

Article XXXVI.—A NEW SPECIES OF TREMATODE (*CLADORCHIS GIGAS*) PARASITIC IN ELEPHANTS.¹

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PLATES CVIII-CX.

The material brought to the Museum from the Belgian Congo comprised a large number of parasites from the various mammals, birds, fish, etc., which were met with by Messrs. Lang and Chapin during their stay of nearly six years in that country. It is representative of a very extensive tropical fauna, as the collectors were most energetic and industrious in their endeavors to make as large a collection as possible. I wish here to thank the curators of the Department of Invertebrate Zoölogy at the American Museum of Natural History for their great kindness in entrusting this valuable collection to me for identification and study. Where so many unusual forms are found with so little literature to assist, the determination of the species will naturally be rather tentative.

Several specimens of the African elephant (*Loxodon africanus* Blum.) were autopsied. Little has been written about the Entozoa of this species, which apparently differ in many respects from the better known forms infecting *Elephas indicus*.

It is said that elephants succumb to the infestation of parasites more than from any other cause and the worm most often responsible for the destruction of these animals is a species of *Paramphistomum*. Numbers of this genus of trematodes are commonly parasitic among the herbivora in tropical countries and often infest the stomach and intestines in great numbers so as not only to deplete the animal by the great quantity of blood extracted but also to disturb the lining membrane of the stomach and intestine so as to interfere seriously with the secretions and digestion. It may be said that several species of worms are often found living in the same region.

The elephant when suffering from unusual numbers of these parasites is said to make instinctively an attempt to get rid of them and in order to do so it will eat ten or twenty pounds of a certain red earth when it can be found. This acts as a purgative and thus a lot of worms are dislodged and expelled. In India, with domesticated herds of four or five hundred

¹ Scientific Results of the Congo Expedition. Invertebrate Zoölogy, No. 2.

of these valuable animals, the loss from Entozoa is sometimes serious. "The usual remedy given to domesticated elephants is a solution of Kallahmimok or 'bit noben,' 4 oz. to as many gallons of water. This is one of the best remedies and is said to be an impure chloride of sodium containing a little sulphuret of iron. It is a purgative and is claimed to be quite efficient, the good effects lasting some time." (Cobbold.)

Family PARAMPHISTOMIDÆ, Fiscoeder.

Subfamily CLADORCHINÆ, Fiscoeder.

Genus *Cladorchis* Fiscoeder.

I have recently published an exhaustive discussion of the nomenclature of the Paramphistomidæ and a revision of the described species.¹ Some additional species are: *Cladorchis pangasii* in *Pangasius nasutus*, a siluroid fish from Sumatra, and *Cladorchis helostomatis* in the stomach of *Helostoma temminckii*, a fish from Palembang, Sumatra; both species described by Dr. W. G. MacCallum.² Also two species from turtles: *Paramphistomum papillostomum* G. A. MacCallum,³ in the colon of a very large *Chelonia mydas* from Key West, Florida; *Paramphistomum aspidonectes* G. A. MacCallum,⁴ found in 1916 in the oviduct of *Trionyx spinifer*.

However, in 1901 Fiscoeder⁵ published a revision of the Amphistomes and in this he divided them into two great groups, viz., those with pharyngeal cæca (Cladorchinæ) and those without such appendages (Paramphistominæ). The former subfamily only interests us here; he describes them as having a ventral acetabulum at the posterior end, two pharyngeal pockets present, testicles branched, vas deferens without pars muscosa, cirrus pouch present and the body slightly flattened dorso-ventrally. The body has an anterior conical portion; the disc is concave and the acetabulum small. This diagnosis would include such genera as *Gastrodiscus*, *Cladorchis*, etc. A parasite described as *Amphistomum*, but probably belonging to the genus *Gastrodiscus* Fiscoeder, 1901, selects at times even man as host.

¹ Zoopathologica, I, 1, 1916, p. 31.

² On two new Amphistoma parasites of Sumatran fish. Zool. Jahrb. Syst., XXII, 1905, p. 667.

³ Zoopathologica, I, 1, 1916, pp. 31-33, fig. 13.

⁴ Zoopathologica, I, 2, 1917, pp. 59-60, fig. 26.

⁵ Die Paramphistomiden der Säugethiere. Zoolog. Anzeiger, XXIV, 1901, pp. 367-375.

