

ON SIX SPECIES OF MONOGENETIC TREMATODES, PARASITIC ON THE GILLS OF MARINE FISHES FROM THE INDIAN SEAS

by

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(with 47 figures in the text)

ABSTRACT

Six species of monogenetic trematodes, collected from the gills of marine fishes of the south west coast of India, are described. Two new genera, *Churavera* and *Eyelavera* have been created to accommodate the two new species *Churavera macrova* and *Eyelavera typica*. Of the remaining four species which all come under the more familiar genera *Gastrocotyle* and *Pseudaxine*, three viz., *Gastrocotyle kalla*, *Gastrocotyle kurra* and *Pseudaxine kurra* are new species while *Gastrocotyle indica* SUBHAPRADHA, 1951, is recorded for the first time from the west coast of India.

Introduction

During the course of investigations on the parasites of marine food fishes from the Indian seas, in the Marine Biological Laboratory of the University of Kerala at Trivandrum (south west coast of India) and at the Central Marine Fisheries Research Institute at Mandapam Camp (south east coast of India) the author collected specimens of six species of monogenetic trematodes from fishes of the inshore waters along the south west coast of India. These species are described below. They all belong to the family Gastrocotylidae PRICE, 1943. The collection and treatment of the specimens was as described in a previous work (cf. UNNITHAN, 1957 pp. 28 - 29).

Family Gastrocotylidae PRICE, 1943

Genus *Gastrocotyle* VAN BEN. & HESS., 1863

Generic diagnosis emend:

Gastrocotylinae, with clamps typically gastrocotylid, ventral arm of median spring with doubly bifurcated distal end and its dorsal arm with

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an appendix; haptoral frill with a single row of clamps on one side of the posterior half of the body, extending beyond half the ovarian zone; male genital pore armed with a regular corona of stout hooks on the genital bulb; vagina unarmed, median dorsal and situated behind the male genital pore; testes numerous, postovarian, intercrural; ovary inverted 'U' shaped. Parasitic on the gills of marine fishes.

Type species: *Gastrocotyle trachuri* V. BEN. & HESS., 1863.

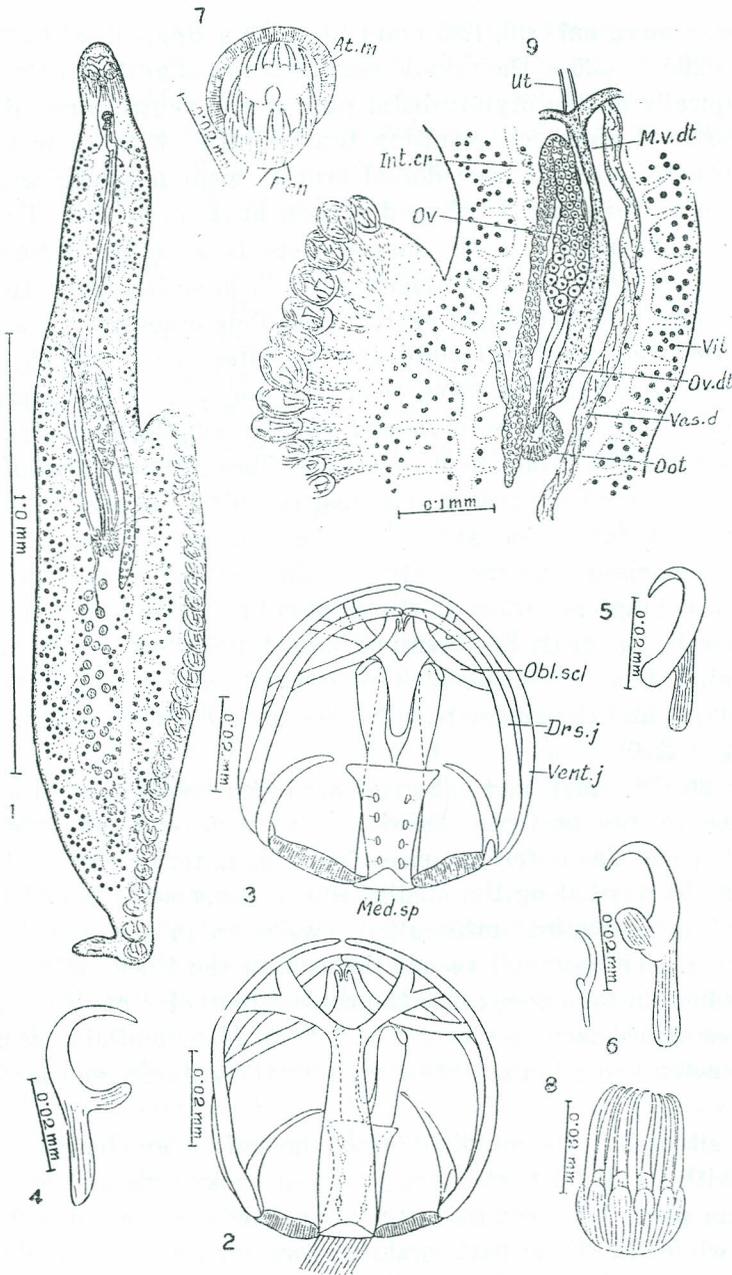
Gastrocotyle kalla sp. n.

(Figs. 1-9)

Several specimens of this new gastrocotylid monogenoidean were collected from the gills of *Caranx kalla* VAL. & CUV. at Trivandrum. A single fish examined on 7th July, 1954 showed gill infection by six specimens of this parasite. Five female fishes were examined on 7th September, 1954. All these fishes were infected by the new monogenoidean, on the gill filaments of the host and a total collection of 75 individuals were obtained. Another collection of five fishes examined on 8th September, 1954, gave a negative evidence for parasitism. These fishes were not infected by gill trematodes but several specimens of larval cestodes were obtained from their body cavity. A single female fish examined on 4th March, 1955, also was not infected by gill parasites while another female fish examined on 5th October, 1955, was infected by 10 specimens of this new monogenoidean. The parasites obtained on 7th July, 1954, are in the ovarian phase and those of 5th October, 1955, are in the testicular phase.

Body typically gastrocotylid; total length 1.2 - 2.4 mm and maximum width in the region of the ovary 0.45 mm; right margin more or less straight and uninterrupted; left margin abruptly expanded to form the haptoral frill which extends from the terminal lappet to a short distance into the anterior half of the body; terminal lappet at right angles to the body (Fig. 1).

Mouth subterminal, transverse and slit like; oral pouches spherical, 32 - 40 μ in diameter, surrounded by a broad rim of fibrous tissue. Pharynx spherical, 24 - 32 μ in diameter; oesophagus long and unbranched, bifurcating behind the male genital pore, at about 0.27 mm from the anterior end of the body in the type specimen. Intestinal crura extending almost to the posterior end of the body, left crus slightly shorter than the right, hind ends of crura not confluent, each crus with narrow ramifying outer and short simple inner branches (Fig. 1).



Figs. 1-9: *Gastrocotyle kalla* sp. n. 1. Complete worm, dorsal view; 2. Clamp, ventral view; 3. Clamp, dorsal view; 4. Proximal anchor; 5. Proximal anchor of another specimen; 6. Proximal and distal anchors; 7. Male terminalia showing penis and male genital pore; 8. Penis with corona of hooks; 9. Middle third of the body, ventral view.

