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On *Aspidogaster ringens* (Linton) and *A. kemostoma* n. sp.

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With 4 figures in the text.

In the family *Aspidobothridae* the determination of genera has been made chiefly upon the character of the ventral sucking disc, the presence or absence of tactile organs in the margins of this disc and the number of testes. The forms which we have to describe fall therefore, as will be seen, into the genus *Aspidogaster*, although in *A. ringens* the median ridge of the sucking disc is so ill developed that the disc has rather the appearance of that seen in *Cotylogaster*. Still the existence of only one testis seems a character of much greater specific importance and since some of the specimens show a median ridge though imperfectly developed, we have not hesitated to place the form in the genus *Aspidogaster*.

Aspidogaster ringens (LINTON).

(Fig. A.)

Very numerous specimens of this form were found in the intestines of *Trachinotus carolinus* varying greatly in size and in the proportion of their bodies. Probably this is due chiefly to the condition of contraction, for one has the impression from the fixed

worm that the anterior end at least can be telescoped to a slight degree. But in addition one finds the hinder portion of the body elongated in some specimens in a way that could hardly be explained on these grounds and it is often in these cases that the great accumulation of eggs in the uterus is responsible for much increase in the bulk of the body. They are white or greyish white and fairly translucent so that the larger organs can be seen through the skin.

The anterior end of the body, as shown in the sketches, is provided with five curiously recurved muscular lobes which when seen in face have an arrangement somewhat like that of the petals of a violet. The dorsal group is composed of two rather large sharply recurved lobes separated by a small rounded one which is much more erect. The ventral group is formed of two still larger lobes which are partly divided from one another by a deep median indentation. They, too, curve back sharply. At the extremity between these lobes there is a central depression, the mouth, which leads directly into the thin walled prepharynx. There seems thus to be no special sucker like arrangement about the mouth but the lobes as well as the whole anterior extremity of the body are so solidly built of muscle fibers that it seems probable that in some way they constitute a sucking or adhering apparatus.

The ventral sucking disc is relatively large and seems extremely powerful. In life it moves actively and may be made concave in both directions although in the fixed specimen it tends to evert itself into a convex structure. The body which is fused into it is especially thick over this disc projecting behind it into a posterior elongation of varying extent and anteriorly into the relatively short neck. The posterior end of the body is often transversely indented and it is evident that the excretory apparatus opens in this indentation.

The large ventral sucking disc measures $1,7 \times 0,7$ mm and is elliptical in form. It is divided transversely into about sixteen grooves the ridges between which are quite sharp and provided with little pyramids of muscle fibers which run in the long axis of the worm, that is at right angles to the ridge. Below these there is a triangular space filled with cells on each side of which begins the radial muscle which forms the sucker-like hollow of the groove. On each side the groove terminates in a rounded complete sucker. Anteriorly and posteriorly a pair of these suckers comes together without an intervening muscular groove so that there are thirty-six

marginal suckers and only sixteen grooves. In many cases, however, there is an unpaired anterior and posterior sucker in this marginal

