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A New Digenetic Trematode from the Barracouta *(Syncoeliidae-Digenea)*

By

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FIGS. 1-9

ABBREVIATIONS USED IN TEXT FIGURES

Cop, copulatory organ; *Cut*, cuticle; *E*, egg; *Hd*, hermaphrodite duct; *Int*, intestine; *Met*, metraterm; *Mgl*, Mehlis' gland; *O*, ovum; *Oes*, oesophagus; *Oo*, ootype; *Os*, oral sucker; *Ov*, ovary; *Ovd*, oviduct; *Ph*, pharynx; *Pp*, pars prostatica; *Pros*, prostate gland cell; *Sem v*, seminal vesicle; *Sp*, spermatic fluid; *Sph*, sphincter; *Tes*, testis; *Ut*, uterus; *Yk d*, yolk duct; *Yk gl*, yolk gland.

On the twentieth day of May, 1947, Professor Hickman and I examined a dozen specimens of the Barracouta (*Thyrsites atun* Euph.), which had been taken by a fisherman operating from Nubeena. We found numerous individuals of a species of digenetic trematode attached to their gill-rakers. The majority of the digenetic Trematodes of fishes are internal parasites. Some species have been described from the gills and the pharyngeal region and certain forms have been found externally on the skin, although in such cases they are suspected of migrating thence from the pharynx or the intestine upon the death of the host. The present species appears well adapted for its relatively exposed habitat. Each individual attaches itself by the acetabulum to the apex of a gill-raker. Efforts to dislodge the trematode from its hold reveal a most tenacious grip, the tip of the gill-raker frequently breaking off and remaining in the acetabulum. This will be shown to result from specialisation of that organ accompanied by unusual internal muscular development.

The species strongly resembles *Accacoelium contortum* (Rudolphi) from the gills of *Mola mola* (L.), in superficial characters, but examination of the internal structure excludes it from the Accacoeliidae. Apparently a similar habit has resulted in parallel adaptation in spite of significant differences in internal organisation. The species presents unusual anatomical features and I have erected a new genus of the family Syncoeliidae Dollfus 1923, to accomodate it.

Family SYNCOELIIDAE DOLLFUS 1923

Capiatestes thyrsitae n.gen. n.sp.

Generic Diagnosis. Medium sized elongate distomes with extremely mobile fore-body. Cuticle non-spinous, papillate. Acetabulum pedunculate, elongated antero-posteriorly. Gape a longitudinal slit dilated at extremities. Extrinsic musculature of acetabulum well developed. Intestinal caeca sinuous, fused posteriorly.

