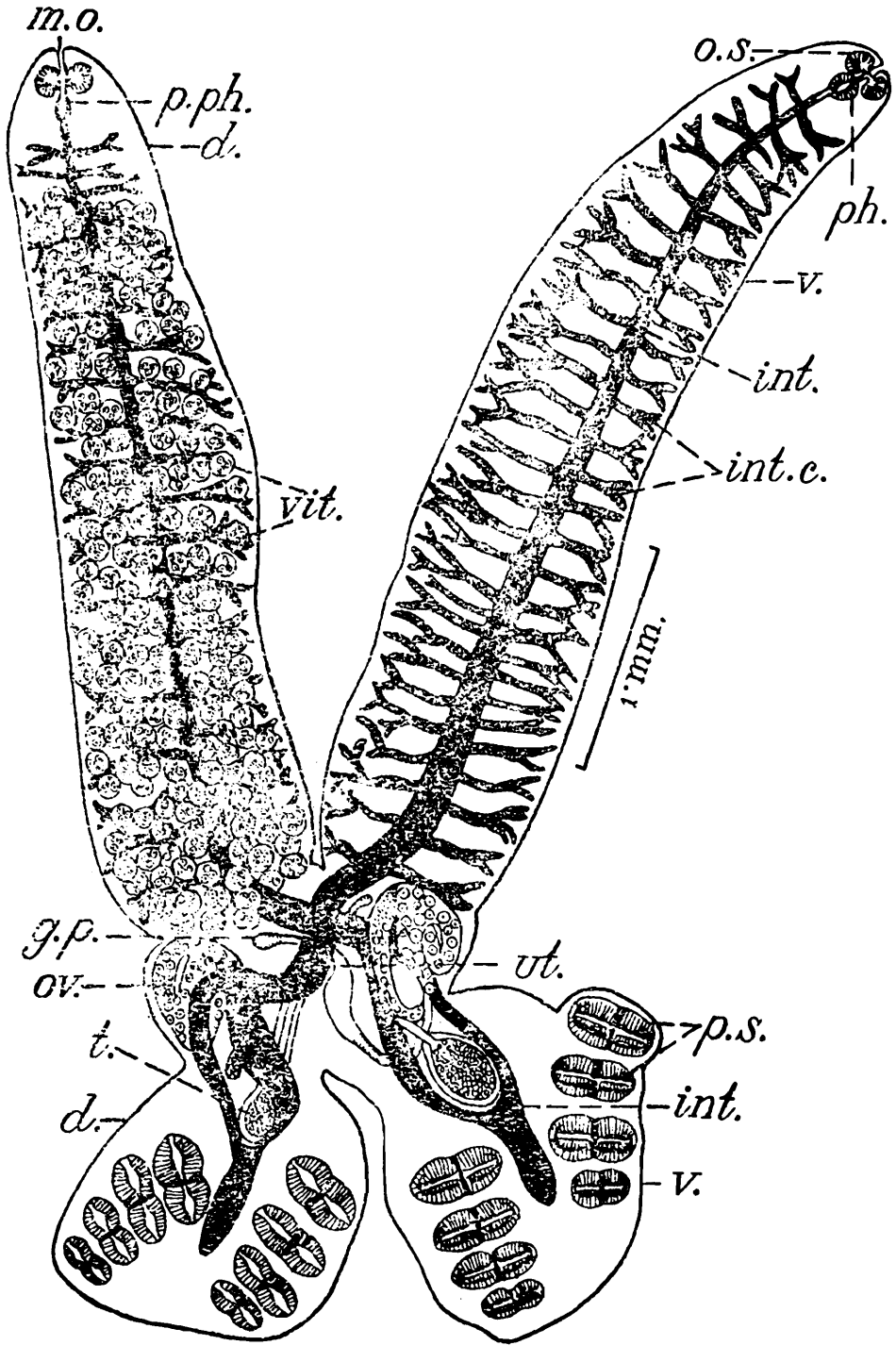
7 Eggs large, operculated, with a long coiled filament and a thick shell, they contain a large amount of yolk and the germplasm is limited in the centre of the egg.

He further states that *D. indicum* differs from *D. paradoxum* and *D. nipponicum*, in the position of the union of the two individuals, in the comparative size of the posterior suckers, in the structure and extent of the intestine, in the position and shape of the ovary and testis, and in the size of the eggs.

Host—Fresh-water fish, *Barbus* (*Puntius*) *sarana* (Ham.).

Location—Gills.

Locality—Gomati river, Lucknow.



TEXT-FIG. 18.—*Diplozoon indicum*; entire view of the two individuals fixed under pressure of a cover glass. The vitelline glands have not been shown on the right side. Genital organs not completely shown (after Dayal).

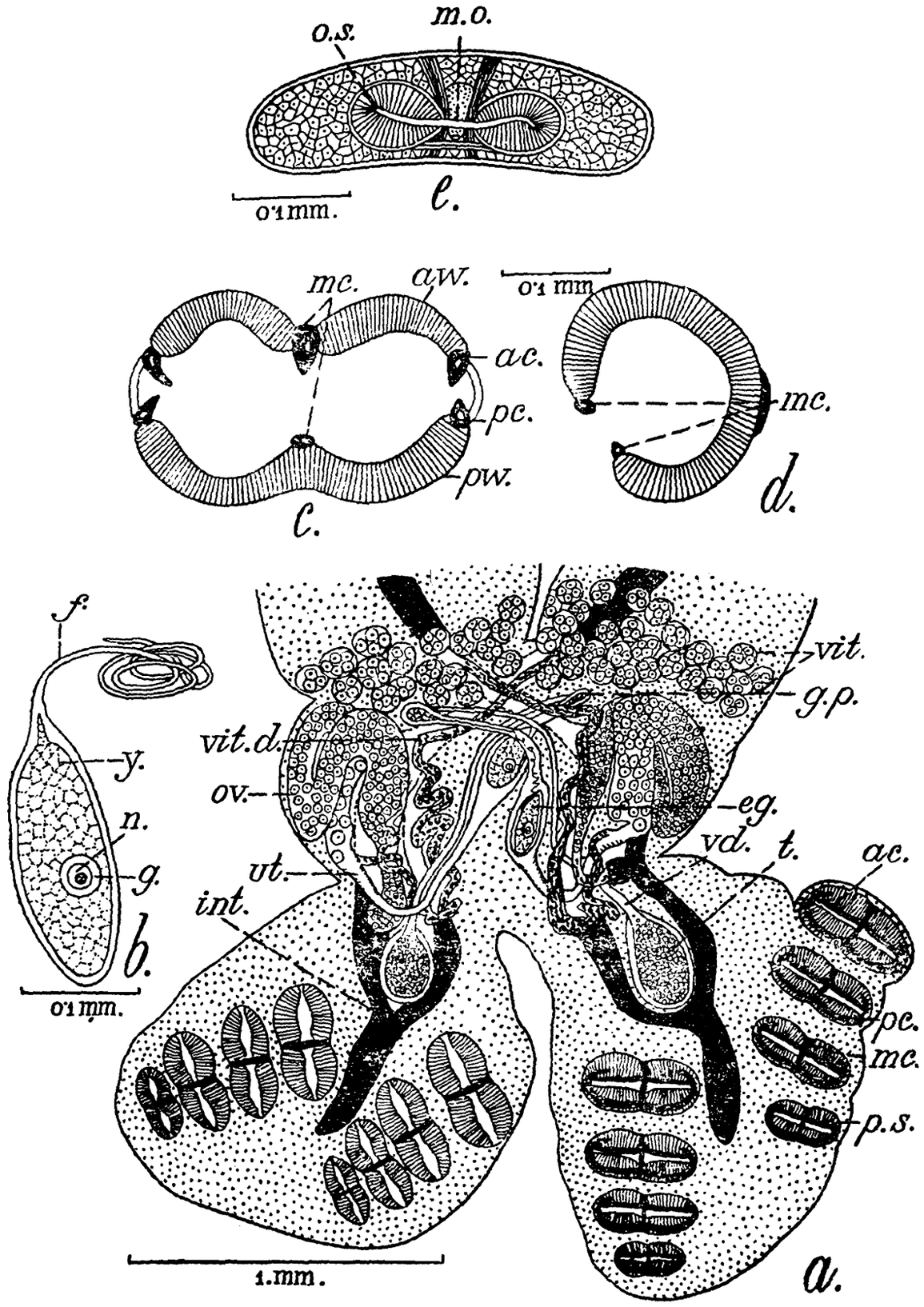
d., Dorsal view; *g. p.*, Genital pore; *int.*, Intestine; *int. c.*, Intestinal caeca; *m. o.* Mouth opening; *o. s.*, Oral sucker; *ov.*, Ovary; *ph.*, Pharynx; *p. ph.*, Prepharynx; *p. s.* Posterior sucker; *t.*, Testis; *ut.*, Uterus; *vit.*, Vitelline glands; *v.*, Ventral view.

17 **Diplozoon kashmirensis** Kaw, 1950.

(Text-fig. 20, *a*, *b*, *c*, *d*.)

Specific diagnosis : *Diplozoon* Nordmann, 1832; with Generic characters.

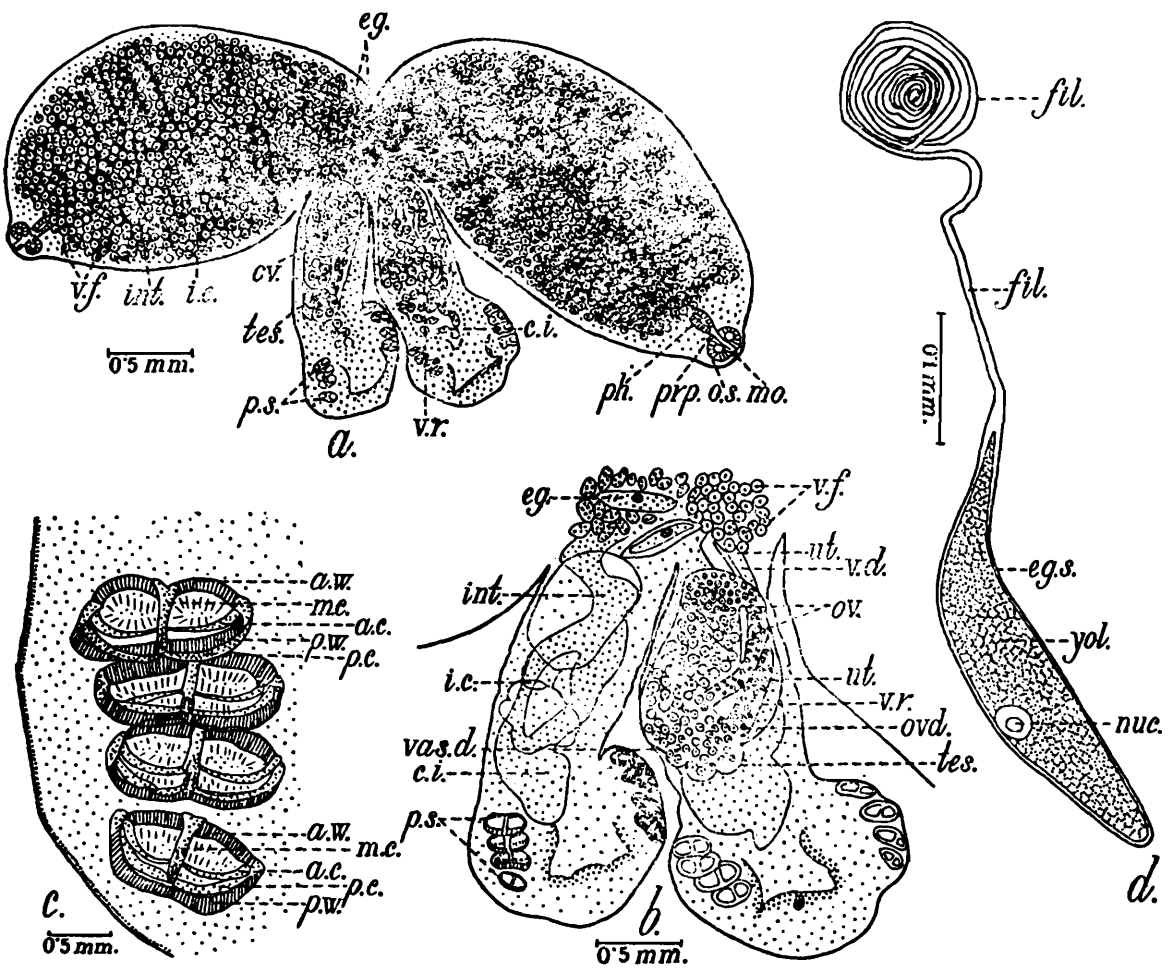
Individuals found in pairs, union taking place in the form of a cross, at about threefifth of body length, then they twist. Body 2·3—4·32. Region in front of cross, dorso-ventrally flattened, leaf-like,



Text-fig. 19.—*Diplozoon indicum*; (*a*) Enlarged view of the posterior region of the body with a diagrammatic representation of the genital organs and the posterior suckers; (*b*) Egg, highly magnified; (*c*) A longitudinal horizontal section through one of the posterior suckers; (*d*) A saggital section through one of the posterior suckers; (*e*) T.S. in the region of the oral suckers and the mouth, showing the groove connecting the mouth and the cavity of the oral suckers (after Dayal).

a. c., Anterior cuticular rod; *a. w.*, Anterior wall of posterior sucker; *eg.*, Egg; *f.*, Filament; *g. p.*, Genital pore; *g.*, Germ-plasm; *int.*, Intestine; cuticular *mc.*, Median rod; *m.o.*, Mouth opening; *n.*, Nucleus; *o.s.*, Oral sucker; *ov.*, Ovary; *p. c.*, Posterior rod; *p. s.*, Posterior sucker; *p. w.*, Posterior wall of cuticular posterior sucker; *t.*, Testis; *ut.*, Uterus; *vd.*, Vas deferens; *vit.*, Vitelline glands; *vit. d.*, Vitelline duct; *y.*, Yolk.

1·4—2·6×0·71—1·51 ; length being more or less double width. Region behind the cross, 0·9—1·72×0—5·0—69, sub-cylindrical, except in posterior region. Anterior suckers, two, cup-shaped, oval. Posterior suckers, in four pairs, lying ventrally on posterior concave disc of body ; cup-shaped,transversely oval, with five cuticular hollow rods ; the median cuticular rod being U-shaped. Size of suckers variable, usually second pair being the largest, while last is the smallest. Mouth terminal. Prepharynx present. Pharynx globular. Intestine very much branched in anterior region of body ; bifurcating in the posterior region, behind the cross and the intestinal crura uniting again, immediately posterior to ovary ; extending down to second pair of posterior suckers. Testis single, globular, situated behind cross. Ovary large, band shaped, folded upon itself, extending from point of body-cross upto testis. Vitelline follicles numerous, scattered from pharynx to body-cross. Uterus elongate tube, containing only one, mature egg. Egg large, oval, operculate, thickshelled, 0·27—0·29×0·07—0·09, with a very long coiled filament.



TEXT-FIG. 20.—*Diplozoon kashmirensis* ; (*a*) Entire ; (*b*) Posterior region ; (*c*) Posterior suckers ; (*d*) Egg (after Kaw).

a. c., Anterior cuticular rod ; *a. w.*, Anterior wall of posterior sucker ; *c. i.*, Fused intestine ; *eg.*, Egg ; *eg. s.*, Egg shell ; *fil.*, Filament ; *i. c.*, Intestinal caecum ; *int.*, Intestine; *m. c.*, Median cuticular rod ; *mo.*, Mouth ; *nuc.*, Nucleus ; *o. s.*, Oral sucker ; *ov.*, Ovary ; *ovd.*, Oviduct ; *p. c.*, Posterior cuticular rod ; *ph.*, Pharynx ; *prp.*, Prepharynx ; *p. s.*, Posterior sucker (haptoral sucker) ; *p. w.*, Posterior wall of posterior sucker ; *tes.*, Testis ; *ut.*, Uterus ; *vas. d.*, Vas deferens ; *v. d.*, Vitelline duct ; *v. f.* Vitelline follicle ; *v. r.*, Vitelline receptacle ; *yol.*, Yolk.

There are four known species of the genus *Diplozoon*, viz. *D. paradoxum* Nordmann, 1832 ; *D. nipponicum* Goto, 1891 ; *D. indicum* Dayal, 1941 and *D. kashmirensis* Kaw, 1950. Out of these *D. kashmirensis*

resembles *D. paradoxum*, in the comparative size of posterior suckers, the form of testis and ovary and the size of eggs, but differs in the proportion of the body-length to its breadth, the position of union of two worms, the arrangement of intestine in the hind portion of the body and the position of testis. It resembles *D. nipponicum* in the comparative size of suckers, the arrangement of intestine in the hind portion of the body and the form and position of testis, but differs in the proportion of the body length to its breadth, the position of union of two worms, the size and position of the ovary, the size of posterior suckers and absence of sticky glands at the entrance of the mouth. It resembles *D. indicum* only in the arrangement of intestine in the hind portion of the worm but differs from it in the proportion of the body-length to its breadth, the position of crossing of two worms, the comparative size of posterior suckers, the form of testis and the size of eggs.

Host—Freshwater fish, *Schizothorax* sp.

Location—Gills.

Locality—Dal Lake, Kashmir.

(*ii*) Subfamily *Vallisinae* Price, 1943.

Taxonomic Observations.

The subfamily was created by Price (1943) as a monotypic subfamily, with *Vallisia* Perugia & Parona, 1890 as the type genus. Sproston (1946) transferred to it the genus *Protomicrocotyle* of Johnston & Tiegs, 1922, which was put by them under a new subfamily Protomicrocotylinae of the family Microcotylidae Taschenberg, 1879.

Sproston herself does not seem to be very much satisfied with this arrangement and regarded it only as a matter of convenience, and as a temporary measure, until our knowledge of these aberrant forms had increased, since it is the only other monogenetic genus (besides *Vallisia*) in which the ovary is wholly posterior to testes, both genera have the body axis bent at an angle, though in *Protomicrocotyle* this asymmetry is in the posterior quarter of worm. She further states that " the structure of the larval haptor and of the region bearing the asymmetrically placed clamps, indicates that this genus is clearly of a different evolutionary line from *Vallisia*." According to her " it is not more closely allied to Microcotylidae and owing to the limited number of clamps it is perhaps preferable to group it with Discocotylidae—albeit—a somewhat heterogenous assemblage "

It may be added here that both the genera, *Protomicrocotyle* and *Bilateracotyle*, differ fundamentally from *Vallisia* or as a matter of fact, probably from any member of the family Discocotylidae also, in the fact that in both of them the clamp structures are not borne on any structure like a separate, discoid haptor or cotylophore but occur on the posterior part of body proper, itself.

Chauhan (1945) added another genus *Bilateracotyle* to the subfamily Protomicrocotylinae, which he mentioned as a subfamily of the family Microcotylidae. As Sproston transfers the type genus, *Protomicrocotyle* of the subfamily to Vallisinae, which has its type genus as *Vallisia*, the subfamily Protomicrocotylinae which was mono-typic becomes synonymous to Vallisinae.

As pointed out elsewhere in this paper, the subfamily Vallisinae has not been recognised by Dawes (1946 ; 1947) who placed the genus *Vallisia* in the subfamily Discocotylinae of the family Discocotylidae and retained the genus *Protomicrocotyle* under the family Microcotylidae.

As I have had no opportunity to handle specimens of either *Vallisia* or *Protomicrocotyle* I am not in a position to express any opinion in this matter. It may, however, be pointed out that Sproston (1946, p. 399) while discussing the position of the genus *Plectanocotyle*, subfamily Plectanocotylinae, in the family Discocotylidae stated that originally the subfamily Plectanocotylinae Montic., 1903 was placed in the family Hexacotylidae Montic., 1899, which was created for those monogenea with six suckers irrespecitve of their other structures and thus such a heterogenous group included together as widely different forms as Hexabothriidae and *Plectanocotyle*. She further added that it is unnecessary to stress the unimportance of the number of clamps developed in this superfamily (Diclidophoroidea), as it is obviously their structure which is significant, hence also the unreality and ultimate breaking up of the old family Octocotylidae. The importance which should be given to this consideration will be evident from the fact that Price (1943) based his entire classification of the families of the superfamily Diclidophoroidea on the type and details of clamp structure only.

When I apply the above considerations to the clamp structure of the genus *Bilateracotyle*, I find that it is so typically microcotylid in form that the genus *Bilateracotyle* cannot be removed from the family Microcotylidae and placed in the subfamily of such a different nature as Vallisinae. In my opinion, the clamp structure of the genus *Protomicrocotyle* as far as I know it, is so closely allied to the genus *Bilateracotyle* that both of them should come together, in the subfamily Protomicrocotylinae which should be retained under the family Microcotylidae. However, in case, if it is considered that the genus *Protomicrocotyle* cannot be separated from the subfamily Vallisinae and it must remain there, then the use of the subfamily name Protomicrocotylinae will be misleading. Therefore the genus *Bilateracotyle* will then have to be placed under a new subfamily *Bilateracotylinae* subfam. nov. of the family Microcotylidae. The proposed new subfamily will then have provisionally, more or less the same subfamily diagnosis as that given elsewhere for the genus *Bilateracotyle* which will be the type genus.

Subhapradha (1951) created another genus, *Vallisiopsis* and assigned it to the subfamily Vallisinae. In my opinion the clamp structure of this genus is so closely allied and similar to that of forms in the family Gastrocotylidae that I propose to remove this genus from the subfamily Vallisinae and transfer it to the family Gastrocotylidae.

(*d*) Family MICROCOTYLIDAE Taschenberg, 1879.

The family diagnosis is emended here to accommodate the subfamily Protomicrocotylinae.

Family diagnosis : *Diclidophoroidea* Price, 1936 : with Superfamily chraacters.

Haptor or cotylophore symmetrical or asymmetrical. Clamps usually numerous ; a paired series ; relatively small in size, usually weakly

cuticularised, borne on either side of the haptor or on posterior part of body proper. Clamp-sclerites are secondarily the simplest, without any accessory sclerites, arranged in a typical way, each having 2 pairs of curved lateral half-hoops which articulate with a single median U-shaped sclerite or with distal pieces, the dorsal most being spurred; distal end of the haptor with 1 or 2 pairs of larval hooks persisting in adults. Testes numerous, follicular, entirely post-ovarial except in Protomicrocotylinae. Ovary generally in front of testes, situated in the middle third of body, elongate, folded in various ways. Vagina usually single, dorsal or lateral; genital atrium generally with a complicated armature of hooks, in more than one series. Eggs with polar filaments.

Type genus—*Microcotyle* Beneden & Hesse, 1863.

I have included in the family as defined above, two subfamilies; Microcotylinae Monticelli, 1892 and Protomicrocotylinae Johnston & Tiegs, 1922. They can be differentiated as follows :—

Key to Subfamilies of Family Microcotylidae.

Clamps numerous; usually borne on haptor. Ovary pretesticular	*Microcotylinae.*
Clamps generally few 4-6; borne on the posterior end of body proper. Haptor, usually set off from body, muscular, transversely oval, discoidal or dumb-bell shaped bearing 2-3 pairs of hooks. Ovary posttesticular ..	*Protomicrocotylinae.*

(i) Subfamily : *Microcotylinae* Monticelli, 1892.

Syns. *Axininae* Monticelli, 1892.
Axininae Nicoll, 1915.

Subfamily diagnosis : *Microcotylinae* Taschenberg, 1879 ; with Family characters.

Haptor symmetrical or asymmetrical, clamps usually numerous, relatively small in size, borne on either side of haptor, which is variable in form ; haptoral, larval hooks may persist. Testes follicular, post-ovarian. Vagina single. Genital atrium armed with cuticular hooks. Eggs with polar filaments.

Type genus—*Microcotyle* Beneden & Hesse, 1863.

Sproston (1946) gave a key to the genera of subfamily as follows :

Key to Genera of Subfamily Microcotylinae.

1.	Some clamps of modified structure present ..	2.
	Clamps all of the same structure	3.
2.	Modified clamps in two rows on one arc of a fishtail-shaped haptor, which is separated off from the body; anchors absent	*Pyragraphorus* Sproston, 1946.
	Modified clamps on a unilateral extension of the haptor along the body-margin; anchors present.. ..	*Cemocotyle* Sproston, 1946.
3.	Posterior end of haptor at the posterior end of the worm; clamps of equal or unequal size; anchors present or absent	4.
	Posterior end of haptor lateral; a tendency to the suppression of growth on one lateral clamp-row present or not; anchors present (? or absent)	5.

4. An approximately equal number of clamps on either side of the haptor ; clamps of equal size.	
Anchors absent in adult	*Microcotyle* von Beneden & Hesse 1863.
Anchors persist in adult	*Gotocotyla* Ishii, 1936.
Unequal numbers of clamps on either side ; clamps in two parallel rows of equal length ; one row of large clamps and the other of very small clamps (anchors ? absent)	*Lintaxine* Sproston, 1946.
5. One side of haptor more or less suppressed, bearing few clamps, which may be of the normal size or smaller (anchors ? absent)	*Heteraxine* Yamaguti, 1938.
Both sides of haptor equally developed, but a complete suppression in growth of the median haptoral axis ; region of formation of clamps on either side of small anchors in the middle of the straight row of clamps	6.
6. Vaginal pore lateral ; anchors present	*Axine* Abildgaard, 1794.
Vaginal pore mid-dorsal ; anchors ? absent ..	*Axinoides* Yamaguti, 1938.

Some more genera may have to be added to it now to make it up to date, with all the valid genera included.

(ii) Subfamily *Protomicrocotylinae* Johnston & Tiegs, 1922.

This subfamily contains aberrant forms of interest from the phylogenetic point of view. As discussed elsewhere, on one hand it has close affinities with the family Discocotylidae through forms like *Vallisia* (subfamily, Vallisinae) whereas, on the other, it is typically more microcotylid fundamentally, however, at the same time, retaining some special characters of its own, which entitle it to this separate taxonomic independent rank and status.

Subfamily diagnosis: *Microcotylidae* Taschenberg, 1879; with Family characters.

Haptor distinctly set off from body, symmetrical, muscular, discoidal, transversely oval or dumb-bell shaped with 2-3 pairs of hooks. Clamps may be pedunculated, few in number, 4-6 placed asymmetrically on one side or symmetrically in two lateral rows, relatively large in size, at the posterior end of body proper. Testes follicular. Ovary elongate, tubular or lobed. Vagina single, to the left ; simple or aperture surrounded by a cuticularised area bearing numerous short spines. Cirrus and genital pore armed or unarmed. Vitellaria follicular. Egg operculate, with filaments at one or both the poles.

Type genus—*Protomicrocotyle* Johnston & Tiegs, 1922.

The genera included under this subfamily can be differentiated as follows :—

Key to Genera of Subfamily PROTOMICROCOTYLINAE.

Haptor dumb-bell shaped with 2 pairs of hooks. Clamps 5 in number, in one row. Ovary looped ; vagina with its aperture surrounded by a cuticularised area bearing numerous short spines. Cirrus armed. Egg with single polar filament ..	*Protomicrocotyle* Johnston & Tiegs, 1922.

Haptor transversely oval, with 3 pairs of hooks. Clamps pedunculated 6, in two lateral symmetrical rows. Ovary tubular; vagina simple. Cirrus unarmed. Egg with polar filament at both ends — *Bilateracotyle* Chauhan, 1945.

Genus **Bilateracotyle** Chauhan, 1945.

The genus, which is monotypic, was created by Chauhan (1945) with *B. chirocentrosus* as the type species and assigned to the subfamily Protomicrocotylinae (Fam. Microcotylidae). He (Chauhan, 1945, p. 154) characterised the genus by the possession of three pairs of clamps in two rows, on the posterior end of body, an oval haptor; only 20-28 testes; an unarmed, long and tubular cirrus and numerous spines in the genital atrium. Sproston (1946, p. 508-9) transferred the genus to the subfamily Vallisinae (Fam. Discocotylidae). She stated "placed by its author in subfamily Protomicrocotylinae Johnst. & Tiegs, which he follows other authors in assigning to Microcotylidae—though, as pointed out above (p. 407) there seems little reason for this. The new genus resembles *Protomicrocotyle*. The asymmetrically placed haptor is muscular and bears two rows of three pairs of small anchors. Anterior to this, the body bears two rows of three small clamps, similar in type to those of other members of the subfamily. The vagina is unarmed distally, and the egg has two polar filaments" I have discussed its systematic position in detail, while dealing with the subfamily Vallisinae elsewhere in this paper.

Generic diagnosis (*emend.*) : *Protomicrocotylinae* Johnston & Tiegs, 1922 ; with Subfamily characters.

Body elongate, asymmetrical, with two elliptical buccal suckers. Intestine bifurcate ; the two lateral caeca, have lateral ramifying branches especially on their outer sides. Haptor distinctly set off from the body, transversely oval, muscular, with 3 pairs of dissimilar hooks but with no other organ running into it. Clamps pedunculated, three pairs, situated symmetrically, in 2 lateral rows, at the posterior end of body proper. Peduncles retractile. Clamp structure typically microcotylid in form. Testes follicular, 20-28, situated in the middle of body, preovarian, intercaecal. Vesicula seminalis very long, sinuous and with well developed prostate gland cells, tubular. Cirrus unarmed. Ovary elongate, median, situated in the anterior portion of posterior half of body, not lobed. Vagina on the left, simple, unarmed. Genito-intestinal canal present. Genital pore situated on the right, elliptical, large, armed with a coronet of long 24-38 cuticular spines. Vitellaria large, follicular. Uterine egg single, elliptical, operculate with a short coiled polar filament at both the poles.

Parasites of marine fishes.

Type species—*B. chirocentrosus* Chauhan, 1945.

18. **Bilateracotyle chirocentrosus** Chauhan, 1945.

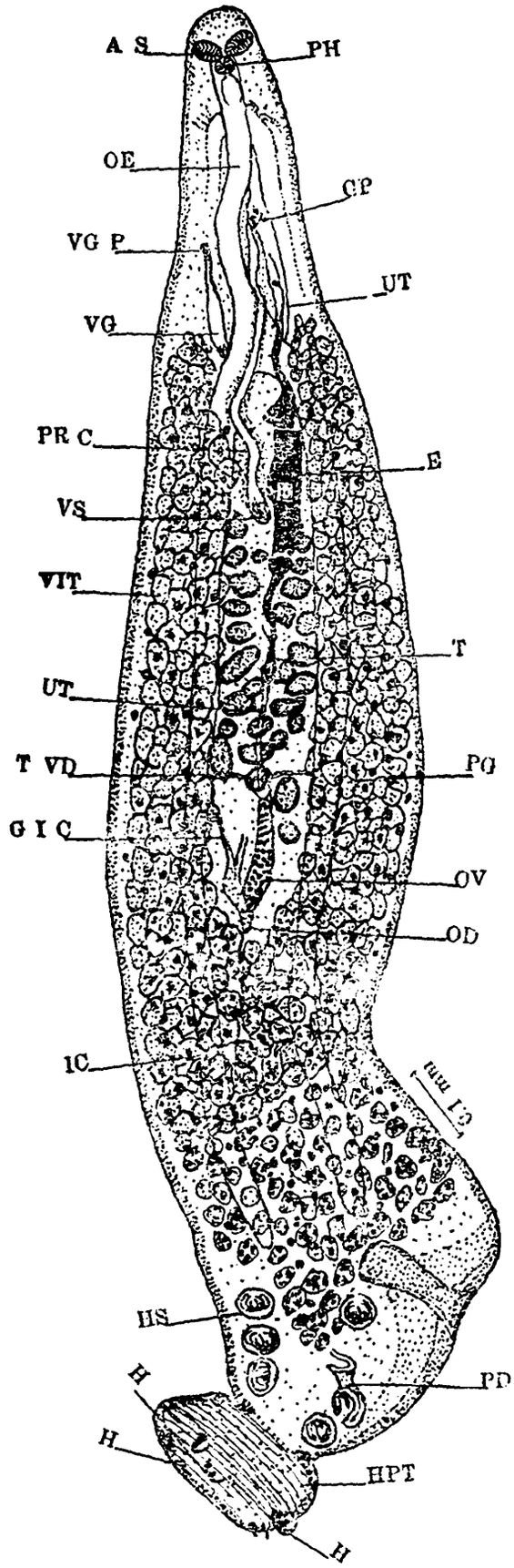
(Text-fig. 21, 22 *a, b, c, d.*)

Sproston, N. G. (1946), *Trans. zool. Soc. Lond. 25* (4) : 508-509.

Manter, H. W. and Donald F. Prince (1953) *Proc. hel. Soc. Washington* **20** (2) : 107.

Specfic diagnosis : *Bilateracotyle* Chauhan, 1945 ; with Generic characters.

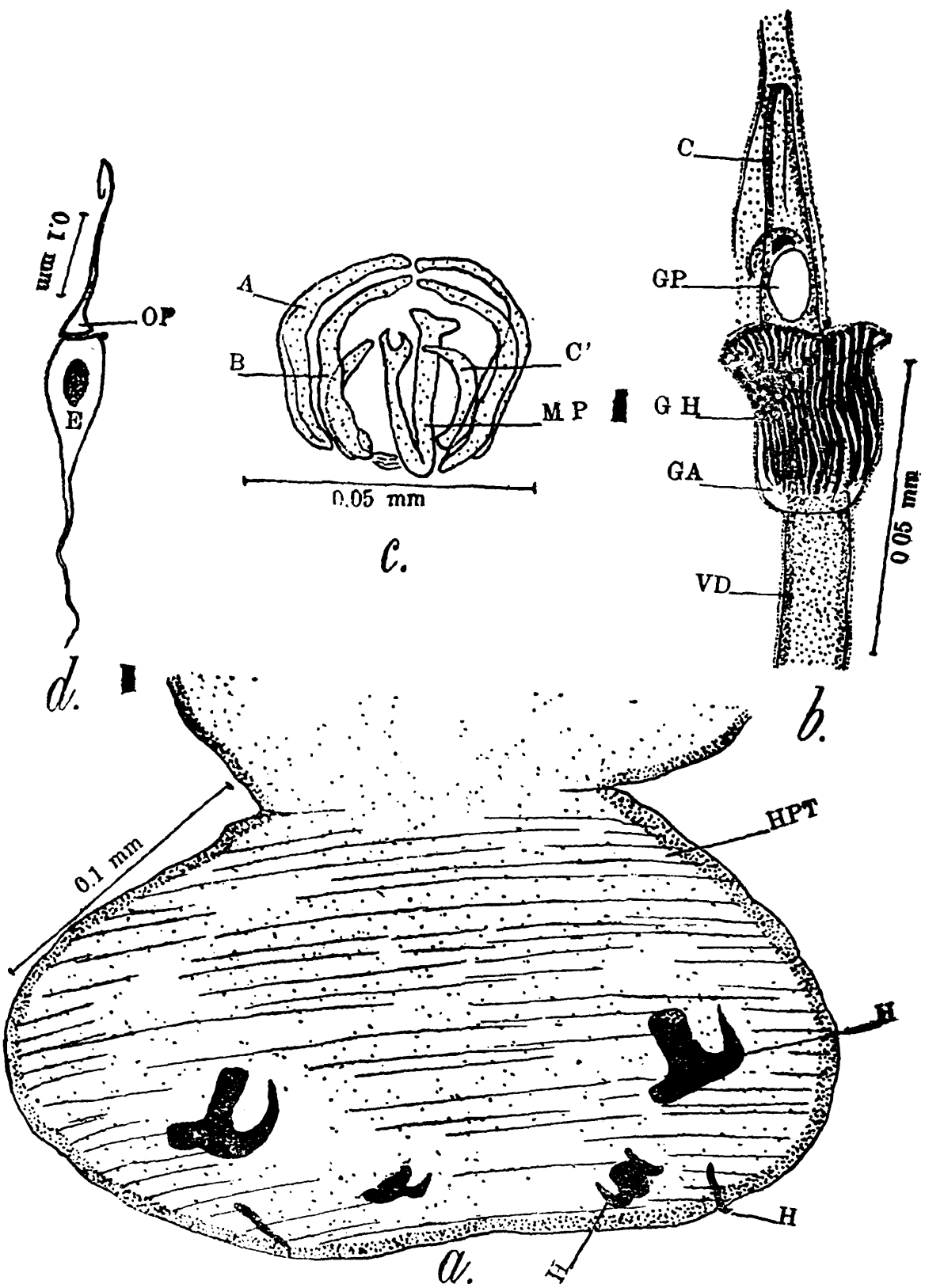
Body asymmetrical, elongate, tapering anteriorly, 2·05×0·41 (maximum). Haptor distinctly set off from body proper, discoidal, transversely oval, highly muscular, usually with three, dissimilar pairs of hooks.



TEXT-FIG. 21.—*Bilateracotyle chirocentrosus*, entire view, dorsal (after Chauhan).

AS, Anterior sucker; *GIC*, Genito-intestinal canal; *GP.*, Genital pore; *E*, Egg., H., Haptoral hooks; *HPT*, Haptor; *HS*, Haptoral sucker; *IC*, Intestinal caecum; *OD*, Oviduct; *OV.*, Ovary; *OE*, Oesophagus; *PD.*, Peduncle; *PH*, Pharynx; PRC, Prostate gland cells; *T*, Testes; *T. VD*, Transverse vitelline duct; *UT*, Uterus; *VG*, Vagina; *VG P*, Vaginal pore; *VIT*, Vitellaria; *VS* Vesicula seminalia.

Posterior end of body proper with three pairs of cuticular clamps, on retractile peduncles, in two symmetrical, lateral rows; structure of clamp sclerites typically microcotylid in nature. Anterior or buccal suckers elongately oval, with membranous septa. Pharynx bulb-shaped. Oesophagus very long, slightly sinuous. Intestine bifurcated



Text-fig. 22.—*Bilateracotyle chirocentrosus*; (*a*) Haptor, showing three pairs of haptoral hooks; (*b*) Genital atrium, showing genital spines; (*c*) Frame-works of cuticular pieces of haptoral sucker; (*d*) Egg. (after Chauhan).

A, Outermost; *B*, Middle; *C'*, Innermost and *MP*, Median pieces of the cuticular framework of the haptoral sucker; *C''*, Cirrus protruded out; *E*, Egg., *GA*, Genital atrium; *GH*, Genital hooks, *GP*, Genital pore; *H*, Haptoral hooks; *OP*. Operculum; *HPT*, Haptor; *VD*, Vas deferens.

with ramifying branches laterally, not united posteriorly, terminating just anterior to clamps. Testes follicular, 20-28, situated in middle third of body, intra-caecal, pre-ovarian. Vas deferens much coiled. Vesicula seminalis very long, sinuous tube, surrounded by well developed prostatic gland cells. Cirrus tubular, long, unarmed. Genital pore on right side, midway between pharynx and intestinal bifurcation. Genital atrium elliptical, large, armed by a coronet of long 24-38 cuticular spines. Ovary median, elongate, situated in anterior portion of posterior half of body. Genito-intestinal canal present. Vitellaria large, follicular, extending from the point of intestinal bifurcation to suckers. Uterus median. Vagina a simple tube, opening laterally on left side, slightly below the level of genital pore. Uterine egg single, spindle-shaped, operculate, with polar filaments, 0·23×0·04 (without filaments). (Type species.)

Host.—*Sciaena belengeri* (type) ; *Chirocentrosus dorab.*

Location.—Gills.

Locality.—Bombay ; Arabian sea, Indian Ocean.

(*e*) Family GASTROCOTYLIDAE Price, 1943.

The forms belonging to this family were formerly included under the closely allied family Microcotylidae Taschenberg, 1879. They also indicate certain resemblances with family Discocotylidae. Price (1943) separated them under a separate and independent family, Gastrocotylidae. He also gave a brief diagnosis. Chauhan (1945) and Dawes (1946) accept independent status of this taxonomic unit. However, Sproston (1946) regards it only as subfamily, Gastrocotylinae Sproston, 1946, of the family Microcotylidae.

Chauhan (1945, p. 155) while creating the genus *Pricea* observed that if criterion of Price for basing the classification of families on the structure and arrangement of the cuticular pieces of framework of haptoral clamps or suckers is followed strictly, probably a new family will have to be created to accommodate his three species of his genus. He further stated that there are a large number of other differences as well to warrant that. However, since this family was in a process of revision by Price himself, he contented himself then, by creating the new genus only, without then proposing a new family for his genus containing these three new species.

He, however, now proposes that the family Gastrocotylidae should be divided into two subfamilies. Subfamily, 1. Gastrocotylinae Sproston (1946) *emend.*, with *Gastrocotyle* (as Type genus) and the other genera included there being *Pseudaxine*, *Vallisiopsis* and Subfamily, 2. *Priceinae*, subfam. nov. with *Pricea* as type genus and other genera included under it being *Thoracocotyle* and *Lithidiocotyle.*

Family diagnosis : *Diclidophoroidea* Price, 1943 ; with characters of the Superfamily.

Haptor with numerous small clamps. Cotylophore may be a simple lateral flange like process, bearing a single row of small clamps ; may also be equipped with 2-3 pair of dissimilar terminal hooks at the tip of haptor and additional hooks on body or haptor (as in *Pricea*). The

clamps may be arranged along the margin of a very large and asymmetrical cotylophore, occupying the posterior two-third of body. Clamps structure stout, consisting of two pairs of lateral pieces, joined but not fused distally; those of the more dorsal lateral pair with curved, inwardly directed spurs; one pair of basal pieces, meeting the laterals; a single curved middle piece, simple or composite which may bifurcate ventrally and additional pair of submarginal, dorsal to main spring and additional pieces sometimes presenting U-shaped appearance and extending from the ventral lateral towards middle sclerite, in one of the valves. Additional sclerites in varying number, in the form of ventral, rib-like, thin, cuticular, transverse bars or plaques between the lateral pairs and middle piece, as in the subfamily Plectanocotylinae (Fam: Discocotylidae) may be present. Testes few, occupying posterior region. Ovary pre-testicular, elongate, folded. Vagina single, opening mid-dorsally. Eggs, each with two pointed filaments. Genital atrium may be armed with a corona of spines. Male pore may bear a simple regular corona of spines or the penis itself is protrusible and regularly armed.

Type genus—*Gastrocotyle* Beneden & Hesse, 1863.

Key to Subfamilies of Family Gastrocotylidae.

Haptor unilateral; rib-like thickenings in clamp-capsule absent; anchors present	*Gastrocotylinae* Sproston, 1946, *emend.*
Haptor bilateral; rib-like thickenings in clamp-capsule present; anchors present or absent	*Priceinae, sub. fam. nov.*

(*i*) Subfamily *Gastrocotylinae* (Sproston, 1946), *emend.*

Subfamily diagnosis: *Gastrocotylidae* Price, 1943; with Family characters.

Haptor unilateral. Rib-like thickenings or plaques in clamp-capsule absent. Anchors present, structure of clamp sclerites as in the genus *Gastrocotyle.*

Type genus—*Gastrocotyle* van Beneden & Hesse, 1863.

Key to Genera of Subfamily Gastrocotylinae (Sproston, 1946), *emend.*

1.	Haptor a terminal frill not covering region of gonads; anchors lateral	*Pseudaxine* Parona & Perugia, 1890.
	Haptor extending forward beyond region of gonads; anchors terminal	2.
2.	Haptor a marginal frill of body; clamp structures numerous; gonads situated in the middle of haptoral portion of body; terminal hooks 2-3 pairs ..	*Gastrocotyle* van Beneden & Hesse, 1863.
	Haptor distinctly separated from body in proper; clamp structures, and gonads situated in region of union of body proper and haptor; 4 pairs; terminal hooks one pair	*Vallisiopsis* Subhapradha, 1951.

(1) Genus **Gastrocotyle** Beneden & Hesse, 1863.

Syn. *Gastrocotyla* Ishii & Sawada, 1938.

Generic diagnosis: *Gastrocotylinae* (Sproston, 1946), *emend.*; with Subfamily characters.

Anterior half of body narrow; posterior wide and with a haptor. Haptor a marginal frill of body, with a single row of numerous, small clamps extending along one side of body to about half way between the anterior end of ovary and vaginal pore. Clamp skeleton with characteristic U-shaped pair of sclerites on middle piece and ventral end of spring attached to ventral loop by bifurcate extensions on both sides of bifurcate end. Rib-like thickenings from the capsule wall absent. Two or three pairs of hooks on terminal lappet. Male pore armed with a regular corona of stout hooks on the genital bulb. Vagina unarmed; pore in the median dorsal line, some way posterior to male pore. Ovary with distal end directed backwards.

Type species—*Gastrocotyle trachuri* van. Ben. & Hesse, 1863.

19. **Gastrocotyle indica** Subhapradha, 1951.

(Text-fig. 23, *a, b, c, d, e, f, g, h, i.*)

Specific diagnosis : *Gastrocotyle* van. Beneden & Hosse, 1863; with Generic characters.

The species is characterised by the haptoral frill not extending beyond the gonads and stopping short of posterior end of ovary; an accessory sclerite being present in dorsal wall in connection with the spring; there being two pairs of hooks on a short languette; the ovary being in the form of an elongated loop.

Length 3·0×530μ width (maximum). Number of clamps varies according to age, maximum number recorded being 36. Two pairs of anchors, one behind the other, on a short languette. Shape of anchor as in *Pseudaxine*. Genital corona with 11-12 hooks, with bifid bases. Ovary in the form of loop, with distal end directed backwards, its greater part lying anterior to haptoral frill. Intestinal crura branched. The two intestinal crura unite together posterior to gonads.

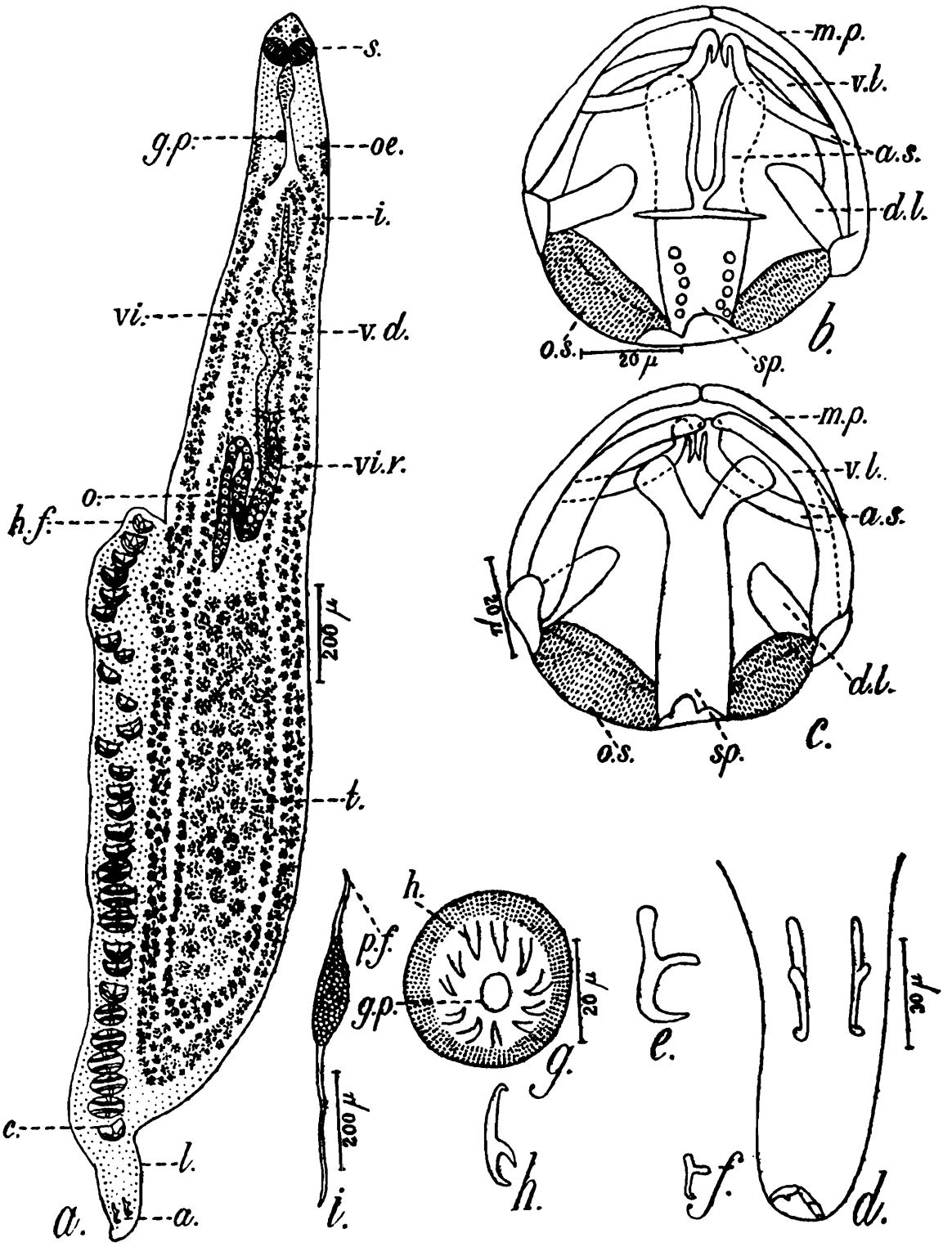
Subhapradha (1951) states that the species agrees with the generic diagnosis of *Gastrocotyle* given in Sproston's work (1946), except that, first, the haptoral frill does not extend forward beyond the gonads and stops short of the posterior end of the ovary, and secondly, the bifurcate ventral end of the spring is not further divided. She does not consider these differences as of generic importance and hence included the species in *Gastrocotyle*. She further records that the species differs from both the existing species in the presence of an additional sclerite in the dorsal wall of the capsule in connection with the spring. It differs from *G. trachuri* in having two pairs of anchors instead of three pairs and from *G. japonica* in the shape of the ovary. In *G. japonica* the ovary is oval, while it is in the form of a loop in *G. indica*.

Host.—Marine fish, *Caranx kalla* Cuv. and Val.
Location.—Gills.
Locality.—Madras.

(2) Genus **Vallisiopsis** Subhapradha, 1951.

The genus was created by Subhapradha (1951). She placed it under the subfamily Vallisinae of the family Discocotylidae. I have discussed under the subfamily Vallisinae, the reasons for its transfer under this family.

Generic diagnosis : *Gastrocotylinae* (Sproston, 1946), *emend.*; with Subfamily characters.



Text-fig. 23.—*Gastrocotyle indica* ; (*a*) Entire specimen, mounted ; (*b*) Clamp skeleton, dorsal view ; (*c*) Clamp skeleton, ventral view; (*d*) Languette, showing the arrangement of the anchors ; (*e*) Larger anchor, lateral view ; (*f*) Smaller anchor, lateral view ; (*g*) Genital corona, front view ; (*h*) Genital hook, lateral view ; (*i*) Egg (after Subhapradha).

a., Anchor ; *a. s.*, Accessory sclerite ; *c.*, Clamp ; *d.l.*, Dorsal loop ; *g.p.*, Genital pore ; *h.*, Hook ; *h. f.*, Haptoral frill ; *i.*, Intestine ; *l.*, Languette ; *m. p.*, Middle piece ; *o.*, Ovary ; *oe.*, Oesophagus ; *o. s.*, Optical section of anterior wall of the capsule ; *p. f.*, Polar filament ; *s.*, Sucker ; *sp.*, Spring ; *t.*, Testis ; *v. d.*, Vas deferens ; *vi.*, Vitellaria ; *vi. r.*, Vitelline reservoir ; *v. l.*, Ventral loop.

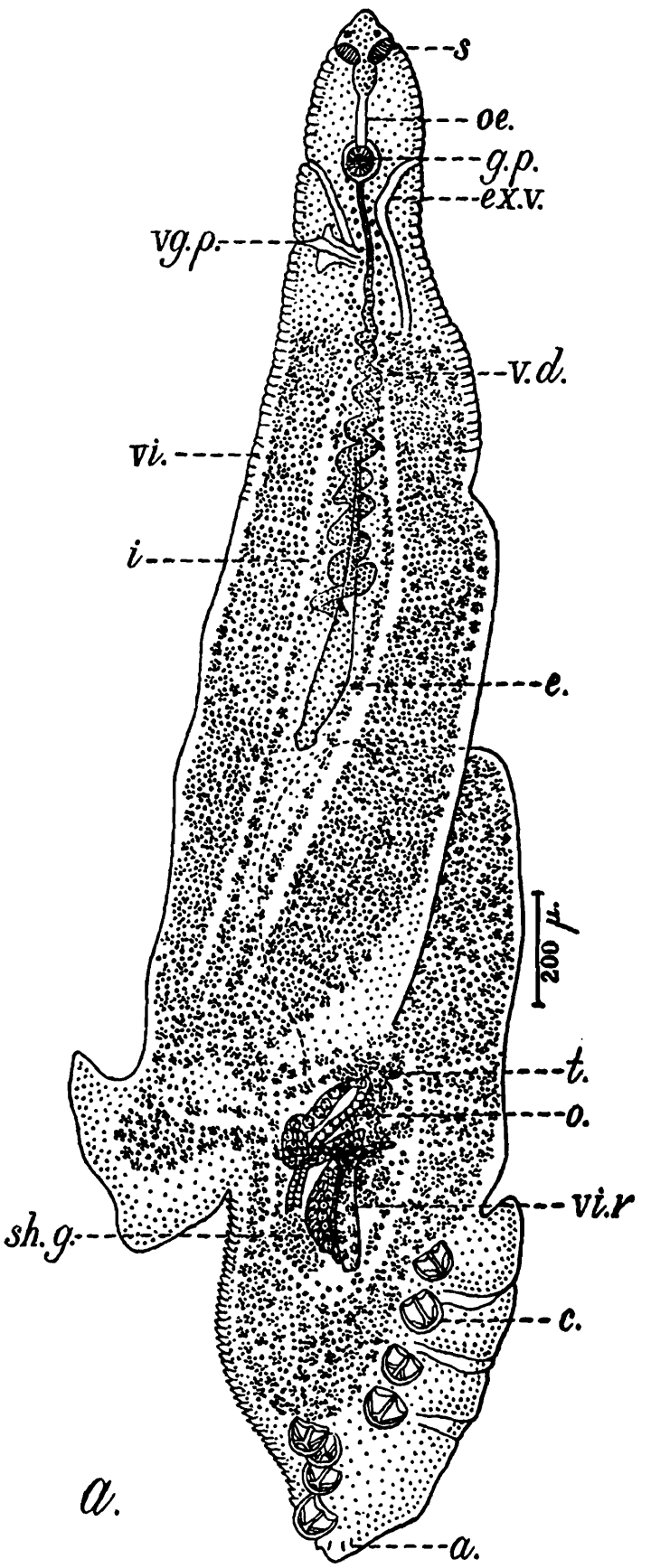
Both the body and the haptor asymmetrical ; gonads lying in the posterior half of the body ; testes follicular, overlapping the anterior part of the ovary and also extending anterior to it ; genital pore armed with hooks ; cirrus armed ; oesophagus long, extending below the genital pore ; haptor with four clamps on either side and one pair of anchors ; clamp skeleton resembles Discocotylids ; with one pair of accessory sclerites ; eggs spindle-shaped, with polar filaments.

Parasites of marine fishes.

Type species—*Vallisiopsis contorta* Subhapradha, 1951.

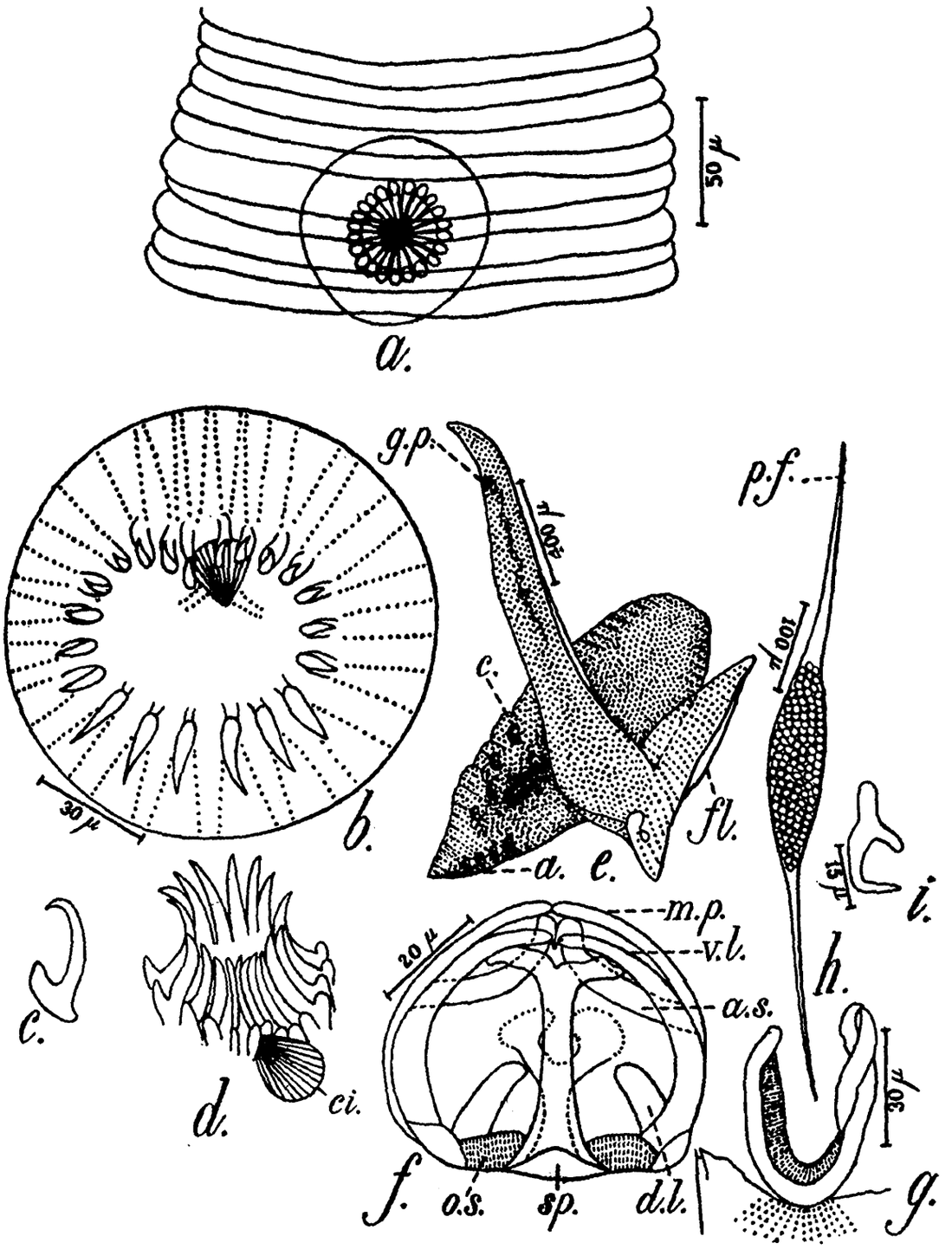
20. **Vallisiopsis contorta** Subhapradha, 1951.

(Text-figs. 24; 25, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*.)



TEXT-FIG. 24.—*Vallisiopsis contorta*; entire specimen, mounted (after Subhapradha). *a.*, Anchor; *c.*, Clamp; *e.*, Egg; *ex. v.*, Excretory vessel; *g. p.*, Genital pore; *i.*, Intestine; *o.*, Ovary; *oe.*, Oesophagus; *s.*, Sucker; *Sh. g.*, Shell gland; *t.*, Testis; *v. d.*, Vas deferens; *vg. p.*, Vaginal pore; *vi.*, Vitellaria; *vi. r.*, Vitelline reservoir.

The species is characterised in having genital corona with 20-21 hooks; vaginal pore being lateral, below the level of common genital pore and ovary in the form of a double loop.



Text-fig. 25.—*Vallisiopsis contorta*; (*a*) Part of an entire specimen magnified, to show the ringed appearance of the surface of the body; (*b*) Genital corona with cirrus, front view; (*c*) Genital hook, lateral view; (*d*) Genital corona, with cirrus, lateral view; (*e*) Entire specimen, drawn from life, showing the natural disposition of the various parts of the body; (*f*) Clamp skeleton, ventral view; (*g*) Lateral view of clamp, partly open; (*h*) egg; (*i*) Anchor, lateral view (after Subhapradha).

a., Anchor; *c.*, Clamp; *c. i.*, Cirrus; *d. l.*, Dorsal loop; *fl.*, Flap; *g. p.*, Genital pore; *m. p.*, Middle piece; *o. s.*, Optical section of anterior wall of the capsule; *p. f.*, Polar filament, *sp.*, Spring., *v. l.*, Ventral loop.

Specific diagnosis : *Vallisiopsis* Subhapradha, 1951; with Generic characters.

Body asymmetrical, bent upon itself and also twisted. In normal condition anterior part lies at right angle to the posterior ; dorso-ventral axis of anterior part is twisted through about 90° ; just at the region where body is flexed there is a flap-like outgrowth. Entire surface of body transversely ringed, presenting laterally serrated appearance. Maximum length 3·5. Haptor asymmetrical, with a pair of hooks terminally and 4 pairs of clamps on each side, placed asymmetrically. Clamp skeleton is recorded typically Discocotylid in pattern and bearing a pair of accessory sclerites in connection with the middle piece, very similar to U-shaped pair of sclerites present in Gastrocotylinae. Two rami of middle piece, joined or quite distinct. Oesophagus long. Intestinal crura branched, the two arms uniting together, posterior to gonads. Testes follicular, ovarlapping anterior half of ovary and extending beyond it. Ovary in the form of double loop ; extending posterior to testes. Vitellaria follicular, co-extensive with intestinal rami. Eggs spindle-shaped, with polar filaments, length 750μ, with filaments ; 200μ, without filament ; width 50μ.

Host.—Marine fish, *Lactarius lactarius* (Bl. Schn.)

Location.—Gills.

Locality.—Madras, India.

(3) Genus **Pseudaxine** Parona & Perugia, 1890.

Generic diagnosis : *Gastrocotylinae* (Sproston, 1946), *emend.* ; with Generic characters.

Haptor unilateral, placed at the posterior end of body, at right angle to body, transversely elongate, not covering region of gonads, clamps in a single row, on the cotylophore. Structure of clamp sclerites, typical of the family and as in *Gastrocotyle*, without rib-like thickening. Terminal lappet, stout at the posterior end of cotylophore, with a large and a small pair of hooks, with bifid roots. Ovary elongate. Genital atrium armed. Genital corona simple. Vagina single, opening in a mid dorsal pore or paired and opening in lateral pores near pharynx. Egg uterine, single, with polar filaments.

Type species—*Pseudaxine trachuri* Parona and Perugia, 1890.

21. **Pseudaxine indicana** Chauhan, 1945.

(Text-figs. 26 ; 27, *a, b, c, d, e, f, g, h, i.*)

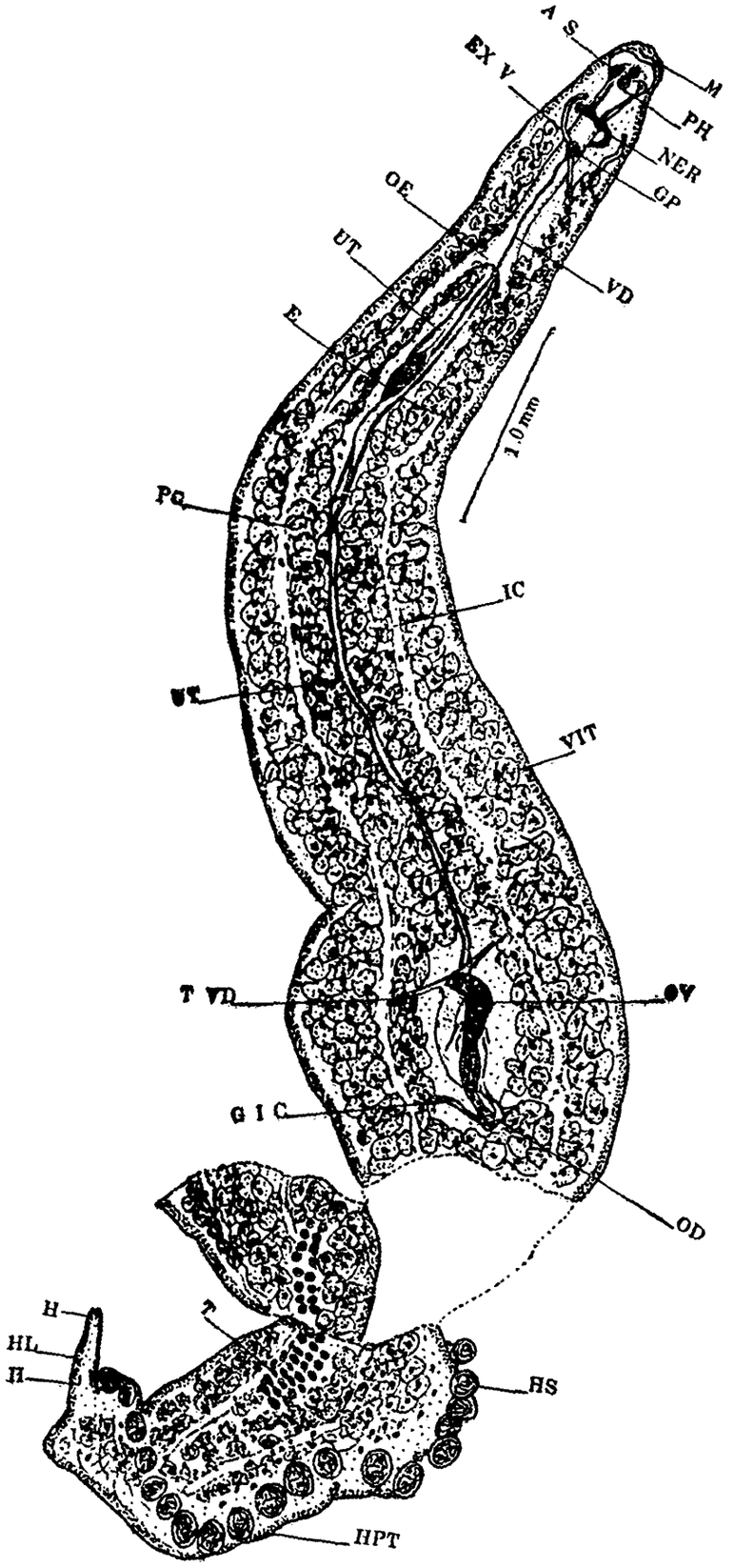
Sproston, N. G. (1946). *Trans. Zool. Soc. Lond.* **25** (4) : 465.

Manter, H. W. and Donald F. Prince (1953). *Proc. Hel. Soc. Washington*, **20** (2) : 108.

Specific diagnosis : *Pseudaxine* Parona & Perugia, 1890 ; with Generic characters.

Body elongate, tapering anteriorly, broad posteriorly, 9·16×1·6 (maximum). Haptor or cotylophore fan-shaped, separated from body by a notch, carrying 19 suckers or clamps, in a single row, on its lower margin. Cuticular structure of clamp sclerites typical. Extreme end of cotylophore carries an elongated, proboscis-like process (hence the specific name *indicana*) bearing 2 pairs of hooks, one in the middle and the other at the tip. Mouth terminal, with two egg-shaped anterior buccal suckers. Pharynx oval. Oesophagus present. Intestinal crura, with lateral, ramifying diverteculae specially on the outer side. Crura

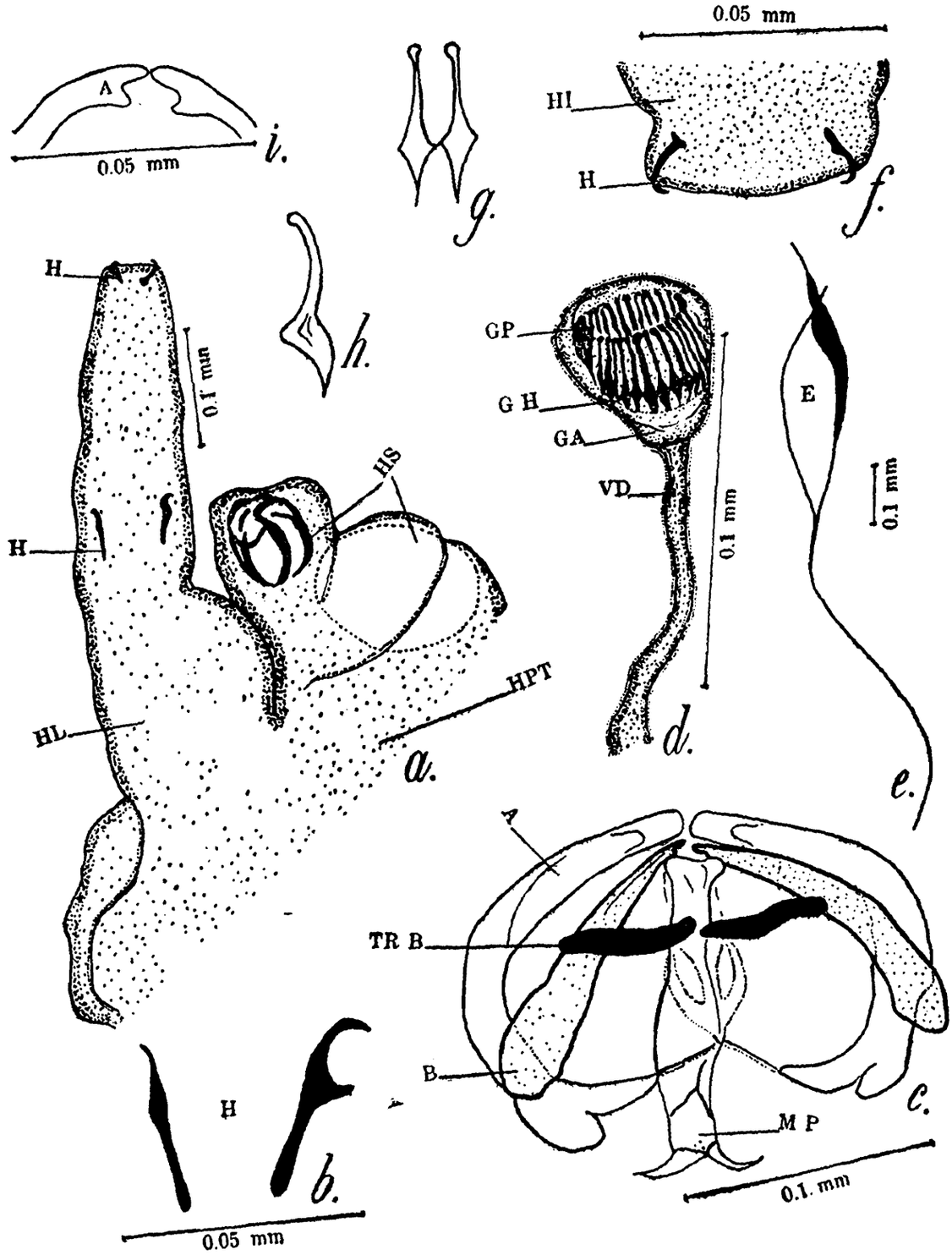
separate posteriorly. Testes small, follicular, about 40, lying irregularly inter-caecal, in two rows, anteriorly and three, posteriorly, post-ovarian;



Text-fig. 26.—*Pseudaxine indicana*; entire view (after Chauhan).

AS., Anterior sucker; *E.*, Egg; *Ex. V.*, Excretory vessel; *GIC.*, Genito-intestinal canal; *GP.*, Genital opening; *H.*, Haptoral hooks; *HL.*, Haptoral languette; *HPT.*, Haptor; *HS.*, Haptoral sucker; *IC.*, Intestinal crura; *M.*, Mouth; *NER.*, Part of nervous system; *OD.*, Oviduct; *OE.*, Oesophagus; *OV.*, Ovary; *PH.*, Pharynx; *T.*, Testis; *TVD.*, Transverse vitelline ducts; *UT.*, Uterus; *VD.*, Vas deferens; *VIT.*, Vitellaria.

a few extending into haptor. Genital pore lying on oesophagus, halfway between pharynx and intestinal bifurcation, armed with a coronet of 24 hooks. Ovary elongate, cylindrical, medial, in posterior half of body. Genito-intestinal canal present. Vitellaria on both sides of body, from the level of genital pore, to end of cotylophore. Uterine egg, single, with polar filaments, 0·3×0·08 (without filament).



TEXT-FIG. 27.—*Pseudaxine indicana* ; (*a*) Haptoral languette ; (*b*) Second pair of haptoral hooks, situated in the middle length of the languette ; (*c*) Framework supporting the haptoral sucker ; (*d*) Genital atrium, showing the genital hooks and genital pore ; (*e*) Egg ; (*f*) Terminal portion of languette, showing the first pair of haptoral hooks ; (*g*) Genital hooks, enlarged ; (*h*) Genital hook, lateral view ; (*i*) Outermost piece, lateral view (after Chauhan).

A, Outermost ; *B*, Middle piece of Clamp ; *E*, Egg.; *GA*, Genital atrium ; *GH* ; Genital hooks ; *GP*, Genital pore ; *H*, Haptoral hooks ; *HL*, Haptoral languette ; *HS*, Haptoral sucker ; *HPT*, Haptor ; *MP*, Median piece of the cuticular framework of the haptoral sucker ; *TRB*, Transverse bar ; *VD*, Vas deferens.

The species differs from other species of the genus in the general shape of body, in the number of testes and suckers, in the number and shape of hooks in the genital atrium, in the position of ovary and particularly in the structure of frame work of haptoral suckers or clamps.

Host.—Marine fish, *Chrysophrys berda.*

Location.—Gills.

Locality.—Bombay ; Arabian Sea, Indian Ocean.

(ii) Subfamily *Priceinae*, subfam. nov.

Subfamily diagnosis : *Gastrocotylidae* Price, 1943 ; with Family characters.

Haptor bilateral. Rib-like thickenings or plaques in clamp-capsule present. Anchors present. Structure of clamp-sclerites as in the genus *Pricea* ; much different from what in the genus *Gastrocotyle* ; specially middle piece, the shape of additional cuticular transverse bars, etc.

Type genus—*Pricea* Chauhan, 1945.

Key to Genera of Subfamily Priceinae, **subfam. nov.**

1. Haptor a bilateral marginal frill, extending forward beyond the region of gonads ; anchors present ..	*Thoracocotyle*	MacCallum, 1913.
Haptor bilateral, separate from body proper ; placed posterior to the region of gonads ..	2.	
2. Haptor a bilateral frill on a posterior extension of body with the two intestinal caeca extending into it ; clamp structures a single row ; terminal anchors on cotylophore not persisting in adult ; vagina smooth ; cirrus long, with many spines	*Lithidiocotyle*	Sproston, 1946.
Haptor a well developed organ, separate from body proper, attached to it at its posterior end ; the two intestinal caeca not extending into it ; clamp structures in double row with retractile peduncle. Vagina with a U-shaped cuticular skeleton. Cirrus has only 10-15 spines. Prehaptoral (Body hooks) present ; terminal end of cotylophore with a pair of hooks	*Pricea* Chauhan, 1945.	

Genus **Pricea** Chauhan, 1945.

Sproston, N. G. (1946). *Proc. Zool. Soc. Lond.* **25** (4) : 469.

Ramalingam, K. (1952). *Rec. Ind. Mus.* **49** (32 and 4) : 337—348.

Ramalingam, K. (1953). *Zool. Soc. India.* **5** (1) : 59—63.

Generic diagnosis : *Priceinae*, subfam. nov. ; with Family characters.

Body elongate, with two elliptical, oral suckers ; intestinal crura discontinuous, with ramifying lateral branches into the vitellaria, specially on the outer sides, terminating before the beginning of the haptor ; a pair of hooks present, at one end of the haptor and one pair above it in the posterior portion of the body proper. Testes post-ovarian 25-38, follicular, not extending beyond the ends of the intestinal crura. Vitellaria follicular, extending from the level of genital pore anteriorly, to the termination of the intestinal caeca, posteriorly. Vaginal opening situated

at the point of bifurcation of oesophagus into intestinal limbs, having a pouch and a U-shaped cuticular hook. Genital pouch situated on the oesophagus, halfway between the pharynx and oesophageal end. It has twelve paired cirrus hooks. Ovary situated in the mid-region. Haptoral suckers with a characteristic structure, situated on both sides of the haptor, in double row, the number varying from 70-122. They may be pedunculated, retractile. Excretory pores two, lateral, situated in the region, slightly below the brain. Parasites of marine fishes.

Type species—*Pricea multae* Chauhan, 1945.

The genus was created with *P. minimae* Chauhan, 1945 and *P. microcotylae* Chauhan, 1945, as the other species besides the Type.

Ramalingam (1952) added another six species from marine fish *Cybium guttatum* from Madras.

He gave a key to the species of the genus, as follows :

Key to Species of Genus PRICEA Chauhan, 1945.

1.	Body hooks present	2.
	Body hooks absent	5.
2.	Number of hooks two	3.
	Number of hooks one	4.
3.	Number of testes 26, genital hooks 12	*P. multae* Chauhan, 1945
	Number of testes 28, genital hooks 10 . ..	*P. minimae* Chauhan, 1945
	Number of testes 25, genital hooks 12	*P. microcotylae* Chauhan, 1945.
	Number of testes 31, genital hooks 14	*P. armatum* Ramalingam, 1952.
4.	One hook in the body only	*P. melane* Ramalingam, 1952.
	One hook in the body and other hook in the haptor ..	*P. tricanthum* Ramalingam, 1952.
5.	Additional hooks present in the haptor	6.
	Additional hooks absent in the haptor ..	*P. robustum* Ramalingam, 1952.
6.	Two additional hooks in the haptor ..	*P. tetracanthum* Ramalingam, 1952.
	One additional hook in the haptor only	*P. minutum* Ramalingam, 1952.

Ramalingam also gave a comparative table showing the characters of the various species of the genus. I am appending it to this paper.

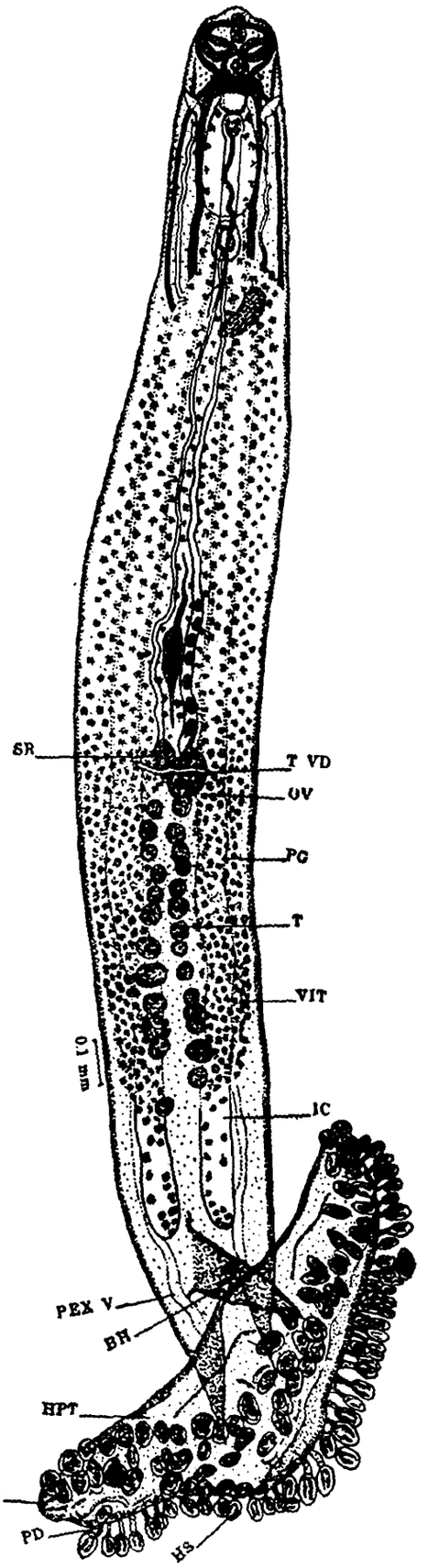
In view of these key and chart, I am not giving below, in this paper, the specific diagnosis of other than the type species.

22. **Pricea multae** Chauhan, 1945.

(Test-figs. 28 ; 29 ; 30 ; *a, b, c, d, e, f.*)

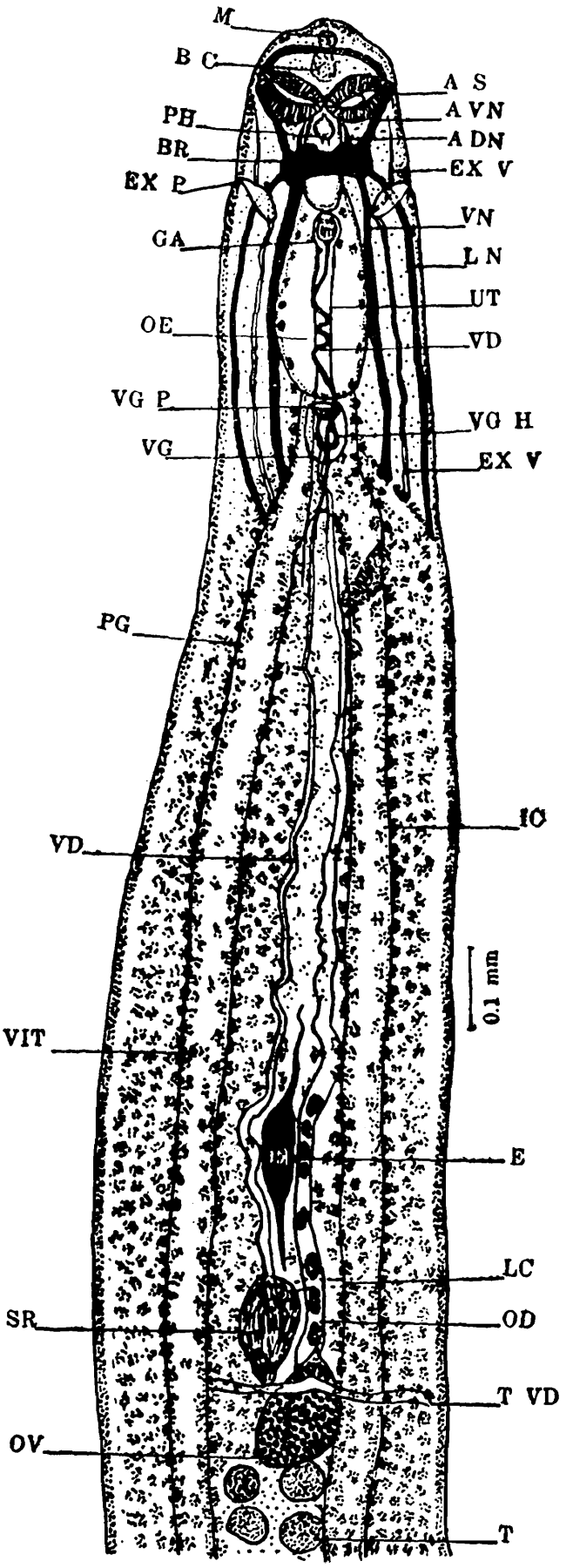
Specific diagnosis : *Pricea* Chauhan, 1945 ; with Generic characters.

Body elongate, cylindrical, slightly tapering anteriorly, 3·22×0·4. Haptor distinctly set off from body, at right angles to it, folded upon



Text-fig. 28.—*Pricea multae*; entire specimen (after Chauhan).

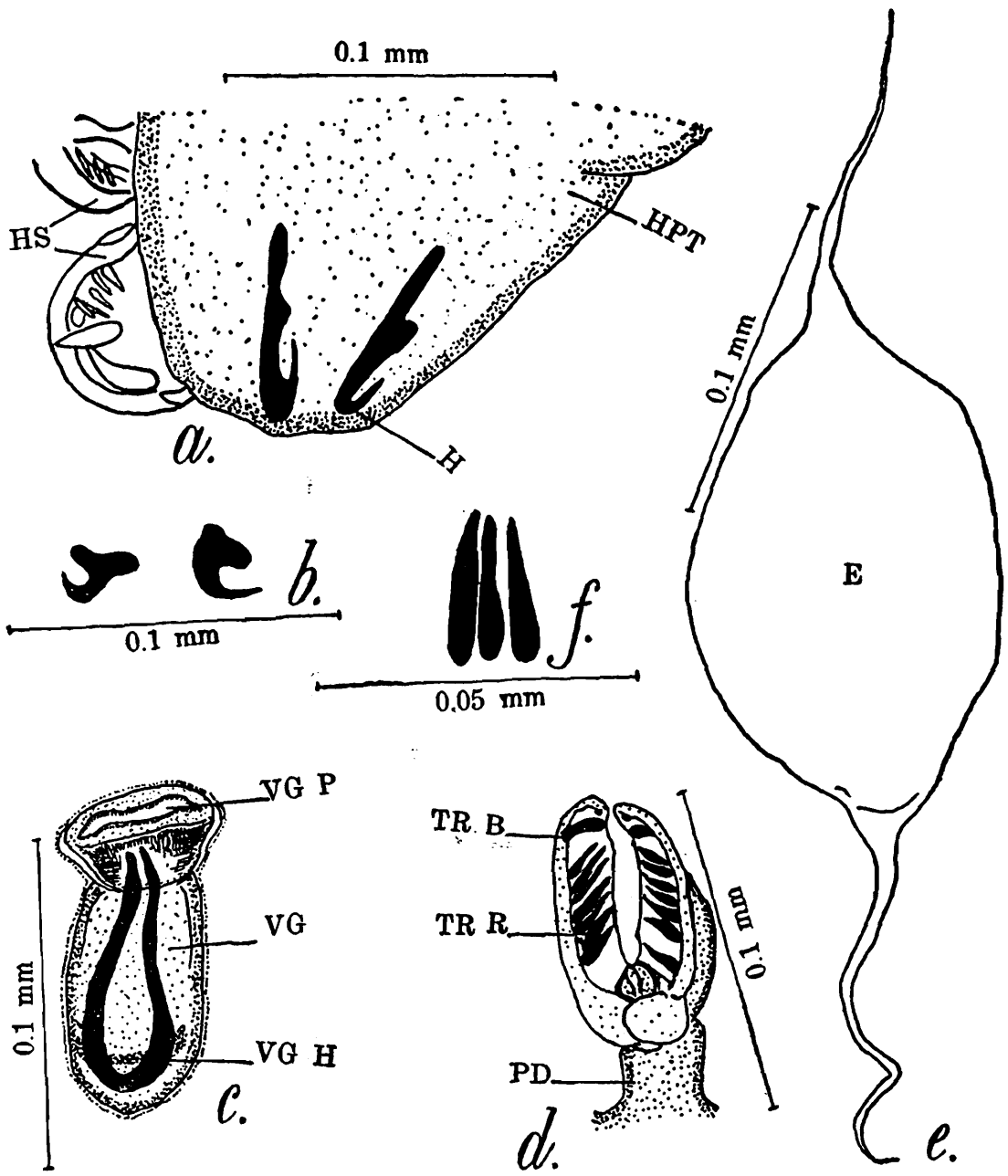
BH, Pre-haptoral hook; *H*, Haptoral hook; *HS*, Haptoral sucker; *HPT*, Haptor; *IC*, Intestinal crura; *OV*, Ovary; *PD*, Peduncle; *PEX V*, Posterior excretory vessel; *SR*, Receptaculum seminis; *T*, Testis; *TVD*, Transverse vitelline yolk ducts; *VIT*, Vitellaria.



TEXT-FIG. 29.—*Pricea multae* ; only anterior half of the parasite (after Chauhan).

AS., Anterior sucker ; *A DN.*, Anterior dorsal nerve ; *A VN.*, Anterior ventral nerve ; *B. C.*, Buccal cavity ; *BR.*, Brain ; *E.*, Egg., *EX P.*, Excretory pore ; *EX V.*, Excretory vessel ; *GA.*, Genital atrium ; *IC.*, Intestinal crura ; *LC.*, Laurer's canal ; *LN.*, Lateral nerve ; *M.*, Mouth ; *OD.*, Oviduct ; *OE.*, Oesophagus ; *OV.*, Ovary ; *PH.*, Pharynx ; *SR.*, Receptaculum seminis ; *T.*, Testis ; *TVD.*, Transverse vitelline duct ; *UT.*, Uterus ; *VD.*, Vas deferens ; *VGH.*, Vaginal hook ; *VG.*, Vagina ; *VG. P.*, Vaginal pouch ; *VIT.*, Vitellaria ; *VN.*, Ventral nerve.

