On nemerteans with a branched proboscis from Zhanjiang, China

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Abstract
Yin and Zeng (Marine Science Bulletin 1984;3:51–58; Oceanologia et Limnologia Sinica 1985;16:323–335; Journal of Shandong College of Oceanology 1986;16:1–9; Marine Science Bulletin 1988;1:176–187) described two new genera and three new species of heteronemerteans with a branched proboscis, Dendrorhynchus zhanjiangensis Yin & Zeng, 1984, Dendrorhynchus sinensis Yin & Zeng, 1985 and Polydendrorhynchus papillaris Yin & Zeng, 1986. All three species were described from specimens collected at the same locality—Xiashan Beach Park, Zhanjiang, China. Additional specimens have been collected from nearby sites during recent years. Observations on these additional specimens and re-examination of the type specimens suggest that all three species should be synonymized under the single taxon, Dendrorhynchus zhanjiangensis Yin & Zeng, 1984.

Keywords: Nemertea, branched proboscis, Dendrorhynchus zhanjiangensis, Dendrorhynchus sinensis, Polydendrorhynchus papillaris, synonymization

Introduction
A total of seven species of heteronemerteans with a branched proboscis have been recorded from the coasts of all continents, except Europe and Antarctica, and also from the shores of a few islands in the Pacific, Indian and Atlantic oceans (Gravely 1927; Dakin and Fordham 1931, 1936; Wheeler 1936, 1940; Coe 1947; Serna de Esteban and Moretto 1969; Gibson 1974, 1977, 1981, 1990; Yin and Zeng 1984, 1985, 1986). The two species of Gorgonorhynchus Dakin & Fordham, 1931, and Dendrorhynchus sinensis Yin & Zeng, 1985, are known to have a relatively wide distribution, but the remaining four species are known only from their type localities (Serna de Esteban and Moretto 1969; Gibson 1977; Yin and Zeng 1984, 1986).

In Zhanjiang and vicinity, the branched-proboscis worms have long been traditionally used as bait by local fishermen, but the worms were not scrutinized by scientists until 1974, when Professor Yin Zuofen collected specimens along the Zhanjiang coast. Examples collected on 12 May 1974, clearly possessed a branched proboscis. In field notes dated
9–11 February 1981, Yin included a brief description of her specimens, as well as several sketches of the branched proboscis. Shortly afterwards, based on specimens collected in 1983 and 1984 at the same locality, Xiashan Beach Park, Zhanjiang, Guangdong Province, Yin and Zeng (1984, 1985, 1986, 1988) established two new genera and three new species (*Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984; *Dendrorhynchus sinensis* Yin & Zeng, 1985; *Polydendrorhynchus papillaris* Yin & Zeng, 1986). In 2002 and 2003, additional nemertean specimens with a branched proboscis were collected from Zhanjiang coasts. Observations on these new specimens in conjunction with re-examination of the type specimens of all three species suggest that they should be united into a single taxon, *Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984.

**Materials and methods**

The present specimens were dug out from littoral mud at Potou (21.4°N, 110.2°E) and Naozhou Island (20.9°N, 110.5°E), Zhanjiang, Guangdong Province, China. Most of the worms were bought at Potou from fishermen who collected the “sea worm” for use as fishing bait. After being anaesthetized with 7.5% MgCl₂, specimens were observed and measured, and then fixed in Bouin’s fluid (otherwise indicated in the following descriptions). Specimens related to the three papers of Yin and Zeng (1984, 1985, 1986) were relaxed with 8% MgCl₂ and fixed with either Bouin’s fluid (Yin and Zeng 1985) or Zenker’s fluid (Yin and Zeng 1984, 1986), and unsectioned specimens were preserved in ethanol.

Sections were cut at 7 µm in 52–54°C m.p. paraffin wax. Slides were stained with the Mallory triple-stain method. A few preserved specimens were dissected to examine the structure of the rynchocoel.

Because the deposited slides of type specimens were faded, they were soaked in dimethylbenzene at about 45°C for at least 24 h before removing their cover slips, and then re-stained with Mallory.

**Description**

*Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984

*Dendrorhynchus sinensis* Yin & Zeng, 1985; Gibson, 1990

*Polydendrorhynchus papillaris* Yin & Zeng, 1986, 1988

**Specimens examined**

*Type specimens of Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984. Yin and Zeng (1984) designated the specimens Zhanjiang-8403 (including a holotype and a paratype) as the type specimens of *D. zhanjiangensis*. Deposited slides of Zhanjiang-8403 consist of six slides (Head 1–6) of the cephalic region, one slide (Middle 11) of the foregut region, 11 slides (Middle 1–10 and Middle 12) of the intestinal region, six slides (Tail 1–6) of the hind body region and three slides (Proboscis 1–3) of the proboscis. A bottle labeled Zhanjiang-8403 contains a complete specimen, two body fragments and two proboscides. The proboscis that has its basal axis cut off (for sectioning) and has six primary branches (four lateral and two terminal) is clearly the one illustrated by Yin and Zeng (1984, Figure 4) as the holotype. The small body fragment (about 22 mm long and 2 mm wide) lacks both anterior
and posterior ends, which are presumed to have been sectioned by Yin and Zeng, and should be part of the holotype. The larger fragment (about 35 mm long and 4 mm wide) of the anterior body region, which has had the dorsal body wall dissected and the proboscis removed, should not belong to the holotype. The intact specimen is about 50 mm long and 3.5 mm in maximum width. As no clues have been found in the paper of Yin and Zeng (1984) or in Yin’s notes, it is not possible to determine which specimen they designated as the paratype. The specimens in bottle Zhanjiang-8403 are now re-sorted. Holotypic material (including a body fragment and a proboscis) are deposited in a bottle labeled Zhanjiang-8403; the complete specimen, whose cephalic region was transversely sectioned, and the foregut region dissected by the present author, are now numbered as Zhanjiang-8403-1 (including section slides and body fragments); the other specimens (including a proboscis and a body fragment) are preserved in a bottle labeled Zhanjiang-8403-2.

There are two related bottles of preserved specimens labeled Zhanjiang-8403A and Zhanjiang-8403B. Zhanjiang-8403A contains six specimens 30–115 mm long and 2.0–4.5 mm wide, two of them have been transversely cut into two and three fragments respectively, the other four are complete. Zhanjiang-8403B contains two specimens. The larger one is about 42 mm long and 2.5 mm wide, its everted proboscis possessing 13 exposed primary branches (11 lateral and two terminal); the smaller one is about 35 mm long and 2.5 mm wide with its dorsal anterior region dissected and its proboscis possessing 10 exposed primary branches (eight lateral and two terminal). Because there is no evidence that the cephalic regions of these specimens were sectioned and none of them were illustrated by Yin and Zeng (1984), the specimens of Zhanjiang-8403A and Zhanjiang-8403B should not be included with the type series of *D. zhanjiangensis*.