***Cladorchis gigas* sp. nov.**

According to Lang this worm is very common in the stomachs of elephants which he had the opportunity of examining. Consequently many specimens are found in the collection, from the northeastern Uele: Van-kerckhovensville, Faradje, and Yakuluku. It is very different from any of the *Cladorchinæ* described from the Indian Elephant: *Pseudodiscus hawkesii* (Cobbold), *P. ornatus* (Cobbold), and *Pfenderius papillatus* (Cobbold).¹

This parasite must be classed under the genus *Cladorchis* and is probably the largest member of the group yet discovered. Consequently it will be named *Cladorchis gigas*. (See Plate CVIII, Figs. 1 and 2.) It was found in great numbers in the stomach and intestine of *Loxodon africanus*. It is pinkish white in color, quite pointed at the anterior end where the mouth is subterminal. The most striking feature however is the presence of two relatively large wings or claspers on each side of the caudal sucker. These claspers are very muscular and strong and are a quarter or one third of the length of the worm. They are probably used by the worm in clearing a space for the caudal sucker to act, since the stomach of the elephant is usually coated throughout, above the mucous membrane, with a very sticky, pasty tenacious layer of mucus about a quarter of an inch deep, which is said by those who have tried, to be exceedingly difficult to clear away. When a worm is detached, however, a circular patch white and smooth is left where the sucker was adherent to the mucous membrane.

Looking at the worm ventrally the mouth is the most anterior opening, then about nine millimeters posteriorly is seen the large genital pore. This is at about the middle of the ventral surface, still further posteriorly and situated between the anterior ends of the claspers is the large ventral or caudal sucker. The ventral surface is not concave as would have been expected but is rather convex, being bulged out as it were by the contents of the abdomen, largely by the immense single testis. Dorsally the body is very convex evenly from the back of the head to the terminal ends of the claspers or alæ. These latter are however divided at the posterior ends, separating them into two, almost up to the ventral sucker, much as in *Amphistomum bicaudatum* (Baird). Indeed this parasite in its external characters is very much like *C. gigas* except in size, as it was said by Baird to measure 6 mm. long \times 5 mm. wide, wings 2 mm. long and the ventral sucker 1 mm. in diameter and to have two testicles placed one on each side against the inner side of the intestine. It is therefore different from *C. gigas*, the exact measurements of which are given on p. 870.

¹ See T. S. Cobbold, Trans. Linn. Soc. London, (2), Zool., II, pt. 4, 1882, pp. 238-242.— L. Geddoelst, Synopsis de Parasitologie, 1911, pp. 88-89.

Plate CVIII, Fig. 3, and Plate CIX show the anatomy of *C. gigas* and illustrate the internal arrangement of its organs as well as its histological structure. The worm was so thick that it was necessary to make four hundred and thirty or more serial sections in the sagittal plane. In Plate CX a reconstruction of these sections is shown and proves a most interesting study. As will be seen here the mouth is relatively small near the tip of the triangular anterior portion of the body opening into a very powerful muscular mouth sucker and behind this there is a stout muscular pharynx from which there opens on each side a large cæcum. The cæca fill almost entirely this portion of the body. The pharynx is continued between these into the œsophagus. This shortly ends in the intestine which here branches into the cœca. The latter are large and convoluted and pass along the sides back as far as the anterior end of the alæ. In the angle of the intestinal cæca appears the genital pore. This may be seen to open into an exceedingly large circular cirrus sac. This is a very peculiar arrangement which encloses the cirrus, vesicula seminalis, ductus ejaculatorius, and vas deferens. It also encloses a part, the terminal portion of the uterus, the metraterm. The cirrus has a well developed muscular prostatic portion and the uterine metraterm is well developed.

As will be seen in the reconstructed worm, immediately beneath the anterior wall of the abdomen is the immense deeply lobulated or branched single testis which sends an arm or prolongation toward the cirrus sac before the real vas deferens is given off. Here too it may be noted that in the first portion of the vesicula seminalis, masses of the sperm forming cells have been forced where they do not usually appear.

The actual copulatory part of the apparatus seems to be the thick muscular sac with folded walls which projects into a broad tube which opens externally — a sort of vagina. This muscular sac receives both the cirrus and the end of the uterus, the uterine opening being just behind that of the prostatic part of the cirrus.

On tracing back the uterus in which eggs are to be seen it is found to pass in a curve backward to the posterior wall of the sac where it becomes very narrow and thick-walled and passes in a slanting direction through the wall to extend in free coils posteriorly. The point of penetration is ventral to the entrance of the vas deferens. Thus there is a very large sac with very dense fibrous walls through which both uterus and vas deferens enter posteriorly, the uterus to pass directly to the muscular sac which opens into the external cloaca, the vas deferens to enter a thin-walled seminal vesicle which passes by a stouter walled prostatic portion to the same sac into which it opens side by side with the uterus.