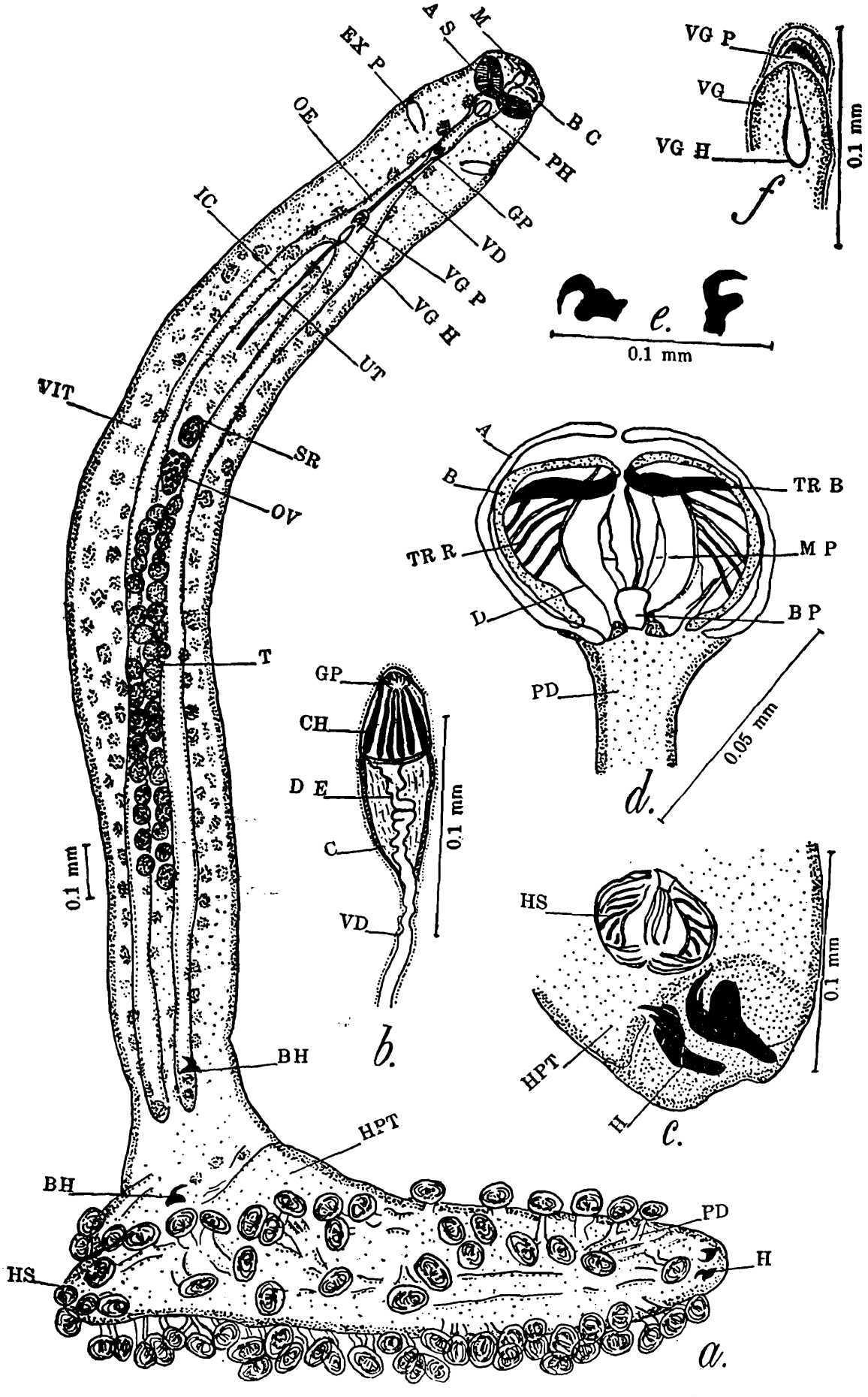
itself, comparatively very broad, transversely oval, carrying a pair of recurved hooks with bifid roots at one end and 122 suckers on retractile peduncles, arranged in two rows, at its margin on both sides. Framework of clamp sclerites very peculiar with additional rib-like thickenings, additional transverse bar, not U-shaped and median piece, with three fork like arms, on a basal piece. An additional pair of hooks—prehaptoral or body hooks just above haptor present. Mouth subterminal. Pharynx very small, globular. Buccal cavity small.



Text-fig. 30.—*Pricea multae*; (*a*) Extreme lateral side of the haptor; (*b*) Body hooks; (*c*) Terminal portion of vagina, showing the vaginal hook and the vaginal opening; (*d*) Haptoral sucker, lateral view; (*e*) Egg; (*f*) Three cirrus hooks.

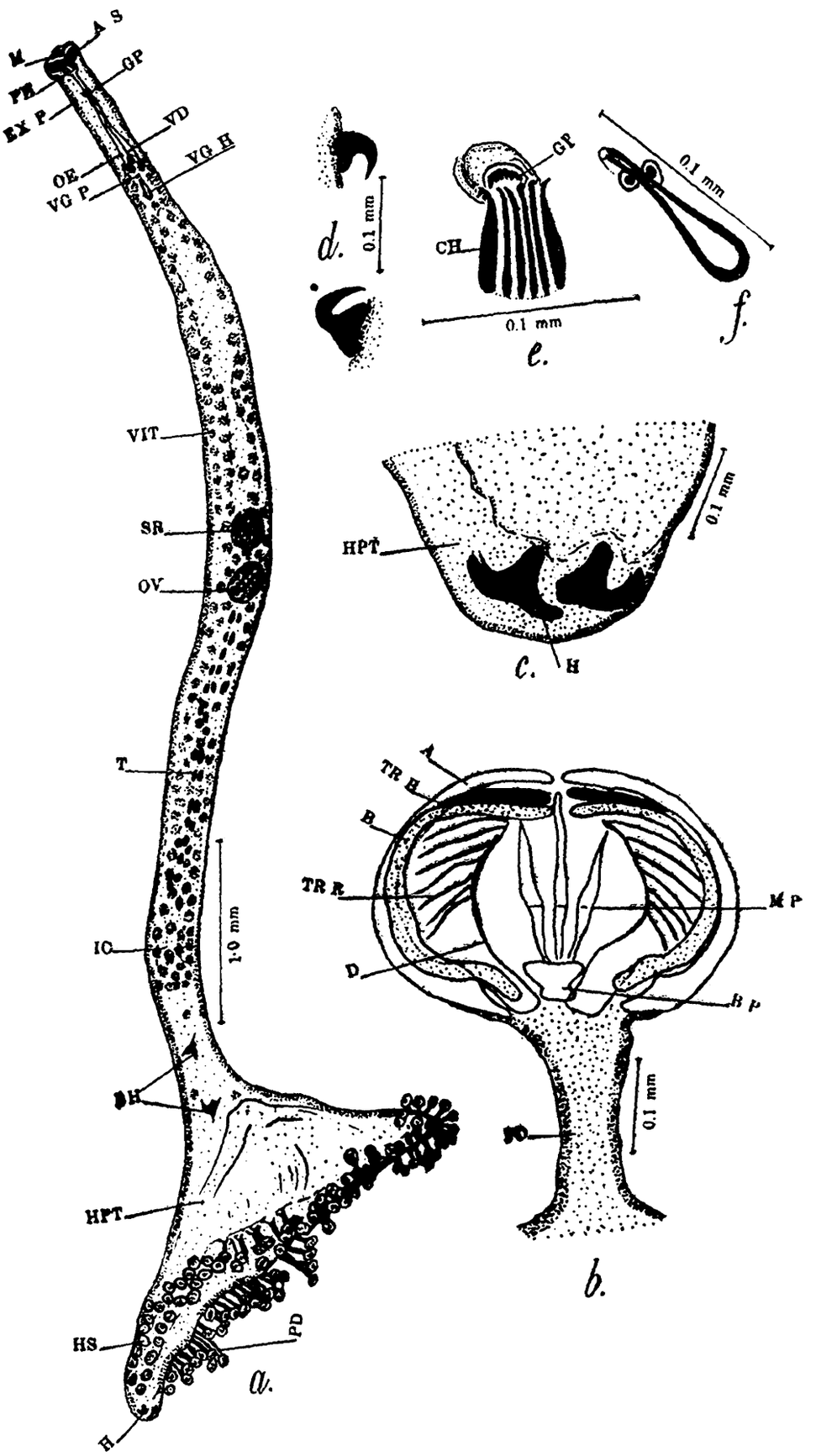
E., Egg.; *H.*, Haptoral hook; *HS.*, Haptoral sucker; *HPT.*, Haptor; *PD.*, Peduncle; *TR. R.*, Transverse rib of the framework of the haptoral sucker; *TR. B.*, Transverse bar; *VG.* Vagina; *VG H.*, Vagina hook; *VG. P.*, Vaginal pouch.

Anterior sucker, bilocular; with two egg-shaped, highly muscular organs, with membranous septa. Oesophagus elongate, club-shaped, bifurcating into intestinal crura; terminating just a little before origin of haptor; with ramifying branches, laterally, more numerous on outer sides. Testes 26, post-ovarian, follicular, in two lateral rows, inter-caecal,



TEXT-FIG. 31.—*Pricea minimae* ; (*a*) Entire view ; (*b*) Cirrus showing the genital pore, arrangement and shape of cirrus hooks, and ductus ejaculatorius ; (*c*) Extreme lateral side of the haptor, showing haptoral hooks ; (*d*) Haptoral sucker, showing the arrangement of the cuticular pieces of the framework supporting it ; (*e*) Body hook ; (*f*) Terminal part of vagina, showing its opening and the vaginal hook (after Chauhan).

A., Outermost ; *AS.*, Anterior sucker ; *B.*, Middle ; *BC.*, Buccal cavity ; *BP.*, Basal piece, supporting the three pronged middle piece of the cuticular framework supporting the haptoral sucker ; *BH.*, Body hook ; *C.*, Cirrus ; *CH.*, Cirrus hook ; *D.*, Innermost thin and lamellar lateral piece of the framework of the haptoral sucker ; *DE.*, Ductus ejaculatorius ; *EX. P.*, Excretory pore ; *GP.*, Genital pore ; *H.*, Haptoral hook ; *HS.*, Haptoral sucker ; *HPT.*, Haptor; *IC.*, Intestinal canal ; *M.*, Mouth ; *MP.*, Median piece of the cuticular framework of the haptoral sucker ; *OE.*, Oesophagus ; *OV.*, Ovary; *PD.*, Peduncle ; *PH.*, Pharynx ; *SR.*, Receptaculum seminis ; *T.*, Testis ; *T. R. R.* Transverse rib of the framework of the haptoral sucker ; *TR. B.*, Transverse bar ; *UT.*, Uterus ; *VD.*, Vas deferens ; *VG.*, *H.*



TEXT-FIG. 32.—*Pricea microcotylae* ; (*a*) Entire view ; (*b*) Haptoral sucker ; showing the arrangement of the cuticular pieces of its framework ; (*c*) Extreme side of the haptor, showing the two haptoral hooks ; (*d*) Body hook ; (*e*) Cirrus hook, showing their arrangement in the cirrus ; (*f*) Vaginal hook (after Chauhan).

A., Outermost ; *AS*., Anterior sucker ; *B*., Middle ; *BP*., Basal piece, supporting the three-pronged middle piece of the cuticular framework supporting the haptoral sucker, *BH*., Body hook ; *CH*., Cirrus hook ; *D*., Innermost thin and lamellar lateral piece of the framework of the haptoral sucker ; *EX. P*., Excretory pore ; *GP*., Genital pore ; *H*., Haptoral hook ; *HPT*., Haptor, *HS*., Haptoral sucker ; *IC*., Intestinal canal ; *M*., Mouth ; *MP*., Median piece of the cuticular framework of the haptoral sucker ; *OE*., Oesophagus ; *OV*., Ovary ; *PD*., Peduncle ; *PH*., Pharynx ; *SR*., Receptaculum seminis ; *T*., Testis ; *TR. B*., Transverse bar ; *TR R*., Transverse rib of the framework of the haptoral sucker; *VD*., Vas deferens ; *VGH*., Vaginal hook ; *VIT*., Vitellaria ; *VGP*., Vaginal pouch.

of varying size. Genital atrium, unarmed, situated on oesophagus. Cirrus long, muscular, cylindrical, armed with 12 small club-shaped cuticular spines. Ovary spherical, in the middle of body. Genito-intestinal canal present. Receptaculum seminis big, oval. Uterus with a single, spindle shaped egg ; operculated, with polar filament at both ends. Vagina, with a U-shaped hook, situated just on the point of bifurcation of oesophagus. Vaginal opening with fleshy, muscular flaps, presenting appearance of rudimentary pseudo-genital sucker. Vitellaria follicular, extending from the level of genital pore upto the extent of testes. Excretory pore double, dorso-lateral, spindle-shaped, at the level of genital pore.

Host.—Cybrium lanceolatus.

Location.—Gill.

Locality.—Bombay ; Arabian Sea, Indian Ocean.

23. **Pricea minimae** Chauhan, 1945.

(Text-fig. 31, *a, b, c, d, e, f.*)

The species has been named so, as comparatively speaking, the number of clamps is few in this ; other differences are given in the table.

Host.—Thynnus pelamys.

Location.—Gills.

Locality.—Bombay, Arabian Sea, Indian Ocean.

24. **Pricea microcotylæ** Chauhan, 1945.

(Text-fig. 32, *a, b, c, d, e, f.*)

Chauhan (1945) states that all the above three forms included in this genus differ from each other in the shape and size of body and haptor ; number of suckers (clamp) ; extent of vitellaria ; number of testes and position and size of body (pre-haptoral) hooks.

Host.—Scomber microlepidotus.

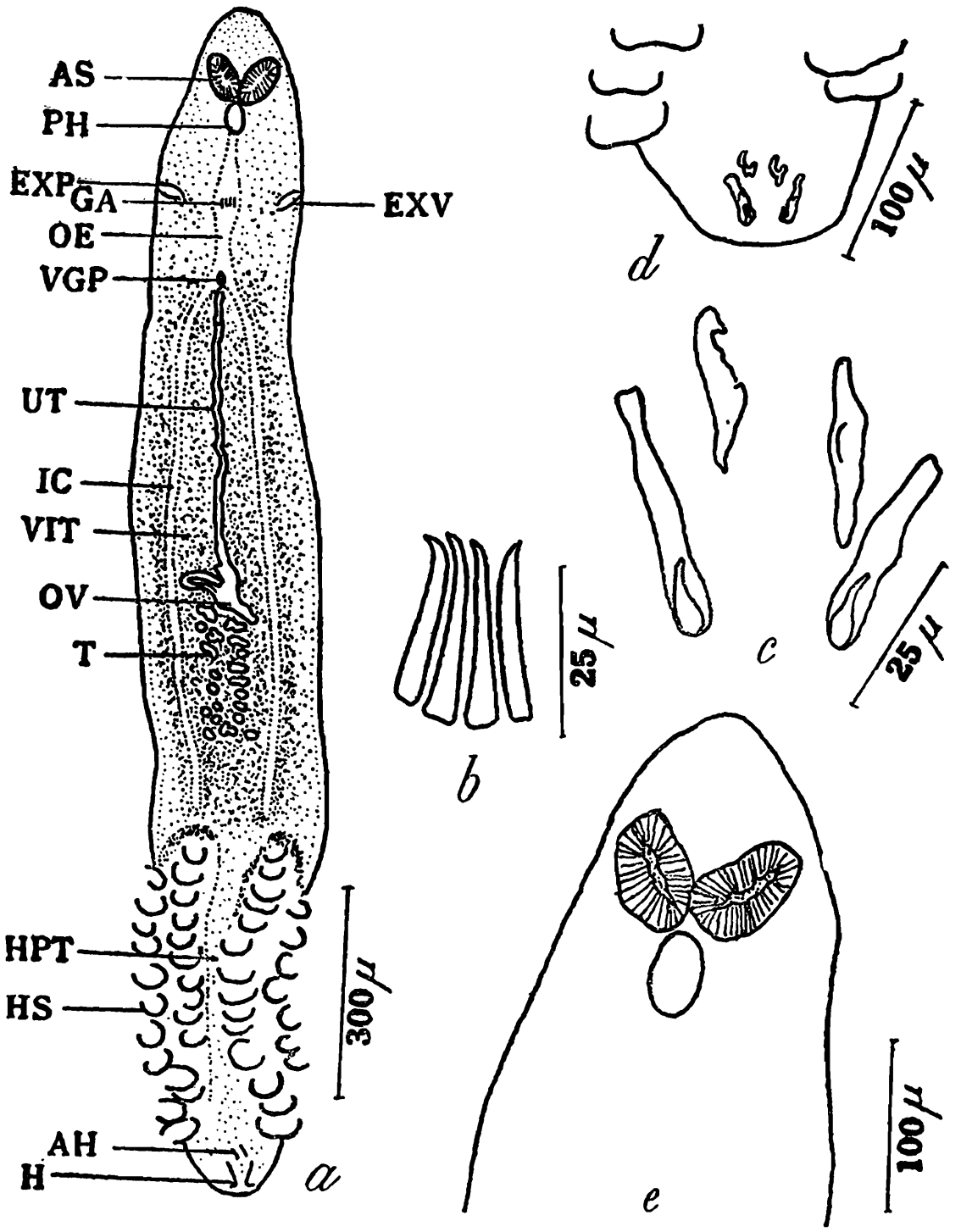
Location.—Gills.

Locality.—Bombay, Arabian Sea, Indian Ocean.

25. **Pricea tetracanthum** Ramalingam, 1952.

(Text-fig. 33, *a, b, c, d, e.*)

Ramalingam (1952) states that *P. tetracanthum* resembles the species, *P. multae*, *P. minimae* and *P. microcotylae* established by Chauhan, 1945, in the general shape of the body and the haptor and in the general structure of the clamps of the haptor. It agrees with *P. multae* and *P. microcotylae* in having 12 genital hooks. It is unique in having four hooks in the haptor, two as additional hooks and two as posterior hooks or anchors, but differs from the rest in the absence of the vaginal hook, in having 20 testes and haptoral suckers, 42 in number. The species is stated to be distinguished by the presence of four hooks in the haptor.



TEXT-FIG. 33.—*Pricea tetracanthum*; (*a*) Entire specimen ; (*b*) Genital hooks; (*c*) One pair of posterior hooks and a pair of additional hooks; (*d*) Position of hooks in situ; (*e*) Anterior portion of the body, showing esoplate and speculate suckers and pharynx (after Ramalingam).

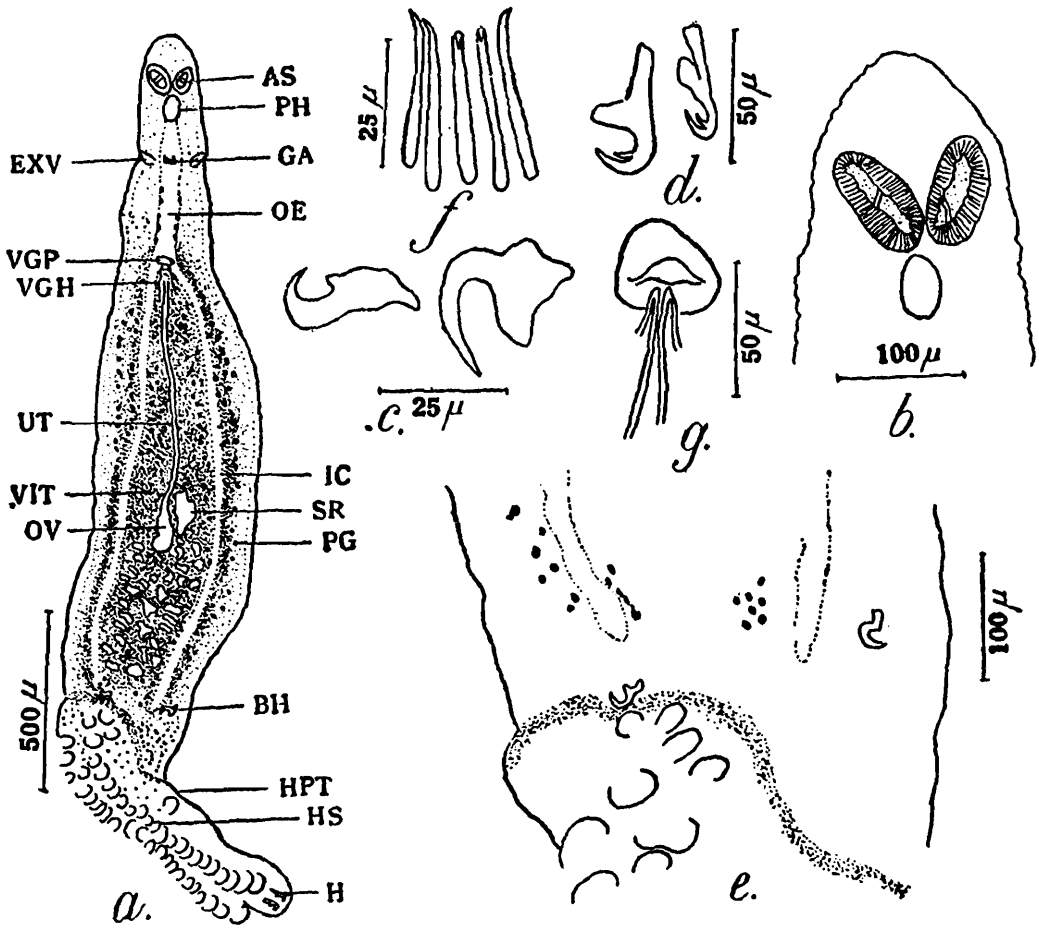
AH., additional hook ; *AS.*, Anterior sucker ; *EXP.*, Excretory pore; *EXV.*, Excretory vesicle ; *GA.*, Genital atrium ; *H.*, Posterior hook or anchor ; *HPT.*, Haptor ; *HS.*, Haptoral sucker ; *IC.*, Intestinal crura ; *OE.*, Oesophagus ; *OV.*, Ovary ; *PH.*, Pharynx ; *T.*, Testis ; *UT.*, Uterus ; *VGP.*, Vaginal pore ; *VIT.*, Vitellaria.

26. **Pricea armatum** Ramalingam, 1952.

(Text-fig. 34, *a*, *b*, *c*, *d*, *e*, *f*, *g*.)

The species is recorded to agree with the other forms in the general shape of the body, the haptor, and in the general pattern o the clamp structure. It agrees with Chauhan's species in having armed vaginal pore and two body-hooks. But it differs from *P. tetracan'hum* in having vaginal hook and in the absence of the additional hooks and differs from

all the species in having 31 testes, 50 clamps in the haptor and in the position of the body hooks, one just below left intestinal diverticula and the other on the right side of the right diverticula.



TEXT-FIG. 34.—*Pricea armatum* ; (*a*) Entire specimen ; (*b*) Anterior part of the body showing the septate and speculate anterior suckers and pharynx ; (*c*) Body hooks or prehaptoral hooks ; (*d*) Posterior hooks ; (*e*) Position of the body hooks, in situ ; (*f*) Genital hooks ; (*g*) Pseudogenital sucker and the vaginal hook. (after Ramalingam).

AS., Anterior sucker ; *BH.*, Body hook ; *EXV.*, Excretory vesicle ; *GA.*, Genital atrium ; *H.*, Posterior hook or anchor ; *HPT.*, Haptor ; *HS.*, Haptoral sucker ; *IC*, Intestinal crura ; *OE.*, Oesophagus ; *OV.*, Ovary ; *PH.*, Pharynx ; *PG.*, Pigment granules ; *SR.*, Receptaculum seminis ; *UT.*, Uterus ; *VGP.*, Vaginal pore ; *VGH.*, Vaginal hook ; *VIT.*, Vitellaria.

27. **Pricea tricanthum** Ramalingam, 1952.

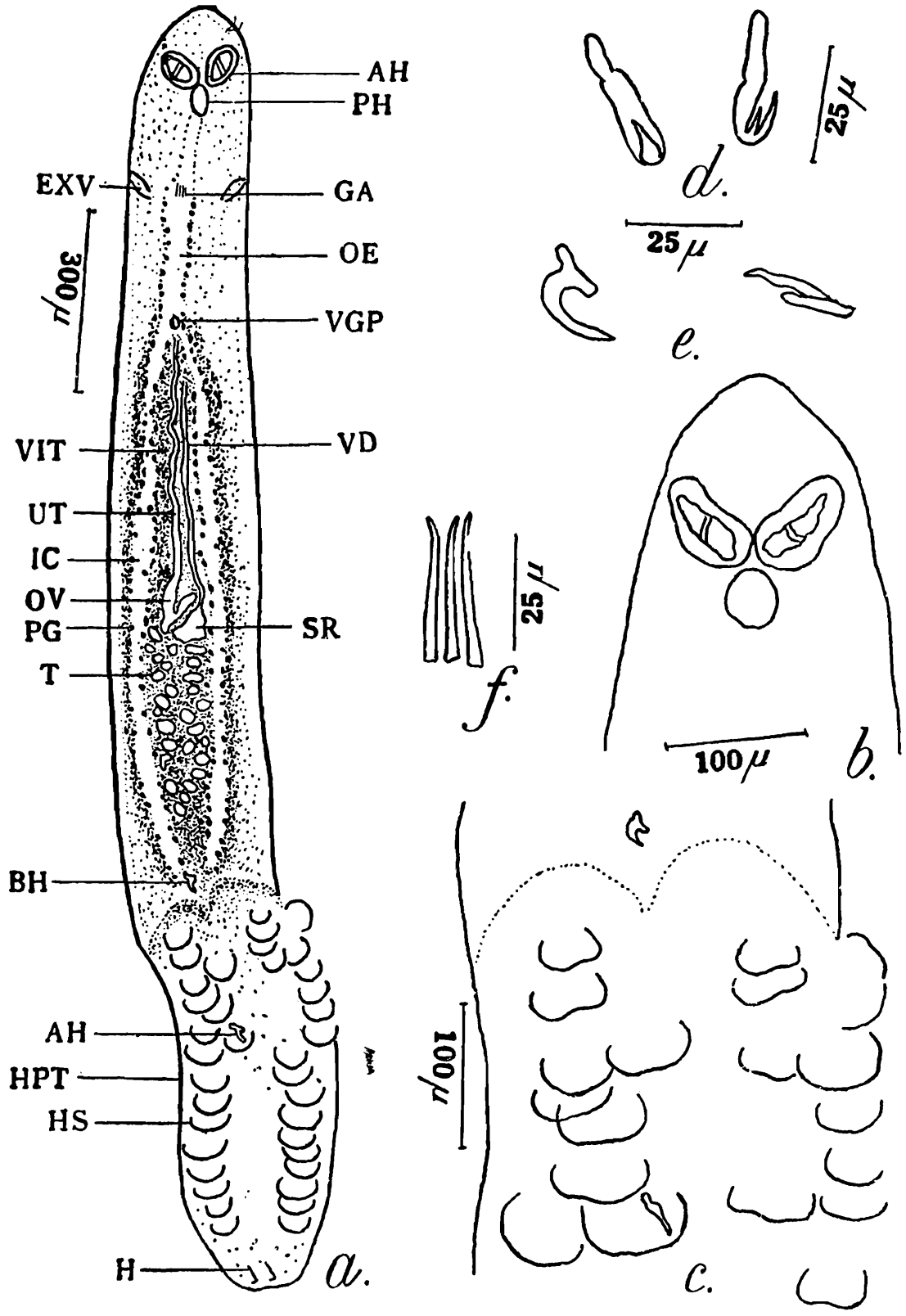
(Text-fig. 35, *a, b, c, d, e, f.*)

This species agrees with other forms in the general shape of the body and the haptor. It differs from *P. minimae*, *P. armatum* and *P. tricanthum* in having 12 genital hooks, agrees with Chauhan's species and *P. armatum* in having U-shaped vaginal hook. It differs from all the species in having only one body hook, 23 testes and 66 haptoral suckers.

28. **Pricea melane** Ramalingam, 1952.

(Text-fig. 36, *a, b, c, d, e, f, g, h.*)

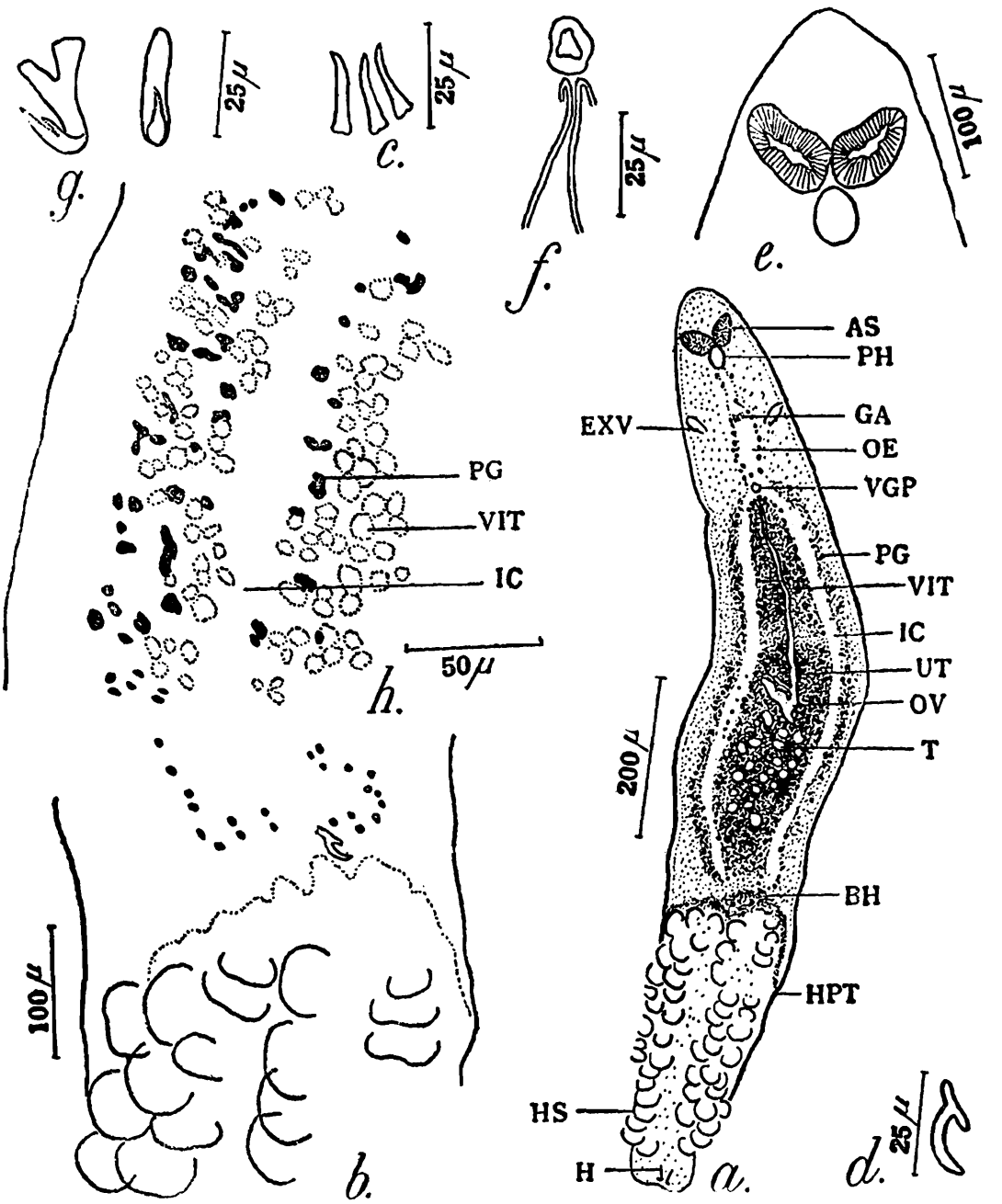
Like *P. tricanthum*, this species agrees with other forms in the general shape of the body and the haptor. It differs from *P. minimae*, *P. armatum*, and *P. tricanthum* in having 12 genital hooks. It agrees with



Text-fig. 35.—*Pricea tricanthum*; (*a*) Entire specimen; (*b*) Anterior part of the body, showing the septate and speculate anterior suckers and pharynx; (*c*) Additional hook and prehaptoral hook, in situ; (*d*) Posterior hooks; (*e*) Prehaptoral hook (left) and additional hook (right); (*f*) Genital hook (after Ramalingam).

AH., Additional hook; *BH.*, Body hook; *EXV.*, Excretory vesicle; *GA.*, Genital atrium; *H.*, Posterior hook or anchor; *HPT.*, Haptor; *HS.*, Haptoral sucker; *IC.*, Intestinal crura; *OE.*, Oesophagus; *OV.*, Ovary; *PG.*, Pigment granules; *PH.*, Pharynx; *SR.*, Receptaculum seminis; *T.*, Testis; *UT.*, Uterus; *VD.*, Vas deferens, *VGP.*, Vaginal pore; *VIT.*, Vitellaria.

Chauhan's species and *P. armatum* in having U-shaped vaginal hook. It differs from all the species in having only one body hook, 23 testes and 56 haptoral suckers.



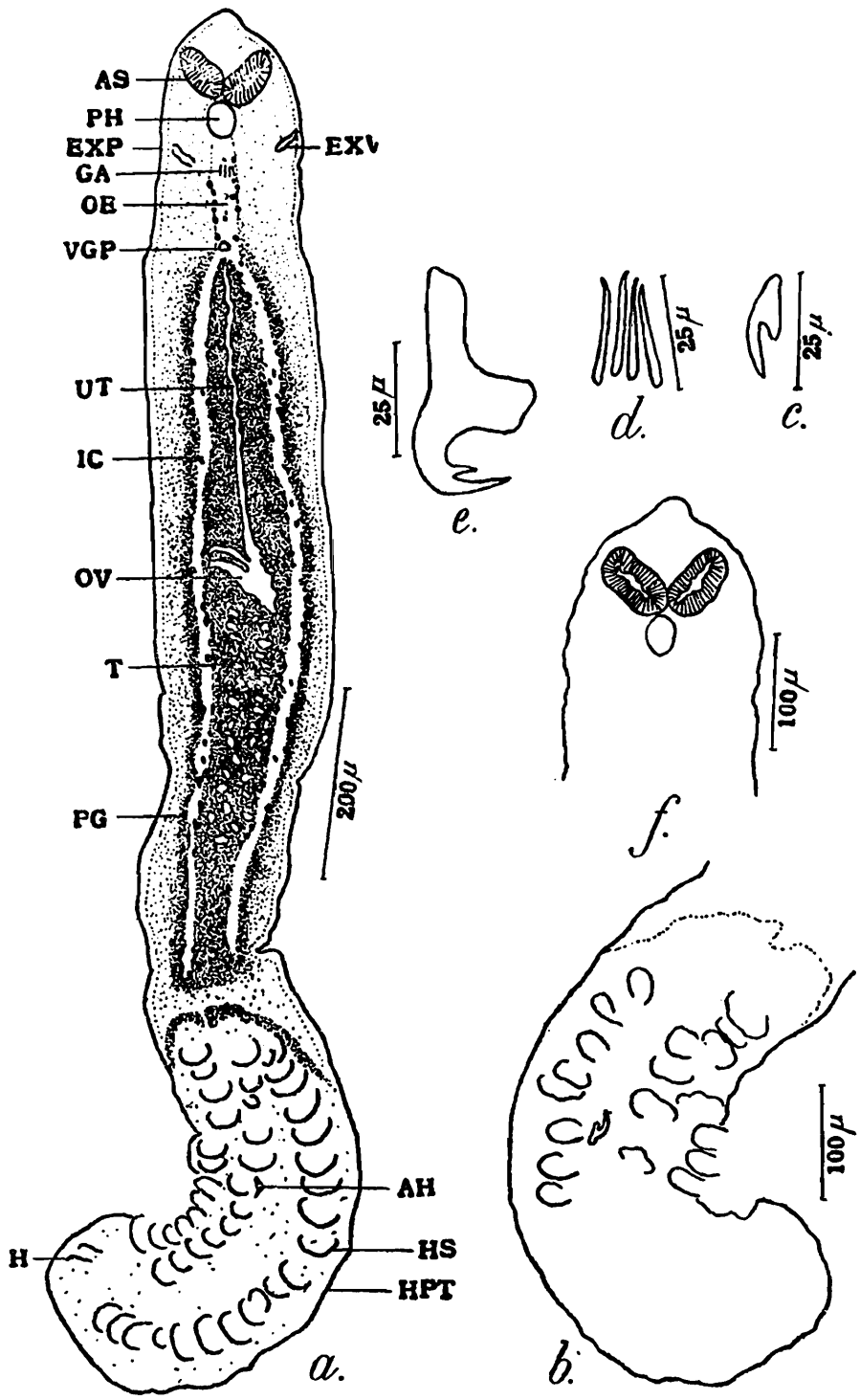
TEXT-FIG. 36.—*Pricea melane* ; (*a*) Entire specimen ; (*b*) Body hook or prehaptoral hook, in situ ; (*c*) Genital hook ; (*d*) Body hook ; (*e*) Anterior part of body, showing the aseptate and speculate anterior suckers and pharynx ; (*f*) Pseudogenital sucker and vaginal hook ; (*g*) Posterior hooks ; (*h*) A portion of the body enlarged to show distribution of the vitellaria and pigment granules. (after Ramalingam).

AS., Anterior sucker ; *BH.*, Body hook ; *EXP.*, Excretory pore ; *EXV.*, Excretory vesicle ; *GA.*, Genital atrium ; *HPT.*, Haptor ; *IC.*, Intestinal crura ; *OE.*, Oesophagus ; *OV.*, Ovary ; *PG.*, Pigment granules ; *PH.*, Pharynx ; *T.*, Testes ; *UT.*, Uterus ; *VGP.*, Vaginal pore ; *VIT.*, Vitellaria.

29. **Pricea minutum** Ramalingam, 1952.

(Test-fig. 37, *a*, *b*, *c*, *d*, *e*, *f*.)

This species resembles other forms in general form of the body, the haptor and in the general structure of the clamps. It agrees with Chauhan's species and *P. armatum* and *P. melane* in having U-shaped vaginal hook ; with *P. armatum*, *P. tricanthum* and *P. minimae* in having 14 genital hooks. But differs from all the species in the absence of both body-hooks as well as additional hooks, in having 19 testes and 110 haptoral suckers.



Text-fig. 37.—*Pricea minutum*; (*a*) Entire specimen; (*b*) Additional hook, in situ; (*c*) Additional hook; (*d*) Genital hooks; (*e*) Posterior hooks; (*f*) Anterior portion of body, showing the aseptate and speculate anterior sucker and pharynx. (after Ramalingam).

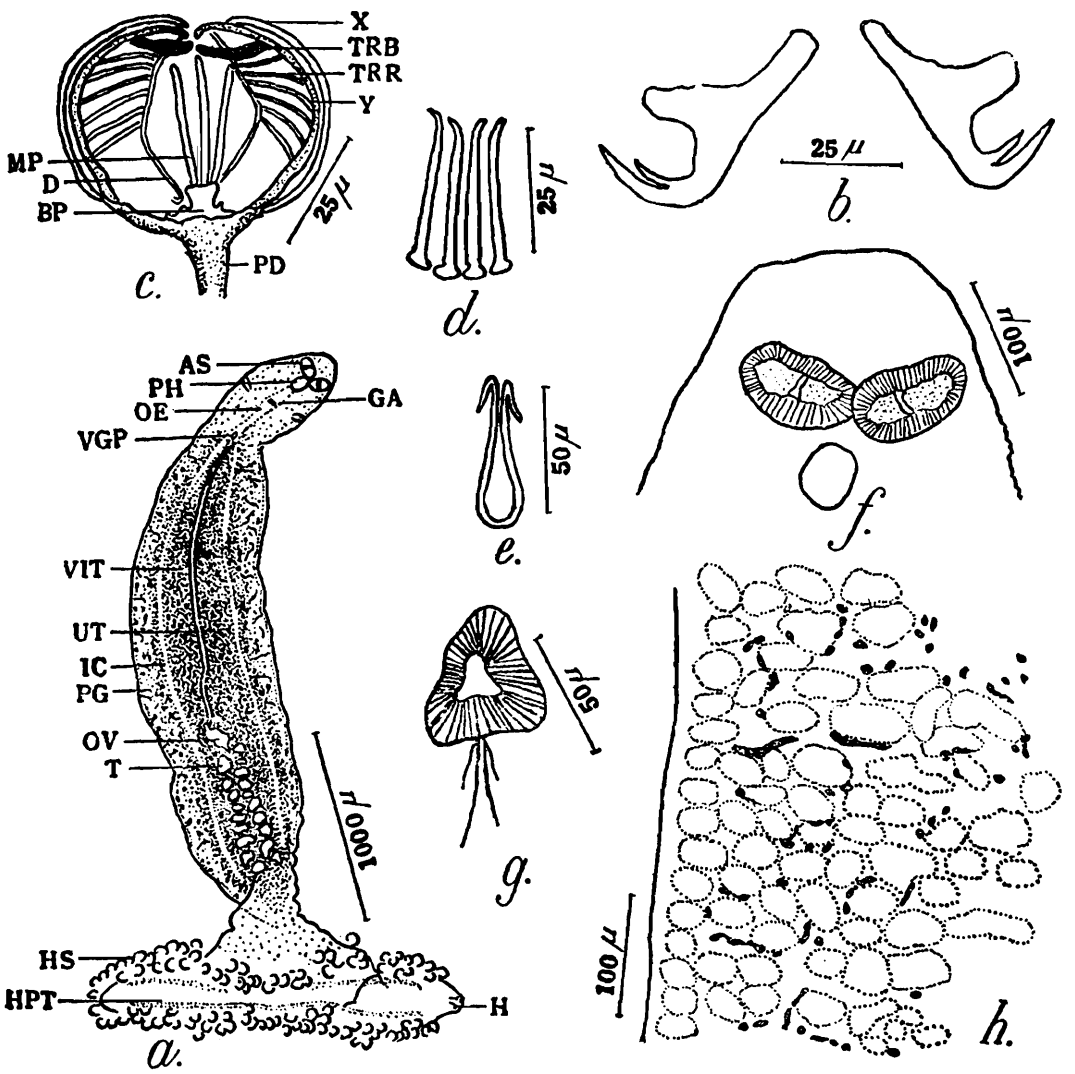
AH., Additional hook; *AS.*, Anterior sucker; *EXP.*, Excretory pore; *EXV.*, Excretory vesicle; *GA.*, Genital atrium; *H.*, Posterior hook or anchor; *HPT.*, Haptor; *HS.*, Haptoral sucker; *UT.*, Uterus; *PG.*, Pigment granules; *VGP.*, Vaginal pore; *VIT.*, Vitellaria.

30. **Pricea robustum** Ramalingam, 1951.

(Text-fig. 38, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*.)

This species resembles other forms in general form of the body, the haptor and in the general structure of the clamps. It agrees with Chauhan's species and *P. armatum* and *P. melane* in having U-shaped vaginal hook, with *P. armatum*, *P. tricanthum* and *P. minimae* in having 14 genital hooks; but differs from all the species in the absence of both body hooks as well as additional hooks, in having 19 testes and

110 haptoral suckers. Ramalingam states that *Pricea robus'um* is the largest form described by him, under the genus.



TEXT-FIG. 38.—*Pricea robustum*; (*a*) Entire specimen; (*b*) Posterior hooks; (*c*) A haptoral ucker or clamp; (*d*) Genital hooks; (*e*) Vaginal hook; (*f*) Anterior part of the body showing the septate and spiculate anterior suckers and pharynx; (*g*) Pseudo-genital sucker and vaginal hook; (*h*) A portion of the body enlarged, to show the distribution of the vitellaria and pigment granules. (after Ramalingam).

AS., Anterior sucker; *BP.*, Basal piece; *D.*, Innermost thin and lamellar lateral piece; *EXP.*, Excretory pore; *EXV.*, Excretory vesicle; *GA.*, Genital atrium; *H.*, Posterior hook or anchor; *HPT.*, Haptor; *HS.*, Haptoral; *PG.*, Pigment granules; *MP.*, Median piece; *PD.*, Peduncle; *TRB.*, Transverse bar; *TRR.*, Transverse rib; *T.*, Testes; *UT.*, Uterus; *VGP.*, Vaginal pore; *VIT.*, Vitellaria; *X.*, Median outermost piece; *Y.*, Middle piece.

III. SUMMARY.

The paper deals with thirty monogenetic trematodes recorded so far from the Indian region—India, Burma, Ceylon and Pakistan. In each case a representative diagram and specific diagnosis is given. Diagnostic keys have been provided at each taxonomic stage, wherever found necessary. The paper is a complete revision of the group, known from this region, gives a brief review of the views of various workers about them and their latest systematic position. Taxonomic position of the

family Chimaericolidae and subfamilies, Vallisinae and Protomicrocotylinae and various genera has been discussed and a new subfamily *Priceinae* proposed. Phylogeny and evolution in the Subclass has been dealt with. At the end, parasite-host and host-parasite lists have been added. Bibliography is confined to selected references, mainly those dealing with forms from the region.

IV. Acknowledgments.

I am grateful to Shri A. K. Bose, Shri G. Ramakrishna and Shri S. Ghoshal for helping me in various ways. I wish to thank my colleague, Shri M. N. Datta, Assistant Superintendent, for going through the manuscript, to make it press ready. I am also obliged to Miss N. G. Sproston for going through the manuscript, making valuable, suggestions and for help in correcting the first page proof.

VI. Parasite—Host List.

List of Monogenetic trematodes recorded from the Indian Region, arranged alphabetically, with their hosts, location, localities of distribution, etc.)

Parasite	Host.
Ancyrocephalus alatus	*Muraenesox talabonoides.* *Arius fulcarius.* *Mugil parsia.* *Harpodon neherius.*
Benedenia macrocolpa	*Rhinoptera javanica Mull. and Henle.*
Bilateracotyle chirocentrosus	*Sciaena belengeri.* *Chirocentrus dorsab.*
Capsala gouri .	Marine Fish, *Thynnus thunnina.*
Capsala laevis	*Histiophorus* (sic) *brevirostris.*
Capsal meagacotyle . . .	Sword fish, *Histiophorus* sp.
Capsala ovalis	*Histiophorus* sp.
Cyclocotyla multaetesticulae .	*Pellona* sp.
Dactylogyrus moorthyi . .	Freshwater fishes, *Puntius puckelli.* *Puntius ticto.*
Diplectanum belengeri . .	*Sciaena belengeri.* *Sciaena carulta,* *Muraenesox talabonoides.*
Diplozoon indicum	*Barbus* (*Puntius*) *sarana* (Ham).
Diplozoon kashmirensis	Fish, *Schizothorax* sp.

Parasite.	Host.
Eupolystoma rajai	*Rana* sp.
Gastrocotyle indica	Marine fish, *Caranx kalla* Cuv. and Val.
Loimos secundus	Indian dog-fish, *Scoliodon sorrakowah.*
Mazocräes orientalis	Clupeid fish, *Dussumieria* sp.
Mazocraeoides prashadi	Clupeid fish.
Paradactylogyrus catlarius	Freshwater fish, *Catla catla* Ham.
Polystomoides kachugae	Water tortoise, *Kachuga lineata* Gray.
Pseudaxone indicana	*Chrysophrys berda.*
Pricea armatum	*Cybium guttatum.*
Pricea melane	*Cybium guttatum.*
Pricea microcotylae	*Scomber microlepidotus.*
Pricea minimae	*Thynnus pelamys.*
Pricea minutum	*Cybium guttatum.*
Pricea multae	*Cybium lanceolatus.*
Pricea robustum	*Cybium guttatum.*
Pricea tetracanthum	*Cybium guttatum*
Pricea tricanthum	*Cybium guttatum.*
Vallisiopsis contorta	Marine fish, *Lactarius lactarius* (Bl. Schn.)

VI. HOST-PARASITE LIST

Host.	Parasite.
Arius fuscarius	*Ancyrocephalus alatus*
Barbus (Puntius) sarana	*Diplozoon indicum*
Caranx kalla	*Gastrocotyle indica.*
Catla catla	*Paradactylogyrus catlarius*
Chirocentrus dorsab	*Bilateracotyle chirocentrosus*
Chrysophrys berda	*Pseudaxine indicana*
Cybium guttatum	*Pricea armatum.*
,, ,,	*P. melane*
,, ,,	*P. minutum*
,, ,,	*P. robustum*
,, ,,	*P. tricanthum*
,, ,,	*P. tetracanthum*
Cybium lanceolatus	*Pricea multae*
Clupeid fish	*Mazocraeoides prashadi*

Host.	Parasite.
Dussumieria sp.	*Mazocräes orientalis*
Harpodon neherius	*Ancyrocephalus alatus*
Histiophorus brevirostris	*Capsala laevis*
Histiophorus sp.	*Capsala megacotyle*
	Capsala ovalis
Kachuga lineata	*Polystomoides kachugae*
Lactarius lactarius	*Vallisiopsis contorta*
Mugil parsia	*Ancyrocephalus alatus*
Muraenesox talabonoides	*Ancyrocephalus alatus*
	Diplectanum belengeri
Pellona sp.	*Cyclocotyla multaetesticulae*
Puntius puckelli	*Dactylogyrus moorthyi*
Puntius ticto	*Dactylogyrus moorthyi*
Rana sp.	*Eupolystoma rajai*
Rhinoptera javanica	*Benedenia macrocolpa*
Sciaena belengeri	*Diplectanum belengeri*
	Bilateracotyle chirocentrosus
Schizothorax sp.	*Diplozoon kashmirensis*
Sciaena carulta	*Diplectanum belengeri*
Scoliodon sorrakowah	*Loimos secundus*
Scomber microlepidotus	*Pricea microcotylae*
Thynnus pelamys	*Pricea minimae*
Thynnus thunnina	*Capsala gouri*

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VIII. A Comparative table indicating main characters of the various Species of the Genus *Pricea* Chauhan,

Species Host & Location.	*Pricea multae* Chauhan, 1945. *Cybium lanceolatus* (Gills).	*Pricea minimae* Chauhan, 1945. *Thynnus pelamys* (Gills.)	*Pricea microctylae* Chauhan, 1945. *Scomber microlepidotus* (Gills.)	*Pricea tetracanthum* Ramalingam, 1952. *Cybium guttatum* (Gills)	*Pricea armatum* Ramalingam, 1952. *Cybium guttatum* (Gills.)	*Pricea tricanthum* Ramalingam, 1952. *Cybium guttatum* (Gills.)	*Pricea m* Ramalingar *Cybium guttat*
Shape and Size of body.	Body elongately cylindrical and the sides of the body almost parallel. Length 3·22 mm. Breadth 0·4 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 3·46 mm. Breadth 0·27 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 7·0 mm. Breadth 0·37 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 1·678 mm. Breadth 0·357 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 2·695 mm. Breadth 0·473 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 2·1 mm. Breadth 0·24 mm.	Body elongately c the sides of the parallel. Length 1·981 mm Breadth 0·398 mr
Shape and Size of haptor.	Haptor elongately oval structure whose long axis is at right angles to the axis of the body. Length 1·02 mm. Breadth 0·33 mm.	The entire haptor has the same relation to the body as a foot has to the leg. Length 0·12 mm. Breadth 0·033 mm.	The haptor asymmetrically placed. — —	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·499 mm. Breadth 0·258 mm.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·757 mm.. Breadth 0·170 mm.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·66 mm. Breadth 0·24 mm.	Haptor elongate long axis of the with the long a Length 0·660 mr Breadth 0·295 m
Number of clamps and size.	122 pedunculated retractile clamps with seven transverse ribs. 70μ.	70 retractile and pedunculated clamps with 5-7 transverse ribs. 30μ × 70μ.	113 pedunculated retractile clamps with seven transverse ribs. 26μ × 78μ.	42 pedunculated clamps with seven transverse ribs. 39μ × 59μ.	50 pedunculated retractile clamps with 5—6 transverse ribs. 50μ × 71μ.	40 pedunculated retractile clamp with six transverse ribs. 43μ × 66μ.	6 pedunculated r with 6—8 t 37μ × 66μ.
Number of testes.	26	28	25	20	31	28	2
Position and Size of the prehaptoral (body) hooks as well as additional hook.	A pair recurved hooks (pre-haptroal) situated in the posterior end of the body just above the haptor. 30μ in length.	Body hooks one behind the other on the posterior end of the body proper. One hook situated on the right intestinal caecum, near its posterior end and the other just anterior to the haptor slightly to the left. 40u in length.	Body hooks situated on behind the other at the posterior end of the body proper, one on the right intestinal caecum as in the last species. 80μ in length.	One pair hooks present as additional hooks in the haptor, just in front of and in between the pair of posterior hooks. 27u in length.	Two pre-haptoral hooks, one situated just below the left diverticula and the other on the right side of the right diverticula. 21μ in length.	One hook as additional hook in the middle of the haptor and other as prehaptoral hook just anterior to the haptor and in the mid-line. 30u and 29μ in length.	A single prehapt body region the haptor.
Posterior hooks or anchors.	80μ	60μ	110μ	39μ	48μ	27μ	
Number of Genital hooks & their size.	12 genital hooks, situated 0·23 mm. from the anterior end. 25μ in length.	10 genital hooks, situated 0·21 mm. from the anterior end. 30μ in length.	12 genital hooks, situated 0·26 mm. from the anterior end. 50μ in length.	12 genital hooks, situated 0·259 mm. from the anterior end, 29μ in length.	14 genital hooks, situated 0·348 mm. from the anterior end, 32μ in length.	14 genital hooks, situated 0·256 mm. from the anterior end, 29μ in length.	12 genital hook mm. from t 21μ in length
Extent of Vitellaria	Vitellaria extending from the level of the genital pore up to the extent of the testes though few follicles extending posteriorly, on the intestinal caeca upto the point of their termination.	Vitellarian follicles very few.	Vitellaria extending from the region anterior to the vaginal pore up to a distance a little posterior to the end of the intestinal crura.	Vitellarian follicles not dense and scattered very loosely.	Vitellarian follicles in dense clusters.	Vitellarian follicles uniformly spread and not in dense clusters.	Vitellarian clusters.

lanes h, 1952.	*Pricea minutum* Ramalingam, 1952.	*Pricea robustum* Ramalingam, 1952.
m (Gills.)	*Cybium guttatum* (Gills.)	*Cybium guttatum* (Gills.)
ylindrical and body almost	Body elongately cylindrical and the sides of the body almost parallel. Length 1·404 mm. Breadth 0·201 mm.	Body elongately cylindrical and the sides of the body almost parallel. This species is comparatively bigger in size. Length 3·58 mm. Breadth 0·75 mm.
y oval with the haptor in line s of the body.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·384 mm. Breadth 0·170 mm.	Haptor elongately oval whose long axis at right angles to the long axis of the body. The specimen of this species were got alive and present an appearance as shown in Text fig. 6*a*, where as the specimens of the rest of the species described were not alive and the haptor appears to be in line with the axis of the body, probably due to post-mortal contraction. Length 1·88 mm. Breadth 0·35 mm.
ractile clamp nsverse ribs.	46 pedunculated retractile clamp with six transve ribs. 21μ × 47μ	110 peduculated retractile clamps with six transverse ribs. 46—51μ × 58μ—69μ.
	31	19
l hook in the anterior to in length.	Only one additional hook near the middle of the haptor. 27μ in length.	There are neither body hooks nor additional hooks.
	36μ	23μ
tuated 0·259 nterior end,	12 genital hooks, situated 0·161 mm. from the anterior end, 25μ in length.	14 genital hooks, situated 0·31 mm. from the anterior end, 30μ in length.
es in dense	Vitellarian follicles not so much in dense clusters.	Vitellarian follicles in dense clusters.

Addendum.

Since this paper went to the Press another paper has appeared on Indian Monogenea. Ramalingam (1953)* has described a new genus *Chauhanea* with *Chauhanea madrasensis* Ramalingam, 1953 as the type species, from *Sphyraena acutipinnis* Day, from Madras. He has assigned the genus to the subfamily Gastrocotylinae *sensu* Sproston, 1946 and has also given a key to the genera of the subfamily, as follows,—

Key to Genera of the Subfamily Gastrocotylinae.

1. Haptor unilateral; rib-like thickenings in the clamp capsule absent; anchors persistent ..	2
Haptor bilateral; rib-like thickenings in the clamp capsule present; anchors persistent or not	3
Haptor bilateral asymmetrical; rib-like thickenings in the clamp capsule absent; anchors absent; genital pore lateral and unarmed. Vagina lateral and armed	*Chauhanea* Ramalingam, 1953.
2. Haptor as a marginal frill, extending forwards beyond the region of gonads; anchors terminal	*Gastrocotyle* van Beneden and Hesse, 1863.
Haptor as a terminal frill not overlapping the region of gonads; anchors lateral ..	*Psoudaxine* Parona and Perugia, 1890.
3. Haptor as a bilateral frill extending forwards beyond the region of the gonads; anchors persistent	*Thoracocotyle* MacCallum, 1913.
Haptor as a bilateral frill on a posterior extension of the body beyond the region of the gonads	
(*i*) Anchors not persistent in the adult ..	*Lithidiocotyle* Sproston, 1946.
(*ii*) Anchors persistent and in addition a pair of " body hooks " one above the other just anterior to the haptor ..	*Pricea* Chauhan, 1945.

Subfamily *Gastrocotylinae* Sproston, 1946.

Genus **Chauhanea** Ramalingam, 1953.

Chauhanea madrasensis Ramalingam, 1953.

(Text-figs. 39)**

Specific diagnosis.: *Chauhanea* Ramalingam, 1953 ; with Generic characters.

Length 3·079-5·64 mm.; breadth 0·682-1·011 mm. Haptor has 30-49 clamps on the right side, 0·846-1·398 mm. in length and 36·55 clamps on the left side, 0·987-1·622 mm. in length. Clamp structure is of the Gastrocotylid type, without rib-like thickenings or plaques. Clamp size is 60-69×48-55μ. Testicular follicles 48-65 in number. Cirrus 0·121-0·130 mm. long. Eggs with unequal filaments, body of the egg is 0·214 mm. long; the posterior and the anterior filaments are 0223 mm. and 0·129 mm. long respectively.

Host. *Sphyraena acutipinnis* Day.

Location. Gills.

Locality. Madras.

*Ramalingam, K (1953). A new genus of Trematode (*Chauhanea*) from the gills of *Sphyraena acutipinnis* Day, *J. zool. Soc. India*, **5** (1) : 59-63.

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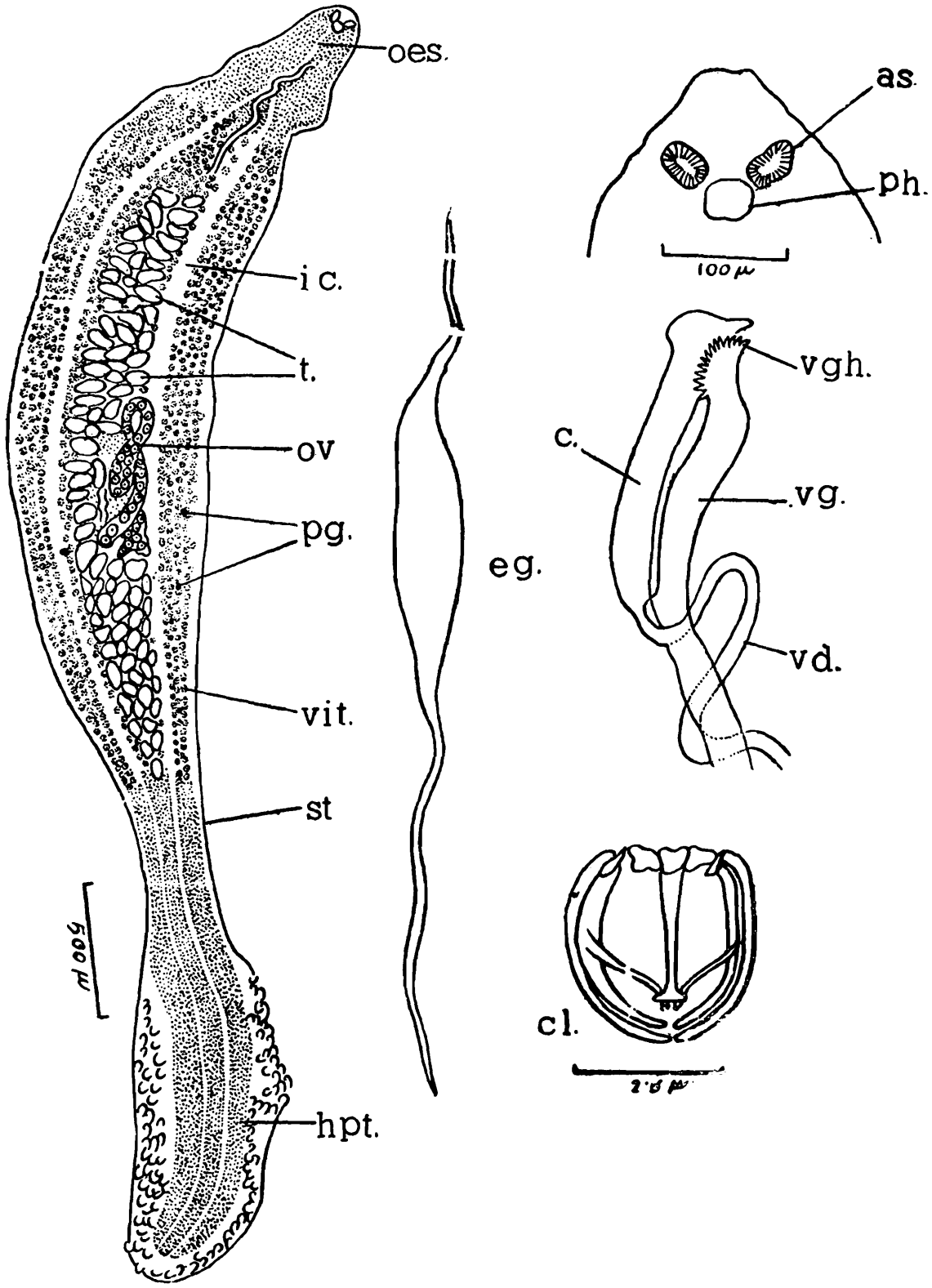

TEXT-FIG. 39.—*Chauhanea madrasensis*, Ramalingam (after Ramalingam.)

a. s., Anterior sucker ; *c*,. Cirrus ; *cl.*, Clamp ; *eg.*, Egg ; hpt., Haptor ; *i. c.*, Intestinal crura *Oes.*, Oesophagus ; *ov.*, Ovary ; *ph.*, Pharynx ; *p. g.*, Pigment granules ; *st.*, Stem ; *t.*, Testes ; *vit.*, Vitellaria ; *v. d.*, Vas deferens ; *vg.*, Vagina ; *vg.h.*, Vaginal hook.

STUDIES ON THE TREMATODE FAUNA OF INDIA

Part II. Subclass ASPIDOGASTREA.

By B. S. CHAUHAN, M.Sc., PH.D., F.Z.S., F.A.Sc., F.Z.S.I., *Assistant Superintendent, Zoological Survey of India, Calcutta.*

CONTENTS.

I. General Account.

The author has elsewhere dealt with the trematode fauna of India, of the suborder *Gasterostomata*. An attempt has been made in this paper to deal briefly with the Aspidogastrid trematode parasites recorded, from the Indian region so far, covering India, Pakistan, Burma, Ceylon, etc.

II. Subclass Aspidogastrea Faust & Tang, 1936.

Syns. *Aspidocotylea* Monticelli, 1892. (unavailable).
Aspidocotylida Lahille, 1918.
Aspidogastrata Faust, 1932.
Aspidogastrea (Order) Faust & Tang, 1936.

Helminth parasites of the class Trematoda have been broadly divided into three groups : *Monogenea*, *Aspidogastrea* and *Digenea*. The Digenea are broadly distinguished by the fact that their life history is not direct, *i.e.* there is alternation of hosts. In contrast to this, the life history of a Monogenea is direct and they are mostly found in different situations as ectoparasites. The representatives of the order Aspidogastrea combine the characters of both the above groups but are disqualified from inclusion into either group because of the equivocal nature of their life history.

Ward and Hopkins (1931) observe that among the trematodes the suborder *Aspidocotylea* attracts particular attention. The number of known forms is small ; they vary considerably from each other as a rule and the group appears, in consequence, as a few short series of widely separated species, each group of which deserves the status of a taxonomic unit. Both in structure and in life cycle, these forms appear to be transitional between the monogenetic trematodes and the other digenetic groups.

Faust and Tang (1936) state that this group of trematodes is one of the most instructive in the phylum Platyhelminthes, yet scant attention has been paid to these species by students of helminthology.

Dawes (1946) distinguishes the Aspidogastrid trematodes from Monogenean and Digenean by the following characterisation:—

"Main adhesive apparatus a single row of suckerlets or alveoli set upon the ventral surface of the body, or three or four longitudinal rows

of alveoli set upon an enormous posterior disc, which lacks hooks or hooklets. Other adhesive organs weakly developed or unrepresented. Excretory and genital pores as in Digenea. Endoparasites of Vertebrata, especially fishes and chelonians, but also in Mollusca and Crustacea."

The parasites of this group penetrate more deeply into the body of the host than do most Monogenea and the adhesive apparatus is again a character of distinction. The anterior organ of attachment is feeble and absent in adult, but the posterior occupies almost the entire ventral surface of the body, consisting of numerous suckerlets or *alveoli*, arranged in one, three or four rows. In some elongate forms a single row of alveoli is developed on the ventral surface but generally three or four rows arise from the surface of a large disc, which is as conspicuous as the 'foot' of a gastropod-mollusc. The maximum number of alveoli in a row are 32 and in four rows 144. There are no hooks or hooklets. I would suggest the use of the term "haptor" widely used, at present, in the study of Monogenea for the ventral (posterior) adhesive apparatus of this group. Alveoli when present in more than one row are usually arranged alternately and when villei or ventral papillae are also present they are generally placed in between these rows—a beautiful example of an economy of space which permits the accommodation of the largest possible number of organs of adhesion. The mouth is situated at the tip of a very mobile anterior conical process. Other external apertures occur in much the same situations as in Digenea. The genital pore is slightly behind the mouth and the excretory pores are posterior. In some, there is a solitary excretory pore. There is no vaginal pore, but Laurer's canal which is closed in some species, may open near the posterior extremity as in Digenea.

The subclass *Aspidogastrea* contains only a solitary family, *Aspidogastridae* Poche, 1907 These are known as parasites of cold blooded, poikilothermous vertebrates and invertebrates of both marine and fresh waters in all the five continents. Notably they occur in gastropod and lamellibranch mollusca, the larger crustaceans, some fishes and chelonians.

According to Stunkard (1917) the family is of special interest to students of trematode morphology. The form of the adhesive apparatus, with its retractile marginal organs, the separation of the body into dorsal and ventral portions by a muscular partition, the sac-like alimentary tract and the details of the genital organs are peculiar to the group. The family contains both ectoparasitic and endoparasitic species ; forms with direct development and at least one species which has an intermediate host, while the hosts infested by the adult parasites include both invertebrates and vertebrates, species having been reported from molluscs, fishes and turtles.

They may inhabit various locations in the host and may be seen through the transparent wall of the pericardium ; sometimes 20-30 individuals being closely packed in the anterior region of the pericardial cavity near the internal opening of the kidney. Juvenile individuals are said to inhabit the intestine and may occasionally be found encysted in the pericardial gland.

The genus *Aspidogaster* is not confined to molluscs, but has been reported both from freshwater and marine fishes. The fact that the same species may occur in both molluscs and fishes, in the opinion of Dawes, indicates that the former may play the part of both the intermediate and final hosts. Parasitized mussels generally present a starved and shrunken appearance.

III. Systematic Account.

A. *Taxonomic Position.*

Since 1827, when von Baer discovered *Aspidogaster conchicola*, the earliest known representative of the group from the fresh water mussels of the genera, *Anodonta* and *Onio* from Prussia, many attempts have been made to find a satisfactory niche in the scheme of classification of the trematode for this interesting group. However, because of its peculiar multiloculate adhesive apparatus which is usually but not invariably a ventral disc bearing a number of suckerlets or alveoli, Burmeister (1856) first called attention to the difference between the genus *Aspidogaster* and the remainder of the trematodes and suggested a division of the trematoda into (1) *Malacobothrii* for the distomes and holostomes, (2) *Pectobothrii* for the polystomes, and (3) *Aspidobothrii* for *Aspidogaster*. Subsequent writers, however, continued to include *Aspidogaster* with the polystomes until Monticelli (1892) revised the classification of Burmeister, but named the three suborders, into which he divided the trematodes, as *Heterocotylea*, *Aspidocotylea* and *Malacocotylea*.

In the classification of Monticelli, the *Aspidocotylea* contained the single family *Aspidobothridae*. Poche (1907) proposed to make the name of the family agree with the rules of Zoological nomenclature according to which " The name of the family is formed by adding the ending—(idae) to the stem of the name of its type genus " Thus the name of the family must become *Aspidogastridae*. Further Poche (1926) placed aspidogastrids in the Digenea, referring them to the suborder Prosostomata and the tribe *Aspidogastroidae*. Faust and Tang (1936) raised objections to the scheme, on the ground that aspidogastrid trematodes combine the characters of both *Monogenea* and *Digenea*. It is disqualified for admission to the *Monogenea* by the nature of its adhesive apparatus, which lacks such accessories as cuticular supports, hooklets or anchors, by the posterior position of the excretory pore or pores and by the simple rhabdocoelan intestine. On the other hand, the absence of an alternation of generations in life-history militates against its inclusion in the *Digenea*. The simplest type of life-history, *e.g.* that of *Aspidogaster conchicola* is one in which the sole host is a gastropod or lamellibranch mollusc. For such reasons, Faust and Tang (1936) proposed the creation of a new subclass, *Aspidogastrea*, equal in rank with Monogenea and Digenea.

In the scheme of classification which I have followed in my studies I have treated the entire group of trematodes as divided into three Subclasses, *viz.* (1) *Monogenea*; (2) *Aspidogastrea*; (3) *Digenea*, the last being further sub-divided into two Orders, *viz.* (*a*) *Gasterostomata*, (*b*) *Prosostomata*. Dawes (1946) mentions the three subclasses as only orders.

Faust and Tang (1936) created a new family, *Stichocotylidae* for the genus, *Stichocotyle*, which has a single row of sucking cups and retained all other forms possessing more than one row of sucking cups under the family *Aspidogastridae*. This arrangement is, however, not accepted by other workers on the group and therefore the family *Stichocotylidae* goes into synonymy to *Aspidogastridae* Poche, 1907.

The important taxonomic characters in the family are, the number of rows and nature of alveoli on the adhesive disc ; presence or absence of papillae on the ventral surface of the disc ; presence or absence of marginal organs ; presence or absence of oral sucker and existence of lips bordering the mouth ; number of testes ; presence or absence of the cirrus pouch, etc.

Dawes (1941) does not consider the presence or absence of an oral sucker to be a factor of generic importance. Stunkard (1917) regards the lack of such a sucker as one of the characters of the genus, *Aspidogaster*, but Eckmann (1932) describes this structure in each of her species, *A. decatis* and *A. enneatis*, and states that it is well developed in the latter species. She (1941) also states that the number of alveoli present on the disc of the adhesive apparatus in different aspidogastrids do not seem to bear any relation to the size of the body or of the disc.

Shipley and Hornell (1904, p. 95) state that the number of alveoli probably increases with age.

B. *Phylogeny.*

Faust and Tang (1936) discussed the systematic position and phylogeny of the group in detail. This subject has been a matter of opinion ever since von Baer discovered the earliest known representative of the group, in 1827. Some workers have considered it as belonging to Monogenea, others to Digenea. Some even classified them with Polystomes. However, majority regards them as belonging to an independent rank, intermediate in position between the Monogenea and Digenea.

As pointed out by Faust and Tang, they are decidedly not members of the Monogenea group. They lack posterior sucking discs or cuticular hooklets or anchors. The excretory pore or pores are posterior in position rather than anterior and their intestinal tract is always rhabdocoelic in type, as in Turbellarians and Gasterostomes (Digenea). On the other hand, there is no evidence that they have an alternation of generations, a characteristic requisite for inclusion in the Digenea. The fully developed embryo within the egg shell, which breaks through the opercular opening to proceed with its development is a larva already possessing the fundamental characteristics of an adult, such as the ventral sucking disc, the excretory system with a posterior opening and the rhabdocoelic gut. This immature adult generally lacks even any suggestion of a ciliated epithelium. Our knowledge of a complete life cycle of an aspidogastrid is lacking, but its development is believed to be fundamentally direct, *i.e.* the young worm develops directly into an adult, either in the same host or in another individual of the same or different species. The mplest type of host relationship is obviously that in

which either a gastropod or a bivalve mollusc is the sole host, as generally in *Aspidogaster conchicola,* when such infected mollusc hosts are ingested by cold blooded vertebrates, such as fishes, frogs and reptiles. These parasites have been recorded to have frequently demonstrated their ability to withstand digestion and to attach themselves to the wall of the stomach or small intestine of the vertebrate, thus indicating initiation of second host association of Digenea. A more complicated condition is present in *Stichocotyle nephropsis,* in which encysted larvae, closely resembling adults superficially, are present in crabs or lobsters while the adults occur in biliary passages of elasmobranchs. Probably a first stage larva of this species develops in some marine molluscs and later reaches passively or actively the malacostracan host and becomes encysted in the abdomen of this second host. Thus there is cumulative evidence in this group of trematodes, indicating how alteration of hosts is in the process of being achieved, apparently without any alternation. By the way, such a situation more closely resembles that in certain nematodes (Spiruroids), than it does a complicated trematode life-cycle and may possibly help in throwing some light on the phylogeny and affinities of parasitic nematode worms. However, as far as aspidogastrid trematodes are concerned, some species of other genera, *e.g. Aspidogaster, Cotylaspis, Cotylogaster,* etc., also occur both in Unionidae and fish, and fresh water turtles and fish. Such a relation indicates the possible transition from the monogenetic type with a single host in the life-history to the digenetic type utilising at least two hosts in life cycle.

C. *Affinities and phylogeny in the Platyhelminthes.*

The original ancestor or ancestors of the various groups of Platyhelminthes appear to have had some common characters such as ciliated epithelium without cuticle, rhabdocoelic gut, life cycle with direct development and free living existence. Evolution in due course may have operated along two lines; one for free living existence as in the case of Turbellarians and the Temnocephalids and the other for parasitic life such as in Trematoda, as will be seen from points of comparative study of the groups. Turbellarians possess eyes and innumerable cilia, covering the epithelium at its surface and lack thick shelled eggs. In Temnocephala, the cilia may occur in patches or localised regions in exceptional instances and eyes occur more frequently than in Trematoda, where they are confined to the larval stages, except in a few Monogenetic flukes. There is no typical external ciliation in Trematoda except in larval stages. Turbellarians generally lead an independent existence, hunting and devouring living prey such as earthworms, snails, woodlice, etc. However, some live in habitual association with molluscs and echinoderms and a few have acquired the habit of penetrating into and living in the bodies of sea urchins, holothurians and other invertebrates thus foreshadowing the parasitic mode of life of trematodes. Temnocephalids attach themselves to the surface of an invertebrate animal, generally a fresh-water crustacean, but they also do not derive nourishment from their host, but capture and devour insect larvae, rotifers and other small creatures, and are thus not parasites in full sense of the term. A trematode habitually nourishes itself at the expense of

another animal, the host. Many trematodes attach themselves to superficial parts of the host, but others penetrate into the body and settle down in one of the internal organs. The former are called ectoparasites (Monogenea) and the latter endoparasites (Digenea). Their life-history provides a more important distinction. Ectoparasitic trematodes develop directly in or on a single type of host whereas endoparasitic trematodes develop through a sequence of young individuals unlike the parent (larvae) with at least one and sometimes more than one change of host. As a rule, digenetic trematodes spend a good part of their larval life in bodies of molluscs and some leave the first host and penetrate into another mollusc or a crustacean or sometimes a fish, before finally settling down in a vertebrate animal to become mature. Aspidogastrids occupy an intermediate position between Monogenea and Digenea as already discussed. Temnocephala seem to occupy an intermediate position in evolution between Turbellarians and Trematoda, particularly Aspidogastrids and Gasterostomes. They further resemble trematodes in having a posterior sucker, a hermaphrodite reproductive system, having a similar general plan, simple and saccular gut, lacking an anus, as in few Turbellarian and Gasterostome trematodes.

The Turbellarians seem to occupy the most primitive and lowest position according to evolution amongst the Platyhelminthes and the Digenea (Prosostomata) probably the most advanced and the highest. The evolution seems to have proceeded along two ecological factors, *viz.* mode of living and feeding. Amongst Trematodes, Monogenea appears to be a primitive group, though it has highly specialised for ectoparasitic life. Aspidogastrids appear to have more resemblance with Gasterostome trematodes than others and seem to have adapted generally for ectoparasitic life by developing ventral adhesive disc or apparatus. Some of them have been recorded from internal situations also. They occupy an intermediate position between the Monogenea and Digenea. The intermediate or probably transitional groups of Aspidogastrids and Gasterostomes, are found to be less common and are comparatively more simple in structure also. This subject of the possible phylogeny of the Platyhelminthes is being dealt with in greater detail in a later paper on Prosostomes (*Hemiuroidea*).

Family ASPIDOGASTRIDAE Poche, 1907.
Sys. *Aspidobothrii* Burmeister, 1856.
Aspidobothridae Monticelli, 1888.
Aspidobothriidae Bresslau, 1912.
Stichocotylidae Faust and Tang, 1936.

Family diagnosis : Subclass *Aspidogastrea* Faust and Tang, 1936; with characters of the Subclass.

Intestine simple; oral sucker very poorly developed or wanting. Ventral sucking organ a powerful conspicuous adhesive disc or apparatus with a series of small suckers. In molluscs and cold blooded vertebrates.

Other diagnostic characters are :—

Adult parasitic on or in the soft parts of molluscs (Gastropods and Lamellibranchs) or in the intestinal canal of cold-blooded vertebrates.

Development probably direct, with ciliated or unciliated larvae; hatching from eggs. Adults hermaphroditic. Oral sucker absent or poorly developed. Ventral sucking organ a powerful adhesive disc or apparatus frequently divided into series of sucking cups; intestine a simple blind sac. Flame-cell pattern of larva: 2 (1+1+1). All known species belong to a single Order *Aspidogastrea* Faust and Tang, 1936 (=Order *Aspidogastrata* Faust, 1932) which has the characteristics of the subclass, *Aspidogastrea* of Faust and Tang (1936).

The family *Aspidogastridae* contains forms of three distinct categories based on the presence of number of rows of alveoli, situated on the adhesive disc which is the most important character for systematic studies in the group. Some forms are with a single row of alveoli; others with three rows and still other forms with four rows. For the sake of convenience in taxonomic studies, the author proposes to divide them in these categories into three systematic units by creating three new subfamilies . *viz.* *Micraspisinae*, for forms with single row of alveoli on the adhesive disc; *Cotylaspisinae* for forms with three rows of alveoli on the sucker or haptor and *Aspidogasterinae* for forms with four rows of suckers or acetabula.

Key to Subfamilies of Family Aspidogastridae Poche, 1907.

1. Single row of alveoli on ventral adhesive apparatus; disc of ventral adhesive apparatus present or lacking	*Micraspisinae*, **subfam. nov.**
2. Several longitudinal rows of alveoli on disc of ventral adhesive apparatus which is invariably present.	3.
3. Three rows of alveoli on disc ..	*Cotylaspisinae*, **subfam. nov.**
4. Four rows of alveoli on disc	*Aspidogasterinae*, subfam nov.

(*a*) Subfamily *Aspidogasterinae*, **subfam. nov.**

(Text-figs. 1, 6 and 8.)

Subfamily diagnosis : *Aspidogasteridae* Poche, 1907 ; **with Family characters.**

Ventral disc of adhesive apparatus invariably present. Four rows of alveoli on the ventral disc. Oral sucker absent. Marginal organs present. Mouth terminal or subterminal. Testis one or two. Cirrus pouch present or absent. Mouth with or without lip like processes. Papillae on the ventral part of the body present or absent.

Type genus—*Aspidogaster* Baer, 1927.

Key to Genera of Subfamily Aspiaogasterinae, subfam. nov.

1. Testis single	2.
Testes two; alveoli numerous ..	*Multicotyle* Dawes, 1940.
2. Papillae on central region of ventral disc, lacking	3.
Papillae on central region of ventral disc present, hollow	*Lophotaspis* Looss, 1902.
3. Mouth with lip-like processes	*Lobatostoma* Eckmann, 1932.
Mouth without lip-like processes	*Aspidogaster* Baer, 1827.

1. Genus **Aspidogaster Baer,** 1827.

This is the type genus of the family and contains the oldest representative of the group, discovered for the first time by von Baer in 1827

Generic diagnosis: *Aspidogasterinae*, subfam. nov.; with Subfamily characters.

Ventral adhesive disc large and oval, with four rows of alveoli. Papillae on central region of ventral disc lacking. Marginal organs present. Mouth subterminal, without liplike processes. Oral sucker absent. Testis single. Cirrus present. Sexual pore median. Ovary small.

Type species—*Aspidogaster conchicola* Baer, 1827; from lamellibranch mollusc, *Anodonta*, Prussia.

So far two species of the genus, *viz. Aspidogaster indicum* Dayal, 1943 and *Aspidogaster piscicola* Rawat, 1948 have been recorded from the Indian region. They can be differentiated as follows :—

Key to Indian Species of Genus Aspidogaster Baer, 1827.

Number of alveoli on the ventral adhesive disc 62. Testis equal in size to ovary	*Aspidogaster indicum* Dayal, 1943.
Number of alveoli on the ventral adhesive disc 58. Testis twice as large as ovary ..	*Aspidogaster piscicola* Rawat, 1948.

(i) **Aspidogaster indicum** Dayal, 1943.

(Text-Figs. 1-5.)

Specific diagnosis: *Aspidogaster* Baer, 1827 : with Generic characters.

Body of the worm leaf-shaped, consisting of two parts, a dorsal containing all the organs and the ventral adhesive disc, measuring 4·52* long×2·20 broad (type). Ventral adhesive disc oval, muscular, multiloculate sucker, with crenate outline, measuring 2·8×2·2 in type specimen. Alveoli 62 in four longitudinal rows; 32 peripheral and 30 in two longitudinal rows of 15 each. Marginal organs present. Excretory pore at the posterior end of body, on dorsal side. Mouth at the anterior end, subterminal. Oral sucker muscular, funnel like. Prepharynx small. Pharynx strong, muscular. Oesophagus small. Intestine long tubular, extending upto the posterior end of testis or even beyond it. Genital opening anterior to adhesive disc, on ventral side, on left side of pharynx. Testis oval or spherical in the posterior half of body, behind ovary. Cirrus sac large, pear-shaped, containing pars prostatica, ejaculatory duct and retractile petaloid cirrus. Vesicula seminalis outside cirrus sac. Ovary situated just anterior to testis, retort shaped. Uterus fills up nearly the whole space between the cirrus sac and posterior end of disc. Female genital opening lies adjacent to male opening, on the anterior side. Vitelline glands consist of a large number of follicles, lateral in disposition, extending from a little posterior to cirrus sac to hinder end of ventral adhesive disc. Laurer's canal, öotype and shell gland present. Eggs oval, with a thick yellowish-brown shell, measuring 0·06-0·09×0·025-0·045.

*All measurements in this paper are given in millimetres.

Host.—Fresh-water fish, *Barbus tor* (Ham.).

Habitat.—Intestine.

Locality.—Lucknow.

The species is characterised by large number of alveoli on the ventral adhesive disc; anterior position of genital pore and petaloid cirrus.

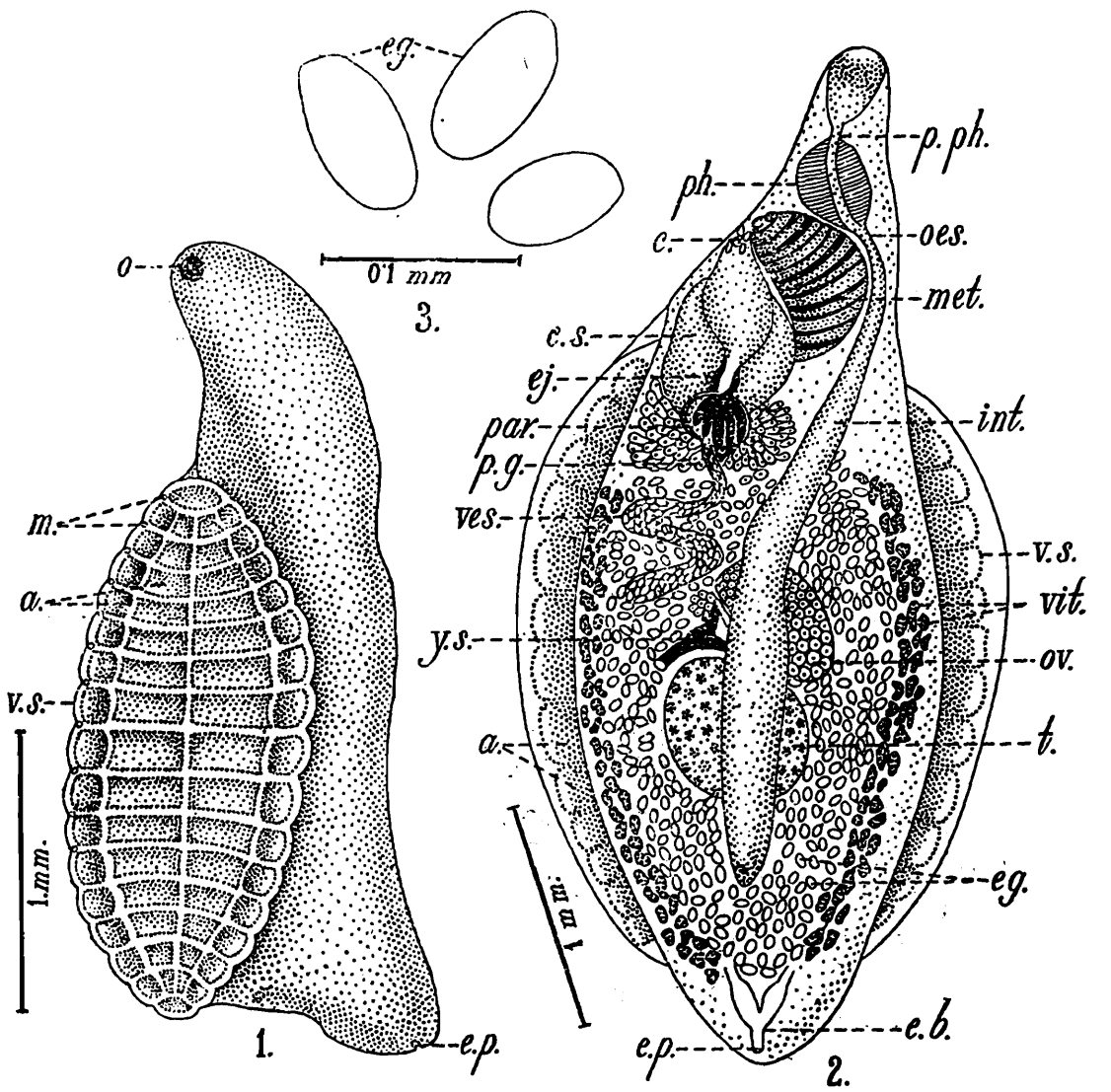

Fig. 1.—*Aspidogaster indicum*, ventro-lateral view of the animal, showing ventral adhesiv e disc or sucker. (Paratype). (After Dayal).

Fig. 2.—*Aspidogaster indicum*, dorsal view of the animal, showing internal organs. (Type specimen). (After Dayal).

Fig. 3.—*Aspidogaster indicum*, eggs highly magnified. (After Dayal).

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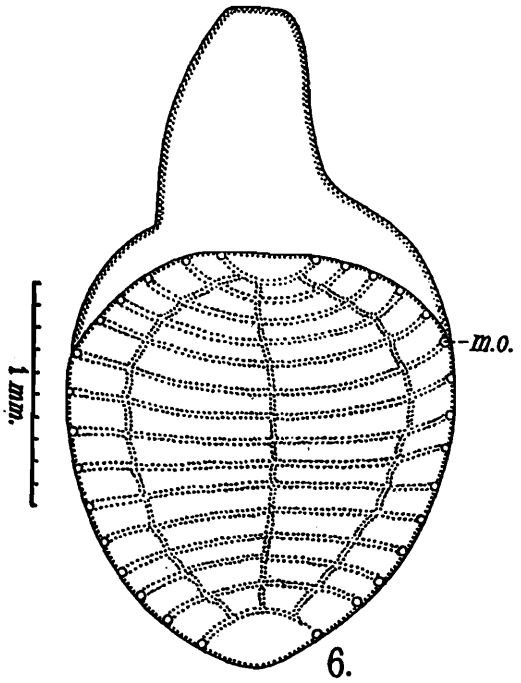
(2) **Aspidogaster piscicola** Rawat, 1948.

(Test-figs. 6, 7.)

Specific diagnosis : *Aspidogaster* Baer, 1827; with Generic characters.