Haptor, a marginal frill, 1.35 mm long, with a single row of 33 clamps, $20 \times 40 \mu$ - $225 \times 225 \mu$, the middle clamps being slightly larger. Clamps (Fig. 2) typically gastrocotylid; distal part of the ventral arm of median spring bifurcated and each resulting branch bifid, with their tips articulating with the ventral jaw; dorsal arm of median spring wider than ventral, with a projecting 'U' shaped process at its distal end. This structure though appearing as a 'U' shaped piece is actually formed of two symmetrically placed accessory sclerites which have heavily cuticularised inner edges and recurved distal extremities. This accessory skeletal piece resembles the well developed additional sclerites commonly observed in species of *Lithidiocotyle* SPROSTON, 1946. The dorsal arm of median spring has four pairs of apertures arranged in two longitudinal symmetrical parallel rows, for the attachment of muscle fibres. Dorsal arm of ventral jaw short and curved inwards and almost reaching the base of the accessory sclerites of the dorsal arm of median spring. Dorsal jaw shorter and less cuticularised than the ventral. Oblique sclerites long with hooked inner ends touching each other in the median line, their outer ends sliding on the ventral jaws (Fig. 3). Terminal lappet $120 \times 45 \mu$, with two symmetrical pairs of lateral anchors, of which the smaller pair is 20μ long, slightly oblique and the longer pair is 150μ long, sickle shaped and parallel (Figs. 4, 5 & 6).

Testes 20-25, small and spherical arranged irregularly in an elongated cluster in the posterior third of the body and confined to the intercrural space. Vas deferens arises from the anterior end of the testes cluster, runs forward along the median line as a zigzag tube and reaching the level of the intestinal bifurcation, swells up into a spindle shaped seminal vesicle. The seminal vesicle opens into the thick walled ejaculatory duct which in turn opens into the conical muscular penis, surrounded by 12 curved spines each 16μ long (Fig. 7 & 8). Male genital pore circular, 30μ in diameter and situated 0.18 mm from the anterior end in the type specimen.

Ovary situated in the middle third of the body is an elongated tubular structure with its distal part sharply curved backwards and overlapping the proximal part. The proximal part is narrow and measures 0.405 mm in length, while the distal part is short, saccular and is only about half as long as the proximal. Oviduct arises from the distal end of the ovary and opens into the ootype which consists of closely packed Mehlis' gland cells, surrounding the junction of the various genital ducts (Fig. 9). Uterus originates from the centre of the ootype and runs forwards ventrally

parallel to the vas deferens to open into the uterine pore situated immediately in front of the male genital pore. Egg spindle shaped with a filament at each pole, body of the egg measures $120 \times 40 \mu$.

Vagina median dorsal, unarmed, with an irregularly circular rim and situated behind the male genital pore (Fig. 1). Vaginal duct narrow and thin walled, extends backwards dorsally parallel to the uterus and opens into the ootype.

Vitellaria co-extensive with the crura and their branches, not confluent across the median line. Follicles irregularly spherical, 20μ in diameter. Transverse vitelline ducts unite in front of the ovary to form a long club shaped median vitelline duct which opens into the ootype. Genito intestinal canal originates from the ootype, runs forwards obliquely and opens into the right crus near the proximal end of the ovary (Fig. 1).

Discussion

This species differs from the type species *Gastrocotyle trachuri* V. BEN. & HESS., 1863, in the non-confluent nature of the crura, the haptor frill extending only slightly more than half the ovarian zone, genital corona being anterior to the intestinal bifurcation, vitellaria being not confluent across the middle line, and the ovary being much longer. Moreover, the accessory skeletal pieces observed at the distal end of the median spring of the present species is absent in the type species and the ventral jaw moieties are separate in this species while they are continuous in the type species.

The present species can be distinguished from all the known species of *Gastrocotyle* by the posteriorly nonconfluent vitellaria and intestinal crura. The long ovarian loops are peculiar to this species and the haptor shows a high growth potential in the addition of clamps. In the structure of the clamps especially of the median spring this species has the greatest resemblance to *Gastrocotyle indica* SUBHAPRADHA, 1951, but the extent of the clamp row is different. Moreover, they differ in the number of testes and the nature of the terminal ends of crura.

Gastrocotyle kurra sp. n.

(Figs. 10 - 17)

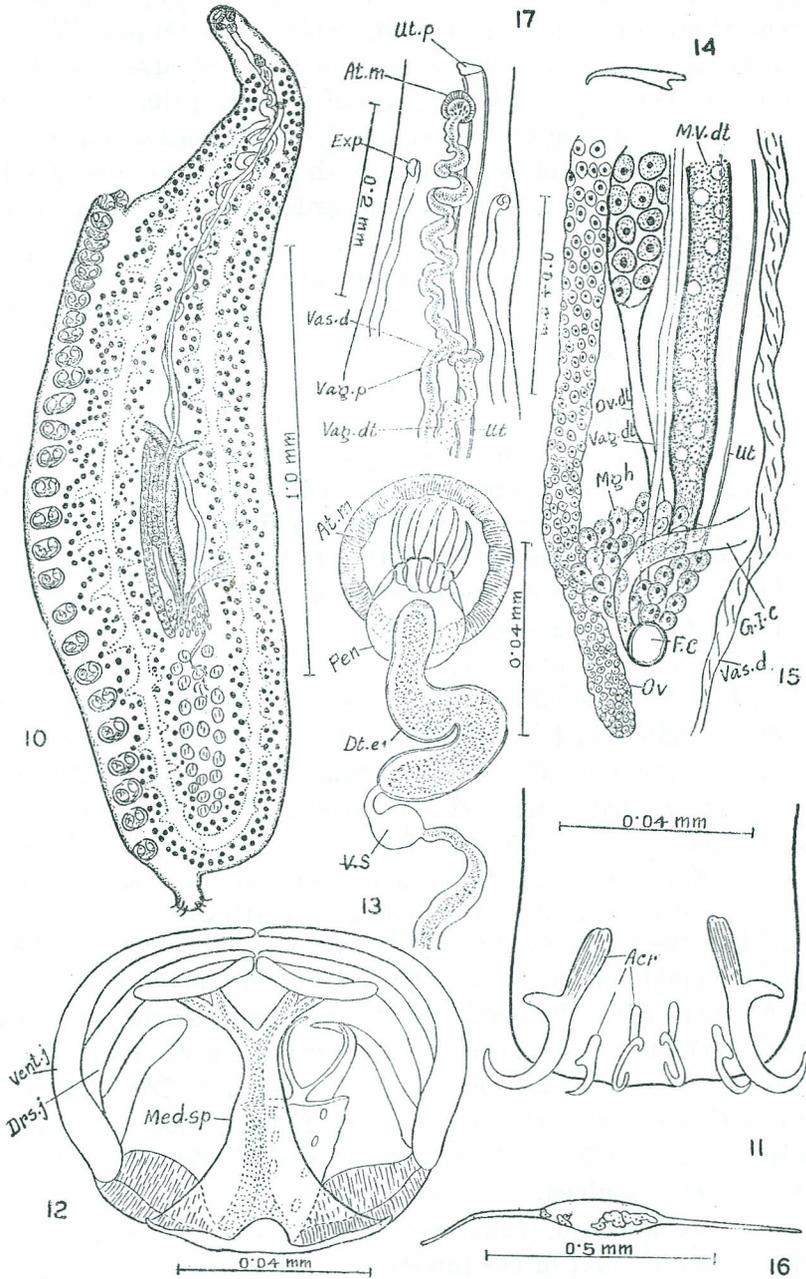
Several specimens of this new gastrocotylid monogenoidean were obtained from the gills of *Caranx kurra* CUV. & VAL. examined on various occasions at Trivandrum and near places. Seven specimens of the host

