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.)

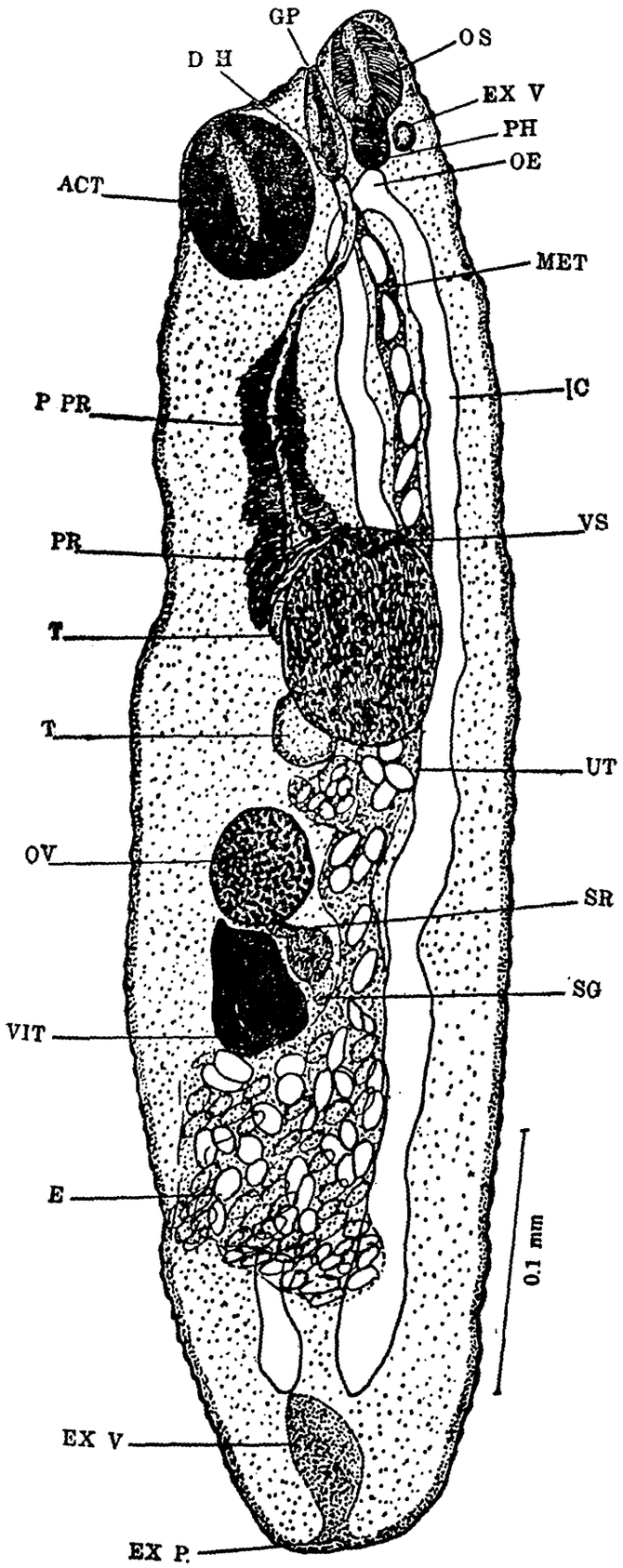
Yamaguti, S. (1952). *Acta Medicinae Okayama*, **8** (2) : 182.

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.

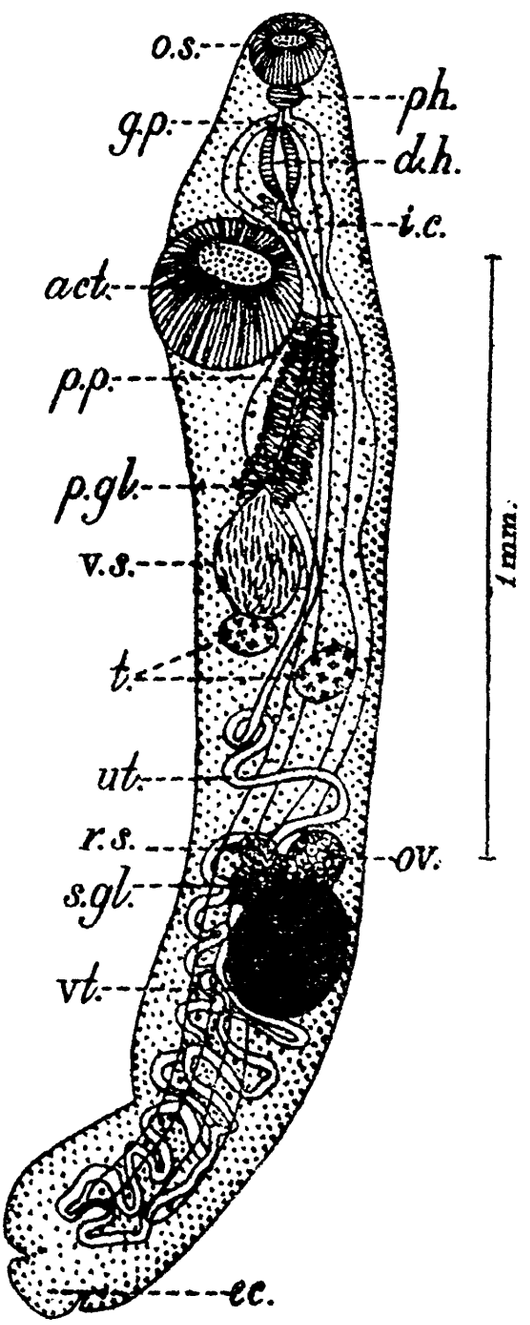
Srivastava (1941) described this species as *Sterrhurus monolecithus.* Manter (1947, p. 344), transfers the species to the genus *Aphanurus.* He observes " *S. monolecithus* Srivastava, seems to belong to the genus *Aphanurus* since the " very rudimentary tail visible only in fully extended individuals " 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.**

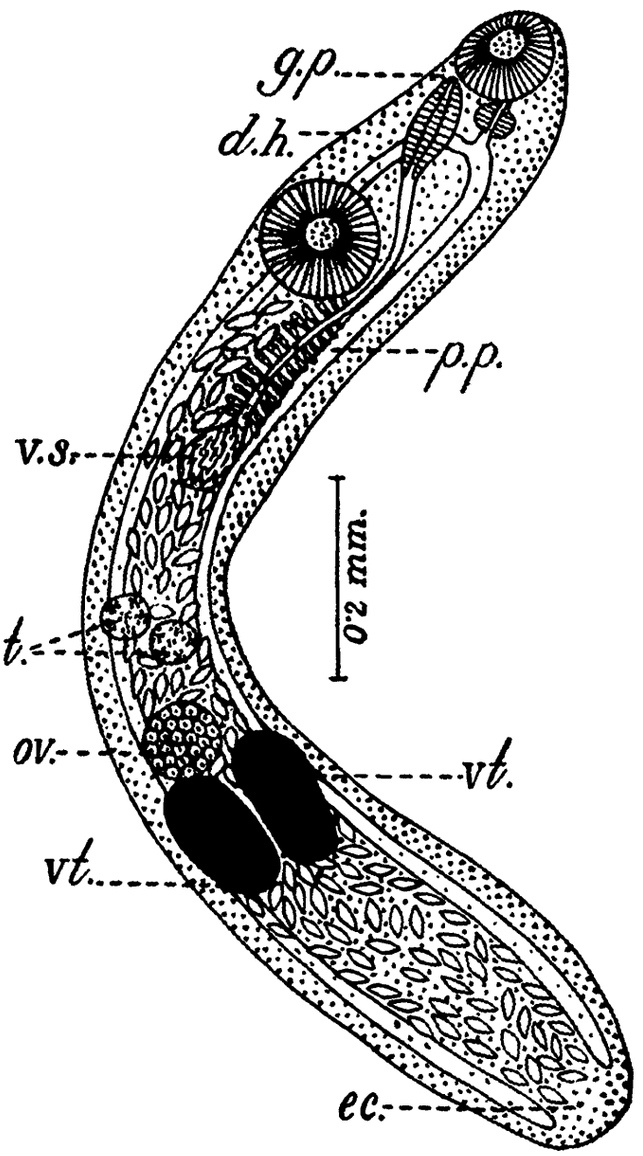
(Text—Fig. 3)

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.

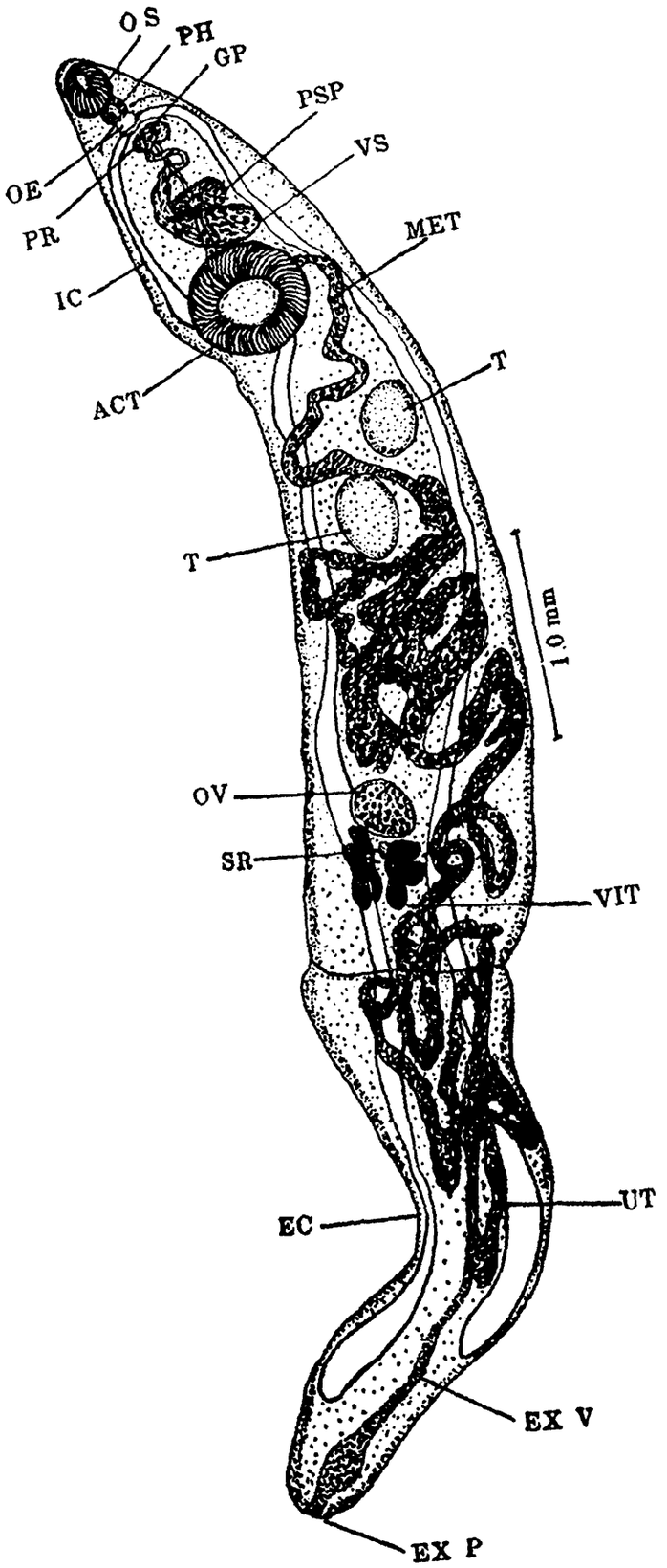
Locality.—West coast of India, Bombay.

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.



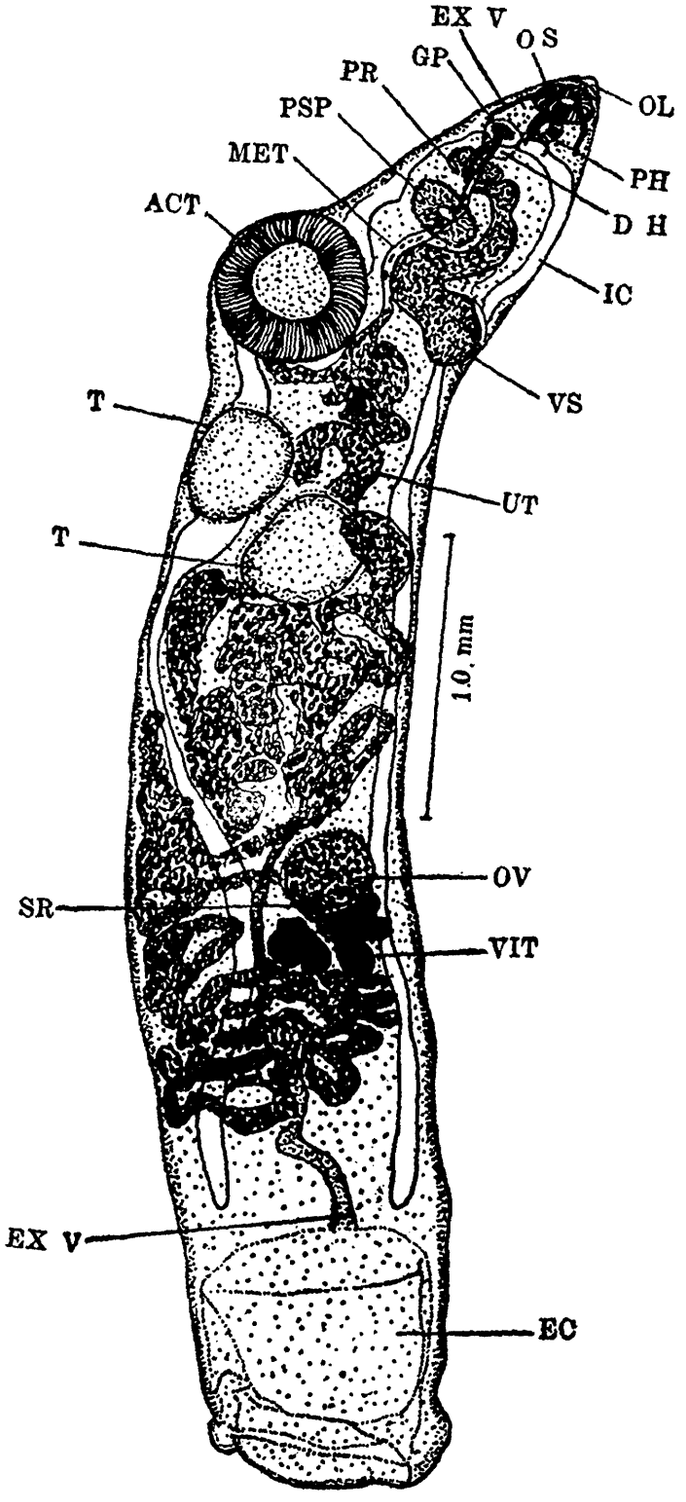
Text-fig. 4.—*Lecithochirium polynemi* ; ventral view.

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.)