Body divided into anterior narrow and posterior broad portions; the former containing the mouth, pharynx, oesophagus, and male and female genital pores; the latter being further divided into a dorsal part, containing the genital organs, their ducts, vitellaria and intestine and, the ventral, 1·82 long×1·59 broad, being subdivided by muscular ridges, transverse and longitudinal, into small fifty-eight alveoli, in four rows, the marginal containing 2(14)+2 and median 14 each. Marginal

organs very small, spherical in shape, lying in interstices between the peripheral alveoli, very near the edge of the body. Mouth terminal, round



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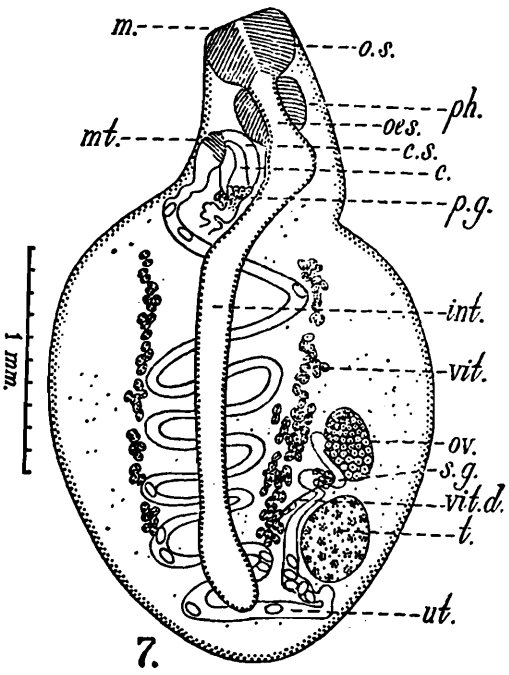

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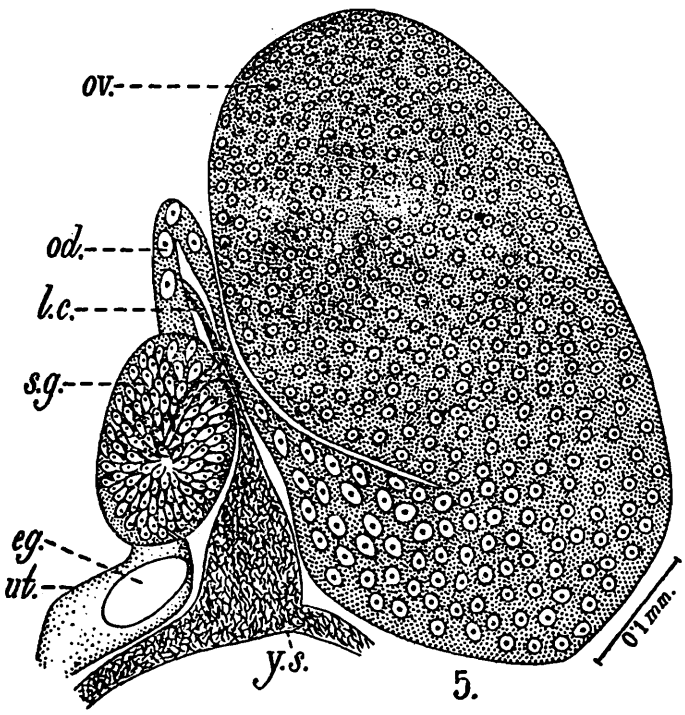

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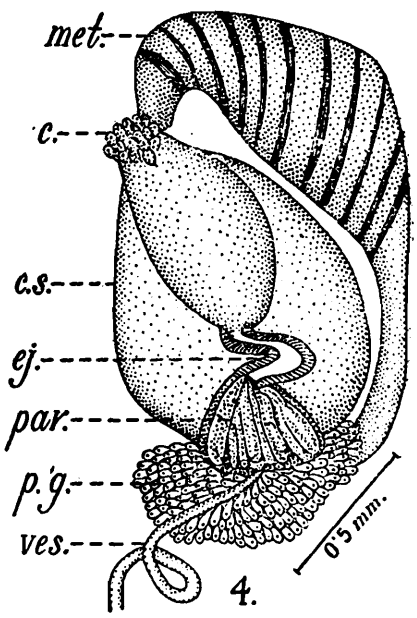

4.

FIG. 4.—*Aspidogaster indicum*, cirrus sac, metraterm, etc. (Sketched from paratype). (After Dayal).

FIG. 5.—*Aspidogaster indicum*, ovary and öotype complex. (Diagrammatic). (After Dayal).

a., alveoli ; *c.*, cirrus ; *c. s.*, cirrus sac ; *e. b.*, excretory bladder ; *eg.*, eggs ; *e. j.*, ejaculatory duct ; *e. p.*, excretory pore ; int., intestine ; *l. c.*, laurer's canal ; *m.*, marginal organs ; *met.*, metraterm ; *m.* mouth opening ; *od.*, oviduct ; *oes.*, oesophagus ; *ov.*, ovary ; *par.*, pars prostatica ; *ph.*, pharynx ; *p. ph.*, prepharynx ; *p g.*, prostate glands ; *s. g.*, shell glands ; *t.*, Testis ; *ut.*, Uterus ; *ves.*, vesicula seminalis ; *vit.*, Vitelline glands ; *v. s.*, ventral adhesive disc or sucker ; *y. s.*, yolk sac.

FIG. 6.—*Aspidogaster piscicola* ventral view, showing the ventral adhesive disc and marginal organs. (After Rawat).

FIG. 7.—*Aspidogaster piscicola* dorsal view, showing internal anatomy. (After Rawat).

c., cirrus ; *c. s.*, cirrus sac ; *int.*, intestine ; *m.*, mouth ; *m. o.*, marginal organ ; *mt.*, metraterm ; *oes.*, oesophagus ; *o. s.*, oral sucker ; *ov.*, ovary ; *p. g.*, prostate glands ; *ph.*, pharynx ; *s. g.*, shell glands ; *t.*, testis ; *ut.*, uterus ; *vit. d.*, vitelline duct ; *vit.*, vitellaria.

opening at the anterior end, leading into oral sucker, a spherical, bulbous, muscular enlargement, measuring 0·23 long—0·4 broad. Prepharynx 0·68 long—0·78 broad, narrow, tube-like. Pharynx 0·31 long—0·27 broad, thick muscular. Intestine, single caecum, median, ending with a little dilatation. Testis single, oval, situated posteriorly, on right side, post ovarian, measuring 0·36 long—0·25 broad. Cirrus sac pear-shaped, sac-like, with muscular walls, situated, anteriorly, on the left side of oesophagus. Cirrus, spherical at the base, containing glandular cells, its gradually narrowing anterior tube opening into the genital pore. Prostate glands, unicellular gland cells, situated around the basal portion of cirrus sac. Vas deferens coiled. Ovary situated a little in front of testis, oval in shape. Shellgland and ootype present. Vitellaria, small, arranged in two lateral longitudinal rows, lying on either side of the intestinal caecum. Uterus very long. Eggs elliptical, with egg case, measuring 0·077—0·087 × 0·038.

Host.—Labeo rohita.

Location.—Intestine.

Locality.—Lucknow.

This species differs from *A. indicum* Dayal, in the number of alveoli, relative size of ovary and testis, size and shape of genital organs.

It will be observed that both these species are recorded from the same locality, although from different hosts but it is a freshwater fish in both the cases. Faust and Tang (1936) pointed out that the same species in this group have been found to occur from two different hosts.

The number of alveoli is a variable character, as stated by Rawat himself, it being 60-74 in *A. conchicola* and 58 in *A. piscicola.*

Shipley and Hornell (1904, p. 95) state that the number of alveoli probably increases with age.

The size of the testis is also a variable character, depending upon the time of its maturation as observed by Sproston (1945), in the case of the genus, *Kuhnia.* Therefore, it probably needs further studies before this species could be finally taken as a distinct, valid species, from *A. indicum* Dayal (1943).

The author had an opportunity to examine a few specimens of *Aspidogaster piscicola* collected from a freshwater fish, *Labeo* sp. at Allahabad. Unfortunately no details could be recorded.

2. Genus **Lophotaspis** Looss, 1902.

Generic dignosis: *Aspidogasterinae,* **subfam. nov.**; with Subfamily characters.

Ventral adhesive organ with four rows of alveoli. Marginal organs present in the form of tentacles, at all the intersections of the ridges of the adhesive disc. Mouth terminal. Oral sucker absent. Intestine median, simple. Papillae on central region of ventral disc present, hollow. A single testis at the posterior end of body, from which a vas deferens extends upto the genital pore. Cirrus absent. Genital pore between the mouth and pharynx.

Type species—*L. vallei* (Stossich, 1899) from the oesophagus and stomach of a marine chelonian, *Thalassochelys caretta* at Corfu, Ceylon.

Syns. *Aspidogaster vallei* Stossich, 1899 : *Lophotaspis adhaerens* Looss, 1902 from *Thalassochelys corticata*.

A representative of this genus has been recorded from Ceylon.

(iii) **Lophotaspis margaritiferae** (Shipley and Hornell, 1904) Ward and Hopkins, 1918.

(Text-fig. 8.)

Syn. *Aspidogaster margaritiferae* Shipley and Hornell, 1904.

Specific diagnosis : *Lophotaspis* Looss, 1902 ; with Generic characters.

Specimen immature, length 6·0, colour brown ochre dorsally but the foot has a beautiful rose-red hue. Four rows of alveoli or suckers on the foot arranged alternately—an economy of space which permits the accommodation of the largest possible number of pits. Number of alveoli not precisely known, it probably increases with age but there are something like 20 in the outer rows and 18 in the two median rows. A number of " tube-feet " project from the area between the outer rows and the middle rows and between the two central rows, none on the outside of the outer rows. They are hollow, thin walled, tubular erectile organs of the simplest structure, possessing the power of extension in an extraordinary degree ; capable of great extension and of complete retraction by inversion, in manner similar to the eversion and retraction

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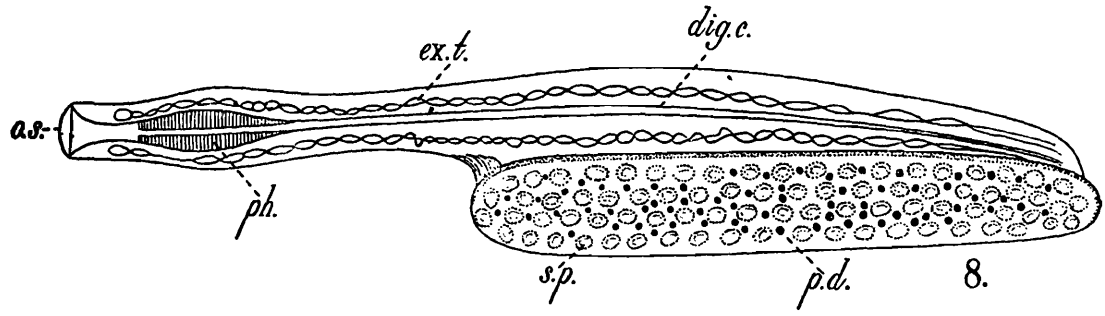

8.

FIG. 8.—*Lophotaspis margaritiferae* : adult from the pericardial chamber of a pearl oyster, seen ventrolaterally. The tube feet are retracted. (After Shipley and Hornell.)

dig. c., digestive caecum ; *ex. t.*, double excretory trunks ; *o. s.*, oral sucker ; *p. d.* pedal disc ; *ph.*, pharynx ; *s. p.*, sucker pits.

FIG. 9.—*Macraspis elegans*, Olss. (After Benham).

of proboscides of the cestode, *Tetrarhynchus*. Partially retracted, they exhibit a closely annulated or wrinkled appearance, reminding one of the annulation of an earthworm, the anterior extremity of which they greatly resemble. Body composed of two distinct regions. Dorsum minutely wrinkled or annulated transversely. Oral sucker a transverse slit bounded by thin mobile lips. Alimentary canal median and unbranched, ending blindly near the posterior end of the body. Mouth situated at the base of oral sucker-slit. Prepharynx, a short narrow buccal canal. Pharynx strongly muscular, oblong in optical section. Oesophagus a thin-walled vesicle. Intestine a long, thick-walled digestive caecum. Excretory system more highly specialised than in some

Distomes. Genital pore just between the pharynx and the anterior end of the foot. Penis well-marked. Testis and ovary single. No vitellaria, uterus or Laurer's canal were distinguishable. Movements, leechlike.

Host.—*Margaritifera vulgaris*, Schum.

Habitat.—Pericardial cavity.

Location.—South and south-east areas of the Cheval Paar, Ceylon.

Most allied to *L. macdonaldi* Monticelli, 1891, in the possession of remarkable " tentacles " or " tube-feet " It however differs in colour, size being nearly half; in the absence of " caeca " in the intestine; in the fewer number of tentacles and alveoli location, host and locality.

3. Genus **Lobatostoma** Eckmann, 1932.

Generic diagnosis : Aspidogasterinae, **subfam. nov.,** with Subfamily characters.

Adhesive ventral disc with four rows of alveoli. Papillae on central region of ventral disc lacking. Marginal organs present. Mouth surrounded by lip like processes. Oral sucker absent. Testis single. Cirrus present.

Type species—*Lobatosoma ringens* (Linton, 1907) Eckmann, 1932, from a marine fish, *Micropogon*, U.S.

4. Genus **Multicotyle** Dawes, 1940.

Generic diagnosis : Aspidogasterinae, **subfam. nov.** ; with Subfamily characters.

Ventral adhesive disc bearing four longitudinal rows of suckerlets or alveoli, of which the openings are reduced to mere transverse slits. Marginal organs present, at the periphery of the disc, only in the anterior region of body. Papillae on the ventral surface of the disc or elsewhere lacking. Mouth subterminal and lacks lip-like processes. A concentration of muscular tissue is to be seen in whole mount around the mouth and this may prove to be the rudiments of sucker. Testes two. Cirrus absent.

Type species—*Multicotyle purvisi* Dawes, 1940, from River turtle, *Siebenrockiella crassicollis* (Intestine), Malaya.

(*b*) Subfamily *Macraspisinae*, **subfam. nov.**

(Text-fig. 9.)

Subfamily diagnosis : *Aspidogastridae* Poche, 1907 ; with Family characters.

Disc of ventral adhesive apparatus present or lacking. Ventral adhesive disc or apparatus with a single row of suckerlets or alveoli, confluent or distinct. Testis one or two. Marginal organs present or absent. Mouth terminal or subterminal. Oral sucker present or absent. Cirrus present. Mouth without lip-like processes.

Type genus—*Macraspis* Olsson, 1868.

Key to Genera of Subfamily MACRASPISINAE, **subfam. nov.**

Ventral adhesive disc present. Suckers confluent. Testis single	*Macraspis* Olsson, 1868.
Ventral adhesive disc lacking. Suckers distinct and separate. Testes two	*Stichocotyle* Cunningham, 1889.

5. Genus **Macraspis** Olsson, 1868.

Generic diagnosis : *Macraspisinae*, **subfam. nov.** ; with Subfamily characters.

Ventral adhesive disc with a single row of confluent acetabula. Marginal organs present. Mouth terminal. Testis single. Cirrus present.

Type species—*M. elegans* (Olsson, 1868) Monticelli, 1891—from gallbladder of a fish, *Chimaera monstrosa* from the coast of Europe.

6. Genus **Stichocotyle** Cunningham, 1884, *emed.* Faust and Tang, 1936.

Generic diagnosis : *Macraspisinae*, **subfam. nov.** ; with Subfamily characters.

Ventral adhesive surface with a single row of more or less distinct, acetabular cups which may either be simple or separated from one another or may be subdivided by transverse septa, which may not only divide the original acetabula into several pockets but also similarly divide the intra-acetabular spaces. Marginal organs absent. Mouth subterminal. Oral sucker absent. One or two testes. Cirrus present.

Type species—*S. nephropsis* Cunningham, 1884, from Norwegian Lobster, *Nephrops* ; adult in bile ducts of Rays (Odhner, 1905).

Faust and Tang (1936) divided the genus into two subgenera, *Multicalyx* and *Stichocotyle* and defined them as follows :—

1. Subgenus *Stichocotyle* : with simple acetabula separated by interspaces. Testes two. Represented by *Stichocotyle* (*Stichocotyle*) *nephropsis* Cunningham, 1884.
2. Subgenus *Multicalyx* : with acetabula subdivided by transverse septa which also produce transverse divisions of the intramuscular space on the ventral side of th body. Testis single. Monotypic. Represented by *Stichoctyle* (*Multicalyx*) *cristata* Faust and Tang, 1936.

(*c*) Subfamily *COTYTASPISINAE*, **subfam. nov.**
(Text-figs. 10 & 12.)

Subfamily diagnosis : *Aspidogastridae* Poche, 1907 ; with Family characters.

Disc of ventral adhesive apparatus invariably present. Rows of alveoli on the ventral disc three. Testis one or two. Cirrus sac present or lacking. Marginal organs present. Mouth terminal or subterminal. Oral sucker present or lacking.

Type genus—*Cotylaspis* Leidy, 1857

Key to Genera of Subfamily COTYLASPISINAE, **subfam. nov.**

1. Testes two. Mouth terminal ; oral sucker present	*Cotylogaster* Monticelli, 1892.
Testis single. Mouth subterminal ; oral sucker absent	2.
2. Cirrus sac present	*Cctylaspis* Leidy, 1857.
Cirrus sac lacking	*Lissemysia* Sinha, 1935.

7. Genus **Cotylaspis** Leidy, 1857.

Syn. *Platyaspis* Monticelli, 1892.

Generic diagnosis : *Cotylaspisinae*, **subfam. nov.**; with Subfamily characters.

Disc of ventral adhesive apparatus present, oval. Number of rows of alveoli on the disc three. Marginal sense organs present. Mouth subterminal. Oral sucker absent. Testis single. Cirrus sac present. Ovary dextral, smaller than testis.

Type species—*C. insignis* (Leidy, 1857) Braun, 1893, from mantle cavity of north American Unionidae mollusc.

8. Genus **Cotylogaster** Monticelli, 1892.

Generic diagnosis : *Cotylaspisinae*, **subfam. nov.;** with Subfamily characters.

Disc of ventral adhesive apparatus present, oval. Number of rows of alveoli on the disc three. Marginal organs present. Mouth terminal. Oral sucker present. Testes two. Cirrus sac present.

Type species—*C. michaelis* Monticelli, 1892, from intestines of a European fish, *Cantharus vulgaris*.

9. Genus **Lissemysia** Sinha, 1935 *emend.* Tandon, 1949.

Generic diagnosis : *Cotylaspisinae*, **subfam. nov.**; with Subfamily characters.

Ventral adhesive apparatus with three rows of alveoli. Marginal organs present. Mouth subterminal, without lip-like processes. Oral sucker absent. Testis one. Cirrus sac lacking. Other diagnostic characters are :—

Size small. Body divided into two parts, anterior dorsal, forebody and a posterior ventral adhesive disc. Adhesive disc divided into three rows of 27-29 alveoli ; 19 peripheral, 8-10 median. Prepharynx absent. Pharynx muscular. Oesophagus short. Intestine sac-like. Excretory system typical of the family. Testis one, on the right side of the median line. Vesicula seminalis coiled and voluminous. Cirrus absent. Ovary in the middle, variable in position. Receptaculum seminis absent. Uterus with or without ascending and descending limbs and containing variable number of eggs. Metraterm absent. Parasites of Chelonia and Mollusc.

Type species—*Lissemysia indica* Sinha, 1935, from a fresh-water chelonian, *Lissemys punctata* (intestine), Lucknow.

Key to Indian Species of Genus LISSEMYSIA Sinha, 1935.

Number of alveoli on median row of adhesive disc 10. Uterus without distinct ascending and descending limbs. Common vitelline duct arising from the middle of the reservoir	*L. indica* Sinha, 1935.
Number of alveoli on median row of adhesive disc 8. Uterus with a descending and an ascending limb. Common vitelline duct arising from the right side of the reservoir	*L. ovata* Tandon, 1949

(4) **Lissemysia indica** Sinha, 1935.

(Text-figs. 10, 11.)

Specific diagnosis : *Lissemysia* Sinha, 1935 ; with Generic characters.

Body composed of two parts, anterior dorsal forebody and posterior ventral multiloculate adhesive disc, measuring (average) 0·62-0.65 length ×0·62-0·66 width. Worm measures (average) 0·89 length, 0·62 width. The number of alveoli is 29, nineteen being peripheral and ten median. Marginal organs fine narrow tube like structures, situated at the end of

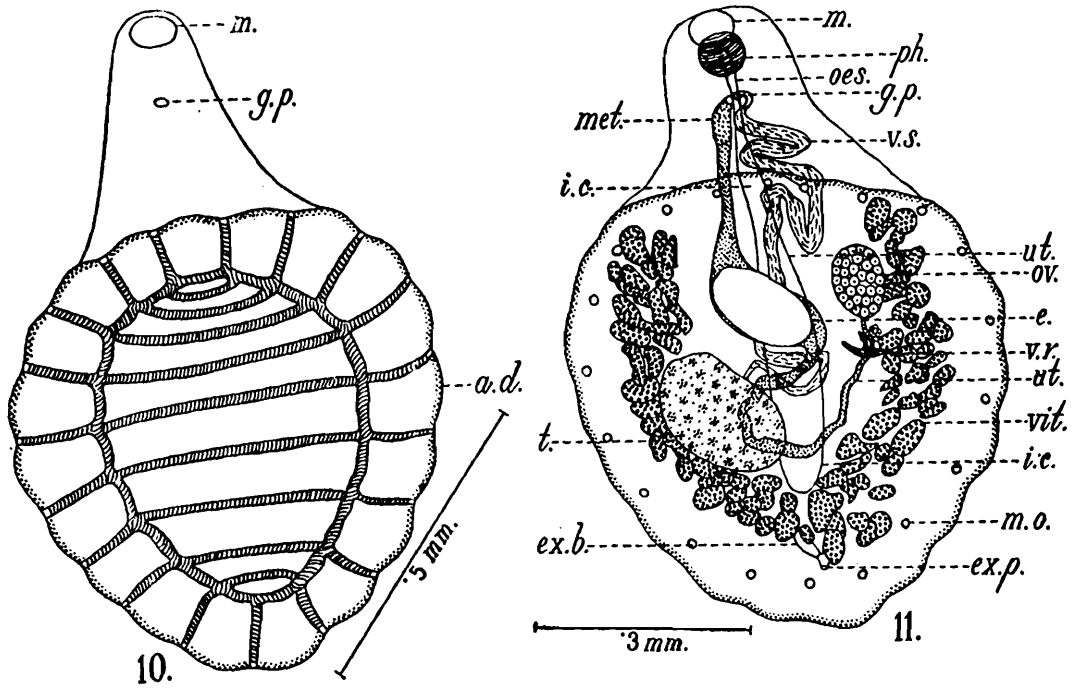

FIG. 10.—*Lissemysia indica*, external characters. (After Sinha).
FIG. 11.—*Lissemysia indica*. general anatomy. (After Sinha).

a. d., adhesive disc ; *e.* egg ; *ex. b.*, excretory bladder ; *ex. p.* excretory pore ; *g. p.*, genital pore ; *i. c.*, intestinal caecum ; *m.*, mouth ; *met.*, metraterm ; *m. o.*, marginal organ ; *oes.*, oesophagus; *ov.*, ovary; *ph.*, pharynx ; *t.*, testis ; *ut.*, uterus; *vit.*, vitellaria ; *v. r.*, vitelline reservoir ; *v. s.*, vesicula seminalis.

cross positions of the adhesive disc, in spaces between muscular edges of adhesive disc and outer wall of body. Mouth like cup-shaped funnel, subterminal, on ventral surface. Oral sucker and prepharynx absent. Pharynx spherical. Oesophagus small. Intestine median, a large sac-like structure. Excretory pore dorsal, near the posterior end of body. Testis single, large, generally on right side, ovoid in shape, measuring 0·20 ×0·13. Vas deferens present. Vesicula seminalis much coiled. Genital pore median, ventral, situated a little behind pharynx. Male and female duct open separately, the latter opening on the right and the former on the left side. Ovary small, ovoid, on the left side, slightly

anterior to the middle of body, measuring 0·075×0·10. Oviduct, common vitelline duct, ŏotype and shell gland observed. Vitelline follicles large, more numerous posteriorly than anteriorly, arranged along sides of the body and are continuous with each other behind intestinal sac. Uterine egg large and oval, observed single in front of testis, measuring 0·156 ×0·09.

Host.—*Lissemys punctata* Bonnaterre.

Location.—Intestine.

Locality.—Lucknow.

The species is characterised by the arrangement of alveoli on the adhesive disc in three rows, nineteen peripheral and ten median ; presence of marginal organs at cross partition of the adhesive disc ; simple, sac-like intestine ; excretory pore on dorsal surface ; one testis, generally on right, absence of cirrus and cirrus sac, receptacula seminis ; arrangement of vitellaria along sides of the body meeting posteriorly ; uterus with discending and ascending coils and presence of a single large egg.

(5) **Lissemysia ovata** Tandon, 1949.

(Text-figs. 12-15.)

Specific diagnosis : *Lissemysia* Sinha, 1935, with Generic charaters.

Body divided into an elongated narrow anterior part and a flattened disc-like posterior part, bearing adhesive disc ; worm measuring 0·96-1·43×0·53-0·63. The adhesive organ is divided into three rows of 27 alveoli, 19 peripheral, surrounding 8 in the median row. Marginal organs present in between the peripheral alveoli, in the interstices between the muscular edges of the disc and peripheral wall ; flask shaped, enclosed in a thin sac-like structure, opening to the exterior by an aperture. Oral sucker absent. Mouth cup shaped funnel, situated subterminally at the antero-ventral end, acting as an adhesive organ, 0·142×0·123. Prepharynx absent. Pharynx, elongated, muscular, 0·085 in diameter. Oesophagus short. Intestine blind sac-like, lined internally with large, elongated and flattened cells. Excretory pore dorsal, median, near the posterior end, surrounded by a small papilla-like structure. Testis single large, oval, on right side, measuring 0·142×0·18. Vas deferens narrow duct. Vesicula seminalis tubular. Cirrus sac slightly swollen tube. Male genital aperture, on left side, posterior to pharynx. Ovary smaller than testis, measuring 0·133-0·104, slightly elongated, situated on the right side, anterior to testis. Oviduct, common vitelline duct, ŏotype, shell gland, & uterine coils observed. Metraterm opens to outside, at the female genital aperture, situated near the male genital pore. Vitellarian follicle arranged on dorsal side of disc, in rows along sides, in the posterior part and continuous at posterior end ; less numerous posteriorly than along the sides and anteriorly ; about 35 on each side. Uterus contains one to three oval and golden yellow operculated eggs, measuring 0·218-0·237×0·114-0·133.

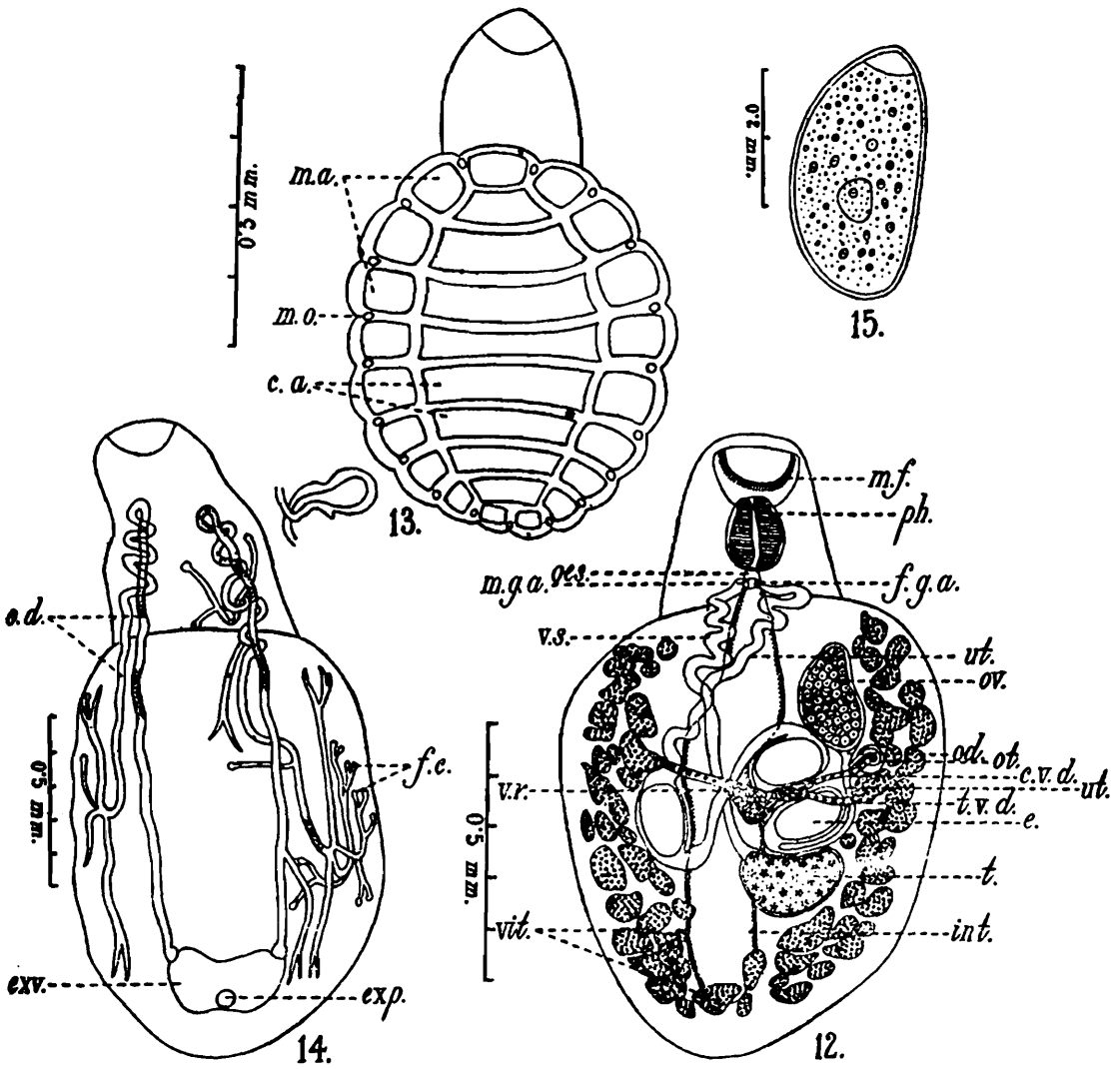

FIG. 12.—*Lissemysia ovata*, ventral view, showing adhesive disc and marginal organs (after Tandon).

FIG. 13.—*Lissemysia ovata*, dorsal view, showing internal anatomy (after Tandon).

FIG. 14.—*Lissemysia ovata*, dorsal view, showing excretory system (after Tandon).

FIG. 15.—*Lissemysia ovata*, egg., freshly taken out of the uterus (after Tandon).

c. a., central alveoli ; *c. v. d.*, common vitelline duct ; *e.*, eggs ; *e.d.*, excretory duct ; *ex. p.*, excretory pore ; *ex. v.*, excretory vesicle ; *f. g. a.*, female genital aperture ; *f.c.*, flame cell ; *int.*, intestine ; *m. f.*, mouth funnel ; *m. g. a.*, male genital aperture ; *m. o.*, marginal organ ; *o. d.*, oviduct ; *oes.*, oesophagus ; *ot.*, shell gland with ôotype ; *ov.*, ovary ; *m. a.*, marginal alveoli ; *ph.*, pharynx ; *t.*, testis ; *t.v.d.*, transverse vitelline duct ; *ut.*, uterus ; *vit.*, vitelline glands ; *v. r.*, vitelline reservoir ; *v. s.*, vesicula seminalis.

Hosts.—*Vivipara bengalensis*, *Lamellidens corrianus* and *Indonaia caerulea*.

Habitat.—Ctenidia.

Locality.—Kukrail stream, Lucknow, India.

This species differs from the other species of the genus, recorded from Lucknow, in its size, shape of pharynx, presence of eight median alveoli instead of ten, disposition of uterine coils, nature of distribution of vitellarian follicles, position of ovary, in the nature of origin of common vitelline duct, large size and number of eggs in the uterus.

IV ACKNOWLEDGMENTS.

I wish to express my thanks to Shri S. Ghosal, Shri Ashim Kumar Bose and Shri G. Ramakrishna for their assistance in various ways.

V. Summary.

This paper deals with the Aspidogastrid trematode fauna, known from the Indian region. Brief specific diagnosis and a diagram have been given in the case of each species. General description of the group, with regard to, particularly salient points of general morphology, anatomy, life-histories, taxonomy, ecology, evolution and phylogeny of the group has been brought out and diagnostic definitions and dichotomous keys at every step, *e.g.*, to the family, subfamilies, genera, subgenera and Indian species have been provided. A new record, with regard to host and locality of a parasite of the group has been incorporated and three new subfamilies have been proposed. The author suggests the use of the term 'haptor' widely used, at present, in the study of Monogenea, for the ventral (posterior) adhesive apparatus, of this group.

List of Indian species recorded; with their hosts, location and locality,

Name of parasite.	Host.	Location.	Locality.
Class. *Trematoda* Rudolphi, 1808.			
Subclass. *Aspidogastrea* Faust and Tang, 1936.			
Family. *Aspidogastridae* Poche, 1907.			
1. Subfamily. *Aspidogastrinae*, **subfam. nov.**			
A. Genus.—*Aspidogaster*, Baer, 1927.			
(1) *Aspidogaster indicum* Dayal, 1943.	Fresh water fish, *Barbus tor* (Ham.).	Intestine	Lucknow.
2) *A. piscicola* Rawat, 1948.	(*a*) *Labeo rohita* (*b*) *Labeo* sp.	Intestine Intestine	Lucknow. Allahabad.
B. Genus.—*Lophotaspis* Looss, 1902.			
(3) *Lophotaspis margaritiferae* (Shipley & Hornell, 1904) Ward & Hopkins, 1918. syn.—*Aspidogaster margaritiferae* Shipley & Hornell, 1904.	Pearl oyster, *Margaritifera vulgaris*.	..	Ceylon.
2. Subfamily.—*Cotylaspisinae*, **subfam. nov.**			
C. Genus.—*Lissemysia* Sinha, 1935.			
(4) *Lissemysia indica* Sinha, 1935.	*Lissemys punctata*	Intestine	Lucknow.
(5) *L. Ovata* Tandon, 1949.	Snail, *Vivipara bengalensis* (Lamarck).	Ctenidia	Kukrail. Lucknow.

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STUDIES ON THE TREMATODE FAUNA OF INDIA.

Part III. Subclass DIGENEA (*Gasterostomata*)

BY B. S. CHAUHAN, M.Sc., PH.D, FZS, FASc, FZSI, *Assistant Superintendent, Zoological Survey of India, Calcutta.*

CONTENTS.

I. General.

Trematode parasites form an important group in the study of helminth fauna of India but unfortunately, so far, there is no compact publication dealing with them in a comprehensive way. An attempt has, therefore, been made in this series to fill up that void. This paper is the first publication in the series and deals with Indian gasterostome trematode parasites. Parts dealing with other groups, *e.g.* Monogenea, Aspidogastrea, Prosostomata, etc., are under preparation and will come out in due course.

The Class *Trematoda* is divided into three Subclasses : A. *Monogenea* B. *Aspidogastrea*, C. *Digenea*. They represent generally three, different ecological habitats of the Orders. The representatives of the Subclass Monogenea are mostly minute forms, usually found as external parasites, clinging to the skin, gills of fishes, lining of buccal cavity, pharynx, urinary bladder of amphibians, etc. and as the name indicates are believed to have direct life-history. The forms belonging to Subclass Aspidogastrea penetrate more deeply into the body of the host than do most Monogenea and their adhesive apparatus is characteristic. It occupies almost the entire ventral surface of the body, consisting of numerous suckerlets or *alveoli* arranged in one or three to four rows, somewhat like the 'foot' of a gastropod mollusc. Most of the other trematodes belong to the Subclass Digenea, which are found as internal

parasites, have well defined oral and or ventral suckers and indirect life-history. The main characters, defining the three Subclasses are more or less as follows :—

Key to Subclasses of Class TREMATODA—

A. Main adhesive apparatus a postero-ventral disc, or one or a number of suckers set upon a disc or upon surface of body, sometimes supplemented by hooks and hooklets. Other adhesive organs, when present, various types of suckers situated near anterior extremity. Excretory pores paired, situated in anterior region. Genital pore or pores also anterior. Parasites living on skin or in other superficial locations of vertebrates, specially on the gills of fishes	MONOGENEA.
B. Main adhesive apparatus a single row of suckerlets or alveoli set upon the ventral surface of the body, or three or four longitudinal rows of alveoli set upon an enormous posterior (ventral) disc, which lacks hooks or hooklets. Other adhesive organs weakly developed or unpresented. Excretory and genital pores as in C ; endoparasites of vertebrates, specially fishes and chelonians, but also of mollusca and crustacea	ASPIDOGASTREA.
C. Main adhesive apparatus, when present, a solitary cup-shaped sucker, situated somewhere on the ventral surface, of the body. Other adhesive organ, when present, a weak oral sucker encircling the mouth. Excretory pore single and posterior. Genital pore or pores ventral, generally in the anterior region, between the suckers. Vaginal pore or pores absent. Opening of Laurer's canal dorsal, near the posterior extremity ; endoparasites of every class of vertebrates, and of some invertebrates	DIGENEA.

II. GENERAL ACCOUNT OF THE ORDER GASTEROSTOMA.

The general morphology and anatomy of Gasterostomes, family Bucephalidae, is peculiar in many and various ways from that of Prosostomate distomes. Therefore, their study is of significance specially from the phylogenetic point of view. Their general pattern is very peculiar though simple, in comparison to that of the monogenetic and other digenetic trematodes, in as much as they show certain resemblances in anatomy to Rhabdocoelid Turbellarians. The following brief, general description of the group will therefore be found of interest.

The representatives of this group are very small, almost transparent forms, usually with the anterior end flattened and the posterior cylindrical. Their oral or mouth opening is placed on the ventral surface of the body instead of the usual anterior terminal position of other trematodes. It is

not guarded by any oral sucker and is a simple, usually crescent shaped, insignificant slit. This is immediately followed by a well developed more or less spherical, muscular pharynx, which leads into a simple, sac-shaped intestinal caecum, the group resembling in this respect most of the Rhabdocœlid Turbellarians. The position of oral opening and muscular pharynx is very much variable even in the same species. It is, however, situated mostly in antero-posterior direction and is never terminal. It may be anterior, posterior or at the level of the gonads, testes and ovary. The intestinal caecum is usually median in disposition and has its blind end usually directed anteriorly but in a few cases it may be directed posteriorly, even in the specimens of the same species. This is also not a constant character.

The cuticle in the group is very thin, and densely covered with backwardly directed minute spines specially towards the anterior end. Their size and density of distribution decreases towards the posterior end.

The head or anterior end of these parasites is furnished with fixation organs, a character used as basis for classification in systematic studies in the group. They are in the form of retractile tentacles on an anterior sucker, as in the case of the genus *Bucephalus* Baer, 1827 ; an anterior sucker alone in *Bucephalopsis* (Diesing, 1855) ; a sucker with a hoodlike process in the genus *Rhipidocotyle* Diesing, 1858, and *Dolichoenterum* Ozaki, 1924 ; a rhynchus or anterior rostellum as in the genus *Prosorhynchus* Odhner, 1905 and *Neidhartia* Nagaty, 1937 and a rhynchus and tentacles as in the genus *Alcicornis* MacCallum, 1917.

The male genital organs are composed of two, compact, spherical, testes typically placed towards the right side, in tandem position or sometimes obliquely situated. The two vas deferens join to form the vasa efferentia, which enters the cirrus sac. Cirrus sac is a well developed elongated organ, situated at the posterior end, towards the left side. It contains anteriorly a comparatively large, usually ovoid vesicula seminalis interna, leading into a spindle shaped, pars prostatica, followed posteriorly by cirrus proper. Prostate gland cells are distributed in the space between the wall of cirrus sac and pars prostatica. Cirrus sac opens subterminally on the ventral side at the posterior end, together with the terminal part of the uterus in a common genital atrium.

The female genital organs are composed of a spherical ovary, usually slightly smaller than the testes, situated anterior to the anterior testes, towards the right side except in the genus *Dolichoenterum* Ozaki, 1924, in which it is situated in between the two testes and in the genus *Neidhartia* Nagaty, 1937, in which it is situated on left side of the testes. Oviduct, arising from the ovary, receives two common vitelline ducts, a very fine Laurer's canal and continues as uterus. Uterine coils generally extend anteriorly upto the anterior limit of vitellaria and its posterior end opens into the common genital atrium. Eggs are small, numerous, golden yellow in colour, oval in shape, thin shelled, with an operculum on the narrow pole but with no lateral spines or filaments. Receptaculum seminis is generally absent. The vitelline glands are composed of spherical follicles, distributed generally in the anterior region, in two lateral bands or groups or in the form of an anterior arch. This combination

may be found in the specimens of the same species and is not considered to be a reliable character for taxonomic studies. The number of vitelline follicles varies slightly on two sides and in different species, the left set opposite the ovary—usually extending further posterior than the right set. The two lateral vitelline ducts meet the oviduct posterior to the ovary.

The excretory vesicle is generally a simple, elongated, sac-shaped vessel; Y shaped in some forms, opening at the posterior end, except perhaps in *Prosorhynchus uniporus* Ozaki, 1924, in which it probably opens in the common genital sinus.

III. SYSTEMATIC ACCOUNT.

Subclass DIGENEA.

This Order is further sub-divided to two Orders, which can be differentiated as follows :—

A. Mouth situated near the middle of the body	Order *Gasterostomata.*
B. Mouth situated near the anterior extremity	Order *Prosostomata.*

Order GASTEROSTOMATA Odhner, 1905.

Syns. *Alcicornida* Poche, 1926 (Superfamily)
Bucephalata La Rue, 1926 (Suborder)
Bucephaloidea Dollfus, 1929 (Superfamily)

The Gasterostomes are digenetic trematode parasites which depart from the usual concepts of trematode structure in that the anterior sucker is unrelated to the mouth opening. The simple rhabdocoelic gut opens on the ventral surface of the body. This unique location of the mouth led Odhner (1905) to apply the descriptive name Gasterostomata to the Order.

Diagnosis : Mouth ventral, near the middle of the body. Haptor a muscular sucker with or without tentacles, or a rhynchus, at the anterior extremity. Intestine sac-like. Genital pore ventral, near the posterior extremity. Gonads globular, generally near the mid-body or posterior Vitellaria located in the anterior region. Uterus having 2 or 3 folded limbs. Cercaria furcocercous. Development with exchange of hosts.

This group occurs mainly in fishes and contains a solitary family, *Bucephalidae.*

Family BUCEPHALIDAE Poche, 1907

Gasterostomidae Braun, *1883.*

Syns. Alcicornidae Poche, 1926.

Diagnosis. : with the characters of the Order.

The oldest recorded species of this group, dates back to Rudolphi who described *Monostomum crucibulum, M. galeatum* and *Distoma gracilescens,* in 1819. Baer (1827) introduced the first generic name *Bucephalus* to accommodate certain encysted cercariae under the name *Bucephalus polymorphus.* Siebold (1848) proposed the genus *Gasterostomum* for an adult trematode, which he named as *G. fimbriatum* and observed the similarity between his species and *Bucephalus polymorphus.* Wagner (1858) regards *B. polymorphus* Baer, 1827 as the larval form of *Gasterostomum fimbriatum* Siebold, 1848 and thus the generic name

Gasterostomum fell into synonymy to *Bucephalus* Baer, 1827. Consequently Poche (1907) changed the family name *Gasterostomidae* to *Bucephalidae*. On this ground some authors regard even the Order *Gasterostomata* as Order *Bucephalata* or *Bucephalida* or superfamily *Bucephaloidea*, etc.

Members of this family are mostly found as adult parasites in the guts of marine and freshwater fishes and larval stages encysted in the nerves.

Representatives of this family were recorded for the first time in India by Verma (1936).

Nicoll (1914) on the basis of the nature of the anterior sucker divided the family into two subfamilies, which can be distinguished as follows:—

Key to Subfamilies of Family BUCEPHALIDAE.

A. Anterior adhesive organ a sucker	*BUCEPHALINAE*, Nicoll, 1914
B. Anterior adhesive organ a rhynchus	*PROSORHYNCHINAE*, Nicoll, 1914.

Eckmann (1932) did not recognize subfamilies but some others like Nagaty (1937), Manter (1940a), Chauhan (1943), Dawes (1946), and Dayal (1948) have followed the classification.

A. Subfamily *BUCEPHALINAE* Nicoll, 1914.

Syn. *Gasterostominae* Bräun, 1883.

The subfamily contains, at present, five genera : *Bucephalus* Baer, 1827 ; *Bucephalopsis* (Diesing, 1855), Nicoll, 1914 ; *Rhipidocotyle* Diesing, 1858 ; *Dolichoenterum* Ozaki, 1924 and *Neobucephalopsis* Dayal, 1948. They can be differentiated by the following key :—

Key to Genera of Subfamily BUCEPHALINAE.

A. Ovary situated in between the two testes	*Dolichoenterum.*
Ovary situated anterior to anterior testis	B.
B. I. Anterior end provided with a muscular sucker, having a circlet of six or seven muscular, retractile tentacles or fimbriae	*Bucephalus.*
II. Anterior end provided with a weak shallow sucker surmounted by a fan shaped hood	*Rhipidocotyle.*
III. Anterior end provided with a simple, globular, muscular sucker only	IV.
IV. Receptaculum seminis absent	*Bucephalopsis.*
Receptaculum seminis present	*Neobucephalopsis.*

(i) Genus **Bucephalus** Baer, 1827

Syns. *Gasterostomum* Siebold, *1848.*

Eubucephalus Diesing, 1855.

The genus was created by Baer (1827) for a new furcocercous cercaria, *Bucephalus polymorphus*, the name denoting a likeness to the head of an ox and the extended tentacles being comparable to horns. The tentacles show specific differences in shape and number. They are conspicuous when extended but are invariably very inconspicuous in retracted condition, when they appear only as small papillae.

Generic diagnosis : *Bucephalinae* Nicoll, 1914, with Subfamily characters.

Body elongate or ovate. Cuticle covered with spines. Anterior end possesses tentacles as well as a sucker on the ventral surface. Oral aperture on the ventral surface, removed from the anterior or the posterior extremities. Oral sucker absent. A well developed muscular pharynx present. Intestinal caecum simple, sac-shaped. Testes two, smooth contoured. Cirrus-sac at the posterior half, towards the left side of the body. Ovary smooth contoured, anterior to the testes. Vitelline glands in two groups, in the anterior half of the body and are either separate or may meet together forming an arch. Excretory vesicle simple, a tubular sac—

Type species : *Bucephalus polymorphus* Baer, 1827.
syns. *Distoma campanula* Dujardin, 1845.
Gasterostomum fimbriatum Siebold, 1848.
Gasterostomum laciniatum Molin, 1859.
Bucephalus elegans Woodhead, 1930.
Bucephalus varicus Manter, 1940.

The following species of the genus have been recorded, so far, from the Indian region :—

(1) *Bucephalus tridenticularia* Verma, 1936.
(2) *B. aoria* Verma, 1936.
(3) *B. jagannathai*, Verma, 1936.
(4) *B. indicus* Srivastava, 1938.
(5) *B. gangeticus* Srivastava, 1938.
(6) *B. barina* Srivastava, 1938.

They can be distinguished by the following key :—

Key to India Species, of Genus Bucephalus.—

(1)	Tentacles four in number	*B. gangeticus.*
	Tentacles more than four in number .	2.
(2)	Tentacles five in number	*B. barina.*
	Tentacles more than five in number	3.
(3)	Tentacles six in number	4.
	Tentacles more than six in number	5.
(4)	Tentacles with two lateral processes .	*B. indicus.*
	Tentacles with a single inwardly directed process	*B. jagannathai.*
(5)	Tentacles eight in number	*B. tridenticularia.*
	Tentacles more than eight in number .	*B. aoria.*

1. **Buchephalus tridenticularia** Verma, 1936.

Dawes, B. (1946). The Trematoda. Cam. Univ. Press., Lond : 192.

(TEXT-FIG. 1.)

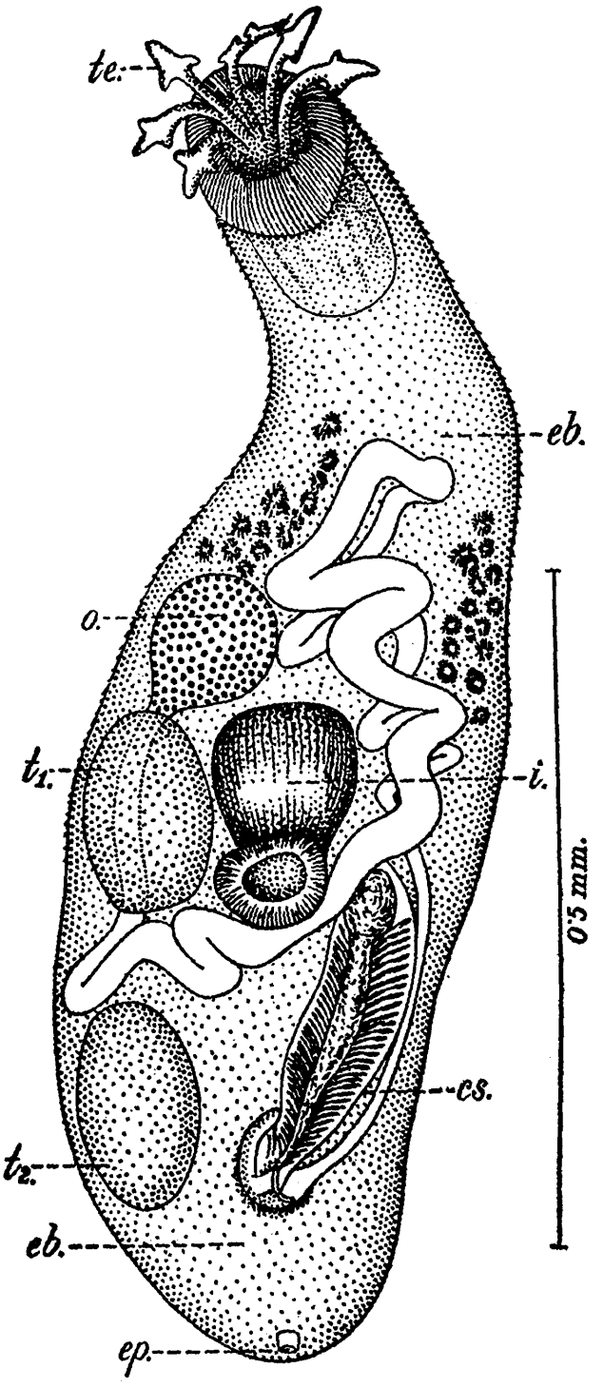
Srivastava, H.D. (1938) *Indian J. vet. Sci.* 8(4) : 321.

Specific diagnosis : *Bucephalus* Baer, 1827 ; with Generic characters.

Body elongate, anteriorly narrower ; length 1·07-1·75 ;* greatest width, in the region of pharynx, 0·38—0·46. Anterior sucker prominent,

*All measurements in this paper are given in millimetres unless otherwise stated.

0·125 in diameter, subterminal, with eight, arrow, head-like tentacles, having 2 lateral processes on opposite sides of the main stem ; 0·026 long 0·013—0·016 broad. Pharynx 0·08—0·11 in diameter, at one-third length of body from hinder end. Intestinal sac anteriorly directed, 0·16—0·38 long, reaching middle of body. Ovary 0·15 in diameter



Text-fig. 1.—*Bucephalus tridenticularia* : entire specimen; ventral view (after Verma).

cs, Cirrus sac; *eb*, Excretory bladder; *ep*, Excretory pore; *i*, Intestine; *o*, Ovary; t_1, Anterior testis; t_2, Posterior testis; *te*, Tentacle.

globular, right sided, situated just ahead of equatorial line or beside intestinal sac. Uterine coils in mid-vitellarial field, between posterior-testis and anterior level of vitellaria. Vitelline follicles minute, 0·018-0·02 in diameter, extending from front margin of intestine or ovary to midway between intestine and anterior sucker, numbering 14-20 on each side. Testes oval, larger than ovary, anterior one behind ovary,

0·14—0·2×0·12—0·16 ; posterior far behind to right of cirrus sac, 0·13-0·19×0·15—0·18. Cirrus pouch large, on left side, 0·29—0·53 long, 0·07—0·12 broad. Genital pore ventral, 0·05—0·15 from posterior end. Eggs light yellow, 0·0189—0·020×0·013—0·015. Excretory bladder elongated, broadly tubular. Excretory pore postero-terminal.

Host—*Aoria aoria=Macrones aoria*, Day and *Aoria seenghala=Macrones seenghala*, Day.

Habitat.—Small intestine, hinder region.

Locality.—Allahabad, India.

2. **Bucephalus aoria** Verma, 1936.

(TEXT-FIG. 2.)

Dawes. B. (1946). The Trematoda. Camb. Univ. Press., Lond. : 192.

Specific diagonosis :—*Bucephalus* Baer, 1827, with Generic characters.

Size small, shape elongate, slightly broader about its middle, measuring 0·8-1·0 in length and 0·25-0·27 in maximum width, in unpreserved state. Length in preserved specimens 0·5-0·6. Anterior sucker placed ventrally measuring 0·118-0·14 in diamteter, bearing along its latero-dorsal margin 14-22 short processes or fimbriae. Pharynx round, situated behind the middle of body, diamter 0·6. Oesophagus short. Intestine sac-like, directed anteriorly or dorso-laterally, measuring 0·125 in length and 0·05-0·067 in breadth in life. Ovary round, lying about the middle length of the body towards the right side, measuring 0·06-0·08 in diameter. Vitelline follicles arranged in two compact masses, one on each side of the body, extending from the level of anterior margin of ovary to midway between it and the sucker. They are minute, varying 16-20 in number on each side, measuring 0·01-0·014 in diameter. Testes nearly oval or somewhat triangular in outline, nearly as big as the ovary, varying in position ; the anterior situated closely behind the female gonad and measuring 0·06×0·04, the posterior lying on the same side as the anterior, separated from it by a distance nearly equal to half its length or lying on the opposite of the body, with the pharynx intervening between it and the anterior testis. It measures 0·05-0·08×0·04-0·06. Cirrus sac nearly equal to one fourth the body length. Genital sinus large, with the bifid muscular tongue inside, surrounded by a narrow circle of unicellular glands. Genital pore subterminal. Egg light yellow in colour, 0·012-0·016×0·0106-0·011 in size.

Host.—*Aoria aoria=Macrones aoria* Day.

Habitat.—Small intestine.

Locality.—Allahabad.

Species created provisionally by Verma (1936).

3. **Bucephalus jagannathai** Verma, 1936.

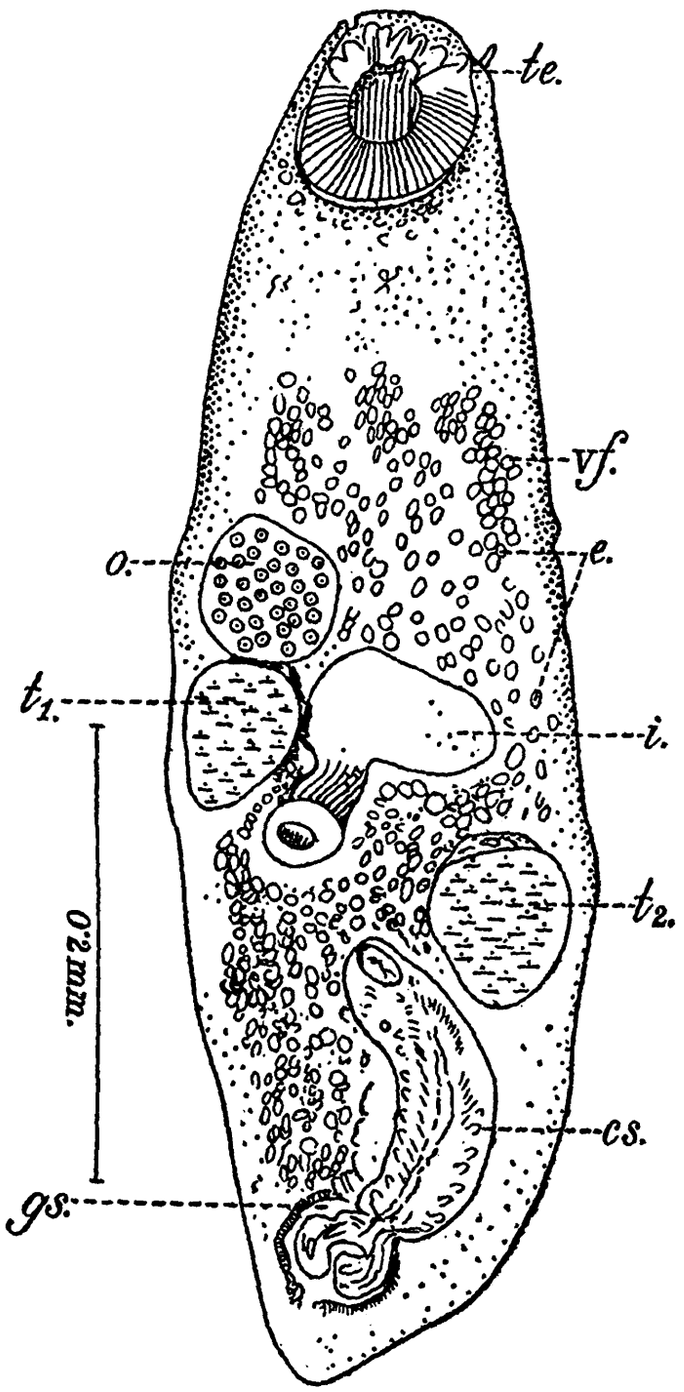
(TEXT-FIG. 3.)

Srivastava, H.D. (1938), *Indian J. vet. Sci.* **8** (4) : 320.

Specific diagnosis. : *Bucephalus* Baer, 1927 ; with Generic characters.

In balsam mounts 1·1-1·7 long by 0·42-0·54 broad, in region of

ovary or intestine. Sucker shallow, ventro-terminal, usually scoop shaped, 0·166-0·193×0·11-0·17 Cephalic tentacles six, each 0·7-0·9 long and 0·016-0·017 broad near middle, where it gives off a short lateral process. Pharynx equatorial, feeble, partly or wholly overlapped by ovary and shell glands, 0·17 in diameter. Intestine sac like, short, 0·15-0·17×0·117-0·126 in size, bent over oesophagus. Gonads packed

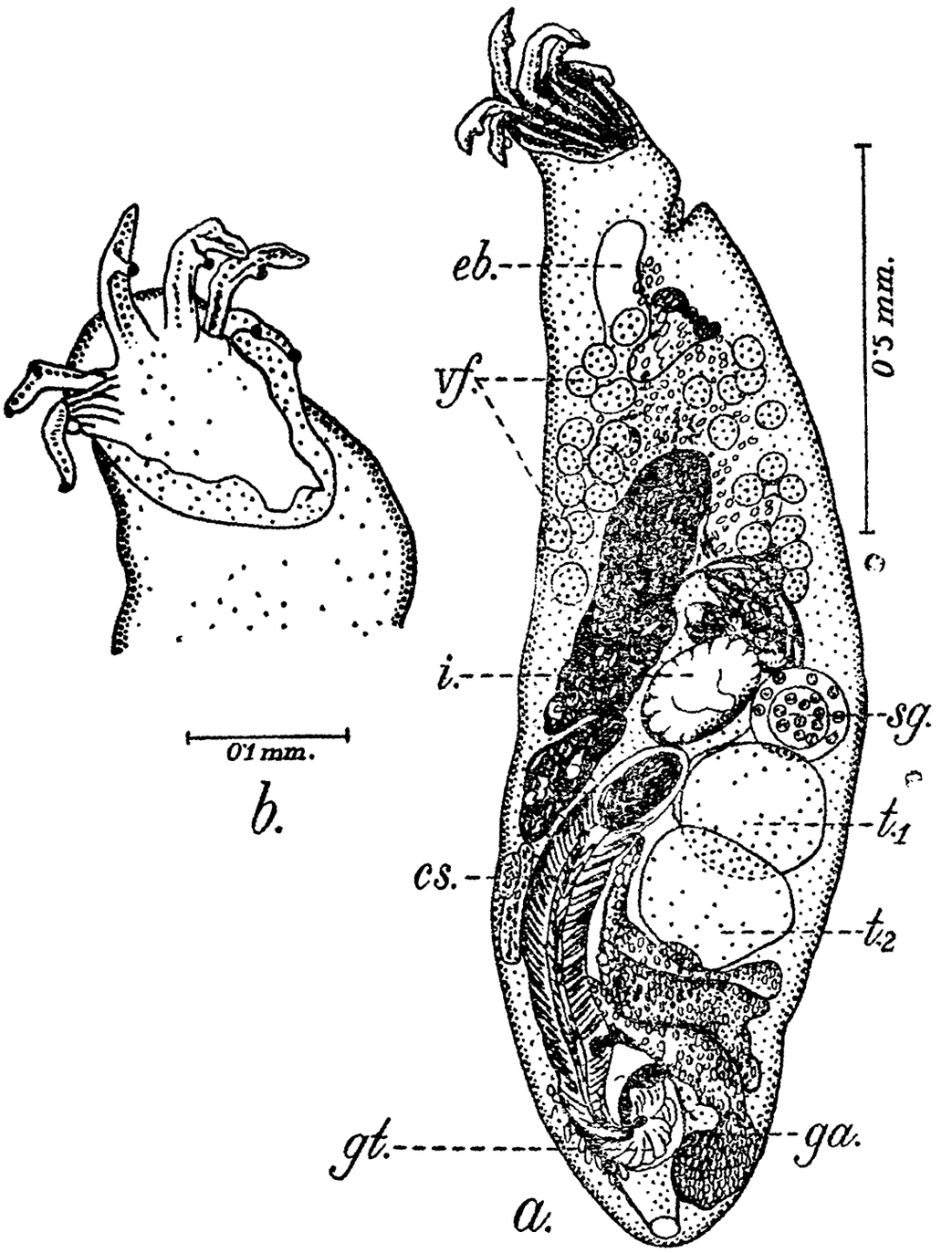


Text-fig. 2. *Bucephalus aoria*; entire specimen, ventral view (after Verma).

cs, Cirrus sac; *e*, Egg; *gs*, Genital sinus; *i*, Intestine; *o*, Ovary; t_1, Anterior testis; t_2, Posterior testis; *te*, Tentacle; *vf*, Vitelline follicles.

together, usually overlapping one another, mostly in third fourth of body. Ovary 0·42-0·84 in diameter, lateral to intestine, near commencement of third quarter of body. Uterine coils extend from near genital atrium to anterior level of vitellaria. Vitellaria lateral, at somewhat unequal levels, in second quarter of body; follicles large, rounded, 0·042—0·058 in diameter, 14-15 in number on the ovarian side, 16-17 on the other.

Testes larger than ovary, partly overlapping one another, along inner side of anterior half of cirrus sac : anterior 0·18—0·23 in diameter, in close contact with ovary or slightly overlapping, posterior smaller than or nearly equal to anterior. Cirrus sac 0·38-0·55×0·08-0·11, sickle



TEXT-FIG. 3.—*Bucephalus jagannathai* ; *a.* entire specimen, ventral view ; *b.* Cephalic part of same showing tentacles (after Verma).

cs, Cirrus sac ; *eb*, Excretory bladder; *ga*, Genital atrium ; *gt*, Genital tongue *i*, Intestine ; *sg*, Shell glands ; t_1, Anterior testis ; t_2, Posterior testis ; *vf*, Vitelline follicles.

shaped, about one third as long as body, to level of front margin of anterior testis. Genital atrium 0·126—0·18 in diameter, 0·09-0·134 ahead of hind end. Genital tongue well developed, muscular, protrusible beyond genital pore. Genital pore ventroterminal, leading into atrium by short sinus. Excretory bladder broadly tubular, to midway between

vitellaria and sucker ; pore postero-terminal. Eggs numerous, light to deep yellow, broadly oval, 0·0186-0·0199×0·0116-0·0133.

Host.—Spotted mackerel, *Cymbium guttatum* (Bl. & Schn.).
Habitat.—Lower intestine.
Locality.—Puri, Bay of Bengal.

4. **Bucephalus indicus** Srivastava, 1938.

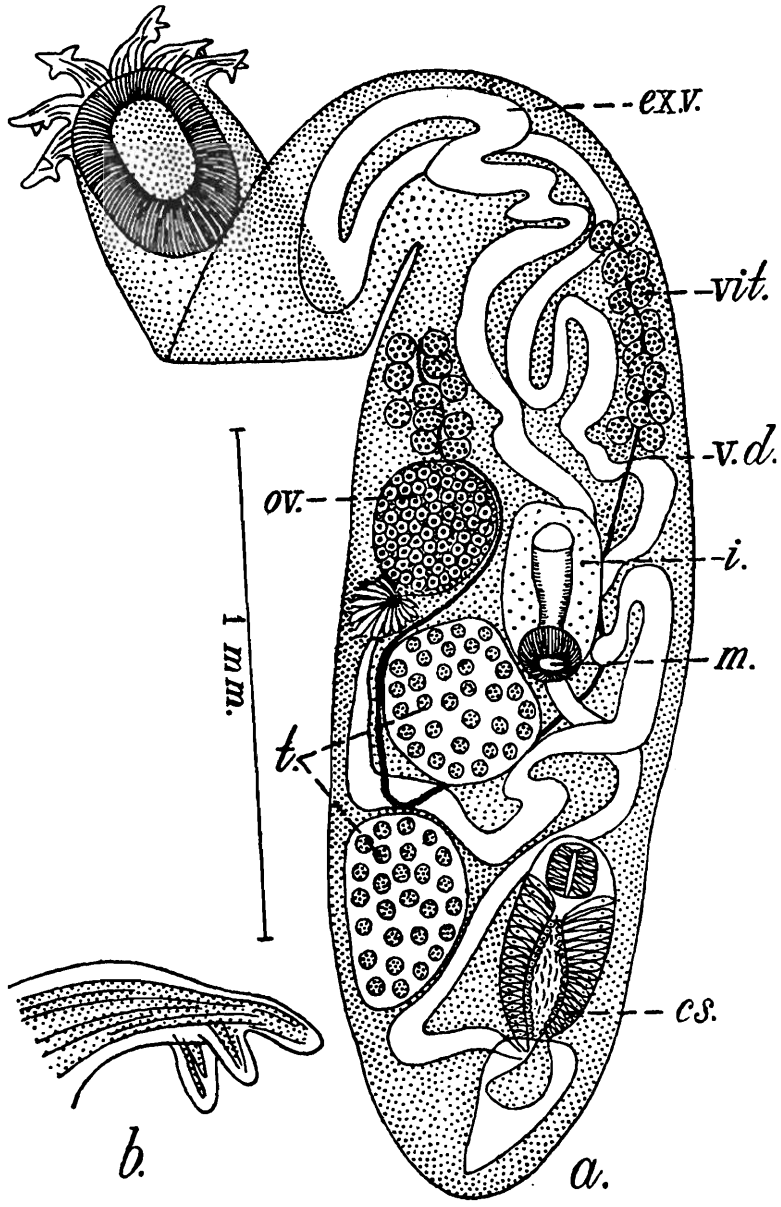
(Text-fig. 4 : a,b.).

Specific diagnosis : *Bucephalus* Baer, 1927, with Generic characters.

Body elongate, somewhat cylindrical, with broadly rounded ends studded with minute backwardly directed spines, more closely set in the anterior part of the worm, measuring 1·4-3·2 in length and 0·28-0·68 in maximum breadth (across the level of the pharynx). Anterior sucker measuring 0·16-0·36×0·14-0·24, with a crown of six well developed and contractile tentacles, having a broad triangular base and two fairly well developed lateral processes on either side. Pharynx circular, 0·08-0·14 in diameter, situated in midline, at about the middle posterior third of body length. Mouth ventral. Oesophagus bottle shaped, 0·06-0·18 in length. Intestine simple, ovoid sac, measuring 0·24-0·4×0·12-0·2, extending forward from pharynx to anterior level of ovary. Testes two, varying in size and shape, situated tandem on left side, separated by uterine coil and the vitelline duct of right side, usually in the first two third of the posterior third of body. Anterior testis 0·14-0·32×0·12-0·32. Cirrus sac elongate, oval, measuring 0·3-0·5×0·06--0·2, extending anteriorly almost to the level of the anterior limit of the posterior testis, enclosing a small ovoid vesicula seminalis, measuring ·06-0·14×0·04-0·12 and spindle shaped. Pars prostatica 0·16-0·36×0·14-0·1 in size, surrounded by prostate glands and a narrow ductus ejaculatorius, measuring 0·06-0·14 in length, having a cuticular lining and opening into a roughly triangular genital sinus, at the base of the tongue like structure, known as genital tongue or cone. Genital sinus surrounded by numerous gland cells. Genital pore subterminal on the ventral surface, a little in front of the hinder end. Ovary spherical, 0·1-0·26 in diameter, lying at the junction of second and posterior third of body length, close in front of anterior testis, separated from it by the compact shell gland complex and vitelline duct of left side. Shell gland complex lies between the left body wall, ovary and anterior testis. Laurer's canal small, starting from the oviduct just before it receives the common vitelline duct. Vitelline glands composed of small and compact, pear-shaped or oval follicles, arranged roughly in pairs along each side of the body, extending longitudinally from the anterior margin of ovary to first third of body length, aggregated into a compact mass in contracted specimens. Initial part of uterus runs backward and passing between the two testes, crosses over to the opposite side, continuing anteriorly into an irregular coil upto the first sixth of the body length and then turning backwards, opening into the genital sinus. It is full of light yellow coloured eggs measuring 0·023-0·027×0·014 in size, oval in shape, with a small knob at one end.

Excretory bladder straight, tubular, extends from a little in front of the anterior limits of the vitellaria to the excretory pore, situated close to the genital opening.

The species resembles *B. jagannathai*, in its number of tentacles, but differs from it in most of its characters *e.g.* shape of body, shape and character of tentacles, extent of cirrus sac, vitellaria and uterus and



TEXT-FIG. 4.—*Bucephalus indicus* ; *a.* entire specimen ; *b.* cephalic tentacles, enlarged (after Srivastava).

cs, Cirrus sac ; *ex. v.*, Excretory vessel ; *i*, Intestine ; *m*, mouth ; *ov*, Ovary *t*, testes ; *vit*, vitellaria ; *v.d.*, Vitelline duct.

topography of gonads, besides difference in measurements. It resembles slightly *B. tridenticularia* in the nature of its tentacles, topography of gonads, extent of vitellaria and shape of excretory bladder, but differs from it in the number of tentacles, anterior extent of cirrus sac and vitellaria, shape of anterior sucker and the difference in the size of the various organs.

Host.—*Macrones seenghala* Day.

Habitat.—Intestine.

Locality.—Rivers, the Ganges and the Jumna, winter months, Allahabad, (India).

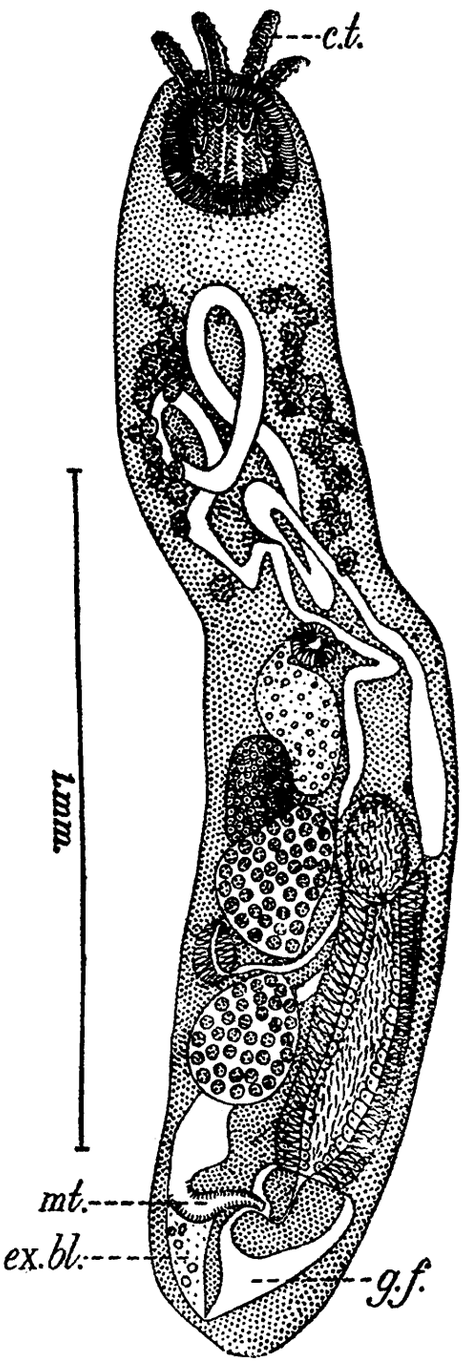
5. **Bucephalus gangeticus** Srivastava, 1938.

(Text-fig. 5.)

Srivastava, H.D. (1937), *Proc. Indian Sci. Congr.* 24: 298.

Specific diagnosis: *Bucephalus* Baer, 1827, with Generic characters.

Body elongate, almost uniformly broad, measuring 1·76×0·38, covered with minute, backwardly directed spines. Anterior sucker situated



Text-fig. 5.—*Bucephalus gangeticus*; entire specimen (after Srivastava).

c.t., Cephalic tentacle; *ex. bl.*, Excretory bladder; *g.f.*, Genital funnel; *mt.* Metraterm.

subterminally, on the ventral side, measuring 0·2 in diameter, with a dorsal crown of four cylindrical and highly contractile tentacles, measuring 0·08×0·02 in size, studded with minute pointed spines. Pharynx small, spherical, 0·06 in diameter, situated in the middle of body length, leading posteriorly through a very short and narrow oesophagus into a saccular intestine, measuring 0·2×0·14.

Testes tandem, situated to the right of the median line, in the posterior half of body. The posterior testis is situated at one sixth of body length from the posterior end, measuring 0·18×0·14 in size, separated from the anterior by the uterus, measuring 0·22×0·18. Cirrus sac is an elongated tubular structure, measuring 0·74×0·14, extending anteriorly upto the posterior end of intestine, enclosing a well developed, ovoid,vesicula seminalis, measuring 0·16×0·10; a long pars prostatica, measuring 0·4×0·1, surrounded by prostate gland cells and a short and narrow ductus ejaculatorius, measuring 0·1 in length and opening into the genital sinus, at the base of the genital tongue or cone. Genital sinus is surrounded by gland cells which secrete the wall of spermatophore. Genital pore is situated at the posterior end, very close to the excretory pore. Ovary pear shaped, situated in the space between the anterior third of the anterior testis, posterior half of intestine and the right body wall, measuring 0·16×0·10. Metraterm small and tubular. Shell gland complex between the two testes and the right body wall. Laurer's canal present. Vitellaria composed of small, rounded follicles, arranged longitudinally on the lateral sides of the body, beginning from a little in front of the pharynx to the anterior fifth of body length. Uterus well developed, containing a large number of oval eggs, measuring 0·015—0·023×0·0076-0095.

Excretory bladder long, tube, extending from anterior fifth of body length to the posterior end, opening, close to the genital pore.

This species resembles, *Gasterostomum* sp. of Linton, 1910 from the gut of *Sphyraena barracuda*, in the number of its tentacles but differs from it in most of its characters *e.g.* shape of body, topography of gonads, position of vitellaria, extent of uterus, cirrus sac, besides differences in measurements.

Host.—*Macrones seenghala* Day.
Habitat.—Intestine.
Locality.—Allahabad (India).

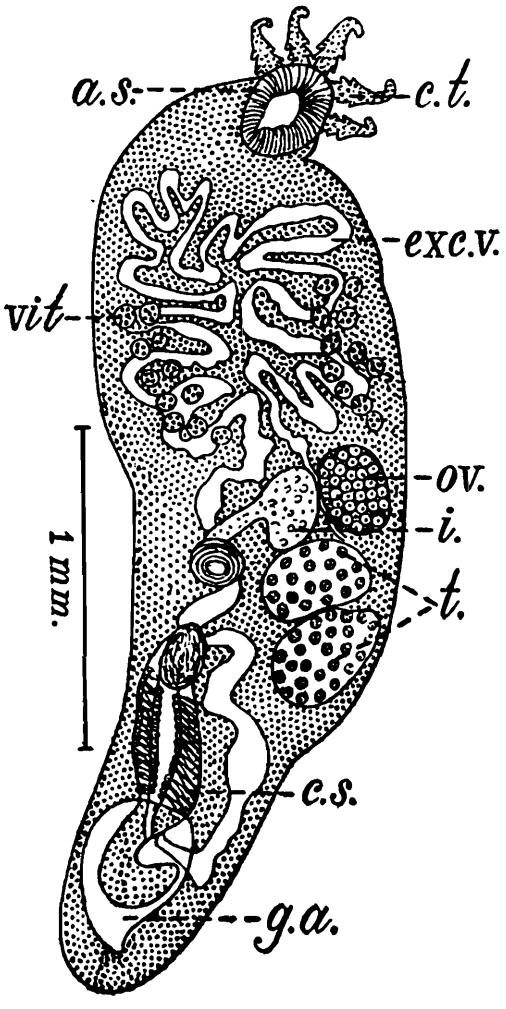
6. **Bucephalus barina** Srivastava, 1938.

(TEXT-FIG. 6.)

Specific diagnosis : *Bucephalus* Baer, 1827; with Generic characters.

Body measures 1·52-2·8 in length and 0·5-0·68 in maximum width (across the middle of vitellaria), covered with very fine, backwardly directed spines. Anterior sucker a fairly muscular structure, measuring 0·14-2×0·12-0·22, bearing on its antero-dorsal surface a crown of five tentacles, measuring 0·076-0·084×0·019-023, with a number of small rose-thorn shaped processes or hooks, arranged radially round their basal halves. Pharynx small, transversely oval, situated usually in the median line, a little behind the anterior half of body. Oesophagus narrow, 0·08 long. Intestine small, sac like, lying at level with ovary, measuring 0·13-0·2×0·1. Testes two, transversely oval, lying in contact, one behind the other, on left side, close behind the cephalic half of body. Anterior testis measuring 0·2-0·32×0·16-0·24 and the posterior 0·18-0·28×0·14-0·18. Cirrus lies along the left side, extending forward up to

the level of anterior margin of posterior testis and measuring 0·44-0·7×0·12-0·2. Vesicula seminalis small, oval, 0·12-0·16×0·06-0·12. Pars prostatica 0·2×0·04-0·08. Prostate glands present. Dutcus ejaculatorius narrow, opens at the base of well developed genital tongue, extending into genital sinus. Genital pore sub-terminal, on ventral surface, a little in front of the posterior end. Ovary lies in front of anterior testis, at middle of body, measuring 0·14-0·22×0·12-0·18, separated from anterior testis by a small and compact shell gland mass. Laurer's canal arising from oviduct, present. Vitellaria consist of small, rounded,



Text-fig. 6.—*Bucephalus barina* ; entire specimen (after Srivastava).

a.s, Anterior sucker ; *c.s*, Cirrus sac ; *c.t*, Cephalic tentacle ; *exc. v*, Excretory vesicle ; *g.a.*, Genital atrium ; *i*, Intestine ; *ov*, Ovary ; *t*, Testis ; *vit*, Vitellaria.

follicles, arranged roughly in pairs along the lateral sides of body, extending from the level of ovary to the first sixth of body length. Uterus well developed, contains a very large number of yellowish-brown oval eggs, measuring 0·015-0·019×0·0095-0·011, extending anteriorly up to a little in front of the suckers. Excretory bladder more or less a straight tube, extending from the anterior limit of vitellaria to the posterior end.

The species is characterised by the number and character of its tentacles It resembles *B. Jagannathai* rather closely in its internal anatomy but differs from it by the number and character of tentacles, besides differences in measurements.

Host.—*Scatophagus argus* Bloch.

Habitat.—Intestine.

Locality.—Puri, Bay of Bengal.

(ii) Genus **Bucephalopsis** (Diesing, 1855) Nicoll, 1914.

syns. *Bucephalopsis* Diesing, 1853 (subgenus).

Prosorhynchoides Dollfus, 1929.

Rudolphi (1819) described a gasterostome from *Lophius piscatorius* from Triesta, as *Distoma gracilescens*. Lacaze-Duthiers (1854) described a larval form from oysters, *Ostrea edulis* and *Cardium rusticum* from Balearic Islands, off the Spanish Coast, in the Mediterranean, as *Bucephalus haimeanus*. Diesing (1855) created a subgenus, *Bucephalopsis* of the genus *Bucephalus* Baer, 1827 for *Bucephalus haimeanus* Lacaze-Duthiers, 1854. Nicoll (1914) on the ground that since *Bucephalus haimeanus* has been proved larval form of *Gasterostomum gracilescens* raised the subgenus, *Bucephalopsis* Diesing, 1855 to the generic rank with *B. gracilescens* (Rud., 1819) nec. Tennent 1906, as type species.

Generic diagnosis : *Bucephalinae* Nicoll, 1914 ; with Subfamily characters.

Body usually elongate or ovate. Cuticle covered with spines. Anterior end having a sucker on the ventral surface but lacking any processes. Oral aperture on the ventral surface, away from the anterior or posterior end. Oral sucker absent. Pharynx present, welldeveloped and muscular. Intestinal caecum simple, sac shaped. Testes two, smooth contoured. Cirrus sac at the posterior half, towards the left side of body. Ovary smooth contoured, usually anterior to testes. Vitelline glands in two separate groups, usually in the anterior half of body.

Type species—*B. gracilescens* (Rud., 1819) nec. Tennent, 1906.

syns. *Distoma gracilescens* Rudolphi, 1819 ;

Gasterostomum gracilescens (Rudolphi, 1819).

The following species of the genus have been recorded, so far, from the Indian region—

1. *B. fusiformis* Verma, 1936.
2. *B. garuai* Verma, 1936.
3. *B. magnum* Verma, 1936.
4. *B. confusus* Verma, 1936.
5. *B. minimus* Verma, 1936.
6. *B. karvei* Bhalerao, 1937.
7. *B. belonea* Srivastava, 1938.
8. *B. microcirrus* Chauhan, 1943.
9. *B. sinhai* Dayal, 1948.
10. *B. thapari* Dayal, 1948.
11. *B. macronius* Dayal, 1948.

Bhalerao (1937) regards, *B. magnum* Verma, 1936 ; *B. confusus* Verma, 1936 and *B. minimus* Verma, 1936 as synonymous to *B. garuaz* Verma, 1936. Srivastava (1938) is inclined to accept *B. magnum* as a valid species but maintains that *B. confusus* and *B. minimus* are synonymous to *B. garuai*. Nagaty (1937) and Chauhan (1943) regard *B. confusus* and *B. minimus* as synonymous to *B. magnum* and not to *B. garuai*

as held both by Bhalerao and Srivastava. Nagaty (1937) further points out that *B. belonea* Srivastava, 1938 shows close resemblance to *B. southwelli* Nagaty, 1937 and that they are obtained from the same host. Chauhan (1943) however, included it as a distinct species in his key to the valid species of the genus.

The Indian species can be identified by the following key—

KEY TO INDIAN SPECIES OF GENUS **Bucephalopsis** (DIESING, 1855 NICOLL, 1914 ; after CHAUHAN (1943).

1.	Excretory bladder Y-shaped . .	2
	Excretory bladder tubular . .	4
2.	Vitelline follicles bilobed, large uterine coils extend on both sides of the body up to near the anterior extremity, ovary anterior to pharynx	3
3.	Distinct vesicula seminalis externa present . .	*B. sinhai* Dayal, 1948.
	Vesicula seminalis externa absent	*B. garuai* Verma, 1936.
4.	Vitelline glands not extending like a band along the sides of the body .	5
	Vitelline glands extending like a band along the sides of the body	6
5.	Cirrus sac half or more than half the body length	*B. karvei*, Bhalerao, 1937.
	Cirrus sac less than half the body length	*B. fusiformis* Verma, 1936.
6.	Testes situated in diagonal position, one on either side of the pharynx	*B. thapari* Dayal, 1948.
	Testes not situated in diagonal position, one on either side of the pharynx . .	7
7.	Vitellaria lie in the middle of body .	*B. microcirrus* Chauhan, 1943.
	Vitellaria lie in the anterior part of the body	8
8.	Cirrus sac extending forward up to the level of the anterior end of oesophagus beyond pharynx. Pharynx situated at the level of posterior testis. Anterior testis comparatively much smaller	*B. belonea* Srivastava, 1938.
	Cirrus sac not extending up to the level of oesophagus. Pharynx situated near anterior portion of the anterior testis . .	*B. macronius* Dayal, 1948.

7. **Bucephalopsis fusiformis** Verma, 1936.

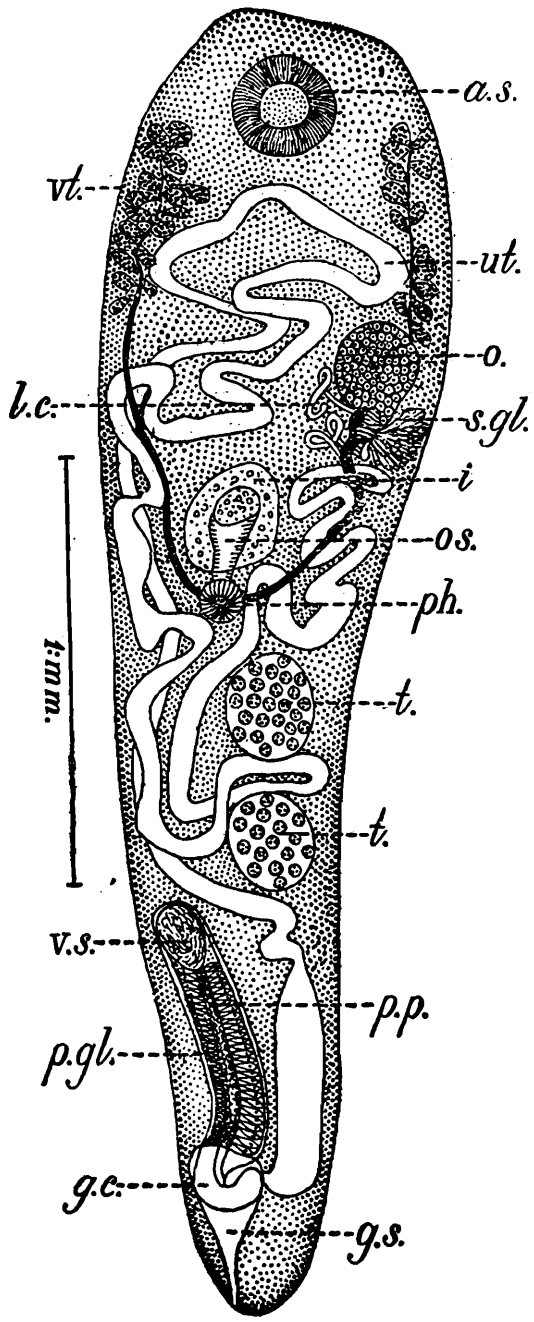
(TEXT-FIG. 7.)

Srivastava, H. D. (1938), *Indian J. vet. Sci.* **8** (4): 330-332.

Dawes, B. (1946). The Trematoda. Lond, : 193.

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914; with Generic characters.

Body minute, fusiform ; in balsam mounts length 1·24-2·52 ; greatest breadth, in region of vitellaria or anterior sucker, 0·39-0·84. Anterior sucker subterminal, diameter 0·17-0·245. Vitellaria compact, between ovary and anterior sucker, follicles 14-16 in each lateral group, on left 1 or 2 more than on right, 0·07-0·09 in diameter. Pharynx inconspicuous



TEXT-FIG. 7.—*Bucephalopsis fusiformis* ; entire specimen (after Srivastava).

a.s. Anterior sucker ; *g.c.* Genital cone or tongue ; *g.s.* Genital sinus ; *i.* Intestine ; *l.c.* Laurer's canal ; *o.* Ovary ; *os.* Oesophagus ; *p.gl.* Prostate glands ; *ph.* Pharynx *p.p.* Pars prostatica ; *s.gl.* Shell gland complex ; *t.* Testis ; *ut.* Uterus ; *v.s.* Vesicula seminalis ; *vt.* Vitellaria.

about middle of body, between ovary and testis, 0·07-0·084. Oesophagus short, curved. Intestine wide, 0·21-0·46 long. Ovary near right margin, rounded, at one fourth body length from anterior end, 0·14-0·21 in diameter. Testes roundish to ovoid ; anterior to right side, equatorial or slightly more ahead, 0·18-0·29 × 0·26 ; posterior behind middle of body, either in same line as anterior or more internal, 0·16-0·25 × 0·15-0·21.

Cirrus pouch long one third to nearly half as long as body, reaches posterior testis or more ahead; 0·46-0·7 long, 0·1-0·14 broad. Genital sinus 0·13-0·16 in diameter. Excretory bladder elongate, tubular or narrow, sac like. Eggs vary in size, 0·013-0·0226×0·0084-0·0146.

Host.—*Eutropiichthys vacha* Day (Butterfish).

Habitat.—Intestine; once in stomach; encysted larval forms on liver, kidney, mesentery round stomach and duodenum.

Locality.—Allahabad (India).

The species resembles *B. haimeanus* (Lacaze—Duthiers, 1854) and *B. ovatus* Ozaki, 1928, in having the vitellaria closely aggregated but differs from the former specially in its fusiform body and in its testes, lying on the same side of the pharynx, instead of, on opposite sides. From the latter it is differentiated by its longer excretory bladder and by the more forward position of its ovary. Leaving aside the character of the vitellaria, the species comes nearest to *B. elongatus* Ozaki, 1928 which has a similar excretory vessel and uterus but the Japanese form has a quite different body form, a longer range of vitellaria and a comparatively longer cirrus sac.

This species is characterised in the position of its intestine which lies between the ovary and anterior testis.

Srivastava (1938) collected specimens of this parasite from the same host at Allahabad. His specimens resemble the type, except for differences in measurements.

8. **Bucephalopsis garuai** Verma, 1936.

(Text-fig. 8.)

Bhalerao, G. D. (1937). *J. Helminth* **15** (2): 103.
Nagaty, H. F. (1937). *Pub., Fac. Med. Egyptian Univ.* **12,**: 1—172.
Srivastava, H. D. (1938). *Indian J. vet. Sci.* **8** (4): 329-330.
Chauhan, B. S. (1943). *Proc. Indian Acad. Sci.*, **18,** 102.
Dawes, B. (1946). The Trematoda. Lond.: 193.