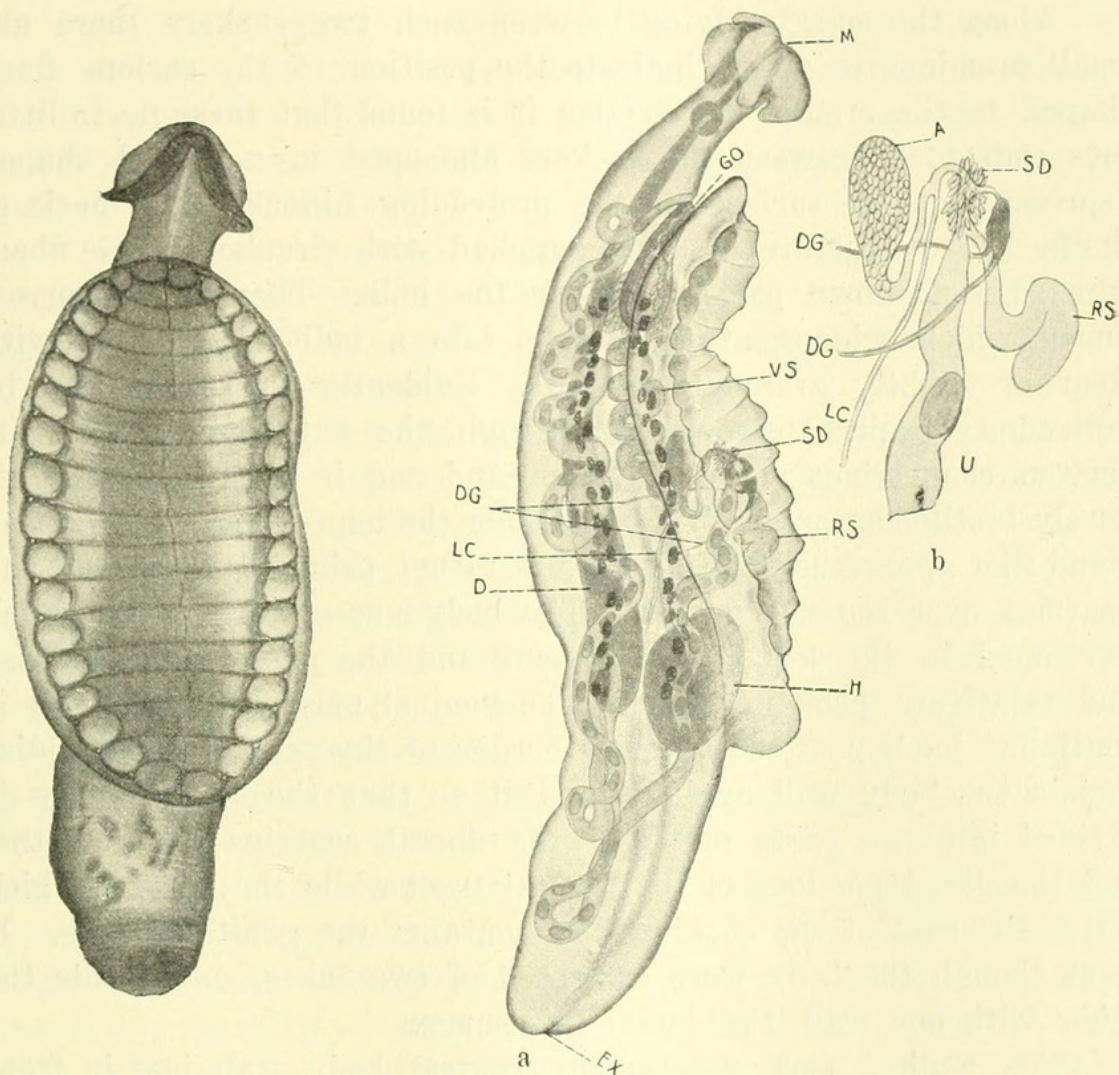


Fig. A.

Fig. B.

Fig. A. *Aspidogaster ringens* (seen from below). The drawing shows the indistinct central ridge in the sucking disc and the regularly arranged tactile bodies between the margin and suckers.

Fig. B. *Aspidogaster ringens*. a Viewed from the side. M mouth opening. D intestinal cecum. GO common genital opening. VS seminal vesicle. DG ducts from vitellarium. LC LAURER's canal. H single testicle. SD shell gland. b enlarged sketch of female genitalia. Letters as above. A ovary.

row and with brilliant illumination there can sometimes be seen a partial or complete median longitudinal ridge. It is difficult to

make this out and it is present in relatively few specimens and then often only in the anterior portion subdividing five or six of the transverse grooves. It is important, however, with regard to the systematic position of the worm.

Along the margins lying between each two suckers there are small prominences which indicate the position of the curious flask shaped tactile organs. In section it is found that these lie in little sacs embedded between the suckers and open in a funnel shaped depression on the surface of the protruding hillock. The neck of the flask like structure is richly supplied with circular muscle fibers which extend down part way over the bulb. There is a narrow lumen which widens at the bottom into a bulbous structure with clear or slightly granular contents. Evidently the organ can be protruded or perhaps everted through the cuticular orifice. Its nervous connections are not evident and one is led to question its purely tactile character. It gives rather the impression of a secreting gland like apparatus. The cuticle is rather thin and is smooth and unarmed over the whole body. The body musculature is fairly well developed in the usual arrangement and the parenchyma is loose and relatively poor in nuclei. The ventral muscular body wall is continued back past the anterior border of the ventral sucking disc to join the body wall again behind it so that the body cavity is divided into two parts of which the dorsal contains the intestine and the distal portions of the genital tract while the ventral which forms the seat of the sucking disc contains the genital glands. It is as though the body were composed of two tubes, one inside the other with one wall, the dorsal in common.