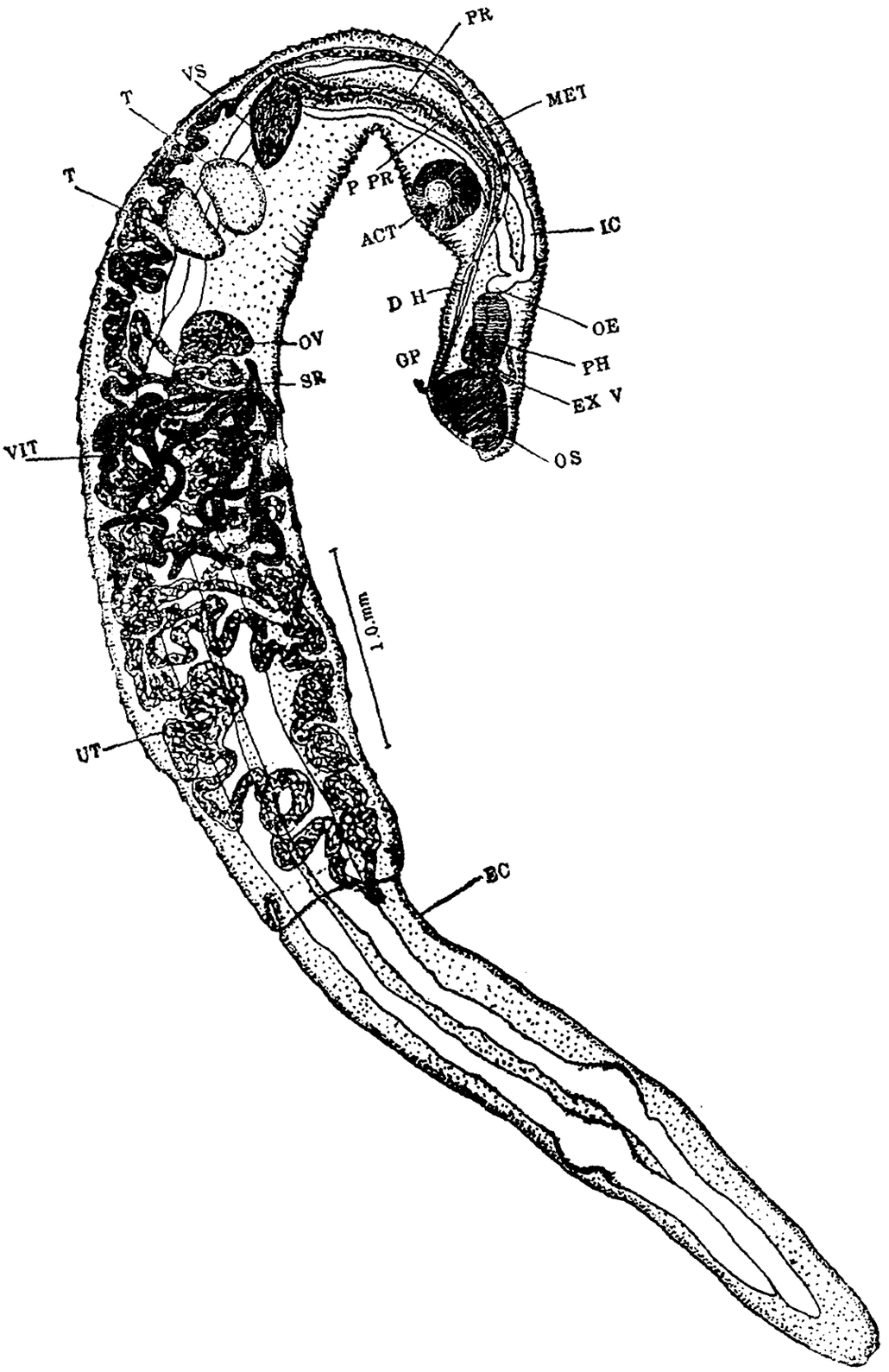
Manter, H. W. (1947). *Amer. Midl. Nat.* **38**(2): 349.

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.

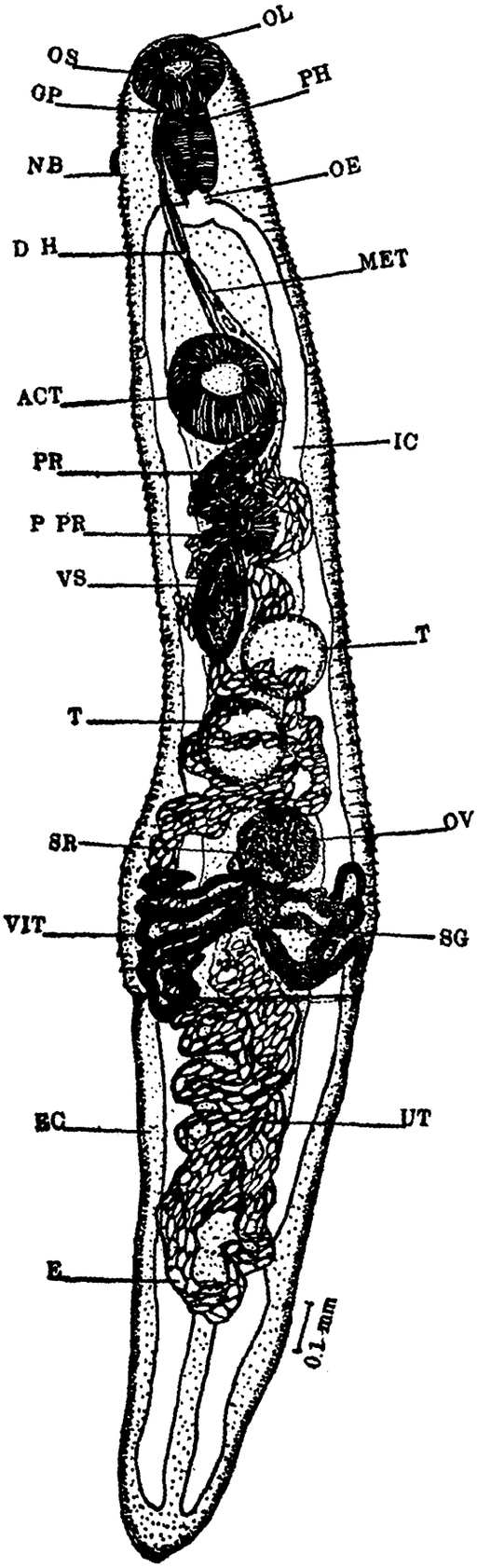
(Text-fig. 8).

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.

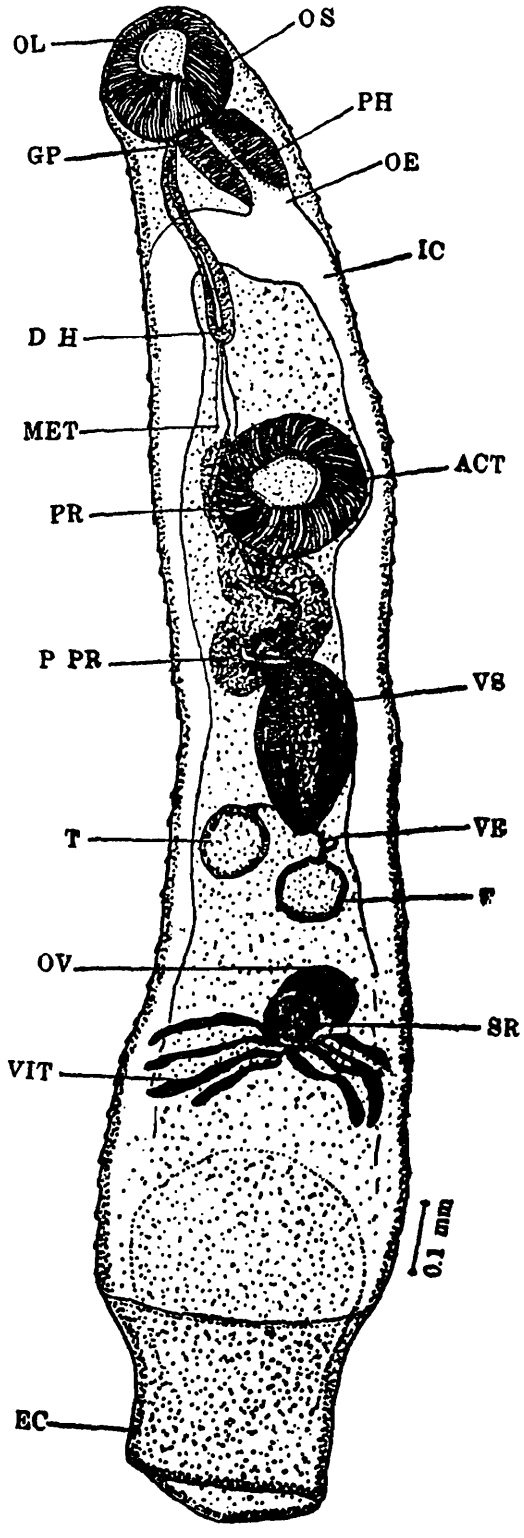
Oesophagus very short. Ventral sucker situated at one-third the soma length. Testes spherical, separate, tandem, lying near posterior to



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).

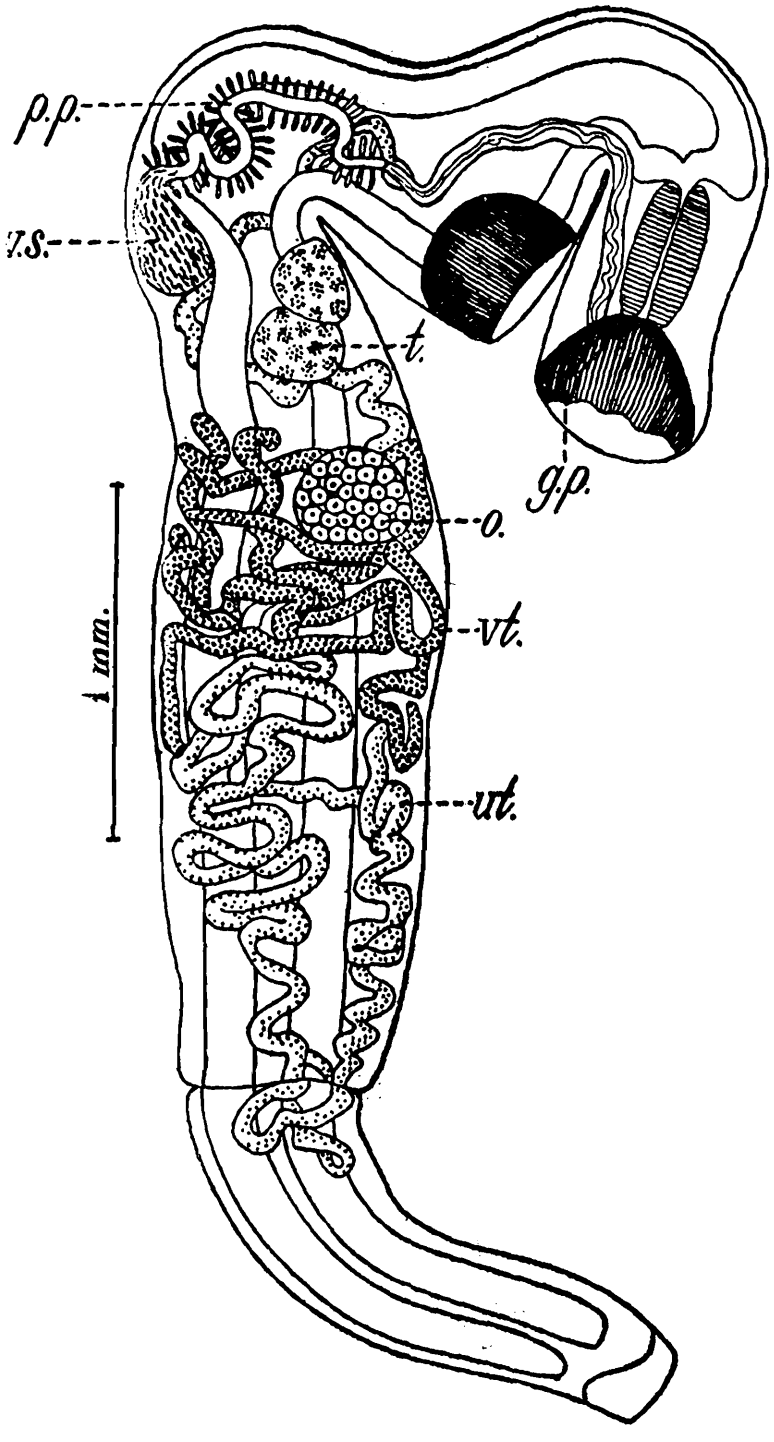
syn. *L. brevicauda* Srivastava, 1937.

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

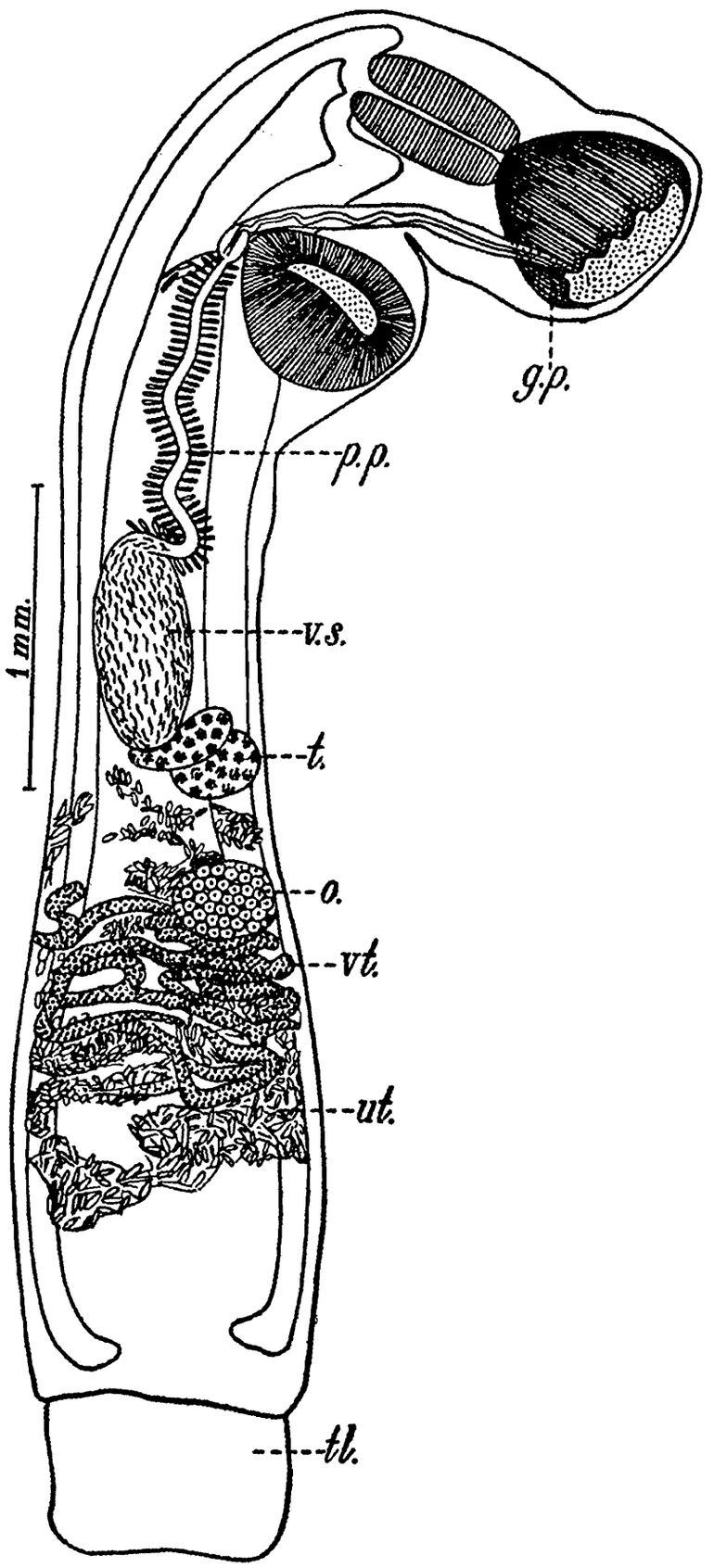


TEXT-FIG. 9.—*Lecithocladium harpondontis*; ventral view.

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).