Within the sac these organs are suspended in a very peculiar tissue which

seems to be made of spongy anastomosing strands of fibre cells and in the meshes of which there are great accumulations of some thick fluid which is coagulated. The vas deferens approaches the sac rather dorsally from behind and is seen as a very wide convoluted tube full of a fluid mixture of spermatozoa and cell complexes from the testicle. This gives it the appearance of being a prolongation or arm of the testis. It suddenly narrows or gives off a small tube which passes through the wall of the cirrus sac in the dorsal median line in a long slant to join the convoluted seminal vesicle, the distal part of which may be called the ductus ejaculatorius. The posterior convolution of the seminal vesicle still shows some of the mulberry-like sperm-forming cells and numerous clusters of the forerunners of spermatozoa. As it proceeds however the contents become pure spermatozoa. It passes forward and in the anterior part of the cirrus sac becomes narrowed to a valve-like constriction as it enters the prostatic part. This is a long broad tube bent once which runs to enter the muscular portion of the cirrus sac by a narrow opening. It is lined with ciliated cells and thickly surrounded by a mass of rather large pear-shaped cells arranged with thin pointed ends toward the lumen. There is also a good deal of muscle in the wall. There are some large pale granular cells interspersed with the others which somewhat resemble the parenchyma cells.

Lying dorsally to the testis and to the right is the semilunar shaped ovary and close against it, with a very short oviduct between, is the shell gland which on account of its size is very beautifully shown with the oviduct entering it to form the oötype. Arising therefrom or terminating in it is plainly seen Laurer's canal passing dorsally to open in the centre of the back. The uterus of course arises or begins outside of the shell gland and in this case is voluminous and lobulated, occupying a large portion of the body cavity. The vitellaria are found to be chiefly situated in the alæ although some lobules are to be seen in a small portion of the body posteriorly. The vitelline ducts from these glands pass forwards and inwards, join and enter the oviduct just before that tube enters the shell gland (Fig. 1).

The ventral sucker is a wonderfully constructed, muscular organ, much like that of smaller trematodes but here it is on such a large scale that it can be studied to advantage as a type. The muscular fibres are plainly shown and are a study in themselves. There are seen here many circular muscular fibres, radial muscular fibres and also longitudinal fibres, and inter-spread between these many muscle cells, the whole forming a very powerful organ.

The water-vascular system is well developed, the whole concentrating in a large reservoir or bladder with a free outlet at the posterior portion in the center of the back and a short distance posterior to the inlet of Laurer's

canal. Large portions of the reservoir are shown in the sections and show even the small mucous papillæ on its surface.

The eggs are large and numerous; they are round and appear to be filled with vitelline granular matter, etc.

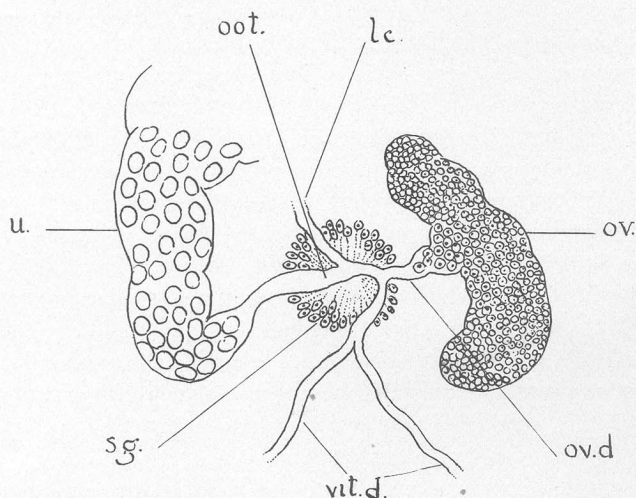


Fig. 1. *Cladorchis gigas* sp. nov. Details of female reproductive organs. Abbreviations as on plates (see p. 871).

The nervous system consists of a somewhat horseshoe-shaped ganglion situated dorsal to the pharyngeal cæca, from which nerve trunks are sent posteriorly and along each side to supply the body generally.

Measurements of *Cladorchis gigas*.

	mm.
Length.....	21
Width.....	10
Diameter of ventral sucker or acetabulum.....	2
Between genital pore and ant. margin of acetabulum.....	5
Length of claspers or alæ.....	9
Width of claspers or alæ.....	5
Antero-posterior depth of body.....	6

EXPLANATION OF PLATES CVIII-CX.