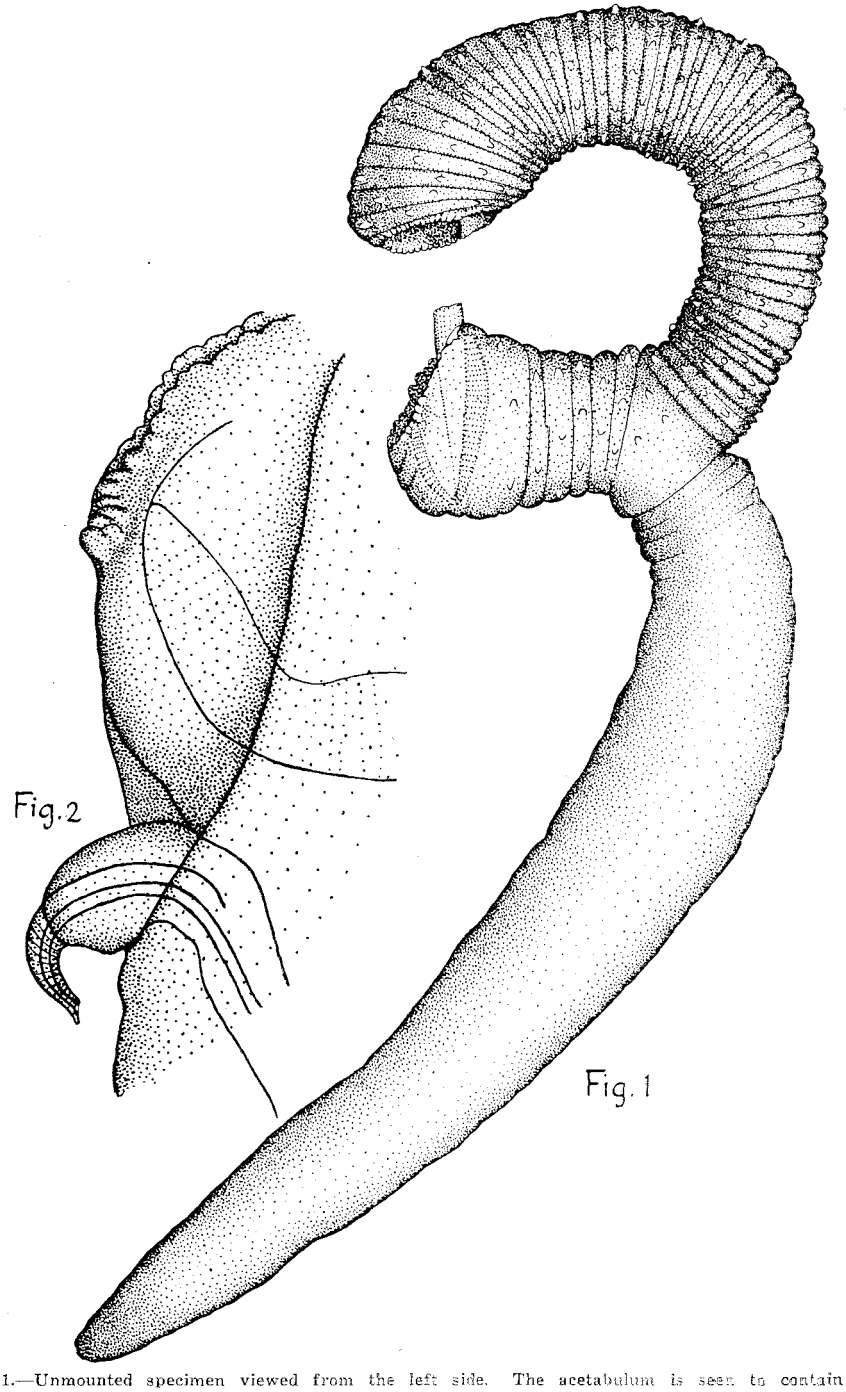

FIG. 1.—Unmounted specimen viewed from the left side. The acetabulum is seen to contain the broken apex of a gill-raker.

FIG. 2.—Portion of anterior end of a mounted specimen with the copulatory organ protruded.

No connection between gut and excretory vesicle. Genital atrium large immediately behind rim of oral sucker, and containing protrusible copulatory organ. No cirrus or cirrus sac. Testes postacetabular, intercaecal, eighteen in number. Vasa deferentia two. Seminal vesicle long and tubular entirely in fore-body. Pars prostatica tubular, prostatic cells free. Ovaries post-testicular intercaecal, five in number opening separately into common oviduct. Uterus large, very long, regularly coiled in hind body dorsal to and obscuring gonads. Receptaculum seminis uterinum present. Eggs very numerous, small ovoid, thick shelled. Yolk glands seven in number, post-ovarian. Metraterm and pars prostatica fused, forming hermaphrodite duct. Excretory vesicle very short, lateral branches sinuous fusing anteriorly. Body tissue extremely glandular.

External Features. The worms are fairly large, measuring approximately 9-15 mm. long when contracted, but extending to a much greater length in life. The body is slender and clearly divisible into a cylindrical pre-acetabular region or fore-body, and a somewhat stouter tapered post-acetabular region or hind-body. When fixed free from pressure the worms contract into a characteristic shape similar to the numeral '3' (fig. 1). The middle arm of the '3' is formed by a stout pedicle, cylindrical in form, which bears the acetabulum. However, individuals mounted under cover-glass pressure may assume a variety of forms. In a large number of whole mounts the fore-body measures 0·48-0·72 mm. wide, the hind-body measures 0·77-1·28 mm. at its broadest point, and the pedicle measures 0·96-1·76 mm. long and 0·88-1·12 mm. broad. The cuticle is non-spinous, but on the fore-body and pedicle is produced into circlets of large, blunt papillae. When the fore-body is contracted, its surface becomes completely annular.