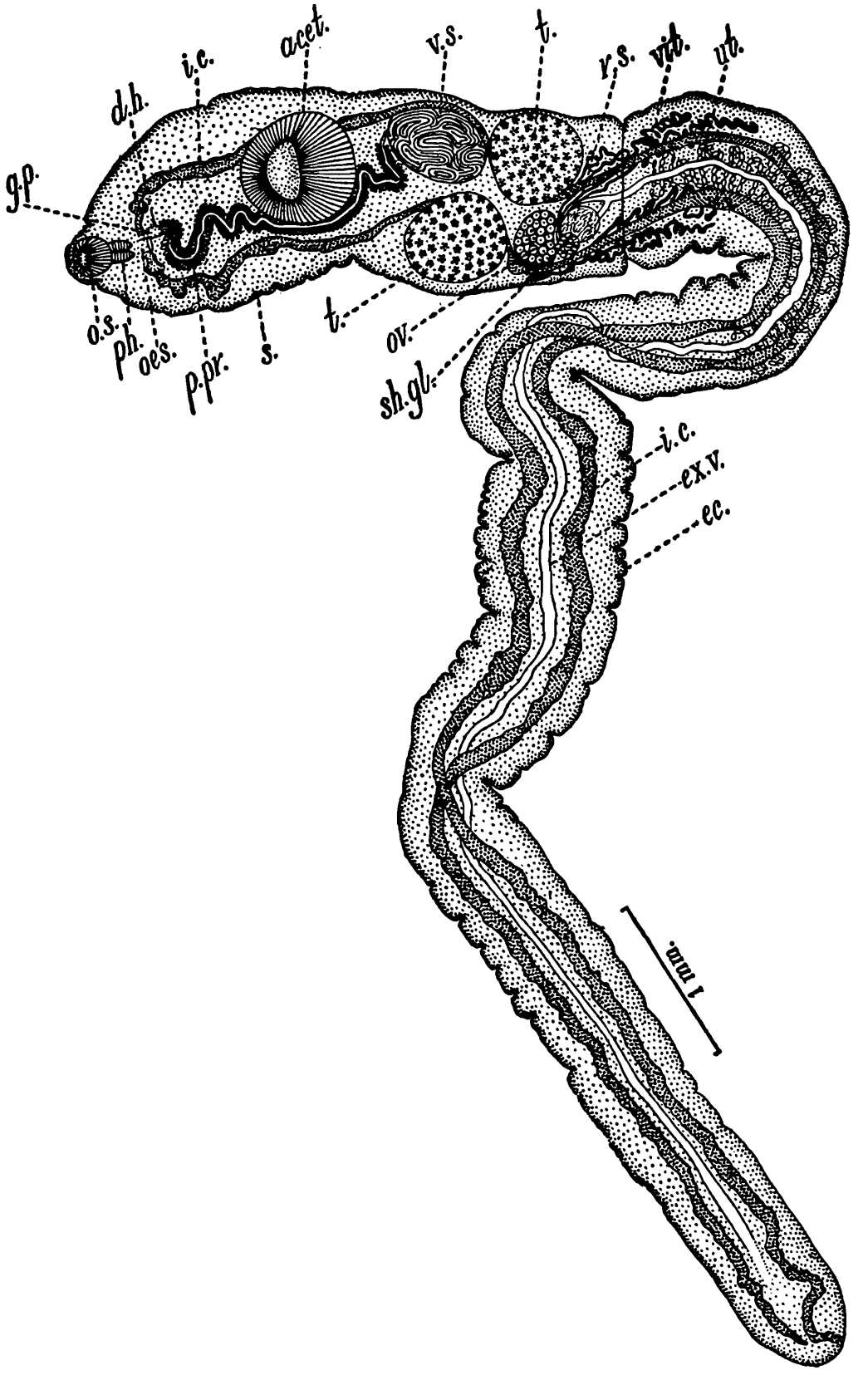
Bhalerao, G. D. (1943). *Proc. Ind. Acad. Sci.*, **18**(5) : 119-120.

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.*).

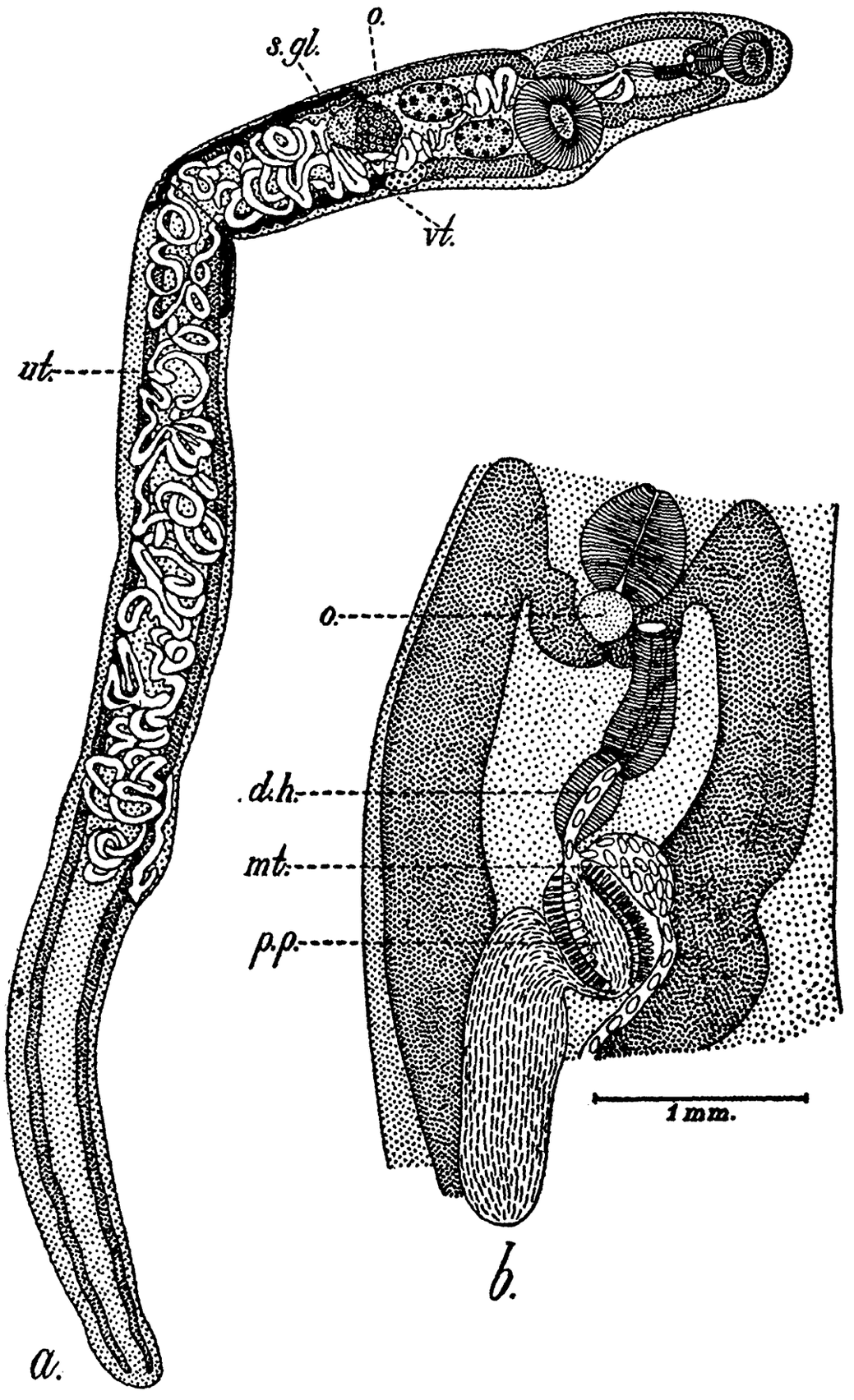
Chauhan, B. S. (1945). *Proc. Ind. Acad. Sci.* **21** (3) 171.
Manter, H. W. (1947). *Amer. Midl. Nat.* **38** (2) : 350.

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.

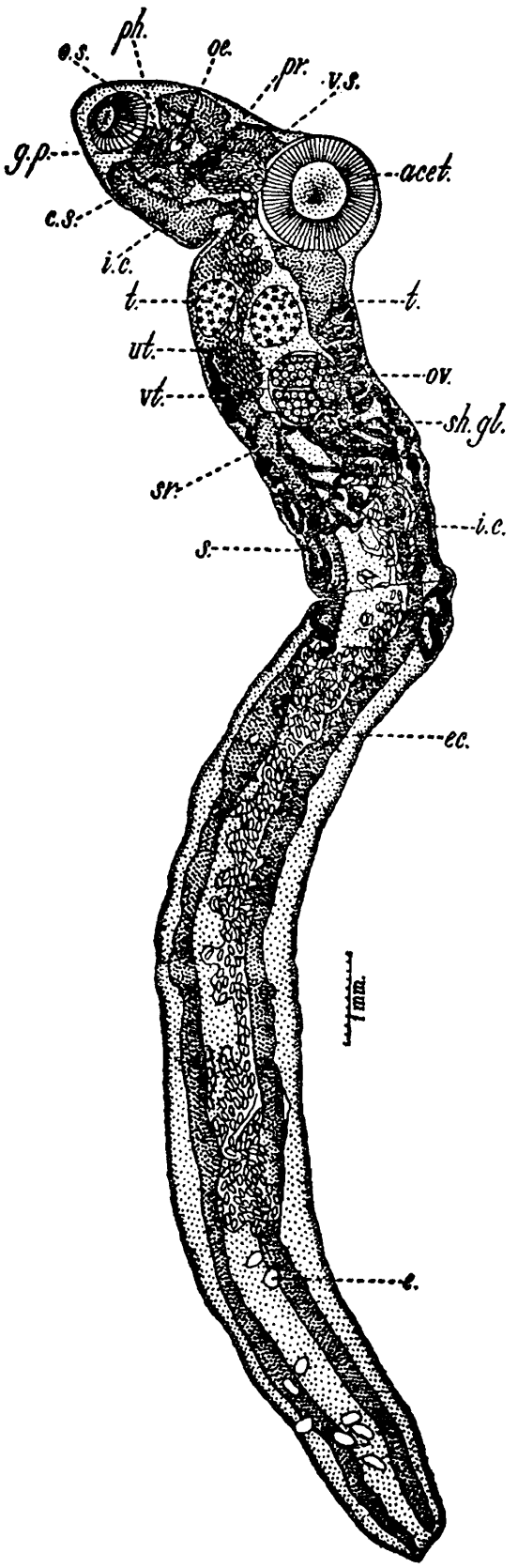
Through the courtesy of Prof. H. R. Mehra, the author had an opportunity to study a specimen, probably a para-or topotype, of this



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.

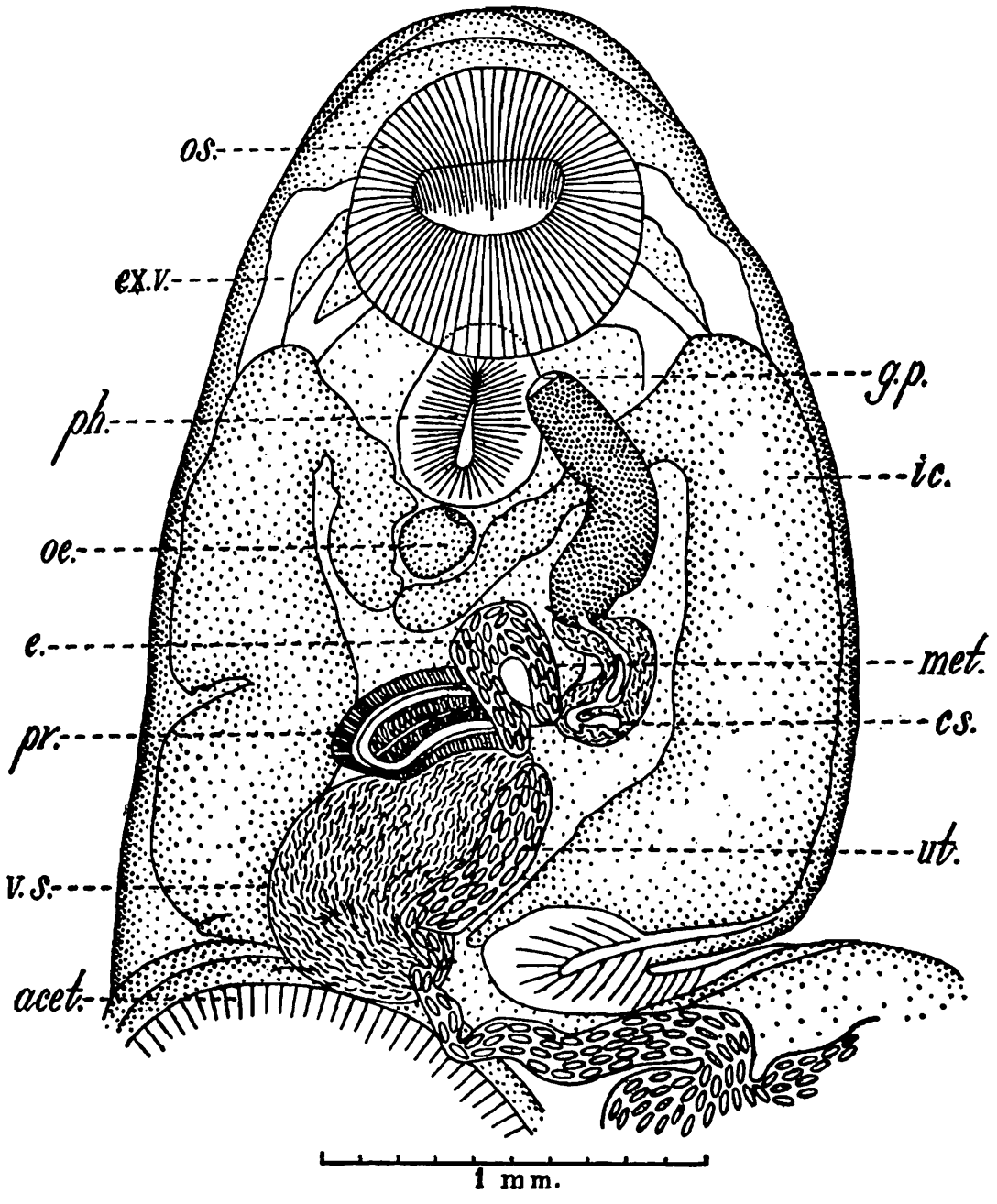
12, a, b, c.) he found that the receptaculum seminis was present, the ovary was four lobed, specially the fourth lobe being a little lobate

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).

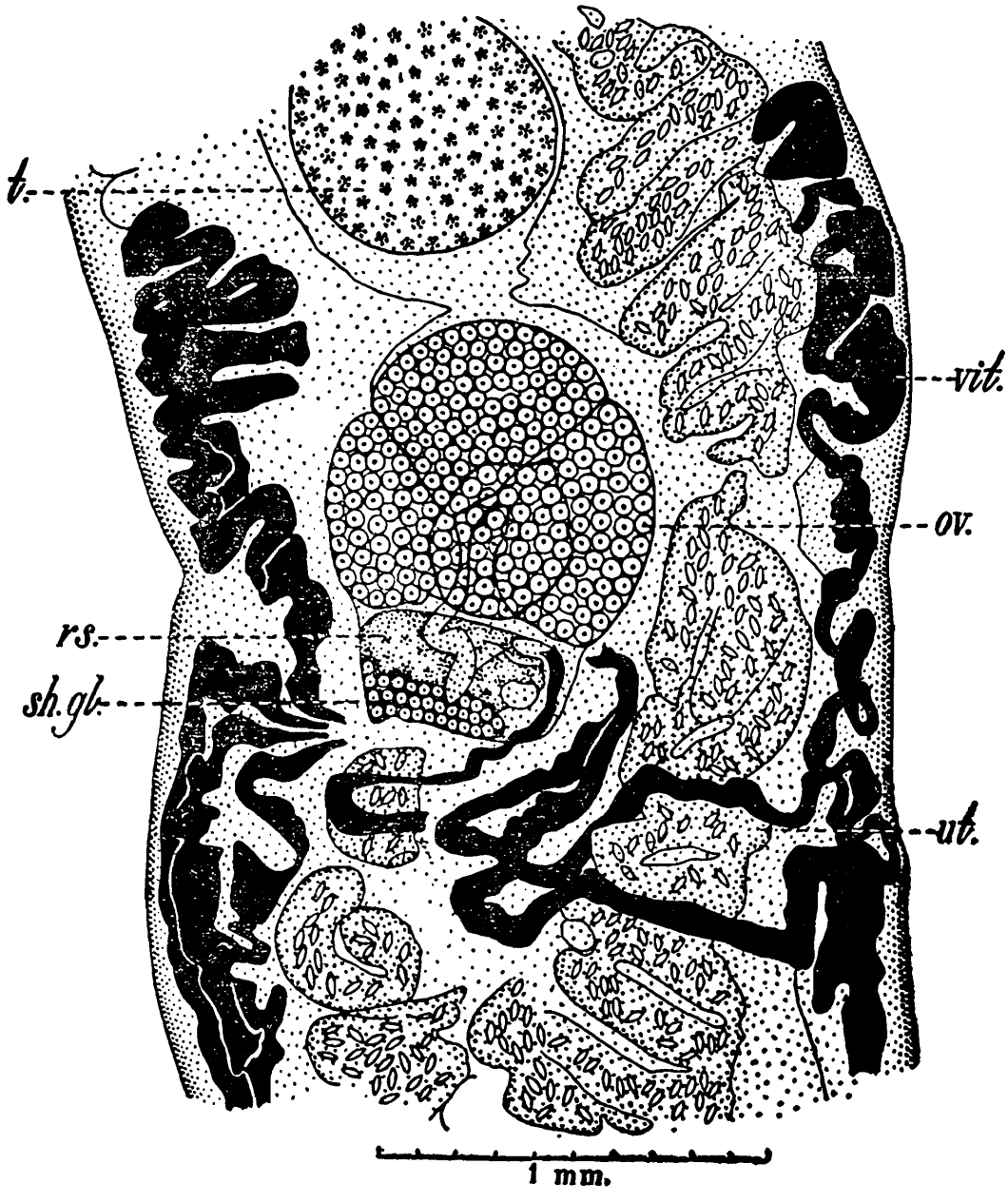
acet., acetabulum ; *c.s.*, cirrus sac ; *e.*, egg ; *ex. v.*, excretory vessel ; *g.p.*, genital pore ; *i.c.*. intestinal caecum ; *met.*, metraterm ; *oe.*, oesophagus ; *os.*, oral sucker ; *ph.*, pharynx ; *pr.*, pars prostatica ; *u.t.*, uterus ; *vs.*, vesicula seminalis.

