

# ON THE INTERNAL ANATOMY OF THE FAMILIES OF OPISTHOMI.

By BIRENDRA KUMAR MITRA, *M.Sc.*, *Demonstrator of Biology, Medical College, Calcutta*, and EKENDRANATH GHOSH, *M.Sc.*, *M.D.*, *F.Z.S.*,  
*F.R.M.S.*, *Professor of Biology, Medical College, Calcutta.*

## INTRODUCTION.

The order Opisthomi comprises two families, Chaudhuriidae and Mastacembelidae. Tate Regan (4) described the skeletal peculiarities of the Mastacembelidae in his osteological notes on the order. One of us (Ghosh, 3) communicated a paper to the Indian Science Congress of 1929, dealing with the skeleton of *Mastacembelus armatus* (Lacep.), *M. pancalus* H. B. and *Rhynchobdella aculeata* (Bloch). The other family Chaudhuriidae was erected by Annandale (2) for *Chaudhuria caudata* which he had described in a previous paper (1). The caudal skeleton was described by Whitehouse (7) and short notes on the skeleton, air-bladder, alimentary canal and gonads were published by Annandale (2). The present paper, which was communicated to the Indian Science Congress of 1931, deals with the internal anatomy of *Chaudhuria caudata*, *Mastacembelus armatus*, *M. pancalus* and *Rhynchobdella aculeata*.

### 1. Fam. CHAUDHURIIDAE.

#### **Chaudhuria caudata** Annandale.

*Alimentary canal.*—The mouth is terminal. There are villiform teeth on the premaxilla and dentary. The buccal cavity is narrow and tubular. The tongue is narrow and elongated. The superior and inferior pharyngeal bones are beset with minute, recurved, pointed teeth on their surface. The oesophagus is more or less funnel-shaped and is imperceptibly continuous with the stomach. The inner surface of the oesophagus is raised into numerous longitudinal folds. The stomach is long, straight, tubular and somewhat tapering. It is placed on the left side. The cardiac portion of the stomach is straight on the left side, but somewhat bulging on the right. The pyloric portion of the stomach is externally demarcated from the cardiac portion by a faint oblique groove. The pyloric constriction is raised internally into an annular ridge. The inner surface of the stomach is raised into four longitudinal ridges. There are no pyloric coeca. The intestine is wide and tubular and shows a slight curvature at the junction of the anterior and middle-thirds of its length. It runs straight to the rectum. The rectum is somewhat club-shaped (fig. 1, *r.*), wide in front and narrow and tapering behind; it is separated from the intestine by a distinct annular constriction. The anus is surrounded by a series of tubular glands (Annandale, 2).

The liver (fig. 1, *l*) is large and elongated, convex on the ventro-external aspect and concave on the dorso-internal side. It consists of a

narrow anterior portion, slightly less than half its entire length, and a wide posterior portion that tapers behind to an acute end. The gall-bladder is a large, pyriform sac placed on the dorso-mesial aspect of the liver at a little distance in front of the posterior margin.

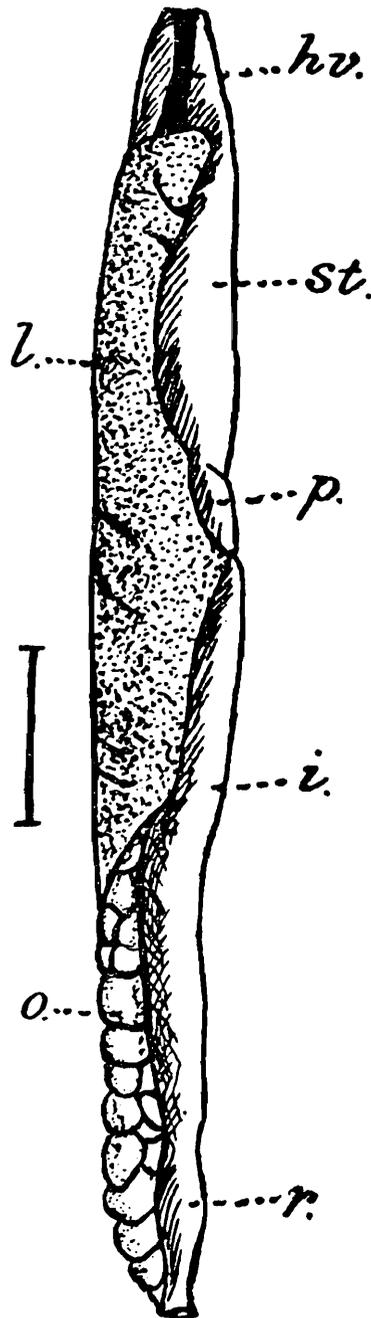


Fig. 1.—Alimentary canal of *Charaduria caudata*. *hv.* hepatic vein; *st.* stomach; *l.* liver; *p.* pylorus; *i.* intestine; *o.* ovary; *r.* rectum.