fish were examined on 6th September, 1954. Only two fishes were infected by the new species of trematode and it was observed always along with another monogenoidean, a new *Pseudaxine*, *Pseudaxine kurra* described below (see page 151). The five fishes which were not infected by gill trematodes harboured larval nematodes and larval tetra-rhynchid cestodes in the body cavity and near the excretory pores. Twenty five specimens collected from the two fishes include few of the *Pseudaxine* sp. also. A single specimen 16 cm long examined on 18th April, 1955, was infected by 15 of the new *Pseudaxine* but only seven of the new *Gastrocotyle* were obtained while a single female specimen of the host 20 cm long examined on 11th August, 1955, was not infected by the new *Gastrocotyle* but showed infestation by *Pseudaxine kurra* sp. n. on the gill rachers. Gill trematodes collected from five fishes (13 - 15 cm long) on 13th April, 1955, included a major percentage of the new *Gastrocotyle* while the *Pseudaxine* sp. were poorly represented. Fishes examined on 15th May, 1955 were not infected by any other gill trematode except *Gastrocotyle kurra* sp. n. always on the gill filaments of the host.

Body typically gastrocotylid, comparatively wide; neck narrow; haptor frill extending forwards from the base of the terminal lappet to the centre and almost straight; total length 1.5 - 2.87 mm and maximum width 0.45 - 0.64 mm (Fig. 10).

Mouth subterminal, circular, surrounded by a muscular rim $44\ \mu$ wide and bordered anteriorly by a row of sticky cells. Oral pouches oval, $25 \times 20\ \mu$ - $30 \times 24\ \mu$, situated obliquely behind the mouth. Pharynx thin, spherical, $40 - 44\ \mu$ in diameter, surrounded by small, scattered gland cells. Oesophagus 0.375 mm long, unbranched, bifurcating at 0.675 mm from the anterior end, behind the male genital pore, in the type specimen. Intestinal crura with several ramifying outer branches and few simple inner branches, extend parallel to the sides of the body to the hind end, become confluent with each other at the level of the last clamp, intercrural branches not confluent across the median line (Fig. 10).

Haptor a unilateral frill, 1.875 mm long including the terminal lappet, in the type specimen; clamps 16-29, arranged in a single row along the margin of the frill, occupying the posterior three fourth of the body, terminal clamps $20 \times 50\ \mu$ and middle ones $60 \times 76\ \mu$. Terminal lappet $225 \times 135\ \mu$ in the form of a terminal knob, armed with three symmetrical pairs of oblique anchors: proximal anchors $40 - 44\ \mu$ long, middle $16\ \mu$ long and distal $20\ \mu$ long and conspicuously hook like, first two pairs diverge while the last two converge towards the median axis (Fig. 11). Clamp



Figs. 10-17: *Gastrocotyle kurra* sp.n. 10. Complete worm, dorsal view; 11. Terminal lappet with anchors; 12. Clamp, ventral view; 13. Male terminalia, dorsal view; 14. Penis spine; 15. Ootype region, dorsal view; 16. Egg; 17. Region of the vagina and male terminalia, dorsal view.

sclerites (Fig. 12) differ considerably from the type species: proximal end of ventral arm of median spring very wide, its distal part 'Y' shaped, each limb again bifid and abutting on the short oblique sclerites, but not reaching the ventral jaws. Dorsal arm of median spring distally broad, and with 4-5 pairs of symmetrical spaces for muscle attachment, margin slightly wavy; distal end of dorsal arm with a forked accessory sclerite, the limbs of which are distally curved inwards and with its inner border heavily cuticular.

Testes 20 - 25, spherical, in three postovarian, intercrural rows almost reaching the crural confluence. Vas deferens long and narrow, shifted slightly to the right side of the median line, runs forwards and opens anteriorly into the seminal vesicle which is a thin walled sac 16μ wide. The seminal vesicle opens into a double walled, 'S' shaped (Fig.13) ejaculatory duct through a narrow neck. The distal end of the ejaculatory duct is an expanded conical structure, armed with 10 - 12 curved spines each 16μ long (Fig. 14). This conical structure functions as a penis. Male genital pore ventral, unarmed, situated in front of the intestinal bifurcation, about 0.225 mm from the anterior and the circular pore is 52μ in diameter in the type specimen.

Ovary in the form of an inverted 'U', situated on the left side of the median line, in front of the testicular zone. Proximal limb of ovary narrow, distal limb broad, extending up to the middle of the proximal limb and containing a number of large ova, each measuring 24μ in diameter. Oviduct originates from the distal end of the distal limb of the ovary and after uniting with the vitelline duct opens into the ootype. Ootype situated between the testes and ovary and surrounded by 2-3 rows of spherical or oval Mehlis' gland cells. Fertilisation chamber spherical or oval, in the centre of the ootype, with an outer cuticular rim (Fig. 15). Uterus originates from the anterior part of the fertilisation chamber, proceeds parallel to the vas deferens, and reaching beyond the intestinal bifurcation, opens into the unarmed ventral uterine pore situated in front of the male genital pore. Egg spindle shaped (Fig. 16), $225 \times 75\mu$ - $255 \times 90\mu$, with a filament at each pole, anterior filament $300 - 375\mu$ and posterior filament $285 - 375\mu$ in length. Many eggs were observed in most of the specimens examined.

Vaginal pore unarmed, transversely oval $16 \times 36\mu$, dorsomedian (Fig. 17), and situated in front of the intestinal bifurcation. Vaginal duct long, narrow and thin walled, runs parallel to the uterus and opens into the fertilisation chamber (Fig. 15).

Vitellaria co-extensive with the crura and their branches and confluent posteriorly around the intestinal confluence; vitelline follicles spherical, 15 - 20 μ in diameter. Transverse vitelline ducts oblique and converging to the median line in front of the ovary to form the median vitelline duct which in turn opens into the oviduct and gets surrounded by the Mehlis' gland cells. The posterior part of its lumen is filled with vitelline matter around scattered spherical spaces. Genito intestinal canal arises from the left margin of the fertilization chamber and curving obliquely outwards and crossing the ootype, opens into the right intestinal crus (Fig. 15).

Excretory ducts lateral with one pore on each side, situated between the vaginal and male genital pores (Fig. 17).