The oral sucker is terminal, with its aperture directed forwards and downwards. The oral aperture proper is bounded by a fleshy papillate lip. A second lip originates dorsally and runs obliquely backwards as it approaches the ventral surface, where it forms the posterior border of the genital atrium (fig. 2). This is a deep pocket-shaped invagination immediately behind the mouth. The acetabulum is elongated antero-posteriorly. It does not possess the usual cup-shaped cavity owing to the thickness of its lateral walls which reduce the cavity to a deep longitudinal slit. The slit-like gape is dilated at its extremities, the posterior dilation being the more pronounced. A fleshy papillate lip protrudes from the pedicle and surrounds the gape. The oral sucker is slightly larger than the acetabulum. In the whole mounts the former measures 0·72-0·88 mm. in diameter, while the latter which is mounted on its side, measures 0·56-0·72 mm. long and 0·4-0·5 mm. deep.

The excretory pore is situated at the posterior tip of the body. It leads into a short invaginated chamber.

Alimentary System (fig. 3). The form and position of the oral sucker is described above. A prepharynx is lacking, the oral cavity leading directly into the pharynx. This is pyriform, with its narrowest diameter at its junction with the oral sucker. It measures approximately 0·33 mm. long and 0·2 mm. in maximum diameter. A very short muscular oesphagus connects the pharynx with a transversely elongated chamber which extends directly to left and right for a short distance. On each side, the transverse duct is abruptly constricted by a strong sphincter into a narrow duct leading into the digestive tube. The oral sucker, pharynx, oesophagus, and transverse chamber are lined by an inward extension of the cuticle. Within the digestive tubes the cuticle is replaced by a digestive epithelium of densely packed cells. The cells stain selectively into two layers, the basal portions only absorbing nuclear stain. Although the proximal regions of the