*Swim-bladder*.—This is a long, tubular sac tapering posteriorly. In the single specimen dissected, the sac was uniformly transparent and no constriction or thickening near the posterior end was found, as observed by Annandale (2).

*Vascular system*.—The bulbus arteriosus has a pair of semi-lunar valves at its junction with the ventricle. The ventral aorta is divisible into an anterior portion from which spring the afferent branchial vessels and a simple posterior portion. The first and second, and third and fourth afferent branchial vessels respectively arise more closely to each



Fig. 2.—Scheme of the origin of afferent vessels in *Chaudhuria caudata*.

other than the 2nd and 3rd (fig. 2). The anterior two efferent branchial vessels open into the cephalic circle, which seems to be incomplete (?) between the two internal carotid arteries. The posterior two efferent vessels unite to form a common trunk which opens into the cephalic circle. The external carotid arises as usual from the antero-lateral side of the cephalic circle (fig. 3a). The coeliaco-mesenteric artery arises from the dorsal aorta a short distance behind its commencement, and the subclavian artery arises from the dorsal aorta behind the coeliaco-mesenteric.

The precaval vein is very short. The anterior cardinal vein persists on the left side. The internal jugular vein is only present on the left side. The left posterior cardinal vein is continuous with the renal-portal vein which is present

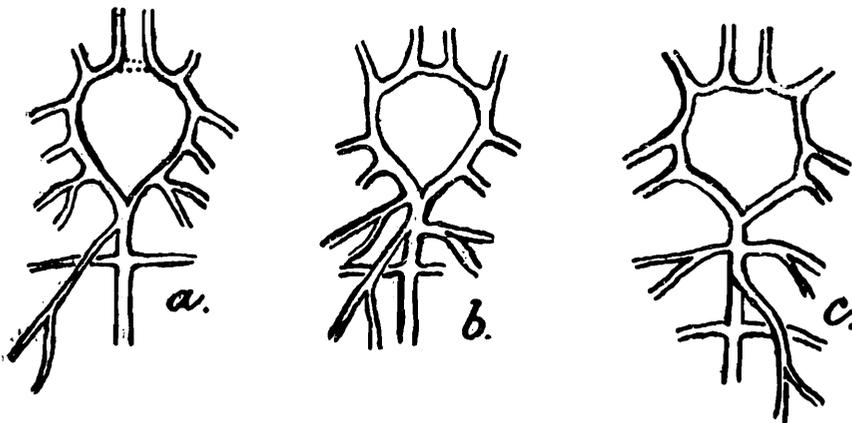


Fig. 3.—Scheme of the arrangement of afferent branchial vessels. (a) *Chaudhuria caudata*. (b) *M. armatus* and *R. aculeata*. (c) *M. pancalus*.

on the left side only. There is a single hepatic vein. A stout genito-mesenteric vein (fig. 4, *gm.*) opens into the right side of the sinus venosus (fig. 4, *sv*); it is formed by a single genital vein from the gonads and a vein from the rectum (?). The anterior abdominal vein arises from the caudal vein and ends in the single hepatic portal trunk.

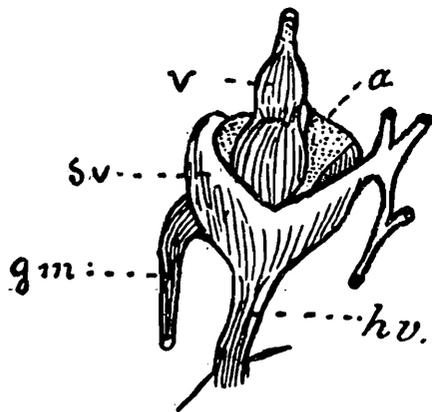


Fig. 4.—Heart of *Chaudhuria caudata* (much enlarged). *a.* auricle; *v.* ventricle; *sv.* sinus venosus; *gm.* genito-mesenteric vein; *hv.* hepatic vein.