Discussion

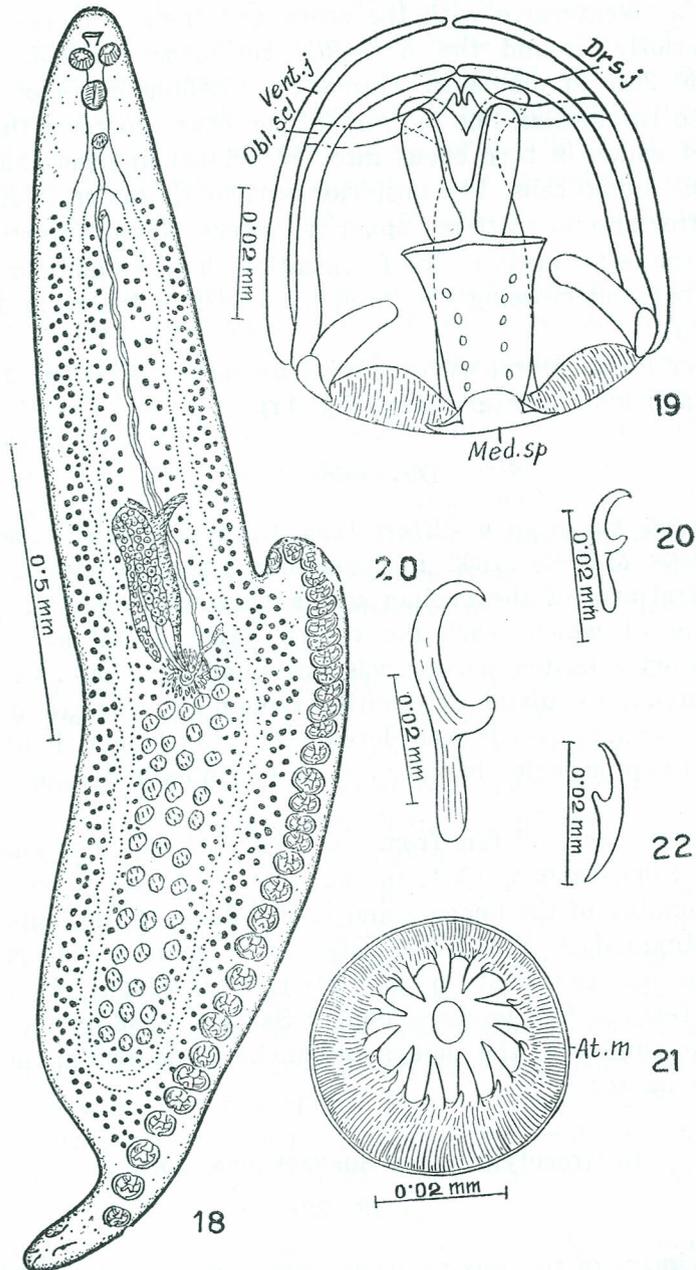
Gastrocotyle kurra sp. n. differs from the type species, *Gastrocotyle trachuri* V. BEN. & HESS., 1863, in possessing, a shorter body with wider clamps; ventral arm of the median spring very wide and doubly forked the distal tips of which reach the ventral jaws, dorsal arm with 'Y' shaped accessory sclerites, oblique sclerites small but stout; ventral jaw proximally broad, its distal extremities remaining separate instead of being united, seminal vesicle well developed, ovary longer, haptoral frill very long and haptor region broader and also anchors and lappet different in shape.

The present species differs from *Gastrocotyle kalla* sp. n. and *Gastrocotyle indica* SUBHAPRADHA, 1951, in the relative extent of the haptoral frill, in the number of the anchors and in the shape of the lappet. It can be easily distinguished from *Gastrocotyle kalla* sp. n. as the crura and vitellaria are not confluent in the latter. *Gastrocotyle kurra* sp. n. differs from *Gastrocotyle japonica* ISHII & SAWADA, 1938, in the shape of the ovary, the number of the clamps and anchors and also in the relative extent of the haptor.

Gastrocotyle indica SUBHAPRADHA, 1951.

(Figs. 18 - 22)

Two specimens of this gastrocotylid species recorded by SUBHAPRADHA in 1951 from the east coast of India were collected from the gills of *Caranx kalla* CUV. & VAL, examined on 7th September 1955, at Ayiramthengu, a marine biological station on the west coast of India, 64 miles north of



Figs. 18 - 22: *Gastrocotyle indica* SUBHAPRADHA, 1951. 18. Complete worm, dorsal view; 19. Clamp, dorsal view; 20. Anchors; 21. Male genital pore with the armatura of spines, ventral view; 22. One spine of the male genital pore.

Trivandrum. The single fish examined was not infected by any other gill trematode.

Measurements

Total length 2.325 - 2.625 mm; width 0.45 - 0.46 mm; haptoral frill 1.275 - 1.305 mm long; terminal lappet $150 \times 50 \mu$; anchors, larger pair 36μ long, smaller pair 16μ long; clamps 32 - 34 in number, $20 \times 48 \mu$ - $60 \times 56 \mu$; pharynx spherical $36 - 40 \mu$ in diameter; oral pouches spherical or oval, $20 \times 28 \mu$ - $24 \times 32 \mu$; oesophagus 0.130 - 0.160 mm long without branches; length of region beyond the haptor 0.93 - 1.25 mm; distance from anterior end to male terminalia 0.21 - 0.22 mm; testicular zone 0.75×0.15 mm - 0.97×0.21 mm, number of spines at the male terminalia 11-12, each spine 20μ long; ovary $300 \times 75 \mu$ - $375 \times 80 \mu$; vitellaria spherical 16μ in diameter; largest ovum 20μ wide; genito intestinal canal present; eggs not observed.

As is evident from the measurements and figures (18 - 22), the specimens of the present collection are not very much different from the type and type series of *Gastrocotyle indica* described by SUBHAPRADHA in 1951. Hence it is considered conspecific with this species. However, it is noteworthy that the present collection was obtained from fishes examined at Ayiramthengu (south west coast of India), while those examined at the other localities did not harbour this species.

Genus *Pseudaxine* PAR. & PER., 1890.

Generic diagnosis emend:

Gastrocotylinae, with the single clamp frill not enclosing the gonadial zones; the clamp row extending as a more or less horizontal frill at the posterior end of the body, with an anchored terminal long and stout lappet; ventral arm of median spring of the clamp not doubly bifurcated; male terminalia armed, resembling *Gastrocotyle*, with a genital corona; vagina single median dorsal and unarmed; ovary inverted 'U' shaped. Parasitic on the gills of marine fishes.

Type species: *Pseudaxine trachuri* PAR. & PER., 1890.

Pseudaxine kurra sp. n.

(Figs. 23 - 32)

Several specimens of this new monogenetic trematode were obtained from the gills of the commonly occurring carangid, *Caranx kurra* CUV. & VAL. examined at Trivandrum on 6th September, 1954, 11th August, 1955