Specific diagnosis: *Bucephalopsis* (Diesing, 1855) Nicoll, 1914; with Generic characters.

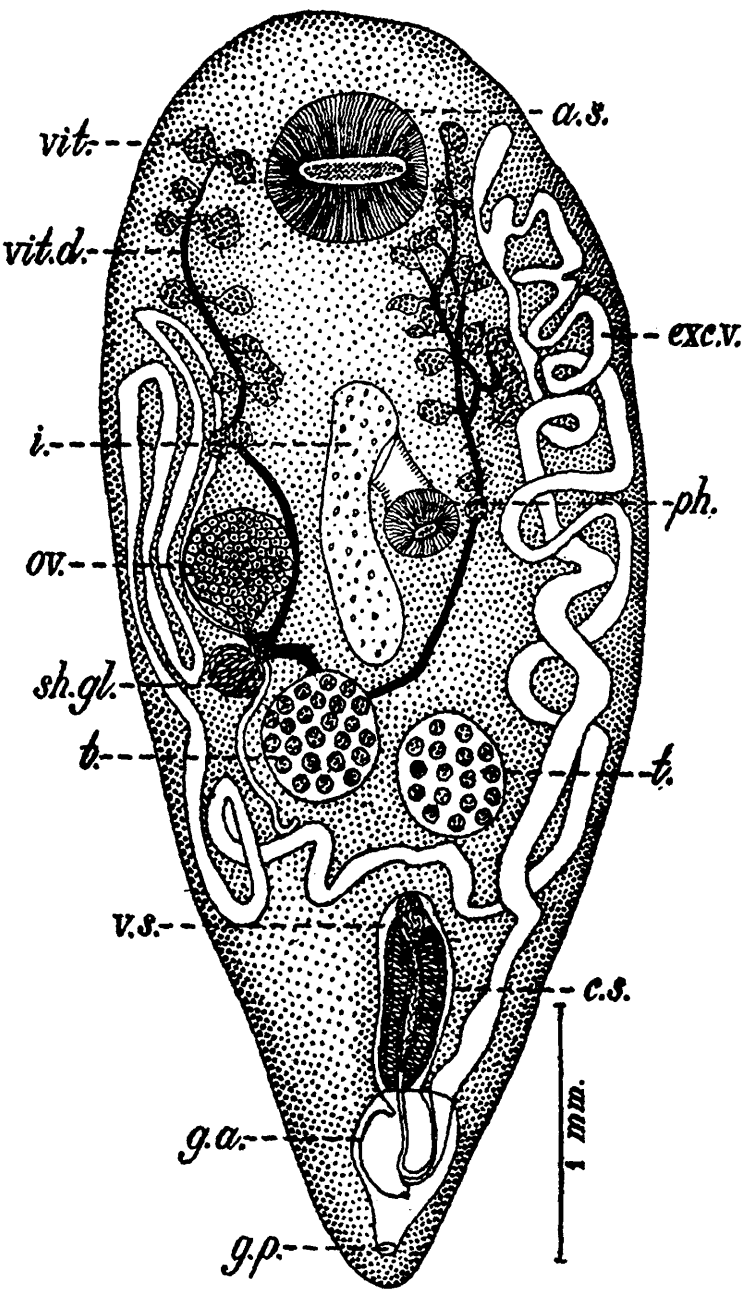
In balsam mounts: body medium sized, with nearly parallel lateral margins, broadly rounded anteriorly; length 5·73-6·20; greatest breadth, 1·38-1·90. Anterior sucker sub-terminal, at times slightly broader than long, 0·56-0·69 in diameter. Vitellaria not compact, follicles extending from ovary to anterior sucker large, bilobed or paired; 12-14 groups on the right, 14-18 on left; largest roundish follicles 0·25×0·21, elongated ones 0·252×0·1008, average sized ones 0·168×0·134. Pharynx in front of middle of body, conspicuous, 0·25-0·2938×0·336. Oesophagus distinct, narrow, anteriorly directed. Intestine doubled upon the oesophagus and pharynx, elongated saccular or tubular, 0·88×0·168-1·26×0·335. Ovary pear shaped, right-sided, a little behind one-third of body length from anterior end, 0·67×0·29-0·58×0·39. Anterior testis variable in form and outline, usually rounded and regular, anterior to right of median line, behind middle of body, 0·68×0·48-0·756×0·463; posterior, more centrally placed, behind anterior, 0·588×0·42-0·67×

0·547. Cirrus pouch short, not reaching posterior testis, about one fifth as long as body, 0·6×0·3-0·924×0·35. Seminal vesicle short, narrow, 0·151×0·042. Eggs, 0·226-0·239×0·0146-0·173. Excretory bladder wide, filling the whole body, Y-shaped.

Host.—*Pseudotropius garua* Day.

Habitat.—Intestine, posterior part and rectum; encysted larval forms in gonads, liver and on mesentery.

Locality.—Allahabad (India).



TEXT-FIG. 8.—*Bucephalopsis garuai*; entire specimen (after Srivastava).

a.s. Anterior sucker; *c.s.* Cirrus sac; *exc. v.* Excretory vesicle; *g.a.* Genital atrium; *g.p.* Genital pore; *i.* Intestine; *ov.* Ovary; *ph.* Pharynx; *sh.gl.* Shell gland; *t.* Testis; *v.s.* Vesicula seminalis; *vit.* Vitellaria; *vit.d.* Vitelline duct.

The species is characterised specially by having Y-shaped excretory bladder, bilobed nature of vitelline follicles, comparatively small seminal vesicle and cirrus pouch and character and disposition of uterine coils.

Srivastava (1938) records it from the intestine of *Silundia gangetica* Cuv. & Val., from Allahabad. He found that this fish was nearly always infested with these flukes and the infestation was often found to be very heavy, the number of parasites from a single host varying from 20 to 860. Specimens in his collection differ slightly from Verma's in measurements, number of vitelline follicles and the anterior extent of vitellaria, in the shape of excretory bladder and absence of a muscular sphincter around the genital pore. Bhalerao (1937) regards *B. magnum*, *B. confusus* and *B. minimus* as synonymous to *B. garuai*. Srivastava (1938) however thinks, *B. magnum* as a valid species but regards *B. confusus* and *B. minimus* as synonymous to *B. garuai*. Nagaty (1936), Chauhan (1943) and Dawes (1946) however regard *B. confusus* and *B. minimus* as synonymous to *B. magnum* and not *B. garuai* Verma.

9. **Bucephalopsis magnum** Verma, 1936.

(TEXT-FIG. 9.)

Bhalerao, G. D. (1937). *J. Helminth* **15**, arab (2) : 100—101.
Nagaty, H. F. (1937). *Publ. Fac. Med. Egypt. Univ.* **12** : 1—172.
Srivastava, H. D. (1938). *Indian J. vet. Sci.* **8** (3) : 333.
Chauhan, B. S. (1943). *Proc. Indian Acad. Sci.* **17**, arab: 102.
Dawes, Ben (1946). The Trematoda, Lond. : 193.

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914 ; with Generic characters.

In balsam mounts, body ovo-oblongish, broadly rounded at both extremities, of large size ; length 8·0-10·0, greatest breadth about middle, 4·2-4·8. Anterior sucker 0·30—0·40 behind anterior end, 0.84 in diameter. Vitellaria from level of pharynx to some distance behind anterior sucker, midway between median line and side of body ; follicles small, round, separate from one another, size 0·26×0·126-0·134×0·11, number 13-16 on right, 17-18 on left. Pharynx conspicuous, in middle of body, 0·46-0·5 in diameter. Oesophagus short. Intestine very wide, broadly oval, backwardly directed, 1·6 long, 0·9 broad. Ovary globular or pear shaped, on right side of intenstine, near equatorial line, 0·38 in diameter. Testes large, rounded, anterior to right of median line, 0·9-1·0 in diameter ; posterior, either on median line or slightly to left of it, smaller than anterior, 0·75-0·84 in diameter. Cirrus sac less than one-fourth as long as body, 1·4-1·6×0·3-0·45. Uterus nearly confined to posterior half of body, coils mainly on left, cross from left to right and *vice versa* between hind testis and cirrus sac. Genital atrium 0·42-0·5 in diameter, both metraterm and genital sinus surrounded by numerous gland cells. Genital pore subterminal. Excretory bladder Y-shaped. Eggs, 0·026-0·028× 0·0167-0·028.

Host.—*Pangasius buchanani* (Cuv. & Val.).

Habitat.—Large intestine.

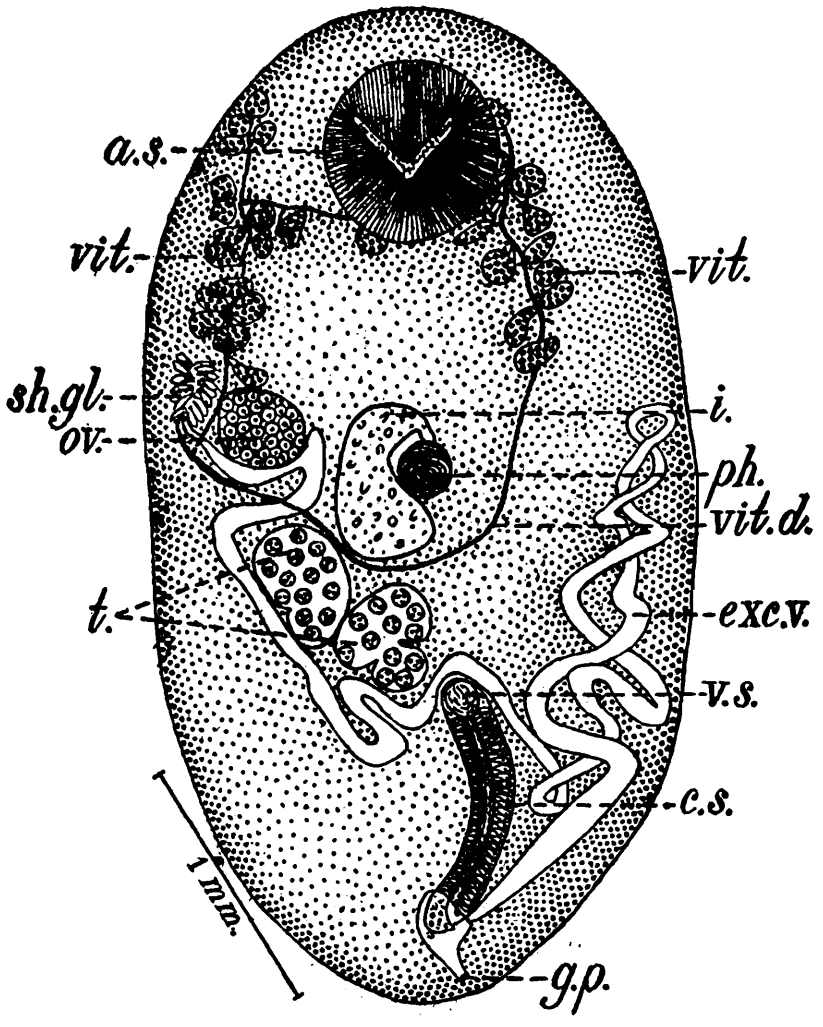
Locality.—Allahabad (India).

The species resembles *B. garurai* in the shape of excretory bladder.

Srivastava (1938) collected specimens of this parasite from the intestines of *Silundia gigantica* Cuv. & Val. at Allahabad. He obtained

only two specimens from the intestine of one out of more than 150 intestines of hosts. They differ from specimens of Verma, besides in measurements, in the anterior extent and conflagration of vitellaria, and in the size and shape of cirrus sac.

Bhalerao (1937) regards *B. magnum* as synonymous to *B. garuai*. From the study of the collection in the possession of Srivastava (1938), he is inclined to accept *B. magnum* as valid species. Nagaty (1936), Chauhan (1943) and Dawes (1946) are in agreement with this view. Dawes (1946) further regards *B. confusus* Verma, 1936 and *B. minimus* Verma, 1936 as synonymous to *B. magnum* Verma.



TEXT-FIG. 9.—*Bucephalopsis magnum*; entire specimen (after Srivastava).

a.s. Anterior sucker; *c.s.* Cirrus sac; *exc.v.* Excretory vesicle; *g.p.* Genital pore; *i.* Intestine; *ov.* Ovary; *ph.* Pharynx; *sh.gl.* Shell gland; *t.* Testes; *vit.* Vitellaria; *vit.d.* Vitelline duct; *v.s.* Vesicula seminalis.

10. **Bucephalopsis confusus** Verma, 1936.

(TEXT-FIG. 10.)

Bhalerao, G. D. (1937). *J. Helmint* **15** (2) : 103.

Nagaty, H. F. (1937). *Publ., Fac. Med. Egypt. Univ.* **12** : 1—172.

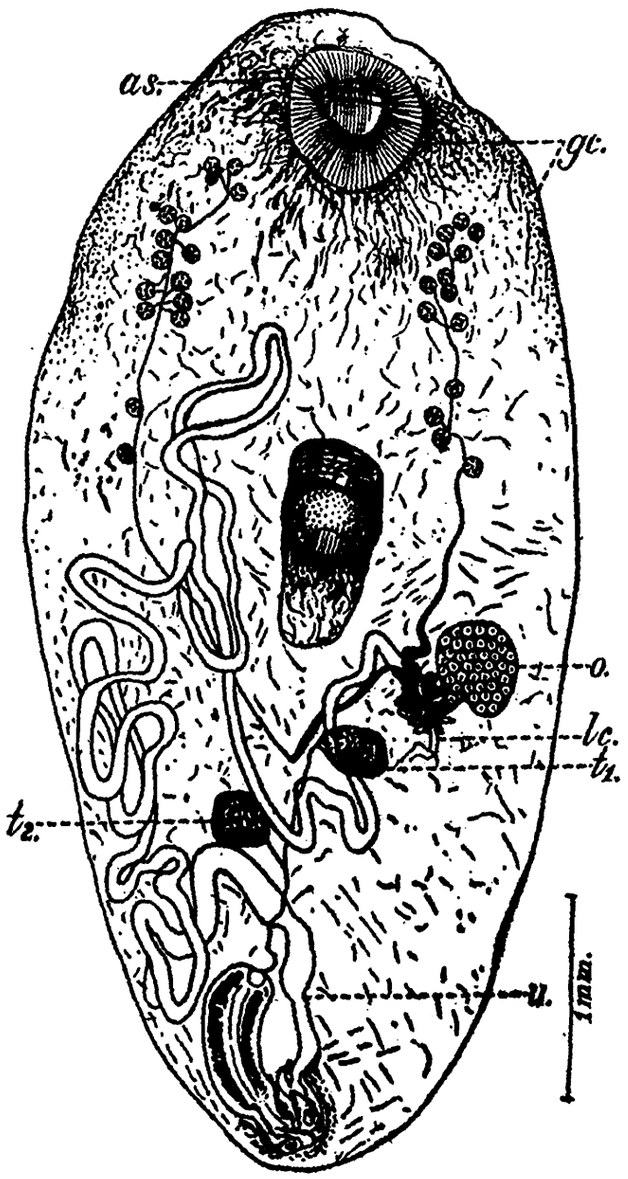
Srivastava, H. D. (1938). *Indian J. vet . Sci.* **8** (4) : 333.

Chauhan, B. S. (1943). *Proc. Indian Acad. Sci.* **17** : 101.

Dawes, B. (1946). The Trematoda, Lond. : 193.

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll 1914 ; with Generic characters.

Body spiny, thick, cylindrical in life ; oval, on fixation under pressure. In balsam mounts, length 4·0-6·5 ; greatest breadth 0·5-0·71. Anterior sucker 0·67 in diameter, with a wide cavity. Pharynx distinct, near middle of body, 0·3 in diameter. Oesophagus short, 0·1-0·15 long. Intestine antero-posteriorly directed, in third sixth of body, 0·88×0·4. Ovary round, right-sided, nearer body margin than intestinal wall,



Text-fig. 10.—*Bucephalopsis confusus* ; entire specimen, dorssal view (after Verma).
a.s. Anterior sucker ; *gc.* Unitellular gland cells ; *lc.* Laurer's canal ; *o.* Ovary ; t_1. anterior testis ; t_2. Posterior testis ; *u.* Uterus.

larger than or nearly equal to testes, behind equatorial line or just touching it, 0·336-0·46×0·306-0·40. Uterine coils few, mostly on left, to midway between pharynx and sucker, internal to vitellaria. Vitellaria from level of anterior border of pharynx to level of posterior border of sucker ; follicles small, rounded, 13-15 on right, 17 or 18 on left, 0·08 in diameter, or 0·1×0·075. Testes variable in shape, usually smaller than ovary, anterior to right of median line, 0·25-0·38×0·26-0·27 ; posterior to left

of median line, 0·25-0·294×0·21-0·294. Cirrus sac curved, one-sixth as long as body; 0·67-0·84×0·21-0·25. Seminal vesicle indistinct. Vas deferens inside cirrus sac, with thicker muscular walls. Gland cells numerous, round anterior sucker and genital atrium. Genital pore subterminal or ventral, 0·12-0·18 ahead of posterior end. Excretory bladder large, Y-shaped. Excretory pore terminal, separate from the genital aperture. Eggs yellowish, 0·0199-0·0239×0·0146-0·0159.

Host.—*Pangasius buchanani* and *Silundia gangetica* Cuv. & Val.

Habitat.—Terminal part of small intestine and rectum.

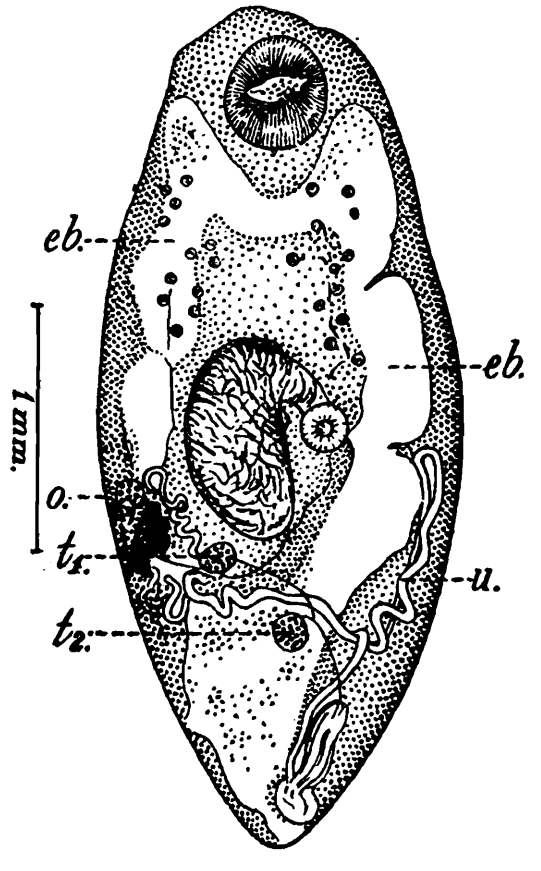
Locality.—Allahabad (India).

Bhalerao (1937) and Srivastava (1938) regard this species as synonymous to *B. garuai*. Nagaty (1937) and Chauhan (1943) however, regard it as synonymous to *B. magnum*. Ben Dawes (1946) also mentions it as synonymous to *B. magnum* Verma, 1936.

11. **Bucephalopsis minimus** Verma, 1936.

(TEXT-FIG. 11.)

Bhalerao, G. D. (1937). *Ind. J. Helminth.* **15** (2) : 97-124.
Nagaty, H. F. (1937). *Publ. Fac. Med. Egypt. Univ.* **12** : 1—172.
Srivastava, H. D. (1938). *Indian J. vet. Sci.* **8** (4) : 113-118.
Chauhan, B. S. (1943). *Proc. Indian Acad. Sci.* B **17**: 101.
Dawes, B. (1946). The Trematoda, Lond. : 193.



TEXT-FIG. 11.—*Bucephalopsis minimus*; entire specimen, ventral view (after Verma). *eb* .Excretory bladder; *o.* Ovary; t_1. Anterior testis; t_2. Posterior testis *u.* Uterus.

Specific diagnosis: *Bucephalopsis* (Diesing, 1855) Nicoll, 1914; with Generic characters.

Small sized body, like thick spindle, anterior end broader than posterior. Cuticular spines feeble. Length 3·0-3·36, greatest breadth, about middle, 1·2-·147. Vitelline follicles minute, 0·0588 in diameter, or 0·059×0·042, from pharynx to near hinder margin of sucker. Pharynx on equatorial line, 0·21-0·25 in diameter. Intestine sac like, 0·75 long. Ovary smaller than testes, right-sided, posterior to pharynx, 0·168× 0·126. Shell gland variable in position, either behind or in front of ovary. Testes ovoidal, larger than ovary; anterior 0·277×0·142 near anterior limit of posterior third of body; posterior, more behind, 0·21× 0·168. Cirrus sac nearly straight, very small, one-eighth to one-ninth as long as body, 0·378×0·126. Genital tongue broad, triangular. Excretory bladder Y-shaped, with very long descending arm. Excretory pore subterminal, separate from genital aperture. Eggs, 0·0226-0·0239× 0·0133-0·0145.

Host.—*Pseudotropius garua* Day.
Habitat.—Large intestine.
Locality.—Allahabad.

Bhalerao (1937) and Srivastava (1938) regard this specios as synonymous to *B. garuai.*

Nagaty (1937) and Chauhan (1943) however regard it as synonymous to *B. magnum.* Ben Dawes (1946) mentions *B. minimus* as a synonym. to *B. magnum* Verma, 1936.

12. Bucephalopsis karvei Bhalerao, 1937

(Text-fig. 12.)

Manter, H. W. and Van Cleave, J. H. (1951). *Proc. U.S. nat. Mus.* **101**: 318.

Specific diagnosis: *Bucephalopsis* (Diesing, 1855) Nicoll, 1914; with Generic characters.

Body inversely pear shaped. Length 0·5-0·965. Maximum breadth 0·27-0·57. Cuticle covered with spines. Anterior sucker subterminal. Pharynx large, muscular, situated at about the posterior third of body. Oesophagus long and slender. Intestine almost round, with thick walls. Excretory bladder tubular. Testes almost tandem, to the right, close to intestine, anterior one usually larger. Cirrus sac to the left, larger than half the length of the body. Ovary to the right, antero-lateral to intestine, occasionally partially overlapping anterior testis and vitelline gland of the right side. Vitellaria antero-lateral, compact groups, round or elongate. Uterine coils on the left side of the body. Eggs, 0·018-0·0215×0·009-0·013.

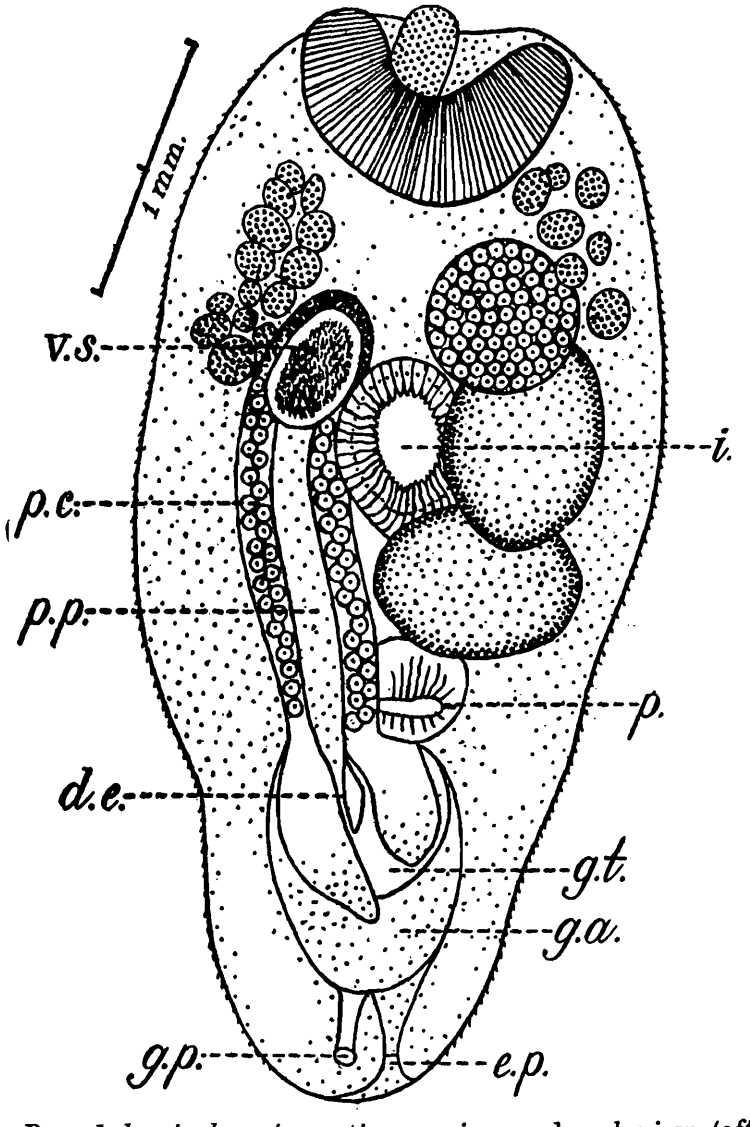
Host.—*Belone cancila.*
Location.—Intestine.
Locality.—Poona, India.

Manter and Van Cleave (1951) think that their species, *Bucephalopsis labiatus* Manter & Van Cleave (1951) is most similar to *B. karvei* Bhalerao, 1937 from *Belone* sp. from the Indian Ocean. They observe that the two species agree in having small body size, mouth posterior to mid-body and cirrus sac reaching anterior to mid-body but differ in that *B. karvei*

has vitellaria in two widely separated groups, does not have a recurved caecum, lacks the preoval lip and has smaller eggs.

They further observe that B. *magnacetabulum* Nagaty, 1937 from *Belone choram*, in the Red Sea resembles and differs from *B. labiatusin* in the same respects except that its cirrus sac is relatively shorter. They believe it may be found that *B. karvei* and *B. magnacetabulum* are a single species.

They also make an interesting observation that the occurrence in Belonidae of species of trematodes apparently most similar to a species occurring in sinistral flat fishes (Bothidae) suggests the host distribution of the species of *Steganoderma* (Manter, 1947). Neither the ecology nor the phylogeny of these families of fishes indicates any relationship that would be suggested by their treamatode parasites.



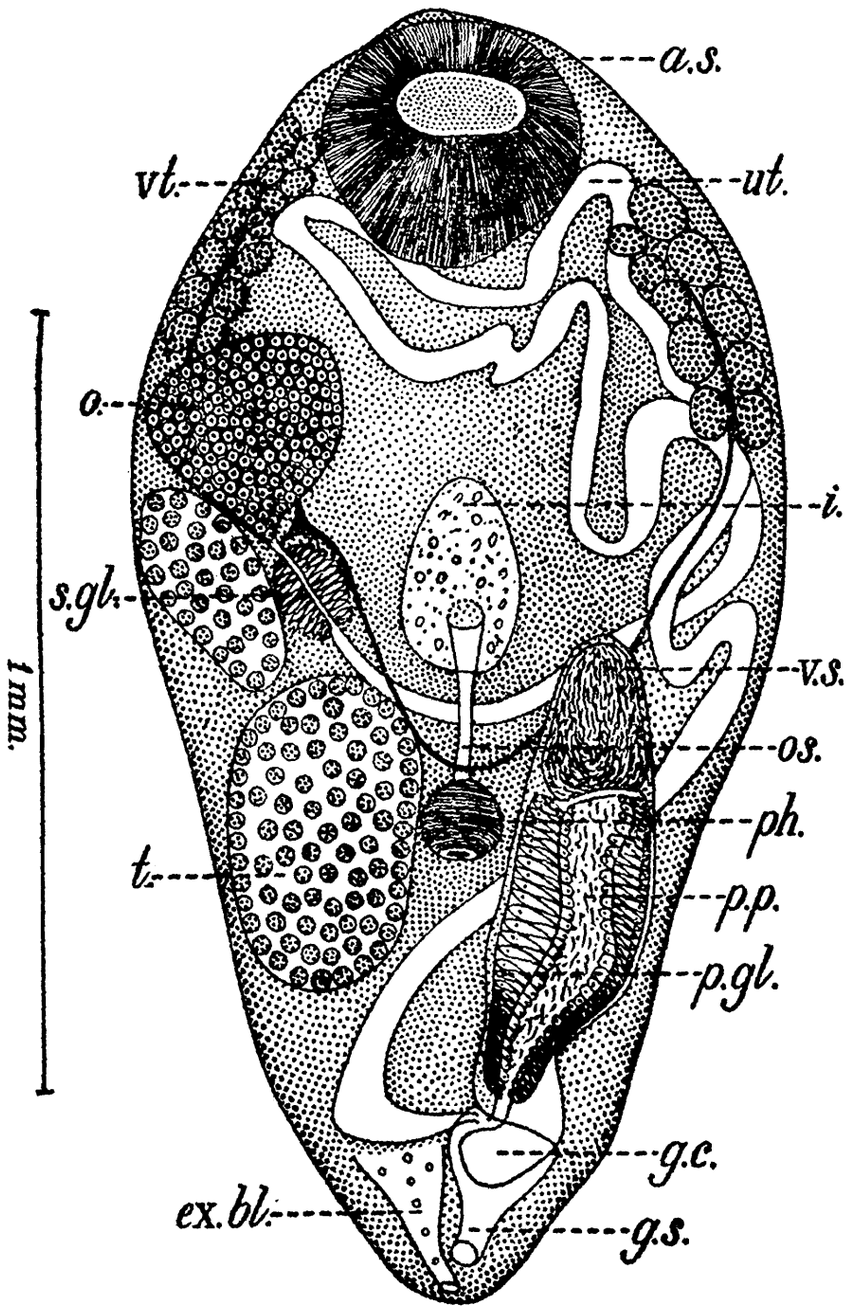
TEXT-FIG. 12.—*Bucephalopsis karvei* ; entire specimen, dorsal view (after Bhalerao).
d.e. Ductus ejaculatorius; *e.p.* Exeretory pore; *g.a.* Genital atrium; *g.p.* Genital pore; *g.t.* Genital tongue; *i.* Intestine; *p*, Pharynx; *p.c.* Prostatic cells; *p.p.* Pars prostatica; *v.s.* Vesicula seminalis.

13. Bucephalopsis belonea Srivastava, 1938.

(TEXT-FIG. 13.)

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914 ; with Generic characters.

Body pear shaped, with broadly rounded anterior end and a narrow, pointed, posterior end, studded with very minute spines, measuring 1·68-2·5 length and 0·82-1·2 maximum breadth (across the level of ovary). Anterior sucker large with diameter 0·3-0·4, ventral, situated at the anterior end. Pharynx muscular, surrounding mouth, 0·1-0·12 in diameter, situated in the median line, at the junction of the middle and



Text-fig. 13.—*Bucephalopsis belonea*; entire specimen (after Srivastava).

a.s. Anterior sucker; *ex.bl.* Excretory bladder; *g.c.* Genital tongue; *g.s* Genital sinus; *i.* Intestine; *o.* Ovary; *os.* Oesophagus; *p.p.* Pars prostatica; *p.gl.* Prostate glands; *ph.* Pharynx; *s.gl.* Shell gland complex; *t.* Testes; *ut.* Uterus; *v.s.* Vesicula seminalis; *vt.* Vitellaria.

posterior third of body. Oesophagus straight narrow tube, 0·2-0·25 in length. Intestine sac shaped, 0·26-0·35×0·14-0·2 in size, situated in the median line, at the level of anterior testis. Anterior testis, 0·24-0·4×0·14-0·26 in size, situated obliquely in front of posterior testis, between the right body wall, posterior half of ovary and the shell gland

complex. Posterior testis 0·42-0·6×0·24-0·3 in size, situated between the pharynx and right body wall, extending from the last quarter of body to the level of the posterior margin of the intestine. Cirrus sac highly developed, 0·66-0·9×0·2-0·3, extending forward up to the level of the anterior end of oesophagus and enclosing a vesicula seminalis, 0·2-0·3×0·14-0·2 ; pars prostatica surrounded by gland cells, 0·36-0·54×0·1-0·15 and a narrow ductus ejaculatorius, 0·1-0·15 long. Genital tongue extends into funnel shaped genital sinus, opening ventrally, a little behind the posterior end. Ovary 0·26-0·32×0·26-0·3, pear shaped, situated to the right of the median line, extending from the leve of the middle of anterior testis to first quarter of body length. Shell gland oval, compact, lying immediately behind ovary. Laurer's canal short arising from oviduct. Vitellaria large, rounded follicles arranged longitudinally in pairs, on the lateral sides of the body, extending from the level of the middle of ovary to that of the anterior sucker. Uterus extends forward up to the anterior limit of vitellaria, containing a large number of light brown eggs, 0·034-0·036×0·011-0·013. Excretory bladder as in *B. karvei*.

In its systematic relationship the species stands nearest to *B. karvei* It resembles it, in the shape of body, excretory bladder, genital pores, and the position and extent of vitellaria but differs from it in being twice its size, anterior extent of cirrus sac, which stops at the posterior level of anterior testis.

Host.—*Belone strongylina* V Hasselt.

Habitat.—Intestine.

Locality.—Allahabad.

Nagaty (1937) states that this species is obtained from the same host as *B. southwelli* and Chauhan (1943) states that the two species resemble rather closely.

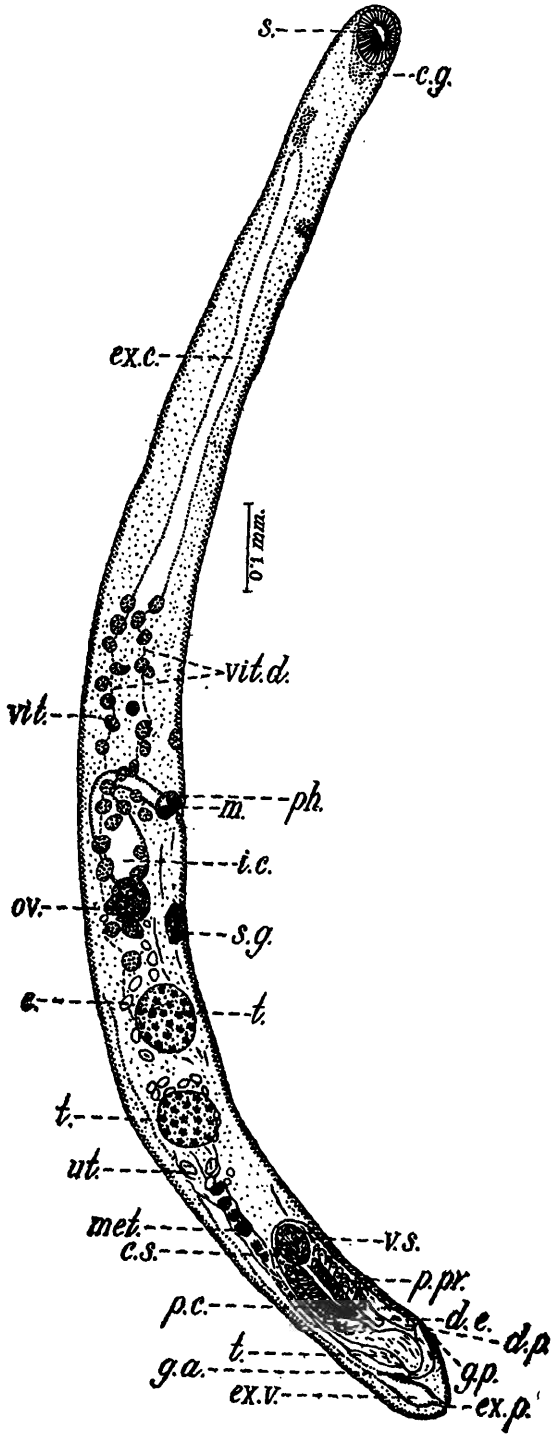
14. **Bucephalopsis microcirrus** Chauhan, 1943.

(TEXT-FIG. 14.)

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914 ; with Generic characters.

Body with spines, very much elongate, with a slightly tapering anterior end, broadly rounded posterior end. Almost all the important organs of the body are contained in the posterior half. Body length 1·71, width 0·12 maximum (in the region of testes). Anterior sucker oval, subterminal, 0·016×0·04, with 'Cytogenous organ' of Tennent (1906) and,' Penetration organ' of Woodhead (1929) present. Mouth simple, inconspicuous, ventrally situated at a distance of 0·9 from anterior end. Pharynx small, compact, globular and muscular, 0·222×0·03. Oesophagus a narrow, thin, straight tube, 0·075. Intestine ovoid, very thin walled, 0·1×0·055 in size. Testes two, globular, post ovarian, median, tandem and separate ; the anterior slightly larger than posterior, 0·075×0·06. The posterior 0·065×0·064. Cirrus sac comparatively small, median, ovoid, highly developed muscular organ, 0·22, Vesicula seminalis compact, ovoid. Pars prosttica elongate,

well developed, surrounded by prostate gland cells. Ductus ejaculatorius elongate. Genital atrium (sinus) large and globular. Genital pore



Text-fig. 14.—*Bucephalopsis microcirrus* ; entire specimen (after Chauhan).

c.g. Cytogenous glands; *c.s.* Cirrus sac; *d.e.* Ductus ejaculatorius; *d.p.* Dorsal process (genital lobe); *e.* Egg; *ex.c.* Excretory canal; *ex.p.* Excretory pore; *ex.v.* Excretory vesicle; *g.a.* Genital atrium; *g.p.* Genital pore; *i.c.* Intestinal canal; *m.* Mouth; *met.* Metraterm; *ov.* Ovary; *ph.* Pharynx; *p.c.* Prostrate gland cells; *p.pr.* Pars prostatica; *s.* Anterior sucke; *s.g.* Shell gland; *t.* Testis; *ut.* Uterus; *vit.* Vitellaria; *vit.d.* Vitelline duct; *v.s.* Vesicula seminalis.

inconspicuous, ventral, a little behind the posterior end. Genital tongue with two processes, the right and left genital lobe or papilla. Ovary globular, pre-testicular, lying partly over the posterior end of intestine, measuring 0·05×0·04. Vitelline glands composed of few large and round follicles, arranged in two lateral rows, 15-17 in number on right and left side respectively, extending from half the distance between ovary and anterior testis to a region much anterior to mouth. Shell gland complex pear shaped. Uterine coils not heavy, longitudinal in extension. Excretory system tubular. Eggs few, thin walled, oval, 0·0035×0·0023.

The species is characterised by very long body, comparatively very small cirrus sac, extension of vitellaria anterior to intestine and pharynx, position of ovary at the posterior end of elongated intestine, clear space between the ovary and anterior testis, and between the two testes and the cirrus sac.

Host.—*Sciæna belengeri.*

Location.—Alimentary canal.

Locality.—Bombay, India.

15. **Bucephalopsis sinhai** Dayal, 1948.

(TEXT-FIG. 15 *a, b, c.*)

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914; with Generic characters.

Body large, oval, with smooth skin, measuring 3·5×1·95 maximum width (in the region of ŏotype). Anterior sucker oval, 0·59×0·55. Mouth in the middle of body. Pharynx well developed, 0·28 in diameter. Oesophagus small, 0·10. Intestine sac like, 0·8×0·25. Testes two, oval in shape, obliquely one behind the other, in the posterior half. Anterior testis on the left side of intestine, oval in shape, 0·51×0·4. Posterior testis, 0·41×0·5. Cirrus sac long, cylindrical, extending from posterior testis to posterior end of body, 1·15×0·21. Vesicula seminalis interna, pars prostatica, prostate gland cells, ejaculatory duct and genital lobe present. Ovary situated at the posterior end of the anterior half of body, on the left side, smaller than testes, 0·41 in diameter. Ŏotype lying posterior to ovary. Shell gland mass compact, oval. Vitelline glands consist of large rounded or oval, sometimes bilobed follicles, running longitudinally on either side, in the anterior portion of body, 15-17 on right side and 12-14 on left. Laurer's canal present. Receptaculum seminis absent. Uterus forms transverse coils. Metraterm well developed, muscular. Eggs thick, brown shelled, 0·021-0·025×0·014-0·016. Excretory bladder Y-shaped. Excretory pore at the posterior end of the body.

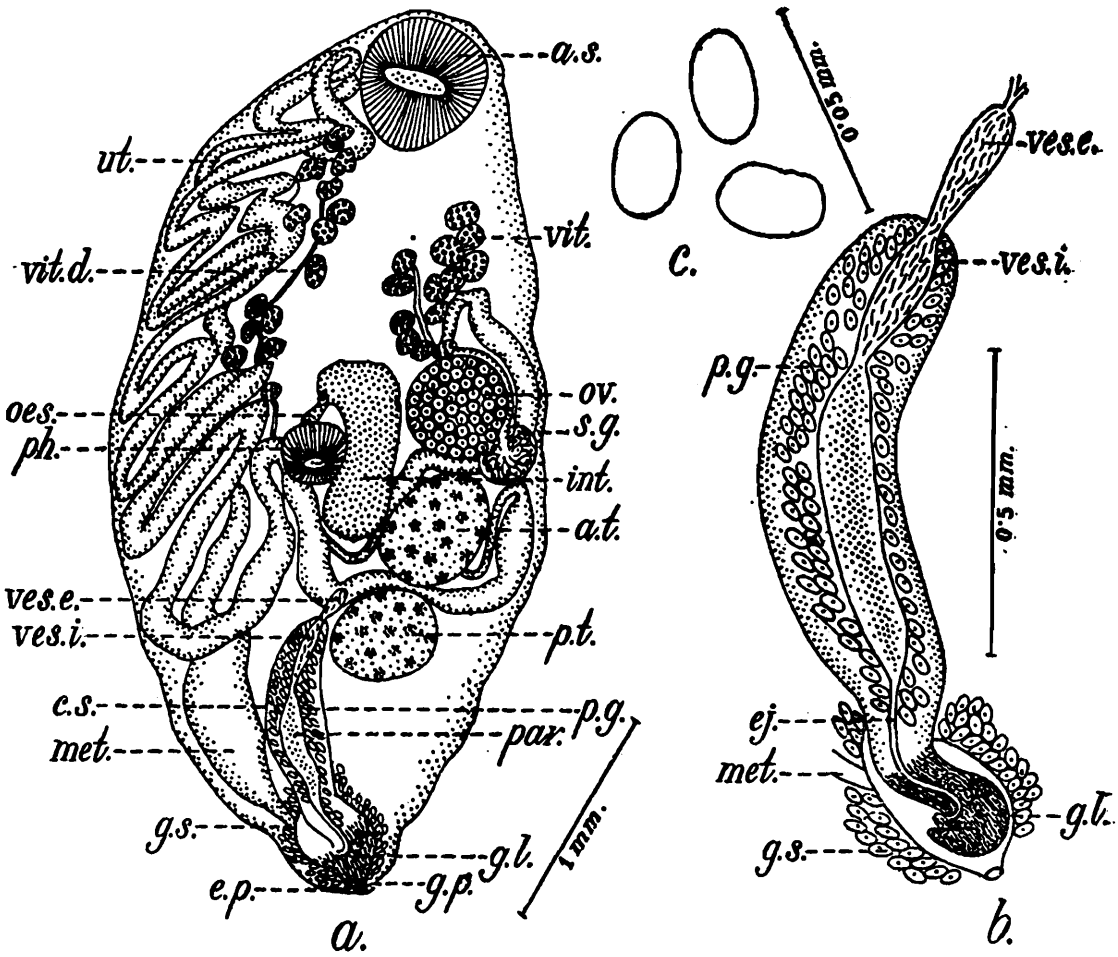
The species resembles *B. garuai* Verma but differs from it in the possession of a distinct vesicula seminalis external and in the relative position of the genital organs.

Opinions may differ, however, it may not be advisable to multiply the number of species on the basis of the character of presence or absence of a distinct vesicula seminalis externa only.

Host.—*Eutropiichthys vacha.*

Location.—Intestine.

Locality.—India.



Text-fig. 15.—*Bucephalopsis sinhai: a.* Entire specimen, ventral view; *b.* Cirrus sac, ventral view; *c.* Eggs (after Dayal).

a.s. Anterior sucker; *a.t.* Anterior testis; *c.s.* Cirrus sac; *e.j.* Ejaculatory duct; *e.p.* Excretory pore; *g.l.* Genital lobe; *g.p.* Genital pore; *g.s.* Genital sinus; *int.* Intestine; *met.* Metraterm; *oes.* Oesophagus; *ov.* Ovary; *ph*; Pharynx; *par.* Pars prostatica; *p.g.* Prostate glands; *p.t.* Posterior testis; *s.g*, Shell glands; *ut.* Uterus; *ves.e*, Vesicula seminalis externa; *ves.i.* Vesicula seminalis interna; *vit.* Vitelline glands; *vit.d.* Vitelline duct.

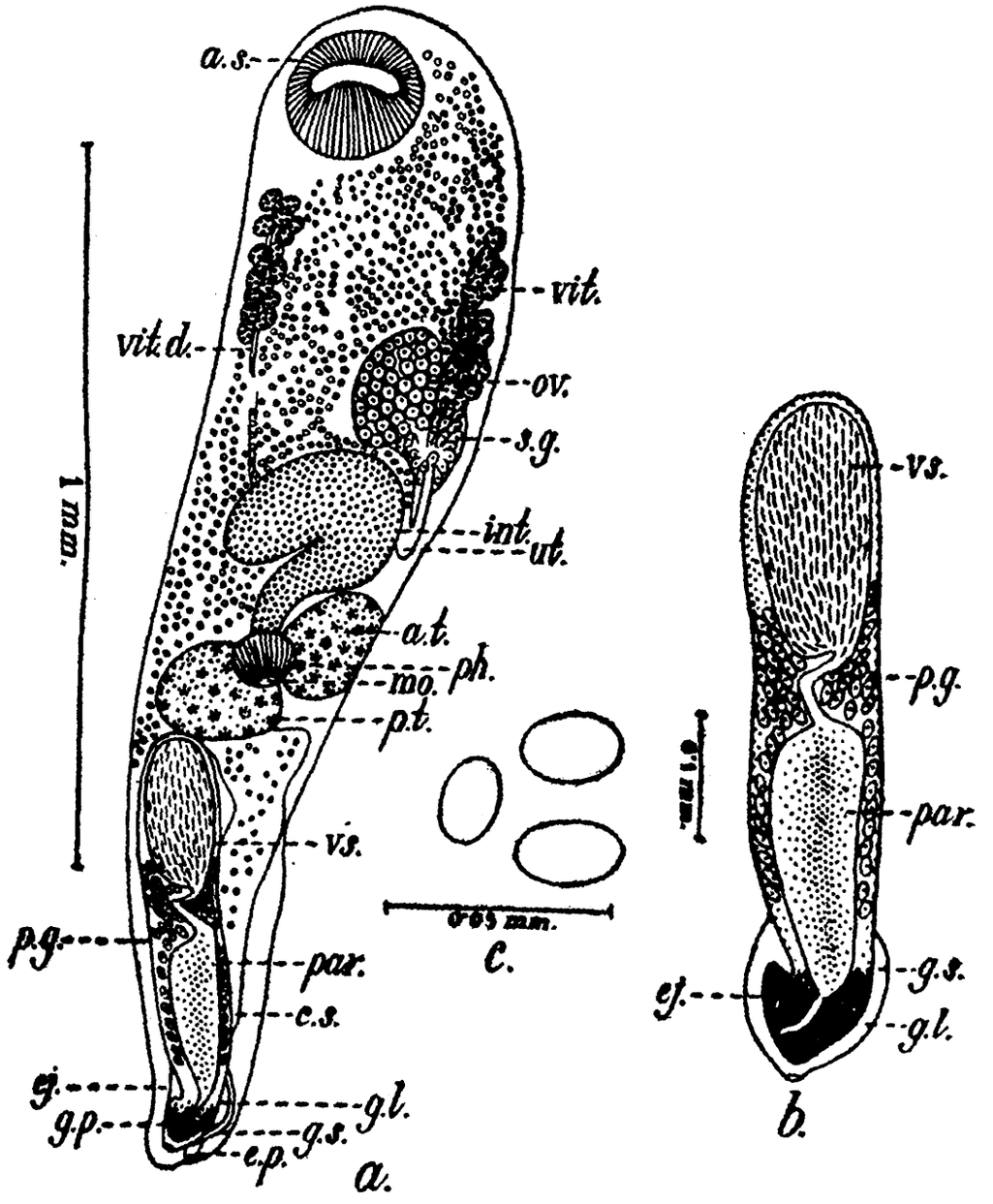
16. **Bucephalopsis thapari** Dayal, 1953.

(Text-fig. 16 *a, b, c.*)

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914; with Generic characters.

Body small, elongated and dorso-ventrally flattened, with anterior end broader than the posterior end of body, measuring 1·62 in length and 0·38 in maximum width (just behind the anterior sucker). Cuticle spined. Anterior sucker well developed, muscular, subterminal, 0·18×0·19. Mouth lying behind the middle of body. Pharynx well developed, muscular, 0·08 in diameter. Oesophagus long, 0·14×0·05. Intestine sac like. Testes two, oval, situated diagonally

on either side of the pharynx, partly overlapping it. Anterior testis lies on the left side of the pharynx, 0·17×0·12. Posterior testis lies on the right side of pharynx, 0·13×0·16. Cirrus sac long, cylindrical, extending from posterior end of body to posterior testis, 0·58×0·11. Vesicula seminalis, pars prostatica, prostate gland cells, ejaculatory duct, genital lobe present. Ovary oval, lies in the anterior half of body,



TEXT-FIG. 16.—*Bucephalopsis thapari* : *a*. Entire specimen, ventral view ; *b*. Cirrus sac, ventral view ; *c*. Eggs (after Dayal).

a.s. Anterior sucker ; *a.t*. Anterior testis ; *c.s*. Cirrus sac ; *e.j*. Ejaculatory duct ; *e.p*. Excretory pore ; *g.l*. Genital lobe ; *g.p*. Genital pore ; *g.s*. Geni sinus ; *int*. Intestine ; *mo*. Mouth ; *ov*. Ovary ; *p.g*. Prostate glands ; *ph* Pharyn x. *par*. Pars prostatica ; *p.t*. Posterior testis ; *s.g*. Shell gland ; *ut*. Uterus ; *v.s*. Vesicula seminalis ; *vit*. Vitelline gland ; *vit. d*. Vitelline duct.

in front of the intestine, on the left side, 0·18×0·12. Vitelline glands consist of large rounded follicles, 16-18, in number extending longitudinally on either side of body from shell glands to about 0·28 from anterior end. Uterus runs into the anterior end of body and occupies the entire space between the anterior sucker and posterior testis. Eggs, a large

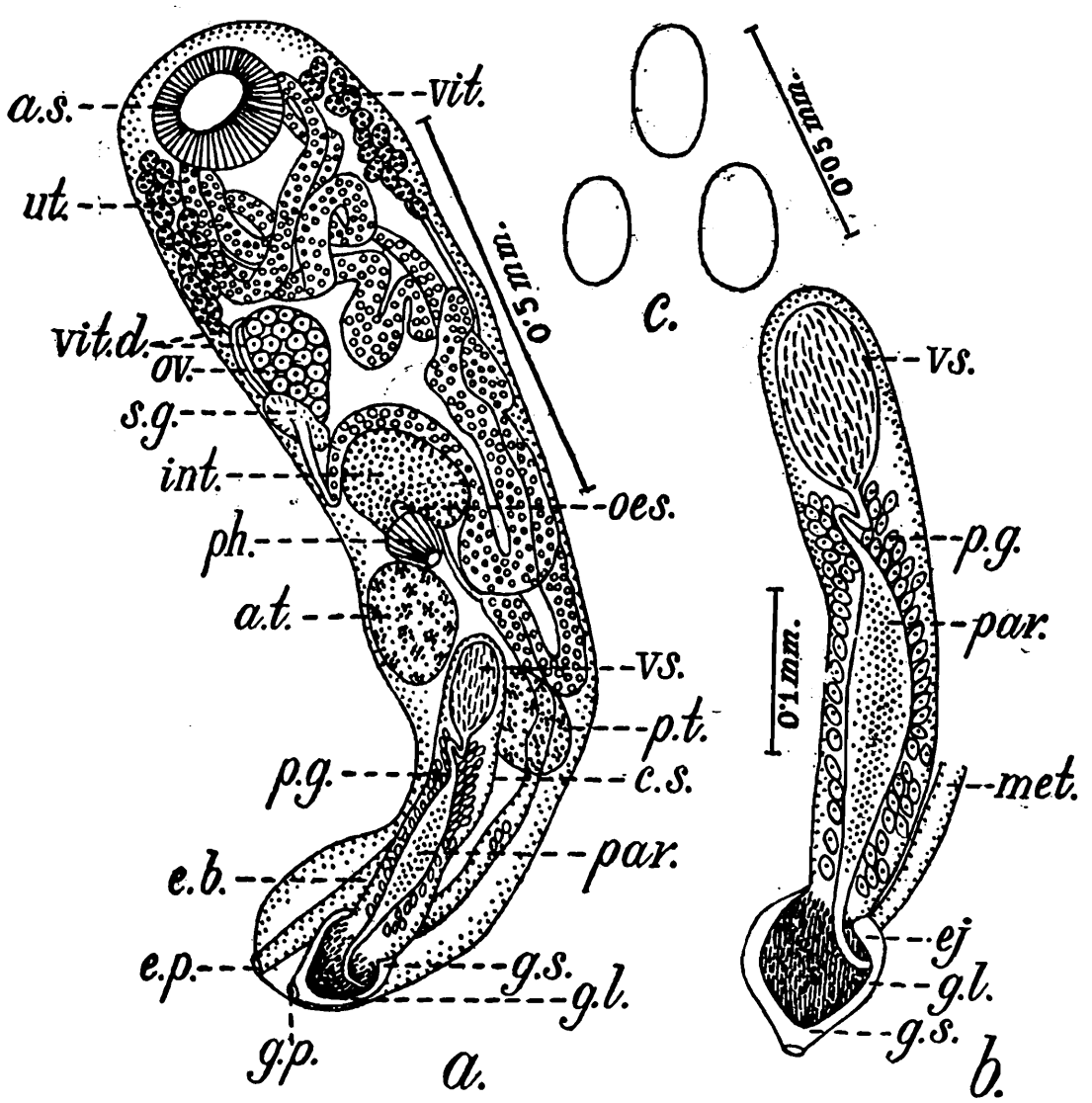
number, with a thin light brown shell, 0·018-0·023×0·012-0·015. Genital pore ventral, in front of the excretory pore, which lies at the posterior end of body. Excretory vessel elongate sac like bladder, extending upto the posterior testis.

The species differs from other species in the diagonal position of testes, one on either side of pharynx, in the position and arrangement of vitelline glands, and relative size of cirrus sac. *B. haimeanus* has testes on opposite side of the pharynx but *B. thapari* differs from it in the arrangement of vitelline glands, position of ovary and extended disposition of uterus.

Host.—*Macrones seenghala.*
Habitat.—Intestine.
Locality.—Lucknow, India.

17. **Bucephalopsis macronius** Dayal, 1948.

(Text-Fig. 17 *a, b, c.*)



Text-Fig. 17.—*Bucephalopsis macronius* : *a.* Entire specimen, ventral view; *b.* Cirrus sac, ventral view ; *c.* Eggs (after Dayal).

a.s. Anterior sucker ; *a.t.* Anterior testis ; *c.s.* Cirrus sac ; *e.b.* Excretory bladder ; *e.j.* Ejaculatory duct ; *e.p.* Excretory pore ; *g.l.* Genital lobe ; *g.p.* Genital pore ; *g.s.* Genital sinus ; *int.* Intestine ; *met.* Metraterm ; *oes.* Oesophagus ; *ov.* Ovary ; *p.g.* Prostrate gland ; *ph.* Pharynx ; *par.* Pars prostatica ; *p.t.* Posterior testis ; *s.g.* Shell gland ; *ut.* Uterus ; *v.s.* Vesicula seminalis ; *vit.* Vitelline gland ; *vit.d.* Vitelline duct.

Specific diagnosis : *Bucephalopsis* (Diesing, 1855) Nicoll, 1914 ; with Generic characters.

Body small, elongate, dorso-ventrally flattened, with broad anterior end and narrow posterior one, measuring 1·4×0·34 (behind anterior sucker). Cuticle smooth. Anterior sucker oval, 0·14×0·16. Mouth lies in the middle of body, on ventral side. Pharynx oval, 0·07×0·06. Oesophagus small, 0·02. Intestine sac like, recurved, 0·17×0·09. Testes two, oval, equal in size, diagonal in position, lying on either side of cirrus sac. Anterior testis lies on right side of cirrus sac, near mouth opening, 0·15×0·11. Posterior testis lies on the left side of cirrus sac. Cirrus sac long, tubular, with all component parts, vesicula seminalis, pars prostatica, prostate gland cells, ejaculatory duct, genital lobe, etc., extending from posterior end of body to middle of anterior testis, 0·49×0·08. Vesicula seminalis oval. Prostate gland cells numerous, genital lobe muscular, spoon shaped. Ovary pear shaped, lying on the right side, anterior to intestine, 0·15×0·09. Vitelline glands consist of 15-16 rounded or oval follicles, extending longitudinally on either side of body from anterior sucker to anterior end of ovary. Uterine coils extend posteriorly upto the anterior region of intestine and anteriorly upto the anterior sucker. Eggs oval, thin shelled, 0·012-0·015×0·01-0·012.

The species resembles *B. thapari* in the longitudinal arrangement of vitelline glands but differs from it in the posterior position of testes, in the extension of vitelline glands upto the anterior sucker and in the relative size of cirrus sac.

Host.—*Macrones seenghala.*

Habitat.—Intestine.

Locality.—India.

(iii) Genus **Rhipidocotyle** Diesing, 1858.

syn. *Nannoenterum* Ozaki, 1924. (Subgenus).

Diesing (1858) created the subgenus, *Rhipidocotyle* with two species, *Gasterostomum gracilescens* (Rudolphi, 1819) and *G. minimum* Wagner, 1852, alloted to it but without naming the type species. Stiles and Hassall (1908) regarded *G. gracilescens* (Rud. 1819) as the probable type. Nicoll (1914) while elevating the subgenus to a generic rank pointed out that the alternative species, *G. minimum* Wagner, 1852, must stand as the type, being the only one of the two species in which a sucker and a fanshaped hood are combined as implied by the name chosen by Diesing. Eckmann (1932) reexamined the original specimens and *G. minimum* Wagner, 1852 from Berlin Museum and came to the conclusion that *G. gracilescens* belongs to the genus *Bucephalopsis* and that *G. minimum* Wagner, 1852 did possess the additional process to the sucker and concurred with the opinion of Nicoll (1914) expressed previously. She also examined the material collected and labelled by Rudolphi (1819) as *G. galeatum* from *Centrontus glaucus*, Naples and considered it to be identical with *G. minimum*, with the result that *G. galeatum* (Rud. 1819) with *G. minimum* as synonymous to it, obtained the status of type species

of the Genus *Rhipidocotyle*. She also relegated *Nannœnterum* in to synonymy with *Rhipidocotyle*, the only difference between the two being trifling matters of shape and the relative positions of the uterus and vitellaria.

Generic diagnosis : *Bucephalinæ* Nicoll, 1914; with Subfamily characters.

Body elongate, cylindrical at its anterior half. Anterior sucker with a horse-shoe shaped structure with or without papillæ or with a fan shaped hood. Cuticle with spines. Oral aperture ventro-central, without sucker. Pharynx present. Cæcum simple, short. Genital aperture ventral, near the posterior end of the body. Ovary pretesticular. Receptaculum seminis present or absent. Laurer's canal present. Vitellaria lateral or transverse. Excretory vesicle a simple tubular sac with terminal pore.

Type species : *R. galeatum* (Rud. 1819) Eckmann, 1932 : syns. *Monotomum galeatum* Rudolphi, 1819; *Gasterostomum galeatum* (Rudolphi) of Stossich, 1898; *G. minimum* Wagner, 1852; *G. triglæ* (Beneden, 1870) of Nicoll, 1909; *Rhipidocotyle minimum* (Wagener) of Diesing, 1858; *Rhipidocotyle viperæ* Nicoll, 1914 nec. Beneden, 1870.

Chauhan (1943) recorded for the first time the following representatives of the genus from India : (1) *Rhipidocotyle ligulum* Chauhan, 1943 (2) *Rhipidocotyle apapillosum* Chauhan, 1943 and (3) *Rhipidocotyle septapapillata* Krull, 1934.

He gave a key to the species of the genus, which he considered to be valid. The Indian species can be distinguished by the following key :—

Key to Indian Species of Genus *Rhipidocotyle* Diesing, 1858.

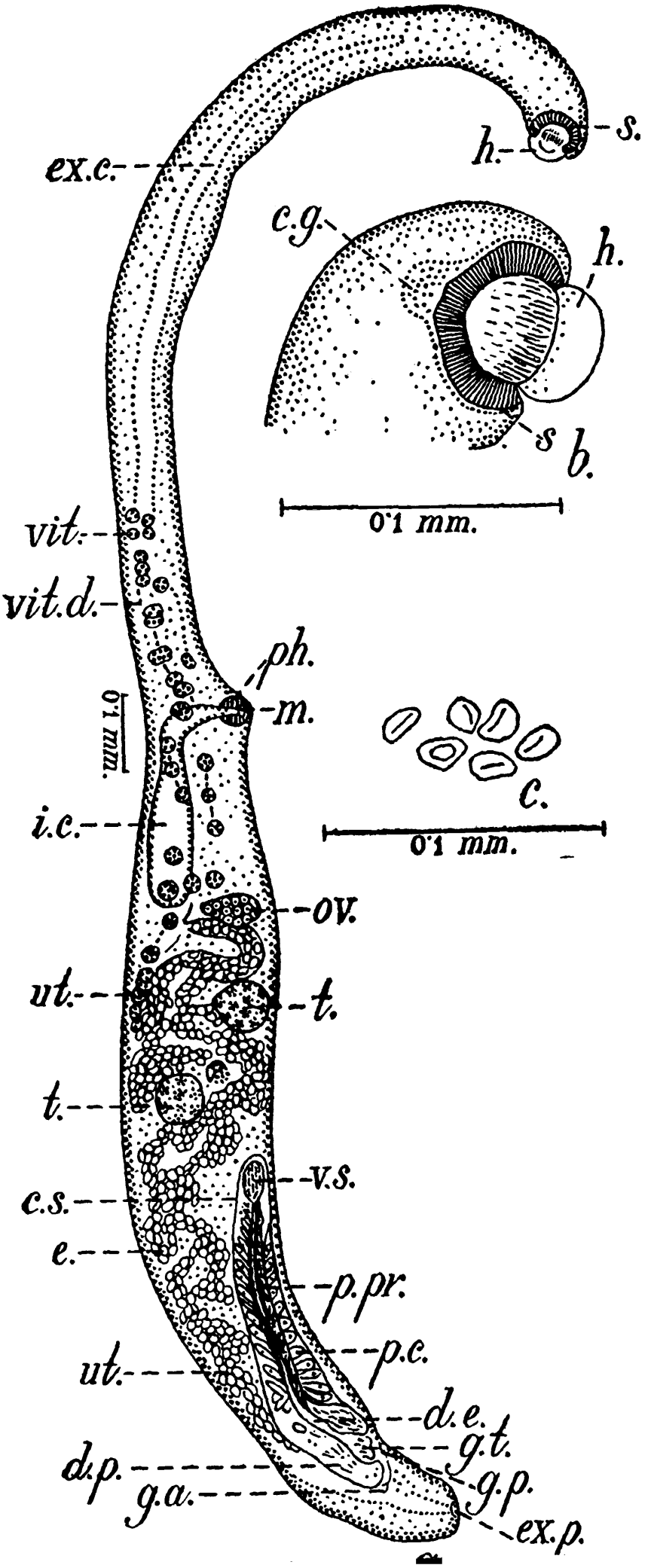
1. Hood or cephalic disc with seven papillæ	*R. septapapillata* Krull, 1934.
Hood or cephalic disc without papillæ	2.
2. Ovary situated in contact with anterior testis; testes contiguous, situated near the posterior end of intestinal sac; cirrus sac reaches upto the level of posterior testis	*R. apapillosum* Chauhan, 1943.
3. Ovary situated at the base of intestinal sac, separated from anterior testis; testes not contiguous, situated midway in the space between the posterior end of intestine and cirrus sac; cirrus sac not extending upto the level of posterior testis	*R. ligulum* Chauhan, 1943.

18. **Rhipidocotyle ligulum** Chauhan, 1943.

(Text-Fig. 18 *a*, *b*, *c*.)

Specific diagnosis : *Rhipidocotyle* Diesing, 1858; with Generic characters.

Body thin, narrow, elongate, measuring 2·68×0·21 maximum (at the level of testes); cuticle with spines. Most of the organs confined to the posterior, cylindrical half of body. Anterior half flat, containing a few vitelline follicles, excretory vessel and anterior organ of attachment. Anterior sucker muscular, subterminal, 0·12×0·075, with a prominent



TEXT-FIG. 18.—*Rhipidocotyle ligulum* : *a*. Entire specimen; *b*. Hood; *c*. Eggs magnified (after Chauhan).

c.g. Cytogenous glands; *c.s.* Cirrus sac; *d.e.* Ductus ejaculatorius; *d.p.* Dorsal process (genital lobe); *e.* Egg; *ex.c.* Excretory canal; *ag.* Genital atrium; *g.p.* Genital pore; *g.t.* Genital tongue; *h.* Hood or Cephalic disc; *i.c.* Intestinal canal; *m.* Mouth; *ov.* Ovary; *p.c.* Prostrate gland cells; *ph.* Pharynx; *p.pr.* Pars prostatica; *s.* Sucker; *t.* Testis; *ut.* Uterus; *vit.* Vitellaia; *vit. d.* vitelline duct; *v.s.* Vesicula seminalis.

but feebly developed muscular, crescent shaped, hood or cephalic disc without any papillæ, with no mid-ventral notch. Mouth small, ventral and indistinct. Pharynx small, compact, muscular and sub-spherical. Oesophagus narrow, very small, horizontal in extension, 0·03 mm. Intestine long, narrow, very thin walled, running along antero-posterior axis, 0·31 long, with maximum width at the level of posterior third of the organ. Gonads spaced, situated posterior to the intestine. Ovary elongate, pear shaped, smooth, pre-testicular, just posterior and lateral to intestine, to its left, 0·085×0·045. Mehlis gland situated midway between testes. Vitelline follicles large, round, about 21 on the right side and 13 on the left, in two longitudinal lateral rows. Uterus not much coiled but heavily laden with eggs, not extending anterior to ovary and posterior to genital atrium. Eggs very small, numerous, ovoid, 0·0035×0·0017 (average). Testes two, post ovarian, separate, obliquely tandem. Anterior testis situated behind ovary, on the left side, 0·07× 0·06. Posterior testis globular, slightly smaller than anterior, 0·06× 0 06. Cirrus sac much elongate and narrow, 0·53×0·08 maximum (in the region of genital lobes). Vesicula seminalis small, compact and oval. Pars prostatica long and sinuous but poorly developed. Prostate gland cells well developed. Genital atrium big with genital tongue and dorsal and ventral genital lobes or papillæ, the left being slender and small and dorsal, massive. Ductus ejaculatorius very narrow, tube like. Genital pore median, ventral, placed at some distance anterior to the posterior end of body. Excretory vessel tubular. Excretory pore terminal posteriorly.

Host.—*Arius falcarius*.

Location.—Alimentary canal.

Locality.—West Coast, Bombay (India).

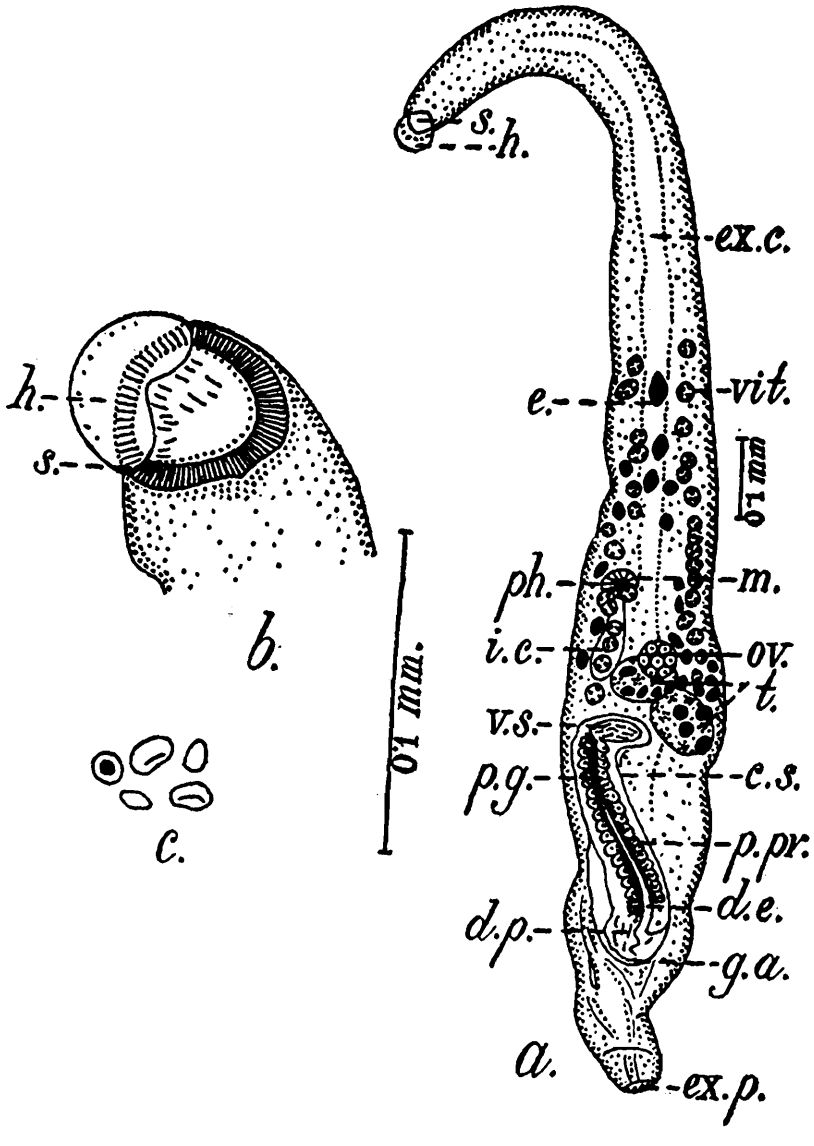
19. **Rhipidocotyle apapillosum** Chauhan, 1943.

(Text-Fig. 19 *a*, *b*, *c*.)

Specific diagnosis : *Rhipidocotyle* Diesing, 1858; with Generic characters.

Body small, elongate, 1·51×0·18 maximum (in the region of posterior testis). Anterior third of body slender, tapering anteriorly and flat; posterior two third contains almost all the important organs and is cylindrical, thick and wider; posterior end broadly tapering and flat. Anterior sucker sub-terminal, weakly muscular, 0·095×0·085. Hood or cephalic disc, in living specimens, slightly wider than anterior end of body, with a dorsal pad-like structure, with a semi-circular anterior edge and posterior edge prominently notched mid-ventrally, so as to divide it into two lateral lobes with rounded edges. Disc measures 0·09×0·06. No cytogenous organ was observed. Mouth ventral, small. Pharynx sucker like, spherical, 0·03 in diameter. Oesophagus small. Intestine sacular, extending posteriorly upto nearly the middle of the anterior testis, about 1/12 body length. Gonads contiguous, crowded together almost at the same level. Ovary small, sub-spherical, by the left side of intestine, anterior to anterior testis, slightly over-lapping it, 0·05×0·04. Vitellaria in two lateral, separated, longitudinal rows of

follicles. Follicles small, round, 14 on the right and 16 on the left side. Uterus does not extend beyond the anterior limit of vitellaria. Eggs minute, few, oval, very thin walled, 0·0125×0·0083 (average). Testes two, obliquely tandem, contiguous, oval. Anterior testis slightly smaller than posterior, situated slightly in mid-axis of body, in the posterior region of intestine, partly below ovary, 0·05×0·07. Posterior testis situated to the left, in contact with anterior one, 0·09×0·07. Cirrus sac extends almost to the anterior end of posterior testis, 0·36. Vesicula



TEXT-FIG. 19.—*Rhipidocotyle apapillosum*: *a*. Entire specimen; *b*. Hood enlarged; *c*. Eggs; enlarged (after Chauhan).

c.s. Cirrus sac; *d.e.* Ductus ejaculatorius; *d.p.* Dorsal process (genital lobe); *e.* Egg, *ex.c.* Excretory canal; *exc.p.* Excretory pore; *g.a.* Genital atrium *g.t.* Genital tongue; *h.* Hood or Cephalic disc; *i.c.* Intestinal canal; *m.* Mouth; *ov.* Ovary; *ph.* Pharynx; *p.pr.* Pars prostatica; *s.* Anterior sucker *t.* Testis; *vit.* Vitellaria; *v.s.* Vesicula seminalis.

seminalis ovoid; pars prostatica rather poorly developed. Prostate gland cells tall. Genital tongue not very conspicuous; left genital lobe or papilla slender, finger-like process; right sided a big spoon shaped papillated structure. Genital pore sub-terminal and inconspicuous. Excretory vesicle tubular bladder. Excretory pore terminal.

Host.—*Clupea* sp.

Location.—Alimentary canal.

Locality.—West Coast of India, Bombay.

20. **Rhipidocotyle septapapillata** Krull, 1934.

Specimens obtained by Chauhan (1943) were very much longer than the type species collected by Krull in Virginia, from *Fundulus diaphanus.*

Host.—*Chrysophrys berda.*

Location.—Intestine; January 1941.

Locality.—Bombay (India).

(iv) Genus **Neobucephalopsis** Dayal, 1948.

The genus has been created by Dayal (1948) to accommodate his new species, *Neobucephalopsis bagarius* which he states resembles the genus *Bucephalopsis* in the structure of the anterior sucker and the relative position of the genital organs but differs from it chiefly in the presence of a distinct receptaculum seminis and in having eggs with thin shell. He further states that receptaculum seminis, as far as, he is aware, is absent in all the known species of *Bucephalopsis* and this difference together with the general topography and the relative size of organs appears to him sufficient to warrant the erection of a new genus for his form.

I will, personally, not regard this as sufficient basis for the creation of a new genus and will therefore like to regard *Neobucephalopsis* Dayal, 1948 as synonymous to the genus *Bucephalopsis* and thus the species, *Neobucephalopsis bagarius* Dayal, 1948 becomes *Bucephalopsis bagarius* (Dayal, 1948), characterised from all the other species of the genus *Bucephalopsis*, known hitherto, chiefly by the presence of a distinct receptaculum seminis and other characters. However, pending the concurrence of other workers on the group, I am mentioning it here separately, under the new genus.

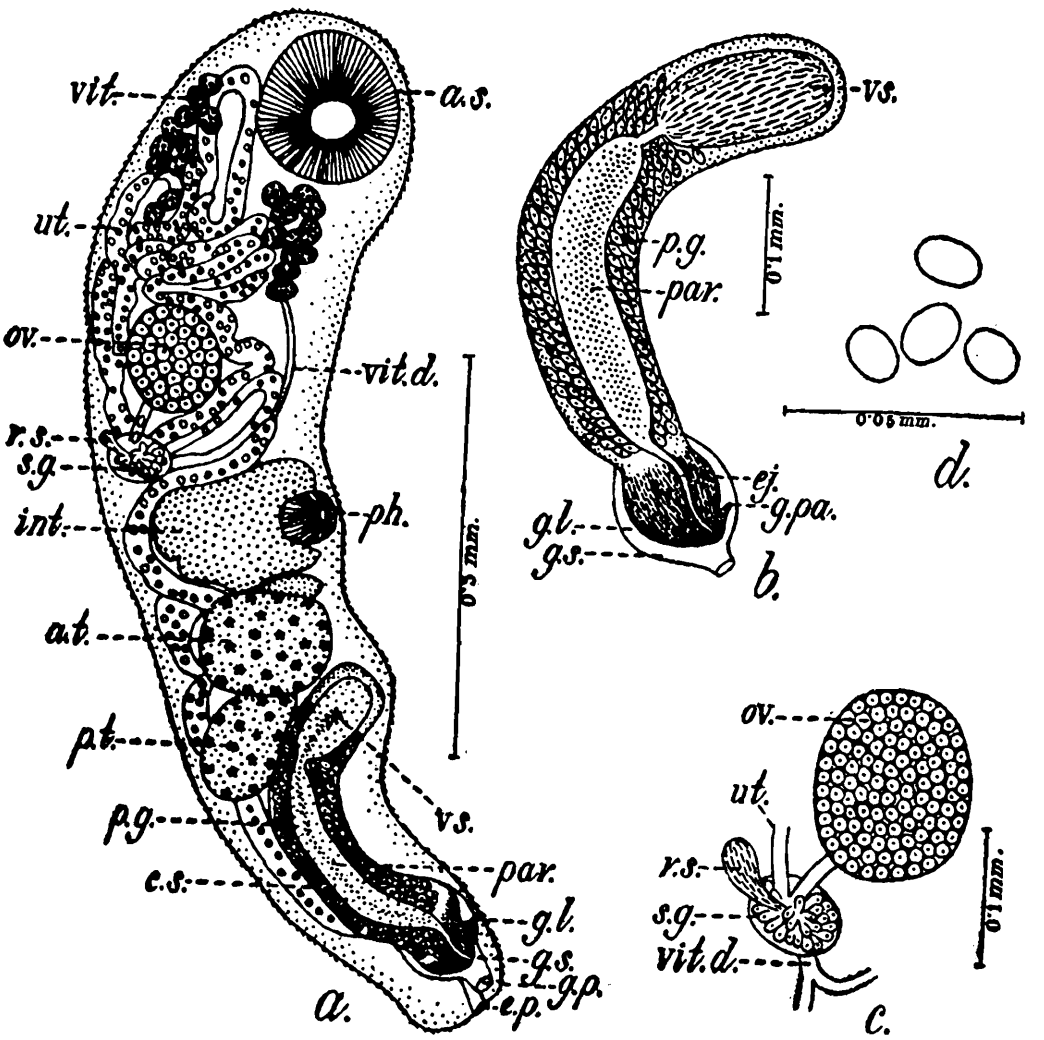
21. **Neobucephalopsis bagarius** Dayal, 1948.

(Text-Fig. 20 *a*, *b*, *c*.)

Specific diagnosis : *Neobucephalopsis* Dayal, 1948; with Generic characters.

Body small, cylindrical, elongate, with a broad anterior and narrow posterior portion, 1·34×0·32 maximum (in the anterior region of ovary). Cuticle spined. Anterior sucker sub-terminal, circular, 0·17×0·175. Mouth opening lies in the middle of body. Pharynx muscular, 0·07 diameter. Intestine sac like, lying transversely in the middle of body. Excretory bladder tubular, extending upto the anterior testis. Excretory pore terminal, posteriorly. Genital pore ventral, lying in front of excretory pore. Testes two, one behind the other, posterior to intestine. Anterior testis larger than posterior, 0·13×0·016 and posterior, 0·15×0·1, partly covered by anterior. Cirrus sac large, crescentic, extending upto anterior testis, 1·51×0·08. Vesicula seminalis

pars prostatica, prostate glands, ejaculatory duct and genital lobe present. Ovary oval, lies anterior to intestine, 0·14×0·12. Vitelline glands consist of large rounded or oval follicles, forming a compact mass, on each side of the body, behind the anterior sucker, 10-13 on each side. Receptaculum seminis present, on the right side of the ootype. Uterine



TEXT-FIG. 20.—*Neobucephalopsis bagarius* : *a.* Entire specimen, ventral view ; *b.* Cirrus sac, ventral view ; *c.* Ovary and ootype, ventral view ; *d.* Eggs, enlarged (after Dayal).

a.s, Anterior sucker ; *a.t*, Anterior testis ; *c.s*, Cirrus sac ; *ej*, Ejaculatory duct ; *e.p*, Excretory pore ; *g.l*, Genital lobe ; *g.p*, Genital pore ; *g.psa*, Genital papilla ; *g.s*, Genital sinus ; *int*, Intestine ; *ov.*, Ovary ; *p.g*, Prostate gland ; *ph*, Pharynx; *par*, Pars prostatica ; *p.t*, Posterior testis ; *r.s*, Receptaculum seminis ; *s.g*, Shell gland ; *ut*, Uterus ; *v.s*, Vesicula seminalis; *vit*, Vitelline gland ; *vit.d*, Vitelline duct.

coils irregular. Eggs, oval, thin shelled, 0·01-0·02×0·009-0·01. (Type species).

Host.—*Bagarius yarrellii.*

Habitat.—Intestine.

Locality.—India.

B. Subfamily *PROSORHYNCHINAE* Nicoll, 1914.

Syns. *Prosorhynchia* Pigulewsky, 1931 (tribe)
Gotonia Pigulewsky, 1931 (tribe).

A number of genera have been referred to this subfami y, from time to time, with the result that the validity of many of them in the

subfamily has become a rather confused matter. Number of workers have tried to study but opinions widely differ. Nagaty (1937) regards only three genera valid under the subfamily *viz.* *Prosorhynchus* Odhner, 1905; *Alcicornis* MacCallum, 1917 and *Neidhartia* Nagaty, 1937. He regards *Gotonius* Ozaki, 1924; *Skrjabiniella* Issaitschikow, 1928; *Mordvilkovia* Piguleswsky, 1931; *Dollfusina* Eckmann, 1932 (pre-occupied) and *Dollfustrema* Eckmann, 1934 as synonymous to *Prosorhynchus Odhner, 1905.* Manter (*1940*,b) believed that *Dollfustrema* and *Mordvilkovia* should be excluded from the synonymy proposed by Nagaty. He further regarded *Pseudoprosorhynchus* Yamaguti, 1938 as a synonym of *Neidhartia.* Jones (1943) considered *Skrjabiniella* to be a valid genus. Ben Dawes (1946) considers only two, *Prosorhynchus* and *Alcicornis* as valid genera under the subfamily. Crowcroft (1946) also does not agree with Jones in regarding *Skrjabiniella* as a valid genus. He divides all the known species of the genus *Prosorhynchus* under two groups, on the basis of disposition of vitelline follicles and shape of rhynchus and puts *P. aculeatus* Odhner, *P. squamatus* Odhner, *P. uniporus* Ozaki and *P. grandis* Lebour under group I, with the yolk follicles in an anterior arc and the rhynchus being oval, and the species, P. *facilis* Ozaki, *P. cortai* Trav., Art. & Per; *P. platycephali* (Yamaguti), *P. manteri* Srivastava; *P. arabiana* Srivastava, *P. ozakii* Manter, *P. rotundus* Manter, *P. gonoderus* Manter, *P. pacificus* Manter, *P. atlanticus* Manter and *P. promicropsi* Manter under Group II, with follicles in two lateral groups and rhynchus being tapering internally. He considers genus *Gotonius* Ozaki to be most suitable genus to receive the members of Group II. He disagrees with the attempt of Srivastava (1938) to show *Prosorhynchus* and *Gotonius* as synonyms based upon comparison of body shape and relative positions of the gonads, neither of which characters he states can be regarded as a sound basis, for comparison in this group. He further considers *Mordvilkovia* as a valid genus. He creates a new genus, *Telorhynchus* with *T arripidis* as type species as possessing a conical rhynchus and yolk follicles in the form of an anterior arc and regards it as a linking form. He states that it differs from the species listed by him under Group I and II, in that the rhynchus is armed with a single circle of spines, interrupted in the mid-ventral line. Dayal (1948) adds another genus, *Neoprosorhynchus* to the subfamily.

The valid genera of the subfamily *Prosorhynchinae* can be identified by the following key.—

Key to Genera of Subfamily *Prosorhynchinae* Nicoll, 1914—

1.	Ovary at opposite side of testes, on the left side.	*Neidhartia*, Nagaty, 1937.
	Ovary anterior to anterior testis, on the right side	2.
2.	Anterior end provided with a rhynchus only	*Prosorhynchus* Odhner, 1905.
	Anterior end provided with a rhynchus and tentacles	*Alcicornis* MacCallum, 1917.

(i) Genus **Prosorhynchus** Odhner, 1905.

syns. *Gotonius* Ozaki, 1924.
Skrjabiniella Issaitschikow, 1928.

Mordvilkovia Piguleswky, 1931.
Dollfusina Eckmann, 1932, pre-occupied.
Dollfustrema Eckmann, 1934.

Odhner (1905) created the genus *Prosorhynchus* to accommodate the species he described as *P. squamatus* from the pyloric cæca and intestine of *Cottus scorpius* and *P. aculeatus* from the intestine of *Conger vulgaris* from Arctic regions, along with *P. crucibulus* (Rudolphi, 1819). He designated *P. squamatus* as the type species. However, as this was found later to be synonymous to *P. crucibulum*, the latter is now regarded as the type of the genus.

Generic diagnosis: *PROSORHYNCHINAE* Nicoll, 1914; with Sub-family characters.

Body elongate, cylindrical, anterior half flatened and posterior cylindrical in some of the species. Cuticle spiny. Anterior end with a conical rhynchus but without tentacles or a sucker. Oral aperture simple, not guarded by an oral sucker and opens on the ventral surface. Pharynx present, muscular. Intestinal cæcum simple and sac shaped with its blind end either directed anteriorly or posteriorly. Testes two, smooth contoured. Cirrus sac elongate, at the posterior end and towards the left side of the body. Ovary anterior to testes. Receptaculum seminis absent. Vitelline glands composed of two sets. Uterine coils extend anteriorly as well as posteriorly. Male and female genital ducts open in a common genital atrium at the posterior end. Excretory vesicle a simple tubular sac, opening at the posterior end.

Type species—*P. crucibulum* (Rud., 1819) Odhner, 1905.

syns. *Monostomum crucibulum* Rudolphi, 1819.
Gasterostomum crucibulum (Rudolphi, 1819) nec. G. *crucibulum* Beneden, 1870.
G. armatum Molin, 1859.
Prosorhynchus costai Travassos, Artigas & Pereira, 1928.
Mordvilkovia elongata Piguleswky, 1931.
Prosorhynchus scalpellus McFarlane, 1936.
P. squamatus Odhner, 1905.
Bucephalus crux Levinsen, 1881.
Prosorhynchus grandis Lebour, 1908.
Prosorhynchus triglæ sq. inqurenda Nicoll, 1914.
P. aculeatus Odhner, 1905.
G. crucibulum Beneden, 1870.
G. armatum Olsson, 1876.
Skrjabiniella aculeatus (Odhner, 1905) Issaitschikow, 1928.

The following species of the genus have been, so far, recorded from the Indian region 1. *P. truncatus* Verma, 1936; 2. *P. manteri* Srivastava, 1937; 3. *P. arabiana* Srivastava, 1937 and 4. *Prosorhynchus* sp. Chauhan, 1943. They can be distinguished from the following key.—

Key to Indian Species of Genus *Prosorhynchus* Odhner, 1905.

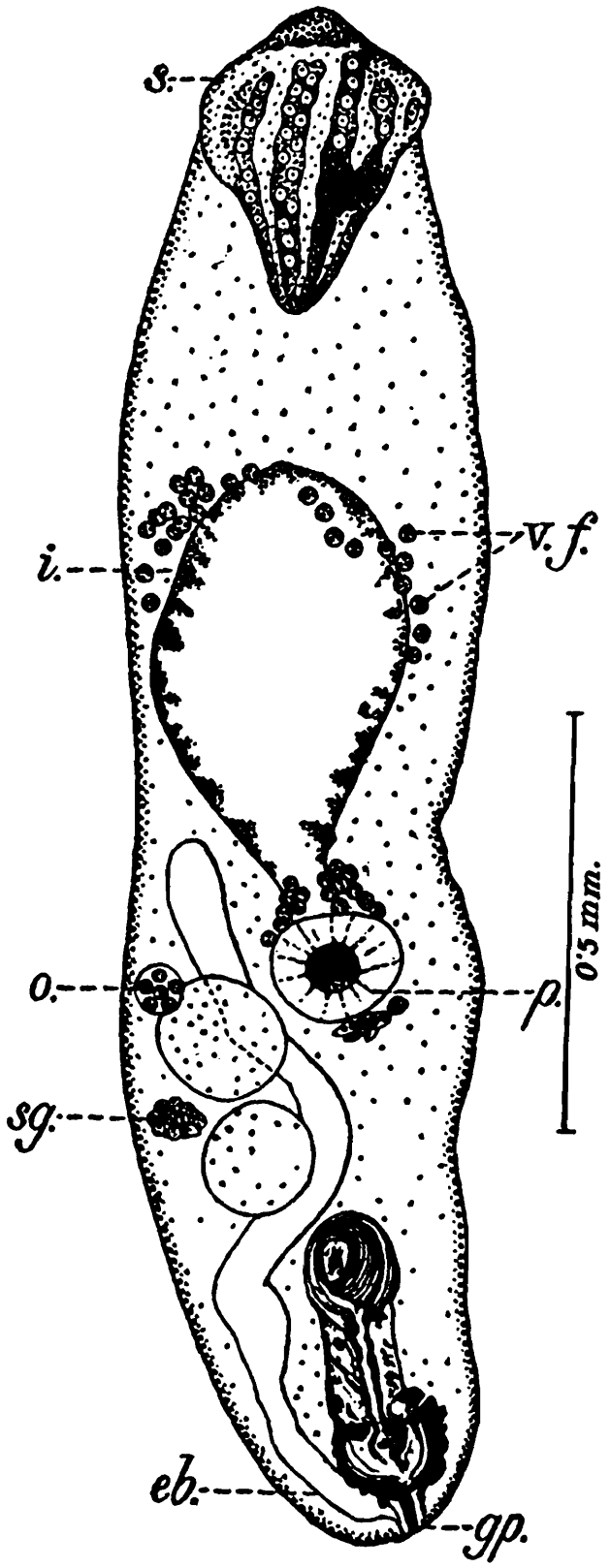
1. Vitelline follicles, extending beyond the middle of body . . . 2.
   Vitellaria, confined to the posterior half of body — *P. arabiana* Srivastava, 1938.
2. Ovary, intestinal sac, mouth opening, vitellaria and pharynx situated in the anterior half of body — *P. manteri* Srivastava, 1938.

