# XIII ON *MESOCOELIUM SOCIALE* (Lühe).

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This species of Trematode appears to be widely distributed throughout the tropical and sub-tropical zones: it was first discovered and described by Lühe (1901, p. 171) from *Bufo melanostictus* Schneid. from the East Indies; subsequently Odhner (1911, p. 88, footnote) obtained specimens, also from *Bufo melanostictus*, in material sent to the Berlin Museum from the island of Biliton in the Dutch East Indies between Sumatra and Borneo, and the same author also records its occurrence in a species of *Bufo* obtained by Fiebrig in Paraguay.

This Trematode was first found by me in a specimen of *Bufo melanostictus*, caught in the compound of the Indian Museum, Calcutta, in May, 1919; subsequent examination of other specimens of this toad obtained from the same locality proved that at this period of the year infection with the parasite is heavy and wide spread and in Table I I give a record of my observations during the months of May and June, 1919.

TABLE I.

Record of occurrence of *Mesocoelium sociale* (Lühe) in *Bufo melanostictus*.

| Date. | Host. | No. of Specimens examined. | | *Mesocoelium sociale* Lühe. | REMARKS. |
|---|---|---|---|---|---|
| May 14 .. | *Bufo melanostictus* | 2 | adults | present .. | in both examples. |
| ,, 15 | ,, ,, | 3 | ,, .. | present .. | in all three. |
| ,, 16 .. | ,, ,, .. | 1 | ,, .. | present .. | 30 specimens obtained. |
| ,, 17 .. | ,, ,, .. | 2 | ,, | present .. | in both examples. |
| ,, 18 .. | ,, ,, .. | 1 | ,, .. | present .. | 50 specimens obtained. |
| ,, 23 .. | ,, ,, .. | 1 | ,, .. | present .. | .... |
| June 11 .. | ,, ,, .. | 3 | immature, measuring 15-18 mm. in body length. | absent .. | .... |
| ,, 13 .. | ,, ,, .. | 1 | adult .. | present .. | 5 specimens only. |
| ,, 18 .. | ,, ,, .. | 1 | ,, | present .. | in large numbers. |
| ,, 21 .. | ,, ,, .. | 1 | a young ♂ .. | absent .. | .... |
| ,, 29 .. | ,, ,, .. | 2 | adults | present .. | in large numbers. |

A point of interest revealed by the above record is the curious fact that it was only in *adult* specimens of *Bufo melanostictus* that examples of the worm were found: in the case of the three immature examples examined on June 11th, and the young ♂ examined on June 21st, no trace of the Trematode was discovered, although in all cases the intestinal contents showed a rich protozoan fauna and in one of the small immature examples several young Nematode worms were present in the large intestine. It appears probable, therefore, either that infection with this parasite occurs late in life or, as seems to me to be more probable, that the period of infection is an annual one and had occurred some time prior to the month of June, and that in consequence specimens of *B. melanostictus* that had been hatched in May or June—after the annual period of infection—were found to be free from the parasite. That the period of infection is not only an annual one but is moreover one of short duration is indicated by the fact that a further series of 5 adult examples of this toad caught in the museum compound in January, 1920 were found to be free from the parasite.

The anatomical locality, in which the worms were obtained by me, was in every case the upper portion of the small intestine. Lühe in his original description states that the worms were found "in the greater part of the small intestine, and especially in the upper part." I never found a single example in the large intestine. In every case the worms were adhering to the mucous membrane by means of their oral suckers but when the intestine was slit up and spread out in water, they quickly relaxed their hold and dropped to the bottom of the dish.

*External Characters.*

The body of the worm is capable of a considerable degree of extension and contraction and its shape varies accordingly. It is always more or less compressed and flattened dorso-ventrally and when fully contracted, or after fixation in Schaudin's fluid, its outline is an elongate oval with both ends bluntly rounded and the lateral margins roughly parallel with each other. When in this condition, my specimens agree with the original description (Lühe, 1901, p. 71), but during the process of extension in the living specimens the anterior region of the body lying in front of the acetabulum becomes narrow and somewhat tapered, whereas the posterior part situated behind the acetabulum undergoes considerably less change in shape, probably on account of the dense coils of the uterus contained in it. In this extended state the outline of the body is bottle-shaped.

The examples examined by me show a much greater range of measurement than is given by Lühe, who states that the length is $1\frac{1}{4}$—2 mm. and the greatest breadth 0·55—0·90 mm. In Table II I have given the measurements of a series of individuals: in each case the worm had been fixed in Schaudin's fluid and was in consequence in a contracted state; every example contained

ripe ova, though in the smaller examples only a few were present, whereas in the large ones the coils of the uterus were densely crowded.

TABLE II.