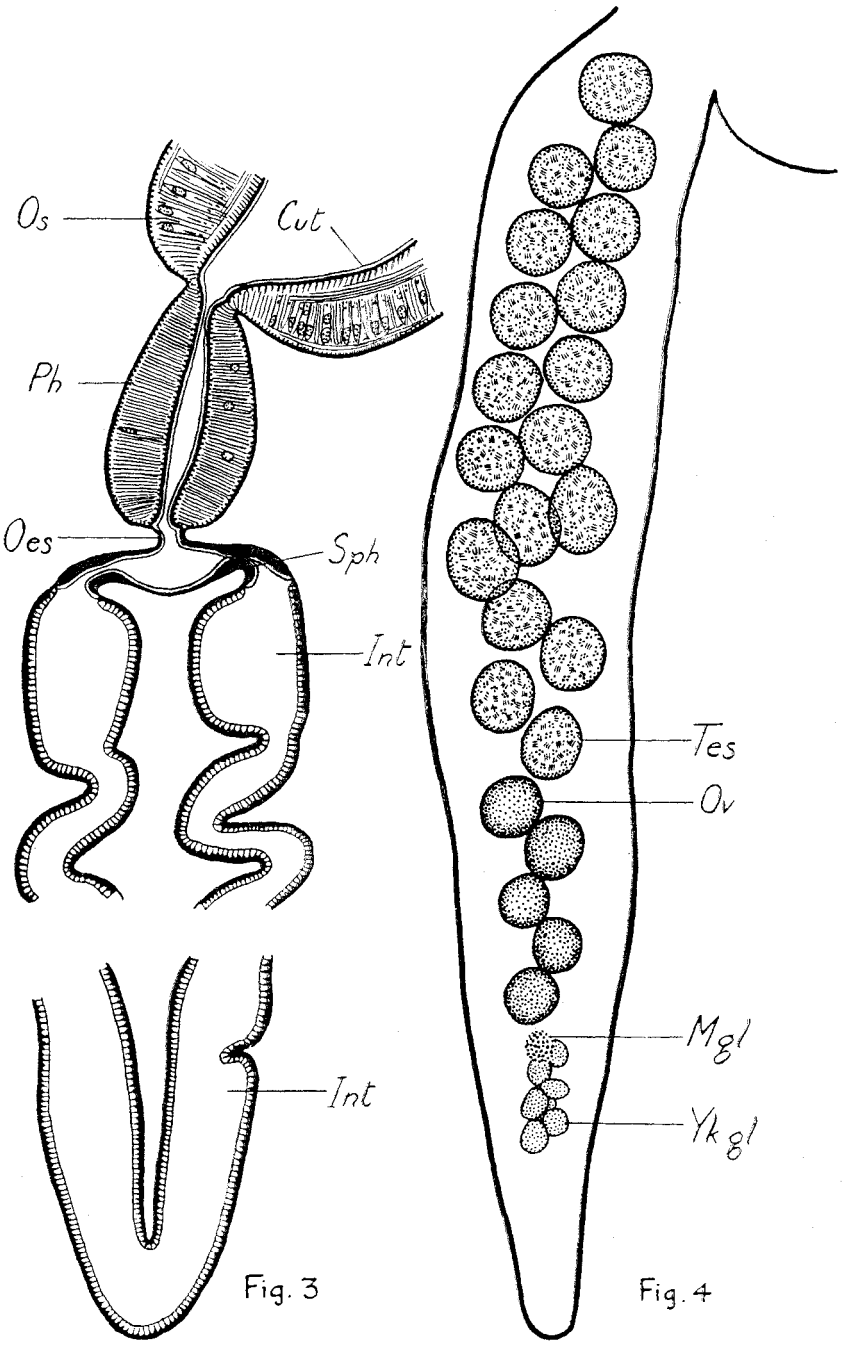

FIG. 3.—Diagram of the anterior and posterior portions of the gut.

FIG. 4.—The hind-body of a mounted specimen. The uterus and the intestine are omitted for clarity.

rami are typically somewhat expanded, no 'Drüsenmagen' are present, as the epithelium of the expanded portions appears identical with the lining of the remainder of the gut. The two gut rami run directly backwards through the fore-body at some distance from the lateral margins. In fixed contracted specimens, their course is extremely and regularly sinuous. In the post-acetabular region the rami remain in a lateral position, slightly towards the ventral surface. They are separated from the lateral margins by the uterus. As the body tapers posteriorly the rami approach one another and fuse in an acute arch a short distance from the posterior extremity. There is no anus or communication with the excretory system.

Excretory System. A narrow excretory vesicle runs forward from a short invagination at the posterior tip of the body and branches above the posterior arc formed by the fusion of the gut rami. The two main collecting trunks diverge and pass forward and downward until they come to lie ventral to the gut rami. In this position they pursue a sinuous course to the pedicle of the acetabulum. They describe convolutions within the pedicle and continue forward through the fore-body. Anteriorly, they expand and pass to the dorsal surface, where they fuse above the junction of the oral sucker and the pharynx.

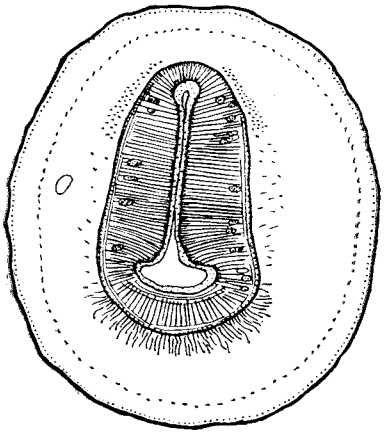

FIG. 5.—Transverse section through the pedicle and acetabulum which shows the form of the gape and a portion of the extrinsic musculature.

Muscular System. The oral sucker is a normal well-developed globular organ, consisting of the usual outer and inner, equatorial and meridional layers, separated by a parenchymatous zone which is traversed by weaker radial fibres. The pharynx is continuous with the oral sucker, but the meridional fibres are lacking. The radial fibres are stouter and more numerous. Few parenchymatous cells are present. The acetabulum is elongated antero-posteriorly. The form of the gape has been described above. It is a well-developed sucker, but is less muscular than the oral sucker. Numerous parenchymatous cells with abundant contents are present (fig. 5).