Ovary, pharynx, mouth opening, situated in the posterior half and the intestinal sac and vitellaria in the middle third of body — *P. truncatus* Verma, 1936.

22. **Prosorhynchus truncatus** Verma, 1936.

(Text-Fig. 21).

Srivastava, H. D. 1938 *J. Indian vet. Sci.* **8**, (4,) : 333.



Text-Fig. 21.—*Prosorhynchus truncatus* : Entire specimen, ventral view (after Verma) *eb*, Excretory bladder; *g.p*, Genital pore; *i*, Intestine; *o*, Ovary; *p*. Pharynx; *s*, Sucker or rhynchus; *sg*, Shell gland; *vf*, Vitelline follicles.

Specific diagnosis : *Prosorhynchus* Odhner, 1905; with Generic characters.

Body elongate, cylindrical, more or less four times, as long as thick, measuring 1·76×0·42 maximum (at the level of pharynx). At the anterior end a truncated triangular rhynchus, 0·25. Cuticle spined. Pharynx globular, situated one third the body length from the posterior end, 0·15 in diameter. Oesophagus 0·084 long. Intestine saccular, 0·46×0·3. Ovary lies at the level of mouth opening, in close contact with the anterior border of anterior testis. Shell gland forms a compact, oval mass in between the two testes. Vitellaria consist of 29, small, rounded follicles, arranged in semi-circles, along the anterior curve of intestine. Follicles do not extend beyond the level of middle of intestine. Testes obliquely tandem, oval. Anterior testis measures 0·151×0·134; posterior 0·134 in diameter, smaller, more rounded, separated from the anterior. Cirrus sac short, 0·33×0·08, extending to the level of the posterior margin of the posterior testis. Genital pore lies at the posterior end. Excretory bladder sinuous and tubular. Eggs, 35-40μ×18-20μ.

Host.—*Arius jatuis.*

Location.—Intestine.

Locality.—Puri, Bay of Bengal, India.

23. **Prosorhynchus manteri** Srivastava, 1938.

(TEXT-FIG. 22).

Jones, D. O. (1943). *Parasitology* **35**, (1 & 2) : 46.
Crowcroft, P. W. (1946). *Proc. Linn Soc.* N.S. Wales 71, (3/4): 113.
Dawes, Ben (1946). The Trematoda of British Fishes. London : 159, 197.

Specific diagnosis : *Prosorhynchus* Odhner, 1905; with Generic characters.

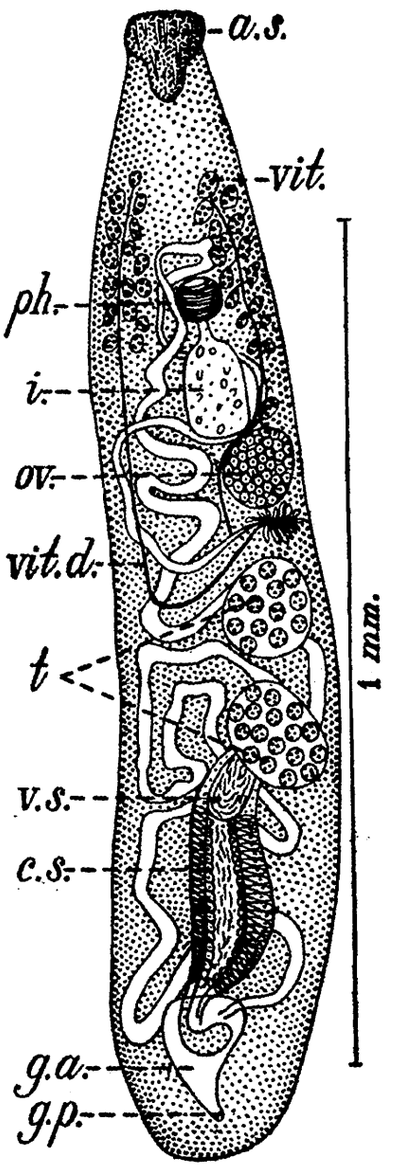
Body cylindrical, anterior end truncated, posterior rounded 0·86-2·26×0·3-0·64. Cuticle with spines. At the anterior end a plug-shaped rhynchus, 0·1-0·12×0·08-0·1, with a thin muscular wall. Pre-pharynx extremely short. Pharynx conspicuous, 0·05-0·1×0·05-0·1 situated in the median axis, at the junction of first and second quarters. Oesophagus short. Intestine bell shaped, 0·12-0·36×0·6-0·34, extending up to the posterior margin of ovary. Testes two, oval, tandem, in the middle third of body. Anterior testis 0·16-0·5×0·18-0·56, posterior 0·12-0·48×0·18-0·5, lying partly on the anterior part of vesicula seminalis. Cirrus sac 0·28-0·6×0·8-0·14. Genital pore ventral. Ovary spherical, with a diameter of 0·16-0·44, lying in front of anterior testis. Vitellaria composed of small, oval follicles, arranged longitudinally, in pairs, along the sides of the body and extending from in front of ovary to the anterior one fifth or eighth of body length. Uterine coils occupy most of the space between the genital sinus and first quarter of body. Eggs oval, 0·019—0·02×0·011-0·013. Excretory bladder a simple, long tube, extending from the anterior level of vitellaria to the posterior end.

The species resembles *P. truncatus* Verma in the shape of body but differs from it in most of its characters, *e.g.* the topography of the gonads, position of pharynx ; intestine, genital pore and vitellaria.

Host.—*Tetradon oblongus* Bl.

Location.—Intestine, duodenum.

Locality.—Puri, Bay of Bengal.



Text-Fig. 22.—*Prosorhynchus manteri.* Entire specimen (after Srivastava).

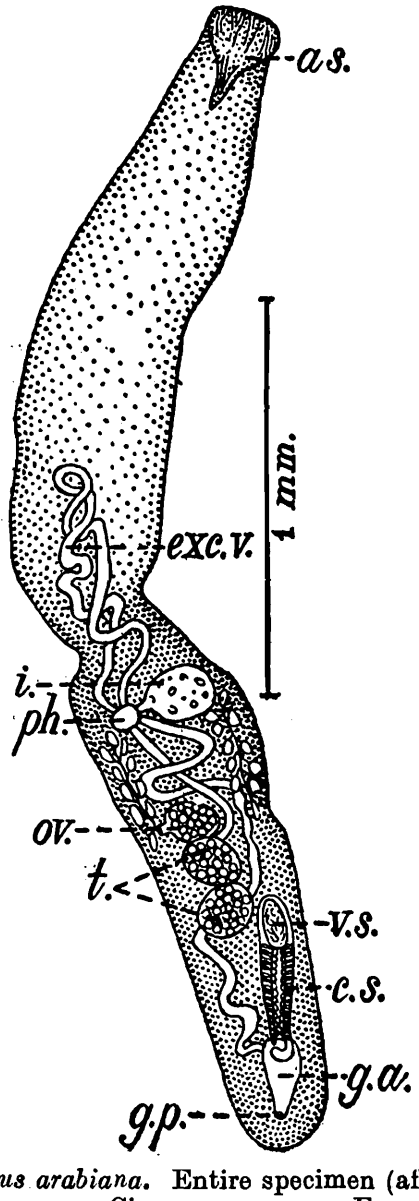
a.s, Anterior sucker; *c.s*, Cirrus sac; *g.a*, Genital atrium; *g.p*, Genital pore; *i*, Intestine; *ov*, Ovary; *ph*, Pharynx; *t*, Testes; *vit*, Vitellaria; *vit.d*, Vitelline duct; *v.s*, Vesicula seminalis.

24. **Prosorhynchus arabiana** Srivastava, 1938.

Crowcroft, P. W. (1946). Proc. Linn. Soc. N. S. W. **71** (3/4) : 113.
Dawes, Ben (1946). The Trematoda of British Fishes. Lond ; 159, 197.
Jones, D. O. (1943). *Parasitology.* **35** (1/2) : 46.

Specific diagnosis : *Prosorhynchus* Odhner, 1905 ; with Generic characters.

Body elongated, cylindrical, 3·3-4·5×0·4-0·6, maximum (at the level of ovary). Cuticle spined. Anterior rhynchus baloon shaped, 0·22-0·3×0·16. Pharynx small, globular, 0·06-0·08 in diameter, situated to the left of median axis, about three fifths of body length from anterior end. Oesophagus small. Intestine bulb shaped 0·16-0·24× 0·12-0·15. Testes tandem. Posterior testis 0·1-0·12×0·08-0·12, anterior 0·1-0·12 in diameter. Cirrus sac small, narrow, club shaped, 0·4-0·26× 0·06-0·08, extending upto the middle of posterior testis. Genital tongue



TEXT-FIG. 23.—*Prosorhynchus arabiana.* Entire specimen (after Srivastava).
a.s, Anter ior sucker ; *c.s*, Cirrus sac ; *exc.v*, Excretory vesicle ; *g.a*, Genitah atrium ; *g.p*, Genital pore ; *i*, Intestine ; *ov*, Ovary ; *ph*, Pharynx ; *t*, Testes ; *v.s*, Vesicula seminalis.

small, hook shaped. Ovary small, ovoid, 0·08-0·12 in diameter, lying in front of anterior testis. Laurer's canal present. Vitellaria consist of small, pear shaped follicles, arranged longitudinally in pairs, on either side, extending from the level of posterior margin of ovary to the level of pharynx. Uterus with many eggs, extending from anterior two fifths of body length upto the genital tongue. Eggs, 0·023×0·012.

Excretory bladder small, elongate, saccular tube, extending from the level of pharynx to excretory pore, which is situated near the genital pore.

Host.—*Synaptura orientalis* Bloch.

Habitat.—Intestine.

Locality.—Karachi, Arabian Sea (Pakistan).

25. **Prosorhynchus** sp. Chauhan, 1943.

Only a few specimens were obtained by Chauhan in 1940.

Host.—*Serranus lanceolatus.*

Location.—Alimentary canal.

Locality.—Bombay (India).

(ii) Genus **Neidhartia** Nagaty, 1937.

syn. *Pseudoprosorhynchus* Yamaguti, 1938.

Dawes, B. (1946). The Trematoda. Cambridge University Press.
Chauhan, B.S. (1943). *Proc. Indian Acad. Sci.* **17** : 112-117.

The genus was created by Nagaty (1937) to accommodate the two new species described by him in 1937 as *N. neidharti* and *N. ghardagae* from the intestine of the fish *Serranus* sp. from Red Sea. Ben Dawes (1946) regards this genus as synonymous to *Prosorhynchus* Odhner, 1905.

Generic diagnosis : *Prosorhynchinae* Nicoll, 1914 ; with Subfamily characters.

Body elongate, cylindrical. Cuticle spiny. Anterior end with a conical rhynchus but without tentacles or a sucker. Oral aperture simple, removed from the anterior end and posterior extremities of the body. There is no oral sucker. A muscular pharynx is present. Intestinal caecum simple and sac shaped. Testes two, smooth contoured, on the right side of body. Cirrus sac elongate, at the posterior end and towards the left side of body. Ovary on the left side of body, opposite the testes. Vitelline glands composed of two sets. Uterine coils extend anteriorly as well as posteriorly. Excretory vesicle simple, tubular sac, opening at the posterior end.

Type species—*N. neidharti* Nagaty, 1937.

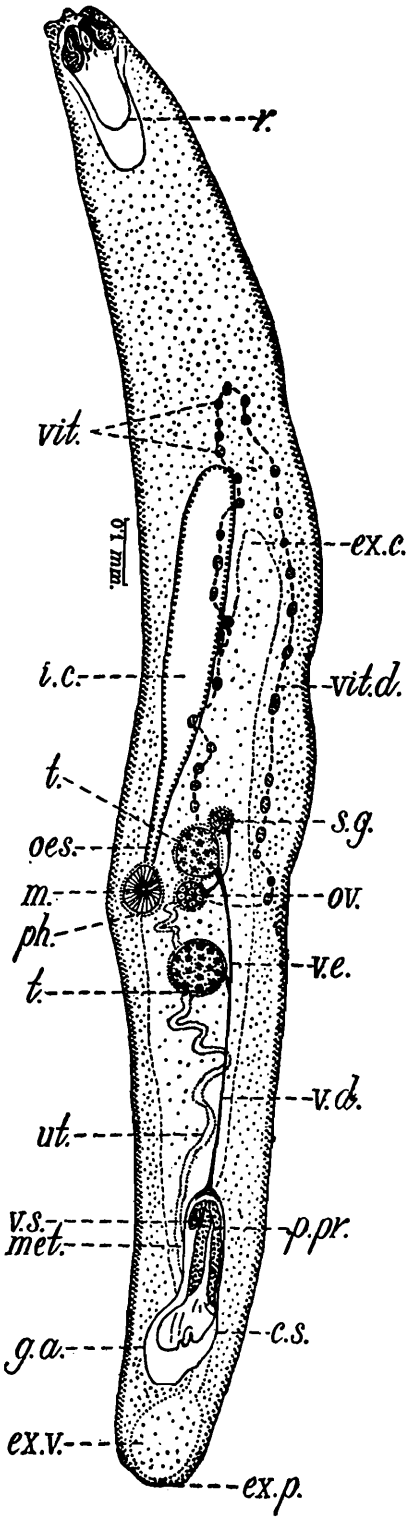
The representatives of this genus were recorded for the first time in India by Chauhan (1943) who recorded the occurrence of *Neidhartia neidharti* Nagaty, 1937 and described a new species, *Neidhartia microrhyncha* Chauhan. These can be distingusihed as follows :—

Key to Indian Species of Genus *Neidhartia* Nagaty, 1937.

Body ovate ; rhynchus large ; cirrus sac small, 1/8 to 1/9 body length ; vitellaria extend upto rhynchus. Cirrus sac extending upto posterior testis and ovary	*N. neidharti* Nagaty, 1937.
Body elongate ; rhynchus small ; cirrus sac large, 1/3 body length ; vitellaria short in extension, much behind the rhynchus. Cirrus sac not extending upto testes and ovary	*N. microrhyncha* Chauhan 1943.

26. Neidhartia microrhyncha Chauhan, 1943.

Specific diagnosis: *Neidhartia* Nagaty, 1937; with Generic characters.



TEXT-FIG. 24.—*Neidhartia microrhyncha*. Entire specimen (after Chauhan)

c.s, Cirrus sac; *ex.c*, Excretory canal; *exc.p*, Excretory pore; *ex.v*, Excretory vesicle; *g.a*, Genital atrium; *i.c*, Intestinal canal; *m*, Mouth; *met*, Metraterm; œs., Oesophagus; *ov*, Ovary; ph, pharynx; *p.pr*, Pars prostatica; *r*, Rhynchus; *s.g* Shell Gland; *t*, Testis; *ut*, Uterus; *v.d.*, vas deferens; *v.e.*, vasa efferentia; *vit.*, Vitellaria; *vit.d.*, Vitelline duct; *v.s*, Vesicula seminalis.

Body very elongate, truncated, 1·39-2·93 × 0·23-0·4, maximum width (in the region of pharynx). Cuticle spiny. Anterior end with a well

developed rhynchus or rostellum, 0·144-0·23 × 0·07-0·106, with two highly muscular ridges. Important organs confined to the posterior half. Mouth simple, ventral. Pharynx small, compact, oval or globular, 0·06 × 0·03-0·10-0·11. The position of pharynx in relation to gonads variable. Oesophagus small. Intestine saccular, thin walled, shape variable, elongate or oval, 0·34-0·8. Gonads always situated much anterior to cirrus sac about the neighbourhood of pharynx and mouth. Testes two, oval or spherical, obliquely tandem. Anterior testis smaller than posterior, 0·062 × 0·062-0·08 × 0·09; posterior 0·075 × 0·062-0·1 × 0·12. Cirrus sac elongate, situated at the posterior end to the left side, 1/8 to 1/9 body length, measuring 0·175-0·33. Vesicula seminalis ovoid; prostate gland cells poorly developed. Ovary small, oval or spherical, inter-testicular, smaller than testes, 0·37 × 0·37-0·08 × 0·05. Shell gland round. Laurer's canal present. Vitelline glands composed of two longitudinal strands of vitelline follicles, arranged laterally, probably coming together anteriorly. Follicles are oval granular, numbering 16-17 on right side and 15 on the left. Uterus consists of few very narrow, thin coils. Excretory organ is a simple bladder.

Host.—*Psettodes erumei.*

Location.—Alimentary canal.

Locality.—Bombay (India).

27. **Neidhartia neidharti** Nagaty, 1937.

Chauhan, B. S. (1943). Proc. Indian Acad. Sci. B **17** : 102

The rhynchus of the specimen obtained by Chauhan (1943) was smaller than that of specimens of Nagaty (1937).

Host.—*Belone* sp.

Location.—Small Intestine.

Locality.—Bombay (India).

(iii) Genus **Neoprosorhynchus** Dayal, 1948.

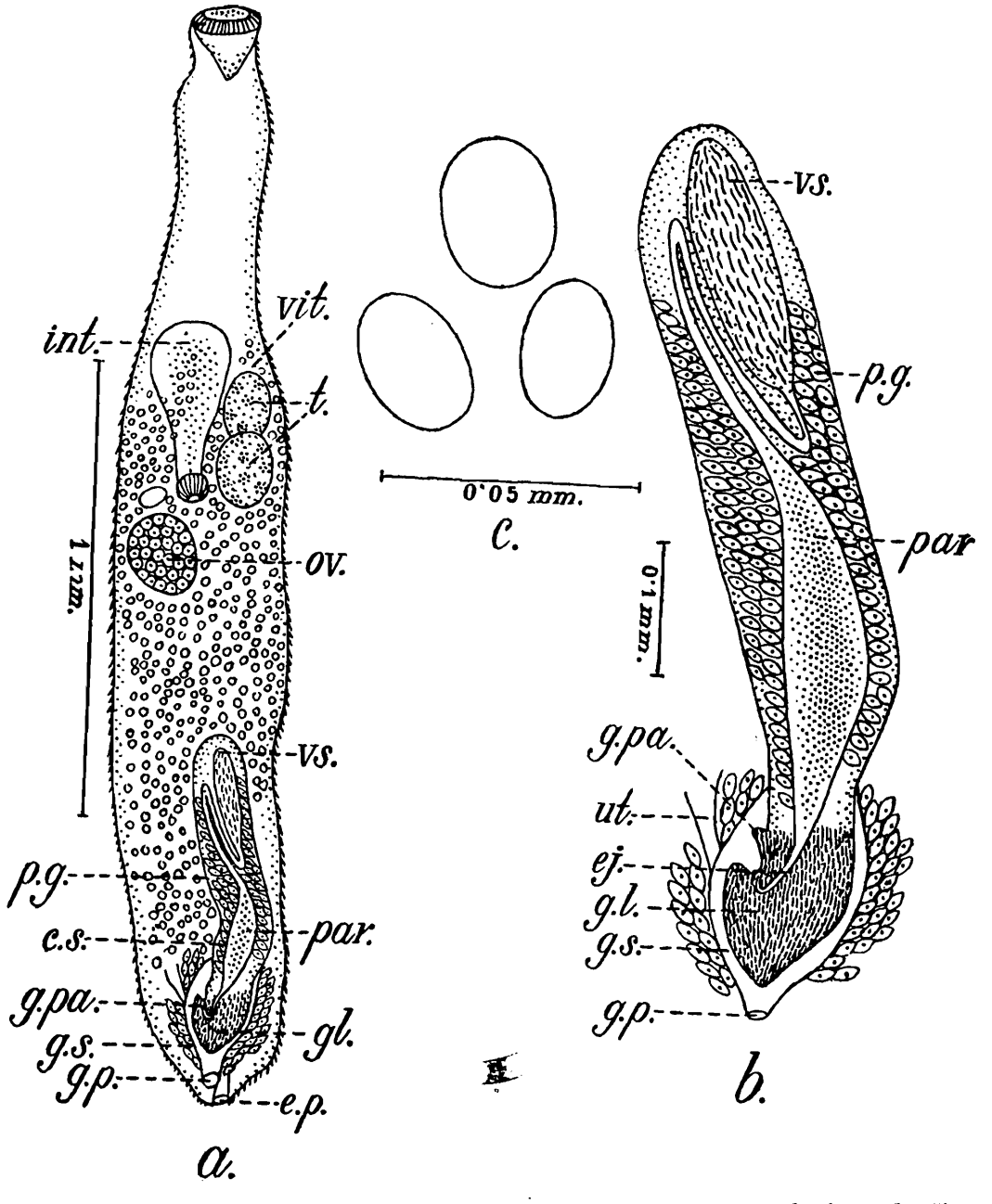
Dayal (1948) created a new genus, to accommodate his new species, *Neoprosorhynchus purius*, on the ground that his species differs from all the known genera in the relative position of ovary and testes and in the possession of a *Y*-shaped excretory bladder. These points seem to him to be sufficient to warrant the creation of the new genus.

28. **Neoprosorhynchus purius** Dayal, 1948.

Specific diagnosis : *Neoprosorhynchus* Dayal, 1948; with Generic characters.

Body small, cylindrical, elongate, with a broad anterior and a narrow posterior portion, measuring 2·4 × 0·37 Cuticle spiny. Anterior rostellum 0·15, having the shape of an inverted cone. Pharynx, 0·07 in diameter. Oesophagus long. Intestine sac like, about 0·26 × 0·19. Excretory pore terminal. Excretory bladder *Y*-shaped. Genital pore ventral. Testes two, oval, tandem, on the left side, at about

the level of pharynx and oesophagus. Anterior testis 0·15×0·1; posterior larger than anterior, partly covering it, 0·16×0·11. Cirrus sac 0·72×0·11. Vesicula seminalis tubular; pars prostatica S-shaped Genital lobe large, muscular. Ovary lies posterior to testes, behind the



TEXT-FIG. 25.—*Neoprosorhynchus purius*: *a*. Entire specimen, ventral view; *b*. Cirrus sac, enlarged; c. Egg, enlarged (after Dayal).

c.s, Cirrus sac; *ej*, Ejaculatory duct; *e.p*, Excretory pore; *g.l*, Genital lobe; *g.p*, Genital pore; *g.pa*, Genital papilla; *g.s*, Genital sinus; *int*, Intestine; *ov*, Ovary; *p.g*, Prostate gland; *par*, Pars prostatica; *p.t*, Posterior testis; *ut*, Uterus; *v.s*, Vesicula seminalis; *vit*, Vitelline gland; *vit.d*, Vitelline duct.

oral aperture, on the right side of median line, 0·18. Vitelline glands consist of small follicles, scattered irregularly, on either side of intestine, partly covering it. Uterine coils, fill up entirely space between ovary and cirrus sac. Eggs, in large number, oval, with a thick brown shell, 0·025-0·027×0·018-0·021.

Host.—*Epinephelus lanceolatus* (Bl.).

Location.—Intestine.

Locality.—Puri, India.

IV. *List of hosts, localities, with parasites recorded from them from the Indian region described in this paper.*

Host.	Parasite.
Aoria aoria (-*Macrones aoria*) Day, Allahabad .	*Bucephalus tridenticularia* *Bucephalus aoria.*
Aoria seengha la (-*M. seenghala*) Day, Allahabad.	*Bucephalus tridenticularia.*
Arius falcarius, Bombay	*Rhipidocotyle ligulum.*
Arius jatuis, Puri	*Prosorhynchus truncatus.*
Bagarius yarrellii, Lucknow	*Neobucephalopsis bagarius.*
Belone sp., Bombay	*Neidhartia neidharti.*
Belone cancila, Poona . . .	*Bucephalopsis karvei.*
Belone strongylina V. Hasselt, Allahabad .	*Bucephalopsis belonea.*
hrysophrys berda, Bombay . . .	*Rhipidocotyle septapapillata.*
Clupea, sp., Bombay . . .	*Rhipidocotyle apapillosum.*
Cymbium guttatum, (Bl. & Schn.) spotted mackerel, Puri.	*Bucephalus jagannathai.*
Epinephelus lanceolatus (Bl.) Puri . . .	*Neoprosorhynchus purius.*
Eutropiichthys vacha Day (Butter fish), Allahabad	*Bucephalopsis fusiformis.* *Bucephalopsis sinhai.*
Macrones seenghala Day, Allahabad . .	*Bucephalus indicus.* *Bucephalus gangeticus.* *Bucephalopsis thapari.* *Bucephalopsis macronius.*
Pangasius buchanani Cuv. & Val. . .	*Bucephalopsis magnum.* *Bucephalopsis confusus.*
Psettodes erumei, Bombay . .	*Neidhartia microrhyncha.*
Pseudotropius garua, Day, Allahabad . .	*Bucephalopsis garuai.* *Bucephalopsis minimus.*
Scatophagus argus Bloch., Puri	*Bucephalus barina.*
Sciaena belengeri, Bombay.	*Bucephalopsis microcirrus*
Serranus lanceolatus, Bombay . . .	*Prosorhynchus* sp.
Synaptura orientalis Bloch, Karachi . . .	*Prosorhynchus arabiana.*
Tetradon oblongus Bl., Puri	*Prosorhynchus manteri.*

V. *Classified list of parasites from the Indian region, with their host and localities.*

Gasterostomata.

Bucephalidae.

A. *Bucephalinae.*

Bucephalus.

Bucephalus tridenticularia . . .	*Aoria aoria* (=*Macrones aoria*) Day Allahabad.
	Aoria seenghala (-*M. seenghala*) Day, Allahabad.
Bucephalus aoria	*Aoria aoria* (-*Macrones aoria*) Day, Allahabad.
Bucephalus jagannathai	Spotted mackerel, *Cymbium guttatum* (Bl. & Schn). Puri.
Bucephalus indicus	*Macrones seenghala* Day, Allahabad.

Host.	Parasite.
Bucephalus gangeticus	*Macrones seenghala* Day, Allahabad (India).
Bucephalus barina	*Scatophagus argus* Bloch, Puri, Bay of Bengal.
Bucephalopsis.	
Bucephalopsis fusiformis	*Eutropiichthys vacha* Day (Butter fish), Allahabad (India).
Bucephalopsis garuai	*Pseudotropius garua*, Day, Allahabad (India).
Bucephalopsis magnum	*Pangasius buchanani* Cuv. & Val. Allahabad (India).
Bucephalopsis confusus	*Pangasius buchanani* Cuv. & Val. *Silundia gangetica*, Cuv. & Val., Allahabad (India).
Bucephalopsis minimus	*Pseudotropius garua* Day, Allahabad (India).
Bucephalopsis karvei	*Belone cancila*, Poona (Bombay Pres.).
Bucephalopsis belonea	*Belone strongylina* V. Hasselt, Allahabad (India).
Bucephalopsis microcirrus	*Sciaena belengeri*, Bombay (India).
Bucephalopsis sinhai	*Eutropiichthys vacha*, India.
Bucephalopsis thapari	*Macrones seenghala*, India.
Bucephalopsis macronius	*Macrones seenghala*, India.
Rhipidocotyle.—	
Rhipidocotyle ligulum	*Arius falcarius*, West Coast, Bombay (India).
Rhipidocotyle apapillosum	*Clupea* sp., West Coast of India, Bombay.
Rhipidocotyle septapapillata	*Chrysophrys berda*, Bombay (India).
Neobucephalopsis.—	
Neobucephalopsis bagarius	*Bagarius yarrellii*, India.
B. *Prosorhynchinae.*—	
Prosorhynchus.—	
Prosorhynchus truncatus	*Arius jatuis*, Puri, Bay of Bengal (India).
Prosorhynchus manteri	*Tetradon oblongus* Bl., Puri, Bay of Bengal.
Prosorhynchus arabiana	*Synaptura orientalis* Bloch, Karachi, Arabian Sea.
Prosorhynchus sp.	*Serranus lanceolatus*, Bombay (India).
Neidhartia.—	
Neidhartia microrhyncha	*Psettodes erumei*, Bombay (India).
Neidhartia neidharti	*Belone* sp., Bombay (India).
Neoprosorhynchus.—	
Neoprosorhynchus purius	*Epinephelus lanceolatus* (Bl.), Pur (India).

VI. ACKNOWLEDGMENT.

I am grateful to Shri A. K. Bose, Shri G. Ramakrishna, B.Sc. (Hons.) and Shri S. Ghoshal, B .A., Dip. Lib. for assistance in various ways.

I also wish to express my gratitude to various authorities and authors whose diagrams have been reproduced in this series.

VII. Summary.

This paper deals with all the Gasterostome Trematode parasites described, from the Indian region so far. A brief account or diagnosis with necessary diagrams, has been given almost in each case; their latest systematic position reviewed and as far as possible, views of other workers on the group given up to date. Identification keys have also been provided at every taxonomic stage.

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STUDIES ON THE TREMATODE FAUNA OF INDIA.

PART IV. Subclass *DIGENEA* (*Prosostomata.*)

(A Revision of *Hemiuroidea* from the Indian Region.)

By B. S. Chauhan, M.Sc., Ph. D., Fzs, Fasc, Fzsi, *Assistant Superintendent, Zoological Survey of India, Calcutta.*

CONTENTS.

I. INTRODUCTION.

As already pointed out in Introduction to the earlier parts of this series, this is the fourth publication in the general series but is the first of the series on the *Prosostomata*. However, unlike, the plan in Part II on Aspidogastrea and Part III on Gasterostomata (Digenea) no attempt has been made in this part to give a brief, general account of Prosostomata, for want of enough space, specially as the forms to be covered in this paper are quite too many.

II. Taxonomy—Trematoda.

It appears that the earliest record of our knowledge of Trematodes dates back to the year 1379, when Jehan de Brie referred to the liver fluke of sheep. But Zedar (1800) was the first to have made a definite attempt to classify the parasitic worms or "Helminths" as they were called then. He divided them into five families representing (i) round worms, (ii) hooked worms, (iii) sucking worms, (iv) tape worms and (v) bladder worms. He recognised three genera under the group sucking worms and gave their diagnosis and species. Rudolphi (1808), however, for the first time used the term "*Trematoda*" for Zedar's sucking worms; with the taxonomic rank of an "Order".

It may, incidentally be mentioned that the Trematode parasites are commonly known as "*Flukes*". The word *fluke* has a very interesting origin. It is derived from the Anglo-saxon '*Floc*'. The disease was supposed to have been caused by eating away of '*Floc*' or young flanders of grass by sheep, which was believed to have reached ultimately the liver of the animal and got turned into this worm. Curiously enough, the corresponding French equivalent name of the parasite '*La douve*' has also the same derivation and means the name of a grass growing in marshy places.

Leuckart (1856) divided the Order *Trematoda* into two families: (a) *Distomea* comprising of endoparasitic forms with a metamorphosis, (b) *Polystomea* comprising of ectoparasitic forms with no metamorphosis. and Burmeister (1856) however, proposed for them three Orders, (i) *Malacobothrii* (=Distomids), (ii) *Pectobothrii* (=Polystomids) and (iii) *Aspidobrii* (=Aspidogaster). Van Beneden (1858), on the basis of lifehistories, made two Orders (i) "*Monogenetic*" (Monogenèsés) for forms with direct life-history and (ii) "*Digenetic*" (Digenèsés) for forms with indirect life-history. Carus (1863) named Leuckart's groups as *Monogenea* and *Digenea*. Monticelli (1892) again revived Burmeister's system of classification into three Orders, with different names, *viz.*—

1. *Heterocotylea* Monticelli (=Polystomea Leuck.; Pectobothrii, Burm.; Monogenea v. Ben.).
2. *Aspidocotylea* Monticelli (=Aspidobothrii, Burm.).
3. *Malacocotylea* Monticelli (=Distomea Leuck.; Malacobothrii Burm.; Digenea v. Ben.).

The Trematoda group has received great deal of attention during the present century and a large number of families have been added to it. Formerly it contained only a dozen: five, *viz.* 1. *Monocotylidae*, 2. *Tristomidae*, 3. *Polystomidae*, 4. *Microcotylidae* and 5. *Gyrodactylidae*, under the Order Heterocotylea; only one *viz.*, *Aspidobothriidae* under Order Aspidocotylea and six, under Malacocotylea, *viz.* 1. *Amphistomidae*, 2. *Distomidae*, 3. *Holostomidae*, 4. *Monostomidae*, 5. *Gasterostomidae*, 6. *Didymozoonidae*.

Odhner (1905) sub-divided the Order Malacocotylea into two suborders, *viz.* 1. *Gasterostomata*, 2. *Prosostomata*.

In recent times Poche (1926) made an elaborate attempt on the subject. He divided the Class Trematoda into two Orders, (i) Monogenea and (ii) Digenea. He recognised thirteen families under the Order Monogeea, which he further sub-divided into two tribes, *viz.* (i) *Monopisthocotylea* and *Polyopisthocotylea*. He probably for the first time, also introduced the conception of Superfamilies and recognised two Superfamilies, *viz.*, *Tristomatides* and *Gyrodactylides* under the tribe *Monopisthocotylea*. In *Digenea*, the suborder Gasterostomata contained only one family but the Suborder Prosostomata was divided into two tribes ; (i) Tribe *Fascioloidae*, with sub-tribes (a) *Fasciolinae* and (b) *Heronimainae* and (ii) tribe, *Aspidogastroidae*. The latter two containing only one family under each. The sub-tribes, Fasciolinae, contained 59 families, with ten superfamilies, *viz.* 1. *Faustulidae*, 2. *Fasciolida*, 3. *Sanguinicolida*, 4. *Schistosomatida*, 5. *Strigeida*, 6. *Hemiurida*, 7. *Didymozoida*, 8. *Notocotylida*, 9. *Paramphistomida* and 10. *Alcicornida*.

Fuhrmann (1928) generally followed classification of Poche but did not mention any tribes, sub-tribes or superfamilies.

Faust (1929) divided the class Trematoda into two subclasses ; 1. *Monogenea*, 2. *Digenea*. The subclass Digenea was sub-divided into two Orders, 1. *Gasterostomata*, 2. *Prosostomata*. He further sub-divided Order Prosostomata into four sub-orders, 1. *Aspidocotylea*, 2. *Monostomata*, 3. *Strigeata* and 4. *Amphistomata*. The superfamilies mentioned by him were 1. *Strigeoidea*, 2. *Schistosomatoidea*, 3. *Paramphistomatoidea*, 4. *Fascioloidea*, 5. *Ecninostomatoidea*, 6. *Dicrocoelioidea*, 7. *Heterophyoidea*, 8. *Opisthorchoidea*, 9. *Troglotrematoidea*, 10. *Hemiuroidea*. His list was probably not exhaustive, as he was dealing with human helminthology only.

In recent publications mention has been made of some more subclasses and superfamilies, *e.g.* subclasses.—*Schistosomata*, *Sanguinicolata*, *Fasciolata* (s. Distomata), etc. and the superfamilies *Sanguinicoloidea*, *Didymozoidea*, *Allocreadioida* (s. *Plagiorchoidea*), *Haploporodea*, *Cyclocoeliodea*, *Clinostomatoidea*, *Notocotyloidea*, *Diplostomatoidea*, *Bolbocephaloidea*, *Cyathocotyloidea*, etc.

This scheme of classification, into subclasses and superfamilies has, however, not been followed universally, so far. It may possibly have to be adopted after the limits of the superfamilies have been properly defined and their diagnosis laid down.

Faust and Tang (1936) have suggested that the Aspidogastrid trematodes form an important intermediate group and therefore should be separated form the rest of the Prosostomata and constituted into a separate and independent rank of Subclass, *Aspidogastratea*, equal in rank with *Monogena* and *Digenea*.

I have dealt with the subject further elsewhere, while discussing the position of the family Haplosplanchnidae.

III. Evolution and Inter-relationships in Platyhelminthes.

In one of the earlier parts of this series, *viz.* Pt. II, I have discussed as to what must have been the nature of the ancestor of Platyhelminthes ;

discussed briefly some of the salient points from their comparative morphology and life-histories which may have some bearing on the subject and how the complicated indirect life-cycle of Digenea may have evolved from the simple and direct life-cycle of Aspidogastrea. The Phylum Platyhelminthes contains at present four classes, *viz.* 1. Turbellaria, 2. Temnocephaloidea, 3. Trematoda, 4. Cestoda. Of these the Turbellaria possess features of special interest and importance, as they not only furnish the explanation of the structure of two parasitic groups, *viz.* Temnocephalida and Trematoda, which have probably arisen from Turbellarian like ancestors, but they occupy the lowest position in the whole group of worms. This is believed to be the simplest group of bilateral animals which has adopted to the habit of creeping and are most closely allied to that great extinct group from which the Nemertinean, Rotifera and even the Annelids may have been derived.

Some Rhabdocoelidan turbellarians resemble *Infusorians* (Protozoan) in their minute size, shape and movements, though they possess an organisation of considerable complexity.

It is very likely that the trematodes are a polyphyletic group *i.e.* the different families or groups may have developed from different families of Turbellaria, altogether independently. In Digenea, the whole life-history appears to have been specially modified in accordance with a parasitic mode of life.

It is almost an axiom that parasitism leads to degeneration of the parasite and this is a great factor, not to be ignored, specially while considering the phylogeny of Trematodes.

In fact, but for the absence of cilia there is no essential major difference between a Trematode and a Turbellarian and there is little difficulty in deriving a Trematode from some Rhabdocoelous form of the Turbellarian which had taken to the habit of temporarily associating itself with a host, as the present day Triclad Bdelluridae do.

As far as the Temnocephaloidae group is concerned, their whole anatomy exhibits a remarkable intermediate condition between the Rhabdocoeldae and Trematoda but they present certain characteristics of their own, which entitle them to a position independent of the Turbellarians and Trematoda.

Regarding the Trematode group proper, there are different opinions. Some regard Digenea as more highly evolved and developed than Monogenea and probably derived from them ; whereas others hold just the contrary opinion that Monogenea are of the higher order. The two groups seem to have diverged at a very early stage in their phylogeny, from their ancestor. This ancestor, may have been very probably some Temnocephalid like form, with only the posterior sucker ; the intestine may have been sac-like and the genital organs may have been posterior to the gut. The mode of life and feeding habits, endo or ecto parasitic may have led to a divergence in evolution, along two lines, one with complicated indirect life cycle, as in Digenea and the other simple and direct may have led to evolution of Monogenea or Aspidogastrea. As discussed, in detail, elsewhere in this paper, the Digenea may have evolved out, through forms like *Haplosplanchnus*. The Gasterostomata could have also

evolved directly or indirectly through parasitic rhabdocoelidan turbellarians, forms like *Macrogynium*, etc.; the general trend of evolution being possibly on the same lines as that of other Digenea.

There also appears to be some intimate relationship between Trematodes and Cestodes and the link is to be sought somewhere in the unsegmented Cestodes, like *Gyrocotyle*, *Amphilina*, *Archigetes*, *Lytocestus* which are though undoubtedly cestodes because of the absence of an enteric cavity and organs of attachment at the posterior end but are not far distant even from present day Trematodes.

IV. SYSTEMATIC ACCOUNT.

Superfamily HEMIUROIDEA Faust, 1929.

Syn. *Hemiurida* Dollfus, 1923, *emend* Poche, 1929.

The superfamily Hemiuroidea was first created as Superfamily *Hemiurida* by Dollfus in 1923. Poche 1926 emended it. Subsequently it was given a new name, *Hemiuroidea* by Faust (1929). Its exact concept and jurisdiction has been varying according to the views of different workers. Faust included the following families under the Superfamily: *Hemiuridae* Lühe, 1901 (Type family); *Halipegidae* Poche, 1926; *Isoparorchidae* Poche, 1926; *Xenopodae* Poche, 1926 and *Axygiidae* Odhner, 1911.

Besides it has been indicated to contain from time to time the following families: *Bunocotylidae*; *Accocoeliidae* Looss, 1912; *Syncoeliidae* Dollfus, 1923; *Sclerodistomatidae*; *Hirudinellidae*; *Bathycotylidae*; *Ptychogonimidae*; *Haplosplanchnidae* Poche, 1926, etc.

Since this paper deals mainly with the Indian representatives of the group, only the families, Hemiuridae and Haplosplanchnidae have been dealt with, in the following pages.

Superfamily diagnosis: *Prosostomata* Odhner, 1905; with the characters of the Order.

Medium to large flukes, usually oval and flattened, producing small to medium-sized eggs, which contain, when oviposited, fully developed, bilaterally symmetrical embryos. Cercariae cystophorous in type, produced in rediae; utilising various insects as second intermediate hosts. Maritae in the intestines and other tissues of fishes. Excretory bladder Y shaped; lateral twigs and capillaries with terminal flame-cells derived directly from the lateral pair of primary collecting tubules, which have an anterior transverse anastomosis. Fundamental flame cell formula of marita: 2 [(2+2+2)+(2+2+2)].

Typefamily—*Hemiuridae* Lühe, 1901.

V A. Family HEMIURIDAE Lühe, 1901, e.p. Looss, 1907.

The family Hemiuridae was created by Lühe in 1901. He divided the representatives of this family in two groups. Group I, containing subfamily Hemiurinae Lühe, 1901 with the genera *Hemiurus* Rudolphi, 1902 and *Lecithocladium* Lühe, 1910 and Group II containing subfamily Lecithochirinae Lühe, 1901 with the genera *Derogenes* Lühe, 1900; *Lecithaster* Lühe, 1901 and *Lecithochirium* Lühe, 1901. He included *Pronopyge* Looss (=*Apoblena*=*Hemiurus*), *Liopyge* Looss (=*Liocerca*,)

Eurycoelum Bröck, *Accocoelium* Montic., *Progonus* Looss, *Syncoelium* Loöss, *Otiotrema* Setti as isolated genera and stated that *Eurycoelum* Brock, 1886 needs further research. It was, however, Looss (1907) who dealt with the morphology of the family in great detail and established criteria for the determination of the various genera and species included under the family.

The family as defined by Dawes (1947) is given below, after slight emendation.

Family diagnosis : *Prosostomata* Odhner, 1905. (Superfamily Hemiuroidea) ; with characters of the Suborder.—

Small to medium sized, elongate and somewhat cylindrical distomes, with tapering extremities; the posterior and often having a tail-like process or ecsoma, which can be introverted into the rest of the body or *soma*. Cuticle non-spinous and sometimes annulated. Suckers fairly large and not far apart in the anterior region ; the ventral sucker projecting only slightly from the surface of the body. Pharynx small. Oesophagus short. Intestinal caeca long and extending into the ecsoma or not, the bifurcation of the gut generally situated between the suckers. Testes round, side by side or tandem, generally not far behind the ventral sucker. Pars prostatica and seminal vesicle lying free in the parenchyma. Genital pore median and situated near the mouth, on the ventral surface. Genital atrium, tubular, receiving a hermaphodite duct which is muscular and functions like a cirrus being sometimes provided with a muscular pouch (or sinus sac) which is said to be " complete " when the muscles form a continuous layer and " incomplete " when they are discontinuous. Ovary globular and situated behind the testes, generally separated from them by folds of uterus. Receptaculum seminis present; Laurer's canal absent. Vitellaria comprising a pair of compact groups of follicles, sometimes lobed or occasionally thread like or tubular, generally situated behind the gonads. Uterus abundantly folded having descending and ascending limbs, entering the ecsoma or not. Excretory vesicle Y shaped, comprising a long median stem and long lateral canals which generally unite above the oral sucker. Eggs very numerous, thin-shelled and small, rarely exceeding 0·03 mm. in length. Cercaria of cystophorous type, generally penetrating a copepod.

VI. Subfamily Classification and Taxonomic Considerations.

Looss (1907 : 1908) limited the conception of the family of Lühe by excluding the genera *Derogenes* and *Accacoelium* and divided the family into four subfamilies and included the genera as given below :—

(1) Hemiurinae Lühe, 1901 : *Hemiurus* Rud., 1809 (*s. str.*) and *Aphanurus*.

(2) Dinurinae Looss, 1907 : *Dinurus* Looss, 1907 ; *Ectenurus* Looss, 1907 and *Lecithocaldium* Lühe, 1901.

(3) Sterrhurinae Looss, 1907 : *Sterrhurus* Looss, 1907 ; *Lecithochirium* Lühe, 1901 (*s. str.*) ; *Synaptobothrium* Linstow, 1904 (*nom. prov.*) ; *Pleurus* Looss, 1907 , and *Brachyphallus* Odhner, 1905.

(4) Lecithasterinae Odhner, 1905 ; *Lecithaster* Lühe, 1901 ; *Lecithophyllum* Odhner, 1905 and *Aponurus* Looss, 1907.

Odhner (1911) thinks that *Derogenes* is so closely related to Hemiuridae that it cannot be separated from it and consequently included it in the family along with *Genarches* and other Syncoeliinae and Accacoeliinae and *Hirudinella clavata* group. Nicoll (1913) agrees with Odhner and thus reduces Looss's conception of the family Hemiuridae to its subfamily status. He also includes his two new genera, *Hemipera* and *Derogenoides* under it. He (1915) included the subfamilies, Hemiurinae, Dinurinae, Sterrhurinae, Lecithasterinae, Syncoeliinae and Accacoiliinae under the family.

Poche (1926) also included the distomes of the genera, *Hysterolecitha, Macradena, Ophithadena, Brachadena, Dichadena, Leurodera, Dictysarca* and *Theletrum* (*nec. Theletrium*) of Linton (1910).

Fuhrmann (1928) observed the following subfamily and generic classification.—

(i) Sclerodistominae : *Sclerodistomum* Looss, *Eurycoelum* Brock, *Hirudenella* Garsin, *Isoparorchis* Southwell (syn. *Leptolecithurus* Kobayashi).

(ii) Derogenetinae : *Derogenes* Lühe, *Progonus* (nec. *Porogonus* Looss (syn. *Genarches* Looss), *Bunocotyle* Odhner, *Gonocerca* Manter, *Lecithophyllum* Odhner, *Genarchopsis* Ozaki and *Halipegus* Looss.

(iii) Hemiurinae : *Hemiurus* (syn. *Apoplema* Dujardin), *Aphanurus* Looss and *Brachyphallus* Odhner.

(iv) Sterrhurinae : *Sterrhurus* Looss, *Lecithochirium* Lühe, (syn. *Synaptobothrium* Linstow) and *Plerurus* Looss.

(v) Lecithasterinae : *Lecithaster* Lühe, *Aponurus* Looss.

(vi) Dinurinae : *Dinurus* Looss, *Ectenurus* Looss and *Lecithocladium* Lühe.

He has given the isolated (imperfectly known) genera as listed by Poche (1926) and also recognised the following two families with the genera listed under them, some of which were considered before under Hemiuridae.

1. Syncoeliidae Odhner : *Syncoelium* Looss, *Otiotrema* Setti, *Derogenoides* Nicoll, *Hemipera* Nicoll, *Liopyge* Looss (=*Liocera* Looss), *Genolina* Manter, *Bathycotyle* Darr. and *Pronoprymna* Poche.
2. Accacoeliidae (Looss) Odhner : *Accacoelium* Monticelli, *Orophocotyle* Looss, *Tetrochetos* Looss, *Rhynchopharynx* Odhner, *Accacladocoelium* Odhner and *Accacladium* Odhner.

Manter (1931) included the genus *Hysterolecitha* Linton, 1910, under the subfamily *Sterrhurinae* and *Brachadena* Linton, 1910 under the subfamily Lecithasterinae.

Lloyd (1938) does not agree with Fuhrmann (1928) in including *Genolina* Manter and *Derogenoides* Nicoll in Syncoeliidae. He puts them under Hemiuridae. He puts the various genera included by him in the family, under subfamilies as ; *Odhnerium* (Accacoelinae) ; *Syncoelium* (Syncoelinae) ; *Lecithaster* (Lecithasterinae) ; *Lecithocladium* (Sterrhurinae) ; *Hemiurus, Parahemiurus, Brachyphallus* (Hemiurinae), *Derogenes* and *Genolina* (Derogenetinae). The genus *Brachyphallus* is regarded as intermediate in between *Hemiurinae and Sterrhurinae.*

Pigulewsky (1938) while revising the genus *Lecithaster* Lühe (1901) in the Livro Jubilar Volume Do Professor Lauro Travassos (Brazil) has generally followed the classification of Looss (1907) and Fuhrmann (1928). He has put his new genera *Lecithurus* under Sterrhurinae and *Mordvlkoviaster* under Lecithasterinae.

Dawes (1946) generally deals with British and other European forms.

Amongst recent workers, who have dealt with the group rather extensively mention may be made especially of Manter (1934 : 1940 : 1947), Yamaguti, Rankin, Srivastava, Chauhan and many others.

The family contains representatives of many of the most common marine trematods. The typical members of the family are those forms with a " tail appendage " or ecsoma. The family consists, at present, of a very large assemblage of variable groups, representing many subfamilies and genera. It has therefore become so large as to be very difficult to be dealt with adequately.

The division of the family into subfamilies is based mostly on characters like presence or absence of ecsoma ; nature of vitellaria, paired or single, compact, lobed, unlobed or finger-like ; presence or absence of lip like process, over-hanging the mouth ; presence or absence of cirrus pouch or cirrus sac (sinus sac of some authors) ; skin smooth or ringed ; testes pre or-post acetabular, etc.

Dawes (1946 : 1947) in his key to the subfamilies of the family Hemiuridae laid main stress on the character of the presence or absence of " ecsoma " He separated the three subfamilies Sterrhurinae, Dinurinae and Hemiurinae as having ecsoma and the subfamilies, Lecithasterinae, Derogenetinae and Syncoeliinae as without ecsoma. Though this is a very reasonable and strong basis it falls through when actually applied to the subfamily Hemiurinae, because this subfamily contains forms like *Aphanurus* which do not have any ecsoma. This difficulty could however be solved if the genus *Aphanurus* could be removed to some other subfamily which is without an ecsoma. The only possible subfamily which could be thought of in this connection is the subfamily Derogenetinae but on close observation it is found that the subfamily Derogenetinae differs fundamentally from the subfamily Hemiurinae, including both forms, like *Hemiurus* or *Aphanurus* ; in the absence of cirrus pouch and smooth cuticle, a character which as Manter (1934) observes " the presence of a ringed cuticula has been a fundamental subfamily character among the Hemiuridae ".

An immediate consideration of this point has been rendered necessary due to the description of two new forms by Srivastava (1941) as *Sterrhurus monolecithus* and *S. karachii.* Manter (1947, p. 344) rightly observes that " *S. monolecithus* Srivastava, 1941 seems to belong in the genus *Aphanurus* since the " very rudimentary tail visible only in fully extended individuals " is probably not an ecsoma but a temporary fold of body wall ; the vitelline mass is single ; the pars prostatica long ; and the seminal vesicle posterior to the acetabulum ". He proposed the name *Aphanurus monolecithus* (Srivastava) n. comb. for the same. As regards *S. karachii* Srivastava 1941, Manter (1947, p. 343) states that

"*S. karachii* 1947 has unlobed vitellaria, a long pars prostatica, posterior seminal vesicle, and a "tail", too rudimentary to be recognised as an ecsoma. It probably belongs to the genus *Derogenes* or some other closely related genus" I am in agreement with Manter as far as the removal of this species from the genus *Sterrhurus* is concerned, because the Sterrhurinae have cuticle smooth and ecsoma well developed, whereas in *S. karachii* the cuticle has prominent transverse annulations all over and the "tail" is extremely rudimentary and the vitellaria are compact, paired bodies. But it is not possible to accomodate this species in any known genus, under any subfamily, as in the subfamily Derogenetinae, the cuticle is smooth, cirrus pouch absent and the tail wanting. This renders the systematic position of *S. karachii* very anomolous. Srivastava (1941) states that *S. karachii* resembles *S. monolecithus* in the position of acetabulum, the almost symmetrical position and size of the testes, the long pars prostatica and the extremely small tail. But it differs from the latter species in the relative positions of genital pore and the vesicula seminalis, in possessing two, compact, elongated, oval symmetrically placed vitelline masses and in marked differences in measurements. It will thus be seen that *S. karachii* has the closest relationship, with the species *S. monolecithus* which is now transferred to the genus *Aphanurus* in the subfamily Hemiurinae. Srivastava (1941), also observes that in the character of its vitellaria, *S. karachii* resembles *Sterrhurus profundus* Manter (1934) but I consider its resemblance is of no consequence, as *S. profundus* differs fundamentally from *S. karachii* in the smooth nature of cuticle. The peculiarity of this species (s. *karachii*) is that on one hand it resembles so closely *Aphanurus* spp., specially in relation to absence of tail, etc., but on the other hand, it resembles so closely *Hemiurus* spp., in the nature of vitellaria, etc. I therefore propose here to create a new genus, *Ahemiurus* with *Ahemiurus karachii* (Srivastava, 1941) as the type species. I further propose to amend the diagnosis of the subfamily Hemurinae to accomodate the genera, *Hemiurus* (Rud., 1802); *Anahemiurus* Manter, 1947 and create a new subfamily, Ahemiurinae to accomodate the genera *Ahemiurus* and *Aphanurus*. This scheme of classification also fully satisfies Dawes' basis of the separation of subfamilies of the family *Hemiuridae*, on the presence or absence of ecsoma.

The two genera, *Anahemiurus* Manter, 1947 and *Dinosoma* Manter, 1934 are really very interesting. The genus *Anahemiurus* as the author points out and its very name suggests, is a close relation of the genus *Hemiurus*, with certain resemblances to the genus *Dinosoma* Manter, 1934, (put under the subfamily *Sterrhurinae*). The greatest peculiarity of both these genera of Manter (1934 : 1947) is that unlike any of the known hermiurids, their cuticle is not either smooth or annulated but has large, conspicuous scales, not clearly arranged in rows (*Anahemiurus*) and transverse rows of scales except at the extreme tip (ventral scales of forebody often large and irregular in shape—*Dinosoma*). Manter thinks that the armature of *Dinosoma* is suggestive of the *Dinurinae*, indicating a stage where the body rings of *Dinurus* tend to split into scales.

An alternate arrangement of these two genera, *Anahemiurus* and *Dinosoma* in the subfamily structure of the family, than to assign them provisionally, into the subfamilies Hemiurinae and Sterrhurinae respectively, would have been to create another new subfamily, *Dinosomainae* with *Dinosoma* as the type genus ; distinguish it from all the other subfamilies of the family by the character of presence of cuticular spines and assign the genera *Anahemiurus* and *Dinosoma* to it. This new subfamily would have obviously resembled most, the subfamily Hemiurinae and Sterrhurinae and would have occupied an intermediate position between the two, a sort of connecting link. In fact it would have differed from Hemiurinae and Sterrhurinae, mainly by this single character and therefore, the alternative to amend the subfamily diagnosis of the subfamilies Hemiurinae and Sterrhurinae to accommodate these two genera was preferred rather than to actually create this new subfamily and multiply the number of subfamilies in the family.

The genus *Dinosoma* may be considered as an intermediate form which shows similarities at least in external morphology, probably due to internal ecological factors, with the subfamily Hemiurinae through forms like *Ahemiurus* on one hand and with Sterrhurinae and the subfamily *Dinurinae* through forms like *Dinosoma* on the other. Manter (1934) states that the genus *Dinosoma* is much like *Adinosoma* Manter, 1947 except for the body scales and the irregular shape of the scales of the ventral surface of the forebody suggests, the irregular cuticular prolongations of *Dinurus barbatus*.

The subfamilies representatives of which have been recorded from the Indian region can be differentiated by means of the following key :—

Key to Subfamilies of Family HEMIURIDAE *Lühe, 1901.*—

1.	Ecsoma present	2
	Ecsoma absent	5
2.	Mouth over hung by a lip ; vitellaria with finger-like or longer lobes	3
	Mouth not over hung by a lip ; vitellaria compact or with only very slight lobes	*Hemiurinae.*
3.	Vitellaria small, with finger-like lobes	*Sterrhurinae.*
	Vitellaria with elongate tubular components ..	4.
4.	Testes pre-acetabular, cuticle unarmed	*Prosorchinae.*
	Testes post-acetabular, cuticle with plications.	*Dinurinae.*
5.	Body cuticle annulated	*Ahemiurinae*, **subfam. nov.**
	Body cuticle smooth	6.
6.	Vitellaria paired ..	*Derogenetinae.*
	Vitellaria unpaired	7.
7.	Vitellaria asterisk-like, generally seven-rayed ..	*Lecithasterinae.*
	Vitellaria with finely shaped, several, slender ramifications	*Sclerodistominae.*

(*a*) Subfamily *Hemiurinae* Lühe, 1901 ; *emend.*

The subfamily was created by Lühe (1901) to accommodate one of his two groups of the representives of the family into which he had divided it.

He included under it the genera *Hemiurus* (Rudolphi, 1802) and *Lecithocladium* Lühe, 1901. The subfamily is defined as follows :—

Subfamily diagnosis : *Hemiuridae* Lühe, 1901 ; with Family characters (*emend.*).

Very small to middle sized forms, with cuticle annulated, ringed or with many conspicuous scales, and with ecsoma. Mouth without the oral lip. Vitellaria paired as a rule compact, very slightly notched or lobed, sometimes 4 on one side and 3 on the other. Arms of excretory bladder on the oral sucker united. Vesicula seminalis single or divided into two parts, behind the ventral sucker. Pars Prostatica tubular, coiled or sinuous. Genital sinus, long, canal shaped, partially or along its entire length, surrounded by a muscular covering, like a 'cirrus beutel', the allied organ, cirrus shaped in form. Cirrus pouch cylindrical in shape. Genital atrium very much reduced. Genital opening close behind the oral opening.

Type genus—*Hemiurus* (Rud. 1802) *e.p.* Lühe, 1901
syn. *Apoblema* Duj.

Included in the Subfamily, at present, are the two genera : *Hemiurus* Lühe, 1901 and *Parahemiurus* Vaz. and Pereira, 1930. However, the validity of the genus *Parahemiurus* is disputed. The genus is distinguished from the genus *Hemiurus* only by divided nature of seminal vesicle. Linton (1910) while describing his new form as *Hemiurus merus* noted its muscular, undivided nature of vesicle, as differentiating it from *Hemiurus appendiculatus* and suggested that this character might be of generic value. Vaz. ard Pereira, in 1930, named the genus as *Parahemiurus* with *P. parahemiurus* from *Sardinella aurita* in Brazil as type. Manter (1934) ; Woolcok (1935) Dawes (1946) consider *Parahemiurus* a synonym of *Hemiurus* and thinks that the undivided seminal vesicle is inadequate as a character of generic distinction. Manter (1947, p. 335) states that the recognition of a genus on such a single character is perhaps more or less an arbitrary matter. He further observes that species of *Parahemiurus* have a seminal vesicle that is never bipartite and usually has thick muscular wall. He, himself, however further observes that some species of *Hemiurus* have a thick wall around the anterior portion of the seminal vesicle while the posterior portion corresponds to an external seminal vesicle.

In the collections I made in 1939, I obtained many forms with seminal vesicle, undivided, completely divided and partly divided. But it was rather difficult to separate them into two distinct groups, on the basis of this character only. As will be noted, the representatives of the subfamily Hemiurinae are forms with fairly well developed musculature. It therefore gave me an impression that the musculature of the forms, particularly near about this region was to a certain extent responsible for such an appearance, depending upon the extended or contracted nature of the preserved specimens. I am therefore inclined to regard the genus *Parahemiurus* as a synonym to the genus *Hemiurus*. Manter (1947) created a new genus, *Anahemiurus*. As the name will suggest, he regarded it as near *Hemiurus*. He states that the genus is like *Parahemiurus*

notably in the reproductive organs but differs in possessing scales rather than annular denticulations. In possessing scales, he states, it is like *Dinosoma* Manter, 1934 but differs in the shape of seminal vesicle, the pars prostatica and unlobed vitellaria. I have included the genus, *Anahemiurus* under the subfamily *Hemiurinae*. The genus *Dinosoma* will probably better fit under the subfamily *Sterrhurinae*, after necessary emendation of the subfamily diagnosis, as already discussed elsewhere, in this paper.

Key to Genera of Subfamily HEMIURINAE Lühe, 1901.

Body armed with cuticular annulations	*Hemiurus* (Rud., 1802).
Body armed with conspicuous scales	*Anahemiurus* Manter, 1947.

(*b*) Subfamily *Ahemiurinae*, **subfam. nov.**

Subfamily diagnosis : *Hemiuridae* Lühe, 1901 ; with Subfamily characters.

Body with cuticular plications, ecsoma absent or almost absent; ventral sucker at least twice as large as the oral sucker. Vesicula seminalis undivided Sinus sac not longer than the breadth of the acetabulum and ending in front of it. Vitellaria in form of two elongated, oval compact bodies or fused into a single mass, which may generally be deeply incisioned, but not as a rule lobed.

Type genus—*Ahemiurus*, **gen. nov.**

The subfamily contains, at present, two genera ; representatives of both of which have been recorded from the Indian region. They can be differentiated as follows.—

Key to Genera of Subfamily AHEMIURINAE, **subfam. nov.**

Pre-oral lip absent ; vitellaria of two sides, fused into a single reniform mass	*Aphanurus* Lühe, 1901.
Pre-oral lip prominent ; vitellaria two, elongated, oval and compact bodies	*Ahemiurus gen. nov.*

Genus **Aphanurus** Looss, 1907.

Generic diagnosis : *Ahemiurinae*, **subfam. nov.** ; with Subfamily characters.

Very small forms, with distinctly and completely annulated cuticle pronounced more sharply posteriorly; Pre-oral lip absent and lack of an ecsoma. Ventral sucker at least twice as large as the oral. Vesicula seminalis simple and undivided, into two parts as in *Hemiurus*. Sinus sac never longer than the breadth of the ventral sucker and ending far in front of it, when the body is extended. Vitellaria of the two sides fused into a single compact mass, which may generally be deeply incised but not as a rule lobed, situated immediately behind the ovary, transversely elongate or reniform.

Type species—*Aphanurus stossichii* (Monticelli, (1891) ; Looss, 1907 ; from the stomach and oesophagus of *Clupea pilchardus* and *Clupea aurita* Neapel (Naples).

syns. *Apoblema stossichii* Monticelli, 1891.
Aphanurus virgula Looss, 1907.

Key to Indian Species of Genus APHANURUS Looss, 1907.

Acetabulum situated very near the anterior sucker ; ovary situated in the second third of body, just below equator ; Vesicula seminalis bigger than ventral sucker or vitellarium ; ductus hermaphroditicus, extending posteriorly upto posterior end of pharynx only	*A. microrchis.*
Acetabulum situated just in front of the second quarter of body length ; ovary lying more posteriorly, in the last third of body length ; vesicula seminalis smaller than ventral sucker or vitellarium mass ; ductus hermaphroditicus ; extending much beyond the posterior end of pharynx	*A. stossichii.*

1 **Aphanurus microrchis** Chauhan, 1945.

(Text fig. 1.)

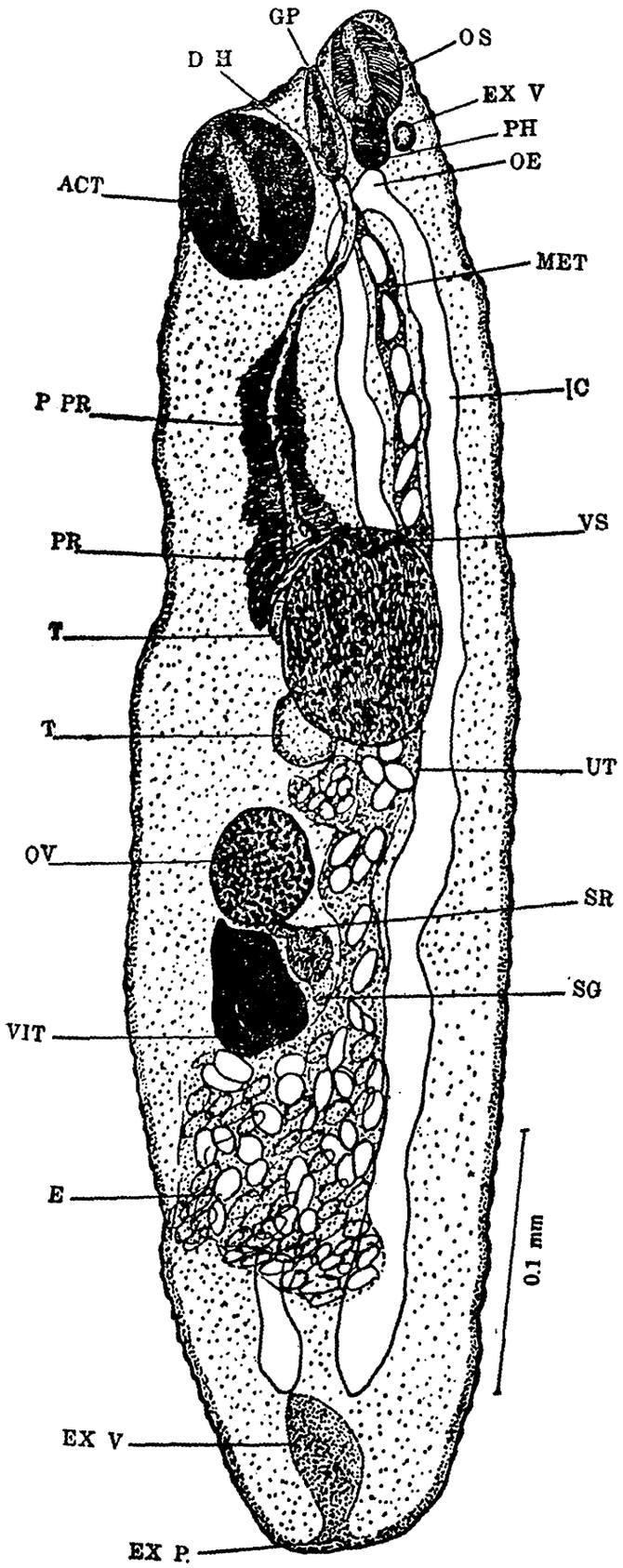
Yamaguti, S. (1952). *Acta Medicinae Okayama*, **8** (2) : 182.

Specific diagnosis : *Aphanurus* Lühe, 1901 ; with Generic characters

Very minute and transparent forms. Body elongately oval, anterior end pointed, posterior broad, measuring 0·58* length and 0·144 width, maximum in the region of vitellaria. Cuticle completely annular and presenting the appearance, in well extended forms, as if beset with minute spines. Oral sucker oval in shape, terminal. Pharynx elongate, muscular and compact. Oesophagus small. Intestinal crura extend almost to the posterior end. Ventral sucker large, more than twice the oral sucker and oval, situated very close to anterior one, measuring 0·063×0·05. Testes two, small, spherical, situated one behind the other, immediately anterior to middle of body. Vesicula seminalis situated in the region of testis, spherical and very large, measuring 0·081×0·062. Pars prostatica not well developed, the duct is sinuous. Prostate gland cells well developed. Ductus hermaphroditicus a short, thick, conical sac, situated in between the two suckers ; smaller than the diameter of ventral sucker, with its end not reaching beyond the middle of the latter, measuring 0·041×0·013. Genital pore situated ventrally, near the oral sucker. Ovary round and post-testicular, measuring 0·044×0·039. Receptaculum seminis and shell gland present. Vitellaria typical of the genus, a single compact mass, being made up of right and left vitellarium fused together, situated immediately behind the ovary but not broader, measuring 0·05×0·037 (maximum width). Uterus partly intercaecal, mostly post-ovarian in extent. Metraterm opens into the ductus hermaphroditicus. Excretory vesicle massive, post caecal. Excretory pore terminal. Eggs large, oval, measuring 0·018×0·009 (average).

The species is distinguished by the characters of relative size and position of two suckers, size and extent of ductus hermaphroditicus, particularly in regard to ventral sucker ; position of testes, being not behind the vesicula seminalis, relative size of vesicula seminalis, ovary and vitellaria. Cuticle in fully extended specimens beset with minute what

* All measurements in this paper are given in millimetres.



TEXT-FIG. 1.—*Aphanurus microrchis ;* lateral view.

Act., Acetabulum ; *DH.*, Duct hermaphroditicus ; *E.*, Egg ; *Ex P.*, Excretory pore ; *Ex V.*, Excretory vessel ; *GP.*, Genital pore ; *IC.*, Intestinal crura ; *MET.*, Metraterm ; *OE.*, Oesophagus ; *OS.*, Oral sucker ; *OV.* Ovary ; *PH.*, Pharynx ; *P.*, *PR.*, Pars prostatica ; *PR.*, Prostrate gland cells ; *SG.*, Shell gland ; *SR.*, Receptaculum seminis ; *T.*, Testis ; *UT.*, Uterus ; *VII.*, Vitellarium.. *VS.*, Vesicula seminalis (after Chauhan).

appear like cuticular spines; prostate gland cells developed comparatively massively but do not extend all along the sinuous duct and the eggs are larger.

Yamaguti (1952) adds a new species, *Aphanurus caesionis* to the genus. He (1952, p. 183) states that his species differs from the most closely related, *Aphanurus harengulae* Yamaguti, 1938 and *A. microrchis* Chauhan 1945, chiefly in the vesicula seminalis being sub-cylindrical and strongly muscular, in the prostatic cells surrounding the whole length of the well differentiated pars prostatica, and in the complete absence of cuticular denticulations.

Host.—*Mugil parsia.*

Location.—Alimentary Canal.

Locality.—West Coast of India, Bombay.

2. **Aphanurus stossichi** (Monticelli, 1891) Looss, 1907.

syns. *Sterrhurus monolecithus* Srivastava, 1941.

Aphanurus monolecithus (Srivastava, 1941) Manter, 1947.

(Text-fig. 2.)

Manter, H. W. (1947). *Amer. Midl. Nat.* **38** (2) : **344.**

Yamaguti, S. (1953) *Acta medicinae okayama 8* (3) : 274.

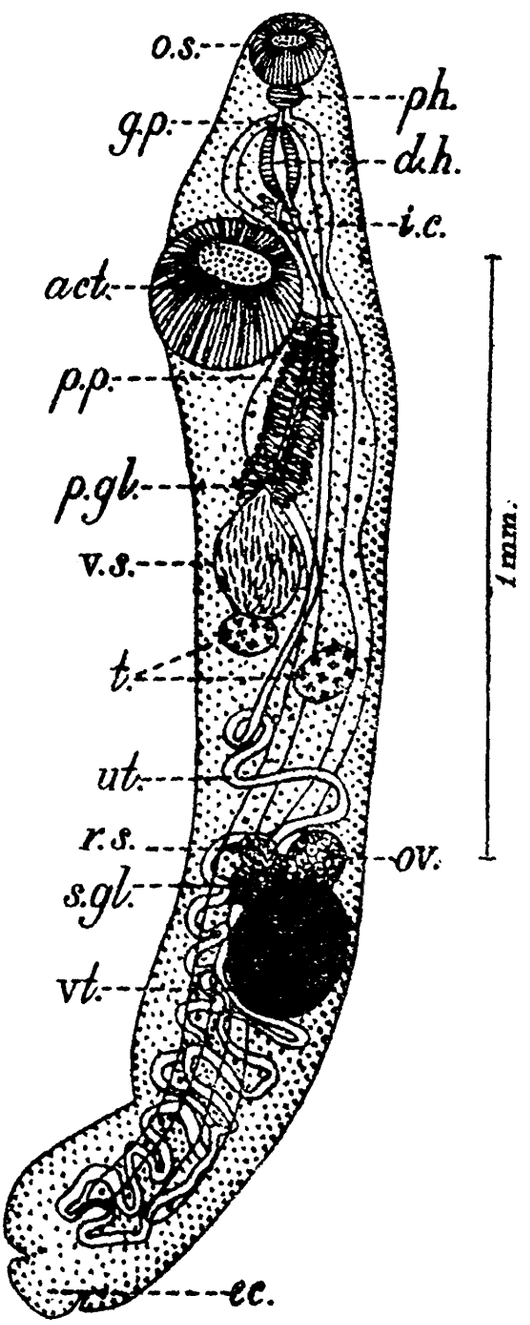
Srivastava (1941) described this species as *Sterrhurus monolecithus.* Manter (1947, p. 344), transfers the species to the genus *Aphanurus.* He observes " *S. monolecithus* Srivastava, seems to belong to the genus *Aphanurus* since the " very rudimentary tail visible only in fully extended individuals " is probably not an ecsoma but a temporary fold of the body wall. The vitelline mass is single; the pars prostatica long; and the seminal vesicle posterior to the acetabulum" He therefore proposed the new combination, *Aphanurus monolecithus* (Srivastava, 1941). However, I am inclined to consider *A. monolecithus* a synonym of *A. stossichi*, the type species.

In the specimens obtained by me also in 1945, a rather granular mass was observed in the posterior part of the worm which presented the appearance of a rudimentary retracted tail appendage or ecsoma but on close examination was found to be excretory vesicle, rather bulbose in shape. Dawes (1946) states that Looss also first mistook such a structure as a small ecsoma but later came to regard it, as an artefact, perhaps a local constriction of the integument posteriorly.

Specific diagnosis : *Aphanurus* Lühe, 1901; with Generic characters.

Worms light brown in colour; body elongate, with nearly uniform breadth, maximum 0·38 at the level of acetabulum, feebly muscular; shape nearly cylindrical. Deep transverse cuticular annulations present all over body. Tail (ecsoma) very rudimentary, visible only in fully extended specimens. Length 2·4, including a small tail, measuring 0·1×0·16. Oral sucker anteriorly directed, transversely oval, 0·09×0·12. A small preoral lip present. Prepharynx and oesophagus extremely rudimentary. Pharynx small and spherical. Intestinal crura long,

narrow, somewhat sinuous, never extending into ecsoma region. Acetabulum well developed, spherical, 0·26 in diameter, situated just in front of the second quarter of body length. Testes paired, small, oval or spherical, nearly equal, situated somewhat asymmetrically, at about the equator of body, right slightly anterior. Vesicula seminalis fairly large pear-shaped, thin walled, 0·2×0·16, situated just in front of anterior



Text-fig. 2.—*Aphanurus stossichi*; ventral view.

act., Acetabulum; *d.h.*, Ductus hermophroditicus; *e.c.*, Ecsoma; *g.p.*, Genital pore *i.c.*, Intestinal crus; *ov.*, Ovary; *o.s.*, Oral sucker; *ph.*, Pharynx; *p.gl.*, Prostate gland; *p.p.*, Pars prostatica; *r.s.*, Receptaculum seminis; *s.gl*, Shell gland; *t.*, Testes *ut.*, Uterus; *vt.*, Vitellarium; *v.s.*, Vesicula seminalis (after Srivastava).

estis. Pars prostatica long, tubular, more or less straight, intercaecal, surrounded by numerous prostate glands. Ductus hermaphroditicus small, starts a little in front of acetabulum, enclosed in a small spindle shaped muscular, hermaphroditic sac, 0·1×0·04. Genital pore ventral, situated at the level of intestinal bifurcation. Ovary small, 0·1×0·8,

situated in front of and slightly overlapping the vitellarium. Vitellarium single, large, ovoid, 0·24×0·18, situated at the base of third quarter of body. Receptaculum seminis present in some specimens, small, bull-shaped, situated at the angle between ovary and vitellarium, near shell-gland. Uterus post testicular, never entering ecsoma. Excretory bladder Y-shaped, main stem bifurcating just behind acetabulum into two lateral cornua, which unite dorsally to oral sucker. (after description of Srivastava)

Srivastava regarded the species unique in having an extremey rudimentary tail and a single compact vitelline mass.

Host.—*Clupea ilisha.*

Habitat.—Stomach.

Locality.—Allahabad, Puri and Karachi (Pakistan).

Distribution.—Recorded to be a very common parasite of the stomach of the Indian migratory fish, *Clupea ilisha*, during winter months, when about ninety per cent hosts were found to labour them. It represents probably the most common trematode infecting Indian fishes, though the infestation was never found to be very heavy, the maximum number found at Allahabad being nineteen.

(ii) Genus **Ahemiurus, gen. nov.**

Generic diagnosis : *Ahemiurinae*, **sub-fam. nov.**; with Subfamily characters.

Rather small forms, with prominent pre-oral dorsal lip; ecsoma extremely rudimentary or absent. Cuticle with prominent transverse annulations all over. Testes small, spherical situated just behind first half of body. Vesicula seminalis pear-shaped. Pars prostatica long, narrow, surrounded by a large number of prostate cells. Ductus hermaphroditicus spindle shaped, enclosed in a hermaphroditic sac. Genital pore situated at level of pharynx. Vitellaria composed of two elongated, oval, compct masses, situated symmetrically; uterus post-acetabular, intercaecal. Excretory vessel Y-shaped. Eggs small.

Type species—*A. karachii* (Srivastava, 1941), **n. comb.**

3. **Ahemiurus karachii** (Srivastava, 1941), **n. comb.**

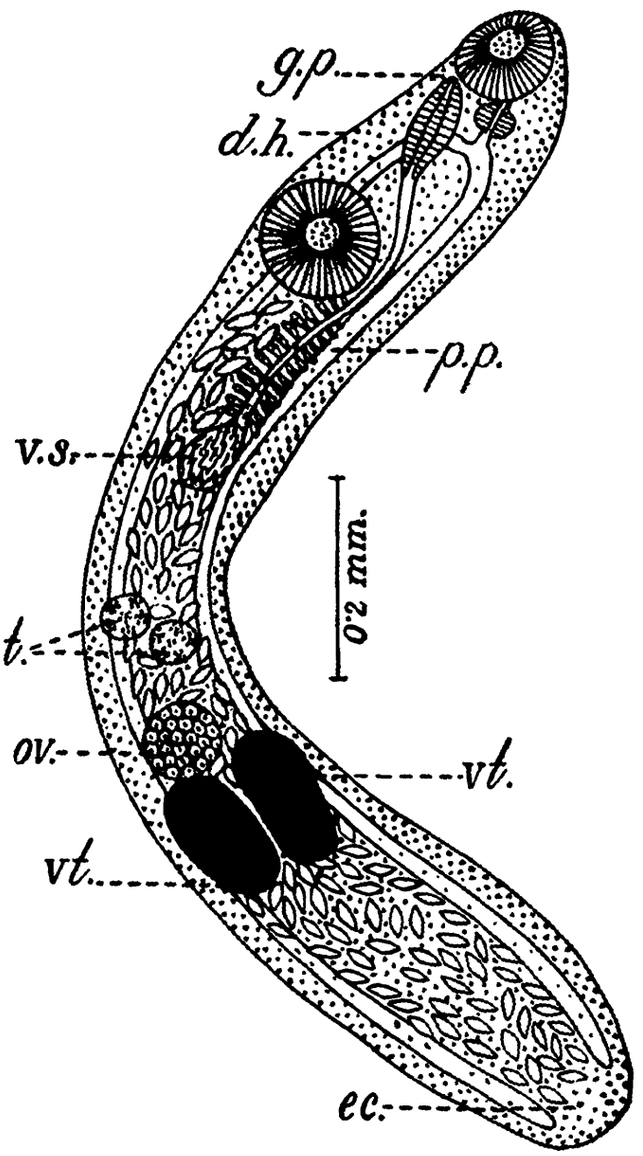
(Text—Fig. 3)

Manter, H. W. (1947). *Amer Midl. Nat.* 38 (2) : 343.

Specific diagnosis : *Ahemiurus*, **gen. nov.**; with Generic characters.

Body elongated, cylindrical, narrow, of nearly uniform breadth throughout; with prominent transverse annulation all over, 1·4×0·2 (maximum). Ecsoma extremely rudimentary. Oral sucker subterminal, spherical, 0·08 (diameter). Oral lip prominent. Prepharynx absent. Pharynx small. Oesophagus present. Intestinal crura long, narrow, tubes extending upto posterior end, never extending into tail. Acetabulum spherical, situated at the end of first quarter of body, 0·15 (diameter). Testes small, spherical, equal, 0·06 (diameter), situated symmetrically just behind the first half of body. Vesicula seminalis pear-shaped, thin-walled sac, slightly bigger than testes, situated medially, a short distance, in front of testes. Pars prostatica long, narrow, surrounded by large number of prostate gland cells. Ductus hermaphroditicus spindle-shaped, enclosed in a hermaphroditic sac. Genital pore at level of anterior

margin of pharynx. Ovary situated just in front of vitellaria, 0·06—0·08. Vitellaria a pair of elongated, oval, compact bodies, situated symmetrically at the junction of last two-third of body. Uterus occupies whole of intercaecal space, between ventral sucker. Excretory bladder as in *Aphanurus monolecithus* (Srivastava), Y-shaped, main stem bifurcating behind acetabulum ; two crura uniting dorsally to oral sucker. Eggs numerous, operculate, 0·015—0·019×0·08.



Text-fig. 3.—*Ahemiurus karachii* ; ventral view.

d.h., Ductus hermaphroditicus ; *ec.*, Ecsoma ; *g.p.*, Genital pore ; *ov.*, ovary ; *p.p.*; Pars prostatica ; *t.*, Testes ; *vt.*, Vitellarium ; *v.s.*, Vesicula seminalis (after Srivastava).

Srivastava (1941) states that in the position of acetabulum, the almost symmetrical position and size of testes, long pars prostatica and rudimentary tail the species resembles *A. monolecithus*, but differs from it in the relative positions of genital pore and vesicula seminalis, in possessing two compact, elongated, oval, symmetrically placed vitelline masses and in marked differences in measurements.

Manter (1947 ; p. 343) states that " *S. karachii* Srivastava, 1941 has unlobed vitellaria, a long pars prostatica, posterior semirial vesicle, and a " tail " too rudimentary to be recognised as an ecsoma. It probably belongs in the genus *Derogenes* or some closely related genus ".

I have discussed, in detail, on p. 298 of this paper the present position of the species.

Host.—*Clupea longiceps.*

Location.—Stomach.

Locality.—Arabian sea, Karachi (Pakistan).

(*c*) Subfamily *STERRHURINAE* Looss, 1907 ; *emend.*

syn. *Lecithochirinae* Lühe, 1901.

Subfamily diagnosis : *Hemiuridae* Lühe, 1901 ; with Family characters.

Small to medium sized hemiurids, with thick body and small tail or ecsoma ; soma thicker and ' abdomen ' or ecsoma relatively thinner. Cuticle smooth, without transverse striations or with transverse rows of cuticular scales, irregularly placed, ventrally, in forebody. The space between the two suckers is curved ventrally and just before the ventral sucker, is intervened by a more or less deep transverse slit—presomatic pit. Oral sucker dorsal with or without a distinct, well-developed lip above it. The arms or crura of excretory bladder, in the anterior region united. Genital pore very much behind the mouth, in the neighbourhood of ventral sucker. Ventral sucker very much muscular. Genital atrium small. ' Cirrus beutel ' pear-shaped or small, cylindrical in form, not always enclosed by muscle fibres, though they may exist. Vesicula seminalis situated before ventral sucker, curved, S-shaped with thick sac-shaped end division. Pars prostatica small. Prostatic cells free in parenchyma. Metraterm well developed and relatively long. Vitellaria small, hand shaped or with finger-like lobes.

Type genus—*Sterrhurus* Looss, 1907

Key to Indian Genera of Subfamily STERRHURINAE.

Pre-somatic pit—an invagination in front of ventral sucker—present .. .. *Lecithochirium.*

Pre-somatic pit absent .. .. .. *Sterrhurus.*

(i) Genus **Sterrhurus** Looss, 1907.

Generic diagnosis : *Sterrhurinae* Looss, 1907 ; with Subfamily characters.

Body smooth, ecsoma present. Oral sucker without definite position and musculature, with inconspicuous lips. Ventral, pre-somatic pit absent. Testes diagonal or asymmetrical, preovarian. Seminal vesicle thin-walled, not extending posterior to acetabulum. Cirrus sac present, well developed, muscular, short, pyriform, cylindrical, sphirical or pear-shaped, surrounding externally the ductus hermaphroditicus, consisting of the metraterm end and short ductus ejaculatorius, which is in the form of a hollow, dilated, bladder-shaped space extended over in the posterior part of the cirrus sac. Pars prostatica short, external, situated immediately posterior to cirrus sac, its opening lying internally at some distance into the vesicle of ductus ejaculatorius. Seminal receptacle small or absent. Vitellaria lobed, lobes may be short, cylindrical or finger-like. Eggs few, large, bulged out and longer than broad.

Type species—*S. musculus* Looss, 1907; from *Anguilla vulgaris* and *Dentex vulgaris.*

4. Sterrhurus sihamai Srivastava, 1937 ; *nomen nudum.*

This species was created by Srivastava in a paper read before the Indian Science Congress, in 1937 as per Proceedings of the Indian Science Congress (Abstracts), along with other two species of the genus, described as *Sterrhurus monolecithus* and *S. karachii* from the stomach of two marine and one migratory fish, *Clupea ilisha,* at Allahabad and Puri. While full description of the latter two has already been published by the above author in 1941, full description and details of this form are still awaited.

Srivastava (1937) observed that in its affinities *S. sihamai* stood nearest to *S. inimici* but differed from the latter in comparatively much smaller length of its tail, besides differences in the size and positions of its various organs. A key to the species and an amended diagnosis of the genus are also recorded to have been included in the paper.

(ii) Genus **Lecithochirium** Lühe, 1901.

syns. *Jajonetta* Jones, 1933.
Ceratrotrema Jones, 1933.

Looss (1908) give diagnostic characters of the genus and distinguished it from *Sterrhurus* on the basis of the presence of two muscular, lateral elevations extending into the lumen on the inner surface of the oral sucker, the presence of a pre-acetabular pit and highly muscular pre-oral lip. Lloyd (1938) and Manter (1934 ; 1947) showed that they are not invariably present and Manter regarded the presence of the presomatic pit as the best diagnostic character, as also Chauhan (1945, p. 164). Manter (1947) regards that the oral elevations or arches constitute a specific rather than a generic character. Jones (1943) concluded that all of the characters, proposed to separate the two genera, occur in varying degree and seem to be features of no more than specific value. Crowcroft (1946) redefined the genera on the basis of the character of the " prostatic vesicle " or the swelling of the male tube in the basal portion of the sinus sac. This character Manter (1947) thinks is not always correlated with the presence of the pre-acetabular pit and he based his revision of the genus chiefly on the presence or absence of pre-acetabular pit ; the other possible characters of generic importance being the loose or open nature of the sinus sac or the character of the male vesicle within the sac.

Generic diagnosis : *Sterrhurinae* Looss, 1907 ; with Subfamily characters (s. str. Lühe, 1901)

Distinguished essentially from *Sterrhurus* through the configuration of bed-head. There are present two pad shaped thickenings from the sides, ventrally, in the lumen of the oral sucker. Lips well developed, broad and square, extending anteriorly. Ventral or presomatic pit surrounded by cells present. Cirrus sac pear-shaped, similar to as in *Sterrhurus.* Vitellaria separate, hand shaped, split up with notches. Their bases thick, connected and towards the ends spreading out. They are often so thick and close to one another that they are seen in a way compact with deeply notched borders.

Type species—*L. rufoviride* (Rudolphi, 1819) Lühe, 1901.

Key to Indian Species of Genus Lecithochirium Lühe, 1901.

Intestinal caecum and uterine coils extending into the ecsoma ; ovary and vitellaria situated in the posterior part of the last third of the body	*L. polynemi.*

Intestinal caecum and uterine coils not extending into the ecsoma; ovary and vitellaria situated just posterior to middle of body in the anterior, second third of body .. .. .. *L. acutum.*

5. **Lecithochirium polynemi,** *nom. nov.*

(Text-fig. 4.)

syn. *Lecithochirium polynemus* Chauhan, 1945,
(*nec. Lecithochirium polynemous* Chauhan, 1945).

Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2) : **338.**
Yamaguti, S. (1953). *Acta Medicinae Okayama.* **8** (3) : 278.

Specific diagnosis : *Lecithochirium* Lühe, 1901 ; with Generic characters.

Body with ecsoma, elongate, tapering at both ends, 7·53×1·1 (maximum), cuticle smooth. Presomatic pit present. Vesicula seminalis tripartite. Ecsoma retractile, about one third body length. Oral sucker oval, subterminal. Pharynx small, compact, muscular and round. Oesophagus very small. Two sinuous crura of intestine extend into ecsoma, upto nearly posterior end. Ventral sucker situated in the middle of first half of soma. Testes two, elongately oval, tandem, post-acetabular, situated in the middle of body. Vesicula seminalis entirely pre-acetabular, a curved broad sac, tapering anteriorly, divided into three unequal parts, anterior portion, continued into the small and rounded genital sinus, through a long and thin, S-shaped duct. Genital pouch surrounded by glandular pars prostatica. Genital pore situated immediately below the bifurcation of the intestine. Ovary spherical, post-acetabular in the last quarter of body. Receptaculum seminis present. Vitellaria situated immediately behind ovary, in two groups ; the right mass having three thick lobes on the outerside and the left four ; their shape varying much. Uterine coils extend into the tail. Metraterm opens into genital sinus. Excretory vessel Y-shaped, with a dilatation in the posterior end ; excretory pore terminal. Eggs oval, 0·01×0·014 (average).