(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.

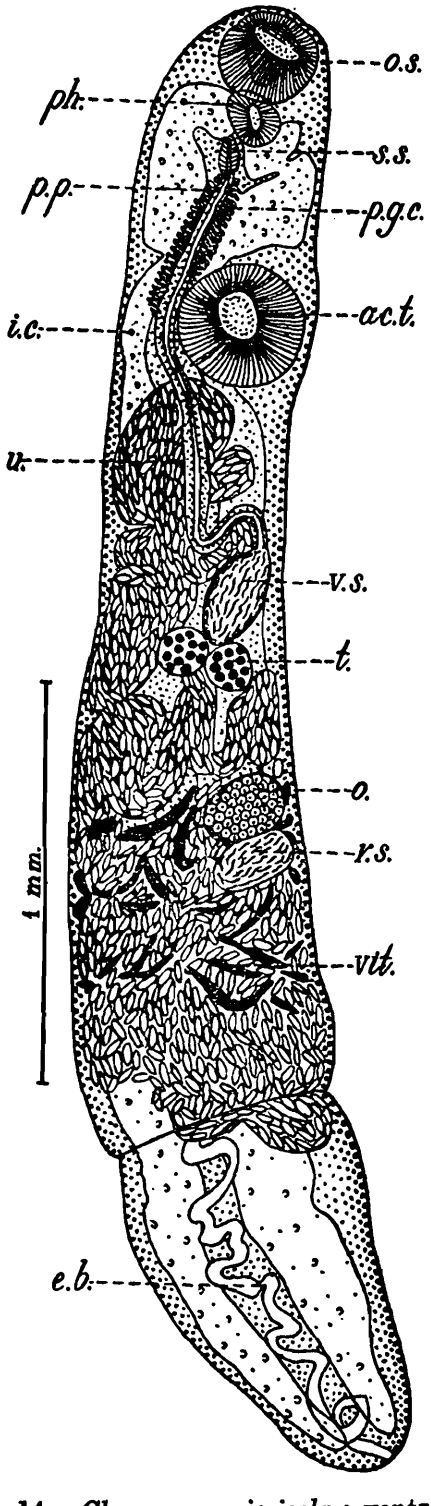
The genus has been defined by Yamaguti (1934) as follows :—

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.

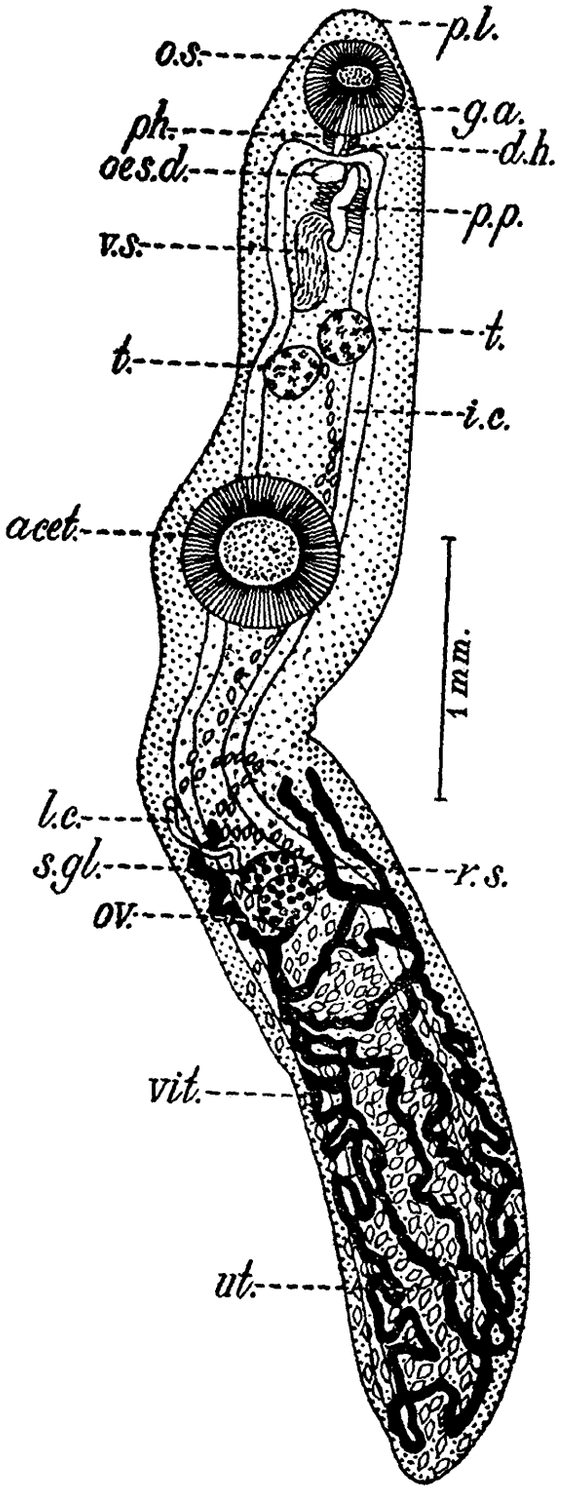
The species is recorded to differ from the type species of the genus *P. psenopsis* Yamaguti, 1934, in the shape and much smaller size of body which is uniformly broad with its maximum breadth occurring across the acetabular region, comparatively cauded position of the acetabulum ; position of the testes, 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.

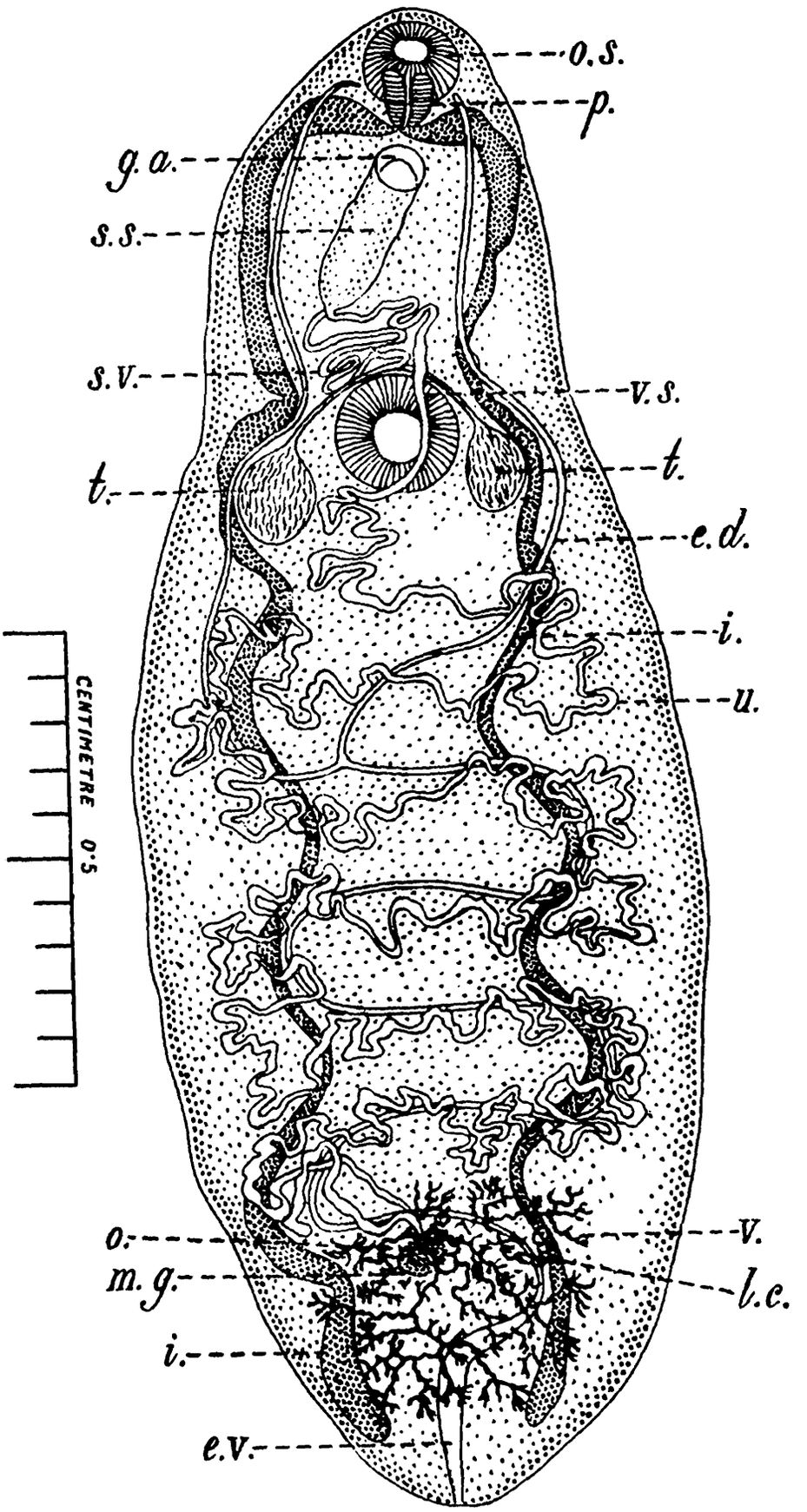
The study of this parasite is of medical significance for it has also been reported from human intestines in India by Chandler (1926) and by Faust (1929) from Hunan Province, China.

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.*

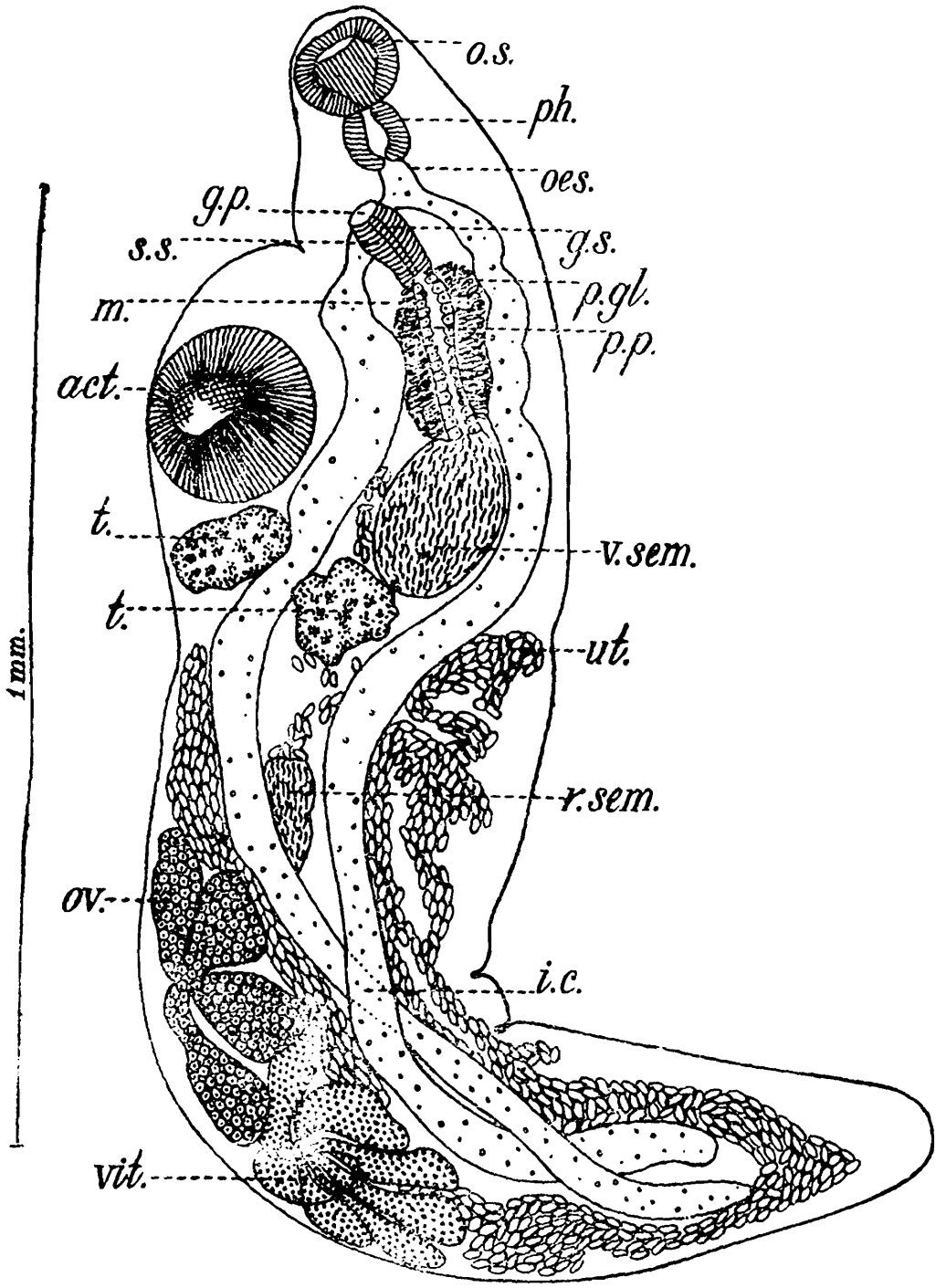
18. **Lecithaster indicus** Srivastava, 1935.

