

# *Acta Medica Okayama*

---

*Volume 8, Issue 4*

1952

*Article 3*

MARCH 1954

---

## Parasitic Worms mainly from Celebes. Part 6. Cestodes of Fishes

Satyu Yamaguti\*

\*Okayama University,

Copyright ©1999 OKAYAMA UNIVERSITY MEDICAL SCHOOL. All rights reserved.

# Parasitic Worms mainly from Celebes. Part 6. Cestodes of Fishes\*

Satyu Yamaguti

## Abstract

Onchobothriidae Braun, 1900 1. *Balanobothrium tenax* Hornell, 1912 2. *Balanobothrium stegostomatis* n. sp. 3. *Phoreiobothrium* sp. Hornelliellidae n. fam. 4. *Hornelliella annandalei* (Hornell, 1912) n. g. Austramphilinidae Johnston, 1931 5. *Gyrometra albotaenia* n. g., n. sp.

## PARASITIC WORMS MAINLY FROM CELEBES

### Part 6. Cestodes of Fishes

With 2 Plates

By

Prof. Satyu Yamaguti

(Department of Parasitology, Okayama University Medical School)

*Received for publication on 22 April 1953*

---

#### Contents

Onchobothriidae Braun, 1900	353
1. <i>Balanobothrium tenax</i> Hornell, 1912	353
2. <i>Balanobothrium stegostomatis</i> n. sp.	357
3. <i>Phoreiobothrium</i> sp.	360
Hornelliellidae n. fam.	362
4. <i>Hornelliella annandalei</i> (Hornell, 1912) n. g.	362
Austramphilinidae Johnston, 1931	367
5. <i>Gyrometra albotaenia</i> n. g., n. sp.	367
Literature	374
Explanation of Plates	374
Abbreviations used in Figures	374

---

#### ONCHOBOTHRIIDAE Braun, 1900

1. *Balanobothrium tenax* Hornell, 1900  
Pl. I, Figs. 1-4.

Habitat and locality. Large intestine of *Stegostoma tigrinum*; Macassar.

Material. A single gravid specimen, fixed in acetic sublimate under cover glass pressure, stained and mounted in toto, and transverse and sagittal sections.

Length about 130 mm, maximum breadth 5 mm. Strobila comprising over 300 segments, increasing in breadth toward gravid proglottides but decreasing again toward endproglottides. Scolex bulbous, 2.0 mm long by 2.8 mm broad; suckers 70  $\mu$  in diameter, not muscular enough to be a sucking organ, apparently emarginate

posteriorly, equidistant from each other near apex ; paired hooks immediately posterior to suckers, each with two sharp-pointed prongs ; anterior prong slightly larger than posterior prong, curved at nearly right angles, measuring  $30\ \mu$  lineally from tip of anterior prong to inner end of its base, posterior prong measuring  $27\ \mu$  in the same way, curved more strongly than anterior prong. Behind the hooks there is a horseshoe-shaped elevation  $0.25\ \text{mm}$  in diameter with a circular depression at the center of its closed anterior end. Collar  $1.25\ \text{mm}$  long, turned over backwardly to encircle the constricted anterior portion of the neck which is  $0.8\ \text{mm}$  broad. Posterior to the collar the neck widens out to a flattened cylindrical portion which is  $1.75\ \text{mm}$  broad and passes imperceptibly into the segmented portion. Anterior proglottides crowded, with transverse wrinkles ; mature proglottides  $0.4-0.6\ \text{mm}$  long,  $3-4\ \text{mm}$  broad, with nearly parallel, more or less corrugated sides, slightly imbricated at posterior margin ; gravid proglottides  $1.0-1.9\ \text{mm}$  long by  $3-5\ \text{mm}$  broad, with convex sides when fully gravid.

Cuticle moderately thick, finely corrugated. Of the subcuticular musculature the outer circular and the inner longitudinal fibers form each a thin but distinct layer. Inner longitudinal muscle sheath forming a very thick layer, internal bundles consisting of several to a dozen fibers, external fibers isolated individually but forming a continuous layer in surface view. The well developed oblique fibers described by Southwell as running between the bundles are delicate parenchymatous muscle fibers coming from the medulla and can be observed on sections alone. There is no definite layer of transverse musculature inside the inner longitudinal muscle sheath, although the medullary parenchymatous fibers may be pressed against the muscle sheath by the gravid uterus and may thus form a distinct layer.

Dorsal and ventral excretory stems running along outskirts of testes with cirrus pouch and vagina between, the dorsal stems are only  $5-6\ \mu$  wide but the ventral are very wide ( $0.12-0.37\ \text{mm}$ ), especially in the endproglottides. There is no transverse anastomosis. Nerve trunk running through lateral edge of vitellaria.

Testes oval,  $20-75 \times 45-90\ \mu$ , arranged in one layer or two in dorsal intervascular medulla,  $160-240$  on the pore side,  $260-340$  on the opposite side, the total number in each proglottis being  $450-550$ . Vas deferens  $20-45\ \mu$  wide, its coils extending transversely

behind vagina from proximal end of cirrus pouch to median field. Cirrus pouch subcylindrical or claviform when extended, pyriform or bulbous when contracted, 0.8-1.1 mm long by 0.11-0.3 mm wide, with comparatively thin wall of oblique muscle fibers, lying transversely at lateral quarter of proglottis near its anterior end with its greater half medial to ventral excretory stems in mature proglottides. In the fully gravid proglottides, however, it is pushed anterolaterally by the uterus and lies obliquely and more or less crooked with its proximal end not overreaching the ventral excretory stem. Ductus ejaculatorius thin-walled, 30-45  $\mu$  wide, twisted or convoluted together with proximal portion of cirrus, with neither muscular coat nor ciliary lining. Cirrus winding, especially at its proximal portion, stouter distally than proximally, lined throughout with spiniform bristles which are most strongly developed at the enlarged distal end. The accompanying cells extend all over the strongly muscular wall of the cirrus consisting of inner circular and outer longitudinal muscles, and form for the cirrus a conspicuous outer coat which becomes thicker toward the distal end. The cirrus and its coat of accompanying cells are enclosed for their entire length in a comparatively thin muscular sheath. Between this sheath and the wall of the cirrus pouch is a considerable space which appears almost transparent in the whole mounts owing to the presence of loose-meshed spongy tissue. Genital pores prominent in the fully gravid proglottides, irregularly alternating with tendency of succession of two to six on the same side, dividing lateral margin of proglottis in ratio of 1 : 1.7-2.8 (usually 1 : 2).