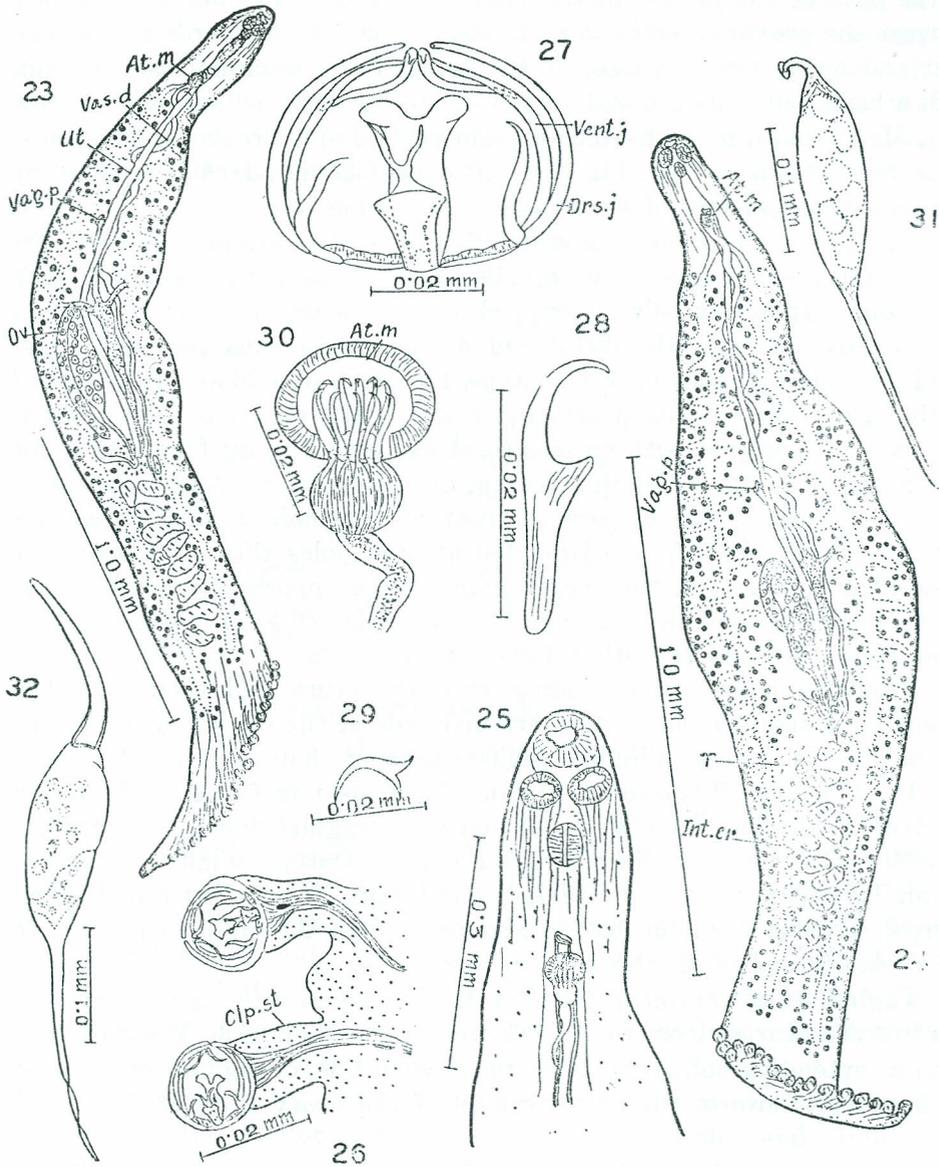
and 18th August, 1955. Several specimens of *Gastrocotyle kurra* sp. n. were also observed on the gill filaments of the host along with this new *Pseudaxine* which is usually observed on the gill rakers. Seven specimens of the host fish varying from 16 to 18 cm in length were examined on 6th September, 1954. Only two of the fishes were infected and a total collection of 25 specimens obtained. This collection includes a major percentage of the gastrocotylid worm. A female fish 20 cm long examined on 11th August, 1955 was infected by only four specimens of the new *Pseudaxine*, all on the gill rakers and not a single specimen of the new *Gastrocotyle* was observed while another female fish 16 cm long examined on 18th August, 1955 was infected by fifteen specimens of *Pseudaxine kurra* sp. n. and only seven specimens of the gastrocotylid worm.

Body 2.82 - 3.2 mm long, maximum width 0.37 - 0.48 mm at the mid ovarian region, tapering towards both ends. Haptoral frill usually on the left side, but occasionally on the right side also (Fig. 23 & 24).

Mouth terminal, funnel shaped and muscular; oral pouches spherical or oval, $20 \times 24 \mu$ - $22 \times 26 \mu$, with ill developed muscle fibres; prepharynx short and conical; pharynx median (Fig. 25), large and oval, $24 \times 32 \mu$ - $30 \times 45 \mu$, with well developed radial muscle fibres on its wall. Oesophagus broad, 0.35 - 0.38 mm in length and bifurcating into the crura at about 0.50 - 0.53 mm from the anterior end. Intestinal crura with numerous short outer and few short intercrural branches, posteriorly terminating independently behind the last testis, the right crus slightly over-reaching the left (Fig. 23 & 24).

Haptor triangular, muscular, typically pseudaxinid, without extensions from body organs, disposed slightly oblique to the long axis of the body, haptoral frill 0.6 - 0.82 mm long and 0.15 - 0.36 mm broad at the base across the body. Terminal lappet $120 \times 40 \mu$, with two pairs of symmetrical anchors, distal pair smaller, each 12μ long with bifid root (Fig. 29); proximal pair typical (Fig. 28), 24μ long. Clamps 15 - 28, arranged in a single row, each measuring $38 \times 20 \mu$ - $52 \times 40 \mu$ and enclosed in a clamp capsule borne on a short peduncle which has axial muscle bundles (Fig. 26). Clamp sclerites typically pseudaxinid, but with specific variations. Dorsal arm of median spring short and wide, with a 'V' shaped cuticular distal process; ventral arm long and wide and distally constricted. Oblique sclerites long and narrow, inner ends almost parallel and touching each other between the distal end of the jaws. Both the jaws including the dorsal arm of the ventral jaw long and narrow (Fig. 27).

Testes 9 - 14, irregularly oval or somewhat rectangular, each $60 \times 75 \mu$ - $75 \times 150 \mu$, broader than long and extending from behind the ootype



Figs. 23 - 32: *Pseudaxine kurra* sp. n. 23. Complete worm, dorsal view; 24. Another complete worm of the same species showing wide variation in shape; 25. Anterior region, dorsal view; 26. Clamps with peduncles; 27. Clamp, dorsal view; 28. Proximal anchor; 29. Distal anchor; 30. Male terminalia, dorsal view 31. Egg; 32. Another egg with both the polar filaments.

to the base of the haptor in the intercrural space. Vas deferens arising between the proximal testes, close to the ootype runs forwards as a zigzag duct and opens into the base of the penis. Penis muscular and conical, with a basal bulb and a distal corona of 10-12 recurved spines each $16\ \mu$ long. Male genital pore unarmed median ventral and circular, with a muscular rim $32-36\ \mu$ wide (Fig. 30), situated 0.35 mm from the anterior end and in the middle of the oesophageal region.

Ovary in the form of an inverted 'U', $75 \times 225\ \mu$, situated on the right side of the median line in the middle third of the body. Proximal limb outer and narrow partially overlapped by the broader distal limb. Oviduct narrow, arising from the distal end of the ovary runs parallel to the vitelline duct and opens into the ootype. Largest ovum $20\ \mu$ wide, observed in the distal half of the ovary and close to the origin of the oviduct. Uterus wide, median, with cuticularised wall and arising from the right border of the ootype, extending ventral to the median vitelline duct, opens into the unarmed uterine pore in front of the male genital pore. Egg spindle shaped, $180 \times 60\ \mu$, filamented at both poles (Fig. 31), opercular filament $20\ \mu$ in length and the filament at the opposite pole $180\ \mu$ long. Another egg observed in a 3.2 mm long worm is $180 \times 75\ \mu$ with one filament $200\ \mu$ long and the other $150\ \mu$ long (Fig. 32).

Vitellaria lateral, co-extending with the crura and their branches except for a small region at the terminal ends of the crura, not confluent behind the testes zone. Vitelline follicles broader than long, $20-40\ \mu$ wide and $10-15\ \mu$ long. Transverse vitelline ducts meet in front of the ovary to form the median duct which receives the vaginal duct and continues parallel to the ovary to open into the ootype. Ootype small, surrounded by an irregular cluster of Mehlis' gland cells. Genito intestinal canal narrow, arising from the ootype and opens into the right crus close to the posterior end of the proximal ovary.