(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

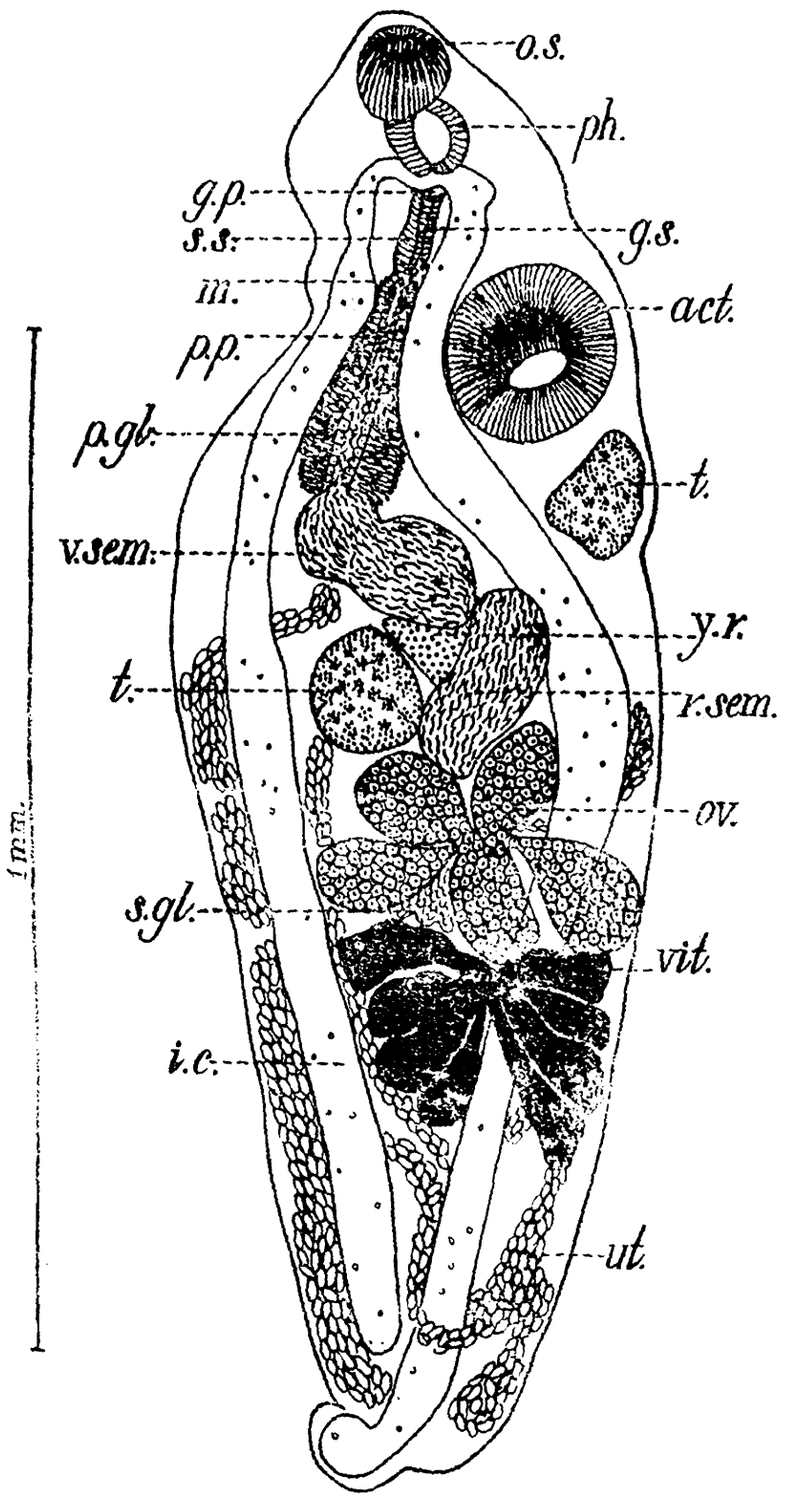


TEXT-FIG. 17.—*Lecithaster indicus ;* ventral view.

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.

(Text-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.

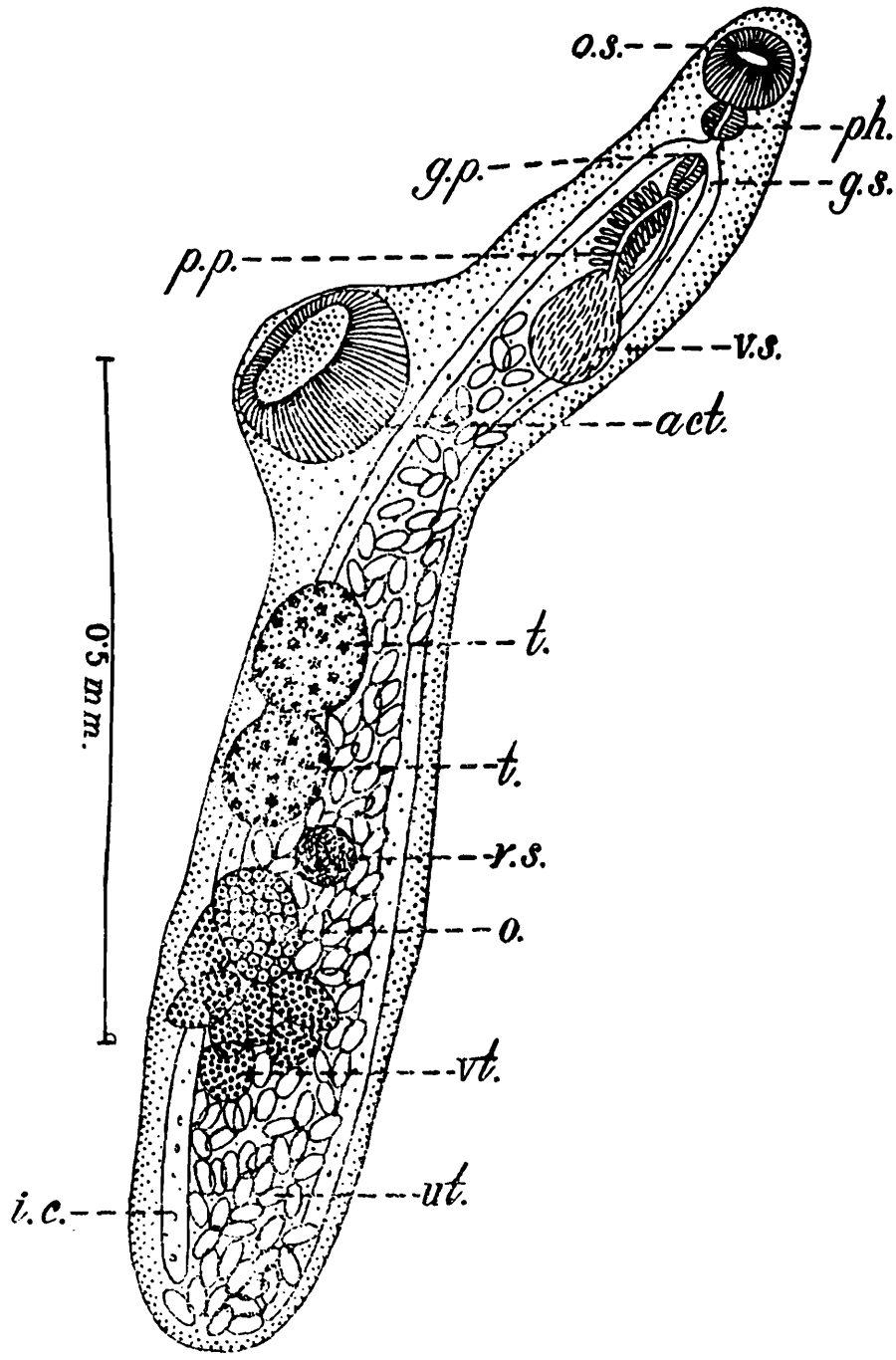
Specific diagnosis: *Aponurus* Looss, 1907 ; with Generic characters.

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 caecum; *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.

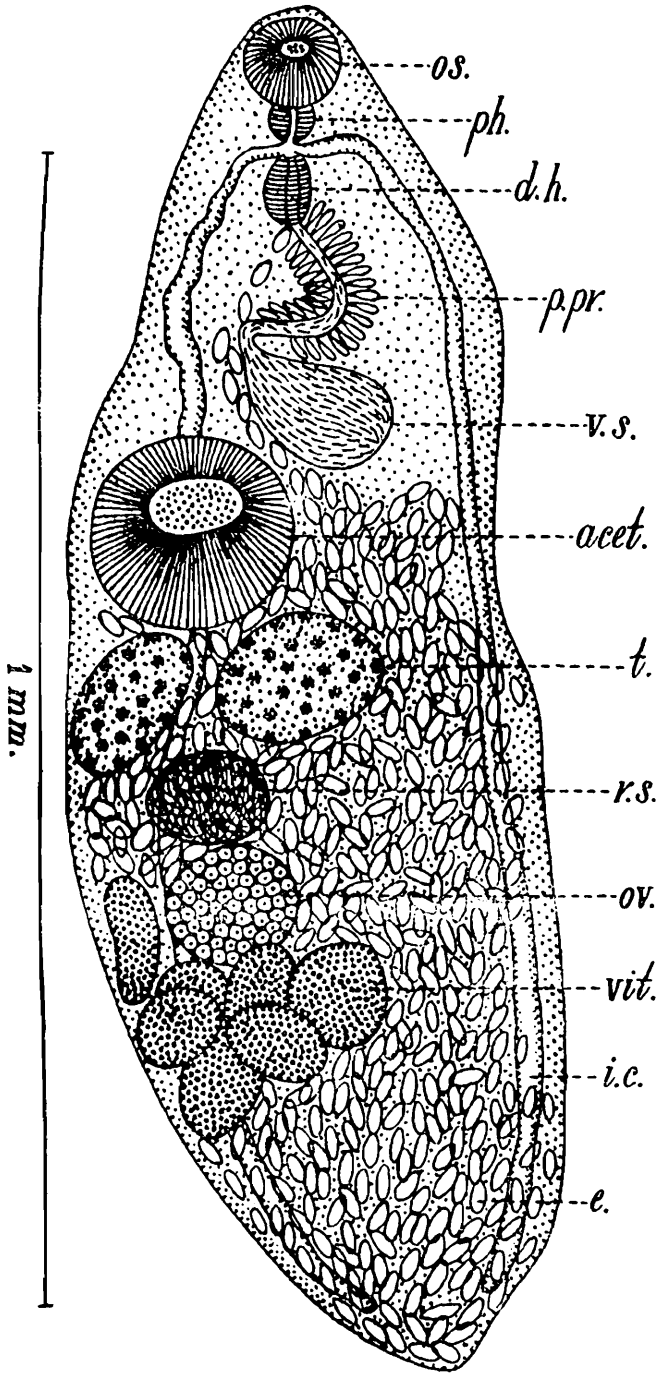
(Text-fig. 20.)

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.

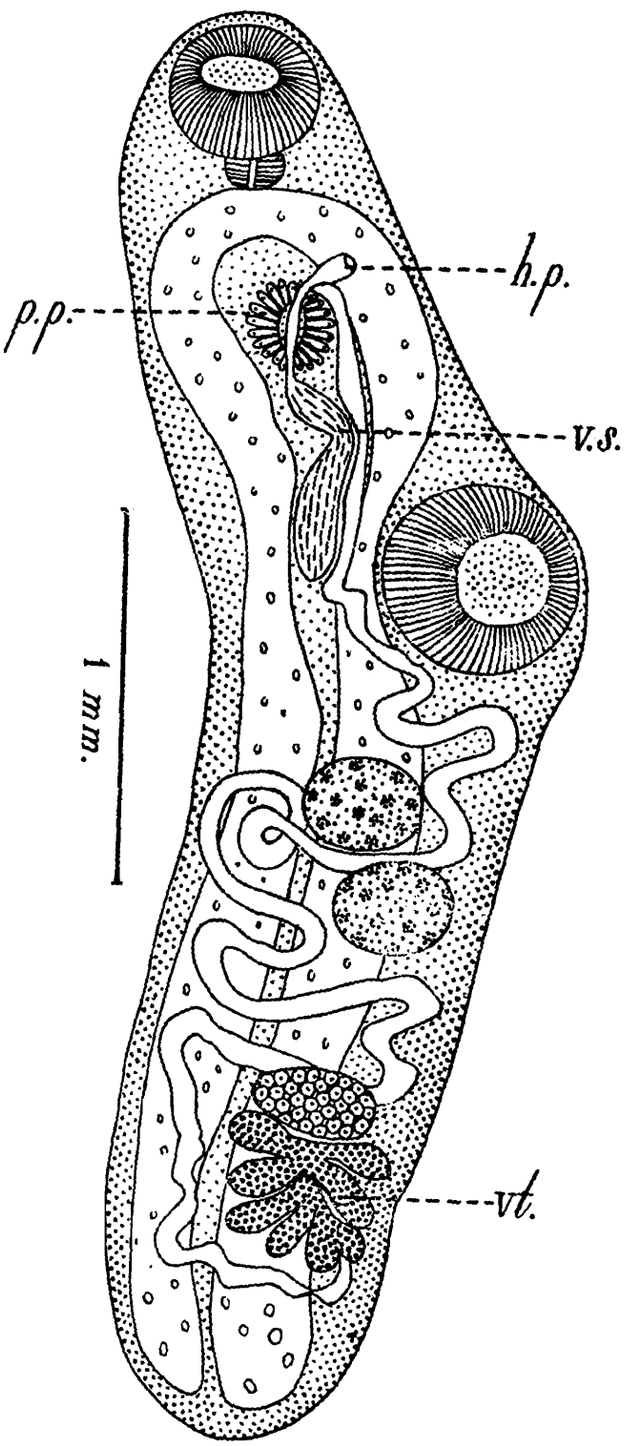
Small forms, without ecsoma or tail appendage. Genital papilla small or copulatory organ or cirrus pouch absent. Vitellaria paired and compact.

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.

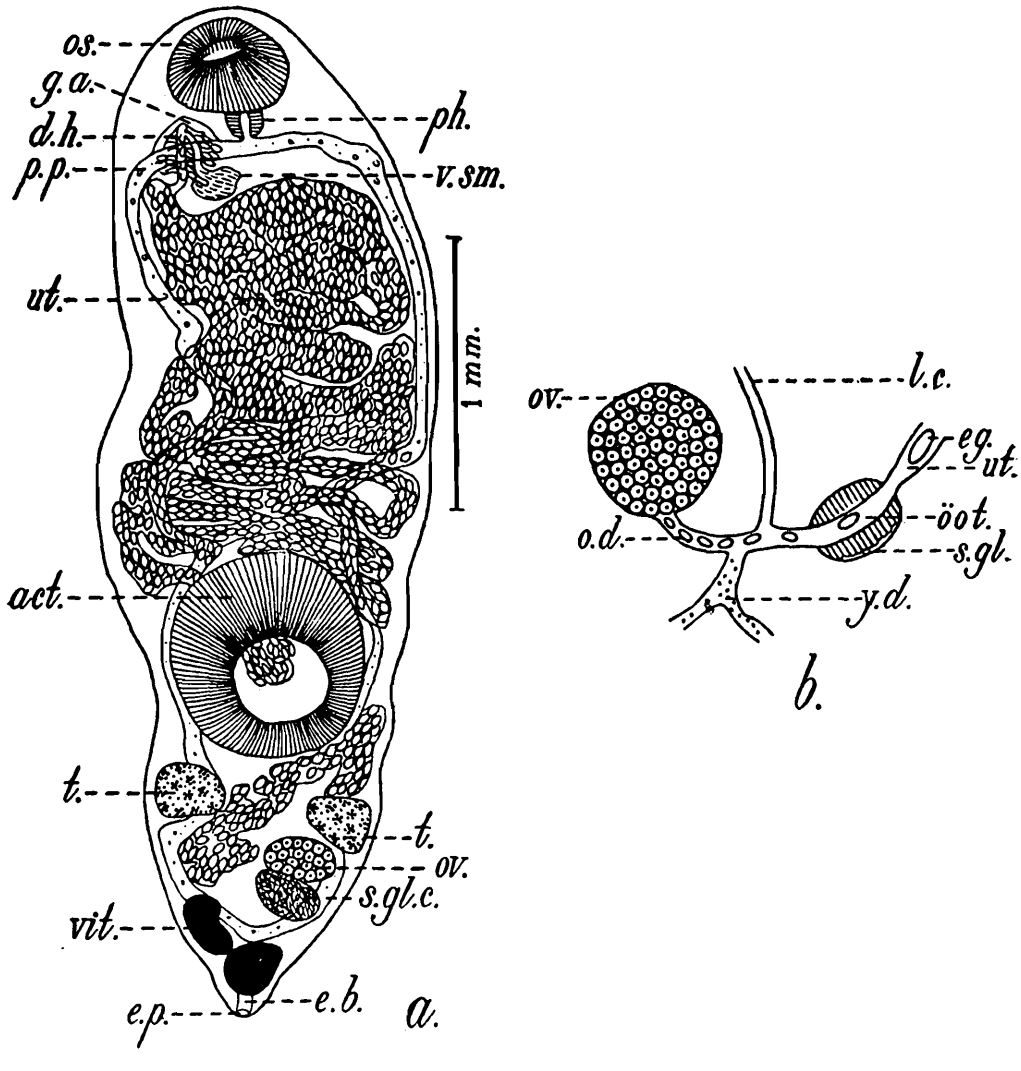
Uterus extends behind the shell gland mass reaching up to the posterior part of vitellaria .. .. .. *P. ovocaudatum.*

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.)