Abbreviations.

<i>al.</i> — alæ or claspers.	<i>ov.</i> — ovary.
<i>c.</i> — cirrus.	<i>ov.d.</i> — oviduct.
<i>ce.</i> — cæcum.	<i>ph.</i> — pharynx.
<i>cl.</i> — cloaca.	<i>p.p.</i> — pars prostatica.
<i>c.s.</i> — caudal sucker.	<i>res.</i> — water-vascular reservoir.
<i>d.ej.</i> — ductus ejaculatorius.	<i>s.g.</i> — shell gland.
<i>ex.p.</i> — excretory pore.	<i>s.v.</i> — seminal vesicle.
<i>g.p.</i> — genital pore.	<i>t.</i> — testis.
<i>i.</i> — intestine.	<i>u.</i> — uterus.
<i>l.c.</i> — Laurer's canal.	<i>v.d.</i> — vas deferens.
<i>m.</i> — mouth.	<i>vit.</i> — vitellaria.
<i>met.</i> — metraterm.	<i>vit.d.</i> — vitelline duct.
<i>m.s.</i> — muscular mouth sucker.	<i>v.s.</i> — ventral sucker or aceraulum.
<i>oot.</i> — oötype.	

PLATE CVIII.

Cladorchis gigas sp. nov. Fig. 1. Side view. $\frac{3}{1}$. Fig. 2. Ventral view. $\frac{3}{1}$.
 Fig. 3. Section through the cirrus sac, showing details of reproductory organs,
 especially the peculiar cloaca with vagina-like portion. $\frac{2\frac{5}{1}}{1}$.

PLATE CIX.

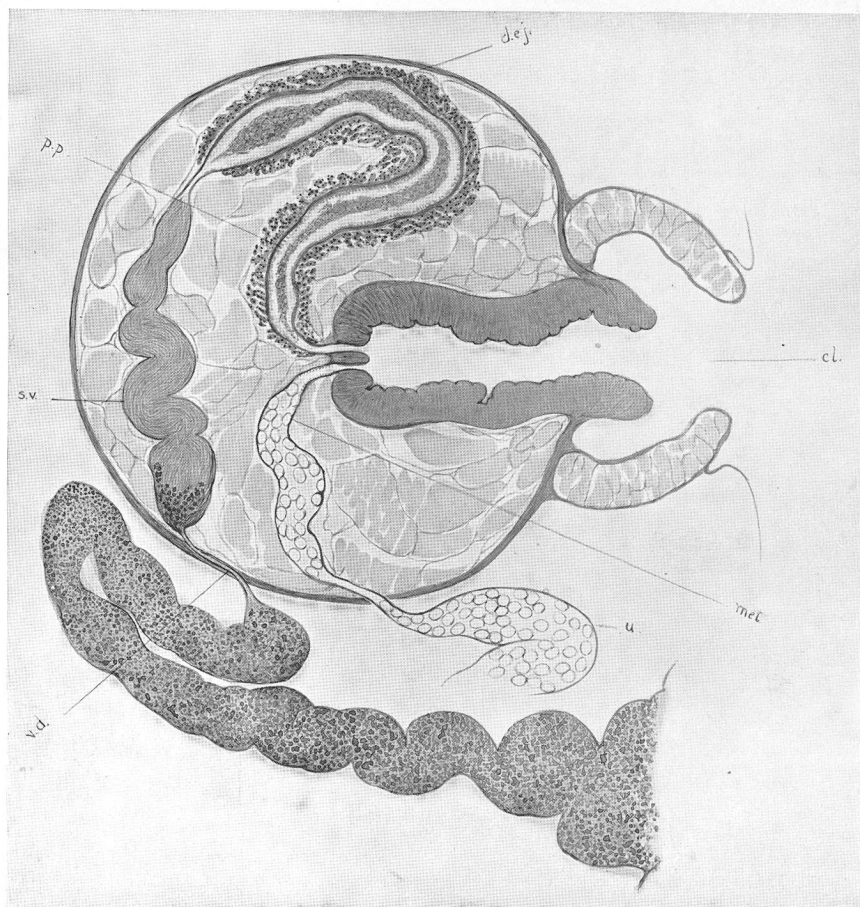
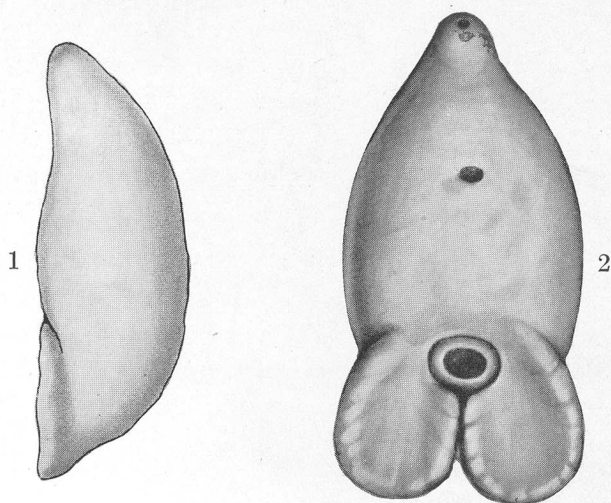
Cladorchis gigas sp. nov. Sagittal section. $\frac{9}{1}$.