**Holotype of Dendrorhynchus sinensis Yin & Zeng, 1985.** Yin and Zeng (1985) designated specimen Zhanjiang-8304 as the holotype of *D. sinensis*. Transverse sections of the holotype consist of 16 slides of the cephalic region (Head 1–16), 14 slides of the intestinal region (Middle 1–14), 11 slides of the caudal end (Tail 1–11), four slides of the proboscis axis (Proboscis trunk 1–4) and six slides of a proboscis branchlet (Proboscis branchlet 1–6). Preserved specimens in the bottle labeled Zhanjiang-8304 consist of two body fragments (one about 48 mm long and 3.5 mm wide, the other 20 mm long and 4 mm wide) and two probosides. One of these, with its basal portion cut off, has a branching pattern identical to that illustrated by Yin and Zeng (1985, Figure 4). This proboscis and the two associated body fragments (dissected by the present author) and slides, thus, form the holotype designated by the original authors. The other proboscis, which has 15 primary branches (13 lateral and two terminal), has been transferred to another bottle labeled Zhanjiang-8304A. This is not part of the type series of *D. sinensis*, because it was not mentioned in the original description, and the holotype was apparently the only specimen described by Yin and Zeng (1985). The basal region of the proboscis of Zhanjiang-8304A was transversely sectioned by the present author.

**Type specimens of Polydendrorhynchus papillaris Yin & Zeng, 1986.** Yin and Zeng (1986) designate a holotype and a paratype (Zhanjiang-8409) for *P. papillaris*. Transverse sections of Zhanjiang-8409 consist of 26 slides of the cephalic region (Head 1–26), five slides of the intestinal region (Middle 1–5), 15 slides of the caudal end (Tail 1–15) and six slides of the proboscis (Proboscis 1–6).

Preserved specimens in the bottle labeled Zhanjiang-8409 consist of eight body fragments sorted into two bundles. The bundle consisting of two fragments of the middle
body region (one about 60 mm long 5 mm wide, the other 82 mm long 4 mm wide) and a
proboscis (the basal region of the trunk has been cut off, the branching pattern is identical
to that illustrated by Yin and Zeng (1986, Figure 4) forms the holotype. A piece of foregut
region and a piece of proboscis axis were sectioned by the present author.

The other bundle of specimens consists of four body fragments, including the head and
the caudal ends, and a proboscis. This specimen comprises the paratype and is now
preserved separately as Zhanjiang-8409A. The head and intestinal regions and proboscis
axis were sectioned by the present author.

Other specimens. Three specimens (NH1, NH2 and NH3) were all dug from littoral mud at
Potou. NH1 after preservation is about 210 mm long and 8 mm in maximum width, and
consists of transverse sections of the anterior body, intestinal and hind body regions, and
body fragments. NH2 is about 336 mm long and 17 mm in maximum width after
preservation and consists of sections of various body regions and unsectioned body
fragments. NH3 consists of body fragments (fixed with 95% ethanol) and transverse
sections of the initial region of the unbranched proboscis axis. One additional preserved
specimen (NH4), collected from Xiashan Beach Park by Yin Zuofen in 1974, about
440 mm long and 8 mm in maximum width, consists of dissected body fragments.

Many other individuals collected from Naozhou Island and Potou were observed in vivo
or dissected.

Habitat and behavior

All specimens of Yin and Zeng (1984, 1985, 1986) were collected from the shore of
Xiashan Beach Park. The environment of the type locality has been drastically changed
due to the rebuilding of the park during the last decade, and no worms have been found at
this location during recent years. Professor Feng Yuai, one of the collectors of the
type specimens, told me that she usually found the worms under stones on sandy-mud
substrata between tides in the 1980s. The worms often hid their posterior region in the
substrate and protruded their anterior end into water left on the sediment surface. Similar
behavior was noted by the present author at Naozhou Island on August 27, 2003. The
worm would rapidly retract its exposed anterior region into its burrow if approached.

The nemertean has been recorded from different sediment types, including sand (Gibson
1990), mud (present observation) and sandy-mud (Feng Yuai, pers. commun.).

The swimming behavior of the worms on the Xiashan coast was noted by Professor Yin
Zuofen. In her fieldwork notes dated 9 February 1981, she wrote “(it) makes snake-like
sidestroke, very rapidly”.

The worm tends to evert its proboscis when stimulated, for example, when handled. As
in Gorgonorhynchus repens Dakin & Fordham, 1931, if the worm is strongly stimulated its
proboscis may be thrown off (see Dakin and Fordham 1936). This is one reason for none of
the present specimens fixed for morphological studies retaining their proboscis in situ. The
thread-like branchlets of a detached proboscis may retain their ability to move for many
minutes. In G. repens, however, “the detached proboscis almost entirely loses its mobility;
only for a few seconds do the finest tips introvert and evert, probably due to the action of
muscles of the wall on fluid which has not yet leaked away” (Dakin and Fordham, 1936).
The everted proboscis is so sticky that attempts to separate it from attached objects are rarely successful.

Like *Polybrachiorhynchus dayi* Gibson, 1977 from South Africa and *Cerebratulus lacteus* (Leidy 1851) from the United States (Gibson 1977; McDermott 2001), *Dendrorhynchus zhanjiangensis* is used as bait by fishermen. Fishermen from Zhanjiang commented that compared with polychaetes, this “sea worm” was rare but an excellent bait.

**External features**

The living worm is ribbon-like, the posterior body (intestinal diverticular) region being more flattened than the anterior region (Figure 1A). The maximum body width occurs in the anterior portion of diverticular region. Worms collected on 28 October 2002 are considerably larger than those recorded by Yin and Zeng (1984, 1985, 1986) and Gibson (1990). The largest living individual measured was 7.9 g in wet weight, and about 325 mm long and 16 mm in maximum width. The largest preserved specimen was 336 mm long and

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**Figure 1.** *Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984. (A) Photograph of a living worm. (B) Dorsal view of posterior region to show the pale body end. (C) Dorsal view of a living worm, with anterior and posterior regions paler than the middle body region. (D) Dorsal view of the anterior body region. (E) Ventral view of the anterior body region. Scale bars: A=20 mm; E=10 mm.
17 mm wide. However, the shape of worms varies greatly in life, one example was noticed extending to a length of about 500 mm but was only 6 mm wide. Most worms are dark red, reddish-orange, or flesh-colored in the middle region of their body. The anterior region is paler than the succeeding regions (Figure 1A), normally showing an orange color, sometimes bearing a slight tinge of greenish yellow on the dorsal surface. In some individuals, a paler posterior region is clearly marked off from the remaining body regions (Figure 1B, C), which is supposed to be the result of regeneration. Through most of the body length, the white lateral margins are fin-like. The brain and lateral nerve cords can be seen in living worms, the latter appearing as a pair of red lines (Figure 1E).

