

for Lukas Schärer, with my best wishes

~~R. Sluys~~

FIRST REPRESENTATIVE OF THE ORDER MACROSTOMIDA IN AUSTRALIA
(PLATYHELMINTHES, MACROSTOMIDAE)

by

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ABSTRACT

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A new species of macrostromid flatworm is described, *Promacrostromum palum* sp. nov., forming the third member of its genus and being the first representative of the order Macrostromida to be reported for Australia.

INTRODUCTION

Macrostromid flatworms have been reported from all major parts of the world, except for Australia and New Zealand (cf. Ferguson 1939, Map 2; Ferguson 1954, Table 1; Williams 1980, p. 52). The majority of the species within the family Macrostromidae belong to the large genus *Macrostromum* O. Schmidt, 1848. The present paper describes a new macrostromid species, which was found in Australia. The species belongs to a genus which has a different and more complex female copulatory apparatus than is the case in *Macrostromum*.

Recent literature on the Macrostromidae is rather scattered but the papers of Ferguson (1939-40, 1954) still represent a useful introduction, whereas those of Papi (1953), Luther (1960) and Young (1976) are some of the larger papers among more recent publications.

SYSTEMATIC SECTION

Family MACROSTOMIDAE Van Beneden, 1870

Genus *Promacrostromum* An-der-Lan, 1939

Promacrostromum palum sp. nov.

Material Examined

Holotype: South Australian Museum, Adelaide, V3973, Elizabeth Springs, South Australia (29°21.36 S, 136°46.30'E), 27.11.1983, coll. W. Zeidler, W. Ponder, sagittal sections on two slides.

Paratypes: SAM, V3974, *ibid.*, horizontal sections on one slide; SAM, V3975, *ibid.*, transverse sections on one slide; Australian Museum, Sydney, W197775-1, Elizabeth Springs, South Australia, 5.09.1983, coll. W. Ponder, E. Hershler, D. Winn, sagittal sections on one slide; AM, W197775-2, *ibid.*, horizontal sections on one slide.

The holotype was sectioned at intervals of 5 μ m; the paratypes at 8 μ m. All sections were stained in Mallory-Heidenhain.

Etymology

The specific epithet is from the Latin *pala* (= spade) and refers to the shape of the hind end of the body.

Description

External Features

The preserved specimens measured 2.38-3.5 mm in length and 0.75-1 mm in diameter. In some specimens of sample AM W197775 the front end of the body was pointed, but in others and in specimens from SAM V3973-75 it was broadly rounded (Figs 1, 2). The hind end of the body is of a peculiar shape. In preserved specimens the posterior lateral margins give rise to a dorsally directed ridge at either side of the body; the posterior margin of the body shows a convex middle section (Figs 1, 2, 3). The preserved animals are devoid of pigment. Eyes were not visible in preserved specimens but only in animals cleared in clove oil.

Epidermis and Subepidermal Musculature

The height of the epidermal cells is about 11.5 μ m; the cells are provided with numerous cilia which have a length of about 9 μ m. Numerous and well-developed packages of rhabdites pierce the body wall, whereas rhabdite-tracks ("Stäbchenstrassen") are present at the front end. "Haftpapillen" are absent. A cyanophilous, granular secretion is discharged through the ventral epidermis at the posterior tip of the body. The gland cells are situated in the parenchyma.