The genital pore pierces the ventral body wall just in front of the ventral disc and the uterus and ejaculatory apparatus open side by side.

The mouth opens as described at the anterior end of the body without any definite sucker. When the cephalic lobes are turned backward, as they generally are, the mouth becomes terminal and is found to lie surrounded by a portion of the root of these muscular lobes which may serve as a kind of muscular lip.

There is a quite long prepharyngeal tube with thin wall and only a few circular muscle fibers. The pharynx is strong with the usual muscular layer and flattened laterally so that in cross section the lumen is a slit. Behind this the oesophagus quickly assumes the character of the intestine which is a simple unforked tube with

thin muscular walls and a very definite rather high cubical epithelial lining. The intestine is rather club shaped and runs back dorsally to end blindly a short way behind the level of the posterior edge of the ventral sucking disc.

The nervous system shows quite distinct on either side of the prepharyngeal tube quite close to the anterior end and embedded in the dense body musculature in the form of ganglion masses connected by a commissure and giving off stout trunks to the posterior part of the body.

The excretory system consists of two thin walled canals which run in the ventral portion of the body cavity backward into the posterior part until they unite into a small sac and empty at the hinder end in the depression described above.

There is but one testis which is relatively large and lies in the ventral or outer tube of the body at the posterior level of the sucking disc or even behind it. From this there is evidently a very fine vas deferens which runs into the dorsal portion of the body to empty into the much coiled seminal vesicle which in turn extends forward to enter the muscular ejaculatory apparatus. This latter is a thick walled muscular sac the outer layer of muscle being longitudinal, the inner circular. Within this is a mantle of loosely arranged cells surrounding an inner tube which itself has a covering of longitudinal muscle fibers. This tube has what appears to be a cuticular lining from which project inward curious shaggy, shred like structures which occupy much of the cavity. Anteriorly this cavity is prolonged into a somewhat coiled tube, posteriorly it is flask shaped and narrows to communicate with the seminal vesicle. The coiled tube may be projected as a rather long thick walled structure from the genital opening. Outside the whole sac there is an accumulation of quite large pear shaped cells which may possibly represent a sort of prostatic apparatus.

The ovary lies near the middle of the body in the substance of the tissue which forms the basis of the ventral sucking disc and is thus ventral to the layer of musculature which divides the body (Fig. Ba and b). It is pear shaped and the ova can be seen to be very immature at the distal part of the gland becoming larger and more distinct as they approach the oviduct. This duct leaves the ovary at its posterior end and curves directly forward so as to lie parallel with the long axis of the ovary. It soon meets and opens into a tube which then continues forward to pass through the shell

gland. This tube is quite narrow and extends far back dorsally to the testes into the region of the abundant uterine coils. We have tried in vain to trace it to an opening on the surface of the body, but even so one can hardly interpret it in any way except as a LAURER'S canal.

While surrounded by a mass of large cells which presumably constitute the shell gland, the combined oviduct and LAURER'S canal receives a duct formed by the union of the canals from the lateral vitellaria. As they unite, these two vitellarian canals form a rather large reservoir from which the narrower channel runs further into the shell gland. The resulting duct gives off a coiled elongated sac like diverticulum or receptaculum seminis which is filled with spermatozoa. It then passes backward and widens to become the uterus which penetrates the muscular partition which in this posterior region is much frayed out, and reaches the dorsal part of the body. After many coils on its way, it passes forward to open at the ventral genital pore in front of the ventral disc. The vitellarium is in the form of small compact lobules ranged rather closely together in lines along the sides of the body just dorsal to the muscular partition and therefore in the angle which this forms with the body wall. The ducts perforate this partition to reach the oviduct. The eggs are elliptical and measure $0,07 \times 0,04$ mm.