The head is marked off from the remainder of the body by a constriction (Figure 1D, E). It possesses a pair of deep horizontal lateral cephalic slits. An elongate proboscis pore is situated ventrally near the anterior tip of the head (Figure 1E). Eyes are absent. In some specimens a few longitudinal stripes can be traced on the dorsal surface of the cephalic region (Figure 1D); these are irregularly arranged and paler than adjacent epidermis. A distinct rhynchodaeal groove, described for both *Dendrorhynchus sinensis* and *Polydendrorhynchus papillaris* by Yin and Zeng (1985, Figure 1; 1986, Figure 1), was not detected in either the present living worms or in sections of the holotypes of both species. It is likely that this groove was caused by retraction of the body. The mouth is slit-like and positioned immediately behind the brain (Figure 1E). The length of the mouth varies according to the relaxed state of the body. In preserved specimens, it may be as long as the cephalic slits.

The posterior end of the body tapers to a slightly pointed tip (Figure 1B, C). A dark “hindgut” can be seen in some living worms (Figure 1B). There is no caudal cirrus.

**Body wall, musculature and parenchyma**

The epidermis contains numerous red-staining serous glands. A very thin zone of connective tissue can be detected between the epidermis and subepidermal circular muscle layer in some sections. The cutis consists of an outer subepidermal gland layer and an inner
connective tissue stratum. The connective tissue layer is well developed in the foregut and anterior intestinal regions (Figures 2A and 5J), but it disappears in the posterior body regions. Gibson (1990) gave a detailed description of the cutis. Specimens observed by the present author show no major differences from Gibson’s description. In the foregut region of the largest sectioned specimen (NH2), the maximum thickness of the eight main body-wall layers were respectively: epidermis, \( \sim 25 \mu\text{m} \); subepithelial circular muscle layer,
~15 μm; subepidermal gland layer, ~150 μm; connective tissue stratum, ~60 μm; outer longitudinal muscle layer, ~440 μm; neural sheath, ~15 μm; circular muscle layer, ~180 μm; inner longitudinal muscle layer, ~80 μm.

Yin and Zeng (1984, 1986) and Gibson (1990) made no mention of the horizontal longitudinal muscle plate, and Yin and Zeng (1985, Table 1) indicated that the muscle plate was absent from *Dendrorhynchus sinensis*. Longitudinal muscle fibers, however, can be detected between the rhynchocoel and the foregut. These muscles are sometimes intermingled with the circular muscle fibers surrounding the dorsal wall of the foregut (Figure 2B).

Parenchyma is extensive in the foregut region, the anterior intestinal region (Figure 5J) and near the caudal end of the body, but it is only weakly formed in regions where the intestinal diverticula are well developed.

Dorsoventral muscles are present in the foregut and intestinal regions, but are only strongly developed in the intestinal region, where they pass between the intestinal diverticula.

**Rhynchodaeum and rhynchocoel**

The rhynchodaeum is lined by a ciliated epithelium and surrounded by a layer of circular muscles (Figure 2C). The epithelium and cilia are mostly about 10–20 μm and 15–20 μm high respectively in the anterior rhynchodaeal region of the largest specimen sectioned (NH2). In the posterior region of the rhynchodaeum the epithelium is thinner and the cilia sparse.

The rhynchocoel extends for almost the full length of the body. In specimens relaxed with 7.5% MgCl₂ with their proboscis everted, the anterior region of the rhynchocoel is spacious and divided into a series of chambers by folds of its wall, with adjacent chambers connected by a narrow channel located near the dorsal rhynchocoel border (Figure 3A, B). In a preserved specimen about 200 mm long and 15 mm in maximum width, some 30 chambers can be distinguished in the anterior region of the body. The most anterior chamber may be about 10 times the length of the remaining chambers. This condition of the rhynchocoel may be common in nemerteans with a branched proboscis. For example, the rhynchocoel of *Gorgonorynchus repens* “is moniliform by the alternation of expanded and contracted sections” (Dakin and Fordham 1936); the cross-sectional shape of the rhynchocoel of *Gorgonorynchus bermudensis* Wheeler, 1940, and *Polybrachiorhynchus dayi* varies considerably (Gibson 1974, 1977). This type of arrangement of the rhynchocoel lumen may not always be clear to an observer. Specimens not anaesthetized but fixed directly with 95% ethanol are greatly contracted and a similar moniliform appearance could not be detected. This arrangement of rhynchocoel (as shown in Figure 3A, B) was not found in Yin and Zeng’s type specimens. However, in specimen NH4 collected from the type locality by Yin Zuofen in 1974, the moniliform arrangement of the rhynchocoel is distinct.

The rhynchocoel wall possesses an endothelium reaching 6 μm thick in some places, a connective tissue stratum about 10 μm in maximum thickness, and an outer circular and an inner longitudinal muscle layer (Figure 2D). Yin and Zeng (1984, 1985, 1986) noted that the rhynchocoelic circular muscles of *Dendrorhynchus zhanjiangensis*, *D. sinensis* and *Polydendrorhynchus papillaris* were dorsally interwoven with the body wall musculature. Gibson (1990) indicated that in Hong Kong specimens of *D. sinensis* this muscle cross was not as strong as described by Yin and Zeng (1985). Present observations suggest that the
development of this muscle cross varies greatly between different body regions. It is evident in some sections of the anterior intestinal region (Figure 2E, F), but similar structures may also be detectable in some sections of the foregut region (Figure 6A; also see Yin and Zeng, 1986, 1988, Figure 2). In addition, several muscle bands that dorsally link the rhynchocoel wall and the body wall muscles have been examined in sections of the anterior intestinal region (Figure 6J).

**Proboscis apparatus**

The proboscis is a tree-like organ, consisting of a single main axis from which the primary branches arise laterally and alternately in the same plane. In contrast to the pinkish color of the proboscis in *Gorgonorhynchus repens* (see Dakin and Fordham 1936), the proboscis in the present species is white.
In the present specimens, the primary branches divide dichotomously two or three times (Figure 3C) to yield successive branchlets, namely the secondary, tertiary and quaternary branchlets (see Gibson 1977). Yin and Zeng listed the absence of tertiary branchlets (between the secondary and terminal branchlets) in *Dendrorhynchus sinensis* as one of the characters for separating that species from *D. zhanjiangensis* (see Yin and Zeng 1984, Table I), and indicated in a later paper that *Polydendrorhynchus papillaris* also lacked the tertiary branchlets (Yin and Zeng 1986). However, a few branchlets in their illustrations for each species can be interpreted as tertiary branchlets (Figure 3D, F; also see Yin and Zeng 1985, Figure 4; Yin and Zeng 1986, 1988, Figure 4). In addition, a primary branch in the holotype of *D. zhanjiangensis* apparently possesses quaternary and sexternary branchlets (Figure 3E; see also Yin and Zeng 1984, Figure 4).