The species is characterised by the posterior extend of the intestinal caeca and uterus into ecsoma, disposition of uterine coils, relative position of gonads, the nature of male genital end ducts and extent of vesicula seminalis.

The specific name *L. polynemus* (*nec. L. polynemous*) is changed to a new name, *L. polynemi*, to confirm to International Rules of Nomenclature, as suggested by Manter (1947). The name, *L. polynemous* is obviously a typographical error.

Host.—*Polynemus indicus* (type) ; *Mugil parsia.*

Location.—Intestine.

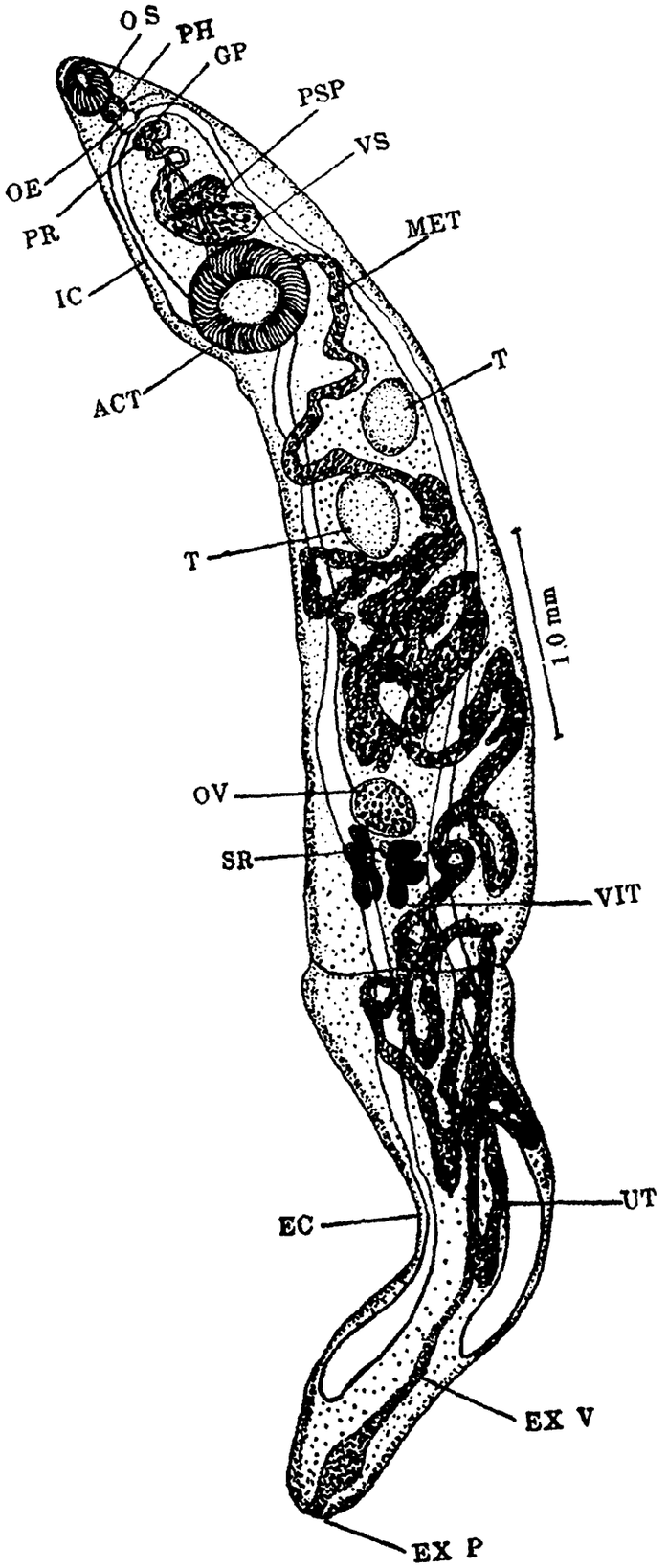
Locality.—West coast of India, Bombay.

6. **Lecithochirium acutum,** *nom. nov*

(Text-Fig. 5.)

syn. *Lecithochirium acutus* Chauhan, 1945.

Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2) : 338.
Yamaguti, S. (1953) *Acta Medicinae Okayama.* **8** (3). 277.



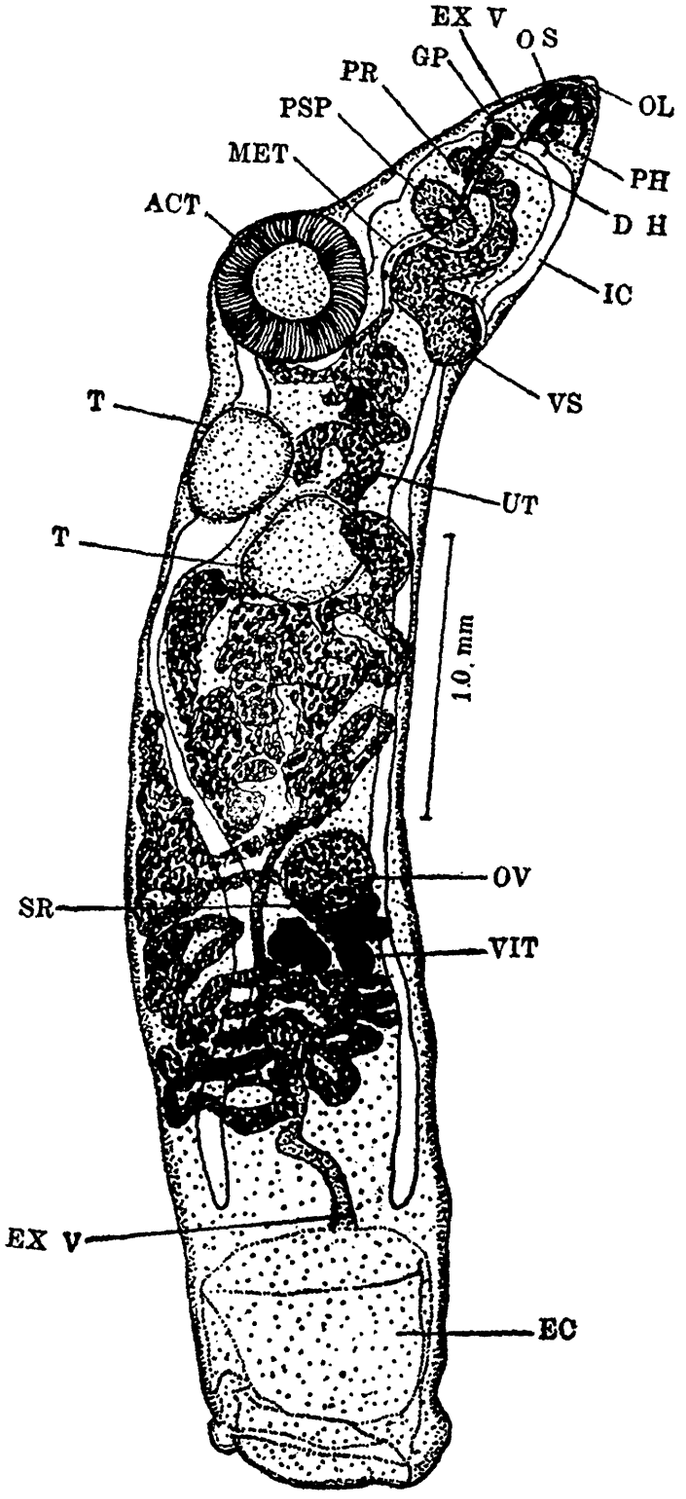
Text-fig. 4.—*Lecithochirium polynemi* ; ventral view.

ACT., Acetabulum ; *EC.*, Ecsoma ; *EXP.* Excretory pore ; *EXV.*, Excretory vessel ; *GP.*, Genital pore ; *IC.*, Intestinal canal; *MET.*, Metraterm ; *OE.*, Oesophagus ; *OS.*, Oral sucker ; *OV.*, Ovary ; *PH.*, Pharynx ; *PR.*, Prostate gland cells ; *PSP.*, Presomatic pit ; *SR.*, Resceptaculum seminis ; *T.*, Testis ; *UT.*, Uterus ; *VIT.*, Vitellaria ; *VS.*, Vesicula Seminalis (after Chauhan).

Specific diagnosis : *Lecithochirium* Lühe, 1901 ; with Generic characters.

Body elongate, anterior end above acetabulum, tapering anteriorly soma or body behind, with parallel sides. Ecsoma short. Cuticle smooth

Length, with ecsoma completely retracted, 5·4, width 1·0 (maximum)- Pre-oral lip dorsal, nipple shaped, small and flat. Presomatic pit, with well developed muscles fibres, transversely oval opening, situated slightly below the middle of the distance between genital opening and ventral sucker. Oral sucker subterminal, small, compact, round and muscular.



TEXT-FIG. 5.—*Lecithochirium acutum*; semi-lateral view.

ACT., Acetabulum; *DH.*, Ductus hemaphroditicus; *EC.*, Ecsoma; *EXV.*, Excretory vessel; *GP.*, Genital pore; *IC.*, Intestinal canal; *MET.*, Metraterm; *OL.*, Preoral lip; *OS.*, Oral sucker; *OV.*, Ovary; *PH.*, Pharynx; *PR.*, Prostate gland cells; *PSP.*, Presomatic pit; *SR.*, Receptaculum seminis; T, Testis; *UT.*, Uterus; *VIT.*, Vitellaria; *VS.*, Vesicula seminalis (after Chauhan).

Pharynx small. Oesophagus very small. Intestinal crura do not extend into ecsoma. Testes tandem, round, situated just behind acetabulum, in anterior third of body; anterior slightly bigger. Vesicula seminalis very massive, thick and tripartite sac, extending posterior to the anterior end of ventral sucker; anterior end long and thin, opening into genital sinus through a ductus hermaphroditicus and surrounded by pars prostatica gland cells, arranged all round the duct, in an oval mass. Ductus hermaphroditicus a small, hollow, muscular sinus. Genital pore situated on the left side of oesophagus, probably surrounded by a few muscle fibres. Ovary post-testicular, oval, slightly behind the middle of body. Receptaculum seminis small. Vitellaria situated immediately behind ovary in two groups, one group consisting of three thick closed finger-shaped lobes and the other usually with four lobes, on their outer sides. Uterine coils heavy. Metraterm opens into genital sinus. Excretory vessel Y shaped. Eggs elliptical, $0{\cdot}01 \times 0{\cdot}015$ (average).

The species is characterised by the peculiar shape of oral lip, the relative size and ration of two suckers, the size and position of testes and ovary, nature of genital sinus, position of pars prostatica and the nature and extent of massive, sinuous vesicula seminalis.

The specific name, *L. acutus* is changed to a new name, *L. acutum* to confirm to International Rules of Nomenclature as suggested by Manter (1947).

Manter (1947) states about these two species, that both species are very large in size, one (*L. acutum*) has a " nipple shaped " preoral lobe and both are described as having a seminal receptacle. These characters, he observes, suggest the genus *Ceratotrema* Jones, 1933 which genus, however, he considers a synonym of *Lecithochirium*, elsewhere in his paper.

Host.—*Arius fulcarius.*

Location.—Alimentary canal

Locality.—West coast of India, Bombay.

Four specimens of this species were obtained in February, 1948, from Ribbon fish, *Trichiurus* sp. (local name, Wakti or Bagi) Sasson docks, Bombay.

(*c*) Subfamily *Dinurinae* Looss, 1907.

The subfamily was created by Looss in 1907, for the genera, *Dinurus* Looss, 1907 (Type); *Ectenurus* Looss, 1907 and *Lecithocladium* Lühe, 1901. At present it includes many other genera.

Subfamily diagnosis : *Hemiuridae* Lühe, 1901 ; with Family characters.

Small to very large sized, very muscular forms, with well developed abdomen or ecsoma. Skin at the anterior end with cuticular annulations or rings, presenting laterally the appearance of saw-like dentitions. Oral sucker with one distinctly characteristic lip, extending anteriorly. The fork of excretory bladder is in between the two testes and ventral sucker ; the arms not uniting in the anterior region, but separate at the sides of the mouth aperture, terminating blindly. Genital pore close

behind the mouth opening. Genital atrium sinuous, also relatively long. Pars prostatica long, tubular but sac like and not at the base of vesicula seminalis but in it. Vesicula seminalis situated behind the ventral sucker, divided into three portions, one behind the other, with incomplete partitions. Cirrus sac, as typical in the family. Vitallaria in the shape of distinct, elongate, characteristic tubules.

Type genus—*Dinurus* Looss, 1907.

Key to Indian Genera of Subfamily DINURINAE Looss, 1907.

1. Cuticular plications or denticulations absent, ecsoma much longer than body and containing most of the intestinal caeca, uterus and parts of vitelline coils	*Stomachicola.*
Cuticular plications present	2.
2. Seminal vesicle tripartite	4.
Seminal vesicle undivided, oval, sac-like	3.
3. Seminal vesicle oval, compact, connected to sinus sac, through a long sinuous duct, only anterior half of which from the posterior margin of sinus sac, to the middle of acetabulum is surrounded by prostate gland cells. Crura of excretory bladder unite dorsal to oral sucker. Vitellaria consist of irregular elongated tubes ..	*Clupenurus.*
Seminal vesicle sac-like with thick muscular walls, prostatic gland cells along all or most of the long prostatic duct mostly confined only to the posterior part of the duct, pharynx strong and cylindrical; excretory crura do not unite; oral sucker funnel shaped; vitellaria consist of usually long tubes arranged side by side in two groups of four and three	*Lecithocladium.*
4. Prostatic gland cells arranged along all or most of the long pars prostatica, vitellaria consist of sinuous tubes. Ecsoma well developed	*Dinurus.*
A long portion of the prostatic duct without prostate gland cells. They are limited to the anterior portion of the prostatic duct. Vitelline ducts smaller. Ecsoma shorter	*Ectenurus.*

No species of the genus *Dinurus* Looss, 1907 has been recorded from the Indian region, so far. It has been included in the key just to give a proper idea of the genus *Ectenurus*.

Other genera considered under the sub family by Manter (1947) are—*Tubulovesicula* Yamaguti, 1934; *Magnacetabulum* Yamaguti, 1934; *Erilepturus* Woolcock, 1935; *Mecoderus* Manter, 1940; *Elytrophallus* Manter, 1940 and *Parectenurus* Manter, 1947.

(i) Genus **Ectenurus Looss, 1907.**

Generic diagnosis: *Dinurinae* Looss, 1907; with Subfamily characters.

Small forms; a close relative of the genus *Dinurus* with which it is stated by Looss (1907) to agree except that the prostatic gland cells were limited to the anterior portion of the prostatic duct and vitelline tubes were shorter. The ecsoma is not so much developed as in *Dinurus*. Cuticular plications are present, seminal vesicle tripartite and the excretory crura do not unite anteriorly.

Type species—*E. lepidus* Looss, 1907.

7. Ectenurus indicus Srivastava, 1937 ; *nomen nudum.*

Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2) : 348.

Srivastava, as recorded in an abstract of a paper supposed to have been read before the Indian Science Congress, in 1937 states that his proposed species, *E. indicus* was the commonest trematode infecting Indian marine fishes. Of all the valid species, his species is recorded to come nearest to *E. hamati* Yamaguti, 1934 specially in respect of its peculiar terminal part of the genital ducts. The important points of specific difference, it is stated, lie in the length of tail portion, testes, disposition and character of vitellaria and the posterior extent of uterine coils.

Manter (1947) holds that as *E. indicus* was not diagnosed in the abstract it is a *nomen nudum.*

(ii) Genus **Lecithocladium** Lühe, 1901.

Generic diagnosis : *Dinurinae* Looss, 1907 ; with Subfamily characters.

Medium to fairly large sized forms with a well developed abdomen or ecsoma ; skin with cuticular hemiurid " rings ". Oral sucker deep, funnel shaped, turned ventrally, with two lateral indentations and one median lip, a neck-hump (Nacken-buckel). Pharynx stout, long and cylindrical. The arms of the excretory bladder in the anterior part of body not united. Cirrus sac tubular, long but very small in width. Vesicula seminalis in the form of a spindle, with very thick muscle bands, not divided into three compartments. Prostatic gland cells along all or most of the long prostatic duct ; mostly confined only to the posterior part of the duct. Vitellaria in the shape of long, split up, convoluted lobes.

Type species—*L. excisum* (Rud. 1819) Lühe, 1901.

syn. *L. excisiforme* Cohn, 1902.

Key to Indian Species of Genus Lecithocladium Lühe, 1901.

1. Vesicula seminalis bulb-shaped or elongate, oval, thin walled ; cuticular annulations faint or absent ; oesophagus absent	2.
Vesicula seminalis spindle shaped, very thick walled. Cuticular annulations prominent ; oesophagus present	3.
2. Intestinal caeca do not estend into ecsoma ; cuticular annulations absent ecsoma broadly truncated ; uterine coils do not extend into the ecsoma, actually stop short before the end of soma or body	*L. brevicaudum.*
Cuticular annulations faint. Intestinal caeca extend into ecsoma, almost to the end ; ecsoma fairly well developed ; uterine coils extend slightly into the ecsoma	*L. herpodontis.*
3. Female genital organs, like Ovary, vitelline gland etc. situated at about the middle of body ; uterine coils extending only upto near the posterior end of body or soma. Number of vitellarian tubules seven ..	*L. annulatum.*

Female genital complex, ovary, vitellaria, etc. situated in the posterior third of body; ecsoma shorter ..	4.	
4. Female genital organs, ovary, vitellaria, receptaculum seminis, shell gland, etc., situated near the posterior end of soma or body; uterine coils extend into ecsoma; vitelline tubules, convoluted		*L. glandulum.*
Female genital organs, ovary, vitellaria, etc. situated in the third quarter of the body; ecsoma comparatively small, more or less truncated; vitelline tubules, in the shape of short, finger like, non-convoluted tubules ..		*L. carultum.*

Manter (1947) discusses the characters of the related genera of Dinurinae, *e.g.*, *Ectenurus*, *Dinurus*, *Lecithocladium*, etc., and lists species under them. While giving the list of species under the genus *Lecithocladium* he states that " Probably not all those species, *i.e.*, listed therein, belong to the genus and the last two named above, *viz.* (he means) *L. harpodontis* Srivastava, 1937 and *L. brevicaudum* Srivastava, 1937 lack cuticular plications and the excretory crura unite."

Srivastava (1937) did observe faint deticulations all over the body in the case of the former. Anyway, both these species do possess certain characters, which are so characteristic of the genus *Lecithocladium*, *e.g.*, seminal vesicle sac-like; prostate gland cells confined to the posterior portion of the prostatic duct; typical long, cylindrical, highly muscular pharynx; funnel-shaped oral sucker, with broken outline etc. that an alternative to place these species but under the genus *Lecithocladium* is not found very plausible. Probably re-examination of types or further study of topotypes may clarify and confirm this position.

8. Lecithocladium annulatum Chauhan, 1945.

(Text fig. 6.)

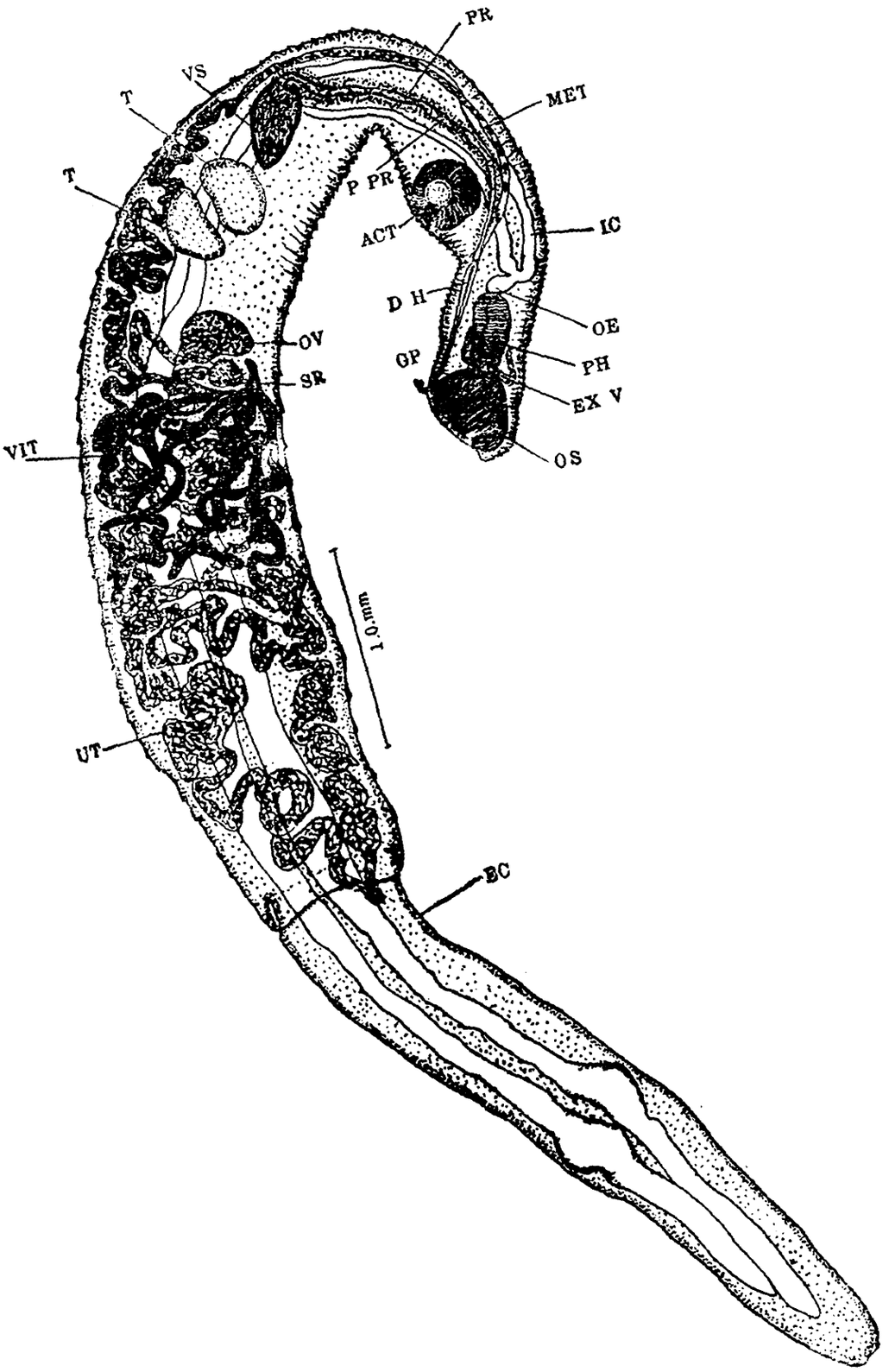
Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2): 349.

Yamaguti, S (1953). *Acta Medicinae Okayama* **8**(3): 280.

Specific diagnosis: *Lecithocladium* Lühe, 1901, with Generic characters.

Body cylindrical, with elongated tapering ends; cuticle of soma beset with strong, saw-like cuticular plications or rings with lateral dentitions more pronounced anteriorly; length 9·87, ecsoma 3·61. Oral sucker terminal, funnel-shaped, with a prominent dorsal lip. Pharynx elongate, cylindrical, with shape characteristic of the genus. Oesophagus short. Intestinal crura extend into ecsoma, almost upto the posterior end. Ventral sucker spherical, situated at about one-sixth body length, 0·35 (diameter). Testes one behind the other, just posterior to vesicula seminalis. Vesicula seminalis pear-shaped, with muscular walls, 0·25 × 0·425, situated at a distance of about one-third body length. Pars prostatica long, tubular, running a little anterior to acetabulum, surrounded by poorly developed prostatic gland cells. Ductus hermaphroditicus, a short tube, 0·7, extending only upto oesophagus. Genital pore situated on the antero-ventral margin of oral sucker, where the sucker has developed a groove. Ovary kidney shaped, 0·35 × 0·25, situated at about the middle of body. Receptaculum seminis present. Vitellaria consist of seven long filiform tubes, entirely post-ovarian, in two groups of four and three. Uterine coils mostly placed in the body behind ovary; Metraterm well developed. Eggs small, elliptical, 0·012 × 0·0048. Arms of the excretory vessel, in the " bed head " not united.

The species resembles most the species, *L. excisiforme forme* Cohn & *L. herpodontis*. It, however, differs from the former specially in regard to the position of ovary, nature of prostate gland cells, non-sinuous nature of



Text-fig. 6.—*Lecithocladium annulatum ;* semi-lateral view.

ACT., Acetabulum ; *DH.*, Ductus hermaphroditicus ; *EC.*, Ecsoma ; *EXV.*, Excretory vessel ; *GP.*, Genital pore ; *IC.*, Intestinal canal ; *MET.*, Metraterm ; *OE.*, Oesophagus ; *OS.*, Oral sucker ; *OV.*, Ovary ; *PH.*, Pharynx ; *P.PR.*, Pars prostatica *PR.*, Prostate gland cells ; *SR.*, Receptaculum seminis ; *T.*, Testis ; *UT.*, Uterus *VIT.*, Vitellaria ; *VS.*, Vesicula seminalis (after Chauhan).

sinus sac, disposition of uterine coils in the soma proper only, etc. It differs from *L. herpodontis*, in having the vesicula seminalis pear-shaped with muscular walls, strong annulation of the cuticle, presence of oesophagus and receptaculum seminis, number of vitelline tube, being only seven and not eight and the cirrus sac, being a short straight tube, not reaching upto acetabulum.

Host.—*Stromateus cinereus.*

Location.—Alimentary canal.

Locality.—West coast of India, Bombay.

9. Lecithocladium glandulum Chauhan, 1945.

(Text-fig. 7).

Manter, H. W. (1947) *Amer. Midl. Nat.* **38**(2) : 349.

Yamaguti, S. (1953) *Acta Medicinae Okayama.* **8**(3) : 281.

Specific diagnosis : *Lecithocladium* Lühe, 1901 ; with Generic characters.

Body short, elongate, spindle shaped, 3·62×0·51 (maximum) ; soma with cuticular annulations. Ecsoma short and stumpy, 1·12. A hump-like ' skin-spur ' with radially arranged muscle fibres termed ' Nackenbuckel ' by Rudolphi (1819) present. Oral sucker subterminal, funnel-shaped with a dorsal broad and prominent oral lip. Pharynx, strongly muscular, elongate and cylindrical. Oesophagus short. Intestinal crura extend into ecsoma, nearly upto the end. Ventral sucker spherical, situated slightly below one-third of body length, 0·2×0·225. Testes equal, tandem, round and separate, placed, in the posterior half of soma. Vesicula seminalis post-acetabular, elongately oval, with highly muscular walls. Pars prostatica tubular, long sinuous, running anterior to posterior end of acetabulum, along with metraterm. Prostate gland cells well-developed, extending nearly upto the middle of the acetabulum. Ductus hermaphroditicus, short, straight tube, lying in a sinus sac, extending posteriorly slightly below the shoulders of the intestinal caecum, running anteriorly on the right side of pharynx. Genital pore situated at the junction of oral sucker with pharynx. Ovary dome-shaped, situated in the last sixth of soma. Receptaculum seminis big. Shell gland spherical. Vitellaria consist of eight thick filiform, convoluted tubules in two groups of four each, posterior to vary, near the regions of conjunction of soma with ecsoma. Uterine coils, extend in ecsoma, upto two-third its length. Eggs elliptical, ·024×0·01 (average).

Host.—*Lutjanus johnii* (type) and *Mugil speigleri.*

Location.—Intestine.

Locality.—West coast of India, Bombay.

10. Lecithocladium carultum Chauhan, 1945.

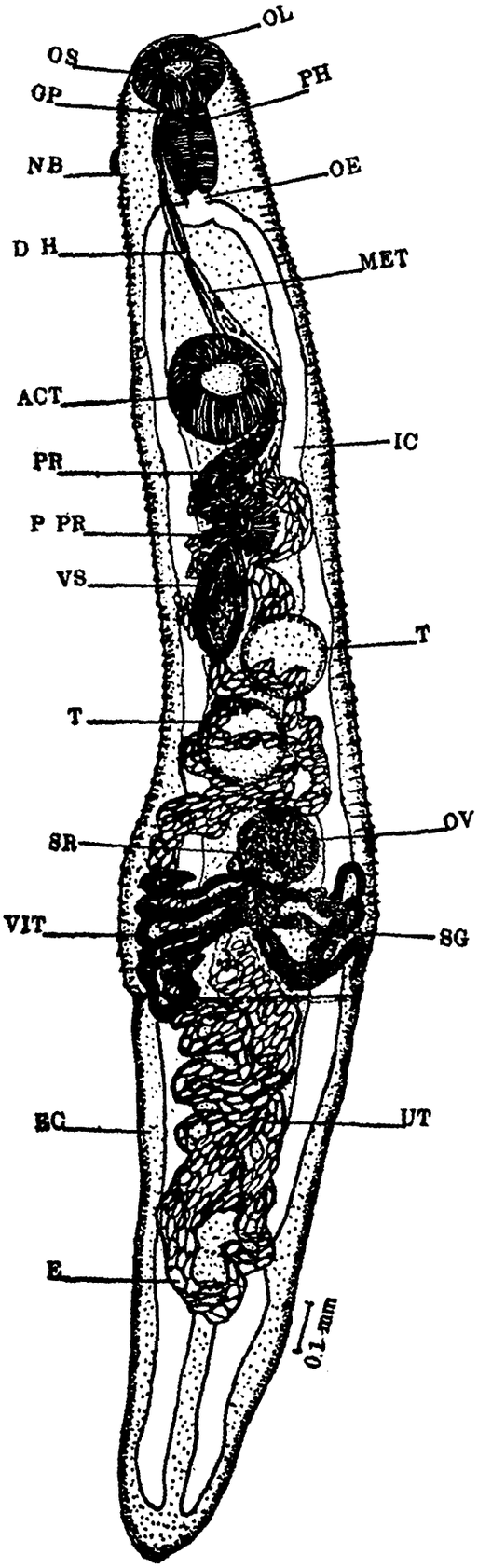
(Text-fig. 8).

Manter, H. W. (1947) *Amer. Midl. Nat.* **38**(2) : 349.

Specific diagnosis : *Lecithocladium* Lühe, 1901 ; with Generic characters.

Body truncated, 2·22×0·44 (maximum). Cuticle weakly annulated. Ecsoma short. Oral sucker subterminal, cup-like. Pre-oral lip dorsal, flat, crescent shaped. Pharynx elongate, cylindrical, highly muscular.

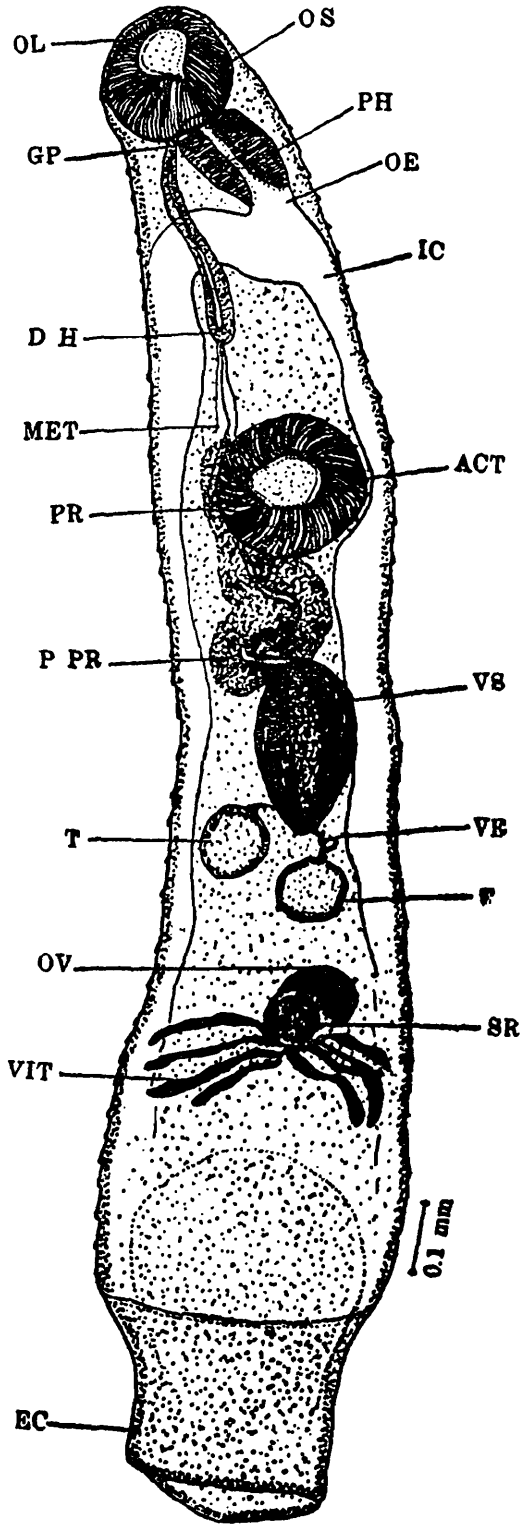
Oesophagus very short. Ventral sucker situated at one-third the soma length. Testes spherical, separate, tandem, lying near posterior to



Text-fig. 7.—*Lecithocladium glandulum* ; ventral view.

ACT., Acetaulum ; *DH.*, Ductus hermaphroditicus ; *E.*, *Egg.*, *EC.*, Ecsoma ; *GP.*, Genital pore ; *IC.*, Intestinal canal ; *MET.*, Metraterm ; *NB.*, Nacken-Buckel ; *OE.*, Oesophagus ; *OL.*, Oral lip ; *OS.*, Oral sucker ; *OV.*, Ovary ; *PH.*, Pharynx ; *P. PR.*, Pars prostatica ; *PR.*, Prostate gland cells ; *SG.*, Shell gland., *SR.*, Receptaculum seminis ; *T*; Testis ; *UT.*, Uterus ; *VIT.*, Vitellaria ; *VS.*, Vesicula seminalis (after Chauhan).

vesicula seminalis. Vesicula seminalis very big, pear-shaped, with highly muscular walls, 0·26×0·15, lying in the middle of body. Pars prosta-



TEXT-FIG. 8.—*Lecithocladium carultum*; ventral view.

ACT., Acetabulum; *DH.*, Ductus hermaphroditicus; *EC.*, Ecsoma; *GP.*, Genital pore; *IC.*, Intestinal crus; *MET.*, Metraterm; *OE.*, Oesophagus; *OL.*, Preoral lip; *OS*, Oral sucker; *OV.*, Ovary; *PH.*, Pharynx; *PPR.*, Pars prostatica; *PR.*, Prostate gland cells; *SR.*, Receptaculum seminis; *T.*, Testis., *VE.*, Vasa efferentia; *VIT.*, Vitellaria; *VS.*, Vesicula seminalis (after Chauhan).

tica tubular, long, sinuous, surrounded by prostate gland cells, only upto the anterior border of acetabulum. Ductus hermaphroditicus

comparatively long, broad and thick; originating about midway between ventral sucker and oesophagus, running by right side of pharynx. Genital pore situated on the posterior border of oral sucker. Ovary small, pear-shaped, situated in the last quarter of the soma. Receptaculum seminis large and round. Vitellaria thin, small, filiform tubes, eight in number, four on each side. Metraterm on the right side. Uterine coils not seen. Eggs elliptical, 0·018×0·006 (average).

Host.—*Sciaena carulta* (type) and *Harpodon nehereus.*

Location.—Alimentary canal.

Locality.—West coast of India, Bombay.

11. **Lecithocladium harpodontis** Srivastava, 1937 : *emend.*

(Text fig. 9)

syn. *L. harpodoni* Srivastava, 1937.

Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2) : 349.

Specific diagnosis : *Lecithocladium* Lühe, 1901 ; with Generic characters.

Body cylindrical, muscular, with faint denticulations all over, 5·26× 0·7 (maximum). Ecsoma narrow, 1·54. Oral sucker anteriorly directed, with a fringed ventral margin. Pharynx well developed. Oesophagus absent. Intestinal crura with prominent shoulders, extending into ecsoma. Acetabulum situated a little behind first quarter of body. Testes small, slightly unequal, lying in contact, one behind the other, at the end of first third of body. Vesicula seminalis bulb-shaped, 0·24×0·16, lying at the level of testes. Pars prostatica sinuous, tubular, surrounded by prostate gland cells. Hermaphroditic duct long, tubular, enclosed in a long, tubular hermaphroditic pouch. Genital pore situated at the antero-ventral margin of oral sucker, slightly to the left. Ovary small, transversally oval. Shell gland complex small, semicircular. Laurer's canal present. Receptaculum seminis absent; initial part of uterus acting as a receptaculum seminis uterium. Vitellaria consists of eight, narrow, coiled tubes. Uterine coils extend for a short distance in ecsoma. Excretory bladder Y shaped, the two lateral cornua uniting dorsally to oral sucker. Eggs numerous, operculate, 0·01×0·01.

Host.—*Chrysophrys datnia* Ham.

Habitat.—Stomach.

Locality.—Puri, Bay of Bengal.

12, **Lecithocladim brevicaudum** Srivastava, 1937 ; *emend.*

(Text-fig. 10).

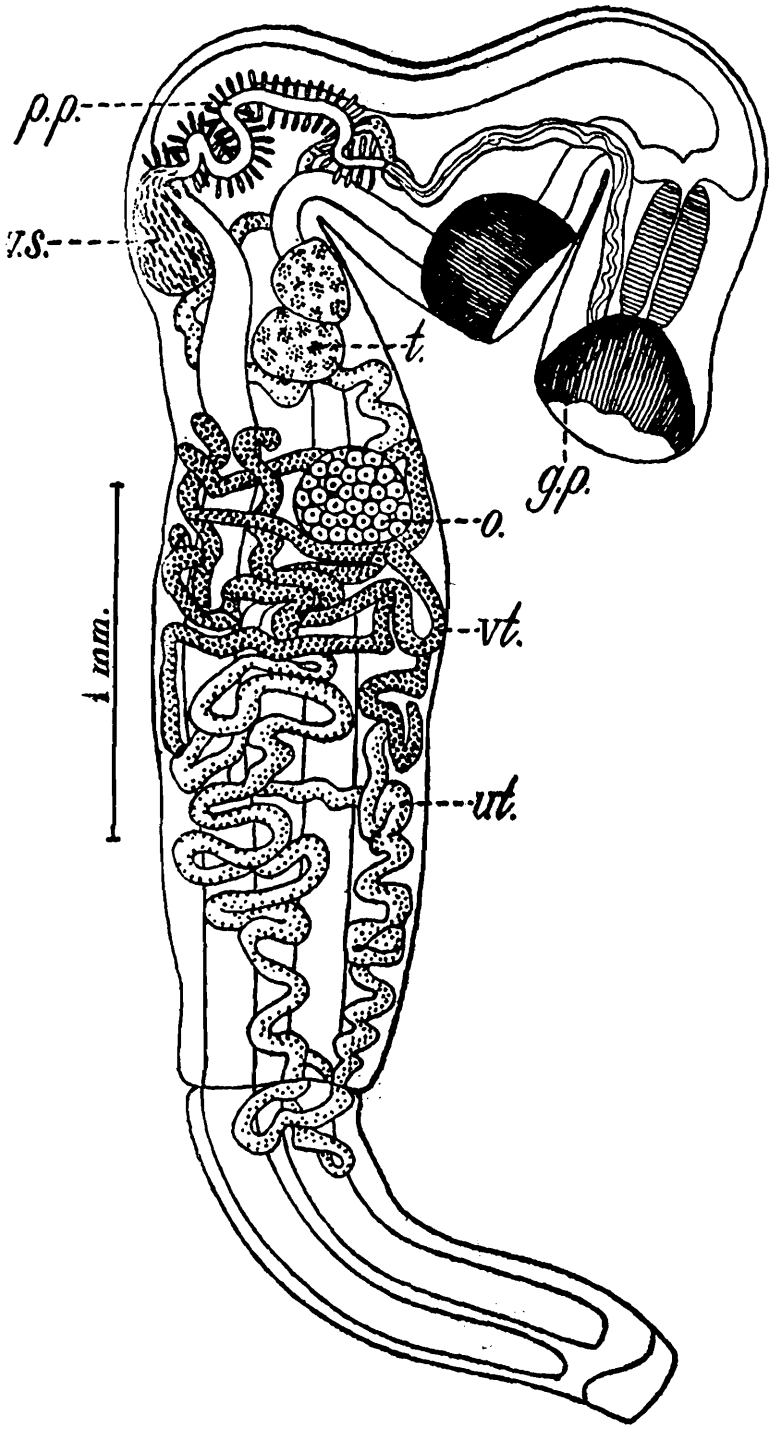
syn. *L. brevicauda* Srivastava, 1937.

Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2) : 349.

Specefic diagnosis : *Lecithocladium* Lühe, 1901 ; with Generic characters.

Body cylindrical, very muscular, devoid of all cuticular scales or spines, 1·02 (maximum) ×5·74, including a truncated ecsoma, 0·44×0·54. Oral sucker well developed, muscular, cup-shaped, with fringed margin. Pharynx elongately oval. Oesophagus absent. Intestinal crura with

prominent shoulders, extending to the hind end of soma. Acetabulum transversely oval, muscular, cup-shaped, situated at about the end of the anterior third of body. Testes small, elliptical, tandem, overlapping each other, a little behind the middle of body. Vesicula seminalis thin-walled, elongate, oval 0·7×0·3. lying in median line, partly overlapping

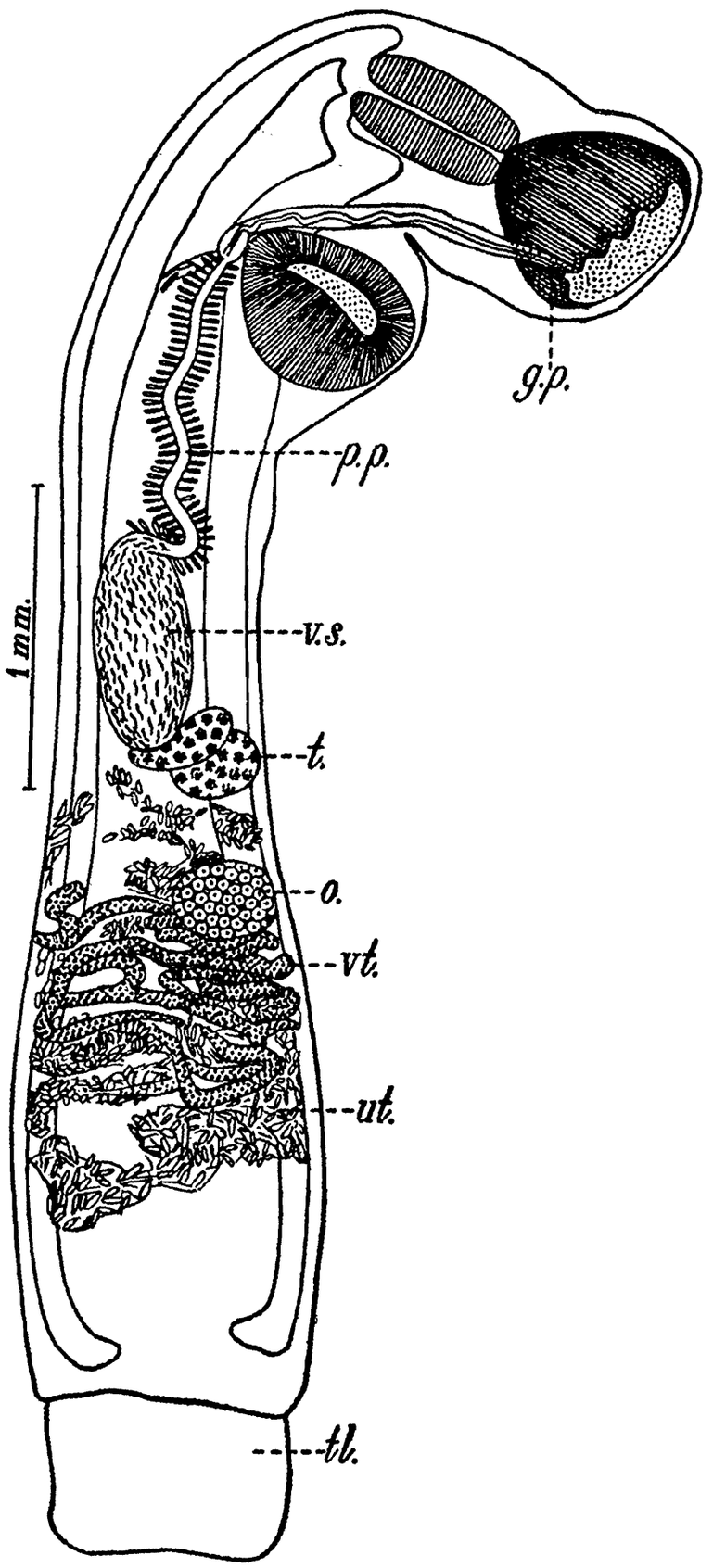


TEXT-FIG. 9.—*Lecithocladium harpondontis*; ventral view.

g.p., Genital pore; *o.*, Ovary; *p.p.*, Pars prostatica; *t.*, Testis; *ut.*, Uterus; *vt.*, Vitellaria; *v.s.*, Vesicula seminalis, (after Srivastava).

anterior testis. Pars prostatica long, narrow, sinuous, surrounded by prostate gland cells, joining the metraterm, at the level of middle of acetabulum. Ductus hermaphroditicus long, sinuous tube, enclosed in a sac. Genital pore at the antero-ventral margin of oral sucker. Ovary transversely ovoid. Shell gland complex behind ovary. Laurer's canal

and receptaculum seminis utarinum present. Vitellaria composed of nine slender, coiled tubes. Uterus transversely coiled. Excretory



Text-fig. 10.—*Lecithocladium brevicaudum*; ventral view.

g.p., Genital pore; *o.*, Ovary; *p.p.*, Pars prostatica; *t.*, Testis; *ut.*, Uterus; *vt.*, Vitellaria; *vs.*, Vesicula seminalis; *tl.*, Tail (after Srivastava).

bladder as in *L. herpodontis*. Eggs numerous, operculate, 0·019×0·011.

Host.—*Chrysophrys bifasciata* Forsk.

Habitat.—Stomach.

Locality.—Puri, Bay of Bengal.

(iii) Genus **Stomachicola** Yamaguti, 1934.

The parasites of this genus are very large worms. They have cuticule without denticulations or plications. Seminal vesicle oval, not markedly muscular ; pars porstatica glandular all along or most of its length, ecsoma much longer than body and containing most of the intestinal crura, uterus and parts of the vitelline coils ; excretory crura usually not observed, probably uniting dorsal to oral sucker.

Yamaguti (1934) defined the genus as follows :—

. **Generic diagnosis**: *Dinurinae* Looss, 1907 ; with Subfamily characters.

Body exceedingly long, very conractile, demacrated behind receptaculum seminis into short stout body proper and excessively long tail. Cuticle and subcuticular musculature of body proper well developed. Powerful tail retractor present. Cortical parenchymatous cells massed together into numerous groups lying in interstices filled with refractive substance. Anterior extremity rounded, strongly flexed ventrad ; posterior more or less pointed. Oral sucker subterminal. Pharnyx posterodorsal and contiguous to oral sucker. Oesophagus short. Caeca sinuous, extending to posterior extremity of body. Acetabulum large, near oral sucker. Testes ventral, closely behind acetabulum, a little obliquely juxtaposed. Vesicula seminalis large. Pars prostatica long, sinuous. Hermaphroditic duct enclosed in muscular pouch, opening into shallow genital atrium. Genital pore behind oral sucker. Ovary ventral, post-testicular. Receptaculum seminis voluminous. Laurer's canal absent. Vitelline gland consisting of seven long filiform tubes, extending into tail through uterine coils. Uterus coiled transversely, encircling caeca and extending into tail. Uterine eggs numerous, small. Parasitic in marine fishes.

Genotype—*Stomachicola muraenesocis* Yamaguti, 1934.

Two species of the genus, *viz. S. muraenesocis* Yamaguti, 1934 (type) and *S. secundus* Srivastava, 1939 have been so far recorded from the Indian region. They can be differentiated as follows :—

Key to Indian Species of genus STOMACHICOLA *Yamaguti, 1934.*

Ovary kidney shaped .. .. *S. muraenesocis.*

Ovary dome shaped, divided into three lobes, all joined at the top .. .. *S. secundus.*

13. **Stomachicola muraenesocis** Yamaguti, 1934.

(Text-fig. 11).

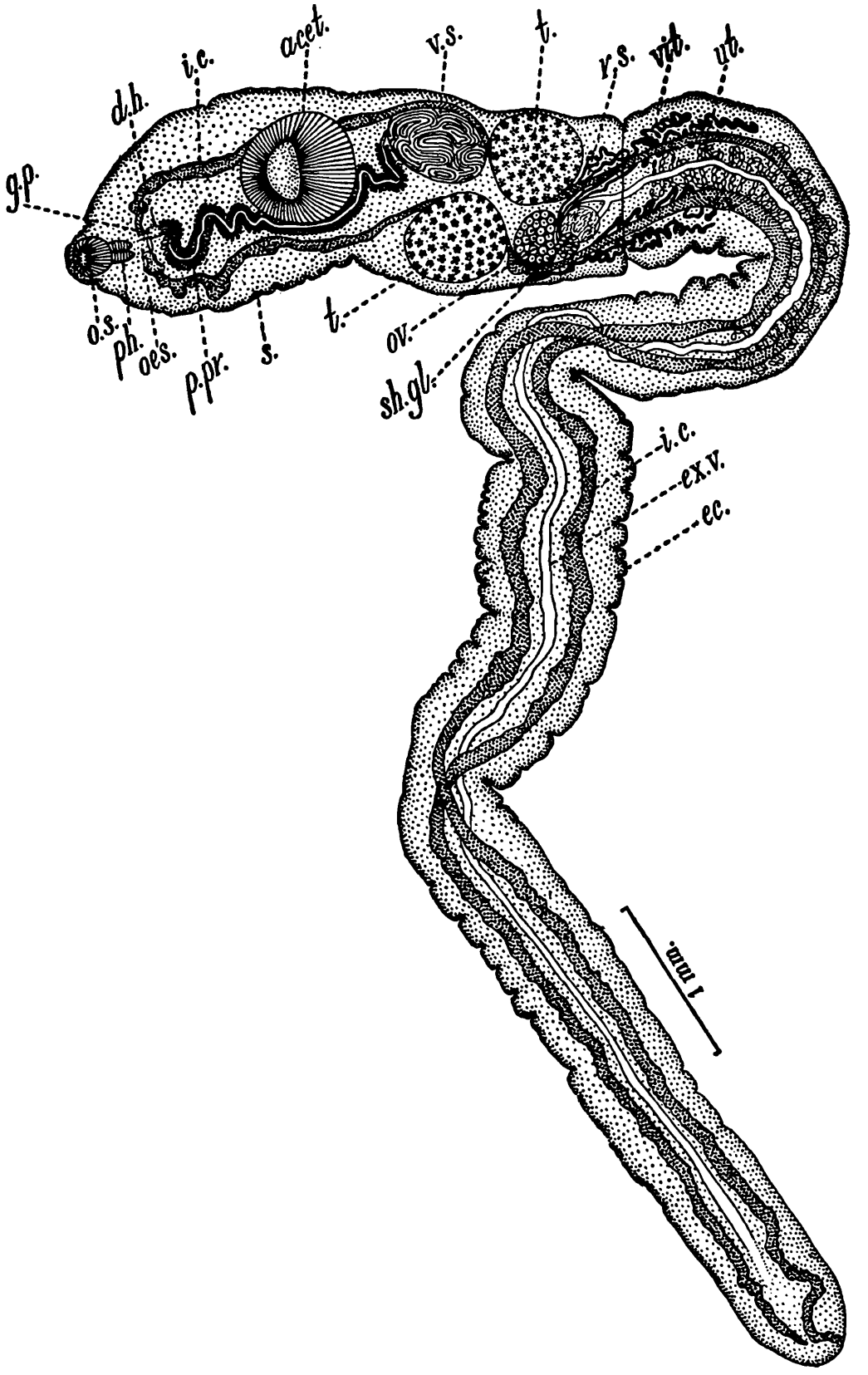
Bhalerao, G. D. (1943). *Proc. Ind. Acad. Sci.*, **18**(5) : 119-120.

Chauhan, B. S. (1945). *Ibid.* **21**(3) : 171.

Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2) : 348-350.

Specific diagnosis : *Stomachicola* Yamaguti, 1934 ; with Generic characters.

Maximum length 55 mm. or more. Maximum breadth about 2·5 mm. Oral sucker 0·23—0·42×0·32—0·58 mm. Pharynx 0·17-0·28 mm. in



Text-fig. 11.—*Stomachicola muraenesocis* ; ventral view (Original).

acet., Acetabulum ; *d.h.*, Ductus hermaphroditicus ; *ec.*, Escoma ; *ex.v.*, Excretory vessel ; *g.p.*, Genital pore ; *i.c.*, Intestinal caecum ; *oes.*, Oesophagus ; *o.s.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.pr.*, Pars prostatica ; *rs.*, Receptaculum seminis ; *s.*, Sema ; *sh. gl.*, Shell gland ; *t.*, Testis ; *ut.*, Uterus ; *vit.*, Vitellaria ; *v.s.*, Vesicula seminalis.

transverse diameter. Acetabulum 0·7—1·36 mm. in diameter. Testes dissimilar in shape ; right 0·46—0·84×0·53—0·64 mm., left 0·28—0·46

×0·52—0·74 mm. Ovary approximately kidney shaped, 0·31—0·46 ×0·53—0·85 mm. Vesicula seminalis and receptaculum seminis very large. Eggs oval, 0·017—0·022×0·0137—0·0143 mm.

Habitat.—Stomach of *Muraenesox cinereus* (Forskal).

Bhalerao (1943) recorded the variations of the representatives of this species collected from the Indian region. Particulars of his collections are.—

Host.—Marine eel, *muraenesox cinercus.*
Location.—Stomach.
Locality.—Ennur, East coast of India.

In view of the exhaustive description of the species by Yamaguti and detailed variations accorded by Bhalerao, Chauhan (1945) did not give much description of the material obtained by him. He transferred *Lecithocladium longicaudum* Shen Tseng (1935) from *Muraenesox cinereus* (Forskal) from China under this genus. Particulars of his collections are.—

Host.—Bombay eel, *Muraenesox talabonoides.*
Location.—Stomach.
Locality.—West coast of India, Bombay.

14. **Stomachicola secundus** Srivastava, 1937.

(Text-fig. 12 *a, b* : Text-fig. 13 *a, b, c.*).

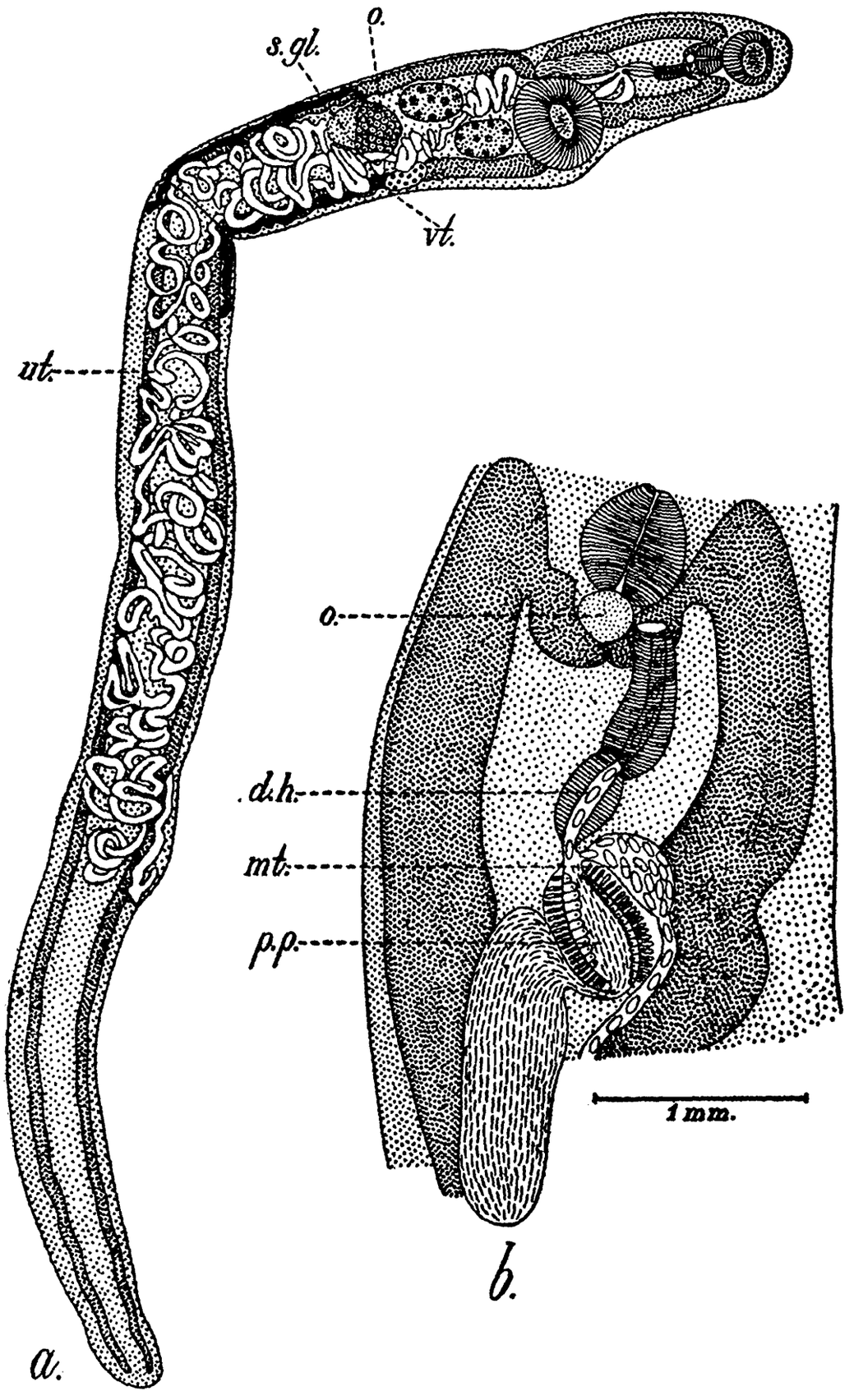
Chauhan, B. S. (1945). *Proc. Ind. Acad. Sci.* **21** (3) 171.
Manter, H. W. (1947). *Amer. Midl. Nat.* **38** (2) : 350.

Specific diagnosis : *Stomachicola* Yamaguti, 1934 ; with Generic characters.

Very large sized form, probably the largest trematode along with *S. muraenesocis*, met with in Indian fishes, so far. Body elongate, muscular, subcylindrical, 23-35 × 2·5-3·4, nearly uniform. Ecsoma twice the length of body proper or soma. Oral sucker cup-shaped, subterminal, 0·72-0·95 (diameter) ; twice the size of oral sucker, situated at junction of first two third of soma. Prepharynx extremely small. Pharynx oval ; oesophagus small, spherical. Intestinal caeca with prominent shoulders, extend upto hind end of ecsoma. Testes intercaecal, obliquely tandem, close behind acetabulum. Vesicula seminalis, elongate, oval, 0·8-1·45×0·4—0·6, extending posteriorly upto middle of acetabulum. Pars prostatica bulbshaped, surrounded by prostate gland cells, uniting with terminal part of uterus into a small, oval, muscular hermaphroditic pouch. Genital sinus long, muscular, tumbler shaped. Genital pore just behind pharynx. Ovary dome shaped, divided into three lobes, joined at top, situated medially, close behind posterior testis. Shell gland mass just behind ovary. Receptaculum seminis absent but receptaculum seminis uterinum present. Vitellaria composed of two long, coiled, tubes, extending laterally, overlapping intestinal caeca, but not uterine coils. Uterus in intricate coils, extending in ecsoma, to about three fifths to two-thirds of its length. Eggs numerous operculate, 0·015—0·023×0·0076—0·01 (after description of Srivastava).

The species is specially differentiated from the type by Srivastava in the shape of ovary, absence of receptaculum seminis and nature of vitellaria.

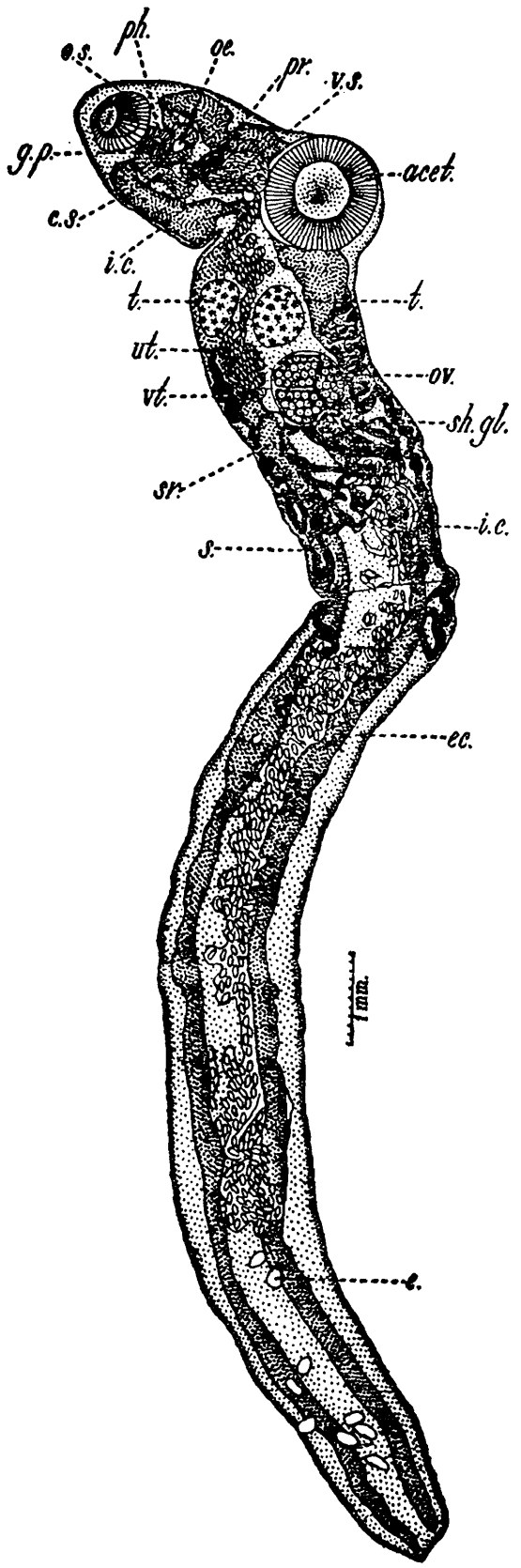
Through the courtesy of Prof. H. R. Mehra, the author had an opportunity to study a specimen, probably a para-or topotype, of this



Text-fig. 12.—*Stomachicola secundus* ; ventral view.

d.h. ductus hermaphroditicus ; *mt.*, metraterm ; *o.*, ovary ; *o.*, oesophagus ; *p.p.*, pars prostatica ; *s. gl.*, shell gland ; *ut.*, uterus ; vt., vitellaria. (after Srivastava).

species, reported to have been collected by Srivastava from *Hemirhamphus limbatus* Cuv. and Val., at Puri. In this specimen (Tex-figs.



TEXT-FIG. 13(a).—*S. secundus* ; ventral view, entire (Original).

acet., acetabulum ; *c.s.*, cirrus sac ; *e.*, egg ; *ec.*, ecsoma ; *g.p.*, genital pore ; *i.c.*, intestinal caecum ; *oe.*, oesophagus ; *os.*, oral sucker ; *ov.*, ovary ; *ph.*, pharynx ; *pr.*, pars prostatica ; *s.*, soma ; *sh.gl.*, shell gland ; *sr.*, receptaculum seminis ; *t.*, testis ; *ut.*, uterus ; *v.s.*, vesicula seminalis ; *vt.*, vitellaria.

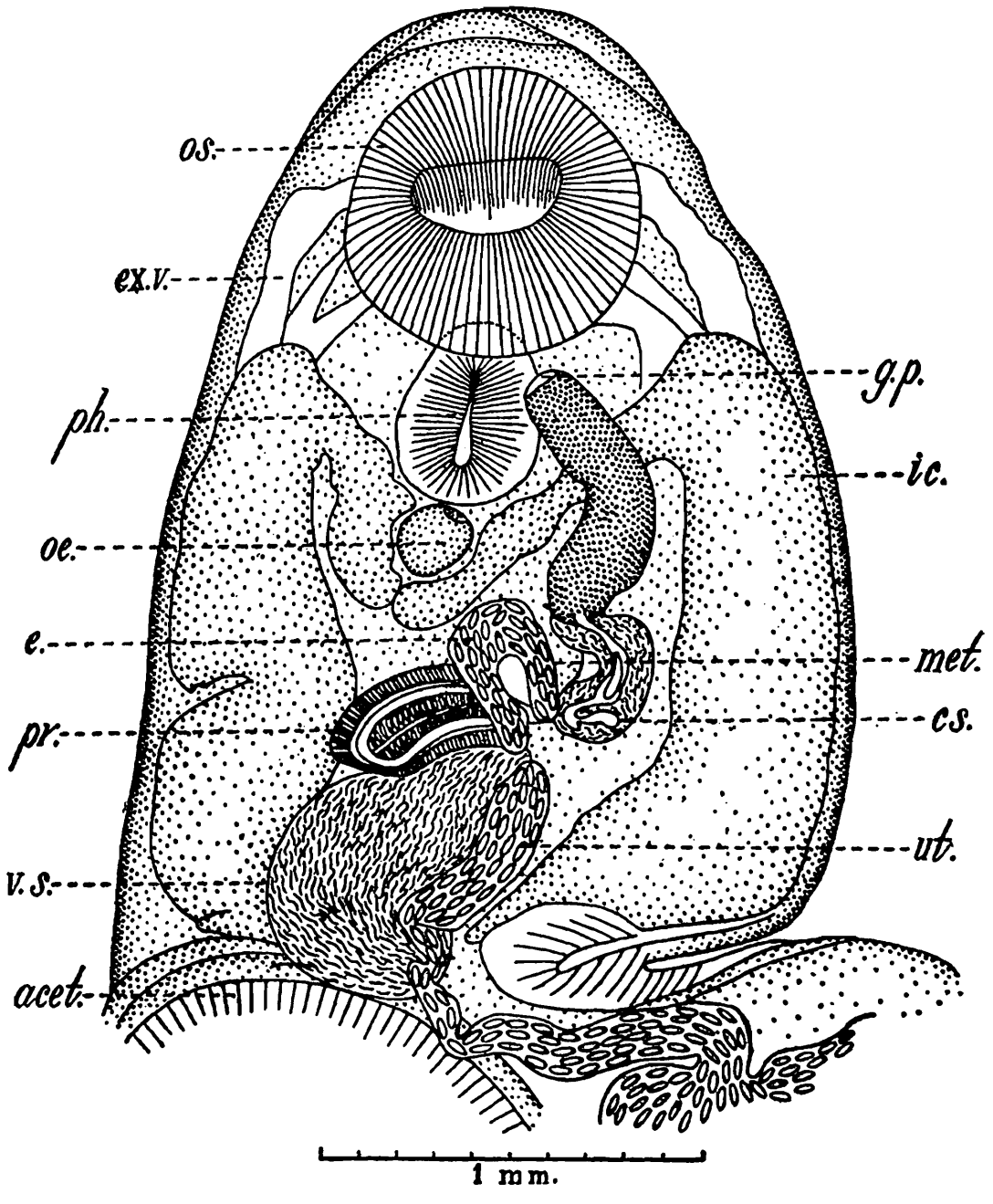
12, a, b, c.) he found that the receptaculum seminis was present, the ovary was four lobed, specially the fourth lobe being a little lobate

in appearance and the number of vitelline tubes was seven. There are other minor differences in details.

Host.—*Hemirhamphus limbatus* Cuv. & Val.

Location.—Stomach.

Locality.—Puri, East coast of India, Bay of Bengal.



Text-Fig. 13(b).—*S. secundus ;* anterior part, highly magnified (Original).

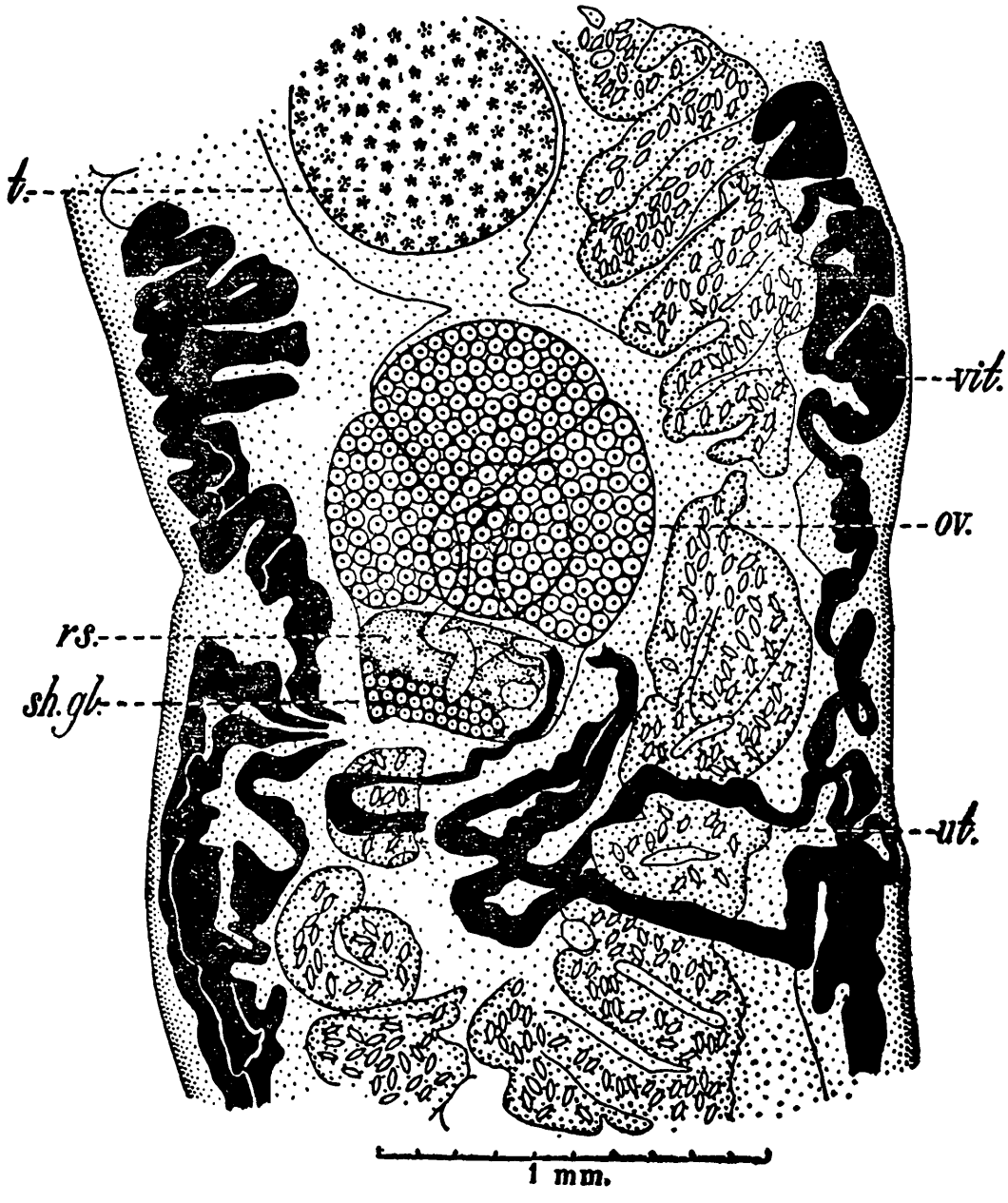
acet., acetabulum ; *c.s.*, cirrus sac ; *e.*, egg ; *ex. v.*, excretory vessel ; *g.p.*, genital pore ; *i.c.*. intestinal caecum ; *met.*, metraterm ; *oe.*, oesophagus ; *os.*, oral sucker ; *ph.*, pharynx ; *pr.*, pars prostatica ; *u.t.*, uterus ; *vs.*, vesicula seminalis.

(iv) Genus **Clupenurus** Srivastava, 1935.

Manter, H. W. (1940). *Allan Hancock. Expds.* **2** (14) : 423.
Manter, H. W. (1947). *Amer. Midl. Nat.* **38** (2) : 350.

Manter (1940, p. 423) while discussing the differences in characters of his new genus *Elytrophallus*, with *Tubovesicula* Yamaguti, 1934 stated that their differences, *viz.* " smooth body but a larger tail, a very long pars prostatica, and a short pyriform sinus sac, also hold for *Clupenurus* Srivastava, 1935 a genus which probably should be considered a synonym

of *Tubovesicula* ". However, later (1947, p. 350) he states that the genus *Clupenurus* differs from *Tubovesicula* in that more than half the long prostatic duct is without gland cells and cuticular plications are present. He, therefore, states that *clupenurus* should probably stand as a genus closely related to *Lecithocladium* and *Magnacetabulum*.



TEXT-FIG. 13(c).—*S. secundus* ; part with female genitalia, highly magnified (Original).

ov., ovary ; *rs.*, receptaculum seminis ; *sh.gl.*, shell gland ; *t.*, testis ; *ut.*, uterus ; *vit.*, vitellaria.

Generic diagnosis : *Dinurinae* Looss, 1907 ; with Subfamily characters.

Body medium sized, muscular and spindle shaped, with a tail appendage ; tail one fourth of the total length ; conspicuous denticulations on the body proper present. Suckers powerful, spherical ; acetabulum larger than oral sucker, situated in the first quarter of body. Prepharynx and oesophagus either rudimentary or absent, pharynx well developed, oval ; intestinal caeca irregularly broad and sinuous, extending to hinder end of tail. Excretory bladder Y-shaped and coiled, main stem

bifurcating near testes, cornua uniting dorsal to oral sucker, excretory pore terminal. Testes two, spherical, small, almost symmetrically situated about the middle of body; vesicula seminalis muscular, oval, compact, connected to sinus sac through a long sinuous duct only a part of which is surrounded by prostae gland cells; pars prostatica, ductus hermphroditicus and sinus sac small; genital atrium shallow, genital pore behind pharynx. Ovary oval, a little behind middle of body; receptaculum seminis close behind ovary and larger than the latter; shell gland complex postovarian; Laurer's cadal present. Vitellario consist of irregular, elongated tubes in the third quarter of body, extending from anterior level of ovary to a little distance in front of the tail, reaching laterally to body wall. Uterus well developed and coiled, occupying all space from acetabulum to posterior end of body proper and extending a little into the tail. Eggs numerous, small, operculate of 0.0175×0.01 mm. size. Parasitic in the stomach of fresh-water fish.

Type species—*Clupenurus piscicola* Srivastava, 1935.

15. Clupenurus piscicola Srivastava, 1935.

(Text-fig. 14).

Specific diagnosis : In view of the fact, that so far only one species (type of the genus) is known, and that generic diagnosis has already been given above a separate specific diagnosis for *Clupenurus piscicola* has not been considered necessary here, for the present.

Host.—Migratory fish, *clupea ilisha.*

Location—Stomach.

Locality—Allahabad.

(d) Subfamily *Prosorchinae* Yamaguti, 1934.

The subfamily was created by Yamaguti (1934) for his new genus, *Prosorchis*. So far it is the only genus recorded under the subfamily.

Subfamily diagnosis : *Hemiuridae* Lühe, 1901; with Family characters.

Body very long slender, cuticle unarmed. Oral sucker subterminal. Preoral pit prefent. Oesophagus with posterior diverticula. Testes postacetabular. Vesicula seminalis elongate. Ovary ventral, a little behind middle of body. Receptaculum seminis small. Laurer's canal present. Uterine coils convoluted behind ovary. Receptaculum seminis uterinum present. Uterine coils extend upto posterior end of body. Excretory system Y-shaped, uniting in front. Eggs thick-shelled.

Type genus.—*Prosorchis* Yamaguti, 1934.

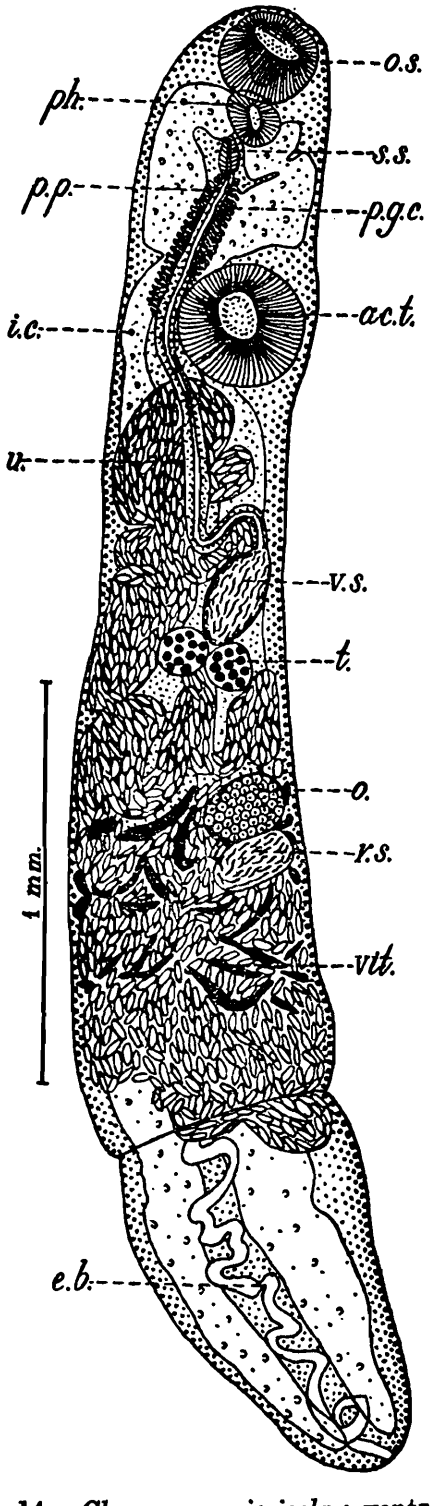
The genus has been defined by Yamaguti (1934) as follows :—

Genus **Prosorchis** Yamaguti, 1934.

Generic diagnosis : *Prosorchinae* Yamaguti, 1934; with Family characters.

Body long, slender, attenuated in postacetabular region. Cuticle thick, unarmed. Inner longitudinal musculature well developed. Oral sucker subterminal. Preoral lip present. Esophagus very short, with posterior diverticula. Intestinal caeca simple, terminating at posterior extremity of body. Acetabulum prominent, large, near oral sucker. Testes dorsal, directly tandem, partly overlapping, just in front of

acetabulum. Vesicula seminalis elongate. Pars prostatica well differentiated. Ductus hermaphroditicus present. Genital atrium opening ventrally, near anterior border of oral sucker. Ovary ventral, litte behind middle of body. Receptaculum seminis small, immediately



TEXT-FIG. 14.—*Clupenurus piscicola* ; ventral view.

act., Acetabulum ; *e.b.*, Excretory bladder ; *i.c.*, Intestinal caecum ; *o.*, Ovary ; *o.s.*, Oral sucker ; *p.g.c.*, Prostate gland cells ; *p.p.*, Pars prostatica ; *ph.*, Pharynx ; *r.s.*, Receptaculum seminis ; *s.s.*, Sinus sac ; *t.*, Testis ; *u.*, Uterus ; *v.s.*, Vesicula seminalis ; *vit.*, Vitellaria (after Srivastava).

behind ovary. Laurer's canal opening into dorsal terminal vesicle in front of ovary. Uterine duct convoluted behind ovary. Receptaculum seminis uterinum present. Uterus extending to near posterior end of

body. Vitellaria tubular, long, convoluted, extending from ovary to posterior end of body. Eggs numerous, thick-shelled. Excretory system Y-shaped, uniting in front. Parasitic in marine fishes.

Genotype—*Prosorchis psenopsis* Yamaguti, 1934.

26. **Prosorchis breviformis** Srivastava, 1936.

(Text-fig. 15).

Specific diagnosis : *Prosorchis* Yamaguti, 1934 ; with Generic characters.

Body sub-cylindrical, elongated, with nearly uniform width, cuticle smooth, 4·5—5·4×0·75—0·96 (maximum). Pre-oral lip long, roughly triangular. Oral sucker ventrally placed, transversely oval. Acetabulum spherical, situated at the junction of first and second third of body length, about twice the size of oral sucker. Prepharynx rudimentary. Pharynx oval, well developed. Oesophagus extremely small with oesophageal diverticulum, as in the genus, *Ophiocorchis*. Intestinal caeca long, sinuous, extending upto the posterior end. Testes, small, spherical, obliquely tandem, intercaecal, about halfway between the intestinal bifurcation and acetabulum. Vesicula seminalis small elongately swollen tube, lying between the testes and intestinal bifurcation. Pars prostatica short, tubular, surrounded by numerous prostate gland cells, continuing anteriorly to join ductus ejaculatorius which joins the terminal part of uterus to form ductus hermaphroditicus. Ovary transversely ovoid, 0·16—0·23×0·2—0·27, situated in intercaecal space, in the first fifth part of posterior half of body. Oviduct short. Receptaculum seminis small, spherical. Yolk reservoir, shell gland very small ; öotype present. Laurer's canal prominent, long and coiled tube ending in a terminal vesicle. Vitellaria consist of two to four longitudinal, highly convoluted, tubes extending from ovary to hinder end, main tubes giving off secondary branches which anastomose. Genital atrium median, ventral, at the level of posterior third of oral sucker, enclosing a very small genital papilla, on which the ductus hermaphroditicus opens. Uterine coils extend upto posterior end. Excretory bladder Y-shaped, main stem sinuous, bifurcating just behind acetabulum, into two lateral cornua, which anastomose dorsal to pharynx. Eggs numerous, small, 0·033—0·038×0·018—0·025.

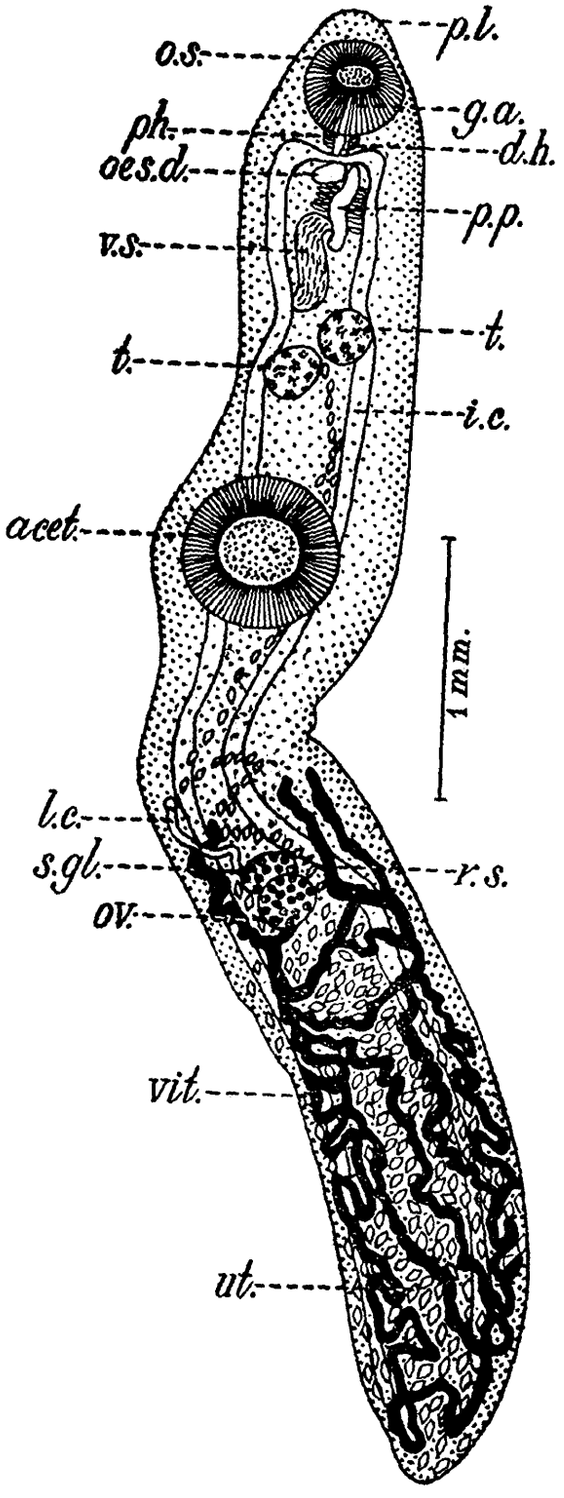
The species is recorded to differ from the type species of the genus *P. psenopsis* Yamaguti, 1934, in the shape and much smaller size of body which is uniformly broad with its maximum breadth occurring across the acetabular region, comparatively cauded position of the acetabulum ; position of the testes, shell gland complex and receptaculum seminis and the character and dispositon of the vitellaria.

Host.—Fish, *Seriolicthys bipimulatus*.

Location—Intestine.

Locality—Puri, Bay of Bengal.

Dollfus (1947) described a new species under the genus as. *Prosorchis* (*Prosorchiopsis*) *legendrei*, which he, however, placed under a subgenus *Prosorchiopis* created and defined by him.



TEXT-FIG. 15.—*Prosorchis breviformis* ; ventral view.

acet., Acetabulum ; *d.h.*, Ductus hermaphroditicus ; *g.a.*, Genital atrium ; *i.c.*, Intestinal caecum. ; *l.c.*, Laurer's canal ; *o.s.*, Oral sucker ; *oes. d.*, Oesophageal diverticulum ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.l.*, Preoral lobe ; *p.p.*, Pars prostatica ; *r.s.*, Receptaculum seminis ; *s.gl.*, Shell gland complex ; *t.*, Testis ; *ut.*, Uterus ; *v.s.*, vesicula seminalis ; *vit.*, Vitellaria (after Srivastava).

(e) Subfamily *SCLERODISTOMATINAE* (Odhner, 1927) Dollfus, 1932.

syns. *Sclerodistominae Odhner*, 1927. *Sclerodistomatidae* Dollfus, 1932. *Hirudinellida* Dollfus, 1932. *Isoparorchidae* Poche, 1926. *Isoparorchinae* Travassos, 1920. *Isoparorchinae* Johnston, 1927. *Hirudinellinae* Dollfus, 1932.

The Subfamily was created by Odhner in 1905 for the *Distomum clavatum* group. Dollfus (1932) proposed that the subfamily Sclerodistominae be raised to family rank and separated from *Hirudinella*, largely on the basis of the excretory system. Manter (1934) taking into consideration the terminal genital ducts, the tubular vitellaria, the shell gland complex and the similarity in body form was inclined to retain *Sclerodistomum* and *Hirudinella* in the *Sclerodistomatinae*. In both genera the excretory vesicle is voluminous either as much coiling tubes or as a bulbous inflated tube.

SCLERODISTOMATINAE (= *Distomum clavatum* groupe).

Subfamily diagnosis : *Hemiuridae* Lühe, 1901 ; with Family characters.

Large and strongly built forms, without tail or ecsoma. Copualtory organ, strong and spherical, with a very wide genital sinus protruding in it. The inner part of the sinus with an incision like opening ; this genital structure is often a mass of much coiled muscle. Vitellaria with many fine tubular ramifications or branches.

Type genus—*Sclerodistomum* Looss, 1911. (with type species, *Sclerodistomum italicum* (Stossich) Looss.

The various genera usually included under this subfamily are.—

Sclerodistomum Looss, 1911 ; *Eurycoelum* Brock ; *Hirudinella* Garsin, 1730 ; *Isoparorchis* Southwell, 1913 (syn. *Leptolecithum* Kobayashi, 1915).

Genus **Isoparorchis** Southwell, 1913.

syn. *Leptolecithum* Kobayashi, 1915.

The genus *Isoparorchis* was created by Southwell (1913) for his new species, *I. trisimilitubis* from the air bladder of a Siluroid fish, *Wallagonia attu* from Bankipore, India. Two years later in 1915, Kobayashi, evidently unware of Southwell's paper described a similar trematode as *Leptolecithum eurytremum*, a new genus and new species from the air-bladder of *Parasilurus asotus* in Japan. In 1921 he redescribed the worm and added *Pseudobagrus aurantiacus* as a new collateral host. Travassos (1922) regarded *Leptolecithum* Kobayashi as synonymous with *Isoparorchis* Southwell. Bhalerao (1926) on the basis of comparative studies established definitely the synonymy. Johnston (1927) recorded another species of the genus, as *I. tandani* from the Australian siluroid fish, *Tandanus tandanus*. Odhner (1927) records that the trematode from the swim bladder of *Macrones* sp., Tonkin (Annam) described by Billet in 1898 as *Distomum hypselobagri* probably also belongs to the genus. Ejsmont (1932) after examining the material contents that all the three species described under the genus, were one and the same and designates *I. hypselobagri* (Billet, 1898) Odhner, 1927 as the type. Yamaguti (1934) shares Ejsmont's view. However he is of the opinion that since *Distomum hypselobagri* Billet is not fully known, it is better to select Southwell's species, *I. trisimilitubis* as genotype. He regards the differences observed in the description of the three species as merely individual variations.