PLATE CX.

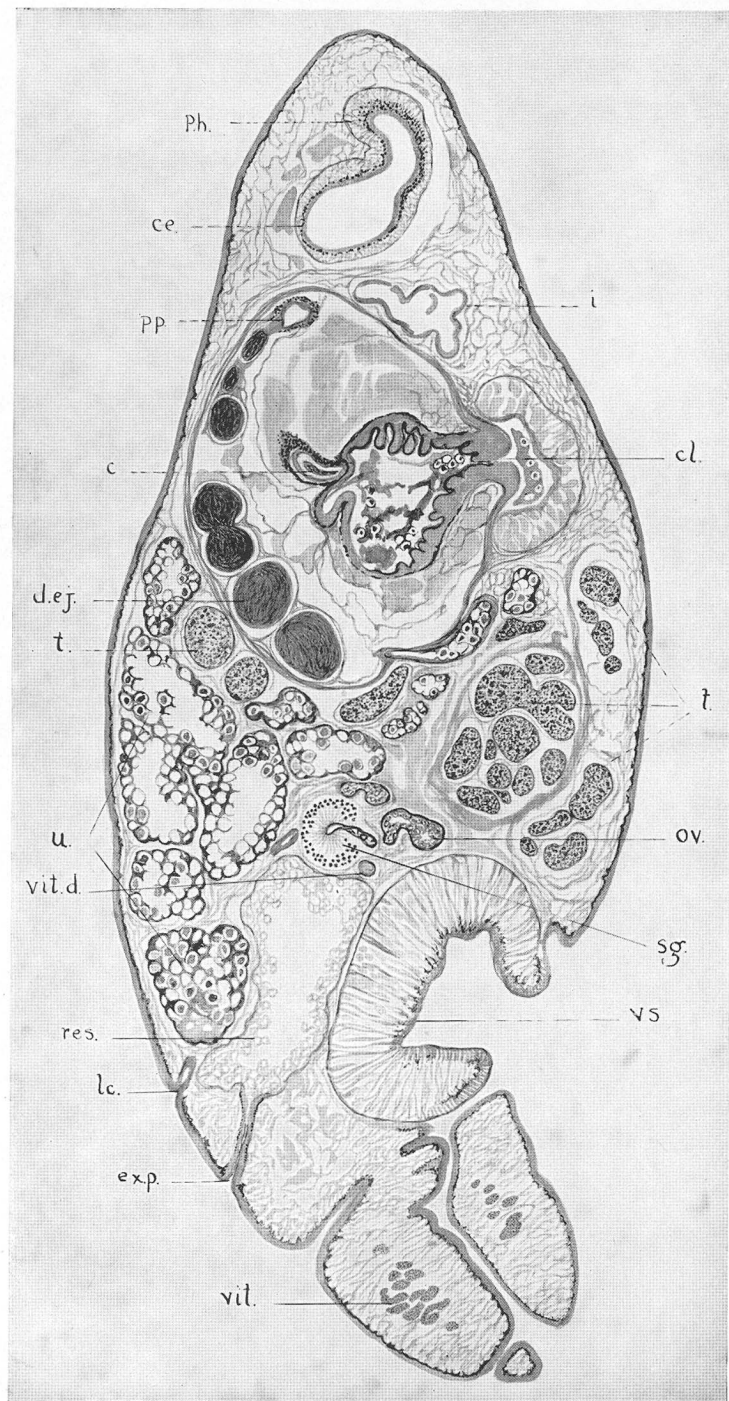
Cladorchis gigas sp. nov. Ventral view. Reconstruction of the internal anatomy
 after serial sections. $\frac{8}{1}$.

TEXT FIGURE.