The number of branchlets that can be detected from each branching order varies considerably between individuals. Larger specimens tend to bear more branchlets at each branching level than smaller ones. The maximum number of primary branches is 20 (18 lateral and two terminal); the maximum number of terminal branchlets is 110 (Figure 3C). Both numbers are much greater than recorded by Yin and Zeng (see Table I). However, it appears that in none of the specimens examined has the proboscis been either fully everted or retracted, and the complete branching pattern cannot be determined at present.

Yin and Zeng (1984, 1985, 1986) recorded that the main proboscis axis of *D. zhanjiangensis*, *D. sinensis* and *P. papillaris* is composed of eight distinct layers, an outer glandular epithelium, an outer connective tissue layer, an outer longitudinal muscle layer, a neural sheath, a circular muscle layer, an inner longitudinal muscle layer, an inner connective tissue layer and an endothelium. Gibson (1990) indicated that the Hong Kong specimens of *D. sinensis* possessed an additional inner circular muscle layer between the endothelium and inner connective tissue stratum. This muscle layer is distinct in the present specimens and in the holotype of *D. zhanjiangensis* (Figure 2J) but was not detected in the type specimens of *D. sinensis* and *P. papillaris*, probably because the sections were not ideally stained.

Gibson (1990) illustrated two proboscis muscle crosses in *D. sinensis*, while Yin and Zeng (1984, 1985, 1986) described the proboscides of *D. zhanjiangensis*, *D. sinensis* and *P. papillaris* as possessing, respectively, one, one and no muscle crosses. The presence of two...
muscle crosses in all the sectioned proboscides can be confirmed by careful examination. In the holotypes of the two Dendrorhynchus species the weaker cross that was missed by Yin and Zeng is represented by a few muscle bundles leading from the circular muscle layer (Figure 2H, I). In the holotype of P. papillaris, both muscle crosses are weakly developed (Figure 2K, L).

In the initial part of the main axis, the proboscis is composed of an epithelium, an outer connective tissue layer, a longitudinal muscle layer separated into two portions by a neural sheath, an inner connective tissue layer and an endothelium. In this region, circular muscle layers and muscle crosses are absent, but distinct proboscis nerves can be seen in all the proboscides sectioned (Figure 2G).
| Character                                                                 | \(D. \textit{zhanjiangensis}\) | \(D. \textit{sinensis}\) | \(P. \textit{papillaris}\) | Results of present observations and comments |
|--------------------------------------------------------------------------|-------------------------------|-----------------------------|-------------------------------|---------------------------------------------|
| Rhynchodaeal groove                                                     | Absent                        | Present                     | Present                       | Presence of the rhynchodaeal groove most probably the result of contraction |
| Number of muscle layers of main axial branch                            | 3                             | 3                           | 1 in basal part, 3 above the basal part | All holotypes with single longitudinal muscle layer in the initial region of proboscis axis, and with three muscle layers distally |
| Muscle papilla in proboscis                                             | Absent                        | Absent                      | Present                       | “Papilla” formed by muscles protruded from a damaged portion of proboscis and cannot be interpreted as an genuine structure in this nemertean |
| Number of muscle crosses in proboscis axis                              | 1                             | 1                           | 0                             | All sectioned proboscides with two muscle crosses, although may be weakly developed |
| Nerves in proboscis axis                                                | Clear (1984, p. 54)           | Not clear                   | Clear                         | Detectable in the initial region of proboscis of \(D. \textit{sinensis}\) (Figure 2G) |
| Branch pattern of proboscis in holotype                                 | 6 primary branchlets, each branching dichotomously 1–3 (1–5, Figure 3E) times. | 13 primary branchlets, each branching dichotomously 1–2 (1–3, Figure 3D) times. | 12 primary branchlets, each branching dichotomously 1–2 (1–3, Figure 3F) times. In everted condition | Full eversion or retraction of proboscis not obtained, a complete branching pattern impossible to be outlined so far, but large individuals seeming to bear more branchlets at each branching level. Maximum number of primary and terminal branchlets in present specimens being 20 and 110, respectively |
| Number of terminal branchlets “Mid-dorsal rhynchocoelic blood vessel”   | 29                            | 44                          | 36                            | \textit{Ibid} |
| “Neurochord cells” around ventral fibrous cores                         | Absent                        | 1 pair                      | 2 pairs (in plate II Figure 5, the top is ventral, the bottom is dorsal) | Detectable in \(D. \textit{zhanjiangensis}\) (Figure 2F) and \(P. \textit{papillaris}\), the structure being interpreted as a rhynchocoelic nerve in the present paper |
| Body-wall connective tissue stratum in mid-intestinal region (=intestinal region) | Thin                           | Loose                       | Disappeared                   | Present in sections of the anterior portion of intestinal region but absent in sections of the posterior portion of intestinal region. Sections of holotypes, however, representing different portions of intestinal region |
| Body-wall connective tissue in foregut region                           | Loose                         | Dense                       | Loose (1986, p. 3)            | This difference most likely to be intraspecific variation |
| Position of protonephridial ducts                                       | Posterior foregut and anterior intestinal regions | Foregut region | Foregut region (1986, p. 6) | None of the deposited slides of three holotypes containing full section series from head to anterior intestinal region. New sections suggesting that the system emerges a short distance behind the mouth and extends posteriorly to the anterior border of intestinal region |
| Mid-dorsal nerve                                                        | Absent                        | Present                     | Present                       | Detectable in some sections of foregut region in \(D. \textit{zhanjiangensis}\) |
Digestive system

The mouth is an elongate slit opening ventrally a short distance behind the brain. The foregut possesses a subepithelial gland cell zone (Figure 4A). In most places, the foregut epithelium and the subepithelial gland regions can only be distinguished by the nature of their glands, as in Polybrachiorhynchus dayi (see Gibson 1977). The epithelium and subepithelial gland cell zone together are up to 120 µm deep in the ventral foregut wall, but weakly developed dorsally and normally less than half their ventral height.

As indicated by Gibson (1990), a circular muscle layer enclosing the foregut runs outside the subepithelial gland zone. On the dorsal foregut borders, the circular muscles are intermingled with longitudinal muscle fibers (Figure 2B), which form a weakly developed muscle plate.

The structure of the intestine is similar to that of Polybrachiorhynchus dayi, consisting of two regions. A short anterior region forms a dorsoventrally compressed tube without lateral pouches. Posteriorly, as the body becomes broader and more compressed, the intestine begins to bear shallow lateral pouches. More posteriorly, the intestine is characterized by numerous deep diverticula and the main intestinal duct is reduced. This unusual distribution of lateral diverticula has been recorded in Dendrorhynchus zhanjiangensis by Yin and Zeng (1984) and P. dayi by Gibson (1977), but was not mentioned in the type specimens of D. sinensis and Polydendrorhynchus papillaris (see Yin and Zeng, 1985, 1986). Subdivision of the intestinal diverticula was not detected in the Zhanjiang worms, while the diverticula of P. dayi are subdivided in the posterior portion of the intestinal region (Gibson, 1977).