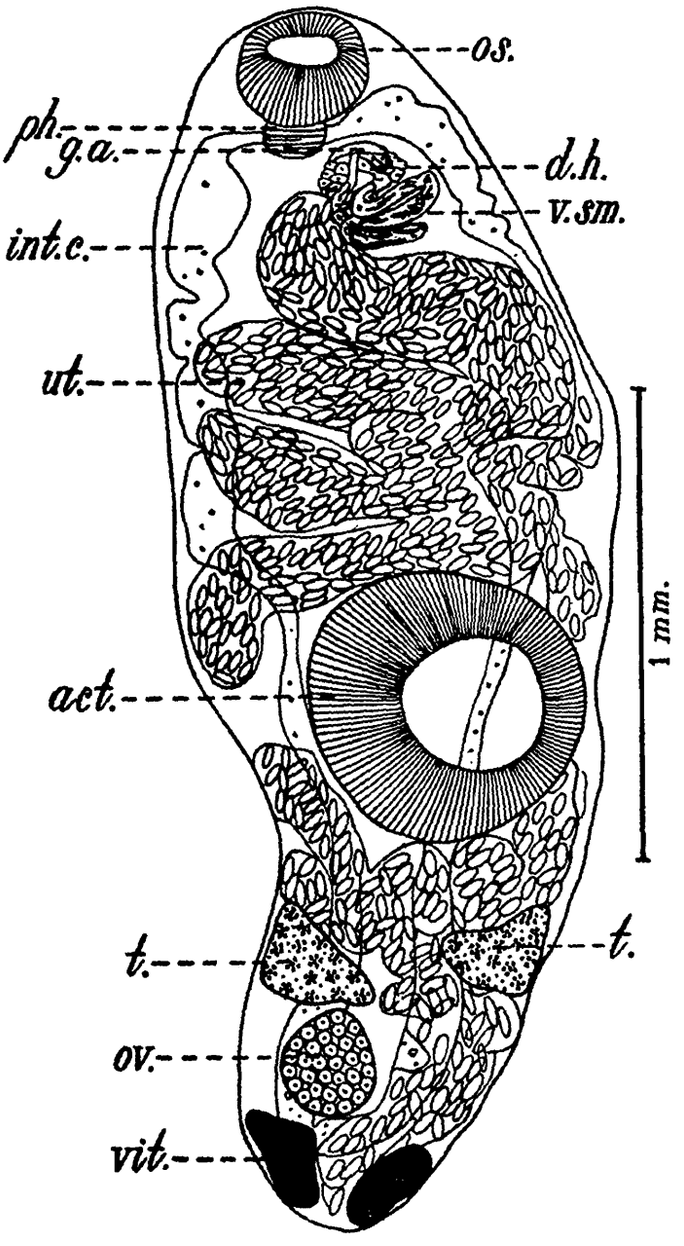
Syn. *Progonus ovocaudatum* Srivastava, 1933.

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.

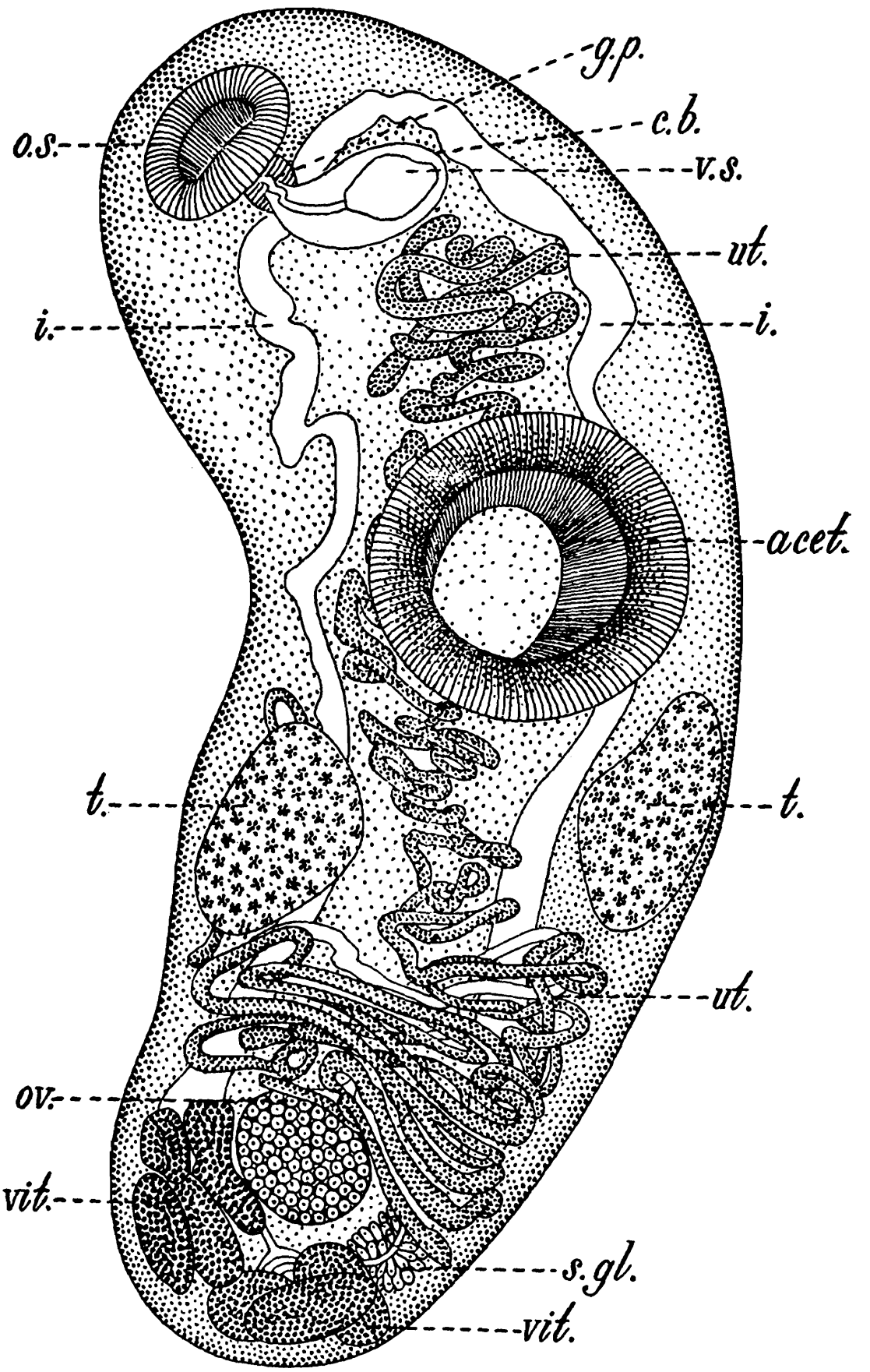
Klein, W. (1905). *Zool. Jahr.* **22**: 65-68
Bhalerao, G. D. (1936). *J. Helm.* **14** (4): 14-15.
Bhalerao, G. D. (1939). *Vol. Jub. Prof. Yohsida.* **2**: 155-159.
Rankin, J. S. (1944). *Trans. Am. Micr. Soc.* **63** (2): 149-164.

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.

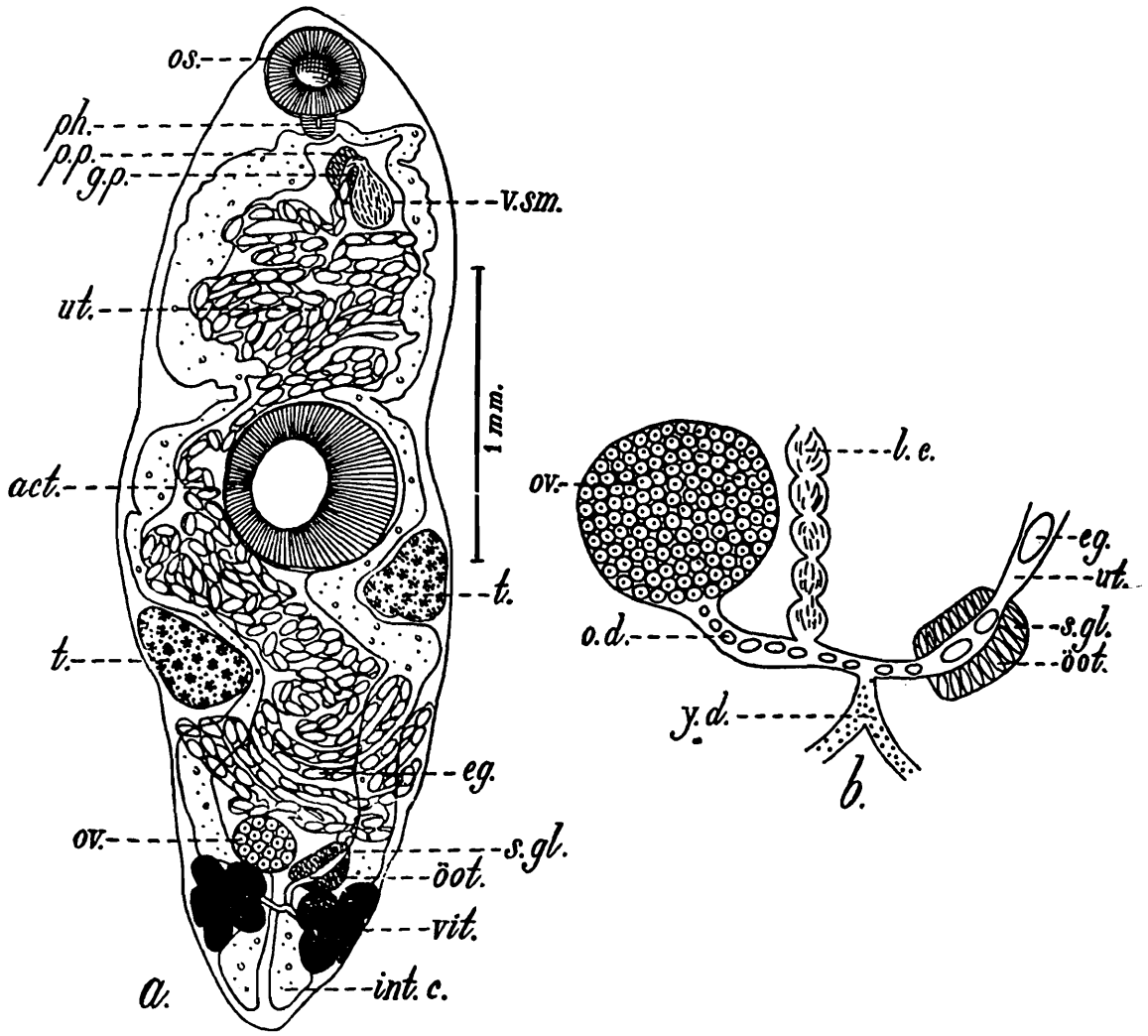
Specific diagnosis : *Halipegus* Looss, 1899 ; with Generic characters.

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. occiduxlis* 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).

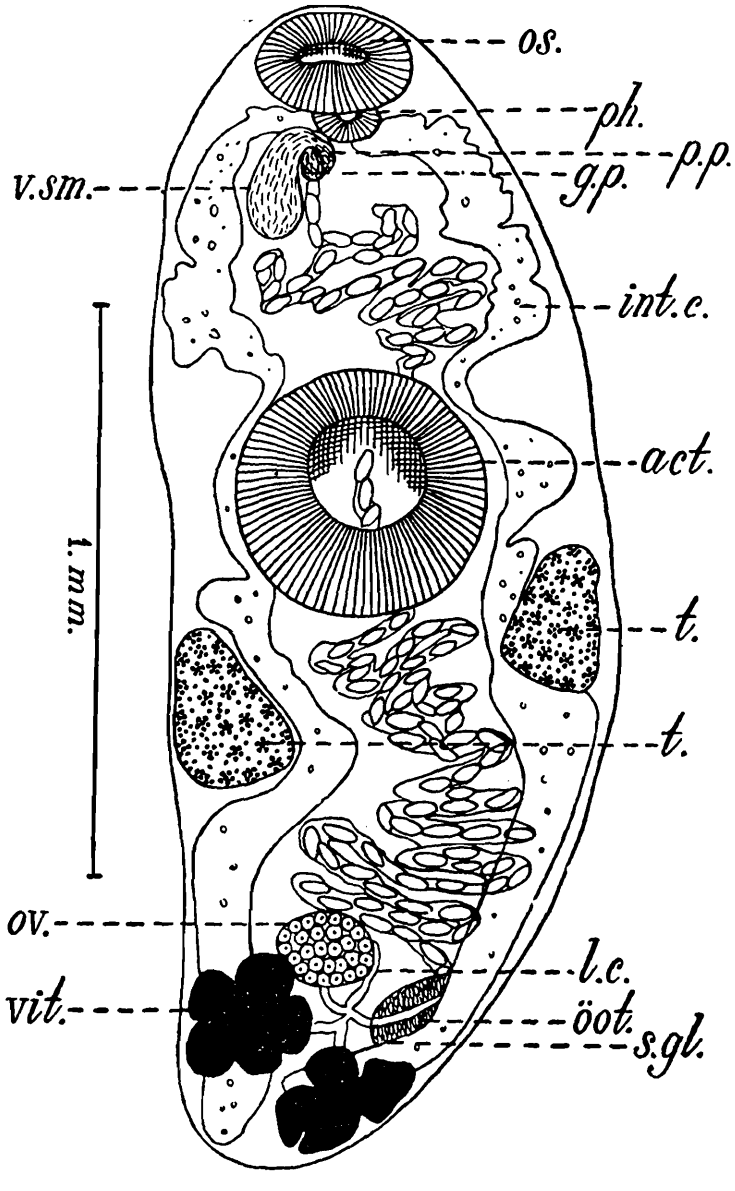
TEXT-FIG. 25b.—*H. mehransis ;* diagrammatic veiw of femal sexual organs.

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.



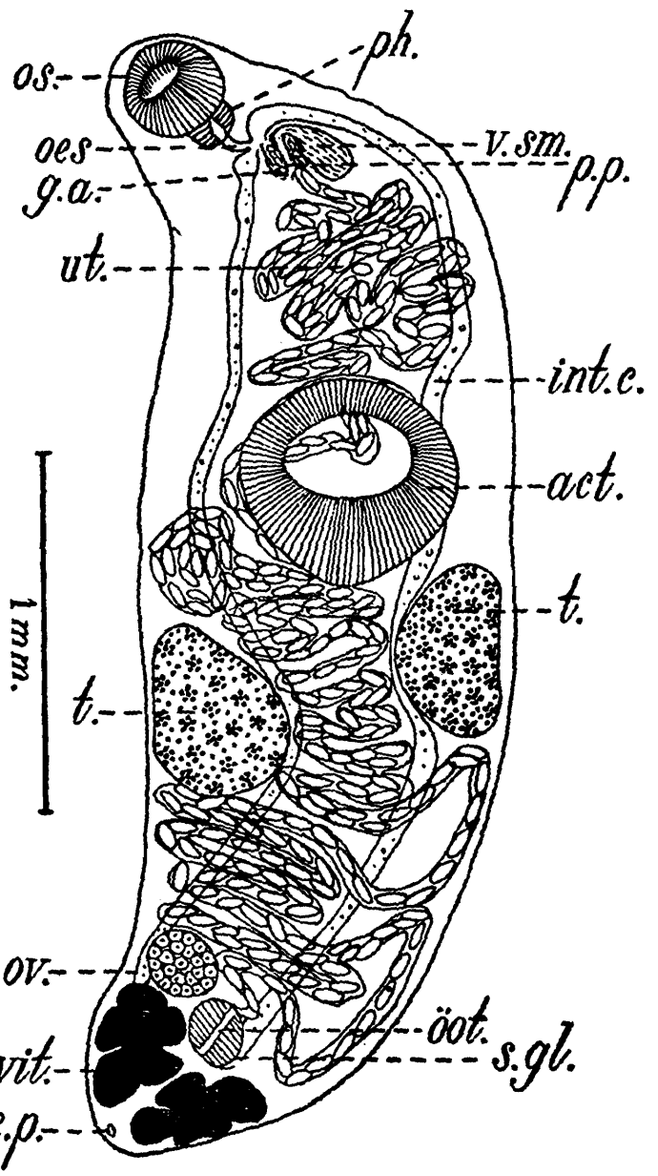
TEXT-FIG. 26.—*Halipegus mehransis*; ventral view.

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*".