The spleen is a small irregular mass lying in front of the gall-bladder.

*Excretory system.*—The kidneys are fused along their entire length, except in front, where they are separated by a rounded notch, and at some 16-17 places, where small rounded gaps occur in the middle line (fig. 5). The fused kidneys are continued behind for a considerable distance into the haemal



Fig. 5.—Two fused kidneys of *Chaudhuria caudata*.

canal The two short ureters arise in front of the first haemal arch and fuse to form a single duct, which is connected to a hemispherical urinary bladder. The duct opens into the cloaca.

*Generative system.*—The testes are band-like and are fused in the middle line. The right testis is a little longer than the left (Annandale, 2). The single duct ends in the cloaca. The ovaries (fig. 1, o) are large and the two oviducts unite to form a single wide duct. The right ovary is a little longer than the left.

## II. Fam. MASTACEMBELIDAE.

### (I). *Mastacembelus armatus* and *M. pancalus*.

*Alimentary canal.*—The mouth is sub-terminal. The teeth, tongue, buccal cavity and pharyngeal bones are similar to those in *Chaudhuria*. The oesophagus is narrow and tubular and its inner surface is raised into 4-11 longitudinal folds. The stomach is bent a little in front of the pyloric end in a V- or U-shaped fashion. The tubular cardiac portion of the stomach (figs. 6-8) widens out behind and particularly at the bend; it consists of the long anterior limb, the bend and the short posterior limb, ending in the pylorus. The pyloric portion is not demarcated externally from the cardiac portion. The pyloric constriction is raised inside into an annular ridge in the form of a sort of truncated cone. The inner surface of the stomach is raised into numerous folds. There are two lateral pyloric coeca. In *M. armatus* the left coecum is tubular and the right one hemispherical. In *M. pancalus* both of them are tubular and of the same size. The intestine is long, narrow, and bent like a U (figs. 6-8). It consists of a short limb, the bend and a long second limb. The first limb is nearly half the second in length. The second limb is directed forwards and ends in the rectum. The rectum is elongately fusiform and is much wider than the intestine.

The liver is large and elongated as in *Chaudhuria*. It is somewhat narrow in front and ends in a tongue-like projection behind. In *M. pancalus* the anterior portion presents a small rounded process on the left side. The gall-bladder is placed at the base of the tongue-like projection. It is spherical in *M. armatus* and pyriform in *M. pancalus*. The bile-duct enters the intestine midway between the bend of the stomach and that of the intestine.

*Swim-bladder.*—This is a long, tubular sac tapering behind.

*Vascular system.*—There are two semilunar valves at the base of the bulbus arteriosus as in *Chaudhuria*. In *M. pancalus*, as in *Chaudhuria*, the first and second, and third and fourth afferent branchial vessels arise more closely to each other, but the other two pairs arise further apart (fig. 2). In *M. armatus* (fig. 8a) the third and fourth afferent vessels

arise together, being placed at the same distance from the second as the second is from the first.