The systematic position of this worm is difficult to establish with certainty. It is probably the same as that described by LINTON from the same fish (*Trachinotus*) and labelled *Aspidogaster ringens*, but his descriptions are extremely meager and it is hardly possible to be quite sure. He himself named it *Aspidogaster* with some hesitation on account of the inconstancy and frequent absence of the median ridge on the ventral disc. Apparently the structure of that disc changes as the worm grows older and larger and that may account for the number of grooves and marginal suckers which he describes, a number greater than we find (forty-two whereas we find thirty-six). Nevertheless the resemblance is so close as far as one can judge that we feel that this worm must be assigned to that specific name.

Measurements:

Length	3,5
Length of disc	1,7
Eggs	$0,07 \times 0,04$
Testes	$0,37 \times 0,25$
Breadth of head	0,45
Breadth of neck	0,33

Aspidogaster kemostoma n. sp.

In the examination of fifty pompanos (*Trachinotus carolinus*) 5 specimens of this type were found in the intestines.

The worm measures 5 or 6 mm in length, the body about 0,6 mm

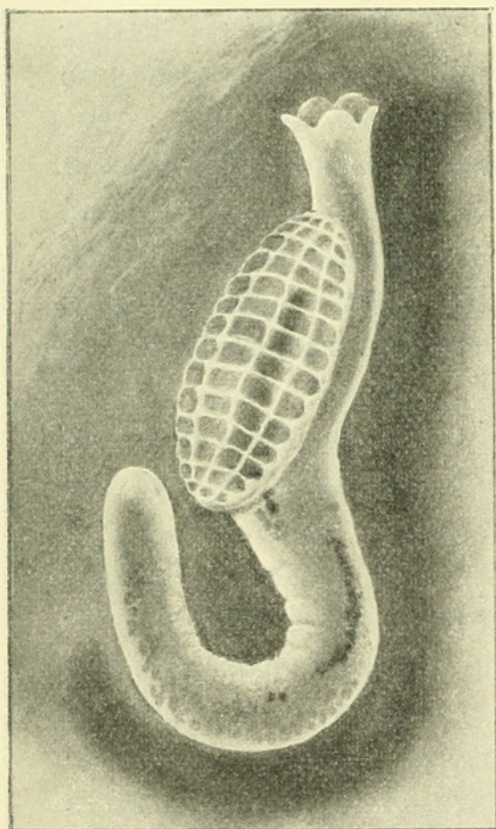


Fig. C.

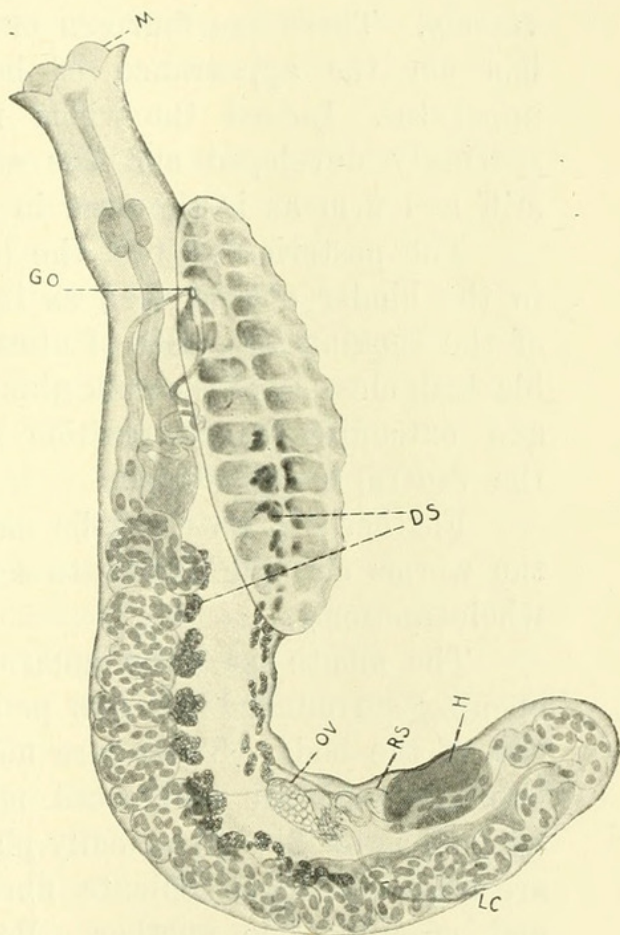


Fig. D.