As in P. dayi, the epithelium of the main intestinal tube and diverticula can be distinguished by their histological difference. The epithelium of the diverticula possesses more red-staining glands and more granular components than that of the main intestinal tube (Figure 4B).

The intestinal tube is enclosed by an outer circular and an inner longitudinal muscle layer (Figures 5J and 6L). As having been recorded for P. dayi (see Gibson 1977), the circular muscles are derived from the dorsoventral muscles. The longitudinal muscle layer is strongly developed, and connections between this muscle layer and body wall musculature were not found. In some sections of the anterior intestinal region, the longitudinal splanchnic muscle layer may reach the thickness of body wall inner longitudinal muscle layer.

Blood system

The blood system is similar to that of Polybrachiorhynchus dayi. The cephalic blood supply, beginning as a transverse connective in front of the proboscis pore (Figure 5A), consists of a series of inter-connected lacunae surrounding the dorsal and lateral margins of the rhynchodaeum (Figure 5B, C). It forms two crescent-like lacunae near the proboscis insertion (Figure 5D). In the anterior cerebral region, these two lacunae fuse ventrally to form a U-shaped lacuna (Figure 5E). More posteriorly the U-shaped lacuna is ventrally divided by connective tissues and muscle fibers, from where a mid-dorsal blood vessel and a ventral cerebral lacuna emerge (Figures 4D and 5F, G). The mid-dorsal blood vessel runs for a short distance in the rhynchocoel wall, and then forms the rhynchocoelic villus (Figures 4H and 5H, I). At the rear of the cerebral region, the lateral cerebral lacuna expand to bathe the rear portion of the cerebral sense organs (Figures 5G and 6I). The ventral cerebral lacuna, namely the "esophageal blood vessel" (see Dakin and Fordham
Figure 5. *Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984, a series of schematic transverse sections through different regions of the holotype of *D. zhanjiangensis*; the blood system is indicated by solid black. (A) In front of the proboscis pore. (B, C) Through the rhynchodaeal region. (D) At position of proboscis insertion, arrows point to the crescent-like lacunae. (E)–(G) Through successive positions of cerebral region. (H) At anterior border of mouth region; arrows point to the branches of “esophageal blood lacuna”. (I) Through foregut region. (J) Through the anterior portion of intestinal region. (K) Through the position near posterior end of body. Abbreviations: bc, transverse blood connectives between the mid-dorsal and lateral blood vessels; cm, circular muscle layer of body wall; cso, cerebral sensory organ; ct, connective tissue stratum of body wall; dg, dorsal cerebral ganglion; fg, foregut; fvp, foregut vascular plexus; ilm, inner longitudinal muscle layer of body wall; im, muscles surrounding intestine; in, main duct of intestine; lcl, lateral cerebral lacuna; ln, lateral nerve; lv, lateral blood vessel; m, mouth; mv, mid-dorsal blood vessel; ns, neural sheath; olm, outer longitudinal muscle layer of body wall; pa, parenchyma; rc, rhynchocoel; rd, rhynchodaeum; rv, rhynchocoelic villus; sec, subepidermal circular muscle layer; sl, spacious lacuna that posteriorly leads to lateral blood vessel; ul, U-shaped cerebral lacuna; vc, ventral cerebral commissure; vcl, ventral cerebral lacuna; vg, ventral cerebral ganglion.
1936; Yin and Zeng 1984, 1985, 1986), is inter-connected with the lateral lacuna in some places. This lacuna divides into two near the mouth (Figure 5H). More posteriorly, blood lacunae are subdivided to form a foregut vascular plexus, which contains two spacious lacunae flanking the rhynchocoel (Figure 5I). In the rear foregut region, these two lacunae become thicker-walled and continue posteriorly as the main lateral vessels. Throughout most of the intestinal region, the blood supply consists of a pair of lateral vessels and a mid-dorsal vessel, linked by a series of transverse connectives (Figure 5J). Near the anus, the mid-dorsal vessel is clearly expanded in some specimens (Figure 5K). A distinct anal lacuna, linking all three longitudinal blood vessels, as indicated by Yin and Zeng (1984, 1985, 1986), was not detected in the present studies.

Gibson (1990) stated that “Yin and Zeng (1984) distinguish between them principally in that compared with D. sinensis, D. zhanjiangensis exhibits a reduced proboscis branching, different dermal connective tissue organization and has no rhynchocoelic villus” (p 137). Furthermore, he states that Dendrorhynchus and Polybrachiorhynchus resemble each other in “..., foregut vascular plexus and rhynchocoelic villus (erroneously indicated as missing from Polybrachiorhynchus in Yin and Zeng’s 1985 table)” (p 138). Gibson (1990) evidently misunderstood Yin and Zeng’s term “mid-dorsal rhynchocoelic blood vessel” to mean rhynchocoelic villus. In Yin and Zeng’s (1985, Figure 3) paper, a weakly stained structure situated close to the dorsal rhynchocoel wall was called a “mid-dorsal rhynchocoelic blood vessel” (also see Figure 2E) and, therefore, listed as present in D. sinensis (Yin and Zeng 1984, Table 1; 1985, Table 1), but absent from D. zhanjiangensis (Yin and Zeng 1984, Table 1) and from the genus Polybrachiorhynchus (Yin and Zeng 1985, Table 1). The rhynchocoelic villus, termed “rhynchocoelic ridge” by Yin and Zeng, was reported present in D. sinensis, D. zhanjiangensis and P. papillaris by Yin and Zeng (1984, 1985, 1986). The so-called “mid-dorsal rhynchocoelic blood vessel” of Yin and Zeng is interpreted as a rhynchocoelic nerve in the present studies (vide post).

The main longitudinal vessels are thick-walled and bear inner circular and outer longitudinal muscle fibers, but the longitudinal muscles are only well-developed in the mid-dorsal vessel.

Excretory system

Although Yin and Zeng (1984) indicated that in Dendrorhynchus zhanjiangensis the excretory collecting tubules extended to the anterior intestinal region, this was not found in the present studies in the deposited slides of Zhanjiang-8403 (slides Middle 1–12), which represent the foregut region (slide Middle 11) and the anterior intestinal region (slides Middle 1–10 and 12). In fact, none of the deposited slides of the holotypes of D. sinensis, D. zhanjiangensis and Polydendrorhynchus papillaris consist of complete series of sections from the head to the anterior portion of the intestinal region.

