ON THE FUNCTIONAL MORPHOLOGY OF A NEW FAUNA OF MONOGENOIDEA ON FISHES FROM TRIVANDRUM AND ENVIRONS PART V. GEPHYROCOTYLIDAE FAM. NOV.

by

R. VISWANATHAN UNNITHAN *)

Material for this paper was obtained during the course of studies on monogenetic trematodes from marine fishes of the peninsular coast of India, conducted by the author in the Central Marine Fisheries Research Institute at Mandapam Camp and the Marine Biological Laboratory of the University of Kerala at Trivandrum, as detailed in Part I (UNNITHAN, 1957) of this series.

Gephyrocotylidae fam. nov.
Gephyrocotyle gen. nov.

Gephyrocotyle ixoracorona gen. *et* sp. nov. (Figs. 1 - 9)

A single mature specimen of the new monogenetic trematode was collected from the gills of a single female fish, *Caranx kalla* CUV. & VAL., 20 cm/14.5 cm long examined at Trivandrum on 18th August 1955. Four specimens of a new gastrocotylid worm, *Gastrocotyle kalla* sp. nov. were also collected from the same host along with the single specimen of *Gephyrocotyle*. Several specimens of the same species of the host were examined on several occasions but none yielded a single specimen of this species though a minimum number of 2 specimens of the new species of *Gastrocotyle* were invariably present. The gill of the host infected by *Gephyrocotyle* was covered with dense secretion of mucous but the gill filaments were not damaged.

Body mazocraeoid in shape 1.43 mm long and with maximum width of 0.517 mm at the horizontal level of the proximal most clamps. The right margin of the body upto the posterior extremity has a nearly straight edge. The left side upto half the length of the body is only slightly expanding posteriorly, but behind this level the body margin is pushed out laterally from the proximal most clamp row; behind this region the body margin is expanded and results in a slight asymmetry of the posterior half of the body (Fig. 1).

*) Present address: Indian Ocean Biological Centre, Ernakulam — 6. India

The subterminal mouth is crescentic (Fig. 2) with the two oblique oral pouches, 36 × 28 μ - 40 × 32 μ immediately posterior to it. Long filamentous muscle fibres arising from the thin walls of the oral pouches take a wavy course into the posterior regions of the body by the side of the oesophagus (Fig. 2). The spherical pharynx, 28 μ in diameter, is situated immediately behind the oral pouches and is covered externally with many small spherical gland cells. The pharynx has also thin muscle fibres arising from its wall and extending to the posterior region of the body. The rather wide and unbranched oesophagus is 0.48 mm long and bifurcates into the intestinal crura at about one third the length from the anterior end of the body. The two wide lateral intestinal crura have numerous nonanastamosing outer branches and very few short intercrural branches. The two crura are confluent at the posterior region behind the testicular zone.

The haptor as a separate unit is absent and the clamps are embedded along the lateral margins of the body in the posterior half. There are four clamps one behind the other on the left side; were the clamps are more near the left crus and away from the left margin of the body. Similarly on the right side of the body there are four clamps one behind the other but here they are marginal far away from the right crus. The clamps on the left side are 36 × 32 μ - 40 × 32 μ while those of the right side are 40 × 30 μ - 44 × 36 μ.

The clamps on the right have the general gastrocotylid pattern of jaw sclerites (Fig. 3) with dorsal and ventral jaws and short dorsal arm for the ventral jaw; the median spring has a distally bifurcated ventral arm and a slender median spring appendix for its dorsal arm. The oblique sclerites are narrow and slightly sigmoid with sliding articulations between the dorsal and ventral jaws. The wall of the clamp capsule is interrupted by 8 - 9 pairs of thin rib like cuticular thickenings. The adaxial and abaxial sides are nearly symmetrical.