The ovary lying at the posterior end of the proglottis between the excretory stems of the two sides is flattened anteroposteriorly and X-shaped in transverse section as is usually the case with Tetraphyllidea, so that it consists of four wings contrary to Southwell's statement, each wing is made up of large numbers of small, elongated claviform acini lying transversely with their swollen ends directed laterally. The transverse dimension of the whole organ amounts to 2.0 to 3.3 mm in the mature and gravid proglottides, but is reduced to 1.3 mm in the fully gravid endproglottides owing to atrophy. The shell gland complex lies immediately behind the middle of the ovary, somewhat intruding into the succeeding proglottides, and the connection of the germiduct with the vagina or of

the fertilization duct with the vitelline duct occurs in the same way as in the species to be described below. The uterus appears in the preovarian median field ventral to the testes and vagina, with sinuous walls; the shelf-like transverse folds arising from the uterine walls divide the uterine cavity into several successive compartments, but as the uterus is distended with eggs and occupies almost the whole intervascular medulla, overreaching the ventral excretory stems laterally, the septal trabeculae atrophy at the center and persist in the periphery alone, 4 or 5 on each side. Southwell says that the uterus opens on the ventral surface by a large pore even before it contains eggs, but I have been unable to detect such a primary opening. The ventral uterine pore which is to be seen in the endproglottides alone is evidently due to dehiscence of the ventral wall of the uterus and of the body as is usual in Tetraphyllidea. The eggs, discharged from the endproglottides, were examined and measured in life; the round egg shell, 30 - 40  $\mu$  in diameter, contained granular substance in the wide space between itself and the embryo, and the embryo or the segmenting ovum in which no hooks were observed, measured 21  $\mu$  by 24  $\mu$ . In the mounted endproglottides the egg shell is 27 - 30  $\mu$  in diameter, and the embryo about 15  $\mu$  by 18  $\mu$ .

The vitelline follicles extend the entire length of the proglottis in the extravascular medulla just inside the inner longitudinal muscle sheath, being interrupted by the cirrus pouch and vagina; they may intrude into the space among the muscle bundles of this sheath, and also into the intervascular field as far as the outskirts of the testes, passing between the excretory stems and the inner longitudinal muscle sheath. At the posterior end of the proglottis they extend inwards in the form of a wedge, and may well reach to the outer edges of the ovary. The vagina, opening into the genital atrium immediately in front of the male aperture, runs inwards directly anterior to the cirrus pouch and vas deferens coils, and then bending backwards at right angles runs down windingly in the median field dorsal to the uterus. Upon reaching the dorsal side of the center of the ovary it passes into a very narrow seminal duct which in turn joins the germiduct arising from the oocapt. Throughout its course it is covered inside with spiniform bristles and outside with accompanying cells. The latter are delimited from the surrounding parenchyma by an inconspicuous sheath

which appears to be made up of parenchymatous muscle fibers.

2. *Balanobothrium stegostomatis* n. sp.

Pl. I, Figs. 5-7.

Habitat and locality. Large intestine of *Stegostoma tigrinum*; Macassar.

Material. A single gravid example, fixed in acetic sublimate, stained and mounted in toto. Eggs were examined and measured in life.

Length about 120 mm, maximum breadth 1.65 mm. Number of proglottides over 400. Scolex subglobular, 0.4 mm long by 0.5 mm broad, with a sagittal groove at its apex. Suckers 75-90  $\mu$  in diameter, without definite suckorial cavity. Postacetabular compound hooks with two prongs of different shape and size; the anterior prong is curved just distal to its middle and measures 42  $\mu$  along the curvature, while the posterior is more strongly curved at the proximal portion with its greater distal part parallel to the base, and measures 24  $\mu$  long; the common base of the hook is about 30  $\mu$  long and projects anteriorly in form of a horn-like process like that of *Balanobothrium parvum* Southwell, 1925. Immediately behind the hook there is another circumscribed sucker-like area 60-75  $\mu$  in diameter. Collar 0.15 mm long by 0.42 mm broad, enclosing base of scolex and anterior end of neck. Neck constricted to a diameter of 0.16 mm just posterior to collar, whence it widens out gradually toward the segmented portion. Since the segmentation commences imperceptibly the exact length of the neck is unable to make out. Proglottides crowded anteriorly, increasing in length and breadth toward mature ones which are 0.55-1.1 mm long and somewhat constricted at both ends but enlarged toward the post-equatorial level which is 1.4-1.65 mm wide. The lateral margins of the mature segments are therefore convex and not imbricated. The gravid terminal proglottis with convex sides is 1.6 mm long by 1.53 mm wide, with the greatest transverse diameter at about the middle.

Inner longitudinal muscle bundles strongly developed, 80-100 in number, the largest one consisting of more than a dozen fibers. Oblique fibers running from one bundle to the other are few. No definite layer of transverse muscles except the intersegmental one. Dorsal and ventral excretory stems running in vitellarian fields

along outskirts of testes, with cirrus pouch and vagina between; dorsal stems 6-8  $\mu$  wide, ventral stems 50-60  $\mu$  wide in mature proglottides. There is no transverse anastomosis.

Testes subglobular to oval, 45-80 $\times$ 40-70  $\mu$ , arranged mostly in one layer in the whole intervascular medulla, 67-96 on the pore side (33-52 anterior, 34-45 posterior, to cirrus pouch), 84-112 on the opposite side, the total number for each proglottis being 174-200. Vas deferens up to 75  $\mu$  wide in fully mature segments, strongly coiled in median field in front of turning point of vagina. Cirrus pouch claviform or pyriform, 0.4-0.55 mm long by 0.15-0.3 mm broad, lying transversely or a little obliquely, with the blunt-pointed proximal end directed anteromedially, provided with a very thin muscular wall. Ductus ejaculatorius 20-45  $\mu$  wide, twisted or winding together with proximal portion of cirrus, provided with a moderately muscular wall and a coat of accompanying cells. Cirrus more or less winding, especially at its proximal portion, 30-75  $\mu$  wide, covered inside with spiniform bristles and outside with a dense coat of accompanying cells, which is most strongly developed at the distal end of the cirrus, and enclosed for its entire length in a delicate membranous sheath recognizable under high power magnification alone. The free space within the cirrus pouch, clear and transparent under a low power microscope, contains a very loose meshwork of scanty delicate fibers. Genital atrium rather shallow, opening by a wide, depressed aperture irregularly on the right or the left, dividing the lateral margin in ratio of 1:1.4-2.0.