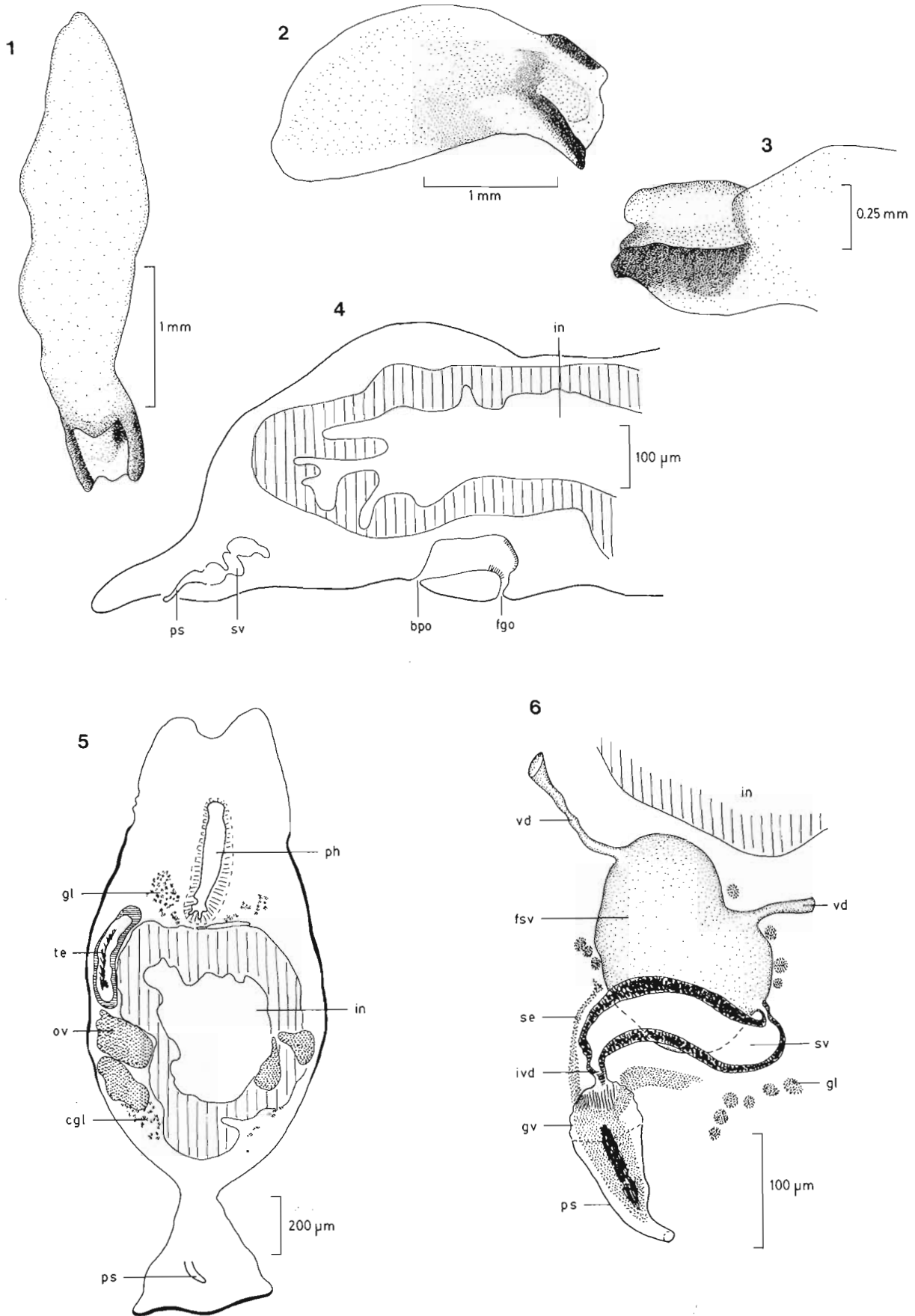
The subepithelial musculature consists of outer circular muscle fibres and inner longitudinal fibres.

Nervous System and Eyes

The brain lies just in front of the pharynx and is closer to the ventral than to the dorsal body surface. The two eyes are situated just on top of the brain.

Alimentary System

The thin epithelium lining the simple pharynx bears numerous well-developed cilia. Erythrophilous gland cells surround the pharynx where it communicates with the intestine. The intestinal cells are provided with long, but not very conspicuous, cilia. The intestine is underlain with a well-developed row of circular muscle



FIGS 1-6. *Promacrostomum palum* sp. nov. 1. Dorsal view of preserved specimen from sample W197775. 2. Dorsal-lateral view of preserved specimen from sample V3973-75. 3. Lateral view of the hind end of the body. 4. Sagittal reconstruction of holotype to show the position of the male and female copulatory organs and the intestine. 5. Horizontal section of V3974. 6. Horizontal reconstruction of the male copulatory organs of V3974.

fibres which is bounded by an outer row of longitudinal fibres. The sac-shaped intestine extends backwards to the male copulatory apparatus, and thus runs over the female copulatory system (Fig. 4).

Male Reproductive System

The two elongated testes are situated ventrally and shortly behind the pharynx, one follicle at either side of the body (Fig. 5). The vasa deferentia open behind the posterior tip of the intestine, into a large false seminal vesicle (Fig. 6). The false seminal vesicle communicates with the true seminal vesicle by means of a considerable, muscularized constriction. This true seminal vesicle lies partly underneath the false seminal vesicle; the former is an elongated sac which is provided with a very thick muscular wall. A short and narrow intervesicular duct connects the true seminal vesicle with the rounded granular vesicle which receives the granular secretion of glands that lie distributed in the parenchyma. The wall of the granular vesicle is provided with a thin layer of muscles.