Vaginal pore unarmed, dorsal, with few gland cells and situated in front of the ovarian loop, slightly shifted to the right side. Vaginal ducts narrow, extending obliquely across the median line, opens into the median vitelline duct close to the anterior level of the ovary (Fig. 23 & 24).

Discussion

Pseudaxine kurra sp.n. differs from the type species *Pseudaxine trachuri* PAR. & PER., 1890, in being shorter in size and the male genital pore being anterior to the intestinal bifurcation, armed with only 10-12 recurved spines. No structure identical to the genital corona having an

outer rim of 24 small hooks and 17 larger hooks below it at the end of the vas deferens is observed in the new species. (This structure was not observed in the congeneric Japanese and Plymouth species also. cf. SPROSTON, 1946, p. 464). Unlike in the type species the ovary is on the right side of the median line in the present species. The new species differs from *Pseudaxine indica* CHAUHAN, 1945, in being smaller but with almost the same or greater number of clamps. There are 24 hooks forming the armature of the male terminalia in *Pseudaxine indica* while only 9-12 in this species. Moreover, there are 40 testes and the ovary is in the posterior half in Chauhan's species. *Pseudaxine katsuwonis* ISHII, 1936 and *Pseudaxine vagans* ISHII, 1936, though included under Genus *Pseudaxine*, differ from the new species by the same characters in which they differ from the remaining species of *Pseudaxine*, namely in the presence of lateral vaginae, one on each side near the pharynx. *Pseudaxine mexicana* MESERVE, 1938, though shorter than the new species, has greater number of clamps and the oral pouches are septate whereas in the present species the oral pouches are aseptate though the mouth opening is guarded by a thick rim. Moreover, the relative position and extent of the ovary differ in these two species.

***Churavera macrova* gen. et sp. n.**

(Figs. 33 - 36)

Several specimens of this new monogenoidean were collected from the gills of *Euthynnus affinis* (CANTOR) examined at Trivandrum on several occasions. The type specimen is collected from a female fish examined on 20th November, 1954. Specimens of a new genotype *Homostoma chura* (Hexastomatidae) and *Uraxine chura* UNNITHAN, 1957, (Axi-nidae) were also collected from the host on several occasions, along with the present species. Copepodes were rare and whenever they were present no gill trematodes were observed.

Body lanceolate, total length 3.15 mm, maximum width 0.421 mm at the base of the haptor, left posterior margin fleshy and slightly curved inwards; haptor triangular with terminal lappet; anterior end of body narrow and conical (Fig. 33).

Mouth subterminal, transverse crescentic and surrounded by scattered gland cells. Oral pouches elliptical, $20 \times 12 \mu$ - $24 \times 16 \mu$ with delicate muscle fibres extending backwards. Pharynx median, slightly smaller than the oral pouches, $16 \times 12 \mu$ - $18 \times 14 \mu$. Oesophagus long, narrow and

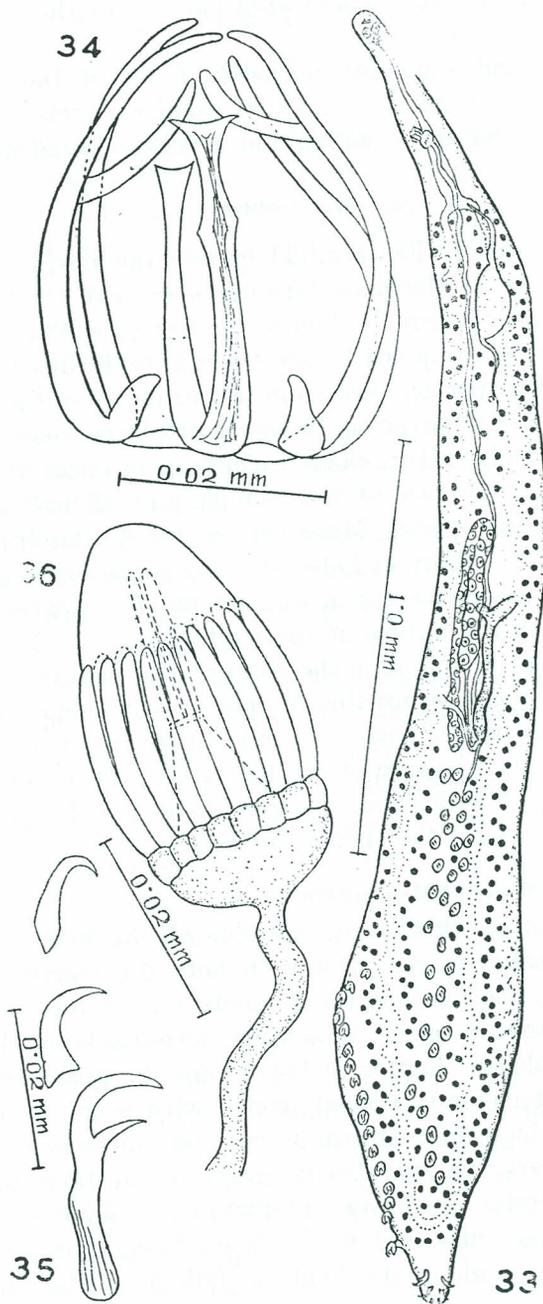
unbranched, bifurcating into the crura with several outer and few inner branches even in the gonadial area, confluent behind the testicular zone.

Haptor unilateral, occupying the right posterior quarter of the body, its margin fleshy and cushion like and anteriorly curved inwards. Clamps $28 \times 20 \mu$ - $32 \times 24 \mu$, arranged in a single row, pedunculate and typically gastrocotylid except that the arms of the median spring are more or less equal in length and development (Fig. 34). A loose flange of tissue is observed along with the frill. Terminal lappet muscular and large compared with the size of the body, armed with three pairs of symmetrical anchors (Fig. 35): proximal $35 - 40 \mu$ long, with a double blade and long root, median 12μ long and distal 15μ long. The distal and median anchors are simple and curved.

Testes small, numerous, in 2-3 longitudinal intercrural postovarian rows extending to the anterior level of the crural confluence. Vas deferens arising from the anterior margin of the testes zone runs forwards along the median line and opens into the ejaculatory bulb. The anterior part of the vas deferens, immediately behind the ejaculatory bulb, is slightly wavy thick walled and muscular, this portion representing the ductus ejaculatorius. The ejaculatory bulb is fleshy and hemispherical, above it is a hollow conical structure with a flanged fleshy basal margin of which is continuous with the margin of the ejaculatory bulb. This fleshy margin carries 15-18 cuticular spines, each about 20μ long. The apex of the conical structure is surmounted by a forceps like semicircularised process, apparently forming the forcepiform penis (Fig. 36), which projects out more or less midway between the pharynx and intestinal bifurcation, slightly shifted to the right side.

Ovary in the form of an inverted 'U' is situated on the right side of the median line, in the middle third of the body. Proximal part of outer limb slightly expanded, inner limb two-third as long as the outer. Oviduct originates as a continuation of the distal end of the ovary and opens into the ootype close to the vitelline duct. Uterus median ventral and visible up to the anterior limit of the middle third of the body. Egg large, spindle shaped, $189 \times 186 \mu$, anterior filament 168μ long and posterior filament 210μ long. In all the specimens examined, this large solitary egg was always observed in the posterior half of the anterior third of the worm (Fig. 33).