Ovary four-lobed, 0.11-0.5 $\times$ 0.8-1.25 mm, extending transversely at posterior end of proglottis between excretory stems of two sides; each wing is composed of numerous claviform lobules; at first it is elongated transversely but its anteroposterior dimension increases gradually as development proceeds, and in the gravid endproglottis it becomes longer than broad, and is separated one from the other by the intervening uterus. The germiduct is narrow as it arises from the oocapt which is up to 45  $\mu$  in diameter and lies on the posteroventral side of the ovarian isthmus, but soon widens out to a maximum diameter of 30  $\mu$  and turns anterodorsally to unite with the seminal duct on the antiporal side of the median line near the posterior end of the proglottis; the fertilization canal thus formed passes transversely toward the pore side and then curves



forward to receive the vitelline duct just before entering the shell gland mass. The uterine duct emerging from this gland mass runs forward across the ovarian isthmus to open into the uterus. The shell gland complex occupies the whole space posterior to the ovarian isthmus. The uterus develops on the ventral side of the median portion of the vagina as an anteroposteriorly elongated sac with several transverse folds projecting into the cavity in form of shelf-like trabeculae. In the endproglottis it assumes an elliptical shape with persistent septal folds and contains developing eggs. It is 0.6 mm in diameter, and reaches a little anterior to the middle of the segment. There is no primary uterine pore. The eggs dissected out in the fresh state were just like those of *Balanobothrium tenax*, measuring 33 - 36  $\mu$  in diameter, and the embryo or the segmenting ovum without hooks was 21  $\mu$  by 24  $\mu$ . The vitelline follicles extend the entire length of the proglottis inside the longitudinal muscle sheath; in the mature proglottides they intrude medially across the excretory stems and overlap the outskirts of the testes and of the ovary, reaching more inwardly at the posterior end of the proglottis than elsewhere. They cover up the distal portions of the cirrus pouch and vagina more extensively on the dorsal side than on the ventral. The vitelline ducts from the two sides run transversely ventral to the ovary and unite together ventral to the shell gland to form a common duct, which turns back on itself and joins the fertilization canal.

The vagina, opening into the genital atrium immediately in front of the cirrus, runs inwards transversely along anterior border of cirrus pouch, at the medial end of which it turns backwards to take a median position dorsal to the uterus between the vas deferens coils and the ovarian isthmus. This median portion is wider than the transverse portion (up to 0.12 mm wide) and may probably function as receptaculum seminis, but its sinuous posterior portion crossing the ovarian isthmus dorsally narrows again and passes at the level of the oocapt into the still narrower ductus seminalis. The latter, only 60  $\mu$  long by 8  $\mu$  wide in the fully mature proglottis, proceeds backwards and joins the germiduct coming down from the oocapt. The wall of the vagina is thicker toward the external aperture, the cuticular lining shows fine annular corrugations at the transverse portion as well as at the anterior end of the median portion, but no spines or bristles. The cuticular corrugations may,

however, occur at the dilated median portion when the latter is contracted. The accompanying cells surround the whole length of the vagina though they are sparser proximally than distally.

This species differs from the closely related *Balanobothrium parvum* Southwell, 1925, in the length of the strobila and in the number of the testes.

Southwell prefers to assign *Balanobothrium* to the Order Cyclophyllidea because it possesses four suckers, to the suborder *Multi-vitellata* Southwell, because the vitelline glands are paired, but it can be relegated to the Order Tetrephyllidea on the assumption that the four bothridia are fused together.

The suckers in *Balanobothrium* are different histologically from those of the Cyclophyllidea, but analogous with the accessory suckers in the Onchobothriidae of the Tetrephyllidea and the circumscribed sucker-like area behind the paired compound hooks is comparable with the loculus of the bothridia in that family. The alleged fusion of the four bothridia is evidenced by the apical groove observed in *Balanobothrium stegostomatis*. As regards the internal anatomy of the proglottides there is a definite conformity between *Balanobothrium* and *Onchobothriidae*. Moreover, a member of the latter family, *Thysanocephalum* Linton, 1889, has a ruffled neck collar resembling somewhat that of *Balanobothrium*. In view of these considerations it is certain that *Balanobothrium* belongs to the Tetrephyllidea, and it should be assigned to the *Onchobothriidae*, though somewhat aberrant in the character of the scolex.

### 3. *Phoreiobothrium* sp.

Pl. I, Figs. 8-9.

Habitat and locality. Spiral valve of *Carcharias* sp.; Macassar.

Material. Two immature specimens fixed in acetic sublimate, stained and mounted in toto.

Length 6-11 mm, breadth 0.16-0.21 mm. Scolex 0.175-0.3 mm long, 0.225-0.3 mm broad at level of hooks. Bothridia 0.18-0.24 mm long (including sucker), 0.126-0.17 mm broad at posterior end, flattened, longitudinally fluted on external face, not cylindrical at all, with thickened lateral borders which are divergent toward posterior end, widens out in form of a conical bell; accessory sucker 75  $\mu$  in diameter; paired hooks rake-shaped, each with three parallel

prongs and a short handle embedded in the bothridium; middle prong 36-40  $\mu$  long, inner prong 18-21  $\mu$  long, outer prong 20-27  $\mu$  long; transverse bar 48-57  $\mu$  in length including the horn-like process projecting at its inner end. Between this process and the inner prong is a distinct notch in contrast with the simple curvature in *P. lasium*. Neck slender, 42-45  $\mu$  wide at its narrowest part immediately behind scolex, covered with sharp evanescent spines which are 9-12  $\mu$  long and obliquely truncated at the base. First sign of segmentation appearing about 2.5 mm behind scolex. Proglottides oblong, increasing in length and breadth posteriorly, two last ones of the larger specimen still immature, measuring 0.65 $\times$ 0.21 mm and 0.68 $\times$ 0.275 mm respectively. Subcuticular longitudinal muscles well developed, but no definite sheath of inner longitudinal muscle. Ventral excretory stem narrow, but widened at intersegment, where transverse anastomosis occurs; dorsal stem unable to detect.

