

XVIII NEW CESTODES FROM INDIAN
FISHES.

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(Plates ix—x.)

- I.—PROSTHECOBOTHRIUM UROGYMNI, n. sp.
II.—BALANOBOTHRIUM TENAX, n. gen. et sp.
III.—TETRARHYNCHUS ANNANDALEI, n. sp.

(I). PROSTHECOBOTHRIUM UROGYMNI, n. sp.

(Pl. ix, figs. 1—3).

Two specimens of this fine cestode were obtained from the spiral valve of a male *Urogymnus asperrimus* (Bl. Schn.), trawled in 9 fathoms on the north end of the Periya Par, one of the Ceylon Pearl Banks in the Gulf of Manaar, February 1908.

When alive the larger of the two measured 25 cm. in length, shortening to 14 cm. at death. The species is closely related to *P. dujardini* (van Beneden); differing therefrom chiefly in its much greater size, the great elongation of the neck and the superior development of the suckorial loculi of the bothridia.

The scolex is furnished with four elongated sessile bothridia. Each is sub-lanceolate in outline, divided into three distinct loculi by two transverse muscular costæ. The most anterior loculus is considerably the longer being equal to the combined length of the two posterior ones. In life the mobile edges of the bothrium curve inwards and all three loculi are distinctly seen as deep sucker-like cavities; in this latter characteristic the present species exhibits a marked divergence from Diesing's type of the genus where the bothridia are described as undivided, each having a suckorial appendage at its posterior extremity. Johnston's description of the same species (*P. dujardini*) necessitates a modification of the original generic diagnosis as he describes each bothrium as "really divided into three loculi by two transverse curved costæ," adding, however, that the most anterior loculus "is not apparently concave." The distal portion of each bothrium possesses a tongue-like mobility enabling it to twist and turn in search of a new holding when the living worm is dislodged from its attachment within the host's intestine. The tips of the bothridia may then be seen projecting prominently and at a considerable angle from the neck.

In anterior view the scolex appears sub-quadrangular, the thickened anterior extremities of the bothridia forming the four angles; as seen in figure 2 the bothridia extend some distance towards the centre of the "head," by their slight prominence forming a distinct cruciform depression upon the apical surface. The thickened anterior extremity of each bothrium bears a pair of double hooks; each consists of two sub-equal slightly curved long and slender prongs fused together by their bases. The curve in each prong is double—a light divergent curve from its fellow and a somewhat abrupt or right-angled curve on the under side whereby its holding power in attachment is increased. The acute-angled apex of the base of each double hook is approximated to that of its fellow in the same pair. The prongs project considerably and overhang slightly the anterior margin of the proximal bothridial loculi. In colour the hooks are dark brown and in appearance are chitinous. No accessory suckers or acetabula are present, thus differentiating this genus from the otherwise closely allied *Calliobothrium*.

The neck is very long and slender; about 0.4 mm. broad. The proglottides are extremely numerous and always markedly broader than their length. The width of the great majority, 0.75 to 0.9 mm., is characteristically almost twice as great as the length; a few at the posterior extremity as they ripen become somewhat more elongate and narrower. The lateral edge of the proglottides is slightly curved, the posterior margin very slightly produced and overlapping the front edge of the next succeeding. The genital pores are lateral. The general appearance and proportions of the strobila thus approximate closely to what is seen in *P. trygonis*, Shipley and Hornell.

It is noteworthy that the stomach contents of the host which yielded this cestode consisted (with the exception of a fragment of a Nemertine) of a great mass of one or more species of *Amphioxus*; there were hundreds of individuals in the mass. Other parasites present were *Tylocephalum uarnak*, Shipley and Hornell, in great numbers, a single specimen of *Tetrarhynchus ætobatides*, and numerous individuals of an undetermined Nematode.

The dimensions of the host were:—

Length of body to base of tail	3 ft. 1 in.
Breadth of disc	3 ft. 0 in.
Length of tail	1 ft. 8 in.

The diagnosis of *P. urogymni*, n. sp., is as follows:—Long slender cestode. Head elongated, twice as long as broad, armed with four large sessile, elongated and regularly disposed bothridia, each sub-lanceolate and trilocular with mobile edges and posterior tip; anterior extremity of each bothrium tumid, armed with a pair of double dark brown chitinous hooks. Prongs of each hook slender, equal, curved in two planes, the tips projecting beyond the anterior margin of the proximal loculus.