The clamps on the left side have a slightly different arrangement of jaw sclerites. The adaxial and abaxial sides of the clamps show marked asymmetry (Fig. 4). The adaxial half of the jaw sclerites are shorter than the abaxial and the oblique sclerite of the adaxial side is larger than on the abaxial. The ventral arm of the median spring is long and slender and its distal bifurcation is shallow. The dorsal arm of the median spring is highly peculiar; its dorsal appendix is broad and short and shows nearness to a *Lithidiocotyle* type. The broad distal end of the dorsal arm of the median spring is concave accomodating the irregularly convex proximal end of its dorsal appendix. The median spring appendix at its distal

end is deeply notched with one branch conical and long while the other short (Fig. 4). The jaw sclerites abaxially have small cuticularised rectangular or cuboid pads along their inner margin at the distal ends. Riblike thickenings are present as seen in clamps of the right side.

The slight asymmetry in the disposition and pattern of the sclerites in clamps of either sides might have been brought about by the marked asymmetry of the left and right sides of the body in the posterior half where the clamps are distributed; thus resulting in a more complex arrangement for adhesion for the left side since this side is more developed and expanded.

Anchors and terminal lappet are absent and the body appears to be abruptly ending at the distal most clamps.

Testes five, post ovarian, two pairs on either side of the median line in the intercrural field and a single testis at the median posterior axis in front of the confluent intestinal crura. The testes are irregular in shape somewhat broader than long, 40 × 56 μ - 48 × 48 μ. All the testes are in a spent condition. The zig-zag vas deferens is very clearly seen in the mid ovarian field left to the median axis of the body; anteriorly this duct is thin and extends along the median axis and joins the base of the armed male terminalia at the vaginal zone. The male terminalia consists of a semicircular penis bulb from which arise a corona of eight *ixora* shaped cuticularised structures forming the armature of the penis. Each cuticularised piece has a stem 44 - 52 μ long jointed at about one third its length from proximal end and the distal end is 10 - 12 μ broad (Fig. 5 & 6). The corona of cuticularised structures project out though the median ventral male pore which is at about 0.24 mm from the anterior end of the worm. Seminal vesicle was not observed in the specimen, it may not be present as a permanent structure. The area of the male pore and male terminalia is surrounded by small spherical prostate cells.

Ovary shaped like an elongated inverted 'U' and with limbs closely apposed, is situated in the intercrural field in front of the testes and closer to the left crus. The proximal ovary is 80 × 40 μ situated close to the anterior left testes and continues as the proximal narrow limb which extending almost the same length of the distal limb curves backwards into the inner distal limb which has larger ova 12 μ wide at its distal end. The distal ovarian loop is 200 μ long; from its expanded distal extremity arise the short and narrow oviduct which proceeds backwards obliquely and joins the base of the ootype (Fig. 7). Any special arrangement for expulsion of ova was not observed in connection with the oviduct. The wide uterus arises from the anterior region of the pear shaped ootype

and extends anteriorly along the median plane to open near the male pore. A single large spindle shaped operculate egg was observed in the middle region of the body. Its anterior filament is 200 μ long and solid while the posterior filament is 140 μ long, and hollow. Both the filaments are twisted at their distal ends (Fig. 8). The egg is in the cleavage or embryo stage. Two well formed larval hooks (Fig. 8) are observed on a conspicuously stained portion in the middle regions of the egg. Body of the egg is 180 μ long and 56 μ broad and the operculum is 40 × 40 μ. The presence of a single but relatively large egg may be corelated with the small size of the worm and lesser number of eggs produced.

Vitellaria irregularly spherical 16 - 20 μ wide distributed uniformly from the zone of intestinal bifurcation to the posterior extrimity of the body. Posteriorly behind the testicular zone the vitellaria are not confluent across the middle line. Vitellaria are co-extensive with the intestinal branches both extra and intercrurally and surround the area of the clamps on the left side while the right clamps only partly. Transverse vitelline ducts are not observed in the specimen but a wide short median vitelline duct is observed close to the posterior end of the ootype.

A genito intestinal canal is indicated as a short narrow duct extending from the base of the ootype to the left(?) side. The median ootype is pear shaped placed in front of the testicular zone between the distal ovary and the common vaginal duct.