Fig. C. *Aspidogaster kemostoma*. Showing the general form of the body and the second disc.

Fig. D. *Aspidogaster kemostoma*. M mouth. GO genital cloaca. OV ovary. RS receptaculum seminis. H testicle. DS vitellarium. LC LAURER'S canal.

in width. The neck is rather short and merges into the wider part of the body which supports the large ventral sucking disc. The hinder part of the body is relatively long, cylindrical in form and usually found somewhat curved ventrally in dead specimens.

The anterior end flares gracefully out into a flower like or trumpet shaped ring of five curved "lips" which are nearly equal in size. In the center of these is the unarmed oral opening. Ventrally the neck is sharply marked off from the sucking disc and in the angle there lies in the median line the genital opening.

The sucking disc which measures 1.75×80 mm occupies a little more than the second quarter of the body. It is elliptical in form and subdivided longitudinally by three ridges one of which occupies the mid line while the other two curve outward as shown in the sketch so as to leave the marginal depressions rather short transversely. There are fourteen or fifteen of them in each row. This has not the appearance of being an extremely strong sucking apparatus. Indeed the whole musculature of the body is rather sparingly developed and the worm is flaccid and by no means so stiff and firm as is the case in *Aspidogaster ringens*.

The posterior part of the body is somewhat club shaped, and in the hinder end, as well as in the dorsal portion, up to the level of the sucking disc, coils of uterus filled with eggs can be seen. The blackish clusters of the yolk gland can be seen ranged along the sides and extending into a position near the center of the body above the ventral sucking disc.

Further details could be made out only upon section. One of the worms cut sagittally into serial, sections gave very clearly the whole anatomy.

The mouth is quite unarmed and is merely a funnel shaped opening surrounded by five petal like subdivisions of the anterior end of the body. These are not sucker like in their arrangement but have a much reinforced musculature, the most bulky part of which has its fibres vertically placed to the oral surface while there are other far more delicate fibres lying parallel to these surfaces and crossing one another. Posteriorly the main muscular fibres merge into those of the body and it is found that the anterior part of the body is, in comparison with the remainder, very abundantly supplied with strong muscular fibres. It seems possible that the whole perioral arrangement connected as it is with the musculature

of the anterior end of the body, may act as a kind of sucking apparatus.

The prepharyngeal part of the oesophagus is rather long and very thinwalled. It is provided with delicate longitudinal muscle fibers and toward the pharynx five or six rings of circular fibers. The pharynx is a cylindrical thick muscular ring with a delicate refractive lining membrane. Anteriorly it is bevelled outward to the oesophagus and this concave bevelling is surrounded by a group of muscle fibers which run parallel to its inner surface. Elsewhere it has an inner layer of thin ring fibers and an outer layer of coarser flat ring fibers. The remainder consists of abundant radially arranged fibers of finer character. Just behind the pharynx the oesophagus merges into the simple intestine which runs as a single tube to a point near the posterior end of the body. Throughout to its blind end it is smooth and thin walled and supplied with delicate longitudinal and circular muscle fibers. It is lined with rather high cuboidal epithelium.

The ventral sucking disc has a peculiar structure. It is elevated on a soft mass of the body parenchyma through which run numerous long stout muscle bundles to reach its muscular wall. In sagittal section the whole mass appears as a projection from the rest of the body the ventral surface of which is in occupied by a continuous series of sucker like structures over the surface of all of which the cuticle runs. Each of these cups which represent the depressions seen on the ventral surface of the disc has practically the structure of a sucker. There are fine subcuticular transverse muscle fibers, a predominant mass of a radial fibers, but no external transverse or longitudinal fibers. Where the cups adjoin one another, the separating ridge is composed at its crest of a bundle of short fibers extending longitudinally as though to connect one cup with another. This condition alone is to be found in the more central part of the disc, but around the margin the little triangular space which lies beneath this connecting band of muscles is found to lodge a finely granular and fibrillated mass which probably represents the sense organ so frequently noted in such forms. From these structures there generally runs a fibril probably of nervous character to the interior of the body. Such bodies show no evident ganglion cells but have the general appearance of the nervous tissue seen in the large ganglia. They send a

process quite to the apex of the ridge between the sucker like depressions.