Dimensions of *Mesocoelium sociale* (Lühe) in millimeters.

| Measurement. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| | mm. | mm. | mm. | mm. | mm. | mm. | mm. |
| Total body-length .. .. | 0·684 | 0·842 | 0·982 | 1·702 | 2·018 | 2·06 | 2·21 |
| Greatest breadth .. .. | 0·403 | 0·349 | 0·438 | 0·860 | 0·596 | 0·706 | 0·737 |
| Oral sucker .. Length .. | 0·139 | 0·140 | 0·143 | 0·225 | 0·219 | 0·228 | 0·263 |
| Oral sucker .. Breadth .. | 0·125 | 0·140 | 0·132 | 0·214 | 0·228 | | |
| Acetabulum .. Length .. | 0·121 | 0·093 | 0·107 | 0·168 | 0·175 | 0·175 | 0·210 |
| Acetabulum .. Breadth .. | 0·125 | 0·121 | 0·114 | 0·178 | 0·193 | | |
| Pharynx .. Length .. | 0·064 | 0·050 | 0·054 | 0·086 | 0·096 | .. | .. |
| Pharynx .. Breadth .. | 0·064 | 0·057 | 0·064 | 0·107 | 0 105 | .. | .. |
| Distance of end of intestinal caeca from posterior end of body. | 0·161 | 0·236 | 0·314 | 0·564 | 0·632 | .. | .. |
| Caeca extend back in body length | 2·29/3·00 | 2·15/3·00 | 2·04/3·00 | 2·00/3·00 | 2·05/3·00 | .. | .. |

In the case of a living example the body when extended showed a length of 2·65 mm. and a breadth of 0·30 mm., but when fully contracted the length was only 1·18 mm. and the breadth had increased to 0·65 mm: in this example both suckers gave a measurement of 0·18 mm. in the transverse diameter, but the oral sucker was somewhat elongate in shape and had an antero-posterior length of 0·235 mm.

The oral sucker occupies the rounded anterior end of the body and, as is only natural, varies in size in specimens of varying degrees of growth, being smaller in specimens with a small body-length and larger in those whose growth and development has proceeded further. Its general outline is found to vary in different individuals; in some cases, as in Examples 1, 3 and 4 in Table II, its antero-posterior length is greater than the transverse diameter, whereas in others, such as example 5, it is the transverse measurement that is the greater. This difference is probably directly correlated with the degree of extension or contraction of the anterior end of the body, in the extended condition the long diameter being antero-posterior, while in the contracted state it becomes transverse. The mouth is subterminal in position and it leads back into the cavity of the oral sucker: around its margin in young immature specimens is a double ring of small papillae, but as the worm grows these appear to become proportionately smaller and in the largest examples seem to have disappeared entirely.

The acetabulum is situated on the ventral surface, where it forms a well-marked projection, about one-third of the body-length from the anterior end: its exact position varies according to the degree of growth to which the specimen has attained. As Cort (1919 (b), p. 295) has pointed out in the case of *Margeana californiensis*, during development " there is relatively a much greater growth of the post-acetabular region, undoubtedly correlated with the development of the coils of the uterus to hold the enormous numbers of eggs produced." Exactly the same phenomenon occurs in this species, and, in consequence, as the body-length increases the relative position of the acetabulum moves steadily towards the anterior end. In specimens having a body-length of 1·0 mm. the proportion of pre- and post-acetabular regions is 38 : 62; while in specimens which have attained a body-length of 2·0 mm. the pre- and post-acetabular regions have a relative proportion of only 30 : 70. This sucker is somewhat smaller than the oral sucker, the proportional sizes being about 5 : 4, and a study of the measurements given in Table II above show that at any rate in fixed and contracted specimens it is slightly oval in outline, its long-axis lying in the transverse diameter.

The skin is provided in the anterior two-thirds of the body with numerous fine posteriorly-directed spines, which are arranged in transverse rows, those of one row alternating in position with those of the row in front and behind: in the posterior third of the body the cuticular spines gradually thin out and finally disappear altogether. In addition to this cuticular armature the skin on the dorsal surface of the anterior region of the body is provided with a number of scattered unicellular glands: these gland-cells are somewhat irregular in shape, but usually possess an elongate pyriform outline; they are composed of refractile, finely-granular protoplasm and appear to possess a short narrow neck or duct, which opens by a small pore to the exterior. Exactly similar cutaneous glands have been described and figured by Looss in several closely-related species, e.g. in *Opisthoglyphe ranae* (Frölich) [Looss, 1895, p. 86, fig. 155] and in *Haplometra cylindracea* (Zed) [Looss, 1895, p. 66, fig. 149], both of which are placed by Odhner in his Family Lepodermatidae: also in *Pleurogenes claviger* (Rud) [Looss, 1895, fig. 171 A] and *P. medians* (Olss.) [Looss, 1895, figs. 36 and 187, C.], in *Lecithodendrium glandulosum* (Looss) [Looss, 1900, p. 66, fig. 43], *L. obtusum* (Looss) [Looss, 1900, p. 78, fig. 53], *L. hirsutum* (Looss) [Looss, 1900, p. 69, figs. 45, 47], and *L. sphaerula* (Looss), [Looss, 1900, p. 81, fig. 57] and in *Anchilotrema sanguineum* (Sons.) [Looss, 1900, p. 107, fig. 75], all of which Odhner places in the Family Lecithodendriidae. It seems probable that the presence of these unicellular cutaneous glands is of frequent, if not of universal, occurrence in the members of the Lepodermatidae and Lecithodendriidae and other closely related families, and that they are the persistent remains of the cystogenous cells that are present in the larval, cercarial stage [but see Looss, 1895, p. 124].