Genus **Isoparorchis** Southwell, 1913, *emend.* Kuang, Wu, 1937.

Generic diagnosis : *Sclerodistomatinae* (Other ; 1927) with Subfamily characters.

Body somewhat elliptical, flattened dorsoventrally. Cuticle aspinose-Oral sucker subterminal ; ventral sucker at the end of first third of body length. Prepharynx absent ; pharynx well developed ; oesophagus almost indistinguishable. Glandular stomach very distinct ; intestnal caeca of several windings extending to near posterior end of body. Teistes two, symmetrically located, adjacent to posterior margin of ventral sucker. Seminal vesicle convoluted, free in the parenchyma, preacetabular. Sinus sac (term suggested by Manter, 1926) very muscular, containing both male and female ducts (genital sinus). Genital pore situated between suckers—Ovary band like lying transversely. Seminal receptacle and Laurer's canal present. Vitellaria dendritic, near posterior extemity of body. Excretory vesicle Y-shaped ; excretory pore terminal. Eggs small and numerous. Uterus long, convoluting, slightly extending beyond the intestinal caeca.

Type and only species—*I. hypselobagri* (Billet, 1898) Odhner, 1927

Hosts : Adults in freshwater fishes mostly Siluridae : *Parasilurus asotus ; Wallagonia attu ; Pseudobagrus auranticus ; Tandanus tandanus*; *Macrones* sp.; *Pelleobagrus fulvidraco* and *Odontobutis obscrura.*

Location—Swimbladder.

Distribution—India, Japan, Australia, Annam, China, Java.

An interesting point about the distribution of this parasite is that so far, it has been recorded only from different Eastern countries, mostly Asian, *viz.*, India, Japan, Annam, China, Java and Australia. The second point is if its record usually from the swim air or gas bladder, is in some way significant, specially from Siluroid and allied cat fishes, almost from all countries from where it has been recorded so far.

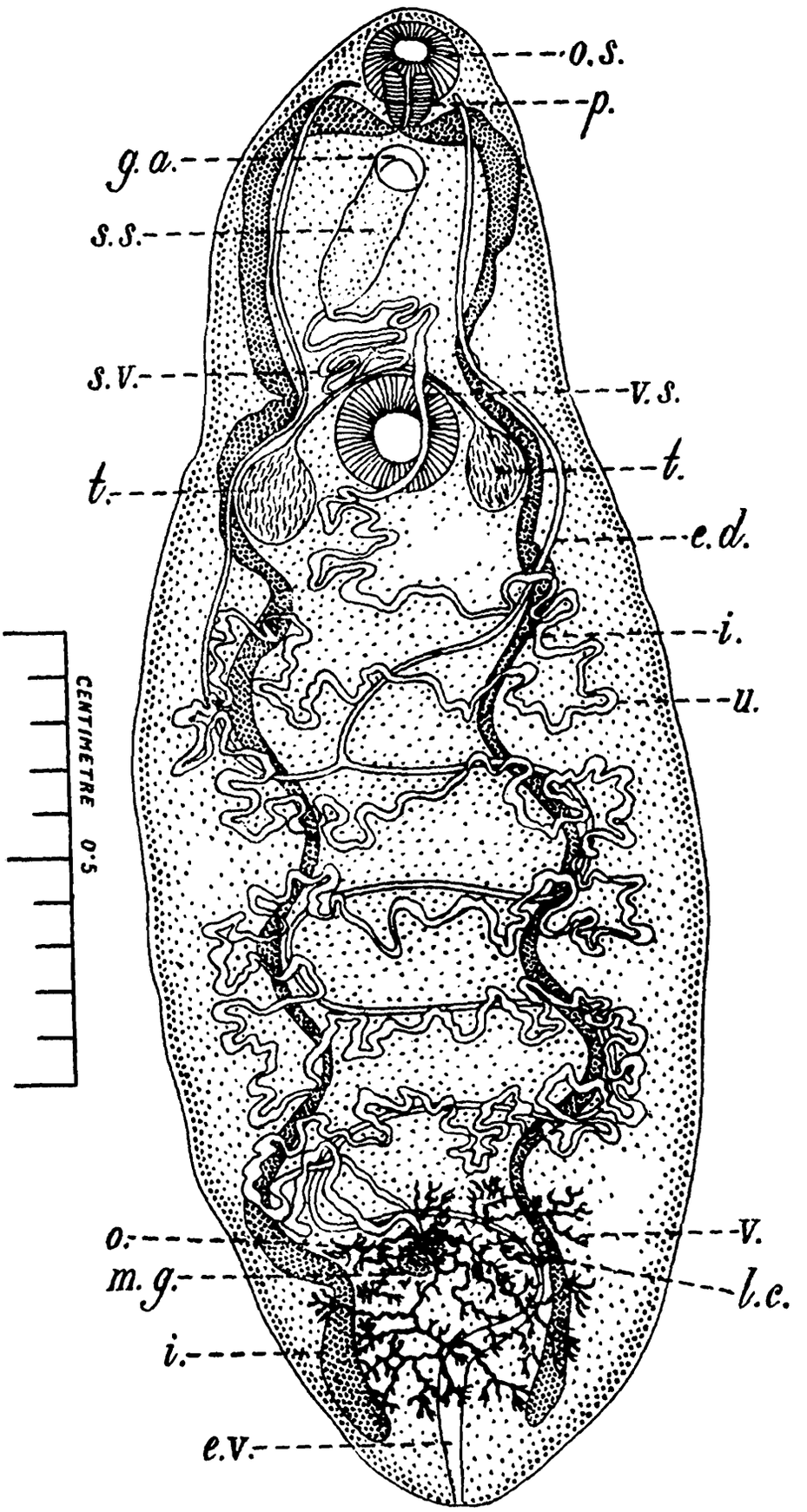
The study of this parasite is of medical significance for it has also been reported from human intestines in India by Chandler (1926) and by Faust (1929) from Hunan Province, China.

The life cycle of this worm is imperfectly known.

17. **Isoparaorchis hypselobagri** (Billet, 1898) Odhner, 1927. (Text-fig. 16).

syns. *Distomum hypselobagri* Billet, 1898.
Isoparorchis trisimulitubis Southwell, 1913.
Leptolecithum eurytremum Kobayashi, 1915.
I. tandani Johnston, 1927.

Southwell, T. (1913). *Rec. Ind. Mus.* **9** : 91-95 and 100-101.
Southwell, T. and Prashad, B. (1918). *Rec. Ind. Mus.* **15**(5), 341-355.
Bhalerao, G. D. (1926). *Ann. Mag. Nat. Hist.* (9) 17 : 246-250.
Bhalerao, G. D. (1926). *Ind. J. vety. Sci. & Anim. Husb.* **2**(4), 406-407.
Bhalerao, G. D. (1936). *J. Helm.* **14**(4) : 17-19.
Kuang, Wu (1938) *Paking nal Hist. Bull.* **24**(4) : 273-277.
Chauhan, B. S. (1947). *Rec. Ind. Mus.* **45** (2 & 3) : 133-270.



Text-fig. 16.—*Isoparorchis hypselotagri* ; dorsal view.

e.d., Excretory duct ; *e.v.*, Excretory vesicle ; *g.a.*, Genital atrium ; *i.*, Intestine *l. c.* Laurer's canal ; *m.g.*, Mehlis gland ; *o.*, Ovary ; *o.s*, Oral sucker ; *p.*, Pharynx *s.s.*, Sinus sac ; *s.v.*, Seminal vesicle ; t., Testis ; *u.*, Uterus ; *v.s.*, Ventral sucker ; *v.* Vitellaria (after Kuang, Wu).

Specific diagnosis : In view of the elaborate generic diagnosis given above and that the only one species of the genus, the type has been recorded so far, no separate, specific diagnosis is considered necessary here.

The detailed distribution of the species is, however, given as below.—

DISTRIBUTION IN INDIA.

Host.	Location.	Locality.
Wallagonia attu	Gas-bladder ..	Bankipur, Calcutta (Southwell, 1913).
Human beings ..	Stools	Calcutta (Chandler, 1926).
Crocodile ..	Stomach ..	Assam (Bhalerao, 1932).
Barbus tor	Muscle ..	(Capt. Parker, 1910).
Ophiocephalus striatus Bloch ..	Lateral muscles ..	Beel Kola Khuln (Pakistan) (Southwel and Prashad, 1918).
Ophiocephalus striatus Bloch ..	Muscles and Coelomic cavity.	Nagpur (Bhalerao, 1936).
Notopterus notopterus	Mesentery and liver	Hyderabad (Dn.).
Ophiocephalus marulius (Ham.) Buch.	Muscles ..	Ditto.
Ophiocephalus punctatus ..	Ditto ..	Ditto.
Ophiocephalus gachua ..	Ditto ..	Ditto.
Gobius giuris ..	Ditto ..	Ditto.
Mastacembelus armatus ..	Muscles ..	Ditto.
Ambassis nana	Liver, body cavity and subcutaneous tissue.	Poona (Ditto).
Wallagonia attu	Liver	Salebhata, Patna Dist. (Orissa state) (Chauhan, 1947).

Southwell and Prashad (1918) obtained some immature forms of fish parasites from the lateral muscles of *Ophiocephalus striatus* Bloch figured by them as No. 4 and 5. Bhalerao (1936) regards them as those of *Isoparorchis hypselobagri*.

(f) Subfamily *LECITHASTERINAE* Odhner, 1905.

Subfamily diagnosis : *Hemiuridae* Lühe, 1901 ; with Family characters.

Small forms, body spindle shaped, thickest at the level of ventral sucker, without the typical well-developed abdomen or ecsoma. Cuticle smooth. The arms of excretory bladder in the ' bed head ' united. Genital pore at the hinder end of oral sucker or pharynx. A true " cirrus sac " either sac or pear-shaped. Uterine coils lie at the sides of the body. Vitellarium unpaired, star like, radiating from a common center, aster normally made up of distinctly seven, spherical to tubular shaped expanded pieces which collect together to a point, where they are connected or hang together.

Type genus— *Lecithaster* Lühe, 1901.

The genera included in this subfamily can be differentiated by the following key.—

Key to Genera of Subfamily Lecithasterinae Odhner, 1905.

1.	Ovary four lobed ; posterior end tapering ..	*Lecithaster.*
	Ovary entire, non-lobed, posterior end rounded ..	2.
2.	Vitellaria rounded in seven separate parts ..	*Aponurus.*
	Vitelline mass seven or eight distinct lobes either rounded or somewhat longer than wide, centrally fused ..	*Hysterolecitha.*

(i) Genus **Lecithaster** Lühe, 1901.

syns. *Leptosoma* Stafford, 1904.
Mordvilkovaster Pigulewsky, 1938.
Dichadena Linton, 1910.

Generic diagnosis : *Lecithasterinae* Lühe, 1901 ; with Subfamily characters.

Body essentially spindle shaped tapering posteriorly, largest width being at the level of ventral sucker. Vesicula seminalis situated usually close by or near the end of ventral sucker, always narrowing anteriorly. Cirrus beutel, short, pear-shaped, reaching to about ventral sucker. Pars prostatica long, tubular, much longer than genital sinus. Genital pore lies rather distant from oral sucker, at about the middle of two suckers. Ovary four lobed. Vitellaria elongate in seven connected parts, star like in appearance. Uterine coils mostly on the sides of the body, outside the intestinal caeca and behind the ventral sucker. Eggs small, thin-shelled. Parasites in stomach.

Type species—*Lecithaster bothryophorus* (Lühe, 1901) Odhner, 1905

Syn : *Distomum gibbosus* (Rud., 1802) Odhner, 1905.

Only two species of the genus, *viz. L. indicus*, Srivastava, 1935 and *L. extralobatus* Srivastava, 1935 have been so far recorded from the Indian region. They can be differentiated by the following key.—

Key to Indian Species of Genus, Lecithaster Lühe, 1901.

Ovary four lobed ; vitellaria consist of seven lobes ; vesicula seminalis, bulb shaped, undivided	*L. indicus.*
Ovary consists of five huge lobes ; vitellaria consisting of eight lobes ; vesicula seminalis slightly constricted in middle	*L. extralobotus.*

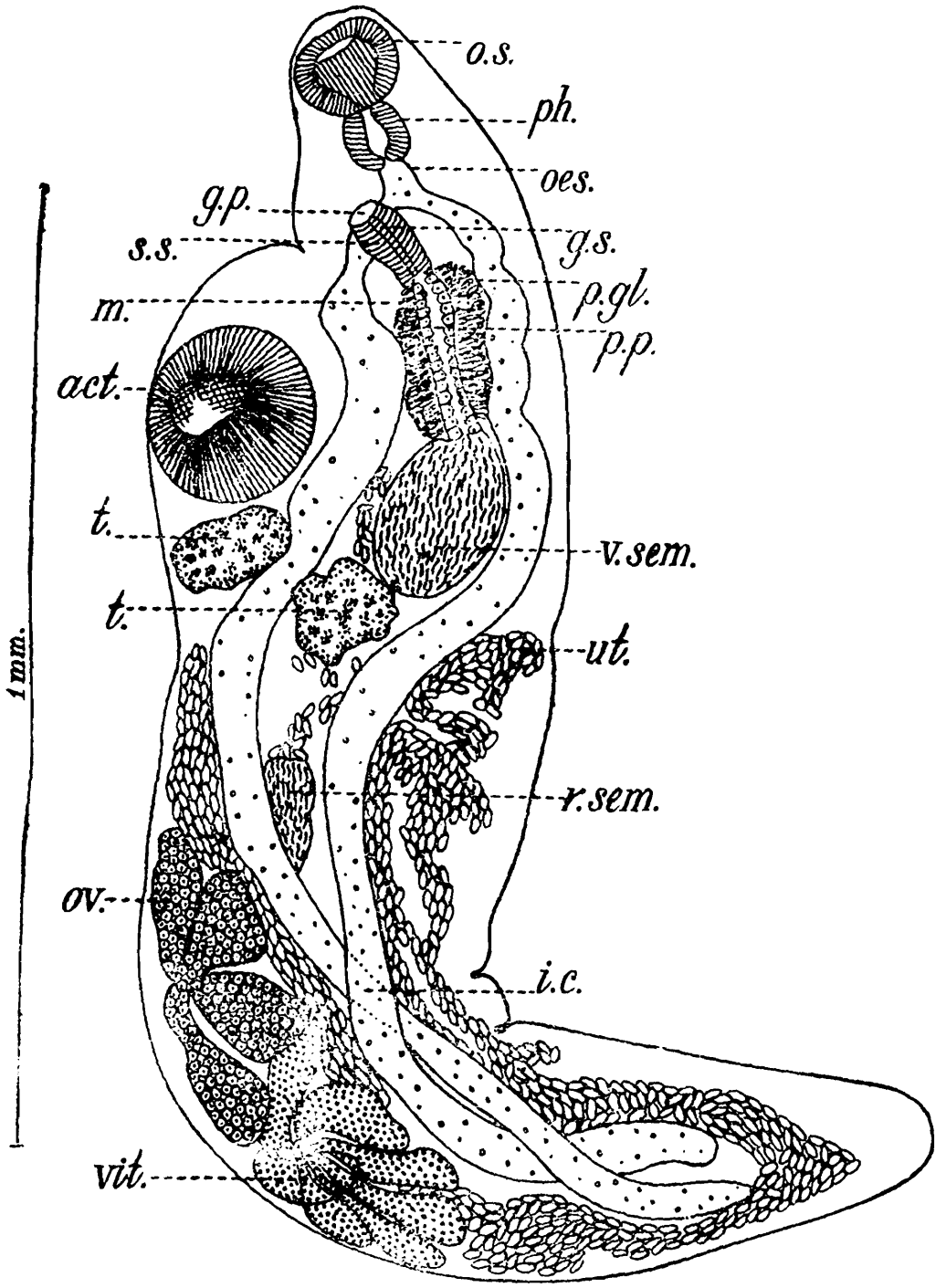
18. **Lecithaster indicus** Srivastava, 1935.

(Text-fig. 17).

Specific diagnosis : *Lecithaster* Lühe, 1901 ; with Generic characters.

Body smooth, muscular, fusiform or spindle-shaped, with nearly uniform diameter, except at ends, which are bluntly pointed, 0·95—0·7 ×0·24—0·43 (maximum). Oral sucker subterminal, slightly elliptical. Acetabulum 0·16×0·17 in diameter, situated a little behind intestinal bifurcation, at about middle of anterior half of body. Prepharynx small ; pharynx oval, muscular ; oesophagus small. Intestinal caeca long, sinuous, extending a little in front of posterior end. Oral sucker, prepharynx, pharynx, oesophagus and part of caeca lined internally by cuticle. Testes small, spherical, close behind the acetabulum, in the

second quarter of body. Vesicula seminalis undivided, bulbshaped, median. Pars prostatica fairly long tube with prostate gland cells. Ductus hermaphroditicus or genital sinus tubular, half the size of pars prostatica. Genital pore, median, at the level of intestinal bifurcation. Ovary consists of four elongated bulb-shape lobes, all connected together

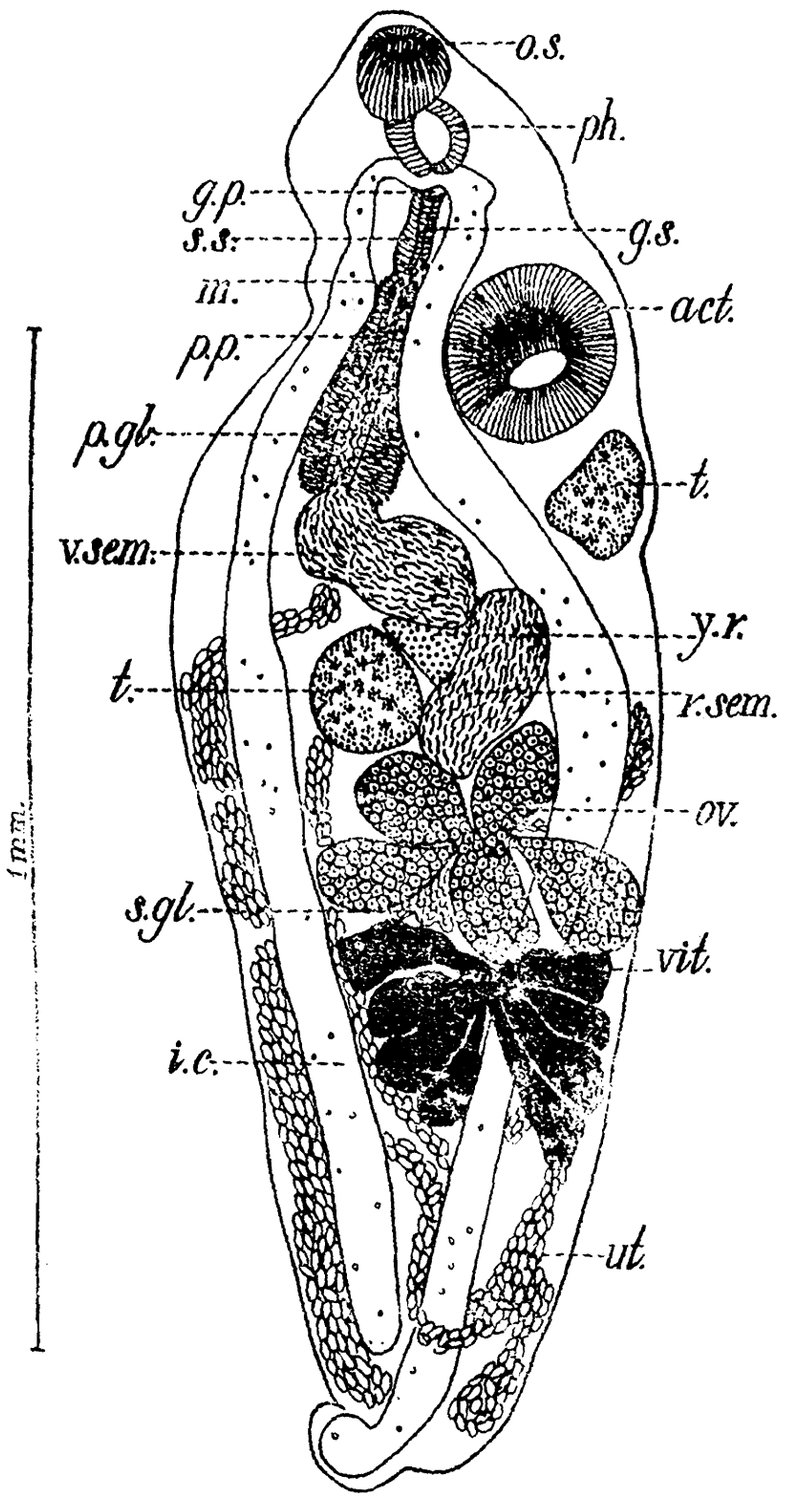


TEXT-FIG. 17.—*Lecithaster indicus ;* ventral view.

act., Acetabulum ; *g.p.*, Genital pore ; *g.s.*, Genital sinus ; *i.c.*, Intestinal caecum; *m.*, Metraterm ; *o.s.*, Oral sucker ; *oes.*, Oesophagus ; *ov.*, Ovary ; *p. gl.*, Prostate glands; *p.p.*, Pars prostatica ; *ph.*, Pharynx ; *r. sem.*, Receptaculum seminis ; *s.s.*, Sinus sac; *t.*, Testis ; *ut.*, Uterus ; *v. sem.*, Vesicula seminalis ; *vit.*, Vitellaria (after Srivastava).

situated in posterior third-quarter of body. Receptaculum seminis well developed, bulb shaped, situated just in front of ovary. Laurer's canal present. Vitellaria consist of seven finger shaped lobes, with

sacular distal ends, all connected together in centre. Shell gland complex between ovary and vitellaria. Uterine coils post-acetabular. Metraterm short. Excretory bladder Y-shaped, with cornua uniting dorsal to pharynx. Eggs numerous, small operculate 0·015—0·02 × 0·007—0·01.



Text-fig. 18.—*Lecithaster extralobatus ;* ventral view.

act., Acetabulum ; *g.p.*, Genital pore ; *g.s.*, Genital sinus ; *i.c.*, Intestinal caecum ; *m.*, Metraterm ; *o.s.*, Oral sucker ; *ov.*, Ovary ; *p. g.l.*, Prostate glands ; *p.p.*, Pars prostatica ; *ph.*, Pharynx ; *r. sem.*, Receptaculum seminis ; *s. gl.*, Shell gland ; *s.s.* Sinus sac ; *t.*, Testis., ; *ut.*, Uterus ; *v. sem.*, Vesicula seminalis ; *vit.*, Vitellaria ; *y.r.* Yolk reservoir (after Srivastava).

Host.—*Clupea ilisha.*

Habitat.—Intestine.

Locality.—Allahabad.

The incidence of infection of the host, in winter months is nearly cent per cent. The degree of infestation varies from 8-20 parasites per host.

It is recorded to stand nearest to *L. salmonis* Yamaguti, 1934.

19. **Lecithaster extralobatus** Srivastava, 1935.

(Test-fig. 18.)

Specific diagnosis: *Lecithaster* Lühe, 1901; with Generic characters.

Body smooth, muscular, spindle shaped, tapering at both ends, 1·44×0·47 (maximum). Suckers muscular, spherical. Oral sucker subterminal. Acetabulum situated at junction of first and second quarters of body, their ratio is 1 : 2. Prepharynx and oesophagus absent. Pharynx spherical, highly muscular. Intestinal caeca unequal, sinuous, running upto hind end. Cuticle is present in alimentary canal as in the other species. Testes oval, a symmetrical, postacetabular. Vesicula seminalis fairly large in size, slightly constricted in middle, situated behind acetabulum. Pars prostatica a straight tube, surrounded all along its length by well developed prostate gland cells. Sinus sac 0·09×0·04. Genital pore ventral, median, just behind intestinal bifurcation. Ovary consists of five huge lobes, all connected in the centre, situated just behind anterior half of body. Receptaculum seminis large, elongated, sac-shaped. Vitellaria consist of eight finger-like lobes, as in *Hysterolecitha microrchis* Yamaguti, 1934, with swollen ends, disposed off in two forms of pouch, each like the wings of a butterfly. Uterus well developed. Excretory bladder Y-shaped. Eggs oval, thin-shelled, 0·015×0·01.

Host.—*Clupea ilisha.*
Location.—Stomach.
Lacality.—Allahabad.

(ii) Genus **Aponurus** Looss, 1907.

The genus *Aponurus* was considered by Looss (1907) as most nearly related to *Lecithaster*, although showing relationships to *Brachyphallus*.

The genus also bears close relationship to *Lecithophyllum*, a genus which was created by Odhner (1905) for Olsson's *Distoma botryophoron*. Odhner studied Olsson's type material. The table by Manter (1926) given below shows the differences between the three genera. It is based on data as given by Odhner and Looss.

	Lecithaster.	**Lecithophyllium.**	**Aponurus.**
(1)	Genital pore rather distant from oral sucker.	Genital pore rather close to oral sucker.	Genital pore rather close to oral sucker.
(2)	Ovary 4-lobed	Ovary entire	Ovary entire.
(3)	Posterior end tapering	Posterior end broadly rounded.	Posterior end broadly rounded.

	Leciteaster.	Lecithophyllum.	Aponurus.
(4)	Pars prostatica much longer than genital sinus.	Pars prostatica shorter than genital sinus.	Pars prostatica as long as genital sinus.
(5)	Genital sinus reaching about to ventral sucker.	Genital sinus reaching almost to ventral sucker.	Genital sinus reaching only about half way to ventral sucker.
(6)	Eggs small (15 to 25u) thin shelled	Eggs large (60u) thick shelled.	Eggs small (26u)
(7)	Vitellaria elongate in 7 connected parts.	Vitellaria elongate in 7 connected parts.	Vitellaria rounded in 7 separate parts.

It has been suggested by Manter (1934) that two genera *Lecithophyllum* and *Aponurus* should perhaps be considered identical. The two differences are the larger eggs and the longer genital sinus of *Lecithophyllum*. Manter (1947, p. 353) holds that ordinarily, these differences would seem to be only specific but as the number of species in *Aponurus* increases it seems convenient to retain the genus and characterise *Lecithophyllum* as possessing eggs 55 to 65u long and a genital sinus as long or longer than the pars prostatica. Eggs size of *Aponurus* would be from 22-23u.

The genus is defined as below :—

Genus **Aponurus** Loss, 1907 ; *em nd.* Yamaguti, 1934.

Generic diagnosis : *Lecithasterinae* Odhner, 1905 ; with Subfamily characters.

Hindbody cylindrical. Acetabulum larger than oral sucker, preequatorial. Intestinal caeca extending through uterine coils and terminating at posterior extremity of body or further in front. Testes more or less obliquely tandem in middle third of body. Vesicula seminalis voluminous, chiefly in front of acetabulum. Pars prostatica well developed. Harmaphroditic pouch elongate, extending farther backwards than intestinal bifurcation. Genital pore at level of pharynx or farther behind. Ovary median, ventral, at about junction of middle with posterior third of body. Receptaculum seminis conspicuous, sometimes enormous, anterodorsal to ovary. Vitellaria closely behind ovary, consisting of seven simple lobes. Shell gland dorsal to vitellaria. Uterus confined to dorsal side, extending farther backwards than vitellaria, sometimes not occupying postvitellarian area. Uterine eggs elliptical, numerous. Parasitic in stomach of marine fishes.

Genotype—*A. laguncula* Looss, 1907.

Srivastava (1939) gave the following key for the identification of the species of the genus.

Key to Species of Genus APONURUS Looss, 1907.

1.	Uterus not extending posterior to vitellaria	*A. brevicaudatus.*
	Uterus extending posterior to vitellaria	2.
2.	Testes symmetrical or slightly diagonal	3.
	Testes tandem or obliquely tande	4.

3. Oesophagus absent	*A. bengalensis.*
Oesophagus present	*A. intermedius.*
4. Genital pore at intestinal bifurcation	*A. breviformis.*
Genital pore at about the level of pharynx ..	5.
5. Receptaculum seminis much larger than ovary	*A. rhinoplagusiae.*
Receptaculum seminis much smaller than ovary ..	6.
6. Vesicula seminalis not extending much beyond the anterior margin of the acetabulum ; eggs 0·27×0·016 in size	*A. laguncula.*
Vesicula seminalis extending up to the middle of acetabulum ; eggs of 0·056—0·065×0·026 size	*A. sphaerclecithus.*

Two sepcies of the genus, *A. breviformis* Srivastava, 1939 and *A. bengalensis* Srivastava have been recorded from India. Manter (1947, p. 353) also reefrs about them. While comparing his species, *A. intermedius* Manter, 1934 with *Lecithophyllum fuscum* Yamaguti, 1938, he observes that *Lecithophyllum fuscum* is considered a synonym of *Aponurus intermedius* and is an example of the wide distribution of trematodes of deep-water fishes. He further states that *Aponurus bengalensis* Srivastava 1939 is possibly another synonym of that species.

20. **Aponurus breviformis** Srivastava, 1939.

(Text-fig. 19.)

Manter, H. W. (1947). *Am. Midl. Nat.* **38**(2) : 353.

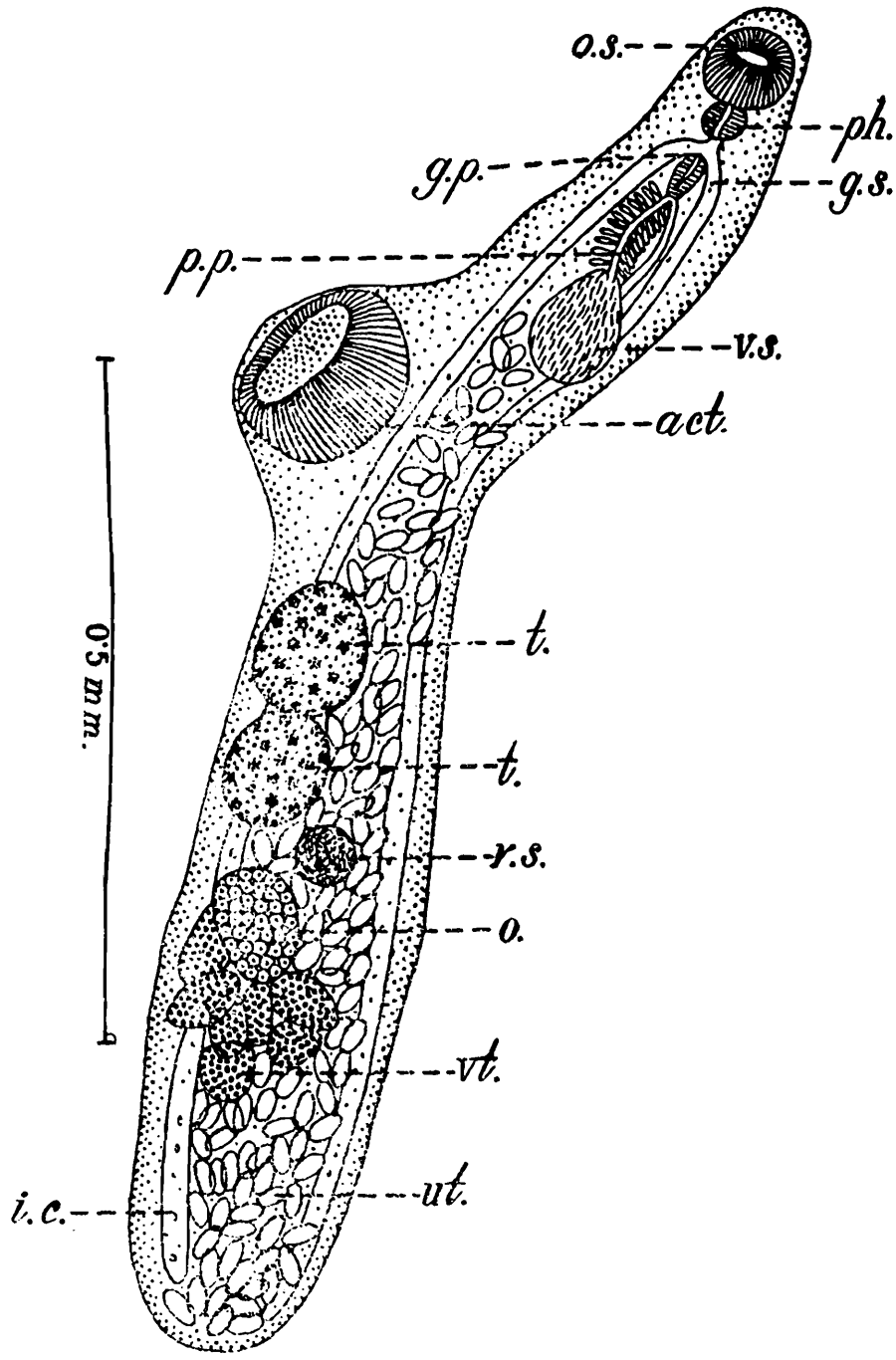
Specific diagnosis: *Aponurus* Looss, 1907 ; with Generic characters.

Body smooth, broadly rounded posteriorly, 1·08×0·2 (maximum) ; ecsoma absent. Oral sucker subterminal, spherical. Pharynx small ; oesophagus extremely short. Intestinal caeca straight, extend upto posterior end of body. Acetabulum cup-shaped, muscular, situated at the beginning of middle third of body length. Testes tandem, at the end of middle third of body. Vesicula seminalis pear-shaped, extending posteriorly upto level of anterior border of acetabulum. Pars prostatica tubular, surronded by prostate glands, its distal end uniting with uterus to form a small ductus hermaphroditicus, enclosed in sinus sac. Genital pore close behind intestinal bifurcation. Ovary 0·11×0·075, is behind posterior testis, at the anterior end of last third of body. Receptaculum seminis extremly small, spherical sac, situated obliquely in front of ovary. Shell gland mass posterior to ovary. Vitellaria consist of seven follicles, aggregated close together behind ovary. Uterus occupies entire intercaecal space posterior to vesicula seminalis. Metraterm on the left side of a Pars prostatica. Excretory bladder Y-shaped, with lateral cornua uniting dorsal to oral sucker. Eggs numerous 0·022×0·01—0·015.

Host.—*Therapon puta* Cuv. & Val.

Location.—Intestine.

Locality.—Puri, Bay of Bengal.



TEXT-FIG. 19.—*Aponurus breviformis* ; ventral view.

act., Acetabulum ; *g.p.*, Genital pore ; *g.s.*, Genital sinus ; *i.c.*, Intestinal cæcum ; *o.*, Ovary ; *o.s.*, Oral sucker ; *ph.*, Pharynx ; *p.p.*, Pars prostatica ; *r.s.*, Receptaculum seminis ; *t.*, Testis ; *ut.*, Uterus ; *vt.*, Vitellarium ; *v.s.*, Vesicula seminalis (after Srivastava).

21. **Aponurus intermedius** Manter, 1934.

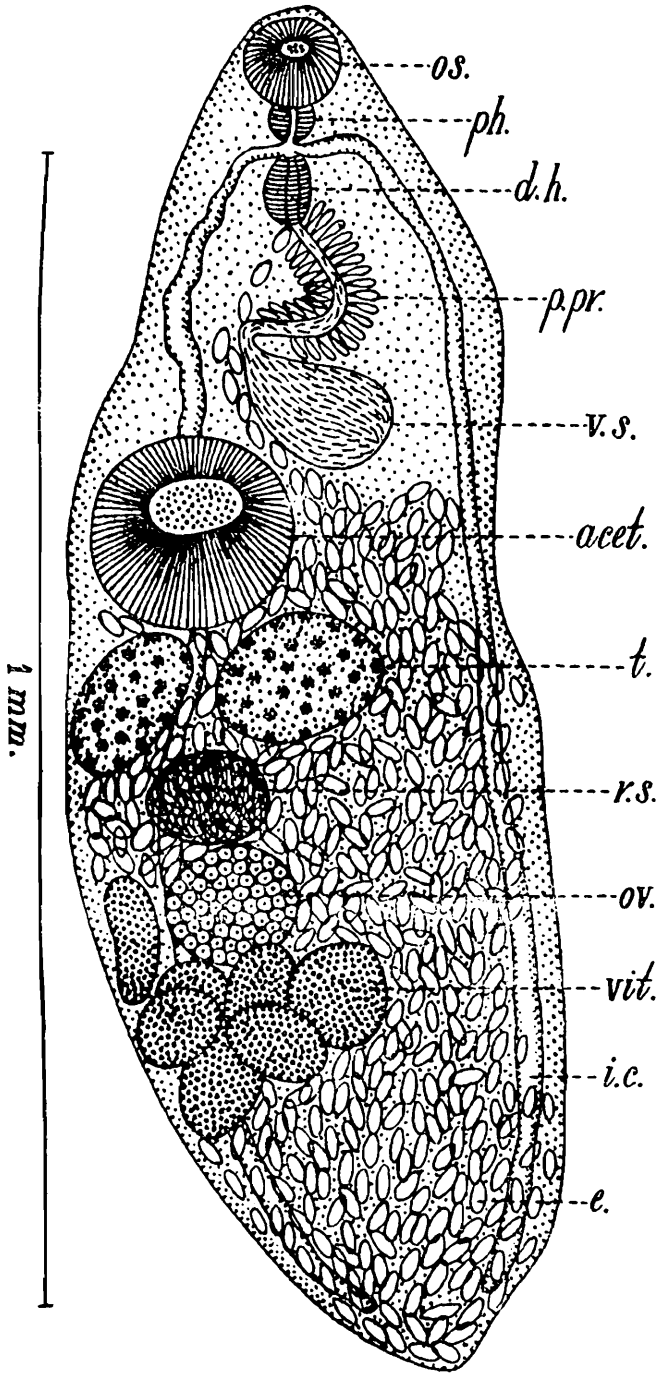
(Text-fig. 20.)

Syns. *Aponurus bengalensis* Srivastava, 1939.
Lecithophyllum fuscum Yamaguti, 1934.

Specific diagnosis : *Aponurus* Looss, 1907 ; with Generic characters.

Body smooth, cylindrical, with tapering ends, 1·2×0·45 (maximum). Oral sucker subterminal, slightly less than half the size of ventral sucker Acetabulum situated at the junction of first and middle third of body Prepharynx and oesophagus absent. Pharynx small, oval. Intestinal

caeca extend upto a little behind the posterior end. Testes situated symmetrically, close behind acetabulum. Vesicula seminalis bulb-shaped, 0·16×0·1, lying obliquely in front of ventral sucker, with its posterior end extending upto anterior third of acetabulum. Pars prostatica bow-shaped, tubular, 0·19 ; surrounded by well-developed prostate



TEXT-FIG. 20.—*Aponurus intermedius ;* ventral view.

acet., Acetabulum ; *d.h.*, Ductus hermaphroditicus ; *e.*, Egg ; *i.c.*, Intestinal caecum ; *o.s.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.pr.*, Pars prostatica ; *r.s.*, Receptaculum seminis ; *t.*, Testis ; *v.s.*, Vesicula seminalis ; *vit.*, Vitellaria (after Srivastava).

gland cells. Sinus sac 0·1×0·06. Genital pore at intestinal bifurcation. Ovary small, nearly spherical, 0·12 (diameter), situated at junction of middle and last third of body. Receptaculum seminis between ovary and testes. Vitellaria composed of seven follicles, situated behind

ovary ; one follicle lying to the right of ovary. Uterus occupies whole space behind vesicula seminalis. Excretory bladder Y-shaped. Eggs numerous, 0·03×0·015 (after description of Srivastava).

Host.—*Therapon puta* Cuv. & Val.

Location.—Stomach.

Locality.—Puri, East coast of India, Bay of Bengal.

(iii) Genus **Hysterolecitha** Linton, 1910.

Manter (1947) assigns the genus to the family *Lecithasterinae* on the basis of the absence of the ecsoma. He states that *Aponurus* is a related genus but the body is less elongated, the vitellaria are of seven rounded, separate follicles ; a seminal receptacle is present ; and the uterus, except in *A. brevicaudatus*, is more extensive posterior to the ovary extending to or beyond the tip of the caeca. He defines the genus as below.

Generic diagnosis : *Lecithasterinae* Looss, 1907 ; with Subfamily characters.

Body smooth, elongated, almost cylindrical, without ecsoma. Acetabulum in anterior half of body. Genital pore near intestinal bifurcation. Excretory crura uniting anteriorly. Testes oblique ; seminal vesicle tubular, preacetabular ; prostatic vesicle lacking ; prostatic portion of male tube separated from seminal vesicle by a non-glandular portion, as in *Aponurus*. Sinus sac small and weak, pyriform ; ductus hermaphroditicus muscular. Ovary oval, unlobed, far posterior to testes. Seminal receptacle lacking. Intestinal caeca extending posterior to uterus. Vitelline mass of 7 or 8 distinct lobes either rounded or somewhat longer than wide, ventrally fused. Eggs 22 to 34u in length.

Type species—*Hysterolecitha rosea* Linton, 1910.

Srivastava (1939) gives a key, as below, for the identification of the species under the genus :—

Key to Species of Genus Hysterolecitha Linton, 1910.

Ovary and vitellarium close behind the middle of body ..	1.	
Ovary and vitellarium in the last third of body ..	2.	
1. Oesophagus present ; genital pore behind intestinal bifurcation		*H. blepsiae.*
Oesophagus absent ; genital pore close behind oral sucker		*H. elongatus.*
2. Oesophagus present ; vitellarium in lobed masses ..		*H. rosea.*
Oesophagus absent ; vitellarium composed of eight joined lobes ..	3.	
3. Acetabulum at anterior third of body length ; vesicula seminalis extending to anterior border of acetabulum ; genital pore median ..		*H. macrorchis.*
Acetabulum at about middle of body ; vesicula seminalis extending to middle of acetabulum ; genital pore sinistral ..		*H. lintoni.*

Only one species of the genus, *viz.*, *H. lintoni* Srviastava (1939) is recorded from India.

22. **Hysterolecitha Lintoni** Srivastava, 1939.

(Text-fig. 21.)

Manter, H. W. (1947) *Amer. Midl. Nat.* **38**(2) : 359.

Specific diagnosis : *Hysterolecitha* Linton, 1910; with Generic characters.

Body muscular, smooth, elongate, cylindrical with broadly rounded ends, 3·9×1·12 (maximum). Suckers spherical, muscular ; oral subterminal. Acetabulum situated towards the end of anterior half of body ; sucker ratio 3 : 4. Prepharynx and oesophagus absent. Pharynx well developed. Intestinal caeca broad, extend up to hinder end of body. Testes small, oval, tandem, situated a little behind anterior half of body. Vesicula seminalis tubular, constricted in two parts, extending posteriorly in intercaecal space, upto middle of acetabulum, communicating anteriorly through a small narrow duct with oval pars prostatica, surrounded by a spherical mass of prostate gland cells. It unites with distal part of uterus to form a small ductus hermaphroditicus which is enclosed in a bell-shaped hermaphroditic pouch, 0·2×0·01. Genital pore lies at about the middle of pre-acetabular part of body. Ovary transversely oval, 0·2—0·28. Vitellarium composed of eight elongated oval lobes, all joined together behind ovary. Receptaculum seminis absent, but receptaculum seminis uterinum present. Shell gland complex situated dorsal to vitellarium. Uterine coils extend posteriorly by a little behind vitellarium. Excretory bladder Y-shaped, with lateral corrua uniting dorsally to oral sucker. Eggs numerous, 0·023—0·027×0·0076—0·01.

Host.—*Arius dussumieri* Cuv. & Val.

Location.—Intestine.

Locality.—Karachi, Arabian Sea (Pakistan).

(I) Subfamily *Derogenetinae* Odhner, 1927.

Syns.—*Halipegidae* Poche, 1925.
Halipeginae Ejsmont, 1932.
Liopyginae Ejsmont, 1932.

The type genus *Derogenes* Lühe, 1900, of the subfamily was placed by Lühe (1901) when he created the family *Hemiuridae*, with two subfamilies, *viz. Hemiurinae* and *Lecithasterinae*, under the latter. Odhner created the subfamily *Derogenetinae* in 1927

Subfamily diagnosis : *Hemiuridae* Lühe, 1910; with Family characters.

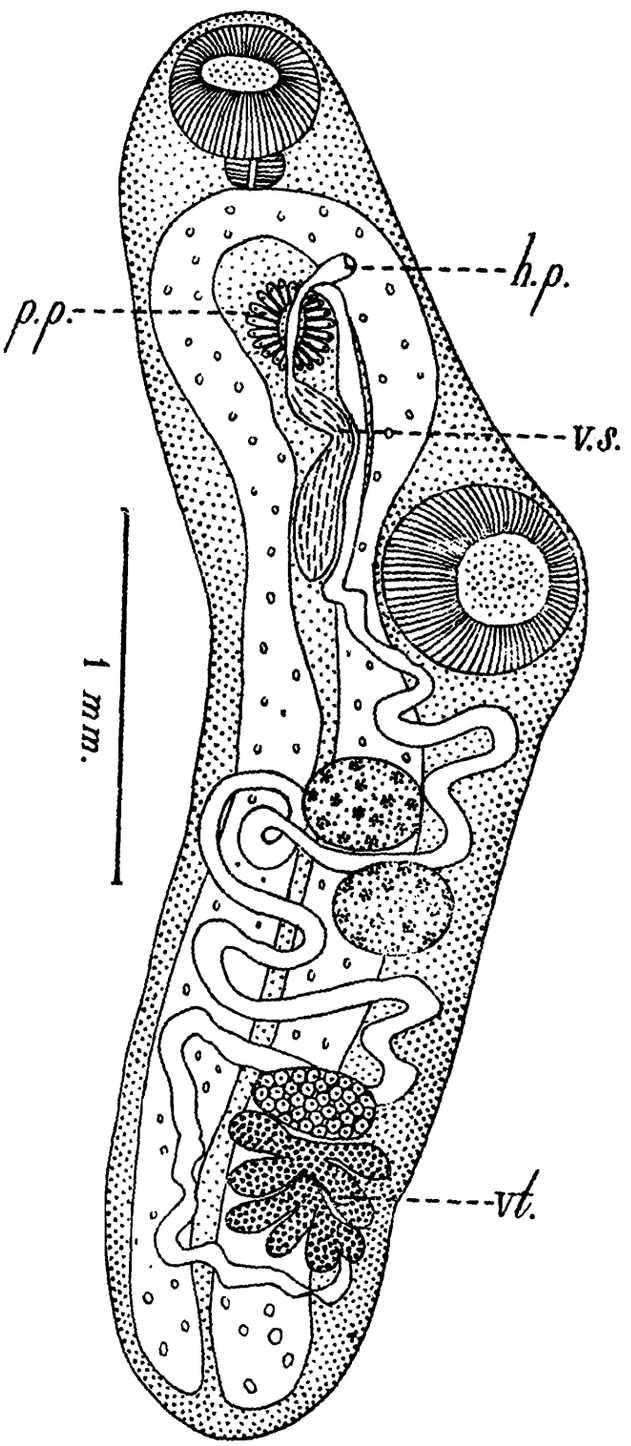
Small forms, without ecsoma or tail appendage. Genital papilla small or copulatory organ or cirrus pouch absent. Vitellaria paired and compact.

Type genus—*Derogenes* Lühe, 1900.

Manter (1934, p. 320 : 1938, p. 34) includes the following genera under the subfamily : *Bunocotyle* Odhner ; *Derogenes* Lühe ; *Derogenoides* Nicoll ; *Genarchopsis* Ozaki ; *Genolina* Manter ; *Gonocerca* Manter ; *Halipegus* Looss (Synonyms : *Vitellotrema* and *Genarchella*) ; *Hemipera* Nicoll ; *Hemiperina* Manter ; *Lipyge* Looss ; *Ophiocorchis* Srivastava ; *Progonus* Looss (Syn : *Genarches* Looss) and *Leurodera* Linton. Other genera will probably find a place here.

He states that most of these genera can be separated from each other on the basis of the following generic characters, eggs filamented or non-filamented ; intestinal caeca united or not ; testes preovarian or postovarian.

Of these genera only *Liopyge, Gonocerca* and *Hemipera* possess testes posterior to the ovary. *Hemipera* is easily recognised by its filamented



TEXT-FIG. 21.—*Hysterolecitha lintoni ;* ventral view.

h.p., Hermaphroditic pouch ; *p.p.*, Pars prostatica ; *vt.*, Vitellarium ; *v.s.*, Vesicula seminalis (after Srivastava).

eggs. *Liopyge* differs from *Gonocerca* chiefly in the extent of the uterus posterior to the ovary and testes, also in the more posterior position of the genital pore, longer prostate gland and more anterior ventral sucker,

Manter (1925, p. 16 : 1926, p. 102) gave a tabular comparison of the above three genera as follows :—

	Lioceroa.	Genocerca.	Hemipera.
Habit	Gills ..	Gills ..	Stomach.
Position of genital pore.	Somewhat distant from oral sucker.	Close to oral sucker	Somewhat distant from oral sucker.
Position of ventral sucker.	About mid-body	Posterior to mid-body.	Posterior to mid-body.
Testes	Behind one another	Behind one another	Lateral to each other.
Cirrus sac	Inclosing only male duct.	Absent ..	Inclosing prostate gland and sem. ves.
Prostate gland	Free, elongate ..	Free, short ..	Inclosed.
Seminal vesicle ..	Near ventral sucker	Near pharynx	Between suckers.
Eggs	Numerous, non-filamented.	Numerous, non-filamented.	Few, filamented.

Form, shape, size, cuticula, excretory and digestive systems are similar in all the three genera.

Gonocerca differs from *Derogenes* in extent and position of prostate gland, position of genital pore, course of uterus, and inverted position of ovary in relation to testes. These same differences except extent of prostate gland separate it from *Genarches*.

Rankin (1944) is in agreement with Manter (1938) with regard to the inclusion of certain genera under the subfamily, except in the matter of some synonymies.

The representatives of the subfamily recorded, so far, from India fall under the genera : *Genarchopsis* Ozaki, 1925 ; *Halipegus* Looss, 1899 ; *Ophiocorchis* Srivastava, 1933 ; and *Inoderogenes* Srivastava, 1941. They can be differentiated as below :—

Key to Indian Genera of Subfamily DEROGENETINAE Odhner, 1927.

1. Intestinal caeca united posteriorly .. 2.
   Intestinal caeca not united posteriorly 3.
2. Oesophageal pouch absent .. .. *Genarchopsis.*
   Oesophageal pouch present .. *Ophiocorchis.*
3. Acetabulum situated at the end of first quarter of body : Intestinal caeca do not extend up to the extreme posterior end, terminate in front of ovary, vitellaria, etc. ; ovary, vitellaria, shell gland, etc. situated in the space between the termination of the intestinal caeca and posterior end of body .. .. .. *Indoderogenes.*
   Acetabulum situated about or in middle of body ; intestinal caeca extend up to the extreme posterior end of body ; ovary, vitellaria, shell gland, ootype, etc. lie on the intestinal caeca .. .. .. *Halipegus.*

(i) Genus **Genarchopsis** Ozaki, 1925.

syns. *Vitellotrema* Guberlet, 1928.
Genarchella Travassos, Artigas and Pereira, 1928.

The genus was created by Ozaki in 1925 and assigned to the subfamily Syncoeliinae. Srivastava (1933) regards it as a synonym of *Progonus* Looss, 1899. He states that as the only distinction between the genera *Genarchopsis* and *Progonus*, *i.e.* in the extent of the uterus ceases to exist in his species, *Progonus ovocaudatum*, the identity of *Genarchopsis* and *Progonus* become quite clear.

Ejsmont (1931) considered *Genarchella* a synonym of *Vitellotrema*. Srivastava (1933) regards the genera, *Vitellotrema* Guberlet, 1928 and *Genarchella* Travassos *et al*, 1928 as synonymous to *Halipegus* Looss, 1899. Manter (1934) also considers *Genarchella* a synonym of *Halipegus*.

Yamaguti (1934), however states that *Genarchella* and *Vitellotrema* are undoubtedly synonyms of *Genarchopsis* Ozaki, 1925. Manter (1938) agrees with Srivastava (1933). He, however, states that *Genarchopsis* differs in the union of intestinal caeca and observes that although Srivastava (1933) thought *Genarchposis* a synonym of *Progonus*, the two can be distinguished-by the fact that *Genarchopsis* has filamented eggs and Srivsatava's species of *Progonus* should be *Genarchopsis piscicola* (Srivastava) and *Genarchopsis ovocaudatum* (Srivastava). He states that Srivastava is incorrect in ascribing filamented eggs to *Derogenes*.

Rankin (1944) believes that the characters found in Guberlet's genus are different enough from *Halipegus* and near enough to *Genarchopsis* Ozaki, 1925, to warrant placing the genus *Vitellotrema* as a synonym of *Genorchopsis*.

Genarchopsis Ozaki, 1925.

Generic diagnosis: *Derogenetina* Odhner, 1927; with Subfamily characters.

Worms of small size, cylindrical. Cuticle unarmed. Suckers fairly muscular, acetabulum larger than the oral sucker and situated slightly caudad of the body centre. Prpharynx absent. Bifurcation of alimentary canal occurring in the oesophagus; intestinal crura continuous at the posterior end of the body. Testes behind the acetabulum, obliquely placed one behind the other. Ovary globular, behind the left testis. Vitellaria symmetrically paired, at the end of the body, oval in form. No cirrus pouch. Genital pore median, immediately posterior to the bifurcation of the alimentary canal. Laurer's canal present. Receptaculum seminis absent. The initial part of the uterus forms a receptaculum seminis uterinum. Uterine convolutions confined between the intestinal crura, anterior to the vitellaria. Ova with filament. Excretory vesicle Y-shaped, the paired limbs uniting dorsal to the pharynx. Parasites of fishes.

Type species—*Genarchopsis goppo* Ozaki, 1925.

Two representatives of the genus have been recorded from India, so far., *viz.* *G. piscicola* (Srivastava, 1933). Manter, 1938 and *G.*

ovocaudatum (Srivastava, 1933) Manter 1938 They can be differentiated as follows :—

Key to Indian Species of Genus GENORCHOPSIS Ozaki, 1925.

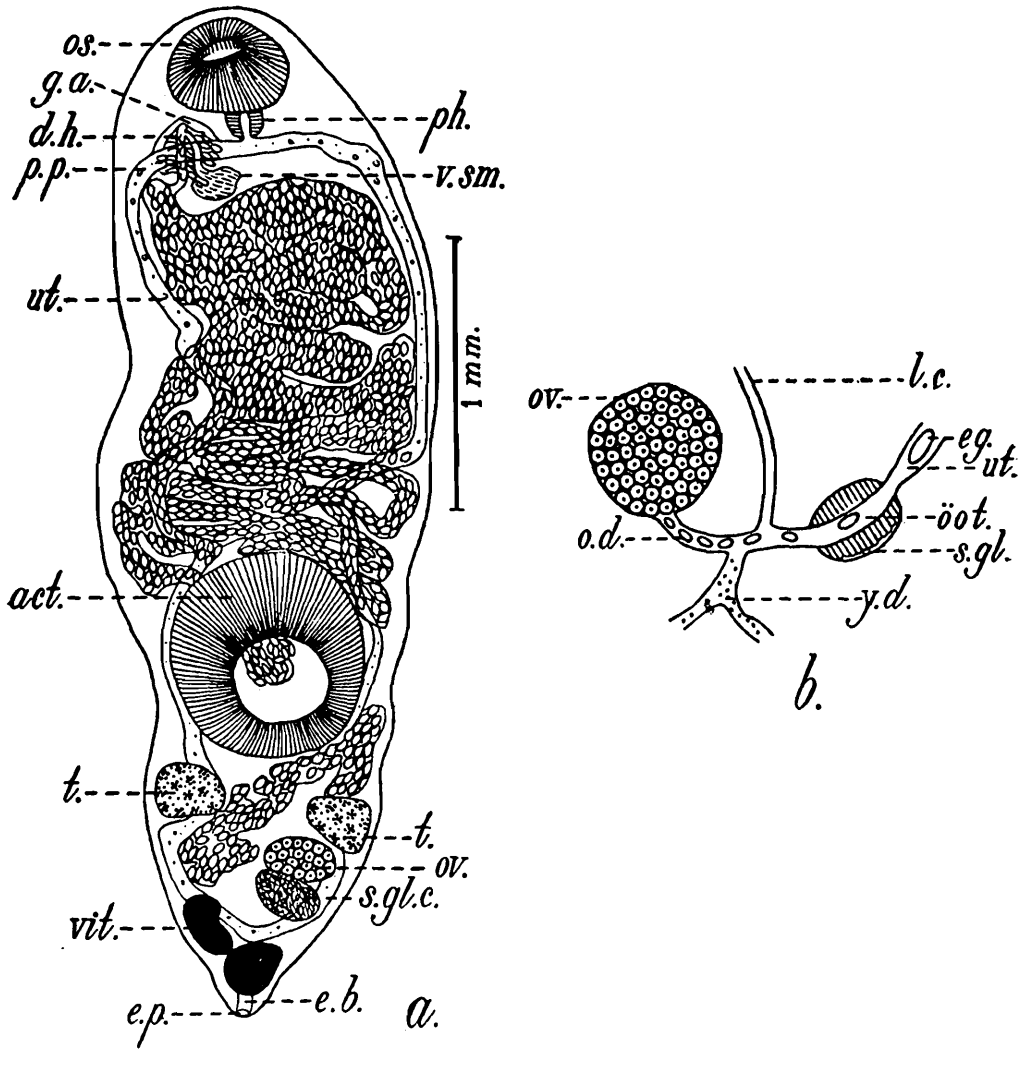
Uterus extends behind the shell gland mass reaching up to the posterior part of vitellaria .. .. .. *P. ovocaudatum.*

Uterus does not extend posteriorly up to the vitellaria .. *P. piscicola.*

23. **Genarchopsis piscicola** (Srivastava, 1933) Manter, 1938.

(Text-fig. 22 a and b.)

Syn. *Progonus piscicola* Srivastava, 1933.
Manter, H. W. (1938). *Tran. Am. Micr. Soc.* 57 (1) : 33-34.
Rankin, J. S. (1944). *Tran. Am. Micr. Soc.* **63** (2) : 149-164.



TEXT-FIG. 22a.—*Genarchopsis piscicola ;* ventral view.

act., Acetabulum ; *d.h.*, Ductus hermaphroditicus ; *e.b.*, Excretory bladder ; *e.p.*, Excretory pore ; *g.a.*, Genital atrium ; *os.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.p.*, Pars prostatica ; *s.gl.s.*, Shell gland complex ; *t.*, Testis ; *ut.*, Uterus ; *vit.*, Vitellaria ; *v.sm.*, Vesicula seminalis (after Srivastava).

TEXT-FIG. 22b.—*G. piscicola ;* diagrammatic view of femal sexual organs.

eg., Egg ; *l.c.*, Laurer's canal ; *o.d.*, Oviduct ; *öot.*, Öotype ; *ov.*, Ovary ; *s.gl.*, Shell gland ; *ut.*, Uterus ; *y.d.*, Yolk duct (after Srivastava).

Specific diagnosis : *Genarchopsis* Ozaki, 1925 ; with Generic characters.

Body muscular, cylindrical in shape, with a broadly rounded anterior and pointed posterior end, 3·3—3·4×1—12 (maximum). Oral sucker subterminal, spherical, 0·33—0·34. Acetabulum twice as large as oral sucker, situated in the first half of post equatorial region, 0·66—0·68. Pharynx spherical, muscular. Oesophagus absent. Intestinal caeca have highly crenated outline, run up to the posterior of body, where they are united, just in front of vitellaria. Testes oval, situated a little obliquely behind acetabulum, extracaecal. Vesicula seminalis an elongated coiled tube. Ductus ejaculatorius short; with few prostate gland cells and metraterm forming a small ductus hermaphroditicus. Ovary situated iner-caecally, to the right, close behind right testis. Shell gland compact. Vitellaria consist of two large, compact glands, situated asymmetrically in the extreme posterior part of body, behind posterior intestinal union. Laurer's canal present. Metraterm and receptaculum seminis absent but terminal end of uterus acts as receptaculum seminis uterinum. Posteriorly uterine coils do not extend beyond shell gland. Genital pore situated ventrally, at the level of pharynx ; Genital sinus with a highly contractile, nipple-shaped genital cone or papilla ; the ductus hermaphroditicus opening into it. Both lined by cuticle. Excretory bladder Y-shaped, two arms uniting dorsally, in the anterior end. Eggs, fairly large, numerous, 0·048×0·015, with a polar filament, 0·04 long.

The species resembles closely *G. goppo*, but differs from it in larger size ; distinctly daudad position of acetabulum ; size and ratio of suckers position of genital pore, topography of gonads, asymmetrical position of vitellaria, arrangement and extent of uterine coils.

Host.—*Ophiocephalus punctatus.*

Location.—Stomach.

Locality.—Allahabad.

24. **Genarchopsis ovocaudatum** (Srivastava, 1933) Manter, 1938.

(Text-fig. 23.)

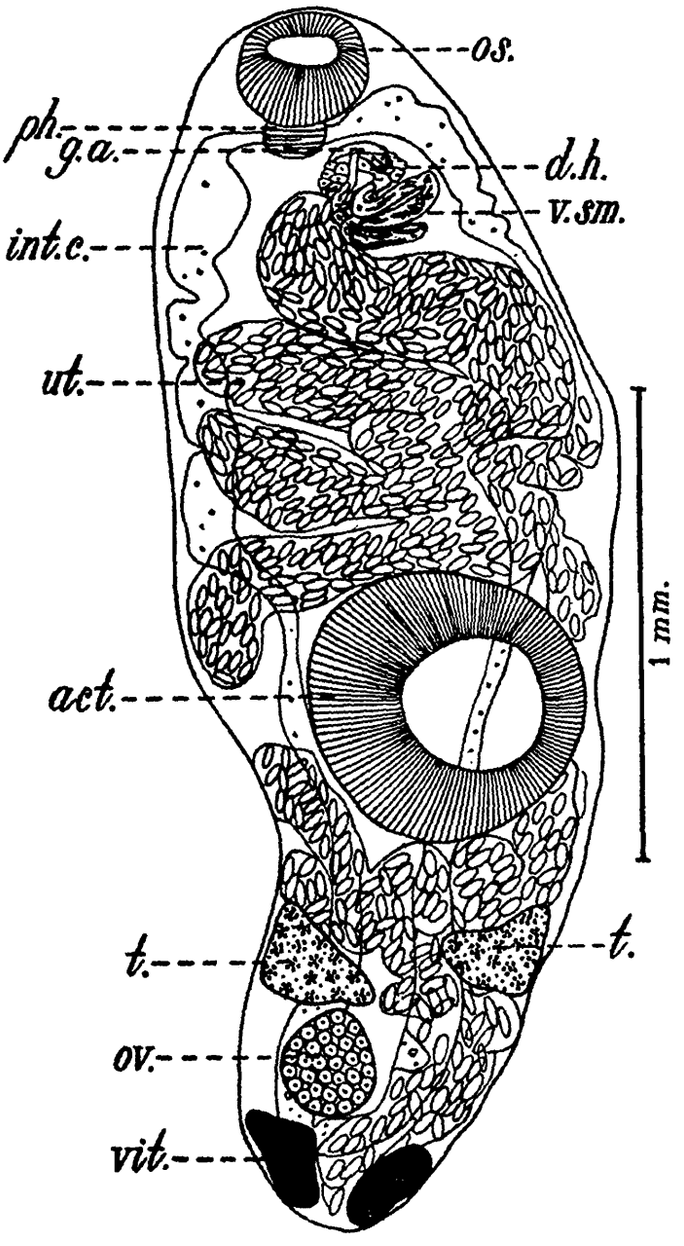
Syn. *Progonus ovocaudatum* Srivastava, 1933.

Specific diagnosis : *Genarchopsis* Ozaki, 1925 ; with Generic characters.

Body muscular, smooth, cylindrical in shape, with rounded ends, 1·5—2·3×0·5—0·8 (maximum). Oral sucker subterminal, ventrally directed, 0·048—0·64, half the size of ventral sucker. Ventral sucker 0·096—0·12, situated in the middle of body, its major portion caudad. Pharynx muscular. Oesophagus absent. Intestinal caeca with broad and sinuous outline, with marked constrictions, continuous, posteriorly, in part of vitellaria. Testes somewhat trianagular in outline, lying a little asymmetrically on either side about the middle of post-acetabular region. Vesicula seminalis curved tube, 0·4×0·05, lying in two turns, to the right, opening into terminal part of uterus, through a small ductus ejaculatorius which is surrounded by prostate gland cells. Genital pore situated just behind intestinal bifurcation. Genital atrium with a small contractile papilla. Ovary situated close behind left testis, spherical, 1·1—1·17 (diameter). Shell gland complex and Laurer's canal present. Receptaculum seminis absent. Vitellaria consists of two compact,

asymmetrical glands, one on either side, at the posterior end, behind the intestinal anastomosis. Uterine coils extend beyond the intestinal caeca on either side, up to the posterior end. Terminal part of uterus and excretory system as in *P. piscicola*. Eggs numerous, small, 0·037 × 0·17, with a small polar filament at the hinder end.

Srivastava (1933) states that this interesting species resembles *G. piscicola* in the general bodyform and size ratio of the suckers, absence of prepharynx and oesophagus, the end apparatus of the reproductive system and the lateral extension of the uterine coils. It differs, however,



TEXT-FIG. 23.—*Genarchopsis ovocaudatum* ; ventral view.

act., Acetabulum ; *d.h.*, Ductus hermaphroditicus ; *g.a.*, Genital atrium ; *int. c.*, Intestinal caecum ; *os.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *t.*, Testis ; *ut.*, Uterus., *vit.*, Vitellaria ; *v. sm.*, Vesicula seminalis (after Srivastava).

from the above species in the smaller size of body, position of the acetabulum, the course of the intestinal caeca, more caudal position of the testes, smaller size and position of the shell gland mass, the symmetrical position of the vitellaria and in the important fact that the uterine

convolutions extend posteriorly beyond the shell gland mass and lie in the space between the two compact vitelline glands at the extreme hinder end of the body. In this last character this species resembles *Progonus mulleri* (Levins).

It appears that the type specimen of *G. ovocaudatum* is comparatively a contracted specimen than the type specimen of *G. piscicola*. I am inclined to regard *G. ovocaudatum* a synonym of *G. piscicola*.

Host.—*Ophiocephalus punctatus*.

Location.—Intestine.

Locality.—Allahabad.

(ii) Genus **Halipegus** Looss, 1899.

This genus was created by Looss, 1899 for *Distomum ovocaudatum* discovered by Vulpian in 1860, parasitic in the mouth cavity and pharynx of European frogs and assigned to the family *Syncoeliinae*. Since then the disposition of the genus has been a matter of contention. It has been considered in no less than three families: *Halipegidae* Poche, 1925; *Hemiuridae* Lühe, 1901 and *Syncoeliidae* Odhner, 1927. Poche (1925) placed it under the family *Halipegidae* Poche, 1926. Ejsmont (1932) and Dolfus (1935) classify it under the subfamily *Halipeginae* Ejsmont, 1932, under the family *Syncoeliidae*. Odhner (1927), Fuhrmann (1928), Srivastava (1933), Manter (1934 : 1938) and Rankin (1944) assign it to the subfamily *Derogenetinae* Odhner, 1927; family *Hemiuridae* Lühe, 1901.

The generic diagnosis is emended by Rankin (1944) as below :—

Halipegus Looss, 1899 *emend.* Rankin, 1944.

Generic diagnosis: *Derogenetinae* Odhner, 1927 ; with Subfamily characters.

Body median to large sized, 1·5—12·0 mm. long, strongly muscular, circular in cross-section; strongly developed suckers, ventral somewhat larger than oral and located at about middle, taking up most of space between intestinal caeca ; cuticula smooth and thick ; gut with muscular, bulbous pharynx, overlapping oral sucker ; no prepharynx ; very short oesophagus, bifurcating into widely separated intestinal caeca extending almost to posterior end of body ; excretory system consisting of elongate bubous bladder, reaching almost to posterior edge of acetabulum ; bladder receives two large lateral collecting ducts, one from each side, which in turn join each other anteriorly, dorsal to oral sucker or pharynx.

Testes large, approximately same size, nearly spherical, entire, on same plane or obliquely placed, directly behind acetabulum, usually intercaecal. Seminal vesicle large, flask-shapped, near bifurcation of caeca, without cirrus. Ovary spherical, just anterior to vitellaria, median or just to one side, intercaecal, somewhat smaller than testes, entire ; seminal receptacle absent. Laurer's canal and well developed Mehlis' gland present ; uterus filling space between caeca, as thick coils, anterior and posterior to acetabulum. Genital pore median or slightly lateral at pharyngeal level. Eggs abundant, long and narrow, yellow shells,

operculated; end with filament one to four times capsule length; embryonated when shed; miracidium equipped with anterior rosette of spines and spiny cuticula. Vitellaria consisting of two groups of four to six thick follicles each, crowded in posterior tip of body behind ovary; vitelline duct very short, without a reservoir.

Miracidia develop into sporocysts in snails, followed by rediae in which characteristic cystophorous cercariae are produced. Cercariae penetrate gut of dragonfly nymphs or crustaceans to form large metacercariae free in the coelom of these second intermediate hosts. Sexually mature in eustachian tubes and mouth cavity of amphibia.

Type species—*Halipegus ovocaudatus* (Vulpian, 1860) Looss, 1899.

Key to Indian Species of Genus HALIPEGUS Looss, 1899.

Vitelline glands lobed; testes situated far behind the acetabulum, close to ovary	*H. ovocaudatus* (*Vulpian*) Looss, 1899.
Vitelline glands unlobed; testes situated close behind the acetabulum, far in front of ovary	*H. mehransis* Srivastava, 1933.

25. **Halipegus ovocaudatus** (Vulpian, 1860) Looss, 1899.

(Text-fig. 24.)

Syns. *H. longispina* Klein, 1905.
H. rossicus Isaitchikov & Zzkharow, 1926.
H. kessleri (Grebnitsky, 1872) Wlassenko, 1929.
Halipegas sp. Bhalerao, 1936.

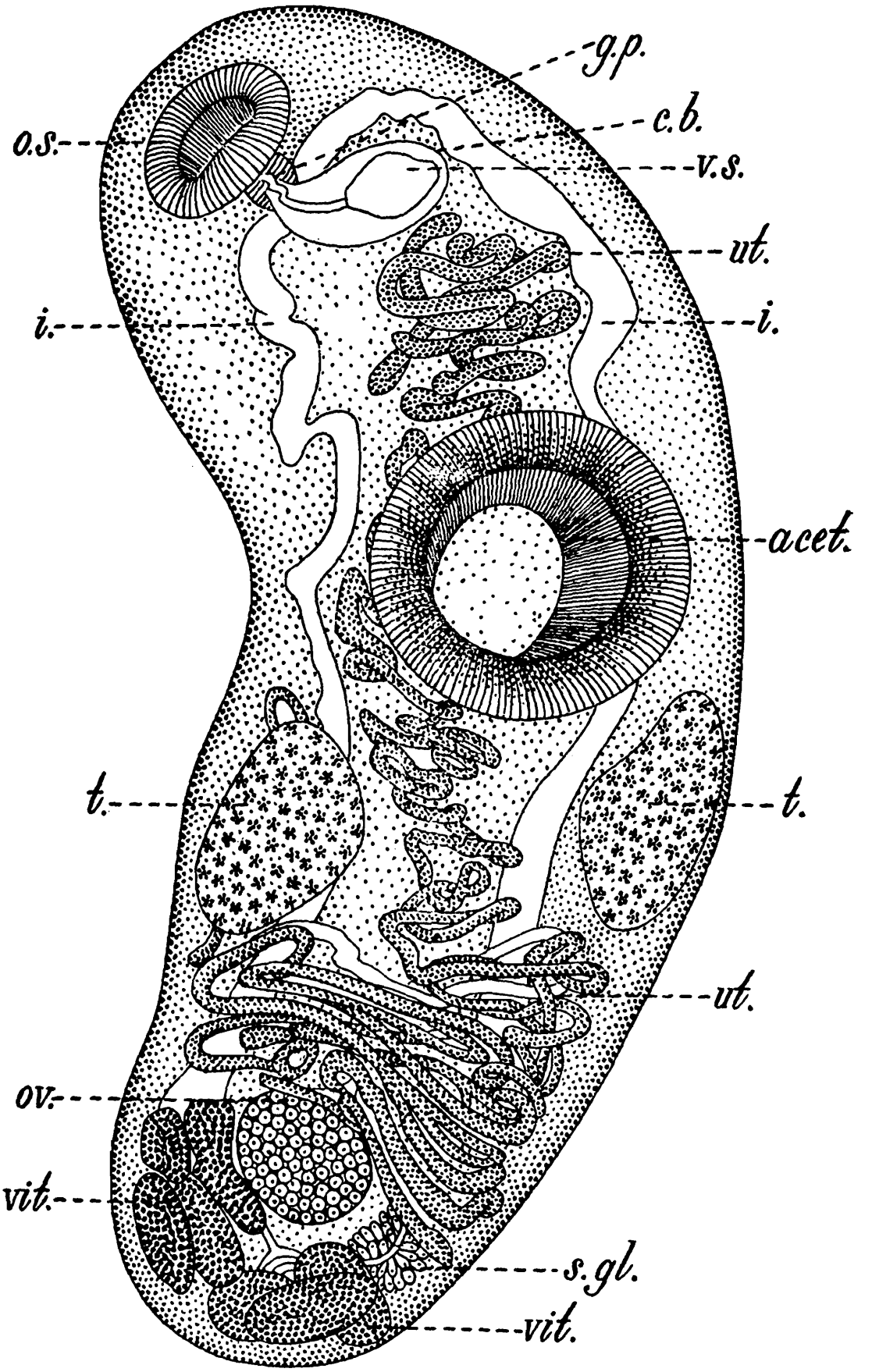
Klein, W. (1905). *Zool. Jahr.* **22**: 65-68
Bhalerao, G. D. (1936). *J. Helm.* **14** (4): 14-15.
Bhalerao, G. D. (1939). *Vol. Jub. Prof. Yohsida.* **2**: 155-159.
Rankin, J. S. (1944). *Trans. Am. Micr. Soc.* **63** (2): 149-164.

Bhalerao (1939, p. 156) creates an impression that Lühe (1905) recorded an Indian new species, as *Halipegus longispina.* It is, however, found that the species, *H. longispina* was actually created by Klein (1905) though based on material of two specimens collected from Indian frog passed to him by Lühe. Rankin (1944) states that the description and figure of Klein give an impression that they are based on highly contracted specimens, all variations of body characters falling within the range of variation of those for *H. ovocaudatus.* He therefore placed *H. longispina* as a synonym of *H. ovocaudatus* (Vulpian, 1860) Looss, 1899, the type species.

Bhalerao (1936) obtained two specimens of *Halipegus* sp. from the intestine of a frog *Rana tigrina.* at Nagpur, which he states resembled closely the species, *H. longispina.*

Rankin (1944) states that the species, *H. ovocaudatus* and *H. occidualis* Stafford (1905) (syn. *H. lermensis* Caballero, 1941) are very similar morphologically, the only outstanding difference according to Stanford, 1905, being "a short space between acetabulum and first testis (in *H. occidualis*) limiting the number of transverse folds of the uterus in this region". Rankin however states that on the basis of adult morphology

alone, one is tempted to consider these two as a single species : consideration of the life cycles, however, each with characteristic larval stages, definitely establishes the identity and validity of both species.



TEXT-FIG. 24.—*Halipegus ovocaudatus* ; ventral view.

acet., Acetabulum ; *c.b.*, Cirrus beutel ; *g.p.*, Genital pore ; *i.*, Intestine ; *o.s* : Oral sucker ; *ov.*, Ovary ; *s.gl.*, Shell gland ; *t.*, Testis ; *ut.*, Uterus ; *v.s.* Vesicula seminalis. *vit.*, Vitellaria (after Klein).

He also regards *H. lermensis* Caballero, 1941, as a synonym of *H. occidualis*.

Host.—Indian frog, *Rana hexadactyla* Less ; frog, *Rana tigrina*.

Location.—Mouth cavity ; Intestine (Bhalerao).

Locality.—Nagpur (Bhalerao).

26. **Halipegus mehransis** Srivastava, 1933.

(Text-fig. 25 *a*, *b* ; 26 , 27.)

Syns. *Halipegus mehransis* var. *minutum* Srivastava, 1933.

Halipegus spindale Srivastava, 1933.

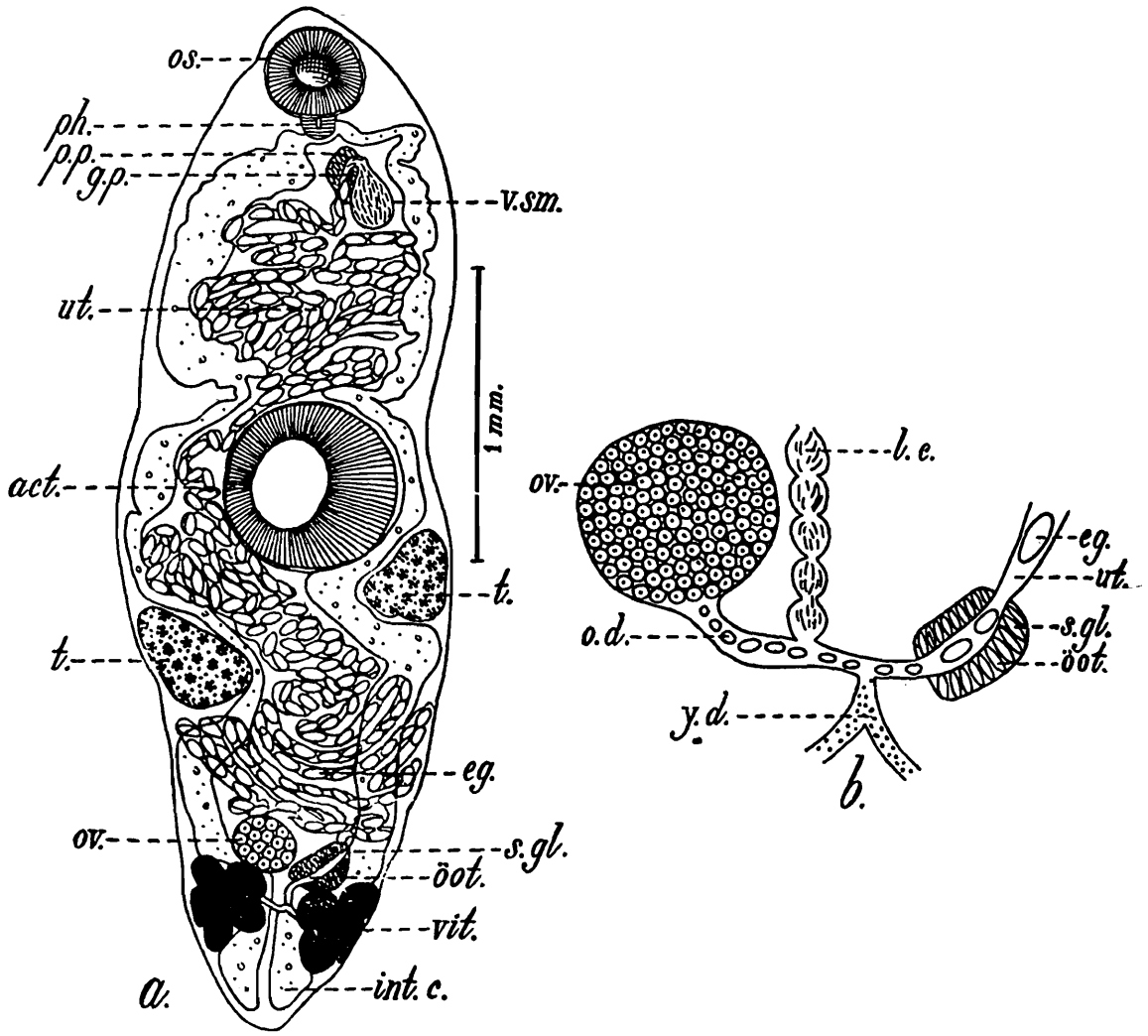
Specific diagnosis : *Halipegus* Looss, 1899 ; with Generic characters.

Body smooth, thick, muscular, spindle shaped, with bluntly pointed ends, 3·1—5·1×0·9—1·2 (maximum). Oral sucker subterminal, ventrally directed, nearly half the size of acetabulum, 0·28 (diameter). Ventral sucker situated in the middle of body, 0·5—0·72 (diameter). Pharynx present ; oesophagus absent. Intestinal caeca broad, wavy with several marked constrictions, extending up to the posterior end. Testes massive, extracaecal, roughly triangular in outline, situated obliquely, close behind the anterior half of body. Vesicula seminalis flask-shaped, situated slightly to the right, a little behind intestinal bifurcation, 0·22—0·25×0·12—0·14, narrowing anteriorly to form ductus ejaculatorius, 0·08=0·01, surrounded by prostate gland cells, lying free in parenchyma which bends downwards on the left side to open on a nipple-shapped cone or papilla, lying in the genital atrium. Genital pore ventral, usually median, a little behind intestinal bifurcation. Ovary nearly spherical, intercaecal, lying just in front of left vitelline gland close to median line. Laurer's canal present. Shell gland oblong. Receptaculum seminis absent. Vitellaria in two groups, ventral to intestinal caeca, one on each side, close behind ovary and shell gland, a little in front of blind extremities of intestinal caeca. Right vitellaria with four well marked lobes, left with five. Receptaculum seminis uterinum present. Uterus with transverse convolutions, extending laterally up to the body wall, both in front and behind ventral sucker but never extending behind the shell gland mass and vitellaria. Terminal end of uterus and ductus ejaculatorius lined internally with cuticle. Uterus opens on the genital papilla, very close to the male opening. Excretory bladder Y-shapped, two cornua uniting dorsally to pharynx. Excretory pore terminal, at the posterior end of body. Eggs numerous, with a very long polar filament, 0·045×0·018 ; filament 0·32 (length) ; seven to eight times the egg length.

Srivastava (1933) states that this species bears a very close resemblance to *H. occidualis* Stafford in the position of suckers, the extent of the intestinal caeca, lobed nature of the vitellaria, position of the gonads and the excretory pore. The important differences which mark it out as a new species are : the absence of the oesophagus, position of vitellaria and the genital pore, the union of the cornua of the excretory bladder in the region of the pharynx and not above the oral sucker, the size of the

ova and the length of their filaments which are 7 or 8 times as long as the ovum and not shorter than the latter as in *H. occidualis*.

Rankin (1944) states about this species that it resembles closely *H, occidualis*, especially in position of suckers, extent of caeca, lobed vitellaria, position of gonads and excretory pore. In as much as all species of *Halipegus* agree fairly closely in these respects, such differentiation is not valid. Likewise the characters used in distinguishing *H. mehransis* from *H. occidualis* are very variable, *i.e.* absence of oesophagus, position



TEXT-FIG. 25a.—*Halipegus mehransis ;* ventral view.

act., Acetabulum ; *eg.*, Egg ; *g.p.*, Genital pore ; *int. c.*, Intestinal caecum ; *os.*, Oral sucker ; *öot.*, Öotype ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.p.*, Pars prostatica ; *s. gl.*, Shell gland ; *t.*, Testis ; *ut.*, Uterus ; *vit.*, Vitellaria ; *v.sm.*, Vesicula seminalis (after Srivastava).

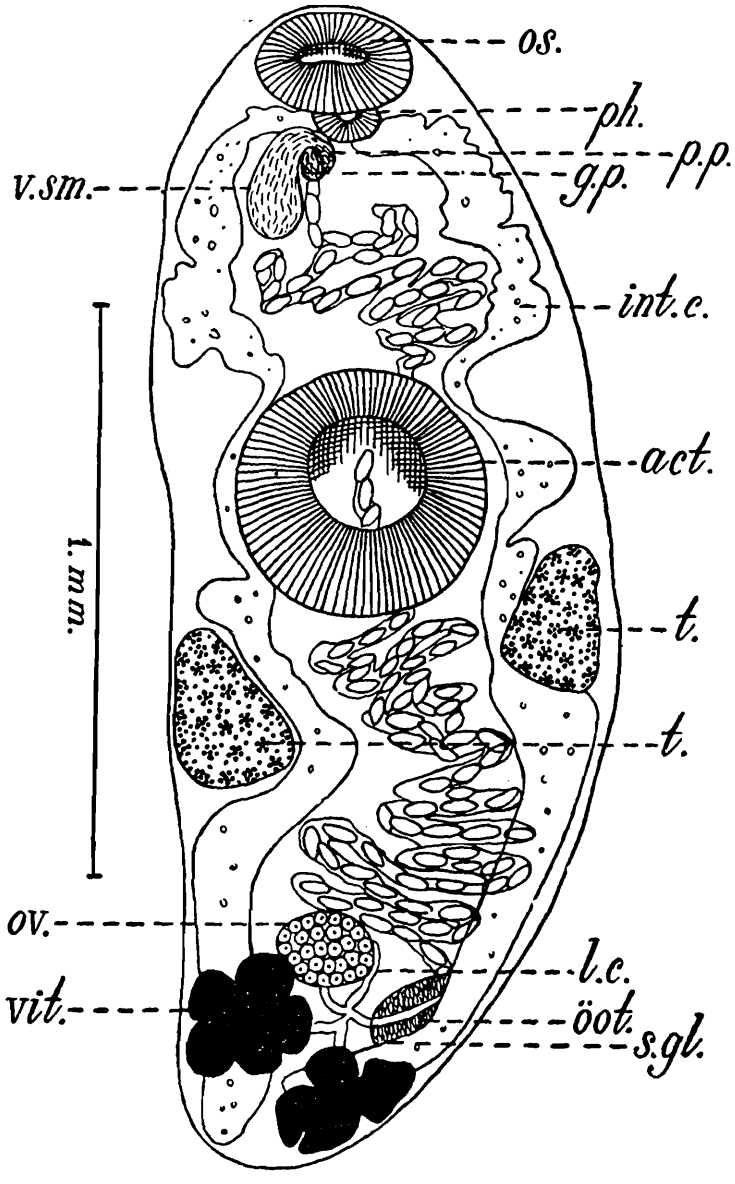
TEXT-FIG. 25b.—*H. mehransis ;* diagrammatic veiw of femal sexual organs.

eg., Egg ; *l.c.*, Laurer's canal ; *o.d.*, Oviduct ; *ov.*, Ovary ; *öot.*, Öotype ; *s.gl.*, Shell gland ; *ut.*, Uterus ; *y.d.*, Yolk duct (after Srivastava).

of vitellaria and genital pore, and union of excretory horns at pharynx, not at oral sucker. Enough difference is apparent, however, in body organ ratios to warrant maintaining this as a valid species, at least until the life cycle has been determined.

Srivastava (1933) also recorded a new variety of this species, as *Halipegus mehransis* var. *minutum*. He states that the variety shows very close resemblance to *H. mehransis* in the general form, shape and topography of various organs, but differs from it in smaller size of body and various organs ; transversely oval shape of oral sucker ; position

size and ratio of acetabulum; size of egg and its filament and the host. Bhalerao (1936) obtained some forms of *H. mehransis* which he states combined characters of both. He therefore proposed that the variety be abolished. Rankin (1944) is in agreement with this view. He observes that the description of this species (*variety*) appears to be one of a small specimen of *H. mehransis*. Bhalerao's (1936) suggestion that *H. mehransis* var. *minutus* be abolished as a valid species is followed.



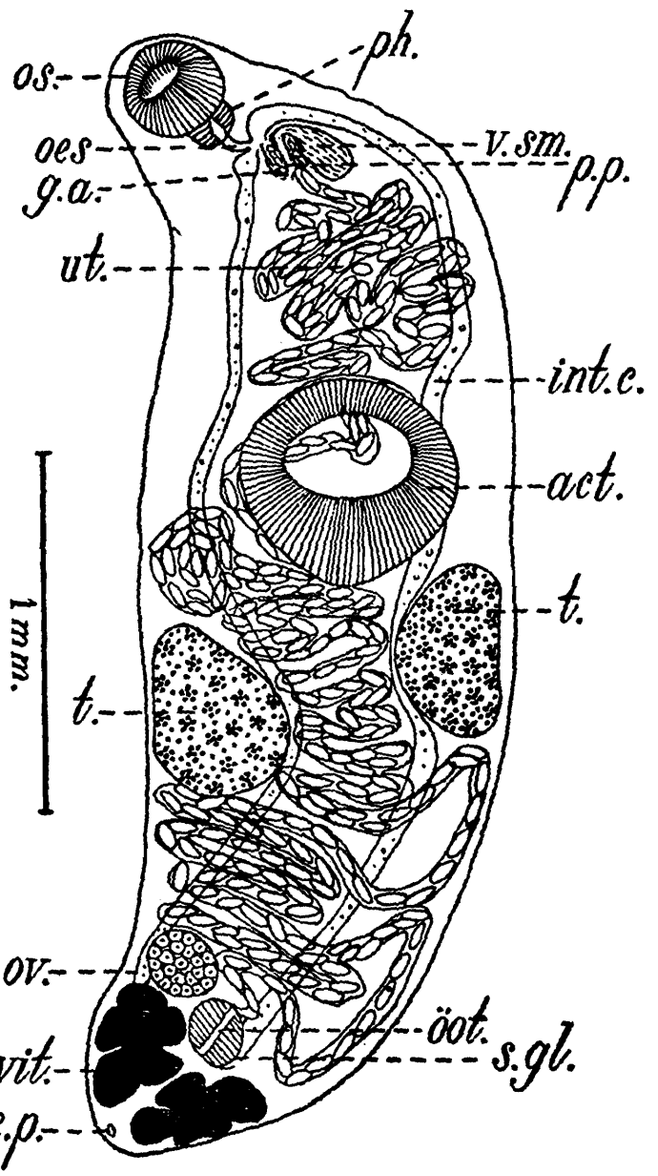
TEXT-FIG. 26.—*Halipegus mehransis*; ventral view.

act., Acetabulum; *g.p.*, Genital pore; *int. c.*, Intestinal caecum; *l.c.*, Laurer's canal; *o.s.*, Oral sucker; *ov.*, Ovary; *öot.*, Öotype; *ph.*, Pharynx; *p.p.*, Pars prostatica; *s.gl.*, Shell gland; *t.*, Testis; *v.sm.*, Vesicula seminalis; *vit.*, Vitellaria (after Srivastava).