In the sections of specimen Zhanjiang-8403-1, the excretory system emerges a short distance behind the mouth and extends posteriorly to the anterior border of the intestinal region. Most of the nephridial ducts spread alongside the ventral and lateral margins of the foregut (Figure 2A) and are mostly in intimate contact with branches of the foregut vascular plexus. A pair of main longitudinal collecting ducts runs dorsolaterally at the outer margins of the foregut (Figure 4C). These ducts may be branched and extend for about the anterior third of the full length of the excretory system. Each of the main collecting ducts posteriorly leads to an efferent canal, which enters the body wall and may run posteriorly for a short distance in the body wall musculature before discharging on the
dorsolateral body surface (Figure 2A). Flame cells (end organs) as illustrated by Dakin and Fordham (1936; plate V, Figure 22) in *Gorgonorhynchus repens* were not found in the present study.

**Nervous system**

The central nervous system is enclosed by connective tissue. Fibrous cores of the cerebral ganglia and lateral nerves are also enclosed by connective tissue (neurilemma). The fibrous
core of the dorsal cerebral lobes, as described by Yin and Zeng (1984, 1985, 1986), is posteriorly forked into upper and lower branches (Figure 5G). The lower branch posteriorly leads into the cerebral organ (Figure 5G). In addition to the well-developed ventral cerebral commissure, another transverse connective between the ventral cerebral lobes, about 20 μm thick, is present in the posterior portion of the cerebral region (Figure 4D). At the front of the brain, from both dorsal and ventral ganglia numerous cephalic nerves emerge, with up to 30 or more on either side clustered along the lateral borders of the rhynchodaeum.

Yin and Zeng recorded that Dendrorhynchus zhanjiangensis and D. sinensis possessed one pair of neurochord cells (Yin and Zeng 1984, 1985), while Polydendrorhynchus papillaris possessed two pairs (Yin and Zeng 1986). The so-called “neurochord cells” illustrated by Yin and Zeng (1984; plate I, Figure 7) for D. zhanjiangensis, by Yin and Zeng (1985; plate I, Figure 3) for D. sinensis, and by Yin and Zeng (1986, 1988; plate II, Figure 5, the upper one) for P. papillaris are in the present study interpreted as buccal nerves (foregut nerves) (Figure 4D, F). These buccal nerves originate from the posterior portion of the ventral cerebral lobes, at first extending posteriorly in the ganglionic tissues (Figure 4D) before emerging to run posteriorly below the rhynchocoel. After leaving the ganglionic tissues, the two buccal nerves are linked by a transverse connective (Figure 4G). In the buccal region, each nerve is subdivided into a few small nerves (Figure 4E), some of which extend posteriorly to the ventral margin of the foregut. The dorsal “neurochord cell” illustrated by Yin and Zeng (1986; plate II, Figure 5, the lower one) is enclosed by connective tissue and appears not to be a cell.

Many large cells, which may be 30 μm or more in diameter and possess a distinct nucleus, are found around the fibrous cores of the dorsal and ventral cerebral lobes (Figure 6B–E). The appearances, number and distribution of these cells are more similar to the Type III cells illustrated for heteronemerteans by Bürger (1895; plate 24, Figures 1–5, 21, 23, 25, 26) than the neurochord cells illustrated by him (Bürger 1895; plate 24, Figures 3 and 5). In the holotype of P. papillaris, a structure which is much bigger than the Type III cells (about 40 μm in diameter), is present in the ganglionic tissues of the posterior portion of each ventral cerebral lobe (Figure 6F). A distinct nucleus cannot be
distinguished in this structure and whether or not it represents a neurochord cell could not be determined. Neurochords were not found in the lateral nerves.

Several transverse connectives between the two lateral nerves were found in the anterior body region, but an anal commissure between the nerves was not traced.

The mid-dorsal nerve (Figure 6A), though difficult to distinguish in some sections, is present in all specimens sectioned. A rynchocoelic nerve, interpreted as a “mid-dorsal rynchocoelic blood vessel” by Yin and Zeng (1985, Figure 3), is present in all the specimens examined histologically. It occurs not only where the muscle cross between the rynchocoel and body wall is well-developed (Figure 2E, F), but also where this muscle crossing is wanting.

Near the inner borders of ventral cerebral ganglia, the ventral cerebral commissure sends a pair of distinct nerves. They run anteriorly for a short distance and then enter the proboscis through the proboscis insertion (Figure 6K) to form the nervous supply of proboscis.

**Sense organs**

Frontal organs were not detected in *Dendrorhynchus zhanjiangensis* by Yin and Zeng (1984), and were not mentioned in the original description of *Polydendrorhynchus papillaris* (see Yin and Zeng 1986). Yin and Zeng (1985) stated that “the cephalic glands (of *D. sinensis*) open to the outside of the body through the front organ at the dorsal part of the head”, but did not describe the structure of the frontal organ. The organs, though small in size, were detected in a few of the specimens sectioned (Zhanjiang-8304, Zhanjiang-8403-1 and NH1) during the present study. They consist of three separate pits (Figure 6G), about 65–95 μm in diameter. The arrangement of the frontal organs is thus similar to that of *Polybrachiorhynchus dayi*, but differs from the trifoliate structure occurring in *Gorgonorhynchus* (see Gibson 1974, 1977).

Horizontal cephalic slits form a pair of deep ciliated grooves extending along the lateral margins of the head. The outer and inner portions of the slits possess epithelium with differing staining features. The outer epithelium contains red-staining serous glands as found in the epidermis. Away from outer margins, the serous gland density decreases and by about the middle of the slits they have disappeared completely. In contrast, the inner epithelium of the slits possesses longer cilia and its basal region contains abundant nuclei (Figure 6H), as in species of the genus *Gorgonorhynchus* (see Dakin and Fordham 1936; Gibson 1974). At about the middle of the cerebral region, each cephalic slit leads to a ciliated cerebral canal, which finally enters the cerebral sensory organ from the ventrolateral border of the dorsal cerebral ganglion (Figure 5G).

The cerebral sensory organs are fused to the lower branch of the dorsal cerebral ganglia (Figure 5G). The most posterior portion of each cerebral organ is bathed by the spacious lateral cerebral lacunae and consists of a cluster of weakly stained gland cells (Figure 6I).

Eyes are absent.

**Cephalic glands**

There are weakly stained glands scattered between the muscle fibers in the cephalic region. Although Yin and Zeng (1985) stated that “the cephalic glands (of *Dendrorhynchus sinensis*) open to the outside of the body through the front organ”, aggregated cephalic glands that discharge via the frontal organs, as recorded in *Polybrachiorhynchus dayi* (see Gibson 1977), were not found.
Reproductive system

No gonads were found in any of the sections examined.

Geographic distribution

*Dendrorhynchus zhanjiangensis* has been reported from the coasts of Xiashan (Yin and Zeng 1984, 1985, 1986, 1988), Potou and Naozhou (present study), Zhanjiang City, Guangdong Province; and from Starfish Bay, Hong Kong (Gibson 1990).