A most striking feature of the animal is the extreme development of the extrinsic musculature of the acetabulum. The pedicle is packed with stout fibres, which are inserted into the dorsal surface of the acetabulum. These fibres separate into anterior and posterior bundles. The anterior group occupies a central position in the 'neck' region. It partly encloses the seminal vesicle above and the uterus below. Most of the fibres terminate in the posterior surface of the oral sucker. The posterior group of the fibres passes backwards in the mid-line but below the

gonads and near the ventral surface. The vasa deferentia are enveloped. The fibres become diffused near Mehlis' gland. Scattered fibres run between the proximal portion of the uterus and the yolk glands.

The body wall of the pre-acetabular region contains well-developed muscle layers. These consist of outer longitudinal, inner oblique, and intermediate circular layers. It is unusual to find the longitudinal layer enclosing the circular. The former is more strongly developed ventrally. However, in the pedicle and in the post-acetabular region the longitudinal and circular layers are completely lacking. Here, the oblique layer consists of very numerous fine fibres.

The form of the acetabulum, coupled with the extraordinary development of the internal muscles, accounts for the tenacity with which the animal grips the gill-rakers of the host. A raker is always gripped in either the anterior or the posterior dilation of the gape. It is engulfed to the maximum extent possible. Thus its apex is thrust obliquely into the posterior or anterior roof of the cavity farthest from the entrance. When efforts are made to dislodge the animal,

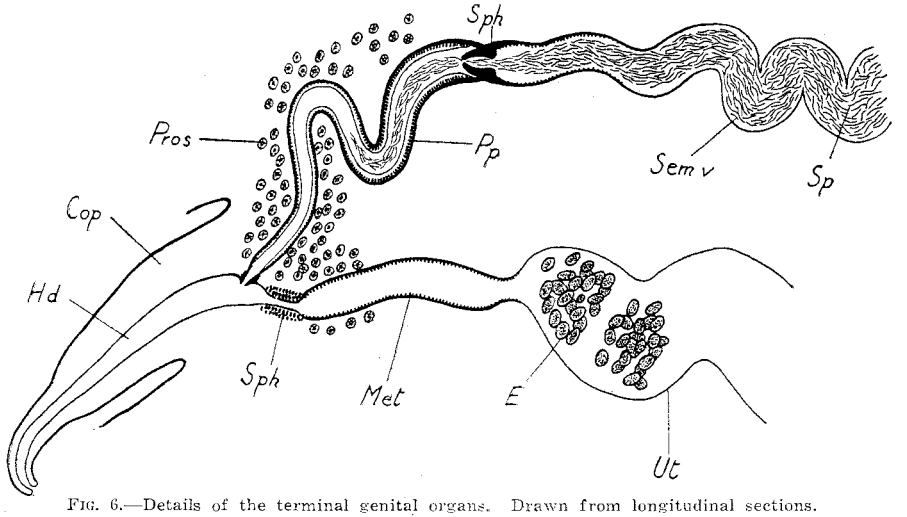

FIG. 6.—Details of the terminal genital organs. Drawn from longitudinal sections.

the tightly closed slit prevents movement of the raker along the length of the sucker to allow a direct pull. This results in the apex being levered further into the sucker. The musculature in the pedicle prevents the rotation of the acetabulum which would allow a direct pull with the resulting extraction. Further it appears that rotation in the opposite direction to that induced by the gill-breaker is set up. This causes the angle at which the raker enters to become more acute and that component of the pull in the direction of the raker is lessened.

Genital System: 1. Male. The testes are eighteen entire round, or oval, bodies measuring approximately 0·36 mm. in diameter in slightly compressed whole mounts. they occupy the intercaecal space immediately behind the pedicle and commonly occur in two alternating linear rows (fig. 4). In some whole mounts they are much displaced, and in strongly contracted flattened specimens become angular in form by mutual compression. Each testis leads by a narrow vas eferens into one of the two vasa deferentia. It was not established whether or not the collection of spermatic fluid is equally divided between the two male collecting ducts, but it is certain that the division is into anterior and posterior groups, as only one vas