The proximal portion of the "chitinized" penis stylet is attached to the granular vesicle and consists of a broad cone that runs parallel to the body surface and which tapers into the much narrower distal section of the stylet. The distal section shows a pronounced bend towards the ventral body surface (Fig. 7). Sagittal sections already suggested the presence of a lateral flexure in the very distal portion of the stylet. This flexure did indeed show up in the transverse sections (Fig. 8). No unequivocal information could be obtained on the opening of the stylet. The sagittal sections suggested that the tip was closed such that there was a subterminal opening. On the other hand, the horizontal sections suggested the presence of a terminal opening, whereas in the transverse sections the tip of the stylet could not be discerned.

Female Reproductive System

The ovaries lie directly behind the testes and are situated ventrally; they are rather small (Fig. 5). The oviducts do not extend backwards but run directly towards the mid-line of the ventral body region, where they unite into a short common oviduct. The latter opens into the female antrum. There is a free connection between common oviduct and female antrum; a so-called "Verschlussapparat" is absent (Figs 9, 10).

The female antrum is lined with more or less cuboidal cells which bear long cilia. In specimen V3975 a large and thick mass of cells was attached to the dorsal surface of the antrum leaving at one place a small opening for the common oviduct. Sperm were attached to the clump of cells (Fig. 9). The antrum opens via a ciliated stalk into the ventral exterior. The lining epithelium of the stalk is penetrated by numerous openings of erythrophilous cement glands which are distributed in the parenchyma around the female antrum. The posterior wall of the female antrum meets a so-called seminal bursa. Communication between

antrum and bursa may take place either via a considerable narrowing, as is the case, for example, in specimen W197775-1 (Fig. 11) and V3975, or via a much wider opening (Fig. 10). The seminal bursa is lined with tall, vacuolated, cells, whereas its lumen may contain sperm. The bursa communicates via a narrow ventral pore with the exterior. Female antrum and seminal bursa are surrounded by a well-developed layer of muscles.