Testes subglobular to oval, 40-50 $\times$ 30-45  $\mu$ , 80-85 in number, arranged in two lateral fields, but may be continuous in median line, extending laterally beyond excretory stems, with their outskirts overlapping vitelline gland. Posterior to the cirrus pouch there are 12-14 testes on the pore side. Cirrus pouch pyriform, 0.11 mm long by 60  $\mu$  broad, thin-walled, lying transversely with its inner end reaching to median line. Vas deferens coiled in median field in front of base of cirrus pouch. Cirrus simple, short. Genital pore irregularly alternating just behind middle of lateral margin of proglottis.

Ovary not yet fully developed, extending outward beyond excretory stems at posterior end of proglottis, with shell gland behind its median isthmus. Uterus not yet developed. Vitelline gland extending entire length of proglottis along outskirts of testes and ovary. Vagina opening in front of cirrus, running transversely immediately in front of cirrus pouch, curving round base of latter and then descending in median line toward ovarian isthmus.

Though still immature the present worm may be distinguished from *P. lasium* Linton, 1889, by the smaller number of testes. Southwell who examined the material sent him from Linton, states that there are about one hundred testes in Linton's species. A specific determination is, however, reserved until mature specimens come to hand. Southwell regards the genus *Phoreiobothrium*

as a synonym of *Cylindrophorus*, but in view of the fact that the bothridium of *Phoreiobothrium* is by no means tubular, it seems to me unlikely that the two genera are identical.

### HORNELLIELLIDAE n. fam.

4. *Hornelliella annandalei* (Hornell, 1912) n. g.  
syn. *Tetrarhynchus annandalei* Hornell, 1912  
Pl. I, Figs. 10-12.

Habitat and locality. Spiral valve of *Stegostoma tigrinum*; Macassar.

Material. Three gravid specimens fixed in acetic sublimate, stained and mounted in toto. Posterior portions of strobilas fragmentary.

Length about 40 mm, maximum breadth about 1.5 mm. Scolex 6.5-9.5 mm long, consisting of 3 portions; pars bothridialis 1.5-2.3 mm long, pars vaginalis 1.8-3.55 mm long, 0.55-0.9 mm broad at narrowest part, pars bulbosa 3.2-3.7 mm long by 0.96-1.2 mm broad, pars postbulbosa practically lacking. Bothridia two, lateral, fleshy, elongated, with thickened, elevated border, emarginate on posterior edge; proboscides 2.5-2.8 mm long by 0.09-0.1 mm broad, armed with about 14 oblique rows of hooks. These vary in shape and size according to the sides and the levels on which they lie; at the posterior end of the rows the hooks on one side are very minute, sharply curved like a rose-thorn, and those anterior to them are small, peg-like with terminal curve, while the opposite ones are very large, curved at a wide angle at about its middle with a relatively small base; those anterior to them are strongly curved and have a base projecting both forward and backward; the others occupying the most part are stout, claw-like, with the root markedly prolonged anteriorly, or rather slender and rootless, or intermediate between these two extremes. Proboscis sheath 60-100  $\mu$  wide, consisting of a thin layer of spiral muscle fibers, containing spirally twisted proboscis retractor 20-40  $\mu$  wide. Around each of the four proboscis sheaths just inside the inner longitudinal muscle there is a long series of transverse annular muscle bundles extending from the posterior part of the pars bothridialis to near the pars bulbosa; the bundles are placed at a certain interval one from another, and each of them is connected laterally with the inner

longitudinal muscle sheath by a few short branches. Besides these muscle rings there are in the axial field of the pars bothridialis and pars vaginalis among the four proboscis sheaths large numbers of I-shaped muscle bundles, whose central part lying dorsoventrally is flattened anteroposteriorly in form of a band, and whose arms are directed outwards and split up into individual fibers before being attached to the inner longitudinal muscle sheath. The arms in the pars bothridialis and the anterior portion of the pars vaginalis are made up of a single very long hair-like filament, which appears entangled with its neighbors, and the central part is long and slender. Muscle bulb cylindrical, 3.2-3.7 mm long, 0.3-0.35 mm wide, with narrow central cavity, to the side of which is attached the proboscis retractor. Its wall consists as usual of two sets of oblique fibers crossing each other. The unsegmented neck region of the strobila ensuing the contractile bulbs is 0.4-0.5 mm long, and 0.95-0.96 mm wide at the anterior end, whence it narrows only slightly to merge into the segmented portion. The genital anlagen make their appearance as segmentation commences. Anterior proglottides much broader than long, increasing in length and breadth posteriorly; mature ones longer than wide, parallel-sided, gravid ones 2.2-2.7 mm long, 1.4-1.5 mm wide, constricted at both ends and somewhat convex on each side, except at the genital pore, where the lateral edge is widely emarginate.

Inner longitudinal muscle sheath consisting of about 50-60 strong bundles, arranged at regular intervals. Inner transverse muscle well developed just inside vitelline gland. Dorsal and ventral excretory stems dorsal to hermaphroditic organs; dorsal stem 10-15  $\mu$  wide, ventral stem 60-110  $\mu$  wide, in mature and gravid proglottides; former medial to latter, running along outskirts of testes; transverse anastomoses present for ventral stems alone. In the pars bothridialis as well as in the pars vaginalis the ventral stem is thrown into complex network, communicating with its fellow of the other side by oblique anastomoses. The interproglottidal excretory vesicle as seen in *Tentacularia* and *Nybelinia* is not present. Nerve trunk lateral to ventral excretory stem.