Neck very long and slender, proglottides very numerous, lateral margins lightly curved, posterior slightly overlapping, usually twice as broad as long, except a few of the most posterior. Length when alive up to 25 cm. Breadth of head under 1 mm.; of typical proglottides, 0.75 to 0.9 mm.

Habitat:—The large intestine of *Urogymnus asperrimus* (Bl. Schn.).

The characteristics of the genus *Prosthecobothrium* may now be amended as follows:—

Scolex with four elongated sessile bothridia divided by transverse costæ into three loculi; no accessory suckers on the anterior margins of the bothridia; a pair of double hooks on the anterior margin of each bothrium.

BALANOBOTHRIMUM, n. gen.

Scolex acorn-shaped, consisting of a bulbous head surrounded at the base by a cup-shaped mobile membranous collar; a pair of very minute two-pronged uncini situated at four equidistant points on the upper circumference of the head, a minute acetabulum above each pair of uncini. Neck extremely short. Strobila ligulate, the proglottides short and wide.

(2). BALANOBOTHRIMUM TENAX, n. sp.

(Pl. ix, figs. 4-6 and 8-10, and x, figs. 7, 11, 12).

This species has been found on two occasions in Indian seas, the first in 1905, when I found several small and immature ones attached to the spiral valve of a *Stegostoma tigrinum* (Gmel.) trawled on the Ceylon Pearl Banks; the second, in the intestine of an individual of the same host trawled in the Bay of Bengal by the Bengal Government Fishery Steamer "Golden Crown." Those obtained by the "Golden Crown" are much the larger and appear to have reached full development. In the dead condition they attain a length of 32 to 33 cm., three of the five specimens being within this range; the other two are shorter, 18 cm. and 21 cm. respectively. Two of the largest are headless. The scolex consists of a bulbous sub-conical head contracted suddenly at the base to a very short and slender stalk from which a delicate membranous upturned cup-shaped collar is given off. In life the bulbous region of the scolex is wholly embedded within a sac-like diverticulum of the surface membranes of the host's intestine. This diverticulum hangs freely within the cavity of the intestine, its base greatly constricted. The os of its free end is minute and encircles closely the constricted base of the parasite's head bulb. In this way the head of the cestode is so firmly held that in removing the worm it is impossible to withdraw it uninjured from the sac and it becomes necessary to tear or cut away the sac at its junction with the intestine. In life the wide collar below the base of the head bulb functions as a suctorial bothrium, enfolding

and clasping the wall of the distal half of the intestinal diverticulum, so that a double purchase is assured—the diverticulum enveloping the parasite's head and the collar of the latter in turn enfolding the distal half of the hollow intestinal outgrowth (pl. x, fig. 11).

When freed from its adventitious envelope, the head is seen to be capable of considerable change of form and it is probable that by its alternate elongation and contraction it functions as a burrowing or penetrating organ, aided by the suckorial action of the bothridial cup which simultaneously anchors the worm securely in position. To supply the means of contraction well-marked muscle fibres pass from the constricted stalk and spread out over the walls of the head. The musculature of the encircling bothrium is weak, but radial and circular fibres appear to be present.

The head is armed in a peculiar manner with four pairs of minute two-pronged hooks situated at four equidistant points well anterior to its widest circumference. In the small and immature specimens obtained in Ceylon the two prongs of each hook are unequal and strongly recurved and rise from a common horizontal base, the larger from one extremity, the smaller from midway between the two ends. Opposite the base of the larger spine is a minute blunt spur-like process. In the large and fully adult specimens from the "Golden Crown" the common basal bar is stouter and wider and no "spur" is to be seen. So minute are these uncini that they cannot be seen until the head be mounted and examined microscopically and then a $\frac{1}{8}$ th-inch objective is required to see the structure clearly. A low fleshy ridge runs backwards from the insertion of each pair of uncini, while immediately anterior to the interspace between the members of each pair is a minute acetabulum (pl. ix, fig. 8).