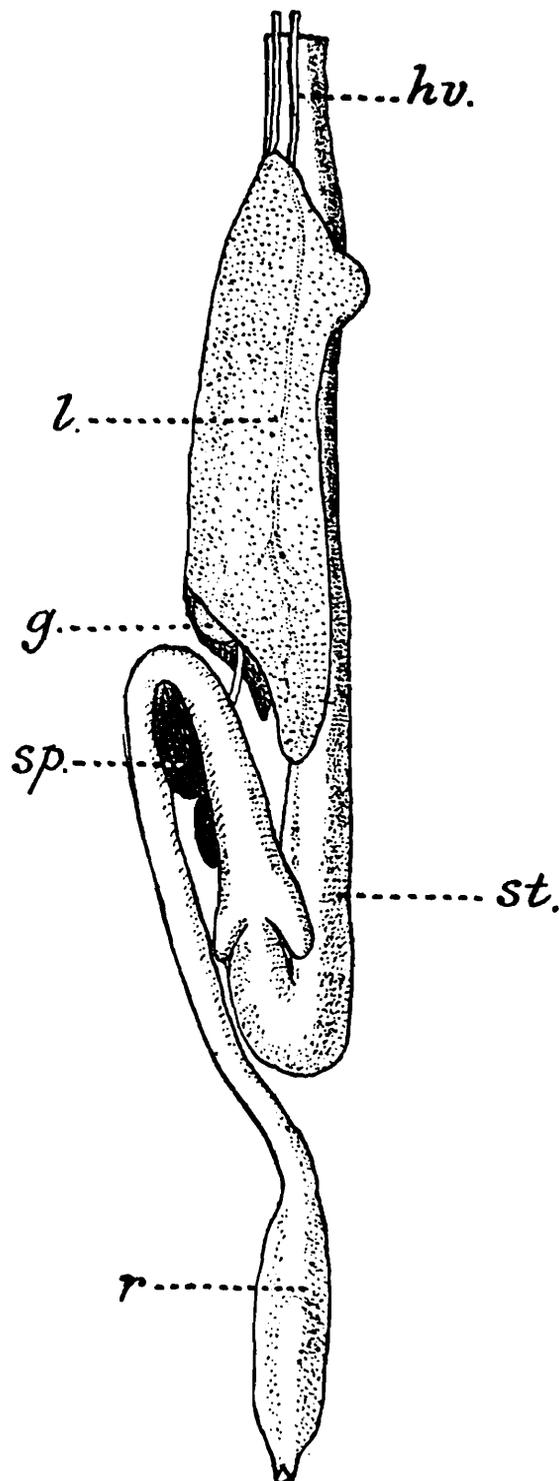


Fig. 6.—Alimentary canal of *M. pancalus*,  $\times 2$ . *hv.* hepatic vein; *l.* liver; *g.* gall-bladder; *st.* stomach; *sp.* spleen; *r.* rectum.

The first two efferent branchial vessels open into the cephalic circle. The last two efferent vessels unite to form a single trunk. In *M. armatus* the left trunk ends at the point of union of the epibranchial with the dorsal aorta and the right one in the right epibranchial close to this point (fig. 3b). In *M. pancalus* the trunks of the two sides end in the

dorsal aorta a little behind its origin (fig. 3c). The external carotid divides into three branches supplying the orbital region, snout and mandibular portion of the head. The internal carotid has the usual structure.

The coeliaco-mesenteric artery arises from the dorsal aorta in *M. pancalus* (fig. 3c), and from the junction of the dorsal aorta with the epibranchials in *M. armatus* (fig. 3b). The artery to the air-bladder arises from the coeliaco-mesenteric as in others. The subclavian artery arises from the dorsal aorta behind the coeliaco-mesenteric.

The precaval vein is very short as in *Chaudhuria*. The anterior cardinal vein is present only on the left side in *M. armatus* and on the right side in *M. pancalus*. The internal jugular vein is present on both sides. The posterior cardinal vein of the right side is continuous with the renal-portal vein. There are two long hepatic veins. The single renal-portal vein of the right side is continuous with the caudal vein, as in *Chaudhuria*.

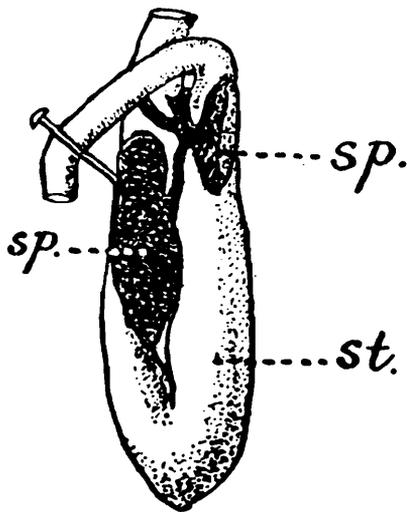


Fig. 7.—Stomach and spleen of *M. pancalus*,  $\times 2$ . *sp.* spleen; *st.* stomach.

*Spleen.*—In *M. armatus* this organ consists of three distinct bodies, placed together behind the intestine; the third one is large and elongated. In *M. pancalus* (figs. 6, 7, *sp.*) it is a bilobed organ with the lobes placed dorsally and ventrally.

*Excretory system.*—The kidneys are elongated, very narrow in front and wide behind. Posteriorly they are fused with each other for nearly one-third of their length. The two ureters unite to form a common duct ending in the cloaca. The urinary bladder is subspherical in *M. pancalus* and club-shaped in *M. armatus*.