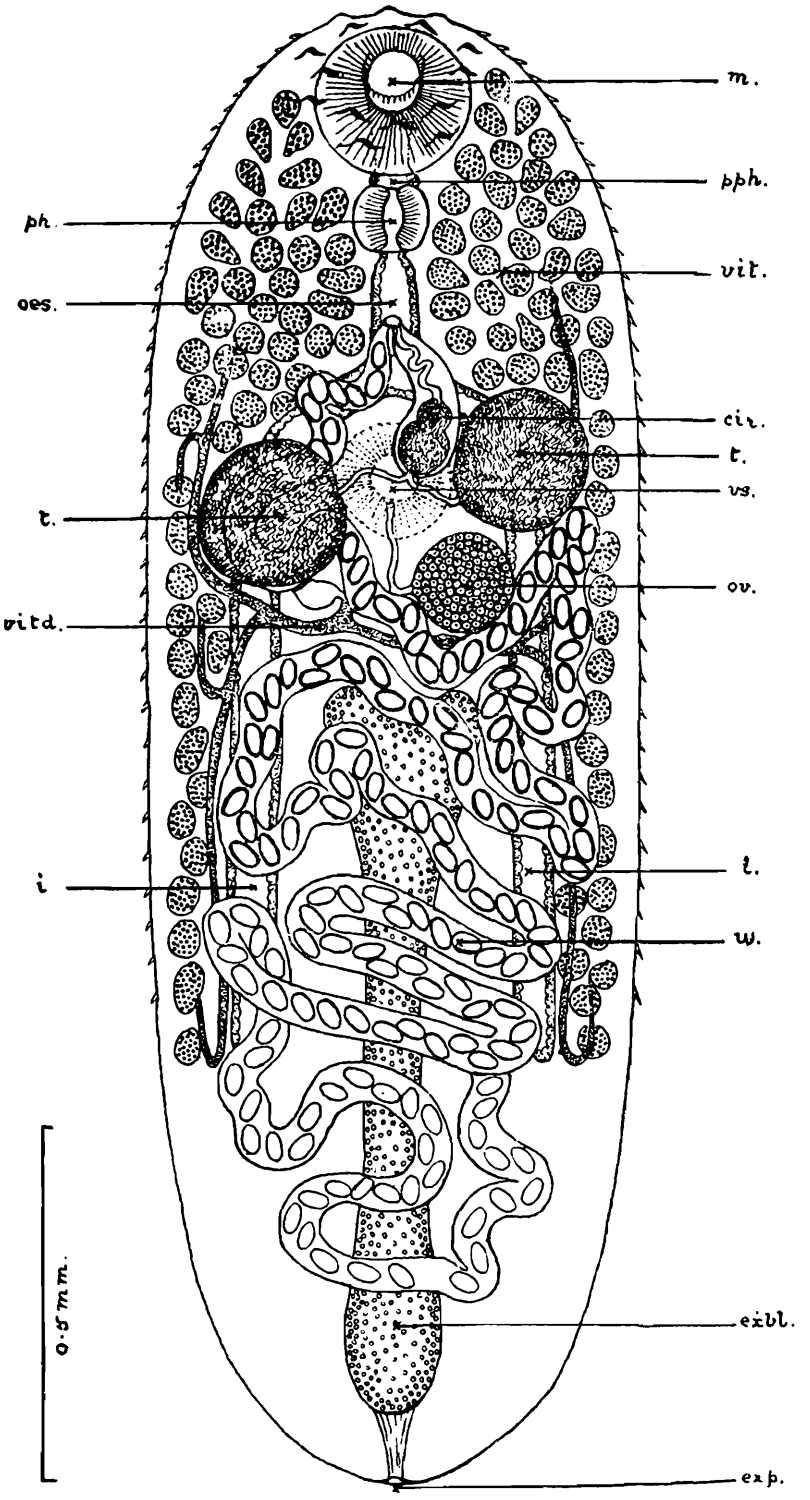


FIG. 1.—Dorsal view of *Mesocoelium sociale* (Lühe) slightly compressed.

*cir.*, cirrus sac; *exbl.*, excretory bladder; *exp.*, excretory pore; *i.*, intestinal coecum; *m.*, mouth; *oes.*, oesophagus; *ov.*, ovary; *ph.*, pharynx; *pph.*, prepharynx; *t.*, testis; *u.*, uterus; *vit.*, vitelline gland; *vitd.*, vitelline duct; *vs.*, ventral sucker.