deferens is present in transverse sections of the posterior testicular region. The vasa deferentia run forward in contact with one another within the large bundle of longitudinal muscle fibres arising from the acetabulum. Approaching the pedicle, they emerge from the muscles and pass towards the dorsal surface. A short distance in front of the pedicle they open into the seminal vesicle. This is a sinuous tube 0·06 mm. in diameter which runs forward through almost the entire length of the fore-body. It is situated near the dorsal surface and is enclosed ventrally by the longitudinal fibres which link the acetabulum and the oral sucker. As the seminal vesicle approaches the pharyngeal region its wall becomes muscular, due to the presence of increasingly stout outer longitudinal and inner circular fibres. The vesicle is then obstructed by a stout sphincter which projects into the cavity and encloses a narrow lumen. This separates the seminal vesicle from the pars prostatica into which it projects as a blunt conical nozzle (fig. 6). The pars prostatica is a strongly muscular tube lined with stout circular fibres and a thick, clear layer which resembles the prostatic layer of many other species but which

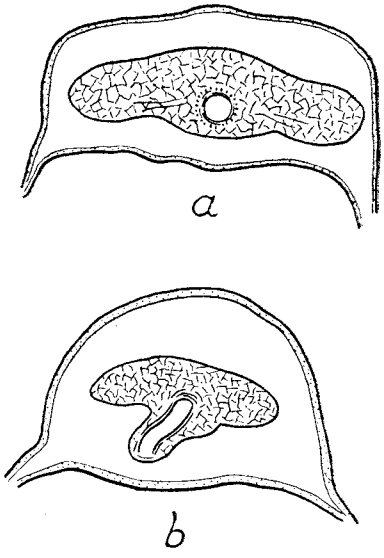

FIG. 7.—Diagrams of two transverse sections through the copulatory organ. (*a*) Near its base. (*b*) Approaching the tip.

does not appear to be of a cellular nature. The pars prostatica narrows and opens into the hermaphrodite duct through a small papilla. A well-developed prostate gland consists of numerous very small cells lying free in the tissue about and above the pars prostatica. The weakly muscular hermaphrodite duct perforates a well-developed copulatory organ, which is not to be considered a cirrus as it is clearly not derived from the male duct. It represents an outgrowth from the wall of the genital atrium. The organ is produced into lateral expansions near its base, but near the tip it narrows abruptly, forming shoulders and terminating in a slender recurved portion which is reminiscent in form of a miniature elephants trunk (fig. 2). Genuine copulation does not seem possible in this species, the copulatory organ serving to deposit spermatic fluid within the genital atrium of the other individual, from whence it is later drawn into the recipients body through its own copulatory organ.

2. Female. Five smooth, round ovaries occur in the intercaecal space immediately behind the testes. They are situated one behind the other, each being obliquely in contact with its predecessor (fig. 4). In slightly flattened whole mounts the ovaries measure 0·33 mm. in diameter. The ova measure 0·0125 mm. Each ovary leads ventrally into a branch of the common oviduct which runs directly backwards in the mid-line below the ovaries (fig. 8). After receiving the ducts from the ovaries the oviduct expands slightly and passes along the dorsal surface of Mehlis' gland. It then tapers and enters the gland. After receiving the yolk duct it turns forward and becomes the ootype. Here it receives numerous fine protoplasmic threads from the surrounding gland cells. The female duct then turns dorsad and emerges from Mehlis' gland as the uterus. The narrow proximal convolutions of the uterus lie behind the gland and function as a receptaculum seminis. The uterus passes to the posterior tip of the body, where it expands and begins a regularly