*Generative system.*—The testes are long, slender and tubular. The right gonad is longer than the left one. The ducts end separately.

## (2). *Rhynchobella aculeata* (Bloch).

*Alimentary canal.*—The mouth is subterminal as in *Mastacembelus*; there are viliform teeth on the premaxilla and dentary. The buccal cavity and tongue are similar to those in others. The superior and inferior pharyngeal bones are beset with teeth as in others. The oesophagus is similar to that of *Mastacembelus*. The tubular cardiac portion of the stomach (fig. 9) widens out behind and particularly so at the bend as in *Mastacembelus*; it consists of a long anterior limb, the bend and a short posterior limb, ending in the pylorus. There are numerous longitudinal ridges on the inner side of the stomach. Of the two lateral pyloric coeca, both tubular in form, the left one is nearly double the right in length. The intestine is similar to that in *Mastacembelus*, the first limb being less than one-third the second in length. The rectum is narrow and tubular at its commencement, but fusiform behind.

The liver is similar to that of *Mastacembelus* in general contour. The gall-bladder is placed at the base of the posterior tongue-like projection; it is pyriform in shape. The bile duct enters the intestine a

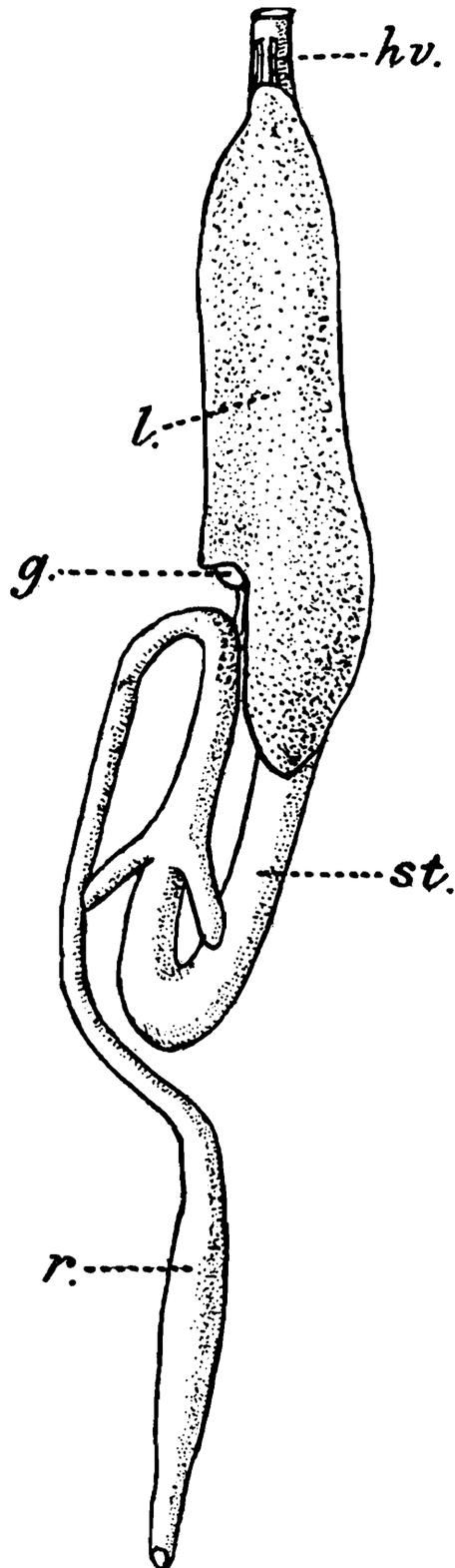


Fig. 8.—Alimentary canal of *M. armatus*,  $\times 3$ . *hv.* hepatic vein; *l.* liver; *g.* gall-bladder; *st.* stomach; *r.* rectum.

little in front of the midpoint between the bends of the stomach and intestine.

*Swim-bladder*.—This is similar to that of *Mastacembelus*.

*Vascular system*.—The third and fourth afferent branchial vessels (fig. 10) arise together, being placed at the same distance from the second as the second is from the first. The third afferent vessel is much stouter than the others.