*Internal anatomy.*

The oral sucker leads back into a short and wide pre-pharynx (fig. 1, *pph.*) with thin walls, and this is followed by a well-developed muscular pharynx (*ph.*). Lühe in his original description states that this organ is rounded with a diameter of 0·075-0·100 mm.: in my examples it was only in the smaller specimens (vide Table II) that the organ presented a rounded outline; in all the larger specimens the pharynx was oval, the long axis being in the transverse diameter. The diameter ranges from 0·064 mm. in the smallest example to 0·105 mm. in the largest. At first sight it appears as if the pharynx did not increase in size proportionately with the rest of the body, for in example 5, although the total body-length is three times as great as in example 1, the diameter of the pharynx has only increased by 50 per cent., but, as I have already pointed out, this increase in the body-length mainly affects only the post-acetabular region and a comparison of the other measurements shows that, so far as they are concerned, the proportional increase in size is approxmiately also 50 per cent. Behind the pharynx is a short wide oesophagus (*oes.*), the wall of which is plentifully provided with muscles. The tube is lined by a layer of cells having a finely granular protoplasm, and outside this lies a double muscular coat, the internal layer consists of circular fibres surrounding the tube, and outside this is a layer of oblique, strong muscle-fibres (fig. 2 *exm.*), which are attached to the oesophageal wall and diverge outwards and forwards, blending with the supporting parenchymatous tissue of the body: external to this again is a further layer composed of a number of pyriform cells (*oesg.*), with oval or rounded nuclei. Monticelli (1893, p. 30) has described this layer of cells in other trematodes as the salivary gland; it is unfortunate that he should have used this term, for Looss (1895, p. 140) has described true "salivary glands," the ducts of which pass forwards to open just *behind* the mouth, in *Pleurogenes claviger* (Rud) and *Heterolope leptostoma* (Olss.). In the former species the salivary gland consists of 5—6 large granular nucleated cells lying behind the pharynx on either side of the oesophagus, from each of these cells a fine duct extends forwards, and they open in a row just behind the mouth, the orifice of each duct being visible as a small refractile spot.

In *Mesocoelium sociale* (Lühe) true salivary glands (fig. 2 *salg.*) also occur, situated behind and to the outer side of the pharynx at the level of the bifurcation of the oesophagus. Each gland consists of about ten pyriform cells, with round clear nuclei and granular protoplasm: these glands are very difficult to see owing to their being surrounded by follicles of the yolk-gland, but their position is shown in fig. 2. From each cell a fine duct arises (*sald.*), these pass forwards in a bundle lateral to the pharynx and reach the side of the oral sucker; they then sweep round its dorso-lateral aspect and open in a transverse row on the *anterior* lip of the mouth, the terminal portion of each duct appearing in

optical section, exactly as Looss describes, as a round refractile spot. It is extremely interesting to note that these gland-cells and ducts agree exactly as regards their appearance and distribution with the "stylet-gland" cells of the Polyadenous group of the Xiphidiocercariae (*vide* Cort, 1914, p. 53 and figs. 68 and 69), and I have no doubt that the two structures are identical.

About midway between the pharynx and the anterior margin of the acetabulum the oesophagus divides into two wide intestinal caeca (fig. 1 *i*), the lumen of which is lined with finely granular

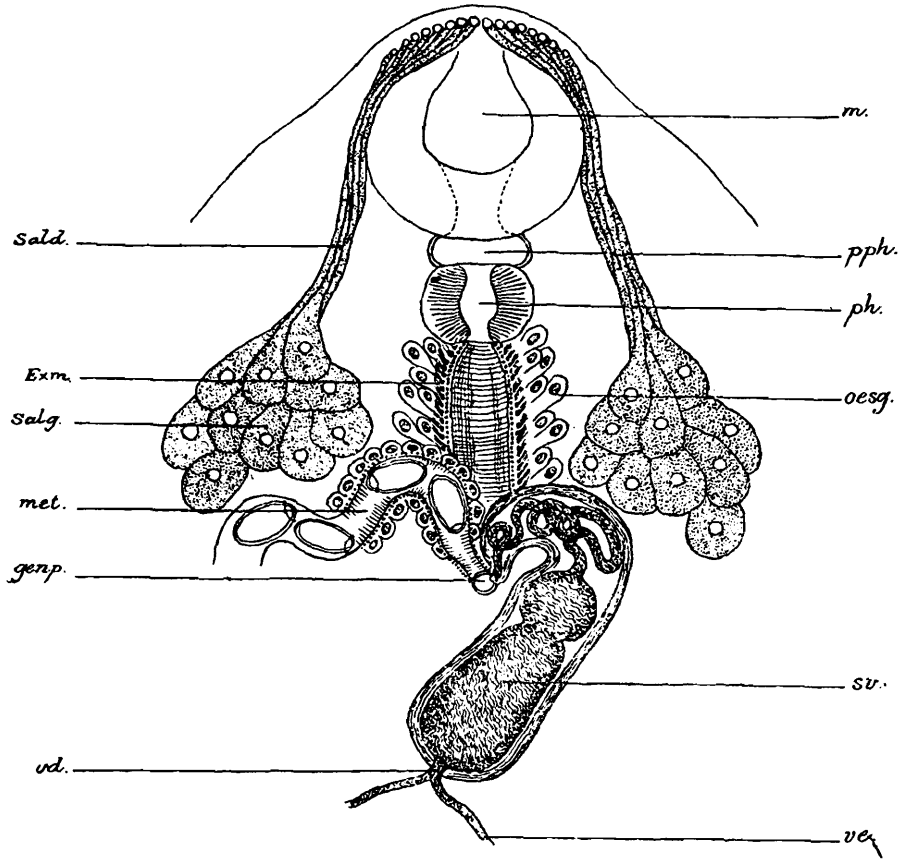


FIG. 2.—Anterior region of *Mesocoelium sociale* (Lühe).