No definite neck region is present. Closely set grooves of incipient segmentation are apparent immediately behind the scolex; they gradually become more and more definite till the segments appear as distinct proglottides. These attain a maximum breadth of 4 mm. anterior to the terminal chain of ripening proglottides; in this region the length of each proglottis is approximately 0.8 mm. The mean breadth of a proglottis in the second and third quarters of the body may be stated at from five to six times that of its length.

The breadth of the strobila increases very gradually and with perfect regularity from 1.3 mm. in the anterior region to 4 mm. which it attains at the region where the proglottides begin to show a change of form, owing to the development of the gonads, about 3 cm. from the posterior extremity in the largest individuals examined. Thereafter the proglottides tend to decrease in width and become more elongate, but in none does the length become equal to the breadth. The ovaries are large and coarsely lobulated, arranged as a rosette of radially disposed pear-shaped lobes in the centre of the proglottis.

The genital apertures are lateral and placed well forward towards the anterior margin; the disposition is very irregularly alternate in series, that is, those pertaining to a number of consecutive proglottides, from two to six in number, may all open on the same side, to be succeeded by a number which open consecutively on the opposite side.

Both surfaces of the strobila are closely marked by transverse striæ; the lateral margins are almost straight, and there is no overlapping; sometimes the posterior lateral margin may be slightly salient and pointed.

The diagnosis of this species is as follows:—

Scolex consisting of a bulbous sub-conical head encircled at the base by a cup-like bothridial collar. Four pairs of minute two-pronged uncini disposed at equal intervals around the circumference of the head-bulb; the prongs are sharply bent at mid-length and borne upon a common horizontal bar; in young specimens a spur-shaped projection occurs opposite the base of the outer and longer prong.

No definite neck. Strobila ligulate, long and stout, 33 cm. in dead condition. Narrow at anterior end, 1.3 mm., increasing slowly and uniformly in width till it attains 4 mm. in front of the region of ripening proglottides.

Proglottides short, five to six times broader than long in the wide region posterior to mid-length; ripe proglottides characteristically short and length never greater than breadth. Grooves of segmentation apparent immediately behind bothridial collar. Cuticle striated transversely with minute furrows.

Ovaries arranged centrally in a rosette of large pear-shaped lobules. Genital pores lateral, opening well forward and anterior to mid-length; disposition irregular, in alternate consecutive series of from 2 to 6 on the same side.

Habitat:—The large intestine of *Stegostoma tigrinum* (Gmel.), Bay of Bengal and Gulf of Manaar.

The *type* specimens of this species are deposited in the Indian Museum, Calcutta, No. ZEV ⁴⁸²⁸/₇.

(3). TETRARHYNCHUS ANNANDALEI, n. sp.

(Pl. x, figs. 13-15a).

Associated with the specimens of *Balanobothrium tenax*, n. sp., described above from the gut of *Stegostoma tigrinum* (Gmel.) were two mature Tetrarhynchids. These both measure 3.6 cm. in length (dead).

The head or scolex is well proportioned and about 8 mm. long. Anteriorly it has two well-developed simple bothridia of lappet form, 2 mm. in length by 1.6 mm. in breadth. They are somewhat fleshy in appearance, the border thickened and elevated and slightly emarginate on the posterior edge. Behind the bothridia, the head becomes slender, cylindrical and neck-like, 0.7 mm. wide;

this section is slightly longer than the bothridia. In this region the proboscival tubules are seen in a prepared specimen to be long and closely coiled, predicating considerable length of the proboscides when extended (they are almost entirely withdrawn in both specimens examined). The posterior region of the head, containing the contractile proboscival sacs, is characterized by its great relative length which equals the combined lengths of the bothridial and duct regions. It is also slightly wider. The four muscular sacs occupy the whole of this posterior head region; the fibres in their walls are arranged as usual in two sets crossing each other obliquely but in these species the criss-cross appearance so produced is particularly distinct and well marked.

Each of the four proboscides emerges from the summit of a minute perforated papilla situated near the anterior bothridial margin. Each bothrium bears two of these papillæ, separated from one another by a considerable interval.

None of the proboscides was sufficiently everted to enable the arrangement of the hooks to be clearly made out. The majority of them are of a sabre-like curve, distinctly stout and apparently laterally flattened. All are not of the same size, and there appears to be a certain variation in the proportions of these spines, some being shorter and more slender. A few extremely minute sharply curved stout hooks, strongly beaked, and with a large base (pl. x, fig. 15a) are also present.