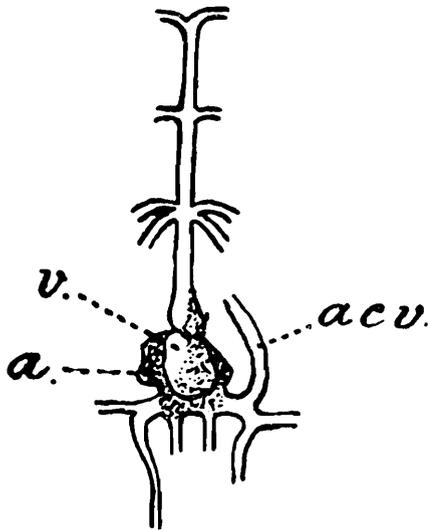


Fig. 8a.—Heart and ventral aorta of *M. armatus*,  $\times 2$ . *v.* ventricle; *a.* auricle; *acv.* anterior cardinal vein.

The first two efferent branchial vessels open separately into the cephalic circle. The last two efferent vessels of each side unite to form a common trunk, which ends in a similar way as in *M. armatus*. The external and internal carotid arteries are similar to those of *Mastacembelus*.

The coeliaco-mesenteric artery arises from the junction of the dorsal aorta with the epibranchials, as in *M. armatus*. The artery to the swim-bladder and the subclavian artery arise and end in the same way as in *Mastacembelus*.

The precaval vein is well developed. The anterior cardinal vein persists only on the left side. An internal jugular vein is present on both the sides. The posterior cardinal veins and hepatic veins are like

those of *Mastacembelus*. Only the right renal-portal vein is persistent.

*Spleen*.—This organ is bilobed and elongated with tapering ends.

*Excretory system*.—The kidneys are fused with each other posteriorly for nearly one-third of their length. The ureters unite as usual to form a common duct ending in the cloaca. The urinary bladder is pyriform.

*Generative system*.—The left gonad is longer than the right one (fig. 9).

*Remarks*.—The two families Chaudhuriidae and Mastacembelidae have been compared by Annandale (2) from the standpoint of their general facies, external characters and skeleton. Having studied the internal organization of the members of the two families we are now in a position to compare them from this point of view also.

The *alimentary canal* is more or less simple in both the families, but it is comparatively simpler in *Chaudhuria* owing to the absence of the bends in the stomach and intestine and also from the absence of the pyloric coeca. Except for these details, the alimentary canal is, in general, more or less similar in the two families. The differences in details have some value for specific distinctions. The *liver* on the whole is more or less similar in general appearance.

The *vascular system* shows some difference in detail. As already shown by Ridewood (6), such differences have no phylogenetic value, although they are of specific significance. The formation of a posterior portion of the *ventral aorta* without afferent branches, the absence of the *anterior cardinal* and *internal jugular* of one side and the elongation of the *hepatic veins* are all correlated with the elongation of the body. The presence of the *genito-mesenteric vein* in *Chaudhuria* is very remarkable.

The presence of a bilobed *spleen* leading to distinct and separate bodies in Mastacembelidae is noticeable.

The *kidneys* are somewhat different in the two families. In *Chaudhuria* they are entirely fused with each other except for several small gaps in the middle line, whereas in the Mastacembelidae they are fused in their posterior portions only. The kidneys are also different in general shape in the two families.