*exm.*, external muscle-fibres of oesophagus; *genp.*, genital pore; *m.*, mouth; met., metraterm; *oesg.*, oesophageal gland cells; *ph.*, pharynx; *pph.*, prepharynx; *sald.*, ducts of salivary glands; *salg.*, salivary gland; *s.v.*, seminal vesicle; *vd.*, vas deferens; *ve.*, vas efferens.

cells. Each caecum passes backwards and outwards around the acetabulum and is then continued back along the sides of the body to a point about one-third of the total body-length from the posterior end. Lühe in his original description states that they extend back three-quarters of the body-length, but here again there seems to be some difference in different individuals, according to the degree of development that has been attained. A reference to Table II shows that in smaller specimens the caeca extend proportionately further back in the body than they do in the larger

examples, as Cort (1919, p. 295) found also to be the case in *Margeana californiensis.*

The genital organs, with the exception of the coils of the uterus, lie in the anterior half of the body and are closely grouped around the acetabulum. A pair of testes (fig. 1. *t*) lie, one on each side, at about the level of the acetabulum: the right testis is as a rule situated rather more anteriorly than the left and is at the level of the anterior acetabular margin, whereas the left testis is usually opposite the posterior margin, but this difference of level appears to depend on the position of the ovary. Lühe in his original description figures the ovary on the right side of the body, and the right testis anterior to the left; in the majority of specimens examined by me this was the condition found but in a number of cases, roughly about 30 per cent. of those examined, the ovary lies on the left side of the body and in these cases it is the left testis that is the more anterior. Lühe further describes the testes as being triangular or oval and he figures the one lying anterior to the ovary as triangular, and the one on the other side of the body as oval. Johnston (1912, p. 336) in his table for the determination of the species of *Mesocoelium* gives "Testes triangular" as one of the diagnostic features of this species, but in all cases examined by me these organs have a rounded outline, when viewed from above: in transverse sections they are seen to be somewhat flattened dorso-ventrally and so present an oval appearance. From each testis a delicate narrow vas efferens arises: these ducts pass forwards and medianwards and unite together close to the base of the seminal vesicle to form a very short vas deferens (fig. 2 *vd.*), which pierces the cirrus-sac at its posterior end. The genital pore (*genp.*) is situated in the middle line of the body about midway between the two suckers and a little in front of the point of bifurcation of the oesophagus (*vide* fig. 1): the cirrus-sac (fig. 1 *cir.*) is large and thick-walled and extends backwards from the genital orifice to a short distance behind the anterior margin of the acetabulum; it is usually slightly curved and is deflected towards the right side of the body. Although Lühe makes no mention of this organ in his original description, he figures it quite correctly. The posterior half of the cirrus-sac is occupied by a large bi-lobed seminal vesicle (fig. 2 *sv.*), which in adult examples is full of ripe spermatozoa: in front of this lies the cirrus, which is long and narrow and is usually coiled up within the sac. The prostate gland appears to be somewhat diffuse; it extends backwards around the anterior end of the seminal vesicle and forwards around the cirrus nearly as far as the genital orifice.

The ovary (fig. 1 *ov.*) lies usually on the right side of the body behind and somewhat to the inner side of the right testis at about the level of the posterior border of the acetabulum, though, as I have remarked above, in about 30% of cases it lies on the left side. In this respect *Mesocoelium sociale* (Lühe) shows a variability that is exactly similar to that found by Johnston in *M mesem-*

*brinum* (*l.c.* 1912, p. 332). In mature specimens the ovary is considerably smaller than the testis: in all my examples its outline is circular and from the median and posterior aspect arises a short wide oviduct (fig. 3 *ovd.*). After a short course the oviduct receives on its posterior aspect the duct from the large pear-shaped receptaculum seminis (*r.s.*), and immediately beyond this point it gives off Laurer's canal (*l.c.*), which turns forwards and upwards and opens on the dorsal surface above the acetabulum: the oviduct is then continued on across the middle line and receives posteriorly the common vitelline duct (*vitd.*); it then enters Mehlis' gland (*Mg.*) and dilates to form the ootype (*oot.*). On leaving the ootype the uterus (*u.*) turns forwards for a short distance and then bends sharply backwards towards the posterior end of the body, which is almost completely filled with