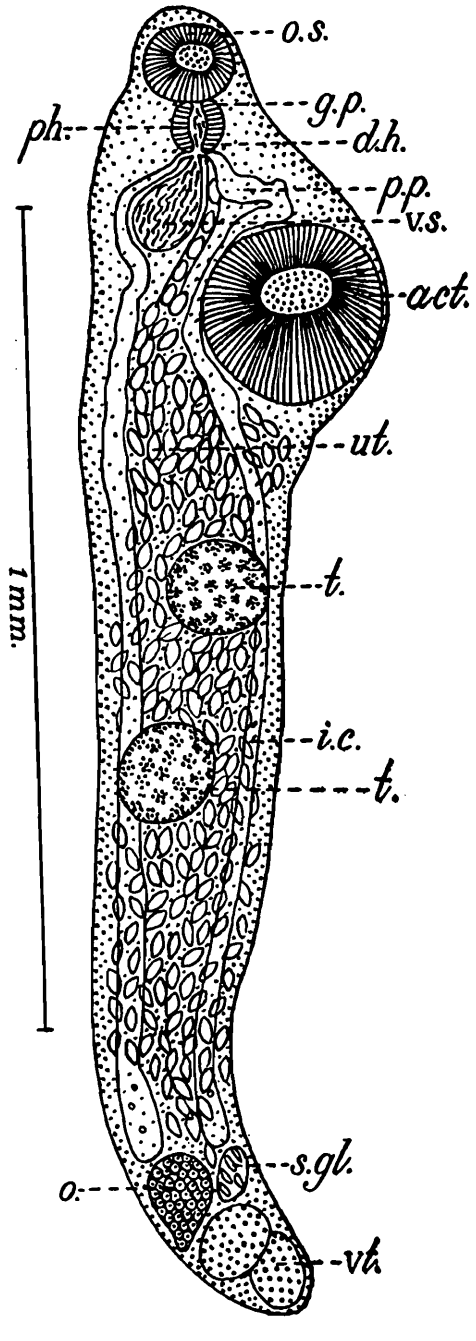
Host.—*Rana cyanophlyctis* (types) ; *Rana tigrina* (variety).

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.

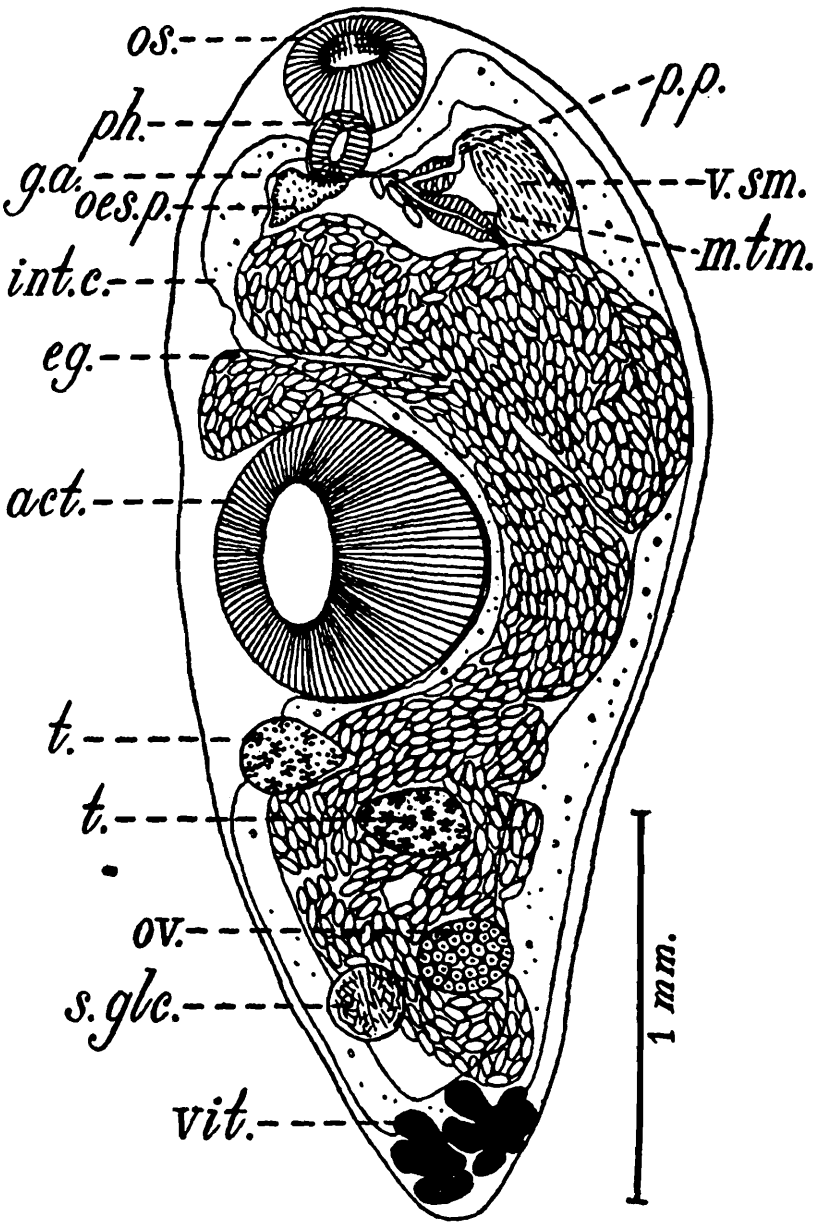
Body smooth, highly muscular, cylindrical, 2·8—3·2×1·1—1·2 (maximum). Oral sucker ventral, subterminal, 0·3 (diameter). Acetabulum situated about the middle of body, two and half time the size of oral sucker, 0·76 (diameter). Prepharynx absent. Pharynx spherical, muscular. Oesophagus absent, but a peculiar 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).

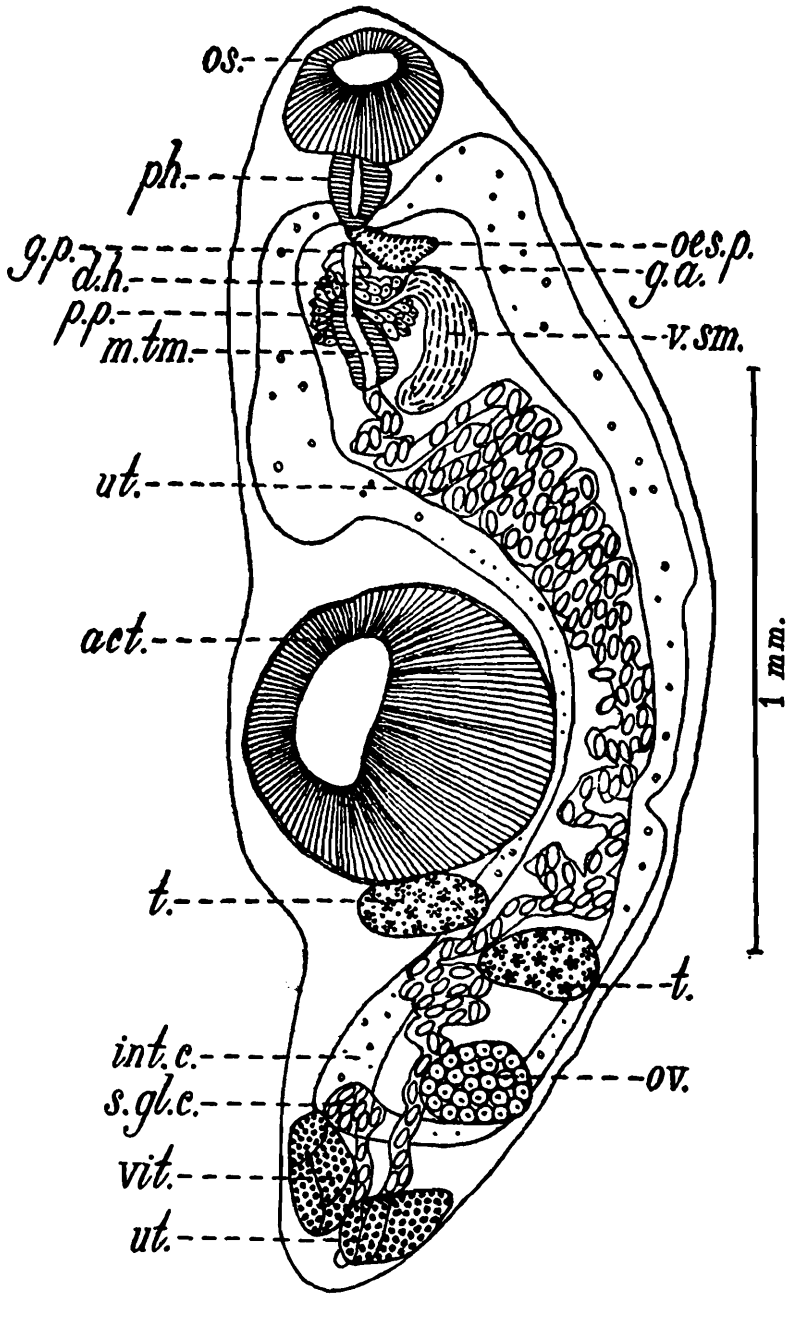
29. **Ophiocorchis singularis** Srivastava, 1933.

(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).

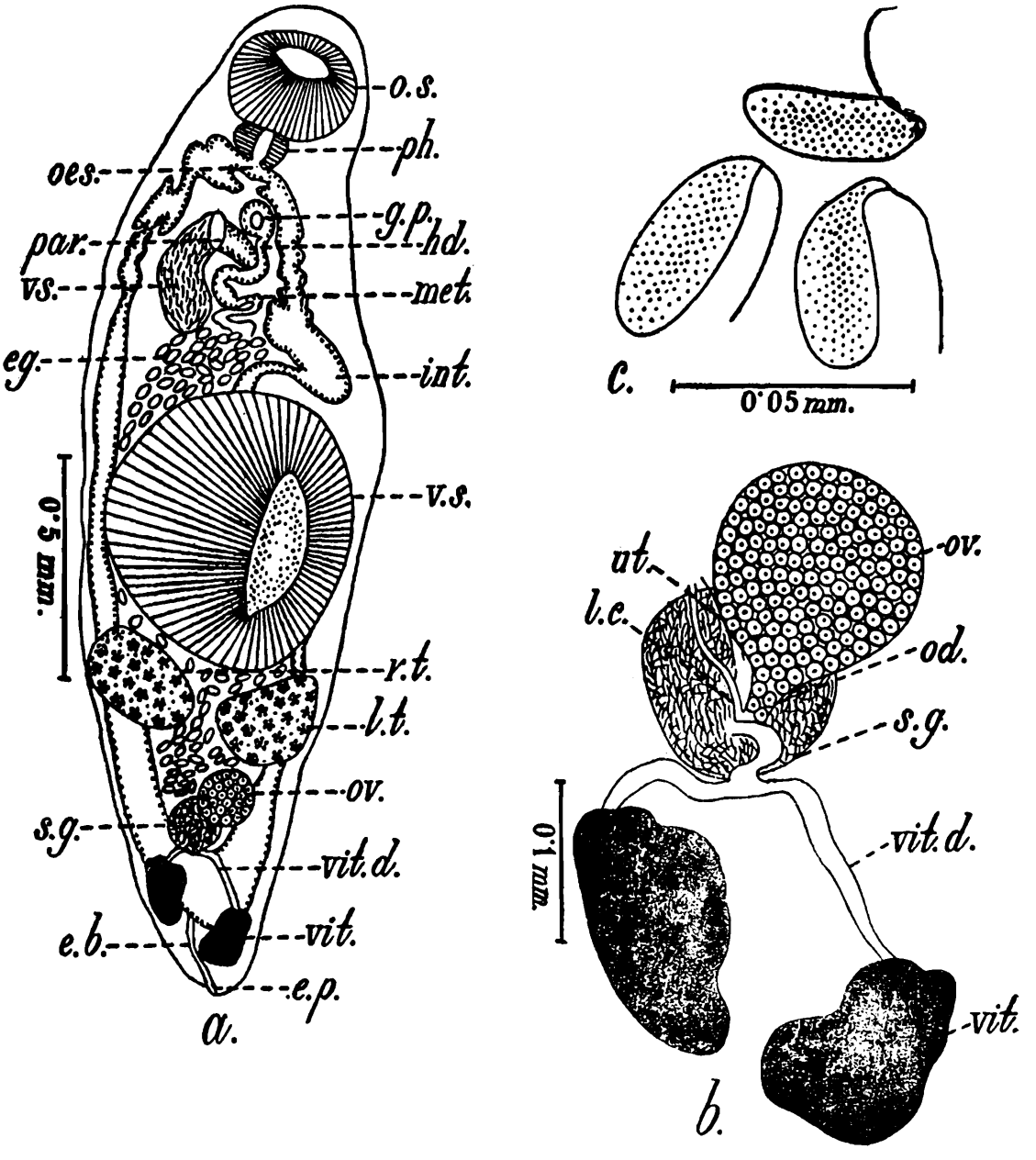
30. **Ophiocorchis dasus** Gupta, 1951.

(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).

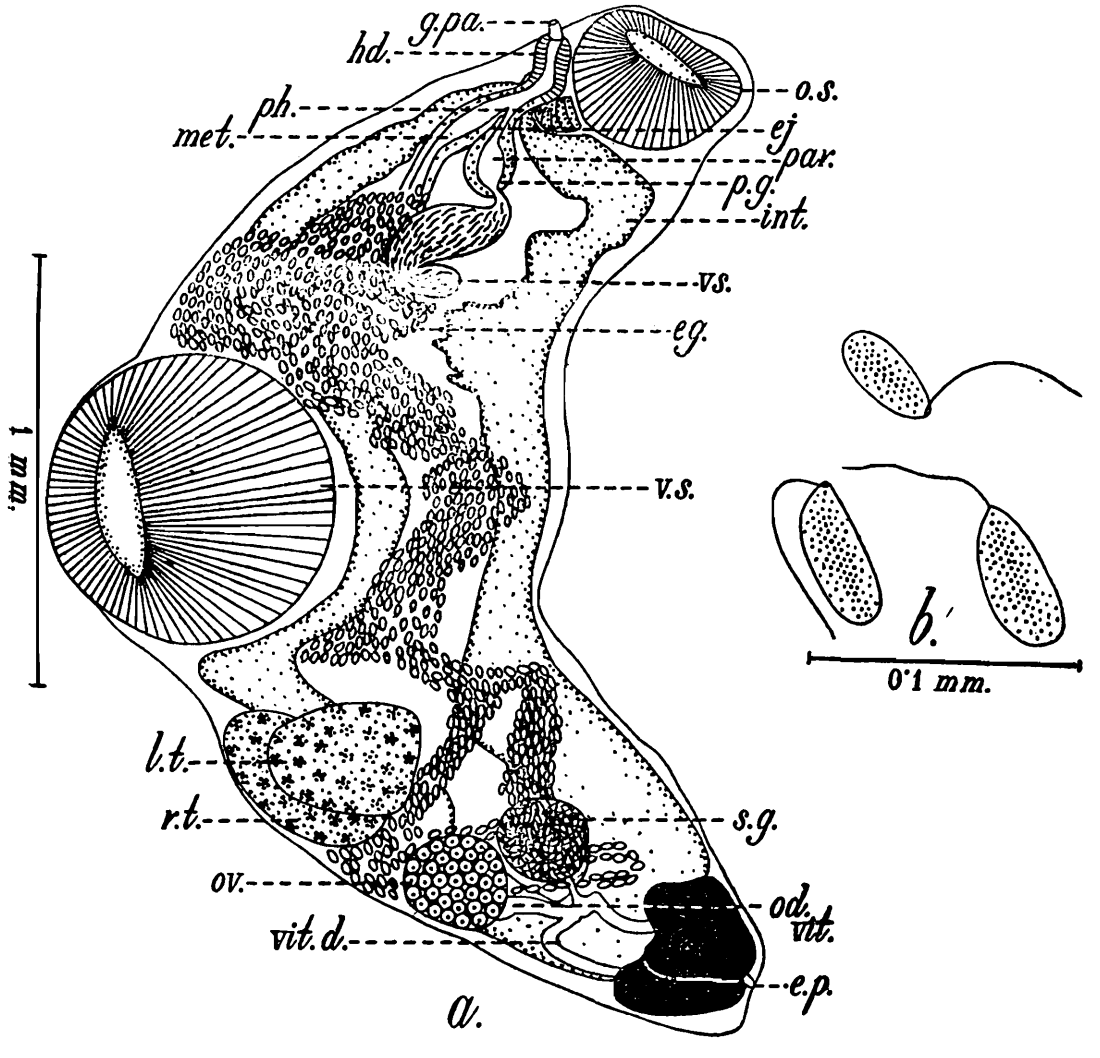
32. **Ophiocorchis faruquis** Gupta, 1951

(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.