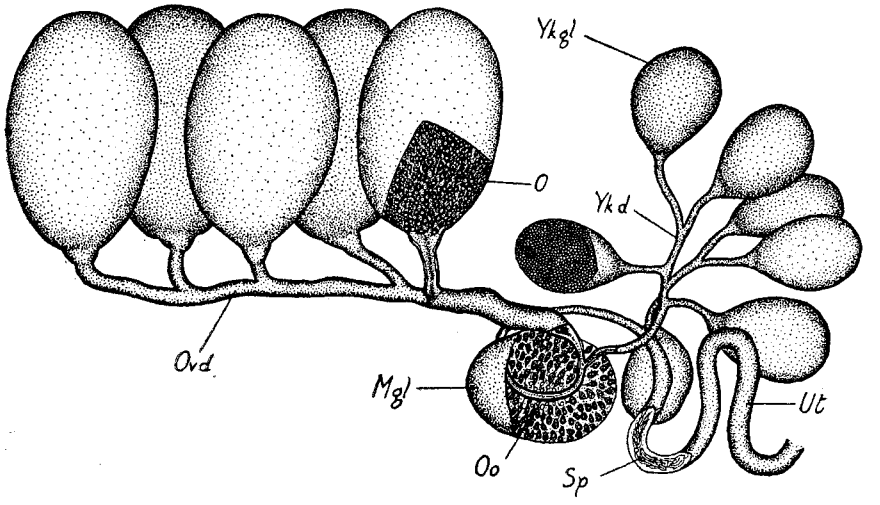

FIG. 8.—Diagram of the female complex reconstructed from sections.

convoluted path forwards. It is extremely long, turning alternately to left and right, the coils passing completely across the body dorsal to the gonads. The loops pass between the intestine and the lateral body margins on each side and extend inwards for a short distance near the ventral surface (fig. 9). On reaching the pedicle, the uterus turns directly forward as a sinuous tube which lies in the mid-line near the ventral surface. Dorsally, it makes contact with the muscle fibres connecting the acetabulum and the oral sucker. As it approaches the base of the copulatory organ the uterus narrows abruptly into a muscular metraterm which possesses well-developed outer longitudinal and inner circular fibres. Near the aperture of the male duct the metraterm communicates with the hermaphrodite duct through a strong sphincter (fig. 6). There is an interesting development in the nature of the wall of the uterus and of its contents as it progresses through the post-acetabular region. In the early convolutions, i.e., those near the posterior of the body, the uterine wall is membranous and the contents consist of a homogeneous mass of groups of yolk cells with their ova. The contents of each egg is bounded from its companions by a thin membranous covering. No sign of shell development is evident. However, as the uterus approaches the pedicle it becomes lined with large gland cells which are packed with darkly staining contents, and the

shells of the eggs become progressively thicker. In the loops of the uterus, immediately behind the pedicle and throughout its course through the fore-body, the eggs are fully formed and possess a thick golden shell. They are roundly ovoid and measure 0·025-0·03 mm. long by 0·0175-0·0215 mm. broad. This indicates that the shell-forming material is passed into the uterus by its glandular lining. The uterine glands are not present in the fore-body.

The yolk glands are constantly seven in number. Each is a smooth pyriform body measuring 0·16 mm. by 0·13 mm. which opens into a slender branch of the yolk duct. They are grouped immediately behind Mehlis' gland (fig. 8).

Discussion. The presence of a multiple of the usual number of two testes is not now thought unusual, but the writer has encountered only one description of a form possessing more than one ovary *Biovarium cryptocotyle* Yamaguti 1934. Species are known to occur in which the ovary is deeply lobed, e.g., *Paracryptogonimus americanus* Manter 1940, and *Metadena globosa* (Linton 1910), etc.

However, in *Copiatestes thyrsitae* n.gen. n.sp. the ovaries are separated well-developed organs. Similarly, although in the genus *Paronotrema* Dollfus which also belongs to the Syncoeliidae, the large number of testes are said to represent segments of two tubular testes (Manter 1940), this is not the case in the present species.

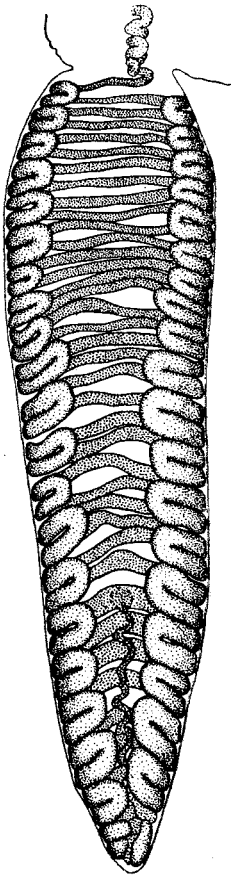

FIG. 9.—Diagram of the course of the uterus in the post-acetabular region. The gonads and intestine are omitted. Drawn from the ventral aspect.

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