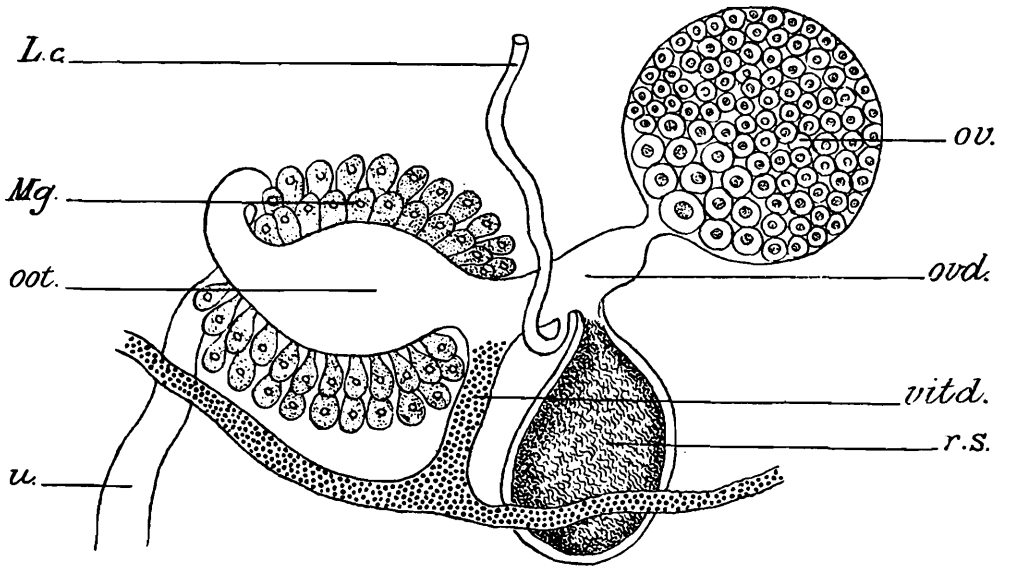


FIG. 3.—The female reproductive system of *Mesocoelium sociale* (Lühe).

*La.*, Laurer's canal; *Mg.*, Mehlis' gland; *oot.*, ootype; *ov.*, ovary; *ovd.*, oviduct; *r.s.*, receptaculum seminis; *u.*, uterus; *vitd.*, vitelline duct.

its coils and convolutions (fig. 1 *u*): it finally turns forwards again and, passing ventrally to the testis on the side of the body opposite to that on which the ovary lies, it bends inwards towards the middle line and opens at the genital pore. The terminal portion of the uterus or metraterm (fig. 2 *met.*) is thick-walled and muscular; internally is a layer of circular muscle-fibres and immediately external to this is a layer of gland-cells, with oval or rounded nuclei

The vitellaria or yolk-glands (fig. 1 *vit.*) consist of a number of oval or rounded follicles, and extend from the side of the oral sucker, backwards along the sides of the body to the posterior extremity of the intestinal caeca: as a rule they do not extend backwards beyond this point, though in a few examples they are slightly more extensive. In the anterior region of the body in

front of the testes, the two glands spread inwards and almost reach the middle line in the region of the oesophagus; this mesial extension is greatest on the dorsal side of the body. Lühe states that in this region each gland may attain a breadth equal to one-third of the body-breadth, but in some of the specimens examined by me, they exceeded this. In the posterior region of the body, behind the acetabulum, the follicles of the yolk-gland lie almost entirely to the outer side of the intestinal caecum, between it and the lateral margin. Anterior and posterior branches of the vitelline ducts run respectively backwards and forwards in the lateral regions of the body and unite opposite the posterior margin of the ovary to form the main duct from each gland (fig. 1 *vitd*). These ducts then pass inwards towards the middle line and where they join the lumen is slightly dilated, forming the vitelline reservoir from which the common duct passes to join the oviduct (fig. 3 *vitd.*).

The eggs are oval in shape and when first formed have a thin greyish transparent capsule, but as they mature the thickness of the capsule increases very considerably and the colour changes to a pale yellow and eventually to a brown tint. At one pole is a small but well-formed operculum with a slightly raised edge. The dimensions of the eggs appear to vary somewhat in different individuals and also in different stages of their development. Young immature eggs in the coils of the uterus lying most posteriorly are distinctly shorter and broader than the ripe eggs in the terminal portion of the uterus. Immature eggs have an average measurement of 0·034 mm. in length and 0·027 mm. in breadth. The measurements of mature ova usually fall within the limits given by Lühe, namely, a length ranging from 0·038 mm. (I presume that the measurement of 0·0038 as given in his original description is a misprint) to 0·040 mm. and a breadth of from 0·024 mm. to 0·026 mm. In certain individuals, however, eggs are occasionally found which show a much greater range of variation; in one young specimen containing only a comparatively few eggs, these were found to vary from 0·037 mm. in length × 0·028 mm. in breadth to 0·050 mm. in length × 0·021 mm. in breadth. Cort (1915, p. 26) has recorded an instance of the eggs of *Pneumonœces similiplexus* Stafford showing a considerable range of variation in dimensions in specimens obtained in different localities, but the present phenomenon falls in an entirely different category, and seems to be more nearly related to the egg-variation described by Leiper (1918, p. 246) in a single female of *Schistosoma haematobium* in which ovulation had only just commenced.

The excretory system is extremely well-developed (fig. 4): a long tubular excretory-bladder (*b*), usually containing a large number of small globular refractile granules of excretory material, passes forwards from the posterior end to a point about the middle fo the body-length and a short distance behind the level of the ovary: it is somewhat narrow in its middle third; posteriorly