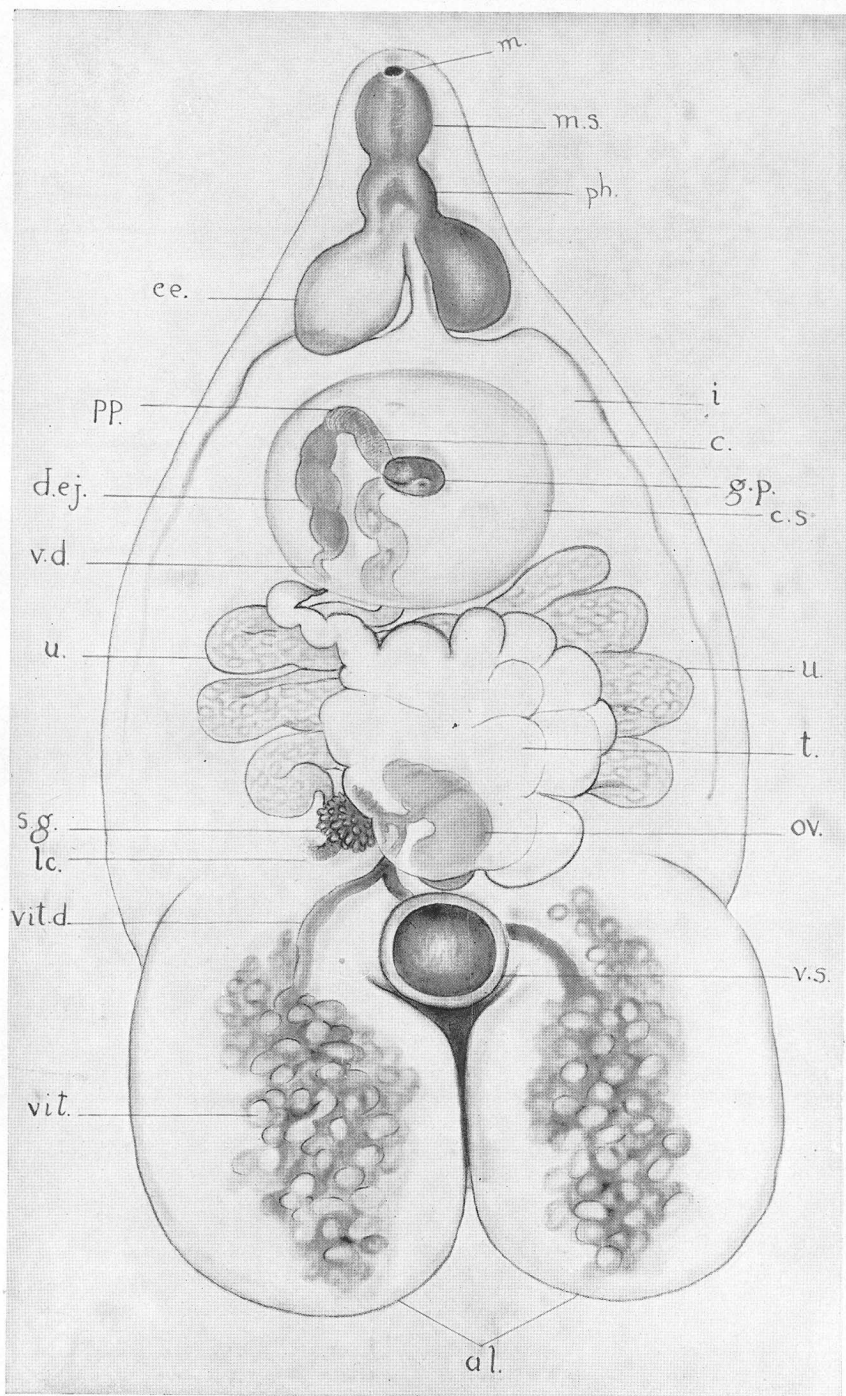
Fig. 1. *Cladorchis gigas* sp. nov. Details of female reproductory organs.
 Abbreviations as on plates.



Cladorchis gigas sp. nov. Fig. 1. Side view. $\frac{3}{1}$. Fig. 2. Ventral view. $\frac{3}{1}$.
Fig. 3. Section through the cirrus sac, showing details of reproductive organs. $\frac{25}{1}$.



Cladorchis gigas sp. nov. Sagittal section. ♀.



Cladorchis gigas sp. nov. Ventral view. Reconstruction of the internal anatomy after serial sections. $\frac{9}{1}$.