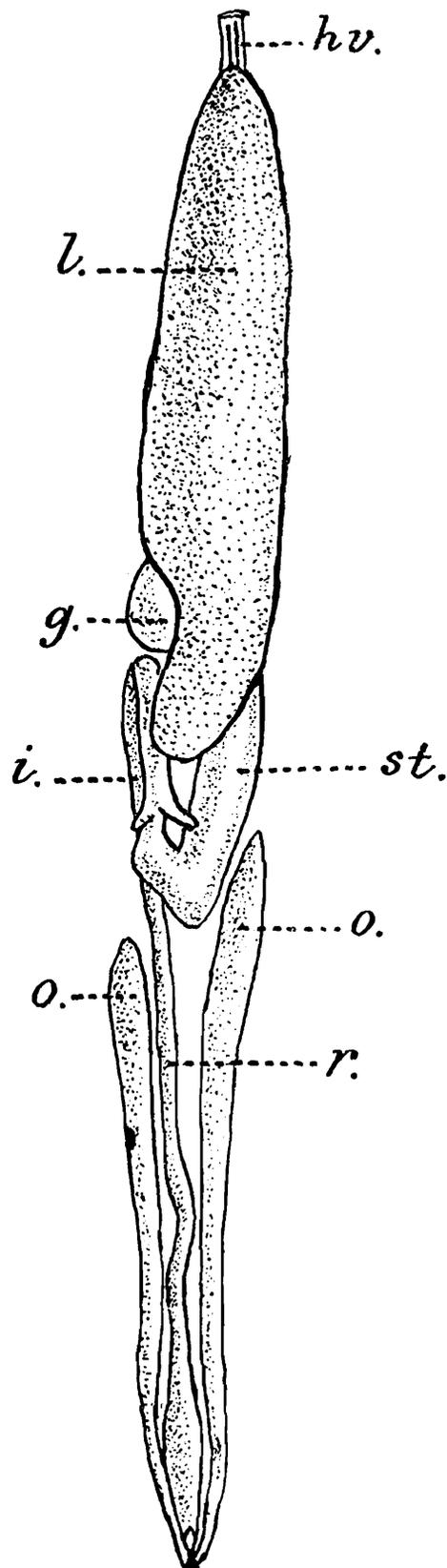


Fig. 9.—Alimentary canal and ovaries of *R. aculeata*,  $\times 2$ . *hv.* hepatic vein; *l.* liver; *g.* gall-bladder; *i.* intestine; *st.* stomach; *o.* ovary; *r.* rectum.

There is a general agreement in the arrangement of *gonads*, except that the testes are fused in the middle line in *Chaudhuria*, but free in the others.

Lastly, we may summarise a few specific characters in the internal anatomy of the species studied.

*Chaudhuria caudata*.—Stomach and intestine without a U-shaped bend. No pyloric coeca. Left anterior cardinal vein persistent. Last two afferent branchial vessels opening by a common trunk into the cephalic circle in front of the beginning of the dorsal aorta. Single spleen. Kidneys entirely fused in the middle line with small rounded or oval gaps.

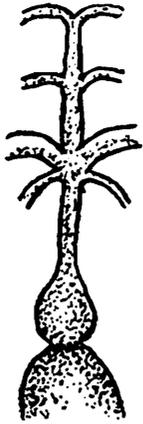


Fig. 10.—Scheme of the origin of afferent vessels in *R. aculeata*.

*Mastacembelus armatus*.—Stomach and intestine with U-shaped bend. Two pyloric coeca, left tubular and right hemispherical. Only left anterior cardinal vein present. The two last afferent branchial vessels opening together near to or at the formation of the dorsal aorta. Three separate spleens.

*M. pancalus*.—Stomach and intestine with U-shaped bend. Two pyloric coeca, both tubular and equal in size. Liver with a triangular process from the ventro-mesial border close to the anterior end. Persistent right anterior cardinal vein. Last two afferent branchial vessels opening together into the dorsal aorta. Spleen dorso-ventrally bilobed.

*Rhynchobdella aculeata*.—Stomach and intestine with U-shaped bend. Two pyloric coeca, both tubular, left being double the right one in length. Persistent left anterior cardinal vein. Last two afferent branchial vessels opening together into the junction of the dorsal aorta with the cephalic circle. The third afferent branchial vessel stouter than others. Spleen antero-posteriorly bilobed.

#### BIBLIOGRAPHY.

1. Annandale, N. Fish and Fisheries of the Inle Lake. *Rec. Ind. Mus.*, XIV, p. 39 (1918).
2. Annandale, N. The systematic position of the Burmese Fish *Chaudhuria*. *Ann. Mag. Nat. Hist.*, (9) XI, pp. 327-333 (1923).
3. Ghosh, Ekendranath. On the Osseous system of Mastacembelidae. Read before the Indian Science Congress, 1929. Abstract published in the Report.
4. Regan, C. Tate. The Osteology of the Teleostean Fishes of the Order Opisthomi. *Ann. Mag. Nat. Hist.*, (8) IX, p. 217 (1912).
5. Regan, C. Tate. Note on *Chaudhuria*, a Teleostean Fish of the Order Opisthomi. *Ann. Mag. Nat. Hist.*, (9) III, pp. 198-9 (1919).
6. Ridewood, W. G. On the relations of the efferent branchial blood vessels to the 'Circulus cephalicus' in Teleostean Fishes. *Proc. Zool. Soc. London*, 1899, pp. 939-956.
7. Whitehouse, R. H. The caudal fin of *Chaudhuria*. *Rec. Ind. Mus.*, XIV, p. 65 (1918).