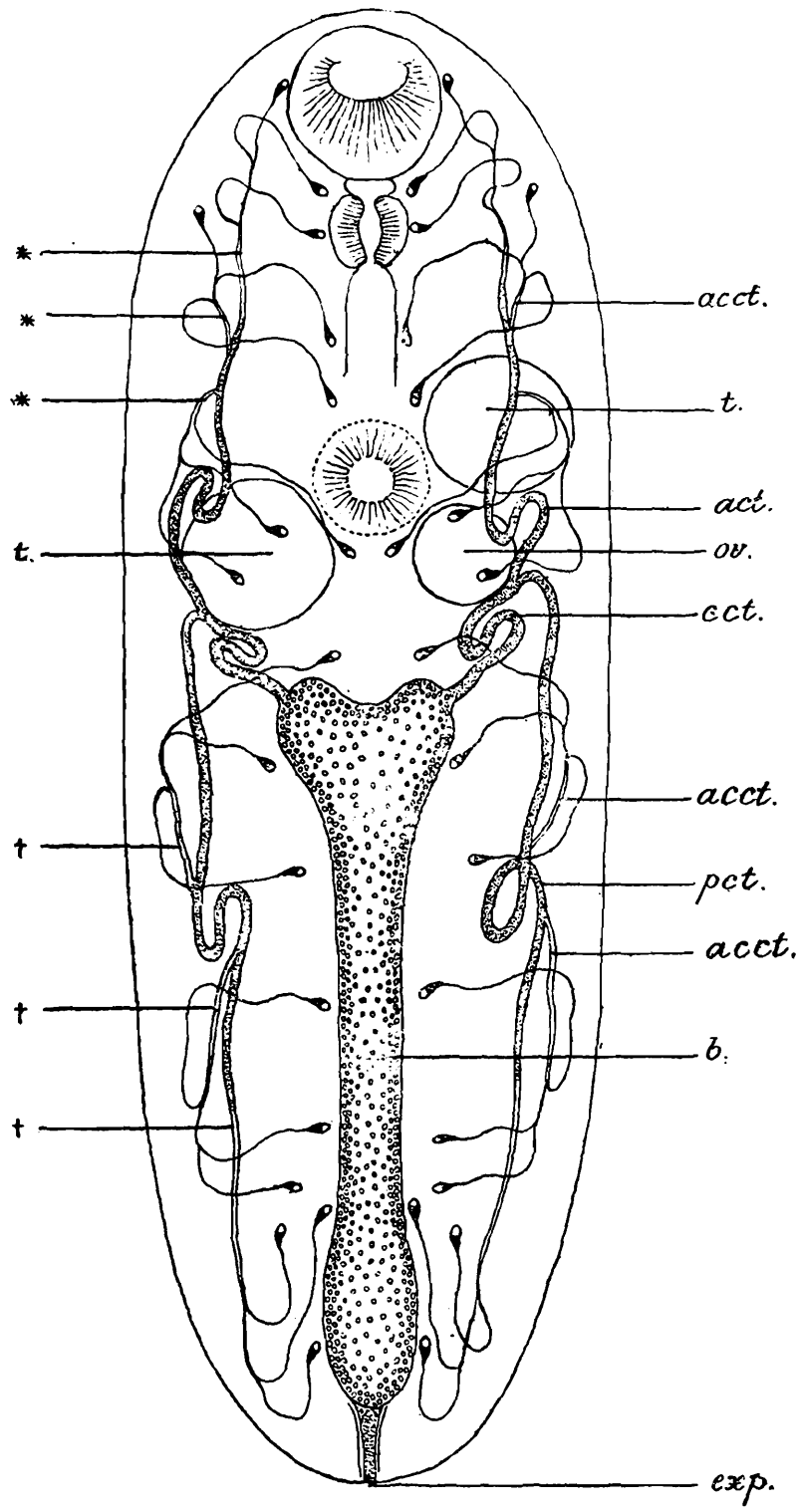


FIG. 4.—The excretory system of *Mesocoelium sociale* (Lühe).

*acct.*, accessory collecting tube; *act.*, anterior collecting tube; *b.*, excretory bladder; *cct.*, common collecting tube; *exp.*, excretory pore; *ov.*, ovary; *pct.*, posterior collecting tube; *t.*, testis.

On the left side of the figure the three anterior accessory collecting tubes are shown * and the three posterior tubes †.

it is somewhat dilated and from this dilated portion a short canal passes backwards to the excretory pore (*exp.*), which is situated at the extreme posterior end of the body. Anteriorly the bladder becomes somewhat dilated and it terminates in two very short and wide lateral diverticula. From each diverticulum a short common collecting tube (*cct.*) can be traced forwards and outwards to a point opposite the posterior margin of the acetabulum, where it divides into anterior (*act.*) and posterior (*pct.*) collecting tubes, running forwards and backwards respectively in the lateral region of the body. Both anterior and posterior collecting tubes receive three accessory collecting tubes (*acct.*), each of which is formed by the union of three capillary vessels originating in three flame cells: of these capillary vessels two unite together to form a single trunk and this is then joined by the capillary of the third flame cell, thus showing what Cort (1919, p. 290) has termed the "two-one" arrangement in the capillary groups. The excretory system of this species is summarised in the formula $2 \times 6 \times 3$, and in fig. 4 I have shown the distribution and arrangement of the capillary groups and collecting tubes. A comparison of this figure and those given by Cort of the excretory systems of *Cercaria polyadena* (*l.c.*, 1919 (a), p. 277) and *Margeana californiensis* (*l.c.*, 1919 (b), p. 293) shows that in all three the systems are identical.

As almost the whole of my researches on this species, *Mesocoelium sociale* Lühe, were confined to the study of living examples, it was found to be impossible to work out the nervous system in detail. On either side of the oesophagus lies a ganglionic mass which is connected across the middle line with its fellow of the opposite side by a short stout commissure running dorsally to the alimentary canal: a pair of large ventral nerves can be traced backwards on the ventral aspect, extending as far as the posterior ends of the intestinal caeca, and a smaller dorsal pair of nerves can be made out on the upper aspect of the body, while several smaller nerves appear to pass forwards around the oral sucker towards the anterior end of the body.