Vitellaria co-extending with the crura and their branches and confluent posteriorly. Testes covered over by intercrural vitellaria. Transverse vitelline ducts short, meeting at the middle of the ovary to form



Figs. 33-36: *Churavera macrova* gen. et sp. n. 33. Complete worm, ventral view; 34. Clamp, ventral view; 35. Anchors; 36. Male terminalia with the forcepiform penis.

the median duct which runs backwards parallel to the ovary and opens into the ootype.

Ootype small and spherical, placed in front of the testes, close to the proximal ovary. A genito intestinal canal connects the ootype with the right crus. Vagina not observed and a vaginal canal not traced.

Discussion

In the structure of the terminal lappet, the position of the testes and in the structure of the male terminalia (except for the forcepiform process) this species resembles genus *Gastrocotyle* VAN BEN. & HESS., 1863. However, the clamp structure though typically gastrocotylid, is well different in this species, more so in the structure of the median spring and the distal ends of the jaws. In *Gastrocotyle* the median spring has double bifurcated ends and its dorsal arm may have an appendix. In the present species the structure is more simple and without additional sclerites except the oblique pieces. Moreover, in this species the anchors have double blade and the haptor includes only the posterior half of the testes zone. The only notable character in which genus *Pseudaxine* resembles the present species is in the nature of the haptor.

The new species is unique in the absence of a vagina and the peculiar disposition of the male terminalia. It has close resemblance to the two genera *Gastrocotyle* and *Pseudaxine* but cannot be included under any of them and hence the creation of the new genus *Churavera* with *Churavera macrova* as the type species. The generic name refers to the Malayalam name of the host and the specific name signifies the large sized egg.

Generic diagnosis of *Churavera* gen. n.

Gastrocotylinae in which only one side of the haptor is developed, clamps, simple, small, gastrocotylid with only the oblique sclerites and no other accessory sclerites nor an appendix for the median spring; rib like thickenings absent in the clamp capsule; terminal lappet large, anchors may have double blades; haptor includes only the posterior half of the testes zone; male terminalia (penis) armed with a corona of hooks and a large ejaculatory bulb, forcepiform process may be present on the penis; egg large and solitary; vagina absent; ovary in the form of an inverted 'U', pretesticular; testes numerous, intercrural; vitelline follicles broader than long; intestinal crura and vitellaria confluent posteriorly. A loose flange of skin present along the haptoral frill. Parasitic on the gills of marine fishes.

Type species: *Churavera macrova* gen. et sp. n.

Eyelavera typica gen. et sp. n.

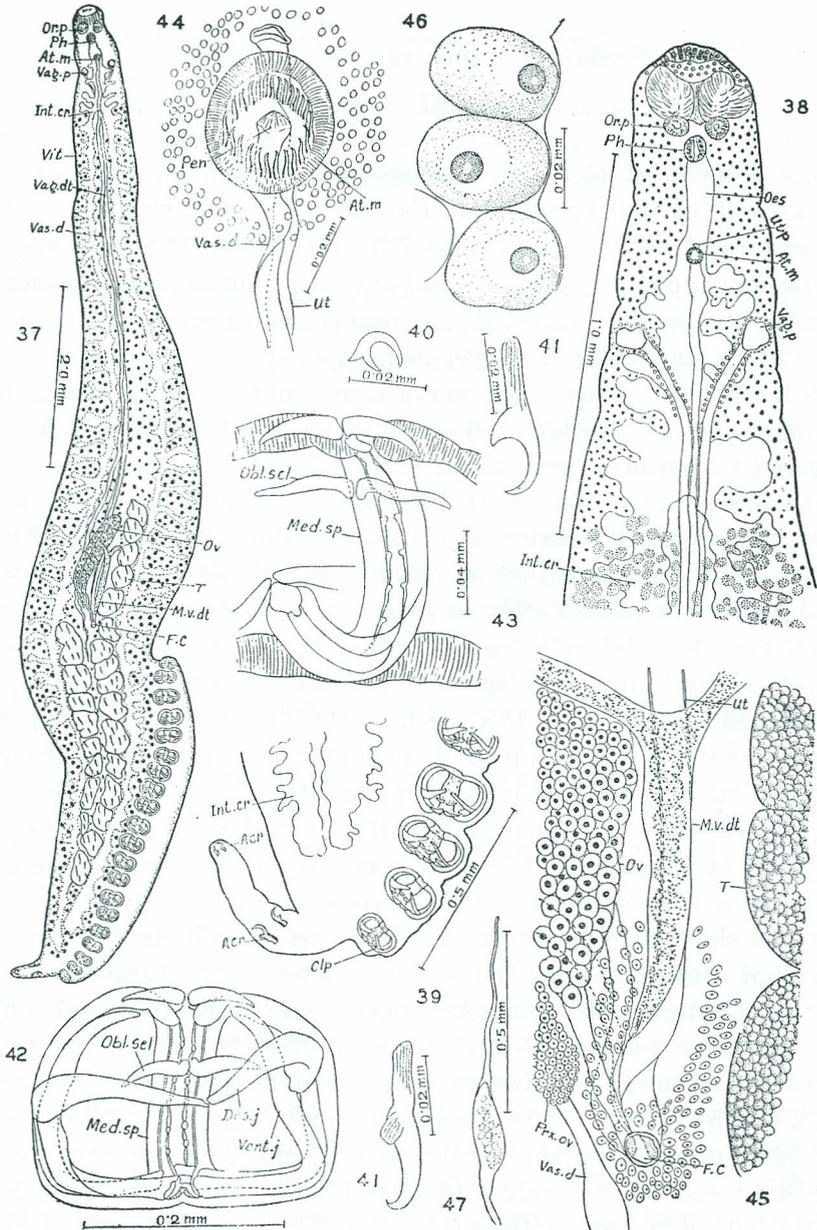
(Figs. 37 - 47)

Five specimens of this new monogenetic trematode were obtained from the gills of a single female fish, *Rastrelliger kanagurta* (CUV.) 23/19 cm long examined at Trivandrum on 7th May, 1956. The fish was not infected by any other gill parasite and the secretion of mucus observed on the gills of the host infected by mazocraeid species was also not observed in this particular fish specimen.

Body lanceolate, anterior end narrow and rounded; total length 8.9 - 11.5 mm and maximum width 1.6 - 3.1 mm at the level of the ovary; posterior end with wormiform lappet (Fig. 37).

Mouth subterminal, wide, funnel shaped, surrounded by a well developed bilobed sucker like region $150 \times 255 \mu$ - $150 \times 300 \mu$, with thickly arranged radial muscle fibres on its outer wall and closely packed groups of preoral gland cells immediately in front. Oral pouches spherical or oval $50 \times 75 \mu$ - $60 \times 75 \mu$, laterally superimposed on the posterior margin of the bilobed 'sucker' like area surrounding the mouth cavity. Pharynx median oval, $60 \times 50 \mu$ - $75 \times 45 \mu$, with scattered gland cells on its wall. Oesophagus 0.85 mm - 0.9 mm long, its anterior one third in front of the male genital pore is narrow and unbranched, hinder portion broad and thin walled with a number of sac like lateral branches, bifurcates into the crura at about 1.12 - 1.20 mm from the anterior end of the body (Fig. 38). Crura with numerous outer branches, some of which rebranch and very few short stumpy intercrural branches, terminate close to each other, but not confluent, near the proximal level of the terminal lappet.