Testes transversely elongated elliptical or oval, innumerable owing to their overlapping one another, occupying whole intervascular medulla between anterior end of proglottis and cirrus pouch, though they extend a little further backward on the anti-

poral side than on the pore side, but never beyond the level of the posterior border of the cirrus pouch. In the median field dorsal to the uterus they lie in one layer, but in 2 to 4 layers elsewhere. The vas deferens runs backward on the pore side of descending vagina, and then crossing it dorsally comes to its antiporal side, where it widens out considerably to form a conspicuous vesicula seminalis. This is very tightly winding and narrows as it proceeds forward from immediately anterior to the ovary toward the base of the cirrus pouch, where it curves round to penetrate the pouch at its anteriorly directed proximal end. Cirrus pouch club-shaped, sub-cylindrical or pyriform, situated transversely at about middle of posterior half of proglottis with its anterolaterally directed proximal end overreaching the median line, enclosing winding cirrus only at commencement of its development, but containing later the hermaphroditic reservoir to be described below. At this stage the whole organ may better be called **hermaphroditic pouch** instead of cirrus pouch and measures 0.6-0.75 mm long by 0.3-0.38 mm broad. The cirrus, covered inside with minute spines throughout, is winding in the dense mass of circular or transverse muscle fibers arising from the wall of the pouch and occupying all available space within the pouch, its lumen is variable in diameter, sometimes collapsed, sometimes so much dilated like a vesicle at base of pouch or at turning points. At the distal end of the pouch is a large clear cavity with corrugated wall of cuticle, which is smooth except on the proximal side, where there are minute spines similar to those of the cirrus. This cavity, which I propose to call **hermaphroditic vesicle**, receives the cirrus as well as the vagina proximally and gives rise distally to a stout duct lined with a thick, smooth, longitudinally folded cuticle and surrounded by a dense layer of muscle fibers, the greater proximal part of which extends over the hermaphroditic vesicle to be further continued over the cirrus pouch proper. This duct, for which the name **hermaphroditic duct** is suggested, projects prominently into the hermaphroditic vesicle in form of a papilla covered with cuticular folds. The longitudinal cuticular folds of the hermaphroditic duct may project into the genital atrium proper which is short cylindrical, 20-60  $\mu$  wide in fully mature proglottides, and lined with thick smooth cuticle, and opens at the middle of a wide shallow marginal notch, alternating irregularly from right to left with a tendency of succession on one

side for 2 to 5 proglottides, dividing lateral margin in ratio of 2'-2.6:1. It is to be noted that there are two transverse bolsters, one in front of and the other behind, the distal portion of hermaphroditic pouch and the hermaphroditic duct. They stain dark in immature proglottides but later become differentiated into muscle fibers running in the anteroposterior direction. When fully developed they may project over the ventral surface parallel to each other or they may be somewhat convergent toward the genital pore.

Ovary four-winged,  $0.18 - 0.2 \times 0.65 - 0.75$  mm, situated close to posterior end of proglottis, from which it is separated by a transverse band of vitelline gland; each wing composed of numerous follicular acini. Shell gland complex behind central isthmus of ovary. Uterus tubular, extending in ventral median field from ovarian isthmus to near anterior end of proglottis, passing along antiporal end of cirrus pouch proper, opening ventrally just in front of middle of proglottis. As fixed in acetic sublimate and measured in water the oval, thin-shelled non-operculate eggs are  $72 \mu$  by  $60 - 66 \mu$ , but smaller ( $60 - 70 \times 45 - 50 \mu$ ) in mounted condition. Vitelline follicles subglobular to oval, a little smaller than testes, extending diffusely in peripheral area between inner transverse muscle and longitudinal muscle sheath except where the uterine pore, hermaphroditic pouch, vagina and paired muscle bolsters are present; intruding into the space among the inner longitudinal muscle bundles. Vagina opening into hermaphroditic vesicle on ventral side of hermaphroditic pouch by a comparatively wide aperture, running obliquely backward; after crossing the posterior border of the cirrus pouch proper it increases gradually in diameter and becomes tightly winding, attaining a maximum width of  $0.12 - 0.18$  mm at the ovarian isthmus, where it passes into a very narrow seminal duct which crosses the isthmus dorsally and joins the germiduct behind the oocapt.

This species, apparently representing a distinct genus for which *Hornelliella* is suggested in honor of the original author, is distinguished from any of the known members of the Tetrarhynchidea by the following characters combined:

- 1). Proboscis sheaths are provided with series of muscle rings.
- 2). Testes confined to intervascular field anterior to cirrus pouch, not extending as far back as ovary.
- 3). Vitelline follicles forming a transverse band behind ovary.

- 4). Cirrus and vagina opening into common vesicle (**hermaphroditic vesicle**) which in turn opens into genital atrium by way of **hermaphroditic duct**.
- 5). A pair of transverse muscle bolsters present, with terminal genitalia between.

It is to be regretted that the descriptions of **Tetrarhynchidean** species by earlier authors are too meagre in respect of anatomy to be compared with the present species, but so far as I can gather from literature there has not been reported any species with a hermaphroditic vesicle into which both the cirrus and the vagina open. In view of this feature together with other characteristics mentioned above it is beyond doubt that a new family should be erected for the present new genus. In this connection I should like to call attention of the systematists to the fact that there is a great difficulty in identifying some tetrarhynchidean species without the knowledge of their detailed internal anatomy. In comparison of the present species with *Tetrarhynchus macroporus* Shipley et Hornell the internal anatomy of the latter should be made out in detail besides the differences in external characters as pointed out by Hornell. Without doing so some author refers the present species to the genus *Tentacularia*, regarding it as identical with *T. macroporus*. *Tentacularia* is, however, quite different in every essential particular both external and internal, from *Hornelliella*.

#### HORNELLIELLIDAE n. fam.

**Family diagnosis.**—Tetrarhynchidea : Scolex with two large lateral bothridia, long pars vaginalis and long pars bulbosa, but no pars postbulbosa. Proboscis long and stout, armed with hooks varying in size and shape, proboscis sheath provided with long series of muscle rings, each of which is connected with lateral bundle of inner longitudinal muscle sheath. Unsegmented neck portion immediately following pars bulbosa of scolex. Strobila apolytic, anterior proglottides crowded, posterior ones more or less elongated. Testes occupying greater anterior part of intervascular medulla. Vas deferens coils extending backward from base of cirrus pouch. Cirrus and vagina opening into common **hermaphroditic vesicle**. Hermaphroditic vesicle opening into genital atrium by hermaphroditic duct. Genital pores irregularly alternating. Ovary four-winged, posterior. Uterus ventro-median, tubular, opening ventrally. Vitelline gland follicular, profusely developed between inner transverse muscle and longitudinal muscle sheath. Vagina winding between hermaphroditic pouch and ovary.