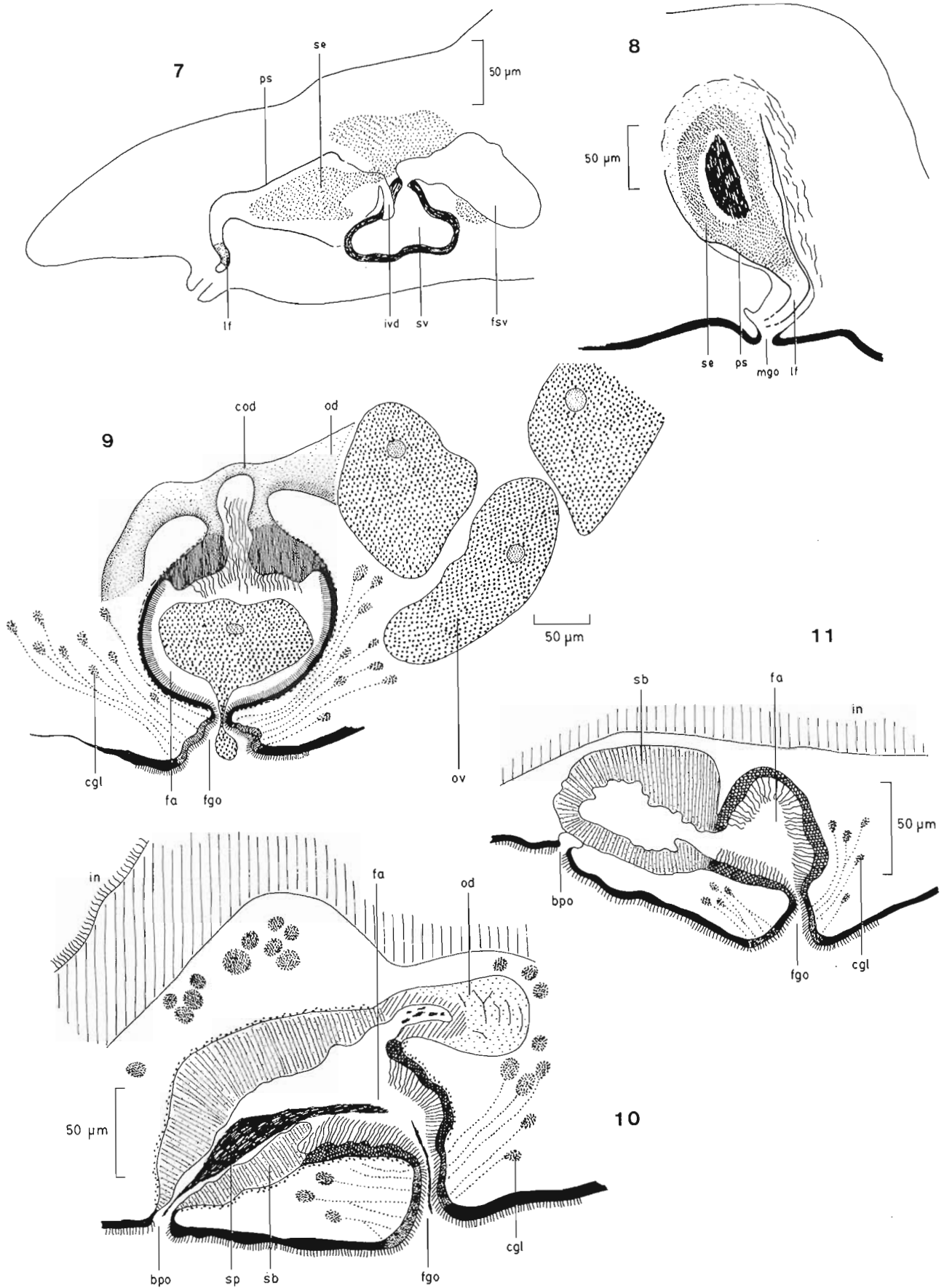
COMPARATIVE DISCUSSION

The genus *Promacrostomum* at present contains only three species, including the one described in this paper. The type species *P. paradoxum* was described from Lake Ohrid, Yugoslavia (An-der-Lan 1939).

On the basis of a description by Gieysztor (1931), Ferguson (1939-40) described the species *Macrostomum gieysztori* which he showed to be different from *M. gracile* (Pereyslawzewa, 1892; Graff, 1905) to which the first-mentioned author had assigned the specimens collected. Papi (1951a) transferred the species to the genus *Promacrostomum*, but Ferguson (1954) erected the genus *Axia* for the species *gieysztori*. The new generic name *Axia*, however, has not been accepted since it is not used in recent literature. *P. gieysztori* has been found in Spain and Italy; it is a thermophilic freshwater species (Ferguson 1939-40, 1954; Papi 1951b).

P. gieysztori has a distinct common oviduct which empties into a structure that possesses two openings to the exterior (cf. Papi 1951b, Fig. 54; Ferguson 1954, Fig. 23). The anterior portion of this body is rather spacious and secretion of cement glands is discharged into its ventral opening. The major part of this anterior structure is lined with cells bearing long cilia. Because of its shape, distinct ciliation, and the presence of cement glands around its pore, I consider this anterior section of the female copulatory apparatus of *P. gieysztori* to be homologous on the one hand with the female antrum of *Macrostomum* species, and on the other hand with the antrum of *P. palum*. As a consequence, the most anterior pore in *P. gieysztori* corresponds with the female gonopore.

The second opening of the female reproductive system in *P. gieysztori* lies posteriorly to the female gonopore and leads into the narrower posterior portion of the female apparatus, of which the ventral section is lined with cells having long cilia. The dorsal portion of this posterior part of the female apparatus is connected to the dorsal portion of the female antrum by means of a curved duct. The non-ciliated lining of this wide duct varies in height and consists of a syncytial cell mass; the duct is surrounded by a rather thick layer of circular muscles (cf. Papi 1951b, Fig. 54). It is because of structural and positional similarities that I consider this duct to be homologous with the seminal bursa of *P. palum*. For the same reasons I consider the posterior female pore of *P. gieysztori* to be homologous with the bursal pore of *P. palum*.



FIGS 7-11. *Promacrostomum palum* sp. nov. 7. Sagittal reconstruction of the male copulatory system of W197775-1. 8. Transversal reconstruction of the penis stylet of V3975. 9. Transversal reconstruction of the female copulatory apparatus of V3975 at the level of the female antrum. 10. Sagittal reconstruction of the female copulatory apparatus of the holotype. 11. Sagittal reconstruction of the female copulatory organs of W197775-1.

Unfortunately, less detailed histological information is available on the female copulatory apparatus of *P. paradoxum*. In this species too, the female apparatus has two ventral openings to the exterior. The posterior pore leads into a well-developed female antrum. The anterior pore leads into a section of the female copulatory apparatus that communicates anteriorly with the intestine and posteriorly with the female antrum. The connection with the female antrum goes via a rather spacious "middle section" of the female apparatus. This "middle section" is surrounded by well-developed circular muscles. The female antrum and "middle section" are lined with a relatively tall, almost syncytial, epithelium (An-der-Lan 1939; Ferguson 1954).