Vaginal pore double marginal one on each side and 0.340 mm from the anterior end of the body. On the left the vagina is slightly anterior to that on the right. The vagina is 'vase' shaped and is strengthened by long petal like cuticularised structures which have corrugated edges (Fig. 9). The whole vaginal area is 60 × 40 μ on right and 52 × 36 μ on the left. Both the vaginae enclose a loose fold in between their petals, functioning as the vulvae. Closely dorsal to each vagina is a cuticularised oval pad like structure with eight small and symetrically arranged cuticularised hooks (Fig. 9) which curve inwards. These pads with the cuticularised armature presumably serve as sockets to fix the partner in position, a presumption strengthened by the fact that each pad has eight cuticularised hooks corresponding to the penis crown of eight *ixora* shaped cuticularised rod like pieces with expanded tips. This structure is separate from the vagina and its funnel. The vaginal zone is slightly bulged out laterally with its cuticular armature projecting like petals. The vagina lead into a funnel shaped portion, the vaginal funnel which posteriorly continues into the anteriorly wide, posteriorly narrow vaginal canals. Each vaginal canal, extending posteriorly, unite obliquely at the intestinal bifurcation to form

a median vaginal duct which extends further posteriorly and meet the ootype close to the union of the oviduct with the common vitelline duct. The course of the median vaginal duct is not very clearly seen in the specimen but its origin and termination is well demarcated.

Discussion

The new gill trematode *Gephyrocotyle ixoracorona* is unique among the genera of monogenoid Oligonchoinea in a variety of different characters. The peculiar disposition and nature (also function?) of certain of its organ systems has not been found in any other single monogenoidean. It shows affinities with some families of Mazocraeidea BYCHOWSKY, 1957, but cannot be reconciled with any of the existing families of the order.

It suggests a parallel evolution with Mazocraeidae PRICE, 1936, in the general shape of the body, arrangement of the clamps and the limited growth potential of the haptor. But the slight asymmetry of the posterior haptoral half of the body together with the presence of complicated gastrocotyloid clamps, clearly excludes it from the family Mazocraeidae.

Gephyrocotyle ixoracorona resembles some of the species of the family Opisthogynidae, UNNITHAN, 1962, in the number of clamps in an asymmetrical haptor, and this resemblance is further strengthened by the fact that some of the species of Opisthogynidae have gastrocotyloid clamps resembling those of *Gephyrocotyle,* and also lack a terminal lappet. However, the most important diagnostic character of the family Opisthogynidae is the invariable post testicular position of the ovary, while in *Gephyrocotyle* it is pre-testicular, as in the majority of Monogenoidea.

Gephyrocotyle ixoracorona also shows some of the characters of the family Discocotylidae, PRICE, 1936, especially in the limited number of clamps, the disposition of the main organ systems, and the position of female and male terminalia. Though the peculiar corona of the new species is of only generic significance, its highly evolved bilateral vaginal complex is only remotely reminiscent of the simple bilateral vaginae of *Discocotyle,* DIESING, 1850. Furthermore, the gastrocotylid type of clamp-sclerites of *G. ixoracorona* are quite unlike the otherwise modified skeletal pattern of the diclidophoroid clamps. In the new species the clamps are somewhat embedded in the body as in mazocraeids, and not borne on short stalks at the posterior end of the body as in diclidophorids. Moreover, here the haptor is not demarcated from the body and the testicular zone is completely accomodated within the haptoral zone, while in Diclidophori-

dae FUHRMANN, 1928, the haptor is typically a well demarcated organ without extensions of testes and other vital organs.

The structure of the clamp skeleton of the left clamps in the present species remotely resembles those of *Lithidiocotyle* SPROSTON, 1946, suggestive of evolution along this line; but they differ conspicuously in most other characters. While the clamp-structure is typically gastrocotyloid, the clamp pairs are limited to the conventional diclidophorid four. But all the species of Gastorocotylidae PRICE, 1943, show an unlimited growth potential in the haptor: there are none with so few as four pairs.