Type genus : *Hornelliella* n. g.



*Hornelliella* n. g.

**Generic diagnosis.**—Hornelliellidae n. fam.: With characters of the family. Bothridia with thickened elevated borders, emarginate at posterior end; proboscis hooks in oblique rows, basal ones minute on one side, others stout, claw-like or rather slender or intermediate between two extremes. Strobila linear, but posterior proglottides more or less constricted at intersegments, with wide shallow notch at genital pore. Dorsal excretory stems running along outskirts of testes; ventral stems lateral to dorsal stems, both dorsal to hermaphroditic organs. Transverse anastomosis between ventral stems of two sides. Testes numerous, extending between anterior end of proglottis and hermaphroditic pouch on pore side, but a little further backward on the other side, but not reaching to ovary. Vas deferens strongly winding and dilated to form seminal vesicle, extending between ovary and proximal end of cirrus pouch proper. Cirrus winding in cirrus pouch, covered inside with minute spines. Hermaphroditic vesicle receiving cirrus and vagina proximally, giving rise to hermaphroditic duct distally. Hermaphroditic duct lined with thick smooth cuticle and provided outside with dense layer of muscle fibers which extend over the hermaphroditic vesicle and are continued further over the cirrus pouch proper, thus forming a hermaphroditic pouch. Two transverse muscle bolsters present, one in front of, and the other behind, hermaphroditic organ. Genital pores with a tendency to open consecutively on one side for a number of proglottides. Ovary near posterior end of proglottis, from which it is separated by a transverse band of vitelline follicles. Uterus extending from ovarian isthmus to anterior end of proglottis; eggs non-operculate, containing unsegmented ovum. Vitelline follicles extending between inner transverse muscle and inner longitudinal muscle sheath, partly intruding into space among muscle bundles of the latter, absent in area where hermaphroditic organs and muscle bolsters are present. Transverse portion of vagina posteroventral to cirrus pouch proper, descending portion strongly winding.

Genotype: *Hornelliella annandalei* (Hornell, 1912).

## AUSTRAMPHILINIDAE Johnston, 1931

5. *Gyrometra albotænia* n. g., n. sp.

Pl. II, Figs. 13-14.

Habitat and locality. Body cavity of *Diagramma* sp.; Macassar.

Material. A single gravid specimen fixed in acetic sublimate, flattened between two slides under pressure of a wire compressorium, stained with hematoxylin and mounted in balsam on three slides, and a series of transverse sections through middle portion.

Body milky white in life, ribbon-shaped, 105 mm long<sup>1)</sup>, 11 mm broad, 1 mm thick; anterior extremity conical, with a pit at the center of the tip but no rostellum or sucker; posterior extremity rounded, with a somewhat flattened, mammilliform, terminal papilla 0.35 mm long by 0.6 mm broad. Cuticle very thick with honeycomb-like sculpture on surface. Subcuticular musculature very strongly developed; the longitudinal muscle divided into two layers by the intervening circular muscle layer; the underlying subcuticular cells forming a thick compact layer, through which the parenchymatous muscle fibers run outwards to be attached to the subcuticular muscle sheath. At the entrance of the apical pit the subcuticular circular muscle is so strongly developed as to form a sort of spincter. Inner longitudinal muscle bundles greatly reduced except at the anterior extremity, where they are fairly well developed and converge toward the apical pit; inner transverse muscles not forming a definite layer, scattered in spongy parenchyma like dorsoventral muscles. There is no distinct boundary between the cortical and the medullary parenchyma. The thick nerve trunk runs from the anterior extremity toward the posterior inside the vitelline gland though nearer to the testes than to the vitelline gland in the testicular area, and crossing obliquely the posterior end of the vitelline gland on its dorsal side, extends into the caudal papilla. The excretory system was unable to trace with certainty.

Testes subglobular to oval, 0.15-0.25 mm by 0.1-0.16 mm, extending around vas deferens just medial to vitelline gland in bunches of two or three each or separated one from another at irregular intervals, commencing on the right about 15 mm, on the left 5 mm, from the anterior extremity, and terminating at different levels. The right vas efferens running obliquely backward across the ventral wide of the receptaculum seminis unites with its fellow from the opposite side on the left of the ovary behind the posterior end of the final ascending limb of the uterus. The vas deferens 4.5 mm long passes obliquely backward toward the vaginal aperture, immediately behind which it opens on the middorsal surface of the terminal mammiliform papilla near its tip. It shows at intervals small round or fusiform dilatations and is provided throughout its course with inner circular and outer longitudinal muscle fibers.

---

1) Before fixation the worm was about 130 mm long.

This muscular coat is rather thin anteriorly but very thick at the greater distal portion which evidently functions as ductus ejaculatorius and cirrus as well, and whose somewhat swollen part corresponds to the "Propulsionsapparat" of Poche in *Schizochœrus liguloideus* (Dies.). Such prostate cells as observed by Poche in *Schizochœrus liguloideus* (Dies.) around the distal portion of the duct are unable to detect, nor the embryonic hooks at the male aperture.

Ovary situated near posterior extremity a little to the right, 1.87 mm long by 4 mm broad, divided into two symmetrical wings, each of which consists of innumerable, distally swollen, tubular lobules giving the organ a moruloid appearance. The germiduct, arising from the isthmus which connects the two ovarian wings, describes an S-shaped curve, at the distal end of which it joins the seminal duct coming down from the receptaculum seminis. The fertilization duct is short and twisted, and becomes suddenly dilated at its junction with the vitelline duct to form a round receptaculum vitelli of Woodland (1923) which is about 0.16 mm in diameter and studded with yolk cells. The wide duct arising from this receptacle narrows considerably as it proceeds dextroventrally and then turning dextrad passes into the ootype 70  $\mu$  wide. There is an oval accessory seminal receptacle ventral to the posterior part of the main receptacle. The shell gland cells are compactly massed together behind the ovarian isthmus around the ootype, enclosing the germiduct, the fertilization duct, the receptaculum vitelli, the terminal portion of the vitelline duct as well as the commencement of the uterine duct. The uterus winds its way forward from behind the right wing of the ovary along the right testes on their inner side, but turns obliquely inwards at a distance of 6 mm from the anterior extremity and crosses the median line between the terminal uterus and the duct of the frontal gland to be described below, where it is much narrower and more loosely winding than before. It is at this point that the ascending uterus passes into the descending which pursues a similar winding course inside the left testes as far back as the left side of the ovary, where it turns medially to take the final ascending course. This median terminal uterus is very wide and coiled tightly from side to side, occupying one third, or even half, of the breadth of the body. It narrows abruptly, however, to a width of about 0.5 mm at a distance of 15