Srivastava (1933) created another new species of the genus, as *Halipegus spindale*, based upon material collected from the same host and from the same place. He stated about its systematic position that of all the species of the genus, *Halipegus spindale* bears a close relationship to *H. mehransis* in the form of the body, position of gonads and vitellaria, the relations of the female genital ducts and in the structure of the end apparatus of the reproductive organs. It differs, however, in the following

important features which mark it out as a new species : the position and size ratio of the suckers, the presence of an oesophagus, the more or less straight and uniform breadth of the intestinal caeca ending in front of the vitellaria and the subterminal position of the excretory opening.

Rankin (1944) states about this " Here again, description is based on few (four) specimens from a single host from the same locality from which



Text-fig. 27.—*Halipegus mehransis ;* ventral view.

act., Acetabulum ; *e.p.*, Excretory pore ; *g.a.*, Genital atrium ; *int. c.*, Intestinal caecum ; *oes.*, Oesophagus ; *os.*, Oral sucker ; *öot.*, Öotype ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.p.*, Pars prostatica ; *s.gl.*, Shell gland ; *t.*, Testis ; *utr.*, Uterus ; *v. sm.*, Vesicula seminalis ; *vit.*, Vitellaria (after Srivastava).

H. mehransis is described. In all respects, *H. spindale* agrees with *H. mehransis*. It is therefore considered a synonym of *H. mehransis*".

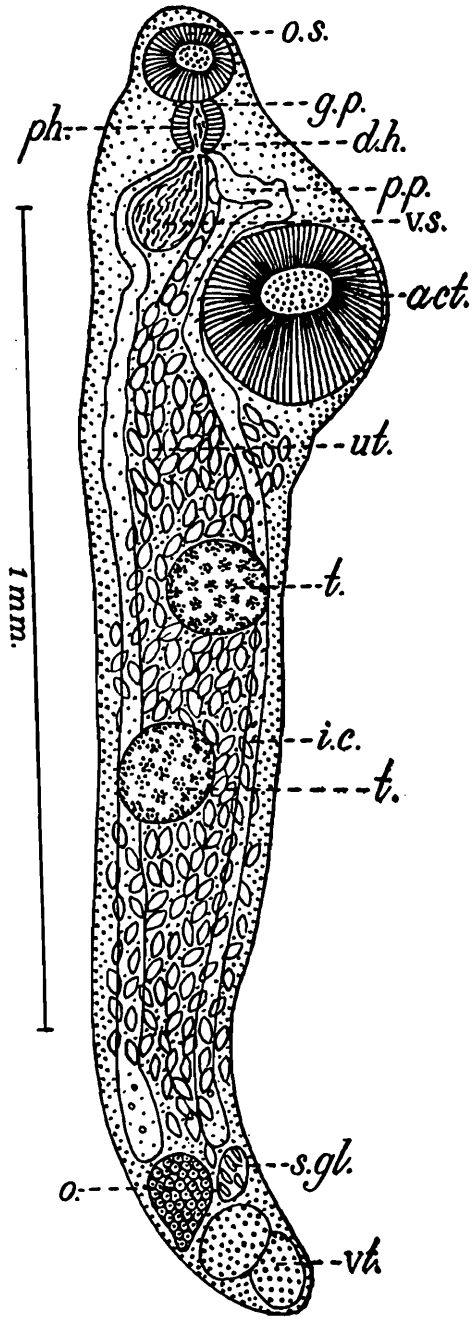
Host.—*Rana cyanophlyctis* (types) ; *Rana tigrina* (variety).

Location.—Stomach, Intestine.

Locality.—Sitapur, U.P. : Nagpur.

(iii) Genus **Indoderogenes** Srivastava, 1941.

This genus was created by Srivastava (1941). He states that it differs from all the genera of the subfamily *Derogenetinae*, to which it obviously belongs, in the markedly anterior position of the acetabulum and the relative positions of the gonads as well as in the length of the caeca and the pars prostatica. He defined the genus as follows :—



TEXT-FIG. 28.—*Indoderogenes purii ;* ventral view.

act., Acetabulum ; *d. h.*, Ductus hermaphroditicus ; *g.p.*, Genital pore ; *i.c.*, Intestinal caecum ; *o.*, Ovary ; *os.*, Oral sucker ; *ph.*, Pharynx ; *pp.*, Pars prostatica ; *s. gl.*, Shell gland ; *t.*, Testis ; *ut.*, Uterus ; *vt.*, Vitellaria ; *v.s.*, Vesicula seminalis (after Srivastava).

Generic diagnosis : *Derogenetinae* Odhner, 1927 ; with Subfamily characters.

Body small, muscular, cylindrical and smooth. Suckers well developed, situated close together in first third of body length. Acetabulum two and a half times the size of the oral sucker, lies close behind the first quarter of body length. Pharynx and oesophagus present ; caeca

terminate blindly in front of the ovary. Testes obliquely tandem, situated at about the middle of body. Vesicula seminalis flask-shaped, extending posteriorly up to the level of the anterior third of acetabulum. Pars prostatica and ductus hemaphroditicus small; genital pore situated on a small conical papilla, close behind the oral sucker. Ovary in front of the two compact oval, vitelline bodies, situated at the extreme hinder end of body. Receptaculum seminis absent. Laurer's canal preset. Uterus preovarian; eggs numerous, operculate, without filament. Excretory bladder Y-shaped, with the cornua anastomosing dorsal to the oral sucker. Parasitic in fishes.

Type species—*I. purii* Srivastava, 1941.

27. **Indoderogenes purii** Srivastava, 1941.

(Text-fig. 28.)

Specific diagnosis.—It does not appear to be very necessary to give a detailed specific diagnosis here in view of the fact that so far only one, the type species, is known, and the generic diagnosis is already given above in sufficient details.

Host.—*Chirocentral dorab* (Forskal).

Location.—Stomach.

Locality.—Puri, (Chilka lake), India.

(iv) Genus **Ophiocorchis** Srivastava, 1933.

The remarkable points of difference which necessitated the creation of this genus, according to Srivastava (1933) are the presence of a well developed, globular pars prostatica, a large and highly muscular metraterm, a protrusible ductus hermphroditicus, capable of functioning as the copulatory organ and the presence of a peculiar structure, termed by him as the "*Oesophageal pouch*"

Gupta (1951) emends the generic diagnosis as below :—

Ophiocorchis Srivastava, 1933, *emend.* Gutpa 1951.

Generic diagnosis : *Derogenetinae* Odhner, 1927 ; with Subfamily characters.

Small distomes with elongated, flattened or cylindrical body, tapering at both ends. Skin smooth, devoid of spines. Suckers well developed; prepharynx absent; pharynx well developed; oesophagus and oesophageal pouch may be present or absent. Intestinal caeca extend to the posterior end of the body where they fuse with each other forming a continuous tube. Excretory bladder Y-shapped with excretory pore at the posterior end. Genital pore variable in position, on the sides of the pharynx, on the intestinal caeca or behind intestinal bifurcation. Testes posterior to ventral sucker; ovary behind testes. Vitelline glands two, at the posterior end of the body. Cirrus sac absent, vesicula seminalis well developed lying free in the parenchyma, pars prostatica with well developed prostate glands, enclosed in a thin walled sac. Uterus with numerous coils between the intestinal bifurcation and the posterior end of the body, strongly muscular metraterm and hermaphrodite duct present. Eggs with filament on one side. Parasites of the alimentary canal of fishes.

Type species—*Ophiocorchis lobatum* Srivastava, 1933.

Srivastava (1933) described two species under the genus, *viz. O. lobatum* (type) and *O. singularis*. Gupta (1951) adds three more species, *viz. O. dasus* ; *O. indicus and O. faruquis*. I think in conformity with the International Rules of Zoological Nomenclature, the names *O. dasus* and *O. faruguis* need to be checked. Gupta (1951) also gave a key to species of the genus as below :—

Key to Species of Genus OPHIOCORCHIS Srivastava, 1933.

1. Genital pore on the side of the pharynx; behind ventral sucker	*O. indicus.*
Genital pore on the ventral side of the left intestinal caecum; near its bifurcation	*O. faruquis.*
2. Oesophagus present, oesophageal pouch absent ..	*O. dasus.*
Oesophagus absent oesophageal pouch present ..	3.
3. Vitelline glands lobed and uterine coils not extending in the region of vitellaria	*O. lobatum.*
Vitelline glands compact, uterine coils extending between the two vitelline glands	*O. singularis.*

28. **Ophiocorchis lobatum** Srivastava, 1933.

(Text-fig. 29.)

Specific diagnosis : *Ophiocorchis* Srivastava, 1953 ; with Generic characters.

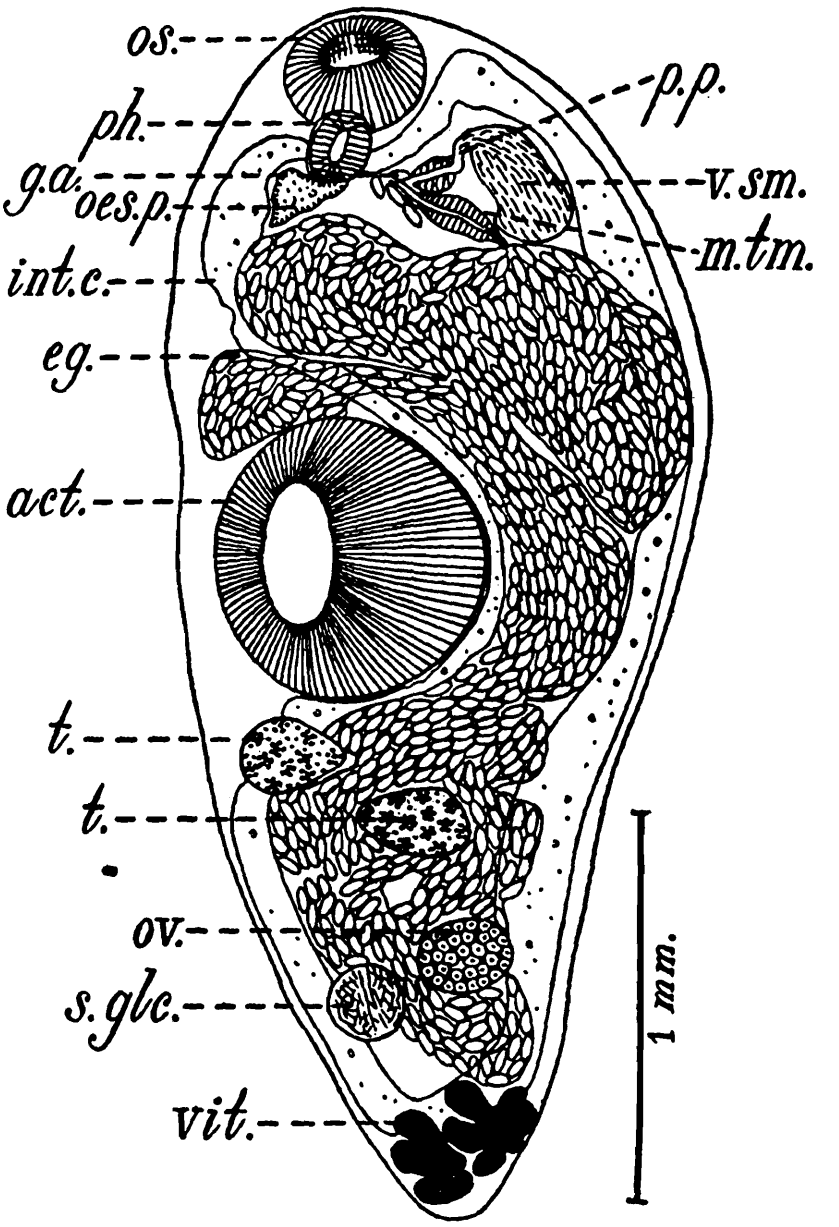
Body smooth, highly muscular, cylindrical, 2·8—3·2×1·1—1·2 (maximum). Oral sucker ventral, subterminal, 0·3 (diameter). Acetabulum situated about the middle of body, two and half time the size of oral sucker, 0·76 (diameter). Prepharynx absent. Pharynx spherical, muscular. Oesophagus absent, but a peculiar and highly contractile, pouch is given off on the dorsal side, from the junction of pharynx with the intestinal bifurcation, termed 'oesophageal pouch', lined internally with cuticle, 0·16×0·08 (maximum). Intestinal caeca broad, wavy uniting at hinder end, slightly in front of vitellaria. Testes transversely oval, lie asymmetrically one on either side, close behind acetabulum. Vesicula seminalis sac-shaped, 0·3—0·4, situated close to right intestinal caecum, anteriorly continued into a short vent neck, opening into oval, compact pars prostatica, which opens directly into terminal part of metraterm. Large number of prostate gland cells lie all round the pars prostatica. Genital pore close behind intestinal bifurcation. Ovary ovoid, situated to the right, about half way between right testis and vitelline gland. Laurer's canal and shell gland present. Receptaculum seminis absent. Vitellaria consist of two lobed glands, one on either side, behind and partly overlapping caudal anastomosis of intestinal caeca. Each gland marked out into a varying number of lobes, right 5-7 and left 4-7 lobes. Receptaculum seminis uterinum present. Uterine coils transverse, extending up to bodywall laterally, posteriorly not extending in the region of vitellaria. Metraterm, well-developed and muscular, receiving pars prostatica at its distal end and continuing as a muscular protrusible ductus hermaphroditicus, capable of functoin as a copulatory

organ. Excretory system as in *Progonus*. Eggs, 0·045×0·02, with polar filament, 0·05—0·06 in length, at its posterior end.

Host.—*Ophiocephalus striatus.*

Location.—Stomach.

Locality.—Lucknow.



TEXT-FIG. 29.—*Ophiocorchis. lobatum ;* ventral view.

act., Acetabulum ; *eg.*, Egg ; *g.a.*, Genital atrium ; *int. c.*, Intestinal caecum ; *m.tm.*, Metratem ; *oes. p.*, Oesophageal pouch ; *os.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.p.*, Pars prostatica ; *s.gl.c.*, Shell gland complex ; *t.*, Testis ; *vit.*, Vitellaria ; *v. sm.*, Vesicula seminalis (after Srivastava).

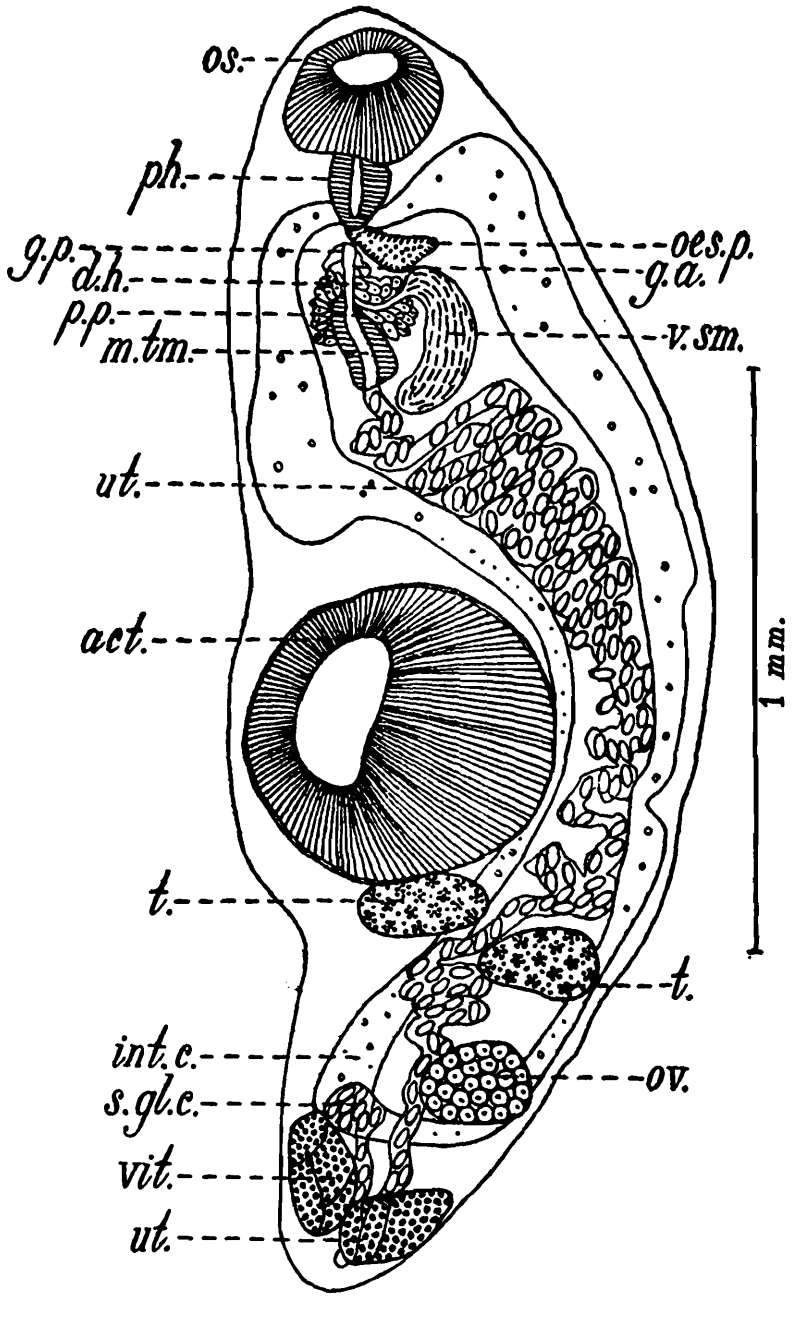
29. **Ophiocorchis singularis** Srivastava, 1933.

(Text-fig. 30.)

Specific diagnosis : *Ophiocorchis* Srivastava, 1953 ; with Generic characters.

Body small, smooth, muscular, cylindrical, 1·96×0·72 (maximum). Oral sucker subterminal, ventral, 0·22 (diameter). Acetabulum cauded, twice the size of oral sucker, 0·46 (diameter). Prepharynx absent. Pharynx muscular. Oesophageal pouch 0·13×0·05. Intestinal caeca

unite posteriorly, in front of vitellaria. Testes oval, situated asymmetrically, one on each side of acetabulum. Vesicula seminalis sac-shaped, 0·27—0·06. Pars prostatica oval. Metraterm muscular. Genital pore median, close behind intestinal bifurcation. Ovary nearly spherical, intracaecal, situated on the right, just in front of intestinal union. Shell gland complex present. Laurer's canal present. Receptaculum seminis



TEXT-FIG. 30.—*Ophiocorchis singularis*; ventral view.

act., Acetabulum; *d.h.*, Ductus hermaphroditicus; *g.a.*, Genital atrium; *g.p.*, Genital pore; *int. c.*, Intestinal caecum; *m.tm.*, Metraterm; *oes. p.*, Oesophageal pouch; *os.*, Oral sucker; *ov.*, Ovary; *ph.*, Pharynx; *p.p.*, Pars prostatica; *s. gl. c.*, Shell gland complex; *t.*, Testis; *ut.* Uterus; *vit.*, Vitellaria; *v. sm.*, Vesicula seminalis (after Srivastava).

absent. Vitellaria two compact, asymmetrically placed behind intestinal union. Glands do not possess clearly marked off lobes but have a compact appearance. Uterus in transverse convolutions, confined to intercaecal area; posteriorly it extends between two vitelline glands. Metraterm

muscular. Ductus hermaphroditicus muscular, 0·12, capable of protruding out and functioning as copulatory organ. Genital atrium present, 0·075 (deep). Eggs, 0·035×0·017 with a polar filament, 0·012 at one end.

The species bears a close resemblance to type species. Points of similarity are presence of an oesophageal pouch, metraterm, pars prostatica and topography of gonads. It differs in the smaller size, extent of uterine coils, position and size of acetabulum and compact nature of vitellarium.

The species is based only on a single specimen. If the little differences, specially invariable characters, can be regarded as individual variations, the species will probably become a synonym of the type species, if the genus is established as a strong one. Recently Gupta (1951) records species under the genus which are without any oesophageal pouch and with compact vitelline glands or it is present only in some specimens of the same species (O. *indicus*).

Host.—*Ophiocephalus striatus.*

Location.—Intestinal caeca.

Locality.—Sitapur, U. P. (India).

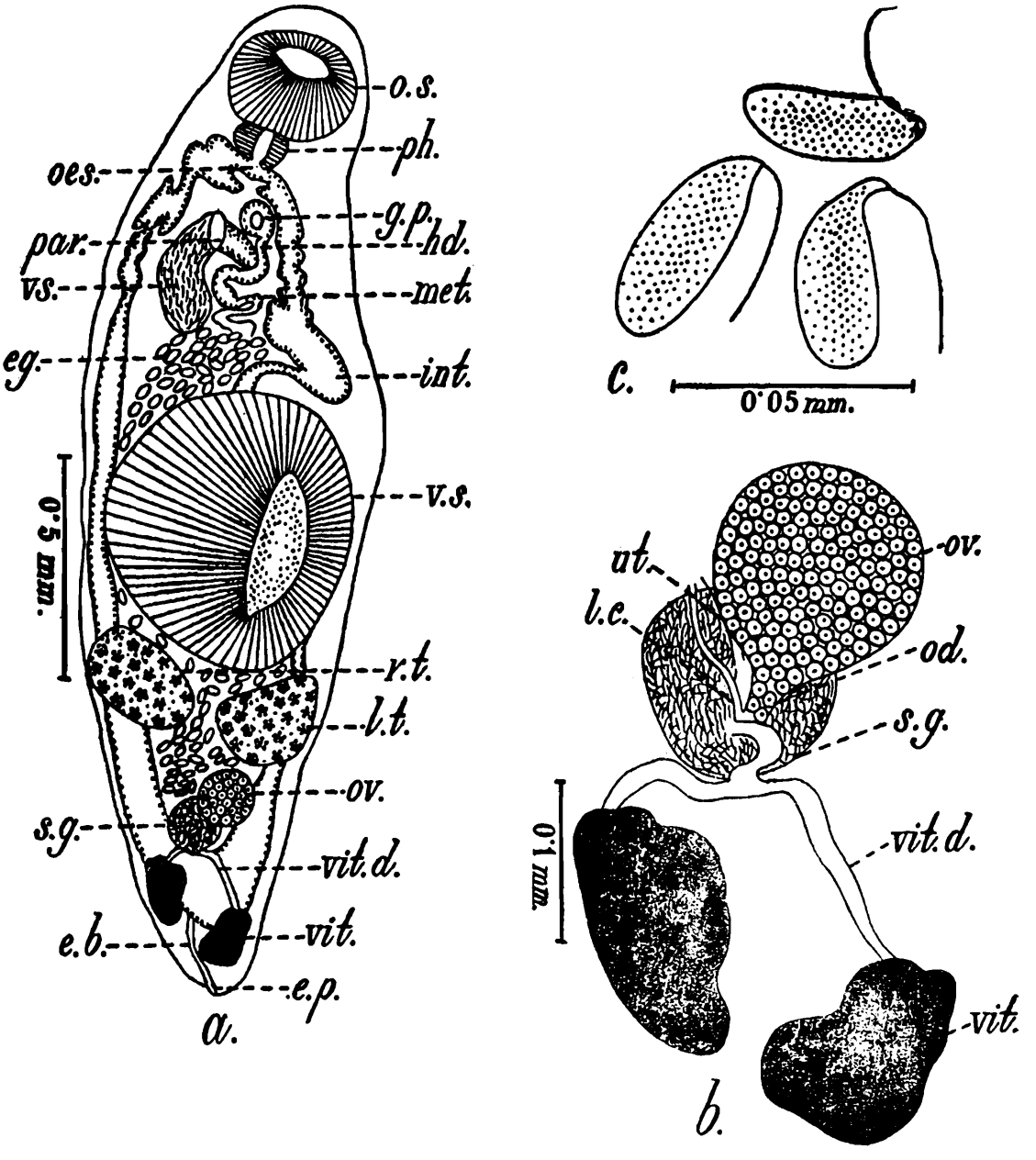
30. **Ophiocorchis dasus** Gupta, 1951.

(Text fig. 31, *a*, *b*, *c*.)

Specific diagnosis : *Ophiocorchis* Srivastava, 1953 ; with Generic characters.

Body smooth, small, spindle shaped, 2·26—0·6 (maximum). Oral sucker ventral, oval, subterminal, 0·23—0·3. Ventral sucker larger than oral sucker, situated about the middle of body, 0·62—0·55. Pharynx muscular. Oesophagus small. Intestinal caeca broad and wavy with several marked constrictions join posteriorly. Testes oval, symmetrical, situated at junction of middle third with posterior third of body, just behind acetabulum. Cirrus sac absent. Vesicula seminalis sac-like cylindrical, 0·27×0·12, lies free in parenchyma between intestinal bifurcation and acetabulum. Pars prostatica surrounded by a large number of prostate gland cells ; both being enclosed in a thin wall sac, 0·15×0·06, opening into muscular terminal part of metraterm. Hermaphroditic duct muscular, 6·08. Genital pore situated behind intestinal bifurcation. Ovary oval, post testicular. Vitelline glands two, compact, asymmetrically placed, at the extreme end of body, dorsal to intestinal union. Ootype present, shell gland, compact, oval. Laurer's canal present. Uterus with transverse coils, laid both anterior and posterior to acetabulum. Excretory vessel Y-shaped, two arms extending up to acetabulum. Excretory pore terminal at posterior end. Eggs oval, 0·039—0·044×0·013—0·018 with polar filament 0·021—0·01.

The species differs from *O. lobatum* and *O. singularis*, in the presence of oesophagus, absence of oesophageal pouch, non-extension of uterine



TEXT-FIG. 31a.—*Ophiocorchis dasus ;* ventral view.

e. b., Excretory bladder ; *eg.*, Egg. ; *e. p.*, Excretory pore ; *g. p.*, Genital pore ; *hd.*, Hermaphrodite duct ; *int.*, Intestinal caecum ; *l.t.*, Left testis ; *met.*, Metraterm ; *oes.*, Oesophagus ; *os.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *par.*, Pars prostatica ; *r.t.*, Right testis ; *s.g.*, Shell gland ; *vit.*, Vitelline glands ; *vit. d.*, Vitelline duct ; *vs.*, Vesicula seminalis ; *v.s.*, Ventral sucker (after Gupta).

TEXT-FIG. 31b.—*Ophiocorchis dasus ;* showing relationship between ovary, vitellaria and various ducts.

l.c., Laurer's canal ; *od.*, Oviduct ; *ov.*, Ovary ; *s.g.*, Shell gland ; *ut.*, Uterus ; *vit.*, Vitelline glands ; *vit. d.*, Vitelline duct (after Gupta).

TEXT-FIG. 31c.—*Ophiocorchis dasus ;* eggs enlarged (after Gupta).

coils, behind shell-gland mass, in relative size of vesicula seminalis pars prostatica, hermaphrodite duct and position of genital pore.

Host.—*Ophiocephalus punctatus* (Bloch).

Location.—Stomach.

Locality.—Saharanpur Dist., U. P. (India).

31. **Ophiocorchis indicus** Gupta, 1951.

(Text-fig. 32, and *b*.)

Specific diagnosis : *Ophiocorchis* Srivastava, 1953 ; with Generic characters.

Body smooth, small, elongated, dorso-ventrally flattened, 1·84-3·15×0·27—1·19 (Type. 3·15×1·19). Oral sucker ventral, oval, subterminal, 0·29×0·39. Ventral sucker placed about the middle third of body, larger than oral sucker, 0·65 (diameter). Pharynx muscular. Oesophagus small. Oesophageal pouch visible only in some cases. Intestinal caeca broad, wavy, with several marked, constrictions, uniting at the posterior end of body. Testes oval, intercaecal, post-acetabular, overlapping each other. Vesicula seminalis long, cylindrical, lying free in parenchyma, behind intestinal bifurcation, 0·35×0·14, opening in a sac-like, pars prostatica surrounded by a large number of prostate gland cells, the latter two enclosed in a thin walled sac, 0·16—0·12. Pars prostatica through ejaculatory duct, opens into distal end of muscular metraterm, forming hermaphrodite duct, 0·16, opening through genital pore. Genital pore just behind oral sucker, at the level of pharynx. Ovary post testicular, intracaecal. Vitelline gland two, large lobed, at the posterior end, ovarlapping. Shell gland compact, spherical. Laurer's canal present. Uterus arising from Ootype laid between intestinal bifurcation and vitelline gland, in coils, transverse intra and extra caecal. Excretory bladder Y-shaped. Excretory pore terminal, at posterior end. Eggs oval, 0·041—0·305×0·018—0·021, with polar filament, 0·064—0·088.

The species is stated to differ from all other species of the genus, in the position of genital pore which is just posterior to oral sucker, on the side of pharynx ; in the structure and position of vitellaria which overlap. These, along with the relative, size and position of other organs are considered enough by Gupta (1951) to separate *O. indicus* from all other species of the genus.

In my opinion, the differences, specially with a species like *O. singularis* are not wide enough to justify a separate, good and valid species. After all there should be margin for individual variations also.

Host.—*Ophiocephalus punctatus* (Bloch).
Location.—Stomach.
Locality.—Lucknow and Saharanpur Dist., U. P. (India).

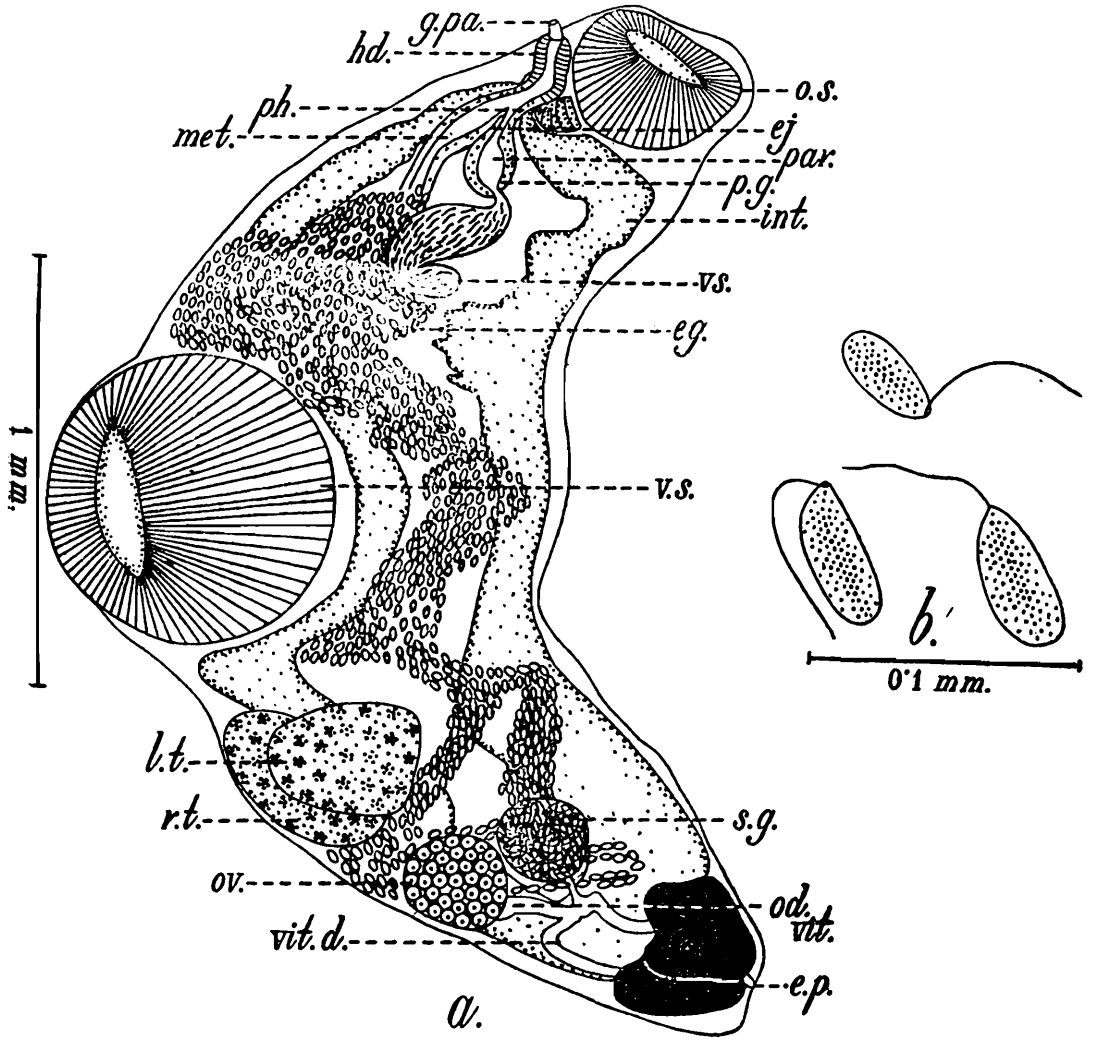
32. **Ophiocorchis faruquis** Gupta, 1951

(Text-fig. 33, *a* and *b*.)

Specific diagnosis : *Ophiocorchis* Srivastava, 1933 ; with Generic characters.

Body smooth, elongated, elliptical, 2·24—2·92×0·82—1·18 (maximum) (Type 2·54×0·95). Oral sucker subterminal, ventral and oval, 0·25×0·31. Ventral sucker larger than oral, 0·64×0·6. Pharynx muscular. Oesophagus smooth, with a small oesophageal pouch, 0·11× 0·05. Intestinal caeca broad, wavy, with marked constrictions, uniting at the posterior end. Testes large, symmetrically placed ventral to

intestinal caeca, behind acetabulum. Vesicula seminalis free in parenchyma, S-shaped, 0·41×0·07. Prostatic duct long, 0·24. Pars prostatica and prostate gland cells, enclosed in a thin walled sac, 0·23×0·09, opening into distal end of muscular metrater, the two together forming hermaphrodite duct, 0·09×0·05, opening through genital pore, on ventral side, on the left of intestinal caecum. Ovary oval, post-testicular ; oviduct arising from right side. Vitelline glands two, deeply lobed, situated obliquely very close to each other, partly overlapping posterior end, behind intestinal union. Shell gland oval, compact, situated round Ootype. Laurer's canal present. Uterus with transverse convolutions between hermaphrodite duct and vitellaria. Excretory vessel Y-shaped ; excretory pore at the posterior end, terminal. Egg oval, 0·04—0·046× 0·017—0·02, with polar filaments, 0·018—0·045.



TEXT-FIG. 32a.—*Ophiocorchis indicus ;* ventro lateral view.

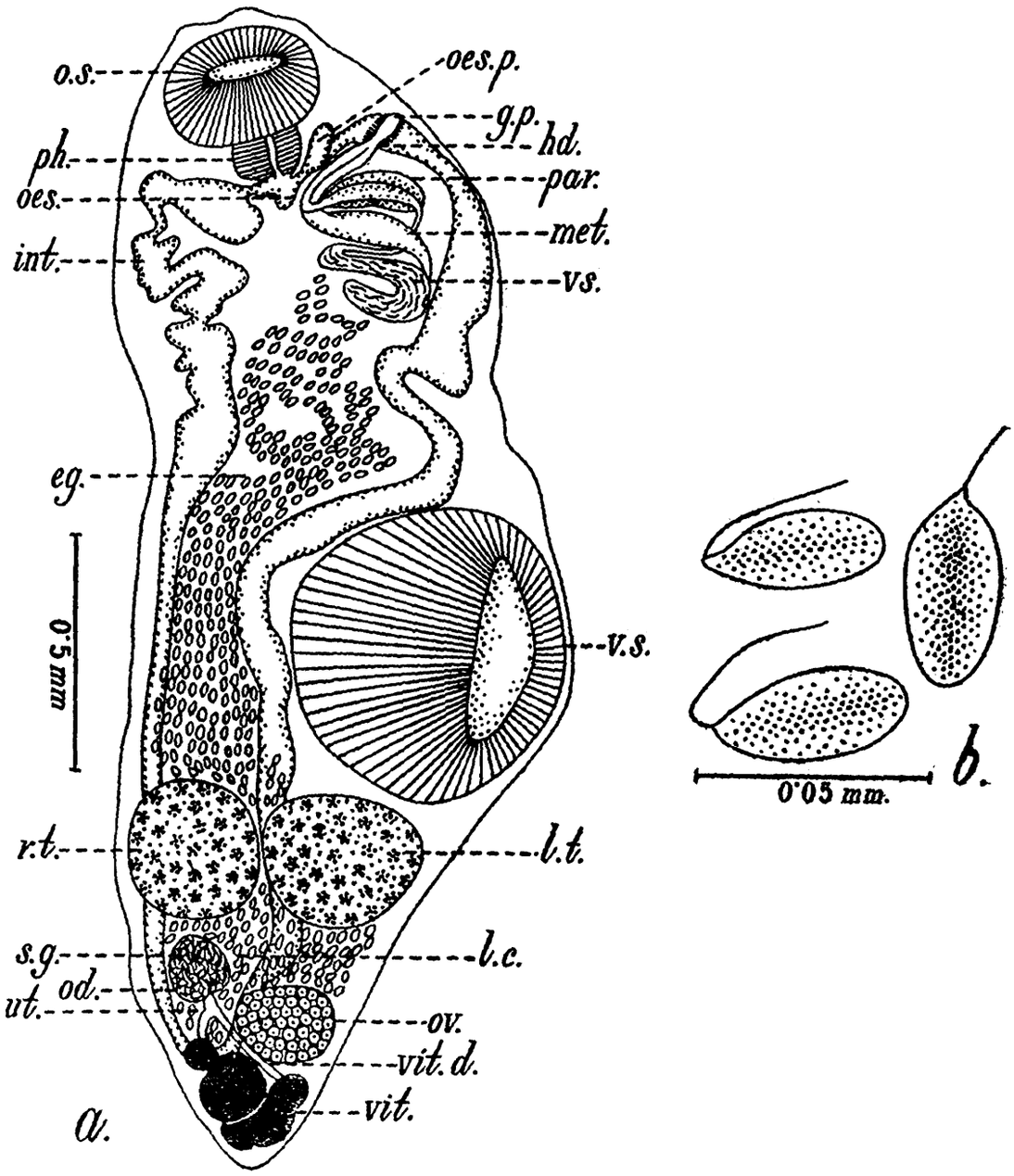
eg., Egg ; *ej.*, Ejaculatory duct ; *e.p.*, Excretory pore ; *g.pa.*, Genital papilla ; *hd.*, Hermophrodite duct ; *int.*, Intestinal caecum ; *l.t.*, Left testis ; *met.*, Metraterm ; *od.* Oviduct ; *o.s.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.g.*, Prostate glands ; *par.* Pars prostatica ; *r.t.*, Right testis ; *s.g.*, Shell gland ; *vit.*, Vitelline glands ; *vs.*, Vesicula seminalis ; *v.s.*, Ventral sucker ; *vit. d.*, Vitelline duct.

TEXT-FIG. 32b.—*O. indicus ;* eggs enlarged (after Gupta).

The species is stated to differ from all the other species, in the position of genital pore, which is on ventral side of the left intestinal caecum, in the structure and position of vitelline glands ; in the extension of uterus

behind intestinal union up to vitelline gland, in the asymmetrical position of testes and in relative size of other organs.

It appears to be synonymous to *O. singularis*. As a matter of fact, I would suggest that except the type species, *O. lobatum* which always has oesophageal pouch and vitellaria distinctly lobed, comparative study of all other species with vitellaria pact or partly lobed be made, to see if



Text-fig. 33a.—*Ophiocorchis faruquis ;* ventral view.

eg., Egg ; *g.p.*, Genital pore ; *hd.*, Hermaphrodite duct ; *int.*, Intestinal caecum ; *l.c.*, Laurer's canal ; *l.t.*, Left testis ; *met.*, Metraterm ; *od.*, Oviduct ; *oes.*, Oesophagus ; *oes. p.*, Oesophageal pouch ; *o.ss*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *par.*, Pars prostatica ; *r.t.*, Right testis ; *s.g.*, Shell gland ; *ut.*, Uterus ; *vit.*, Vitelline glands ; *vit. d.*, Vitelline duct ; *vs.*, Vesicula seminalis ; *v.s.*, Ventral sucker.

Text-fig. 33b.—*O. faruquis*, eggs enlarged (after Gupta).

all of them could be combined into one or two good species on the basis of some strong and non-variable characters, say the nature of their vitellaria, presence or absence of oesophageal pouch, etc., and after leaving due margin for individual variations.

Host.—Fresh water fish, *Mastacembelus armatus* (Lacep.).
Location.—Stomach.
Locality.—Saharanpur, U. P. (India).

VII. GENERAL MORPHOLOGY, INTER-RELATIONSHIPS AND AFFINITIES IN THE FAMILY, HEMIURIDAE LÜHE, 1901.

Studies on evolution, phylogeny, affinities and inter-relationships in *Hemiuroidea* is an intricate but at the same time a fascinating subject. All types of trends and stages of evolution of convergent, divergent and parallel type are met with in the study of this group, sometimes leading to two extremes. In certain characters the family appears to be quite primitive in evolution, whereas in others very specialised one. In external morphology, the family contains some of the smallest distomes, *e.g.* some representatives of the genera *Aphanurus* and *Derogenes*, to some of the biggest known hemiurids, like *Stomachicola* (*Dinurinae*) and *Prosorchis*, which externally look like turbellarians and leeches.

As far as cuticle is concerned, it is smooth in forms like those of subfamily *Derogenetinae* which may be regarded as the lowest in the ladder, of tree of evolution in the family ; plicated in *Hemiurinae* and *Ahemiurinae* and it reaches its height in the subfamily *Dinurinae*, where it is so heavily " ringed " or annulated that it presents the appearance of saw-like cuticular dentitions on sides. The general trend appears to be for the smaller forms with poorly developed musculature to have smooth cuticle, whereas as we proceed higher and forms increase in size and the musculature develops better, the skin annulations also become more pronounced. Further studies may reveal that this fact, its absence or development may have something to do with the nature of the host of the parasites. Another noteworthy observation is that the cuticular armature appears to be less in tailless forms than in tailed ones. There are naturally certain anomolies also. In *Dinurinae* there are certain very long forms, *e.g.* species of *Dinurus*, *Lecithocladium*, etc. which have well developed cuticular plications but surprisingly enough in some big forms like *Stomachicola* and *Prosorchis* (*Prosorchinae*) the cuticle is absolutely smooth. However, the deficiency of poor development of cuticular armature in these forms has been partly met, by great development of body musculature and ventral sucker. There are also some interesting intermediate forms like *Anahemiurus* (*Hemiurinae*) and *Dinosoma* (*Sterrhurinae*) where the cuticle is neither smooth nor annulated, but is in the form of irregularly placed large cuticular spines. On one hand the forms like *Anahemiurus* show close affinity in other respects with forms of the subfamily *Hemiurinae*, like *Hemirus*, whereas on the otherhand with forms like *Dinosoma* (*Sterrhurinae*) which agrees with typical forms like *Adinosoma robustus* in almost all respect, except cuticle and is therefore included in that subfamily. *Dinosoma* in its turn shows certain affinities with *Dinurinae* through forms like *Dinurus barbatus*.

Do these facts foreshadow any clue to the possible progressive evolution of spines in the Digenea ? Here the annular cuticular rings seem to break down to form transverse rows of scales, first regularly and then probably irregularly arranged. On one hand they could disappear altogether and give rise to a condition of smooth skin as in *Sterrhurinae*

whereas on the other, progressively evolve still, to give rise to a condition, with spines, which is found so much evolved and specialised particularly in the Echinostome group of distomes.

The genus *Prosorchis* has certain resemblances with genera like *Hirudinella, Bathycotyle,* etc.

The subfamilies, *Sterrhurinae* and *Dinurinae* have a lip like structure overhanging the mouth, termed as preoral lobe. It presents various modifications probably representing different stages, in its development, in certain genera within the family, *e.g. Lecithochirium, Prosorchis,* etc. This organ may probably be acting something like a feeler.

Another peculiar structure in the subfamily *Sterrhurinae* is a pit like, slit or depression opening on the ventral side betwen the oral sucker and the acetabulum termed as pre-somatic, or pre-acetabular pit. It is a transverse, slit like depression or invagination in *Brachyphallus* but circular and small in *Lecithochirium* and *Synaptobothrium.* Lloyd (1938) thought that this pit might serve as a chemoreceptor playing some part in controlling movements of the ecsoma. It is considered to be a character of generic rank.

In *Dinurinae* (*Lecithocladium*) there is an antero-dorsal " neck hump " a muscular organ termed as " Nacken buckel ".

Another feature of interest in general morphology is a tail like appendage termed as " ecsoma " in the family. Several theories have been advanced in regard to the origin and functions of the ecsoma or tail. It is absent or extremely rudimentary in the subfamilies, *Derogenetinae, Lecithasterinae, Sclerodistominae, Ahemiurinae* but well developed in *Hemiurinae, Dinurinae* and *sterrhurinae.* In the genus, *Stomachicola* (*Dinurinae*) it is as long as two third the body length ; comparatively the cuticle of the ecsoma is thinner. It is a completely retractile, muscular organ. Looss (1907) made a significant observation in this connection. He noted the occurrence of ecsoma primarily in stomach inhabiting forms and not in the genus *Aponurus or Aphanurus* which inhabit the oesophagus nor in *Lecithaster* which is found in intestine and also that it develops largest in larger forms. Looss further suggested that the thick cuticle necessary to resist the action of the gastric juice is too thick to permit of the functions which it probably normally performs in trematodes, *i.e.* absorption of food and possibly also respiration. The ecsoma is, according to him, therefore provided with a thinner cuticle which can be retracted and protected at times when gastric acidity and enzyme concentration is high.

In *Theletrum* (Linton, 1910, p. 93) are found some ventral papillae as in some *Aspidogastrea.* It appears to be a character of parallel *evolution.*

Oral sucker in *Lecithocladium* is a deep funnel or cuplike structure provided with one median, ventral and two lateral lips projecting into its lumen or is fringed and pharynx is long, muscular, compact and cylindrical. Both are considered as generic characters. The genus *Ophiocorchis* is characterised by the presence of a peculiar structure, termed as *oesophageal pouch.* It is behind the intestinal bifurcation and is lined internally with cuticle. In *Prosorchis* also the oesophagus is

with a posterior diverticula. The two arms of the intestinal caeca are united posteriorly, in the genera, *Progonus*, *Genarchopsis*, *Ophiocorchis*, etc. Odhner (1927) observes that the posterior anastomosis of the intestinal caeca must not be given undue systematic importance. It is present in many distinctly related forms such as *Cyclocoelium*, *Progonus*, *Opicoelous*, *Coitocaecum*, *Syncoelium*, subfam. *Tetraonchinae* (*Monogenea*), etc. and therefore must be considered as an example of *parallel evolution*.

Ovary is generally pre-vitellarian, spherical, oval or dome shaped but in *Lecithaster* it is divided into four to five, elongate finger like lobes with saccular ends, united in the centre. In *Stomachicola secundus* it is just split up into four lobes. When receptaculum seminis is absent, sometimes, the initial part of uterus is full of sperms and functions as *receptaculum seminis uterinum*.

The structure of vitellaria is a greatly varied character. They are almost as a rule situated immediately behind the ovary, but amongst all the Hemiurids the genus *Dyctysarca* Linton, 1910, is unique, in having the vitellaria preovarian. It is a compact-reniform mass, in *Aphanurus* ; two compact, oval, unlobed, symmetrical bodies in *Derogenetinae*. In *Hemiurinae*., they are as in *Derogenetinae* but they may be slightly lobed. In *Sterrhurinae*, they have small, finger-like lobes and very long, thread-like processes in *Dinurinae* and greatly filamentous ramifications in *Sclerodistomatinae*. In *Prosorchis*, the convoluted vitelline tubes fill up the entire post ovarian space and anastomose amongst themselves. In *Lecithaster*, the vitellaria are unpaired, forming a seven-rayed mass and in *Aponurus* consist of seven simple round lobes.

Testes are usually two, spherical or oval, post-acetabular or pre-acetabular (*e.g.* in *Prosorchis*) in position. They are generally pre-ovarian but may be post ovarian as well, such as in *Gonocerca*, *Hemiperina*, etc. Vesicula seminalis is either a single oval or pear-shaped or simple thin-walled structure as in *Aphanurus*, *Lecithocladium*, etc. or with very thick muscular walls as in *Lecithocladium*, or tubular as in *Stomachicola*, *Aponurus*, *Tubulovesicula*, etc. It is bipartite in *Adinosoma*, *Dinosoma*, etc. and tripartite, as in *Dinurus*, *Ectenurus*, etc. Pars prostatica may be a long tubular or small bulb shaped, such as in *Stomachicola*, *Hysterolecitha*, *Dinosoma*, etc. Prostate gland cells are found well developed, almost all along the prostate duct, *e.g.*, in *Dinurus*, *Stomachicola* or confined to its anterior part as in *Ectenurus*, *Clupenurus*, etc. or confined to the posterior part such as in *Lecithocladium*. The structure of the end genital ducts of the family is very characteristic and interesting. In a way, it represents a premitive condition, in the sense that neither the male and female genital openings are separate nor the ducts open to the exterior separately. As a matter of fact a true cirrus sac or "cirrus beutel" is wanting. It is represented by ductus hermaphroditicus or a sirus sac only. This ductus hermaphroditicus is a oval or pear-shaped organ, into the base of which open the muscular end of the metraterm and the vesicula seminalis or prostatic duct. This is covered by a sac, termed as sinus sac. Prostate gland cells may be internal or mostly external to it. Cirrus pouch is absent in the subfamily *Derogenetinae*.

The subfamily *Syncoelinae* differs from the subfamily *Derogenetinae* in having a cirrus pouch.

VIII. B. Family Haplosplanchnidae Poche, 1926.

The genus *Haplosplanchnus* was created by Looss (1902) with *H. pachysomus* (Eysenhardt, 1829) as the type species. Poche (1926) created the family *Haplosplanchnidae* for the genus. Since then another genus, *Laruea* has been added to the family by Srivastava (1939). The family can be defined as below :—

Family diagnosis (*emend.*) : Superfamily Hemiuroidea Faust, 1929 with Superfamily characters.

Body small to medium sized. Cuticle smooth. Suckers well developed. Prepharynx and oesophagus short. Pharynx compact. Intestine, a simple short caecum. Ovary pretesticular. Testies single, ovoid, situated posterior to ovary. Vas deferens functioning as vesicula seminalis. Vitellaria poorly developed. Excretory bladder Y-shaped. Eggs numerous, containing miracidium.

Type species.—*H. pachysomus* (Eysenhardt, 1829) Looss, 1902
syns. *Distoma pachysoma* Eysenhardt, 1829.
Podocotyle pachysomum (Eysenhardt, 1829), Stossich, 1898.

In my opinion the family name should be *Haplosplanchnusidae* and not *Haplosplanchnidae* as the name of genotype is *Haplosplanchnus*.

The two genera can under the family included be differentiated as below :—

Key to Genera of family Haplosplanchnidae Poche, 1926.

Body small pyriform, broadest anteriorly ; acetabulum large deep, saccular, situated in anterior portion of body, separated by genital opening — *Haplosplanchnus.*

Body Y-shaped ; acetabulum muscular, long, tubular, club shaped situated in the larger arm of the Y-shaped body — *Laruea.*

(i) Genus **Laruea** Srivastava, 1939.
nec. Laurea Srivastava, 1937

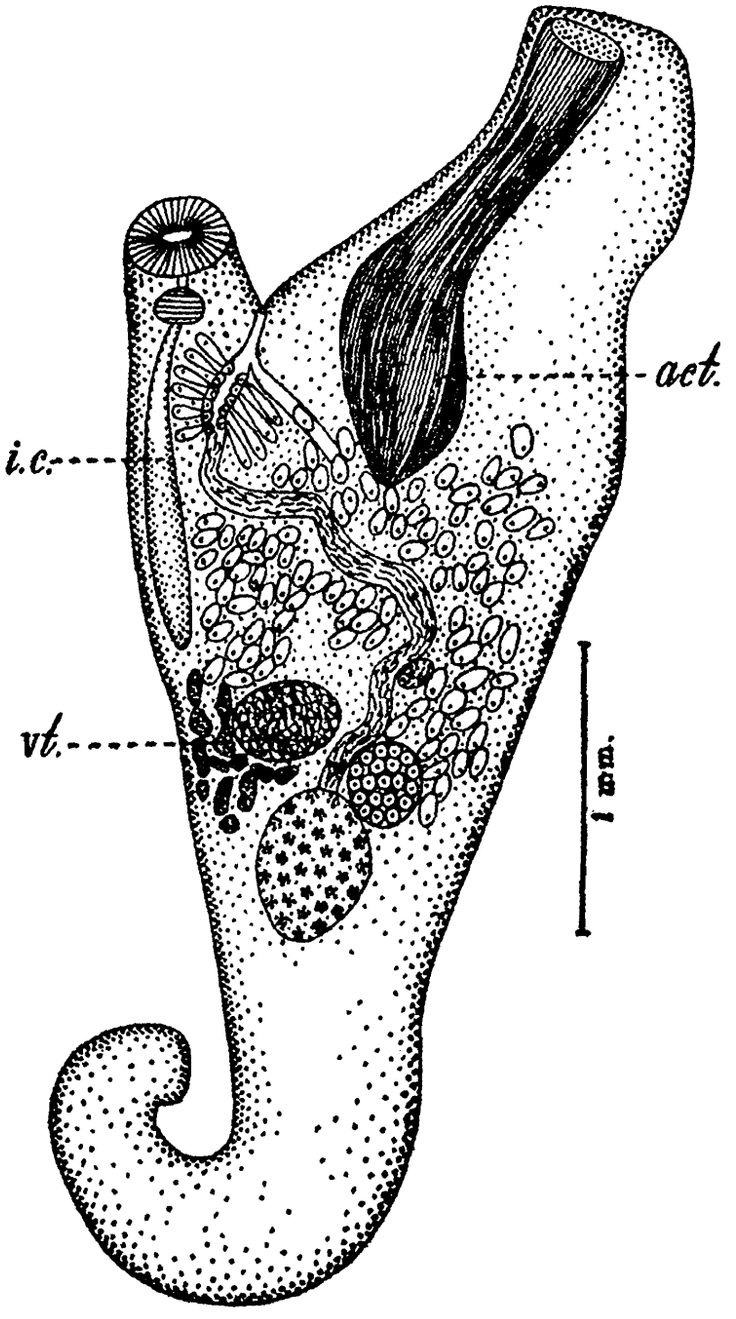
The genus is stated to differ remarkably from the type genus in the peculiar shape of its body and of the acetabulum, and in the position of its gonads and vitellaria. In all other important features the two genera are stated to be alike.

Generic diagnosis : *Haplosplanchnidae* Poche, 1926 ; with Family characters.

Medium sized, plump, smooth, Y-shaped body with unequal arms and semi-spiral posterior end. Oral sucker oval, subterminal ; acetabulum long, tubular, club-shaped and muscular, situated in the longer arm of the Y-shaped body. Prepharynx small ; pharynx small and domeshaped ; oesophagus smaller than the caecum ; caecum single, straight, ending blindly in front of the middle third of the body length. Testis oval, single, situated a little behind the anterior half of the body length. Vesicula seminalis tubular, sinuous ; pars prostatica small, oval with well developed glands and opening into a tubular genital sinus in the angle of the Y. Ovary small, spherical and pre-testicular. Receptaculum seminis and Laurer's canal present. Vitellaria poorly developed and confined to the space between the testis, ovary, blind end of caecum and

the right body wall. Uterus containing numerous eggs, with developing miracidia having prominent eyespots, is confined between the acetabulum and the testis. Terminally, uterus opens in the genital sinus independently of the male opening. Excretory bladder Y-shaped, with small, median stem and long cornua. Parasitic in marine fishes.

Type species.—*Laurea caudatum* Srivastava, 1939.



TEXT-FIG. 34.—*Laurea caudatum*.

act., Acetabulum ; *i.c.*, Intestinal caecum ; *vt.*, Vitellarium (after Srivastava).

33. **Laurea caudatum** Srivastava, 1939.

(Text-fig. 34.)

Specific diagnosis : The genus contains, at present, only one, the type species, therefore no separate specific diagnosis is considered necessary here especially as rather detailed generic diagnosis has already been given above.

Host.—*Mugil waigiensis* Quoy and Gaine.
Location.—Intestine.
Locality.—Puri, Bay of Bengal : Karachi, Arabian Sea.

(ii) Genus **Haplosplanchnus** *Looss*, 1902.

(Text-fig. 35, *H. pachysomus* ; Text-fig. 37.)

Generic diagnosis : *Haplosplanchnidae* Poche, 1926 ; with Family characters.

Body small, pyriform, broadest anteriorly. Cuticle smooth. Suckers well developed ; ventral sucker large, deep, saccular. Prepharynx short. Pharynx spherical. Oesophagus short. Intestine a simple caecum having columnar epithelium confined to the anterior region of body. Genital pore between the suckers, slightly behind the oral sucker. Genital atrium tubular. Testes single, ovoid, post ovarian, not far off from the posterior end of body. Cirrus and cirrus pouch absent. Vas deferens functions as vesicula seminalis. Ovary round, in front of testis. Vitellaria poorly developed, comprising a few follicles between the gut and testis. Uterus small, mainly an ascending loop. Excretory vessel Y-shaped. Excretory pore terminal. Eggs medium sized, thin-shelled, when laid, containing ripe miracidia.

Type species—*H. pachysomus* (Eysenhardt, 1829) Looss, 1902.

Only one species of the genus, *H. purii* has been recorded from the Indian region by Srivastava (1939). It is stated to resemble the type roughly in the shape of body, the digestive system, the general topography of the gonads and the shape of the excretory bladder and differ in the shape of its acetabulum, position of testis, character of vitellarium and the position of the genital pore, besides differences in the measurements of the various organs.

34. **Haplosplanchnus purii** Srivastava, 1939.

(Text-fig. 36.)

Dawes, B. (1947). *The Trematoda of British Fishes* : 223.
Manter, H. W. (1947). *Am. Midl. Nat.* 38(2) : 326.

Specific diagnosis : *Haplosplanchnus* Looss, 1902 ; with Generic characters.

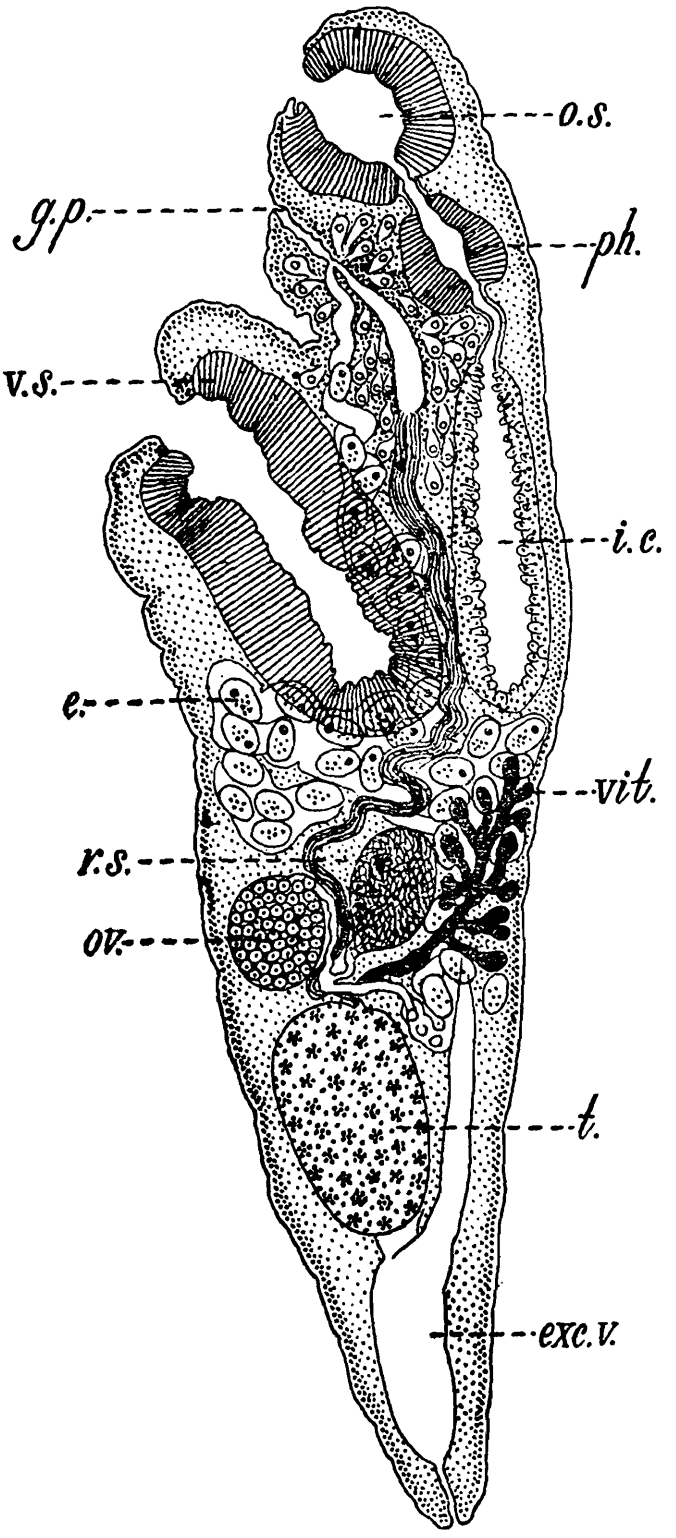
Body fleshy, smooth, roughly triangular with broad rounded off ends, 1·5—2·3×0·54—1·2 (maximum). Oral sucker anteriorly directed, cup-shaped, 0·08—0·22×0·25—0·34. Prepharynx small, narrow. Pharynx dome shaped. Oesophagus small. Intestine a tubular caecum, 0·5—0·9. Acetabulum situated at the junction of first and second thirds of body length, bowl shaped, muscular, 0·22—0·34×0·24—0·38. Testis single, ovoid, situated close to the hinder end, 0·2—0·3×0·18—0·28. Vesicula seminalis narrow, tubular, sinuous, opening into pars prostatica, which is surrounded by prostate gland cells. Genital sinus deep, narrow. Genital pore lies on a prominent conical papilla, half way between oral sucker and acetabulum. Ovary close in front of testis, separated by it only by vitellarium, 0·12—0·2×0·08—0·15. Receptaculum seminis small, spherical or oval. Shell gland complex present. Vitellarium scythe shaped, 0·15—0·43×0·04—0·08, extending from receptaculum seminis to the opposite body wall, the concavity being directed anteriorly. Uterus well developed, occupying the whole space between vitellarium, intestinal caecum, acetabulum and pars prostatica, opening terminally into genital sinus, independently of the male opening. Excretory bladder

as in Type species. Eggs a large number, operculate, 0·049—0·68× 0·023—0·034, containing developing miracidia, with prominent eye-spots.

Host.—*Mugil waigiensis* Quoy and Gain.

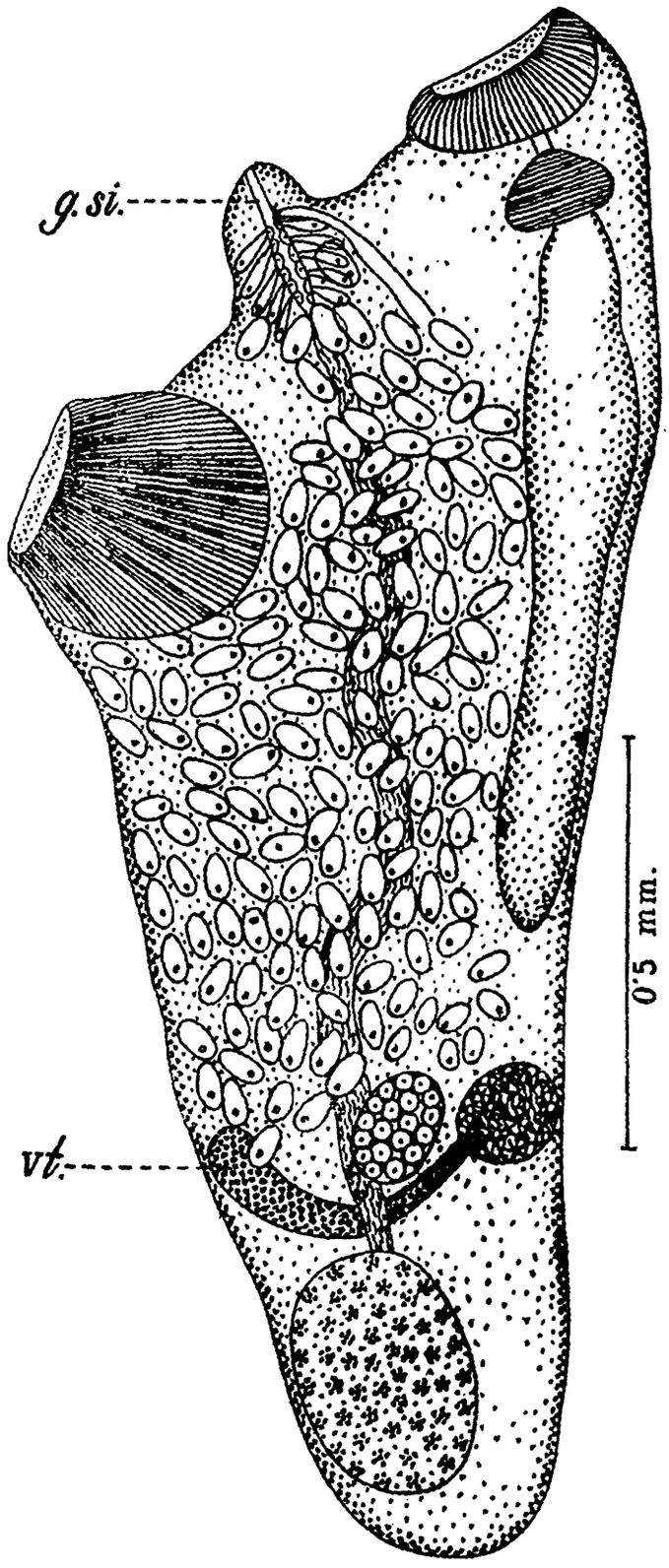
Location.—Intestine.

Locality.—Puri, Bay of Bengal : Karachi, Arabian Sea (Pakistan).



TEXT-FIG. 35.—*Haplosplanchnus pachysoma* ; median sagittal section.

e., Egg ; *exc. v.*, Excretory vessel ; *g.p.*, Genital pore ; *i.c.*, Intestinal caecum ; *o.s*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *r.s.*, Receptaculum seminis ; *t.*, Testis ; *vit*, Vitellaria ; *v.s.*, Vesicula seminalis (after Looss).



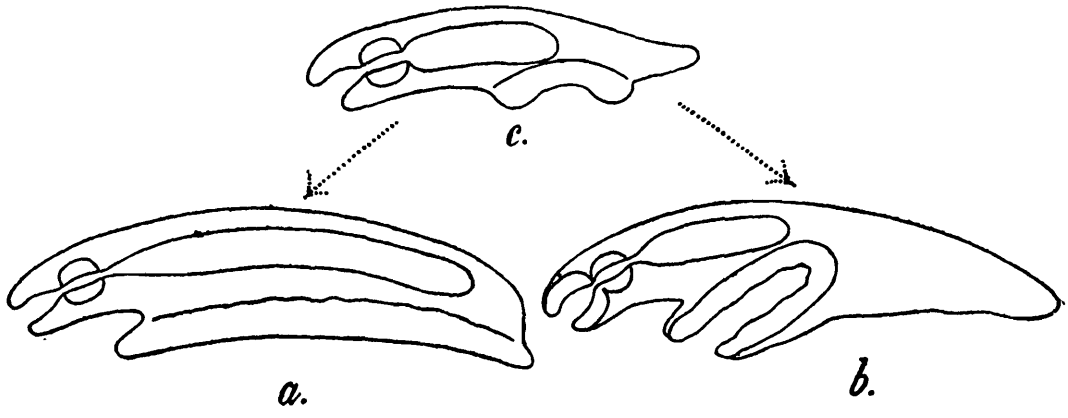
Text-fig. 36.—*Haplosplanchnus purii.*

g.si., Genital sinus ; *vt.*, Vitellarium (after Srivastava).

IX. Taxonomic position of other Haplosplanchnus species.

Linton (1910) created a genus *Deradena* with three species, *D. ovalis*, *D. acuta* and *D. obtusa* all from marine fishes at Tortugas. Linton himself noted a " superficial " similarity of his species *Deradena acuta* to *Haplosplanchnus*. Manter (1931) pointed out that *Deradena* possessed a single caecum and was therefore similar to *Haplosplanchnus* Looss. Manter (1937) after examining probably the topotype material states

that *Deradena ovalis* must be considered a synonym of *Hapladena varia* Linton. I am in full agreement with this view. He, however, further states that " Linton did not indicate the type species of *Deradena* but since *ovalis* is the first species named, it is to be considered the type. The genus therefore falls a synonym to *Hapladena*" He adds that *Deradena acuta* and *D. robusta* are entirely unrelated to *Deradena ovalis*. A single intestinal caecum is present and both species are considered in the genus *Haplosplanchnus*. It may be incidentally mentioned here that Linton's description and figure do not convey this idea. Regarding *Deradena acuta* he records " the rami of intestine appear to extend nearly to the posterior end " etc. His figure (No. 159) is equally unhelpful to throw any more light. Regarding *Deradena obtusa* again Linton states " the rami of the intestine extend to the posterior end and his figure (No. 160) shows actually two ramii. It may however be stated that the figures of these two species given by Manter (1939) show only one ram



TEXT-FIG. 37. *a,b,c.*

Diagrammatic representation of the relation of an adult *Aspidogaster* (*a*) and the genus *Haplosplanchnus* (*b*) with a young *Aspidogaster* (*c*) (after Looss).

and the description could be taken more authentic, if Manter had been actually dealing exactly with Linton's form and not different. Therefore if Linton's type material is later on found to consist of two instestinal caeca, then in my opinion, these two species will also probably have to be transferred to the genus *Hapladena* and the genus *Deradena* going in synonymy to *Hapladena*. However, if they are the forms with which Manter had been dealing I would like to point out here, that apart from other characters, the nature of vitellaria as indicated by Manter, in his diagrams for both *H. obtusus* (Linton) Manter, 1937 and *H. acutus* (Linton) Manter, 1937 along with that of his other species of the genus, *viz. H. sparisomae* Manter, 1937 ; *H. brachyurus* Manter, 1937, *H. pomacentri* Manter, 1937, *H. adacutus* Manter, 1937 and *H.* girellae Manter, 1951 is so fundamentally different from that of the type species of the genus *Haplosplanchnus* that we may have to retain Linton's genus *Deradena*, minus *D. ovalis* Linton, 1910 and with two of his species along with five of Manter, as another valid genus under the family *Haplosplanchnidae*, with probably *Deradena acuta* (Linton, 1910) Manter 1937 as the type species. Manter himself states that " there are some

constant differences between all the Tortugas forms and *H. pachysomus* (Eysenhardt) the type. The vitellaria are much more extensive specially posteriorly, the prostatic cells much less developed unless Looss interpreted the ' neck glands ' of Linton as prostatic cells." [This was not so because Srivastava also observes them.] The eggs are definitely larger and the caecum at least longer. He adds that he prefers to consider these specific rather than generic differences and therefore all the species described by him were placed in the genus *Haplosplanchnus*.

As a matter of fact, in my opinion the two trends of evolution, met with in the studies of the vitellaria of these species is definitely of two different patterns. The one as found in the type species, *H. pachysomus* and the other as found in the various species described by Linton and Manter. The pattern of the type species, appears to be evolving more after the type of tremodode family Monorchiidae and the other on the *Hapladena* type, which appears to have certain, probably superficial, trends towards *Allocreadiidae* type, in this respect. It may, however, be clarified here that my idea may not be confused with Manter's (1935) about inclusion of the Genus *Hapladena* Linton, 1910 under the subfamily *Megasoleninae* Manter, 1935 of the amphistome family, *Opistholebetidae Fukin, 1929*. I am speaking of only one character, *i.e.*, the nature and distribution of vitellaria.

In view of these considerations, I am even inclined to propose two new subfamilies under the family *Haplosplanchnidae*; the subfamily; *Haplosplanchnusinae*, **subfam. nov.**, with the two genera, *Haplosplanchnus* Looss, 1902 and *Laurea* Srivastava, 1939; the former genus being the type genus of the subfamily and the second subfamily, *Ahaplosplanchnusinae*, **subfam nov.** with the genus, *Derodena* (Linton, 1910) as type genus, in the sense of my concept of the genus.

X. Phylogeny and affinities

From the point of view of phylogenetic studies, this aberrant group appears to be of great interest. In unpaired nature of its testis and the structure of vitellaria in general, it seems to show great affinity with the family *Monorchiidae* Odhner, 1911, but in the nature of alimentary canal it is just like *Aspidogastrids*. This point did not escape notice of Looss (1902) also, who made detailed studies on the group and his opinion which has been very beautifully given, I give below, in nutshell.

"The genus *Haplosplanchnus* (*Haplosplanchnidae*) possesses a simple sac-shaped intestine, a character, which is remarkable in that it at once separates it from most of the rest of the Distomes. Since this nature of intestine of *Haplosplanchnus* is so common with that of the so far known Aspidogastrids, it will be of interest to compare the general pattern of anatomy of an Aspidogastrid with that of a sagittal section of *Haplosplanchnus* (Text-fig. 35). If the tube-shaped ventral sucker of *Haplosplanchnus* (Test-fig. 35; V S., Text-fig. 37, *b*) opens up along its length and the hinder half of it is extended behind, it then, in fact, results in a form whose organisation very well resembles in principle with that of Aspidogastrids (Text-fig. 37, *a*). The difference in the structure of the alimentary system is limited in that in the case of the Aspidogastrids

the mouth cavity is not surrounded by a sucker of which indications are found only here and there in Aspidogastrids such as *Lophotaspis vallei*. The difference in the excretory system is exclusively this that in the case of Aspidogastrids, there is a small terminal vesicle, whereas in the case of *Haplosplanchnus* it is somewhat bigger, Y-shaped and an arm commences posterior to the testis and overlaps it. In the case of reproductive system, we have in the case of *Haplosplanchnus* only one testis, as in the case of the majority of the Aspidogastrids and a vas deferens which in the case of this functions as a sperm vesicle (Vesicula seminalis). Regarding the female organs, likewise, one hardly finds any fundamental, natural difference. The Laurer's canal and the blind, closed receptaculum seminis may replace one another. Receptaculum seminis and Laurer's canal are present in the Haplosplanchnidae, likewise a Laurer's canal which is closed in some species is present in Aspidogastrea, which may be near the posterior extremity, as in Digenea. The paired vitellaria are developed in simple outline. (In the case of *Lophotaspis* they are aggregated together, at the hinder end to form a homogeneous mass.) Lastly the terminal part of the genitalia of *Haplosplanchnus* is not remarkably different from that which we find in the case of male Aspidogastrea" (Original in German ; substance translation).

Looss (1902) further states that he is sure, that in fact, we have before us in the genus *Haplosplanchnus* a connecting link between the ' true ' Distomes and Aspidogastrea.

He states that the history of development of *Haplosplanchnus* will be found to be exactly similar to that of *Aspidogaster conchicola*, in which the young ones, after their liberation from the eggs are exactly of the shape of adults. Similarly if the miracidium contained in the eggs of *Haplosplanchnus* are liberated they will result in an animal of the form of adult *Haplosplanchnus*. He states that the young *Aspidogaster* has a simple, suctorial disc like structure, on the ventral side which forms a short cone and over it has the abdominal tip. It keeps pace with the growth or increase of the hinder abdomen and thus form a flattened adhesive disc in outline and results in the adult *Aspidogaster* from the young animal. But in the case of *Haplosplanchnus* the outline of the abdominal disc is not a flattened adhesive structure but on the contrary it increases in depth. The body grows further backwards and the body-form which resembles the form shown in the Text-fig. 37*c* is established.

Looss further thinks that this fact is a material support to the latest opinion advocated by Odhner that the *Aspidocotylea* Montic. is separate in the system of classification of Trematodes.

Recently Faust and Tang (1936) created a new subclass (*Aspidogastrea*) of the class Trematoda for Aspidogastrids and proposed that it should be treated as category of intermediate forms, between Monogenea and Digenea and equal in rank to them. I am also now inclined to concur with this view and suggest that the class Trematoda be subdivided into three *Subclasses*, as 1. *Monogenea*, 2. *Aspidogastrea* and 3. *Digenea*. The subclass *Digenea* will have to be further subdivided into two Orders, *viz.* 1. *Gasterostomata and* 2. *Prosostomata*. I propose that the

Order *Prosostomata* be further split up into two groups: Suborder *Preprosostomata*, **nov.** to accomodate the Family Haplosplanchnidae, after separating it from rest of the *Prosostomata* and the Suborder *Prosostomatida*, **nov.** to accommodate the rest of the *Prosostomata*. The main distinguishing feature of the suborder *Preprosostomata* will be the saccular intestine and the other characters as discussed by Looss (1902), mentioned above.

XI. Parasite—Host List.

List of parasites arranged according to their latest systemetic position, name of host, location, locality, etc., dealt with in this paper.

CLASS TREMATODA RUDOLPHI, 1808.

*Subclass *Digenea* (*Carus 1863*).

*Order *Prosostomata* (*Odhner, 1905*).

Parasite.	Host.
A. Suborder *PREPROSOSTOMATA*, **nov.**,	
Family Haplosplanchnusidae, **nom. nov.**,	
(*a*) Subfamily Haplosplanchnusinae, **subfam. nov.**	
i. Genus *Haplosplanchnus* Looss, 1902.	
1. *Haplosplanchnus purii* Srivastava, 1939 ..	*Mugil waigiensis* Quoy and Gaine; (Intestine) Puri.
ii. Genus *Laruea* Srivastava, 1939.	
2. *Laruea caudatum* Srivastava, 1939	*Mugil waigiensis* Quoy and Gaine; (Intestine) Puri.
(*b*) Subfamily *Ahaplosplanchnusinae*, **subfam. nov.**	
iii. Genus *Deradena* (Linton, 1910) *s. emend.*—sensu *mihi*.	
No representative recorded from the Indian region, so far.	
B. Suborder *Prosostomatida*, **nov.**	
Superfamily *Hemiuroidea* Faust, 1929.	
Family *Hemiuridae* Lühe, 1901.	
(*a*) Subfamily *Ahemiurinae* **subfam. Nov.**	
i. Genus *Aphanurus* Looss, 1907.	
3. *Aphanurus stossichi* (Monti., 1891) Looss, 1907 ..	*Clupea ilisha*, (Stomach) Allahabad, Puri Karachi (Pakistan).
4. *Aphanurus microrchis* Chauhan, 1945 ..	*Mugil parsia*, (Alimentary canal), Bombay.
ii. Genus *Ahemiurus*, **gen. nov.**	
5. *Ahemiurus karachii* (Srivastava), n. comb.	*Clupea longiceps*, (Stomach) Karachi (Pakistan).
(b) Subfamily *Hemiurinae* Lühe, 1901. No representative recorded from the Indian region, so far.	

* The scheme of classification followed in this list is as proposed by me, in this paper.

(c) subfamily *Sterrhurinae, Looss* 1907.

i. Genus *Sterrhurus, Looss* 1907.

6. *S. sihamai* Srivastava, 1937; *nomen nudum* ..	*Clupea ilisha*, (Stomach) Allahabad and Puri.

ii. Genus *Lecithochirium* Lühe, 1901.

7. *Lecithochirium polynemi, nom. nov.*	*Polynemus indicus* (type) ; *Mugil parsia ;* (alimentary canal) Bombay.
8. *Lecithochirium acutum, nom. nov.*	*Arius fulcarius ;* (alimentary canal), Bombay.

(d) Subfamily *Dinurinae* Looss, 1907.

i. *Genus Ectenurus* Looss, 1907.

9. *Ectenurus indicus* Srivastava, 1937; *nomen nudum.*	—

ii. Genus *Lecithocladium* Lühe, 1901.

10. *Lecithocladium annulatum* Chauhan, 1945 ..	*Stromateus cinereus*, (alimentary canal), Bombay.
11. *Lecithocladium carultum* Chauhan, 1945 ..	*Sciaena carulta* (type) and *Harpodon behereus* (alimentary canal), Bombay.
12. *Lecithocladium glandulun* Chauhan, 1945 ..	*Lutjanus johnii* (type) and *Mugil speiglori* (intestine), Bombay.
13. *Lecithocladium harpondontis* Srivastava, 1937, *emend.*	*Chrysophrys datnia* Ham ; (Stomach), Puri.
14. *Lecithocladium brevicaudum* Srivastava, 1937, *emend.*	*Chrysophrys bifasciata* Forsk (Stomach), Puri.

iii. Genus *Stomachicola* Yamaguti, 1934.

15. *Stomachicola muraenesocis* Yamaguti, 1934 ..	Marine eel, *Muraenesos cinereus* (Stomach) Ennur, India, *Muræns-sosnis talabonoi des* (Stomach), Bombay.
16. *Stomachicola secundus* Srivastava, 1939, *emend.* ..	*Hemirhamphus limbatus* Cuv. and Val. (Stomach), Puri.

iv. Genus *Clupenurus* Srivastava, 1935.

17. *Clupenurus piscicola* Srivastava, 1935 ..	Migratory fish, *Clupea ilisha* (Stomach), Allahabad.

(e) Subfamily *Prosorchinae* Yamaguti, 1934.

i. Genus *Prosorchis* Yamaguti, 1934.

18. *Prosorchis breviformis* Srivastava, 1936 .. Fish, *Seriolicthys bipiculatus* (Intestine), Puri.

(f) Subfamily *Sclerodistomatnae* (Odhner, 1927).

i. Genus *Isoparorchis* Southwell, 1913.

19. *Isoparorchis hypselobagri* (Billet, 1898), Odhner, 1927 .. .. .. Please see page 339.

(g) Subfamily *Lecithasterinae* Odhner, 1905.

i. Genus *Lecithaster* Lühe, 1901.

20. *Lecithaster indicus* Srivastava, 1935 .. *Clupea ilisha* (Intestine), Allahabad.

21. *Lecithaster extralobatus* Srivastava, 1935 .. *Clupea ilisha* (Stomach), Allahabad.

ii. Genus *Aponurus* Looss, 1907.

22. *Aponurus breviformis* Srivastava, 1939 .. *Therapon puta* Cuv. & Val. (Intestine), Puri.

23. *A. intermedius* Manter, 1934 .. .. *Therapon puta* Cuv. & Val. (Stomach), Puri.

iii. Genus *Hysterolecitha* Linton, 1910.

24. *Hysterolecitha lintoni* Srivastava, 1939 .. *Arius dussumieri* Cuv. & Val. (Intestine), Karachi, (Pakistan).

(h) Subfamily *Derogenetinae* Odhner, 1927.

i. Genus *Genarchopsis* Ozaki, 1925.

25. *Genarchopsis piscicola* (Srivastava, 1933) Manter, 1938 .. .. .. *Ophiocephalus punctatus* (Stomach), Allahabad.

26. *Genarchopsis ovocaudatus* (Srivastava, 1933), Manter, 1938 .. .. .. *Ophiocephalus punctatus* (Intestine), Allahabad.

ii. Genus *Halipegus* Looss, 1899.

27. *Halipegus ovocaudatus* (Vulpian) Looss, 1899 .. Indian Frog, *Rana hexadactyla* Less, (Mouth cavity), Nagpur ; ?

28. *Halipegus mehransis* Srivastava, 1933 .. *Rana cyanophlyctis* (types), *Rana tigrina* (Variety) (Stomach), (Intestine), Sitapur, U. P., India.

iii. Genus *Indoderogenes* Srivastava, 1941.

29. *Indoderogenes purii* Srivastava, 1941 .. *Chirocentrus dorale* (*Forskal*), (Stomach), Puri, Chilka Lake.

iv. Genus Ophiocorchis Srivastava, 1933.

30. *Ophiocorchis lobatum* Srivastava, 1933 .. *Ophiocephalus striatus*, (Stomach), Lucknow.

31. *Ophiocorchis singularis* Srivastava, 1933 .. *Ophiocephalus striatus*, (Intestinal caeca), Sitapur, U. P., India.

32. *Ophiocorchis dusus* Gupta, 1951 .. *Ophiocephalus punctatus* (Bloch), (Stomach), Saharanpur Dist., U. P., India.

33. *Ophiocorchis indicus* Gupta, 1951 .. .. *Ophiocephalus punctatus*, (Bloch), (Stomach), Lucknow ; Saharanpur Dist., U. P., India.

34. *Ophiocorchis faruquis* Gupta, 1951 .. *Mastacembelus armatus* (Lacep), (Stomach) Saharanpur, U. P., India.

XII. HOST PARASITE LIST.

List of hosts, with the parasites recorded from them from the Indian region, described in this work.

Host	*Parasite*
Ambassis nama	*Isoparorchis hypselobagri*
Arius dussumieri	*Hysterolecitha lintoni.*
Arius fulcarius	*Lecithochirium acutum.*
Barrbus tor	*Isoparorchis hypselobagri.*
Clupea ilisha .	*Aphanurus stossichi.*
	Sterrhurus sihamai.
	Clupenurus piscicola.
	Lecithaster indicus.
	Lecithaster extralobatus.
Clupea longiceps .	*Ahemiurus karachii.*
Chrysophrys bifasciata	*Lecithocladium brevicaudum.*
Chrysophrys datnia	*Lecithocladium harpondontis.*
Chirocentrus dorab	*Indoderogenes purii.*
Gobius giuris	*Isoparorchis hypselobagri.*
Harpodon nehereus	*Lecithocladium carultum.*
Hemirhampus limbatus	*Stomachicola secundus.*
Lutjanus johnii	*Lecithocladium glandulum.*
Mastacembelus armatus	*Ophiocorchis faruquis.*
	Isoparorchis hypselobagri.
Mugil parsia	*Aphanurus microrchis.*
	Lecithochirium polynemi.
Mugil speigleri .	*Lecithocladium glandulum.*
Mugil waigiensis .	*Haplosplanchnus purii.*
	Laruea caudatum.
Muraenesiocis cinereus .	*Stomachicola muraenesocis.*

Notopterus notopterus	*Isoparorchis hypselobagri.*
Opiocephalus gachua	*Isoparorchis hypselobagri.*
Opiocephalus marulius	*Isoparorchis hypselobagri.* *Isoparorchis hypselobagri.*
Ophiocephalus punctatus	*Genarchopsis piscicola.* *Genarchopsis ovocaudatum.* *Ophiocorchis dasus.* *Ophiocorchis indicus.*
Ophiocephalus striatus	*Ophiocorchis lobatum.* *Ophiocorchis singularis.* *Isoparorchis hypselobagri.*
Polynemus indicus	*Lecithochirium polynemi.*
Rana cyanophlyctis	*Halipegus mehransis.*
Rana hexadactyla	*Halipegus ovocaudatus.*
Rana tigrina	*Halipegus mehransis.*
Seriolichthys bipimulatus	*Prosorchis breviformis.*
Sciaena carulta	*Lecithocladium carultum.*
Stromateus cinereus	*Lecithocladium annulatum.*
Therapon puta	*Aponurus breviformis.* *Aponurus intermedius.*
——	*Ectenurus indicus.*
Wallagonia attu	*Isoparorchis hypselobagri.*

XIII. Summary.

The paper deals briefly with the Trematode Fauna, known from the Indian region, belonging to the Superfamily *Hemiuroidea* : Families *Hemiuridae* and *Haplosplanchnidae.* Diagnostic keys and short definitions have been given at the necessary stages, along with, as far as possible, diagram of each species. General morphology, taxonomy, phylogeny, affinities, evolution and interrelationship in Platyhelminths and the two families and their subfamilies are dealt with. For ready reference, a Parasite-host and Host-parasite list has been added. The revision covers about thirty four forms belonging to different genera and a new classification of the class Trematodae has been proposed.

XIV. Acknowledgments.

I wish to record my best thanks to Shri A. K. Bose and Shri G. Ramakrishna, B.Sc. (Hons.), for their assistance in various ways. Shri Y. M. Muley, Deputy Librarian, National Library, Calcutta kindly helped me with some translations. Thanks are due to Shri S. Ghoshal, B.A., Dip. Lib. for help in proof corrections, comparing of manuscript particularly references, etc. I am also grateful to Prof. M. A. Moghe for kindly going through the manuscript at the page proof stage and for giving his suggestions. Shri K. S. Pradhan helped me with the translation of a paper by Looss (1902).

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MGIPC—M—3 ZSI/53—17-11-54—450.