*Development.*

At the present time nothing is known regarding the larval development of this species. Cort (1919 (b), p. 295) has put forward the view that *Margeana californiensis*, which he places in the subfamily Brachycoeliinae Looss, is developed from a cercaria that in all probability will be found to belong to the Polyadenous group of the Xiphidiocercariae. This sub-group of cercariae was created by Cort (1914, p. 53) to accommodate certain forms that possess quite distinctive characters dividing them off from other of the Xiphidiocercaria groups. Omitting certain entirely larval characters, the Polyadenous cercariae were shown by him to possess the following anatomical features:—

(1) Acetabulum smaller than the oral sucker.

(2) Stylet glands, six or more on each side, between the acetabulum and the pharynx.
(3) Excretory bladder bicornuate.
(4) Very short prepharynx and small pharynx. Oesophagus (when developed) short to, of medium length. Intestinal caeca (when present) reaching to posterior end of the body.

Subsequently (1919 (a), p. 275) he described the excretory system in detail in *Cercaria polyadena* and showed that it possesses the 2 × 6 × 3 formula.

All the arguments that Cort adduces in support of his view regarding the development of *Margeana californiensis* apply with equal force to *Mesocoelium sociale* Lühe: here likewise the relative size of the two suckers, the characters of the digestive tract, the type of excretory bladder and the 2 × 6 × 3 type of excretory tubules and flame cells render it probable that this species also possesses a Polyadenous cercaria as its larval stage; and moreover the presence in the adult worm of true salivary glands, as I have shown above (p. 86), comparable in every way with the stylet-gland of the cercaria, serves to still further strengthen the belief that in the case of this species also the cercaria will be found to belong to the Polyadenous sub-group of the Xiphidiocercariae.

*Classification.*

The genus *Mesocoelium* was created by Odhner (1911, p. 88) in order to accommodate this species, which was described by Lühe (1901, pp. 171—173, fig. 5) under the name *Distomum sociale*, and he includes the genus in the subfamily Dicrocoeliinae Looss, though, at the same time, he points out that in many respects this species approximates closely to the sub-family Brachycoeliinae Odhner (*nec* Looss). A year later Johnston (1912, pp. 329—341, figs. 13, 14, 15, 69—76) described three more species (*Mesocoelium mesembrinum*, *M megaloon*, and *M. oligoon*), which he refers to this genus and all of which he found inhabiting the intestine of certain species of Anura. On p. 340 he gives in a tabular form the main features of this genus and of both sub-families for the purpose of comparison, and he arrives at the conclusion (p. 336) that "amongst known distomes, it is to *Brachycoelium crassicolle* R. that the four species of this genus appear to be most closely related"; while on p. 338 he admits that "of all the Brachycoeliinae, the various species of *Mesocoelium* appear to approach more closely to the Dicrocoeliinae than any others of their subfamily." In many respects *Mesocoelium* appears to be a connecting link between the two subfamilies: as regards the spiny integument, the relative sizes of the oral and ventral suckers, and the habitat of the various species, i.e. the intestine of amphibia, *Mesocoelium* agrees with the diagnosis of the Brachycoeliinae; on the other hand in respect of the situation and arrangement of the genital organs, the position of the ovary behind the testes, the juxtaposition of these latter to the

acetabulum, and the opening of the genital pore in the immediate neighbourhood of the bifurcation of the intestine this genus agrees with the Dicrocoeliinae; and as regards the distribution of the yolk-glands and the length of the intestinal caeca the conditions existing in the present known species of *Mesocoelium* are intermediate between or a combination of the conditions existing in the two subfamilies, though the length of the intestinal caeca more nearly approximates to the conditions found in the Dicrocoeliinae and especially is this the case in *M megaloon* Johnston and *M sociale* Lühe.

The resemblance between the genera *Mesocoelium* and *Dicrocoelium* becomes still more marked if we accept the view first put forward by Looss (1899, p. 632), and later accepted by Braun (1902, p. 97), and confine the limits of the genus *Dicrocoelium* "to forms with leaf-like shape, with testes lying near or obliquely behind each other and symmetrically developed yolk-glands," relegating the more elongate forms to Looss' provisional genus *Lyperosomum*. Johnston himself admits (1912, p. 341) that *Mesocoelium* agrees with the Dicrocoeliinae as regards the position of the ovary behind the testes, and he gives this as one of the diagnostic features of the genus. The fact that the ovary may in a certain proportion of cases lie on the left side of the body, as he found in *M mesembrinum* and as I have shown above also occurs in *M sociale* Lühe, instead of being on the right as is usually the case, does not seem to me to have any bearing on the matter and his criticism that we cannot therefore regard the positions of the ovary "as of dominant importance in referring the genus to its subfamily" is invalid In no specimen of this genus examined by me or by any previous observer, not excluding Johnston himself, is it recorded that the ovary has ever been seen to lie *in front* of the testes. We have here a constant anatomical feature that in my opinion definitely separates the genus *Mesocoelium* from the subfamily Brachycoeliinae, in which the ovary invariably lies in front of the testes, and completely justifies its inclusion by Odhner in the subfamily Dicrocoeliinae Looss.

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