Haptor unilateral frill, extending nearly one third the total length along the posterior margin, 3.5 - 4.1 mm long, slightly oblique and reaching to about the proximal ovarian zone, with a single row of 19 - 21 clamps, $120 \times 75 \mu$ - $240 \times 150 \mu$. Terminal lappet (Fig. 39) 0.3 mm \times 0.07 mm — 0.525 mm \times 0.150 mm, extending as a short narrow stumpy tail from the hind end of the body and armed with two pairs of anchors. Distal pair 0.02 mm long with bifid roots (Fig. 40) and curved body, proximal pair typically sickle shaped (Fig. 41), 0.04 mm long, with a short peg like projection at about its middle. Both anchors are surrounded by scattered gland cells and strong muscle fibres extend from their roots to the body of the lappet. The tips of the distal anchors are usually directed towards the median line while those of the proximal anchors



Figs. 37+47: *Eyelavera typica* gen. et sp. n. 37. Complete worm, dorsal view; 38. Anterior region, dorsal view; 39. Hind end of haptor with the anchored lappet; 40. Distal anchor; 41. Proximal anchor; 42. Clamp, dorsal view; 43. Median spring of the clamp with oblique sclerites; 44. Male terminalia with penis and male genital pore and the unarmed uterine pore, ventral view; 45. Ootype region, ventral view; 46. Ova in the ovary; 47. Egg.

are directed outwards. Clamps (Fig. 42) gastrocotylid, with the oblique additional sclerites, jaw sclerites comparatively broad and surrounded by a well developed clamp capsule, the fleshy dorsal and ventral lips of which contain scattered gland cells. Muscle fibres from the wall of the capsule are attached to the oblique sclerites; ventral jaw with a well cuticularised dorsal process which is very broad at its proximal end and narrow at the distal end; dorsal jaw broad, proximal part parallel to the base of the clamp capsule while the distal part is slightly detached and oblique; oblique sclerites short and conical with their bases touching each other in the median line; median spring very broad (Fig. 43) with two rows of apertures for the attachment of muscles, its dorsal arm very short. The 'Y' shaped notches at the median spring extremities, noticed in *Gastrocotyle* are absent in this species. The clamps at the extreme ends are smaller than the middle ones.

Testes 21 - 26, oval or squarish, $150 \times 150 \mu$ - $255 \times 300 \mu$, arranged in two unequal longitudinal intercrural rows extending from the proximal level of the ovary to the anterior two third of the haptoral field, left row shorter with 7 - 9 postovarian testes, right row longer with 7 - 9 postovarian and 4 - 6 parovarian testes extending parallel to the right side of the ovary and reaching up to its anterior level. Vas deferens originates from the anterior testes groups and extends forwards in the median field. Immediately in front of the left row of testes, the vas deferens enlarges into a spindle shaped seminal vesicle, $225 - 375 \mu \times 50 - 90 \mu$. Beyond this it continues as a narrow median duct which in front of the intestinal bifurcation forms the ejaculatory duct opening into the penis. The penis is conical, armed with 24 - 26 cuticular hooks (Fig. 44). Male genital pore large, circular and ventral, 20 - 24 μ in diameter, situated 0.5 - 0.55 mm from the anterior end of the body and surrounded by scattered groups of prostate cells which occur more on the two sides than in front and behind.

Ovary in the form of an inverted 'U', 0.97 mm \times 0.22 mm — 1.20 mm \times 0.30 mm and situated immediately in front of the zone of testes, with a narrow outer proximal limb and wide inner distal limb which contains large ova (Fig. 46). Oviduct arises from the distal end of the ovary, extends backwards and opens into the fertilisation chamber which is a clearly demarkated spherical area, 20 - 24 μ in diameter, with slightly cuticularised outer lining and situated in the posterior region of the ootype (Fig. 45). Uterus wide, arises from the anterior margin of the fertilisation chamber, runs forwards along the median ventral line and opens into the unarmed ventral uterine pore situated immediately in front

of the male genital pore. Eggs large spindle shaped, with cuticularised walls, $225 \times 75 \mu$, operculum 75μ long and 75μ broad, filament at the opercular pole 105μ long and that at the opposite pole 450μ long (Fig. 47).

Vaginal pores two, dorsolateral, unarmed (Fig. 38), circular, 75μ in diameter, with an irregular rim, one on each side of the body behind the median male genital pore and $0.67-0.68$ mm from the anterior end of the body. The two vaginal apertures are surrounded by a row of gland cells which is continued backwards along the two sides of the two narrow vaginal ducts. The two vaginal ducts unite in front of the ovary to form a single long median vaginal duct which runs backwards dorsally parallel to the vitelline duct and opens into the anterior part of the fertilisation chamber.

Vitellaria extend from the level of intestinal bifurcation to the distal ends of the crura and their branches, posteriorly not confluent across the median line; follicles spherical, 45μ in diameter. Transverse vitelline ducts originate from different levels, the left being further forwards than the right. They meet together near the middle of the ovary to form a wide median vitelline duct which narrows posteriorly and opens into the fertilisation chamber.

Ootype pear shaped, situated between the distal end of the ovarian loop and left row of testes. It is surrounded by scattered Mehlis' gland cells which are more concentrated at the hind end of the ootype especially around the fertilisation chamber (Fig. 45). Genito intestinal canal short and broad, arises from the right margin of the fertilisation chamber, runs obliquely to the right side across the ovarian zone and opens into the right intestinal crus.

Discussion

In possessing an asymmetrical haptor, this species comes under the subfamily Gastrocotylinae which includes genera, *Gastrocotyle*, *Pseudaxine* and *Churavera* described above. The present species shows marked differences from these three genera to confirm its new generic status. The haptoral frill though unilateral as in *Gastrocotyle*, is more oblique than parallel and does not include the testicular field completely. Unlike in *Pseudaxine* the haptoral frill here extends to almost near the level, or one or two testes behind the proximal end of the ovary. The short oblique sclerites and the wide median spring with its short dorsal arm and spaces for attachment of muscles along the ventral arm are characteristic of the new species, resembling its nearest relative *Uraxine chura* UNNITHAN,

1957, (Axinidae) except for the additional oblique sclerites. The clamp structure of this new species is highly characteristic in the over development and cuticularisation of sclerites, with the fleshy well developed clamp capsule surrounding them. The long terminal lappet is at the posterior end of the body and not lateral. The presence of two lateral vaginal pores and 4 - 6 parovarian testes, overlapping ovarian zone, widely separates the new species from all the other genera included in the subfamily. Hence the new genus *Eyelavera* has been created to accommodate this new species. The generic name *Eyelavera* refers to the Malayalam name of the host inhabited by the worm.

Generic diagnosis of *Eyelavera* gen. n.

Gastrocotylinae, with a unilateral nearly oblique haptoral frill, at the posterior third of the body, with a single row of gastrocotylid clamps, overlapping a part of the testicular field; clamps heavily cuticularised and with fleshy lips for the capsule, oblique sclerites short, median spring with broad ventral arm and vestegial dorsal arm; vaginal pores two, dorsal and unarmed, situated in the oesophageal zone, laterally behind the male genital pore; testes mainly postovarian, with few parovarian testes; male genital pore median ventral and circular situated in front of the vaginal pores; penis muscular and armed with 24 - 26 hooks; intestinal crura with long ramifying outer branches, crural ends and vitellaria not confluent across the median line. Parasitic on the gills of marine fishes.

Type species: *Eyelavera typica* gen. et sp. n.

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