This restricted number of clamps is paralleled in the genus *Oligapta* UNNITHAN, 1957 (Family Axinidae). But in *Oligapta* the reduction of the number of clamps is most probably brought about by a secondary total growth inhibition, acting simutaneously on both sides of the *Axine*-haptor while in the new species, with other affinities, the limited number of clamps is interpreted as a resultant of the more usual and primitive limited growth potential of the haptor seen in the superfamily Diclidophoroidea PRICE, 1936.

It is thus seen that while the present species is excluded from all the existing superfamilies of Monogenoidea, it combines some of the characters of each of them. To include it in any of the known families would necessitate a complete revision and modification of the family definitions. Hence to accommodate *Gephyrocotyle ixoracorona* it is felt desirable to create a new family namely Gephyrocotylidae, perhaps occupying a colateral position with Opisthogynidae UNNITHAN, 1962, in Gastrocotyloidea PRICE, 1959.

The name *Gephyrocotyle* is derived from Gephyra (Greek, meaning bridge) and *Cotyle* (cup, clamp) hence a bridging genus. Ixora; an Indian flower, like *Stephanotis* in appearance; *ixoracorona* corona like the ixora; hence the name *Gephyrocotyle ixoracorona*.

Diagnosis of **Gephyrocotylidae** fam. nov.

Mazocraeidea, with mazocraeoid type of body, its posterior half being slightly asymmetrical and including the haptor, which has a limited growth potential; the four clamp-pairs are gastrocotylid in structure. Left and right clamps slightly different in sclerite pattern. Ovary inverted "U" shaped. Testes post ovarian; male pore median ventral. Bilateral vaginae confluent in a median vaginal canal. Eggs with bipolar filaments.

Type genus *Gephyrocotyle* gen. nov.

Generic diagnosis of **Gephyrocotyle** gen. nov.

Gephyrocotylidae, with asymmetrical haptor coextensive on the left side with the entire gonad-zone anteriorly but on the right side only half the anterior extent. The gastrocotylid clamps are nonpedunculated, those on the expanded (left) side are themselves asymmetrical, while those on the normally developed (right) side are nearly symmetrical. All clamps have the usual gastrocotylid accessory sclerites and in addition, the asymmetrical series (left) have small cuboid cuticularized pads abaxially on the distal ends of the jaws. Intestinal crura confluent in post-testicular zone. The bilateral vaginae open supramarginally in cuticularized funnels with corrugated petal-like edges enclosing the vulva; which are associated antero-dorsally with hooked cuticularized 'sockets', the bilateral vaginae are confluent in a median vaginal canal right to the ootype. Testes few, irregular and post-ovarian. Male pore opens slightly anterior to vaginal zone, admitting an *ixora*-shaped cluster of rods with flared ends, arising from the basal penis-bulb; egg very large, spindle shaped, operculate and with a filament at each pole; embryonated *in utero*.

Type species *Gephyrocotyle ixoracorona* gen. *et* sp. nov.

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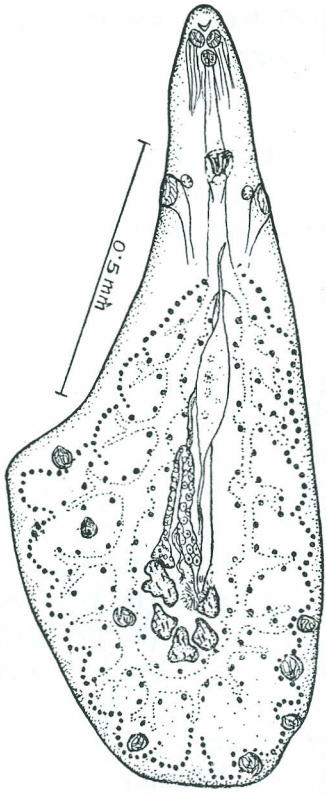

Fig 1.

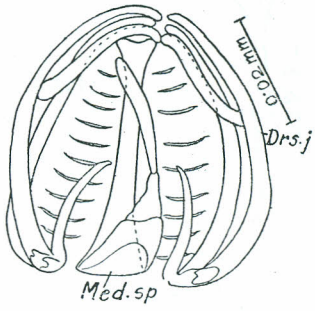

Fig. 3.