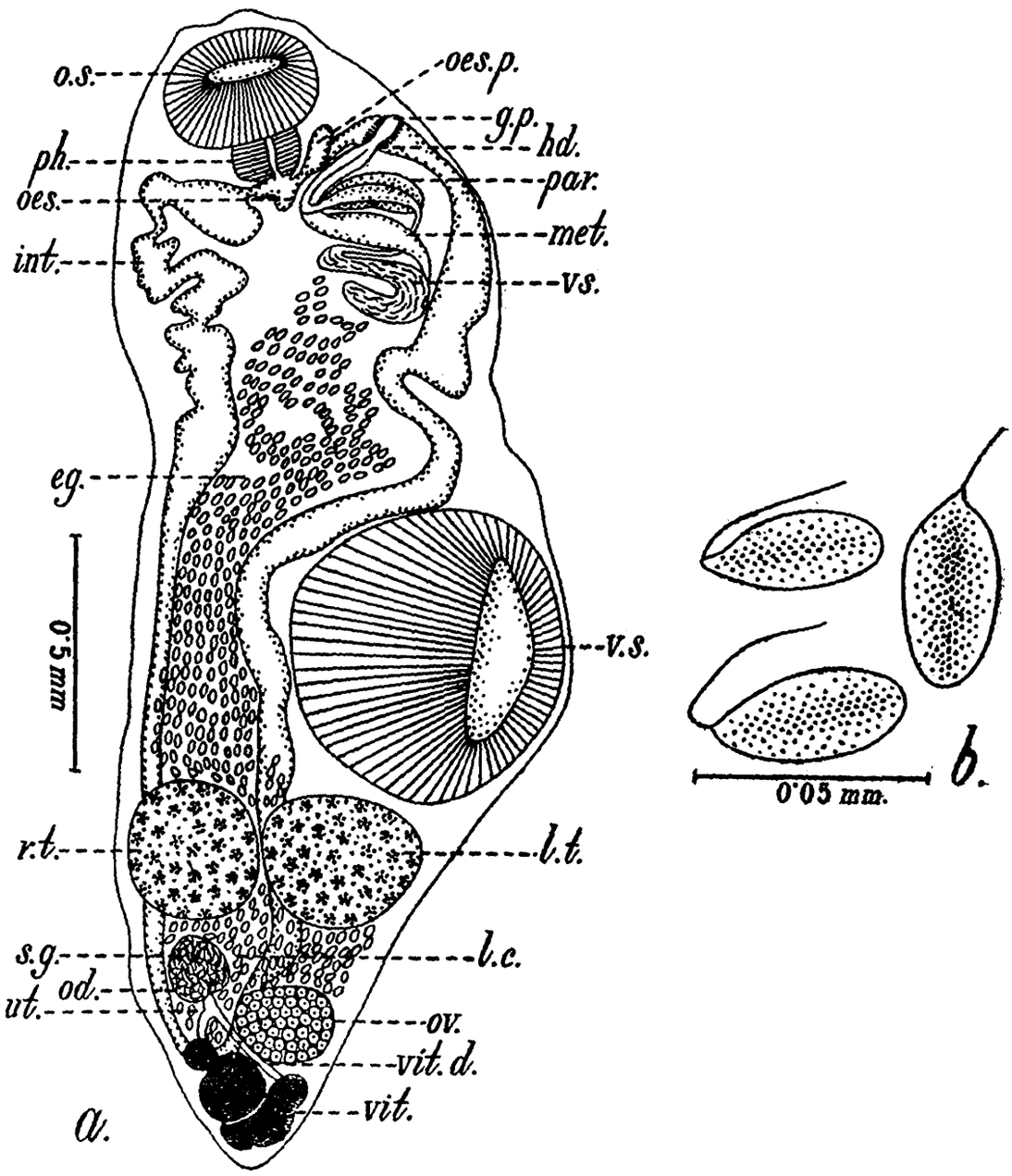
eg., Egg ; *ej.*, Ejaculatory duct ; *e.p.*, Excretory pore ; *g.pa.*, Genital papilla ; *hd.*, Hermophrodite duct ; *int.*, Intestinal caecum ; *l.t.*, Left testis ; *met.*, Metraterm ; *od.* Oviduct ; *o.s.*, Oral sucker ; *ov.*, Ovary ; *ph.*, Pharynx ; *p.g.*, Prostate glands ; *par.* Pars prostatica ; *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

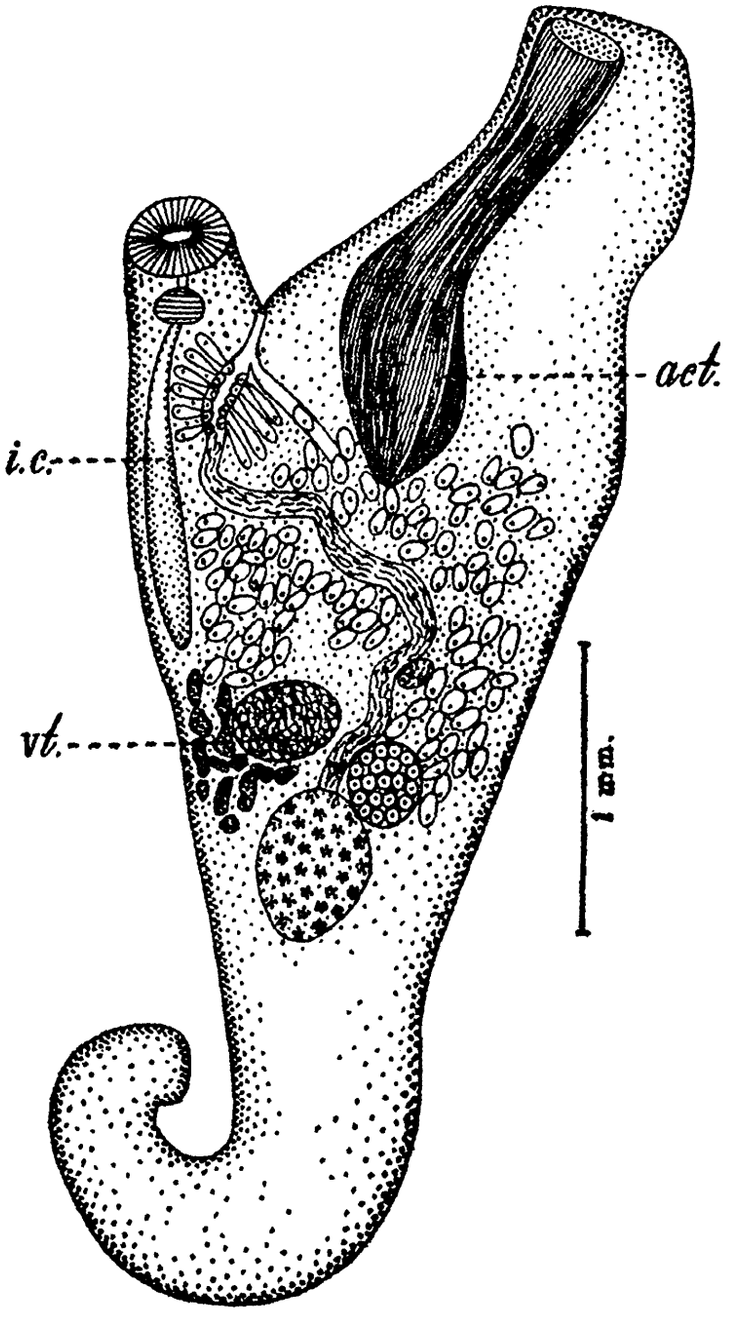
The genus is stated to differ remarkably from the type genus in the peculiar shape of its body and of the acetabulum, and in the position of its gonads and vitellaria. In all other important features the two genera are stated to be alike.

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.

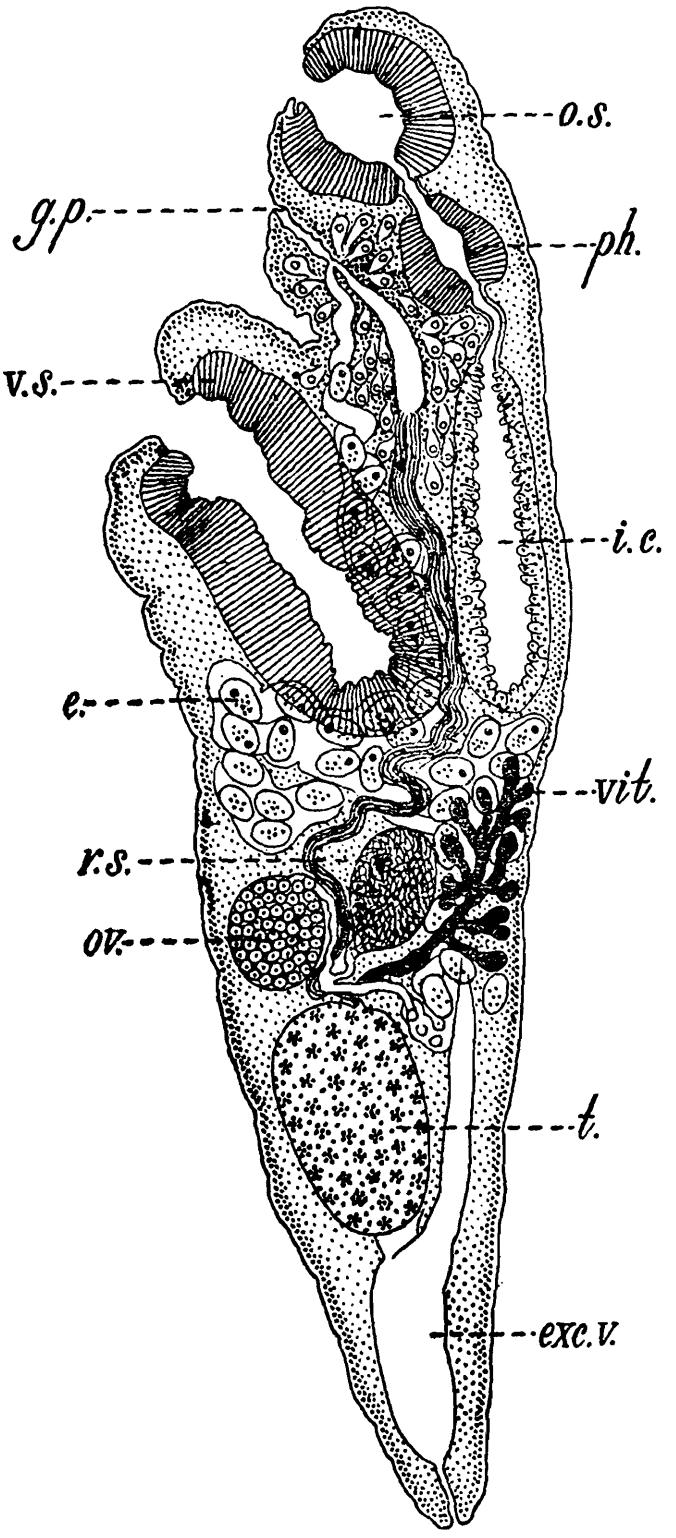
Body fleshy, smooth, roughly triangular with broad rounded off ends, 1·5—2·3×0·54—1·2 (maximum). Oral sucker anteriorly directed, cup-shaped, 0·08—0·22×0·25—0·34. Prepharynx small, narrow. Pharynx dome shaped. Oesophagus small. Intestine a tubular caecum, 0·5—0·9. Acetabulum situated at the junction 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.

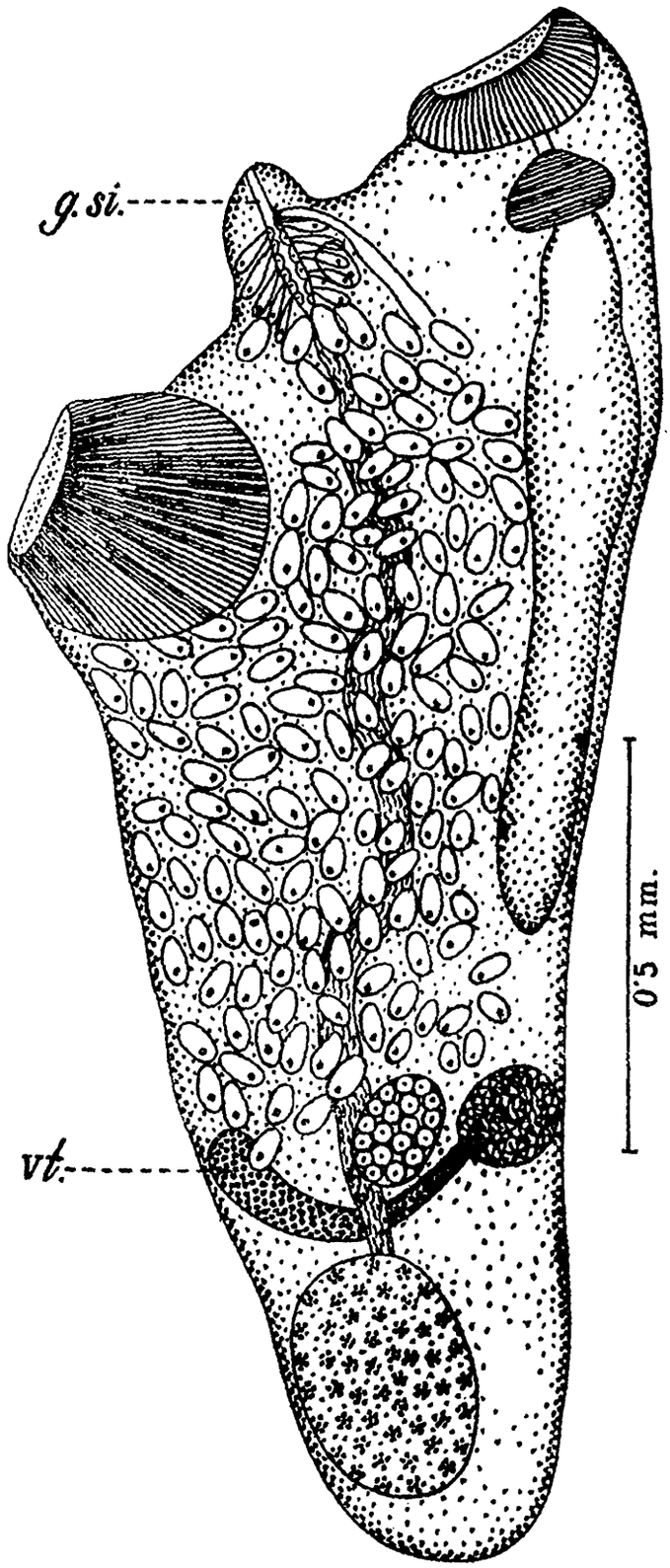
Location.—Intestine.

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).



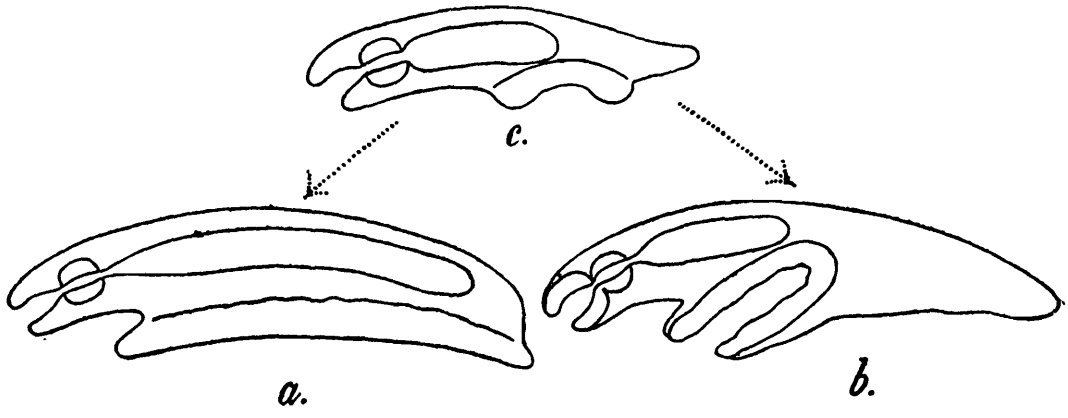
Text-fig. 36.—*Haplosplanchnus purii.*

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.

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