Immediately posterior to the contractile bulbs the worm increases abruptly though slightly in diameter to form a stout cylindrical neck; its surface is wrinkled transversely by a few irregular weak groovings. Its diameter is greatest anteriorly, gradually narrowing till it merges at a distance of one and a half its greatest diameter into the regularly segmented anterior region of the strobila. At first the segments are wider than long and the lines of division difficult to see; after the fifth they become square in lateral view and then gradually increase in length till they attain a length of twice their width. No overlapping occurs and the lateral margins are parallel except in those where the genital pore is developed.

The proglottides number about 25. The last seven are remarkable for the enormous development of the genital pore, in this closely agreeing with *T. macroporus*, Shipley and Hornell, which appears to be a closely allied species. In the present species, the pore is guarded by two great salient tumid lips. In all cases the pores are lateral, but their arrangement is very irregular. In the individual figured (pl. x, fig. 13), of the seven maturing segments, wherein pores are present, we have first one segment (the most anterior of the set) where the pore is on the right side as figured; in the three next succeeding the three pores follow each other consecutively on the opposite side (left) while in the terminal three proglottides, there is again a group of three pores following each other consecutively but this time it is on the right side, giving a formula of R 1, L 3, R 3.

The following measurements are from a specimen preserved in alcohol:—

	Millimetres.
Extreme length	36·00
Length of scolex without neck	8·00
Length of bothridia	2·00
Breadth do.	1·60
Length of region of coiled proboscis sheaths	2·00
Breadth do do	0·70
Length of contractile bulbs	3·80
Breadth of this region.	1·00
Length of neck	1·75
Breadth of neck at anterior end	1·25
Do. posterior end	1·00
Length of a mature proglottis	1·75 to 2·00
Breadth do. including genital eminence	1·20

This Tetrarhynchid is closely allied to *T tenuicolle*, Rudolphi, and to *T macroporus*, Shipley and Hornell. From the former it is sharply divergent in the much greater length of the contractile proboscoidal bulbs, while from the latter it is equally sharply marked off by the form of the bothridia which is simple and entire in *T annandalei*, whereas in *T macroporus* each is divided into halves. The proboscis hooks in the latter appear also to be shorter and stouter and it is stated that there is practically no neck. In both the latter species the relative proportions of the two regions of the head are nearly the same and there is also approximation in the number and general form of the proglottides and in the great prominence of the lips of the genital pore.

Diagnosis of *T annandalei*:—

Length 3·6 cm. Head cylindrical, and fairly long, about 8 mm. Bothridia two, lateral, longer than broad, slightly emarginate on the posterior edge and with a raised and thickened margin. Proboscides four, long, and strongly armed with curved hooks, the majority long and sabre-shaped, fairly stout; a small number of very minute recurved forms with elongated base also present.

The proboscis sheaths long and arranged in closely set spirals; this region of the head including with it the part overlaid by the bothridia is about equal in length to the posterior section containing the contractile sacs. *The latter region is characteristically of great relative elongation* and is slightly wider than the anterior head region. The sacs are cylindrical, with the oblique decussation of the muscle fibres well marked. Neck short, one and a half times as long as wide; greatest breadth seen in this worm occurs in the anterior part which increases in width abruptly immediately behind the contractile sacs. Neck wrinkled slightly transversely.

Proglottides about 25. Anteriorly they are wider than long, but soon become square and then rapidly elongate and in the matur-

ing ones length is twice the breadth. The lateral margin parallel, and none of the proglottides overlap. Cuticle sometimes faintly ringed but this may be a *post mortem* effect.

Last five or six proglottides remarkable for enormous development and prominence of the genital pore. This is lateral and situated at beginning of posterior third of the marginal length of each proglottis. Position of the pores are alternate in consecutive groups, usually in alternate series of 3, *e.g.*, right 1, left 3, right 3.

Habitat:—Intestine of *Stegostoma tigrinum* (Gmel.), Bay of Bengal.

Type specimen in the Indian Museum, Calcutta, No. ZEV $\frac{5920}{7}$.

I have pleasure in naming this elegant form after Dr. Annandale who has done so much to extend our knowledge of Indian Marine Zoology.