Discussion

The manuscript that defined the genus *Dendrorhynchus* Yin & Zeng, 1985, and the species *D. sinensis* Yin & Zeng, 1985 was submitted to Oceanologia et Limnologia Sinica on June 4, 1984. The paper that described *D. zhanjiangensis* Yin & Zeng, 1984, was submitted to Marine Science Bulletin on July 26, 1984. Owing to the delayed publication of the former paper, the name *Dendrorhynchus* was used before the genus had been diagnosed. According to the International Code of Zoological Nomenclature, the available publication date of the genus name *Dendrorhynchus* is 1985 (Article 13.1), the available publication date of the specific name “*zhanjiangensis*” is 1984 in spite of the unavailability of its genus name (Article 11.9.3). The paper that established the genus *Polydendrorhynchus* Yin & Zeng, 1986, and the species *P. papillaris* Yin & Zeng, 1986, was first published in Chinese (Yin and Zeng 1986), with an English translation appearing later (Yin and Zeng 1988). Unaware of the earlier Chinese publication, Gibson (1995) incorrectly gave the publication date for this species as 1988.

Later, Gibson (1990) recorded *D. sinensis* from Starfish Bay, Hong Kong, and found a few differences between his specimens and the holotype described by Yin and Zeng (1985). In Gibson’s material, the organization of the body wall is intermediate between the grades described for *D. sinensis* and *D. zhanjiangensis*, the axis of the proboscis possesses two muscle crosses (one in the original description of Yin and Zeng) and there is a thin inner circular muscle layer between the inner connective tissue stratum and the endothelium (not mentioned by the original authors), and the foregut possesses a well-developed subepithelial gland layer (also not mentioned by Yin and Zeng).

Yin and Zeng (1984, Table 1; 1986, unnumbered table) listed 21 characters in the comparison tables. Those that differ between *D. sinensis*, *D. zhanjiangensis* and *P. papillaris* are summarized in Table I. Among these characters, the presence of a rhynchodaeal groove is probably the result of contraction by the specimen; the “muscle papilla” is formed by muscles protruded from a damaged portion of the proboscis and cannot be regarded as a genuine structure; the branching pattern and number of terminal branchlets in the proboscis may vary according to specimen size and degree of relaxation; the “mid-dorsal rhynchocoelic blood vessel” (Gibson 1990:137, misunderstood Yin and Zeng’s term to indicate a rhynchocoelic villus and erroneously stated that *D. zhanjiangensis* did not possess a rhynchocoelic villus: see earlier explanation) and neurochord cells are incorrect interpretations of structures that do not really differ among the putative species; and a dense or loose development of the connective tissue stratum in the foregut region is now interpreted as due to intraspecific variation. The differences in other characters are the result of incomplete examination of specimens (see Table I). Therefore, the three species (*D. zhanjiangensis*, *D. sinensis* and *P. papillaris*) are here synonymized as a single taxon, *Dendrorhynchus zhanjiangensis* Yin & Zeng, 1984.
A comparison between the four genera of heteronemertean possessing a branched-proboscis is given in Table II. Some characters listed by Gibson (1977, Table 1) and Yin and Zeng (1985, Table 1) are excluded from Table II either because they are the same in all four genera (horizontal cephalic slits, no eyes, and the interweaving between rhynchocoelic circular muscles and the body wall musculature) or are interpreted as unreliable for identifying genera. For instance, the criterion of degree of development of extracellular matrix (so-called parenchyma) and dorsoventral muscles is too subjective, or characters may be differently defined by different authors (e.g. neurochord cells, main collecting tubules of the excretory system). *Dendrorhynchus zhanjiangensis* differs from *Gorgonorhynchus* by all the characters listed in Table II except for the forked fibrous core in the posterior region of the dorsal cerebral lobes and the presence of a horizontal muscle plate between the rhynchocoel and dorsal foregut wall. *Dendrorhynchus zhanjiangensis* differs from *Panorhynchus* Serna de Esteban & Moretto, 1969 (the state of characters in *Panorhynchus* is indicated below by italics in parentheses) by the proboscis branching in a single plane (*as an open spiral*), the unbranched proboscis axis possesses two muscle crosses (*one*), the fibrous core of the dorsal cerebral lobe is posteriorly forked (*not forked*), the horizontal muscle plate is present (*absent*), the foregut possesses circular and longitudinal muscles (*spiral muscles*), there are longitudinal splanchnic muscles around the intestine (*no intestinal muscles*), the lateral diverticula and gland cells show a different distribution in the intestine (*do not show this differential distribution*), the mid-dorsal and lateral blood vessels have distinct muscular walls (*mid-dorsal vessel only*), and there is a subepithelial gland layer around the foregut (*absent*). As indicated by Gibson (1990), *D. zhanjiangensis* is similar to *Polybrachiorhynchus* Gibson, 1977, but differs from the latter by the absence of a caudal cirrus and by the posteriorly forked fibrous core in the dorsal cerebral lobes. In addition to the morphological similarities, *D. zhanjiangensis* occurs in similar habitats to *P. dayi* from South African, both having been found in mud banks and sand (*P. dayi*, unlike *D. zhanjiangensis*, has not been reported from sandy mud). *Gorgonorhynchus repens* (reported from Australia and the Indopacific) and *G. bermudensis* (found in Bermuda and the Atlantic coast of Florida), however, both seem prefer an oxygen-rich substrate; the former is associated with clean sand (Gibson 1981), the latter was found under stones among algae (Gibson 1974).

Gibson (1985) commented, without any phylogenetic study, that Group E (heteronemertean with a branched proboscis) was polyphyletic and split the group into three families. Due to the similarities with the genus *Polybrachiorhynchus*, the genus *Dendrorhynchus* was transferred to the family Polybrachiorhynchidae by Gibson (1990). A diagnosis modified from Yin and Zeng (1985) and Gibson (1990) is given below.

**Genus Dendrorhynchus** Yin & Zeng, 1985
**Synonym Polydendrorhynchus** Yin & Zeng, 1986
**Type species Dendrorhynchus sinensis** Yin & Zeng, 1985

**Diagnosis.** Heteronemertea with a single pair of horizontal lateral cephalic slits; with branched proboscis consisting of an undivided main axis from which primary branches emerge in a single plane, each primary branch dividing dichotomously several times; proboscis axis with three muscle layers (outer and inner longitudinal, middle circular) and two muscle crosses; rhynchocoel circular musculature not interwoven with body-wall longitudinal musculature, but in some places dorsally connected to body-wall circular musculature by a muscle cross; subepidermal gland zone and outer longitudinal...
Table II. Comparison of the four heteronemertean genera with a branched proboscis. Based on data from Gibson (1974, 1977) and the present study.