mm from the anterior extremity, and from here on it is more loosely winding and confined to the median field, and becomes somewhat narrower, though its wall chiefly consisting of circular muscle becomes gradually thicker, as it approaches the apical pit, at the bottom of which it opens to the outside together with the duct of the frontal gland. As fixed in acetic sublimate and measured in water the spherical egg is 70 - 154  $\mu$  in diameter.

As one of the most outstanding features of this worm is what may be called "frontal gland". This is a very long acinous gland which consists of a wide central duct and enormous number of large vesicular acini closely massed around it; it extends sinuously on the dorsal side of the median ascending uterus from the left of the anterior end of the receptaculum seminis to the external opening of the uterus with which it opens together into the apical pit, describing 13 turns on each side, with the first turn on the inner surface of the right ascending uterine coils and the second turn on that of the left descending uterine coils, and so on except for one last turn on the right and two last turns on the left which are separated from the ascending and the descending uterus respectively. From the last left turn it takes a rather straight median course dorsal to the terminal uterus, and from the point where it crosses the junction of the ascending with the descending uterus to the opening of the gland the surrounding acini are no more recognizable. The duct is 0.1 - 0.2 mm wide, lined with a layer of cylindrical epithelia and surrounded by rather dense meshwork of parenchyma which contains abundant muscle fibers directly continuous with those that come from the surrounding parenchyma into the interstices of the gland acini. In the transverse section of the gland the acini form a typical rosette with the duct in the center; each acinus consists of a large retort- or club-shaped vesicular cell which is studded with fine secretion granules and whose attenuated end is directed toward the central duct. The thin distended cell membrane is pressed against the interstitial muscle fibers, so that the latter come in sight more prominently than the former in the stained preparation.

Of the function of this gland *sui generis* I am at present not quite certain, but from its position relative to the apical pit it seems very likely that it has something to do with the act of boring of the worm through the tissue of the host.

The narrow band-like vitelline gland extends along each side of the body from near the anterior extremity to the posterior, commencing about 2.5 mm from the anterior extremity on the right and 38 mm from the same point on the left. It consists of a wide central duct and large numbers of claviform acini compactly massed around its whole length. Externally it presents a moruloid appearance, and in transverse sections a typical rosette, and has a diameter of 0.2-0.4 mm, the central duct being about 0.1 mm wide; each acinus is filled with yolk granules of varying sizes, the largest of which may attain a diameter of 12  $\mu$ . The right vitelline gland gives off two branches, and the left gland one. These branches run forward parallel to the main trunk on its dorsolateral side, and may be easily overlooked; the two right branches are 1.1 mm and 1.0 mm long respectively, the anterior arising 4 mm, the posterior 15 mm, from the anterior end of trunk. The left branch is 1.35 mm long and arises 4.5 mm from the anterior end of its own trunk. The vitelline ducts from the two sides run almost transversely and unite together in the median field just in front of the vaginal pore to form a large triangular vitelline reservoir measuring 0.25 mm antero-posteriorly, the left duct crossing the vagina ventrally just before the union. The common vitelline duct arising from the apex of this triangle proceeds forward and shows different calibers according to the degree of its distension with the yolk; after crossing the vagina ventrally it forms a sausage-shaped dilatation up to 0.2 mm in diameter, but becomes definitely narrow and sinuous as it penetrates the shell gland mass to join the vitelline receptacle.

The vagina, covered inside with cuticular hairs and outside with accompanying cells, opens middorsally at a distance of 0.95 mm from the posterior end of the caudal papilla by a very wide aperture which is 0.3 mm in transverse diameter and provided with powerful sphincter measuring 0.55 mm by 0.65 mm. It runs forward somewhat sinuously on the dorsal side of the body with an almost uniform diameter of 0.1-0.15 mm, across the shell gland and the ovarial isthmus, and forms immediately in front of the ovary a very large oval receptaculum seminis 3.3 mm long by 2.5 mm wide. The seminal duct, arising from the posterior end of the receptaculum seminis just posteroventral to the opening of the vagina into the receptacle, is about 0.8 mm long, 0.11-0.14 mm wide, and narrows only a little halfway but markedly as it joins the germiduct

in front of the receptaculum vitelli. Throughout its length it is lined with cilia directed toward the seminal receptacle, and provided with a fairly thick wall of inner circular and outer longitudinal muscle fibers.

This species differs fundamentally from *Gigantolina magna* (Southwell, 1915) in the course of the uterine limbs, though resembling it in some other respects, and from *Austramphilina elongata* Johnston, 1931 (= *Kosterina kuiperi* Ihle et Ihle-Landenberg, 1931) from Australian *Chelodina longicollis* in the extrauterine disposition of the testes, the bilobed ovary, and the separate opening of the male and vaginal apertures, but agrees well in the course of the uterus with the terminal limb in the median field, and its opening into the rostellar cavity at the anterior extremity. A new genus and a new subfamily are suggested with the following diagnosis respectively and included in Austramphilinidae Johnston, 1931, which is necessarily emended for their reception.

*Gyrometra* n. g.