The body of the worm is curiously divided by a muscular wall which extends from the end of the groove which marks off the sucker from the body anteriorly, backward to fuse in the parenchyma of the posterior extremity. Forward it is quite thick and prominent in the section but it becomes much more delicate posteriorly. It is composed largely of longitudinal muscular fibers together with abundant circular fibers which run to merge in or form part of the general circular musculature of the body. They are the direct continuation of the circular fibers of the neck and indeed practically none go into the formation of the sucking disc, which in this sense might seem to be rather outside the general body. Nevertheless the male and female genital glands lie ventral to this partition and the yolk gland may extend far into the tissue upon which the sucker itself rests.

The uterus and vas deferens perforate this partition in the hinder part of the body, however, so that their distal portions with the seminal vesicle and the ejaculatory apparatus come to lie dorsal to it and to open just above and anterior to its insertion into the body wall at the anterior margin of the root of the sucking disc.

The body musculature in general is very delicate, the most striking features being the long fibers which run into the root of the sucker and apply themselves to the sucking disc proper. Elsewhere, except as described about the anterior end of the body, the circular and other fibers of the body wall are of extreme delicacy. The skin, too, is very thin and the cuticular layer can be made out as a covering of remarkable tensility. The body parenchyma is very loose and composed of a meshwork of fibers with scattered nuclei, evidently holding a considerable quantity of fluid which in the sections appears as a finely granular coagulum.

There is an excretory sac which opens at the posterior end of the body and which, branching, gives rise to two wide trunks which run forward ventral to the muscular partition and receive excretory tubes from the whole of the body. The specimens are not well enough preserved to enable us to follow accurately these branches. The nervous system is also difficult to trace but there is a ganglionic mass on each side of the prepharynx quite far anteriorly toward the mouth from which nerve trunks are given off.

The genital apparatus. The female genitalia lie as stated in part, ventral to the muscular partition in the posterior third of the body. The ovary is pear shaped with the smaller end from which the oviduct arises pointed backward. In its anterior or distal end the cells are quite small but as one approaches the oviduct they become larger and compressed against one another and assume the form of definite ova. The oviduct turns back upon itself and quickly joins the duct from the spermatheca or receptaculum seminis which is a long club shaped sac bent several times upon itself and lying directly in front of the testes. No LAURER's canal is described for this genus but in this form there is a rather long narrow canal running from the oviduct to a papillary projection on the dorsal surface not far in front of the blind end of the intestine, which we interpret as such.

The duct formed by the union of oviduct and the canal from the receptaculum seminis receives the two channels from the yolk gland, and then gives rise to the thin walled uterus which runs in coils past the testes to the posterior end of the body where it becomes more dorsal and with many foldings passes toward the anterior end of the body. It empties into a kind of cloaca which opens as described above. The terminal portion is quite muscular and opens rather anteriorly and to one side of the ejaculatory apparatus. The eggs are elliptical, thick walled and yellow with a sudden narrowing at one end. They measure 0.07×0.05 . The yolk gland extends on each side from about the middle of the sucking disc nearly to the extreme hind end of the body. It is in the form of quite widely separated lobules.

There is one relatively large elliptical testis which lies ventrally near the end of the intestinal trunk. It gives off a vas deferens which penetrates into the dorsal part of the body, and there, at about the level of the hinder end of the sucking disc it passes into a much coiled thin walled seminal vesicle which at its anterior end passes through a mass of large cells into the globular cirrus. This cirrus lies in an indistinct cirrus sac and is very dense and muscular. The large cells which immediately surround it may probably be regarded as prostatic elements. The cirrus may be projected in the form of a small cylinder often with knob like end. It is quite short and apparently does not easily reach out of the cloaca.

Measurements:

Length	5—6	mm
Breadth	0,6	„
Testes	$0,5 \times 0,27$	„
Eggs	$0,07 \times 0,05$	„
Breadth of head	0,42	„



MacCallum, George Alexander and MacCallum, W. G. 1913. "On Aspidogaster ringens (Linton) and A. kemostoma n.sp." *Zoologische Jahrbücher* 34, 245–256.

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