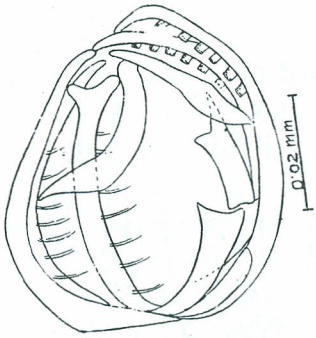

Fig. 4.

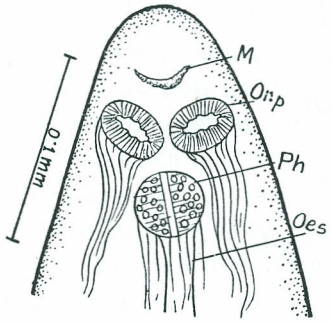

Fig. 2.

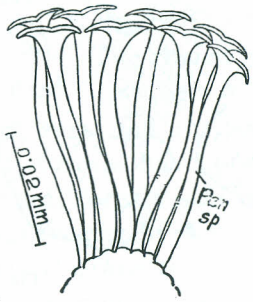

Fig. 5.

Gephyrocotyle ixoracorona gen. *et* sp. n.

1. Complete worm, dorsal view; 2. Anterior region, dorsal view; 3. Dorsal view of right distal clamp; 4. Dorsal view of left proximal clamp; 5. *Ixora* like corona of penis spines.

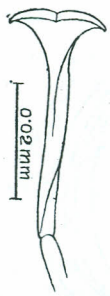

Fig. 6.

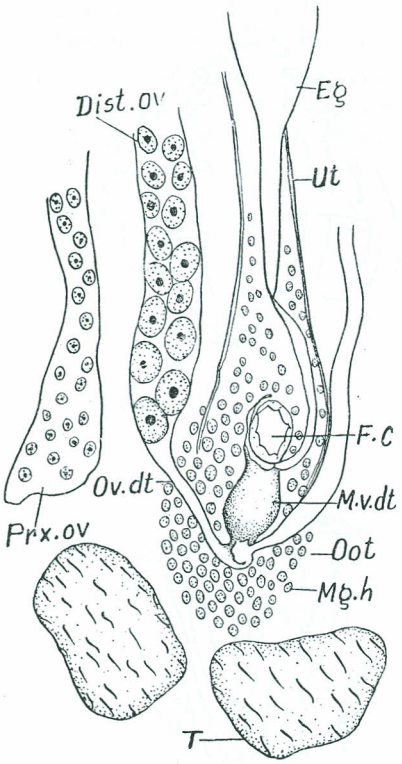

Fig. 7.

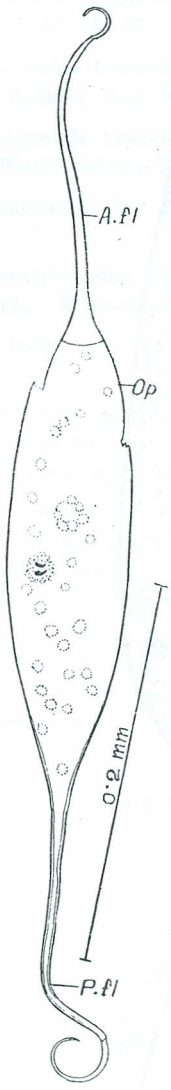

Fig. 8.

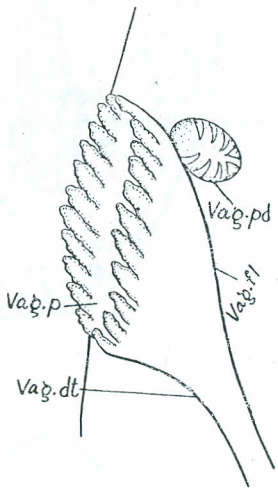

Fig. 9.

Gephyrocotyle ixoracorona gen. *et* sp. n.

6. One penis spine; 7. Ootype region, dorsal view; 8. Egg; 9. Vagina with its armature.