**Generic diagnosis.**—Austramphilinidae: Body long, in form of a fleshy ribbon; anterior extremity conical, with apical pit, at the bottom of which open the uterus and frontal gland duct; posterior extremity with button-shaped or papilliform tip. Testicular bands narrow, commencing at different levels a short distance behind anterior extremity and terminating on one side at ovarian level and more anteriorly on the other side; vasa efferentia uniting together behind posterior end of final ascending uterine limb at level of ovary. Ejaculatory apparatus not strongly developed. No prostatic glands. Male pore on above mentioned terminal papilla. Ovary median, symmetrically two-winged, each wing consisting of compact mass of claviform acini. Fertilization canal forming receptaculum vitelli of Woodland at its junction with vitelline duct. Seminal receptacle proper formed by dilatation of vagina, very large, saccular, situated immediately in front of ovary, giving off ventrally a small accessory receptacle near its posterior end; vagina descending dorsal to unpaired vitelline duct and opening middorsally a little in front of male pore, with powerful sphincter at its aperture. Vitellaria extending along lateral margin of body from near anterior extremity to level of vaginal pore; unpaired vitelline duct ascending. Median terminal limb of uterus very wide, coiled tightly from side to side, occupying one-third or even half breadth of body, then narrowed abruptly to lead into more loosely winding, strongly muscular metraterm and confined to median field, opening into apical pit together with frontal gland duct; eggs spherical, large, without filament. Parasitic in body cavity of Pristipomid fishes.

Genotype: *G. albotaenia* n. g., n. sp. in *Diagramma* sp.; Macassar.

Other species unknown.

### AUSTRAMPHILINIDAE Johnston, 1931, emended

**Family diagnosis.**—Amphilinida: Ribbon-like forms, with an introverted rostellar cavity at anterior extremity. Frontal glands present. Testes very numerous, extending on each side lateral and ventral to uterine limbs or confined to extrauterine field inside vitellaria, leaving both extremities free. A rather long ejaculatory apparatus present. Male genital pore terminal. Ovary compact or bilobed, situated in median or submedian line at a short distance from posterior extremity. Vitellaria with central duct, around which small sessile follicles are arranged, extending from near anterior extremity to ovarian or postovarian level. Uterus 3-limbed, extending nearly whole length of body, with distal ascending limb median and proximal ascending limb on opposite side of descending limb; uterine pore opening at base of rostellar cavity along with duct of frontal glands. Receptaculum seminis very large, median, mainly posterior or entirely anterior to ovary, devoid of a long median anterior extension. Vagina opening at posterior extremity beside male aperture or a little anterior to it on dorsal side, provided with a sphincter or not. Parasitic in chelonians and fishes.

Type genus: *Austramphilina* Johnston, 1931.

#### Key to subfamilies of Austramphilinidae

- Vaginal aperture separated from male aperture ;  
 ovary two-winged ; parasites of fishes ... .. *Gyrometrinae*  
 Vaginal aperture joining male aperture ;  
 ovary compact, not two-winged ; parasites of chelonians ... *Austramphilininae*

#### GYROMETRINAE n. subf.

**Subfamily diagnosis.**—Austramphilinidae: Body fleshy, ribbon-shaped, with long honeycomb-like sculpture on surface, milky white in life; calcareous corpuscles absent. Anterior extremity with apical pit, into which the uterus and frontal gland duct open. Testes in two long strips inside vitellaria; crossing proximal portion of ascending uterine limb ventrally on the right; vasa efferentia uniting together behind posterior end of final ascending uterine limb. Vas deferens with small round or fusiform dilatations at intervals, provided at its greater distal portion with thick coat of inner and outer longitudinal muscle fibers, somewhat swollen part corresponding to Poche's propulsion apparatus; neither prostate cells nor embryonic hooklets at terminal male aperture. Ovary distinctly two-lobed, near posterior extremity. Accessory seminal receptacle small, ventral to seminal receptacle proper, which is a voluminous dilatation of the vagina and lies just in front of the ovary. Vaginal pore median, dorsal, anterior to male pore, with muscle ring. Uterus ascending on the side where the testes extend to the ovarian zone, crossing median line near anterior extremity and descending on the side opposite the first ascending limb, turning forward in front of junction of two vasa efferentia and ascending in median field. Vitellaria of each side consisting

of compact clusters of claviform acini surrounding central duct, with rosettelike structure in cross section, giving off one branch or two. Including type genus only. Parasitic in body cavity of marine teleosts.

### Literature

Hornell, J. (1912), New cestodes from Indian fishes. Rec. Ind. Mus. 7, 197 - 204. — Johnston, T. H. (1931), An Amphiliniid cestode from an Australian tortoise. Austr. Jour. Exp. Biol. & Med. 8, 1 - 7. — Poche, F. (1926), On the morphology and systematic position of the cestode *Gigantolina magna* (Southwell). Rec. Ind. Mus. 28 (1), 1 - 27. — Southwell, A. (1925), A monograph on the Tetraphyllidea with notes on related cestodes. Liverp. Sch. Trop. Med. Mem. (n. s.), No. 2.

### Explanation of Plates

#### Plate I.

Figs. 1 - 4. *Balanobothrium tenax* Hornell, 1912.

Fig. 1. Scolex, Fig. 2. Paired hooks of scolex, Fig. 3. Sagittal section of gravid proglottis through ventral excretory stem and cirrus pouch, Fig. 4. Sagittal section of gravid proglottis through uterus.

Figs. 5 - 7. *Balanobothrium stegostomatis* n. sp.

Fig. 5. Scolex, Fig. 6. Paired hooks of scolex, Fig. 7. Mature proglottis, ventral view.

Figs. 8 - 9. *Phoreiobothrium* sp.

Fig. 8. Scolex and neck, Fig. 9. Bothridial hooks.

Figs. 10 - 12. *Hornelliella amandalei* (Hornell, 1912).

Fig. 10. Anterior part of scolex, Fig. 11. Anterior part of proboscis, Fig. 12. Posterior part of proboscis.

#### Plate II.

Figs. 13 - 14. *Gyrometra albotaenia* n. g., n. sp., dorsal view.

Fig. 13. Anterior extremity, Fig. 14. Posterior extremity.

### Abbreviations used in Figures

ap = apical pit, ars = accessory receptaculum seminis, c = cirrus, cp = cirrus pouch, d = vas deferens, gd = frontal gland duct, gp = genital pore, il = inner longitudinal muscle, mp = male genital pore, o = ovary, rs = receptaculum seminis, sg = shell gland, t = testis, u = uterus, vg = vagina, vp = vaginal pore, vt = vitellaria, vv = ventral excretory vessel.



YAMAGUTI: PARASITIC WORMS MAINLY FROM CELEBES—CESTODES OF FISHES

Pl. I