| Characters                                                                 | Gorgonorhynchus | Panorhynchus | Polybrachiorhynchus | Dendrorhynchus |
|----------------------------------------------------------------------------|-----------------|--------------|---------------------|----------------|
| Caudal cirrus                                                              | Present         | Absent       | Present             | Absent         |
| Branching mode of proboscis                                               | Regularly dichotomous | Alternate from main axis | Alternate from main axis | Alternate from main axis |
| Plane of proboscis branching                                               | Successive branches at right angles to each other | In an open spiral | In a single plane | In a single plane |
| Maximum number of terminal branchlets of proboscis                        | 64\(^1\)        | 22\(^1\)     | 96\(^1\)            | 110\(^2\)      |
| Valves in axils of proboscis branches                                      | Present         | Absent       | Absent              | Absent         |
| Number of muscle layers in main portion of unbranched proboscis axis       | 2               | 3            | 3                   | 3              |
| Number of muscle layers in terminal branchlet of proboscis                 | 3               | 2            | 2                   | 2              |
| Number of muscle crosses in unbranched proboscis axis                     | 0               | 1            | 2                   | 2              |
| Number of muscle crosses in terminal branchlet of proboscis                | 2               | 0            | 0                   | 0              |
| Body wall subepidermal gland zone separated from outer longitudinal muscles by distinct connective tissue stratum | Absent          | Present      | Present             | Present        |
| Fibrous core of dorsal cerebral lobe posteriorly forked or not             | Forked          | Not forked   | Not forked          | Forked         |
| Horizontal muscle plate of longitudinal muscle fibers                      | Present         | Absent       | Present             | Present        |
| Muscles around foregut                                                     | Absent          | Spiral       | Circular            | Circular+longitudinal |
| Foregut subepithelial gland layer                                          | Present         | Absent       | Present             | Present        |
| Longitudinal splanchnic muscles around intestine                           | Absent          | Absent       | Present             | Present        |
| Intestine showing differential distribution of lateral diverticula and gland cells | Absent          | Absent       | Present             | Present        |
| Cephalic lacunar network of blood system                                   | Absent          | Present      | Present             | Present        |
| Foregut vascular plexus                                                    | Absent          | Present      | Present             | Present        |
| Main longitudinal vessels with distinct muscular walls                    | Mid-dorsal vessel only | Mid-dorsal vessel only | Mid-dorsal and lateral vessels | Mid-dorsal and lateral vessels |
| Number of circular muscle layers around rhynchodaeum                      | 2               | 1            | 1                   | 1              |
| Frontal organ                                                             | Trifoliate, opening via a common pore | Unknown | Three pits, opening separately | Three pits, opening separately |
| Rhynchocoelic nerve                                                       | Unknown         | Unknown      | Unknown             | Present        |

\(^1\)Theoretical number. \(^2\)Observed number.
musculature of body wall separated by distinct layer of connective tissue; dorsal fibrous core of cerebral ganglia posteriorly bifurcated; nervous system probably without neurochord cells; foregut with circular muscles and weakly developed longitudinal muscle plate present between dorsal foregut wall and rhynchocoel; intestine with distinct circular and longitudinal muscles; blood system with cephalic lacunar network and foregut vascular plexus, mid-dorsal vessel developed into long rhynchocoelic villus; cephalic glands not extensive; frontal organ with three separate pits; with neither eyes nor caudal cirrus.

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References

Bürger O. 1895. Die Nemertinen des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Fauna und Flora des Golfes von Neapel 22:1–743.

Coe WR. 1947. Nemerteans of the Hawaiian and Marshall Islands. Occasional Papers of Bernice Panahi Bishop Museum 19:101–106.

Dakin WJ, Fordham MGC. 1931. A new and peculiar marine nemertean from the Australian coast. Nature (London) 128:796.

Dakin WJ, Fordham MGC. 1936. The anatomy and systematic position of *Gorgonorhynchus repens*, gen. n., sp. n.: a new genus of nemertines characterized by a multi-branched proboscis. Proceedings of the Zoological Society of London 461–483.

Gibson R. 1974. Occurrence of the heteronemertean *Gorgonorhynchus bermudensis* Wheeler, 1940, in Floridan waters. Bulletin of Marine Science 24:473–492.

Gibson R. 1977. A new genus and species of lineid heteronemertean from South Africa, *Polybranchiorhynchus dayi* (Nemertea: Anopla), possessing a multi-branched proboscis. Bulletin of Marine Science 27: 552–571.

Gibson R. 1981. Nemerteans of the Great Barrier Reef. 3. Anopla Heteronemertea (Lineidae). Zoological Journal of the Linnean Society 71:171–235.

Gibson R. 1985. The need for a standard approach to taxonomic descriptions of nemerteans. American Zoologist 25:5–14.

Gibson R. 1990. The macrobenthic nemertean fauna of Hong Kong. In: Morton B, editor. Proceedings of the second international marine biological workshop: The marine flora and fauna of Hong Kong and southern China, Hong Kong, 1986. Volume 1. Hong Kong University Press. 33–212.

Gibson R. 1995. Nemertean genera and species of the world: an annotated checklist of original names and description citations, synonyms, current taxonomic status, habitats and recorded zoogeographic distribution. Journal of Natural History 29:271–562.

Gravely FH. 1927. Nemertinea. Bulletin of the Madras Government Museum, New Series, Natural History 1:53–54.

McDermott JJ. 2001. Status of the Nemertea as prey in marine ecosystems. Hydrobiologia 456:7–20.

Serna de Esteban CJ de la, Moretto HJA. 1969. Un nuevo heteronemertino con proboscis ramificada *Panorhynchus argentinensis* gen. et sp. nov. Ciencia e Investigación 25:166–171.

Wheeler JFG. 1936. Record of *Gorgonorhynchus* at Bermuda. Nature (London) 137:33.

Wheeler JFG. 1940. Notes on Bermudan nemerteans: *Gorgonorhynchus bermudensis*, sp. n. Annals and Magazine of Natural History, Series 11 6:433–438.
Yin Z, Zeng F. 1984. The study of a new species of genus *Dendrorhynchus* - *Dendrorhynchus zhanjiangensis*, of lineid heteronemertean, possessing multibranched proboscis. Marine Science Bulletin 3:51–58 (in Chinese with English abstract).

Yin Z, Zeng F. 1985. On *Dendrorhynchus sinensis* gen. et sp. nov. of lineid heteronemertean. Oceanologia et Limnologia Sinica 16:323–335 (in Chinese with detailed English summary).

Yin Z, Zeng F. 1986. The study of a new genus and species - *Polydendrorhynchus papillaris* of lineid heteronemertean possessing multibranched proboscis. Journal of Shandong College of Oceanology 16:1–9. plate I and II bound between page 116 and 117 (in Chinese with English abstract; for English translation, see Yin and Zeng 1988).

Yin Z, Zeng F. 1988. The study of a new genus and species of nemertean *Polydendrorhynchus papillaris*, possessing a multi-branched proboscis. Marine Science Bulletin (English edition) 1:176–187 (English translation of Yin and Zeng 1986).