It is evident from An-der-Lan's account that he considered the female antrum of *P. paradoxum* to be homologous with the atrium of *Macrostomum* and considered the posteriorly located pore of the former to be homologous with the single female genital pore in *Macrostomum* species. I agree with An-der-Lan's conclusion, although no data are available on the presence or absence of cement glands around the posterior female genital pore of *P. paradoxum* or on the ciliation of the female antrum, and oviducts were absent in the specimens examined by An-der-Lan. My view on this subject is based only on the position and the overall shape of the female antrum (cf. An-der-Lan 1939, Fig. 3). Nevertheless, I postulate homologous relationships between the posteriorly located female gonopore in *P. paradoxum*, the anterior female genital pore in *P. gieysztori* and *P. palum*, and the single female gonopore in *Macrostomum*. Such relationships are, of course, also hypothesized for the female antra into which these pores lead.

It is even more difficult to evaluate the possible relationships of the anterior pore and the "middle section" of the female copulatory apparatus in *P. paradoxum* with structures in other macrostomids. Because of the poor state of that particular section of the preparations, An-der-Lan (1939) was unable to provide information on the histology of that portion of the female copulatory apparatus which communicates with the anterior pore. Therefore, it is only because of its position that I consider this anterior pore in *P. paradoxum* to be different from the posterior female pore in *P. gieysztori* on the one hand, and from the bursal pore in *P. palum* on the other hand.

If the above interpretation is correct, then both *P. palum* and *P. gieysztori* differ from *P. paradoxum* in that in both the first-mentioned species the "secondary" pore is situated behind the female gonopore, whereas in the latter it lies in front of the "primary" female pore ("primary" pore refers to that opening into which cement glands discharge — as in *Macrostomum* — no phylogenetic meaning is implied).

P. palum differs from the two other members of the genus *Promacrostomum* in the shape of its tail, stylet

and that of the female copulatory apparatus (cf. Papi 1951b, Figs 52-54; Ferguson 1954, Figs 20-24).

Apart from similarities in the female copulatory apparatus, *P. palum* and *P. gieysztori* also agree in the absence of "Haftpapillen" and in the fact that the intestine runs over the female copulatory apparatus (cf. Ferguson 1939-40, 1954; Papi 1951b). In *P. paradoxum* the intestine terminates in front of the female copulatory apparatus and the species possesses well-developed "Haftpapillen" (An-der-Lan 1939).

From the account given above, one could conclude that *P. gieysztori* and *P. palum* have many more morphological similarities in common than either of them shares with *P. paradoxum*. In that respect the genus name *Axia*, as proposed by Ferguson (1954), may form indeed a plausible alternative for expressing the differences between *P. gieysztori* and *P. palum* on the one hand, and *P. paradoxum* on the other hand. However, absence of detailed histological information on the female system of *P. paradoxum* prevents a proper assessment of homologies. Pending such histological information it seems best, for the moment, to assign *P. gieysztori* and *P. palum* to the same genus as *P. paradoxum*.

The structure of the female copulatory apparatus in *Promacrostomum* invites a comparison with quite another member of the Macrostromida, viz. a representative of the family Microstromidae. In contrast to all other *Microstromum* species, the female apparatus of *M. spiriferum* Westblad, 1953 opens to the exterior by means of two ventral pores. These openings lead into two separate ducts, both connected with the single ovary. The most anterior duct is ciliated and opens into a small, ciliated chamber which is separated from the ovary by a sphincter. The posterior duct is non-ciliated and leads into a small seminal bursa which opens into the ovary (cf. Westblad 1953, Fig. 40). According to Westblad (*l.c.*) the anterior duct corresponds with the usual vagina but functions in *M. spiriferum* only as a discharging duct for the fertilized eggs. The posterior female duct would function as copulatory duct. It may be that the same functional distinction between both female pores holds true at least for *P. palum* and *P. gieysztori*. If such is the case, then it is clear that the same end result has been reached through parallel evolution.

It is evident from Papi's (1951b) account that he assumed such a functional distinction to be present in *P. gieysztori*. Papi described the female antrum of this species under the name of "antrum ovipositorium", whereas he designated the female gonopore as "porus ovipositorius". The posterior female pore in *P. gieysztori* leads, according to Papi, into the "vagina". Although I do not question the plausibility of such a functional distinction and even think it to be very likely, I have avoided terms such as vagina and antrum ovipositorium in the description of either *P. palum* or *P. paradoxum* and *P. gieysztori*. In the nomenclature

of the various morphological features of the female apparatus I tried to use the same name for structures considered to be homologous in *Promacrostomum* and *Macrostomum*.

Ball (private communication) during his extensive collecting of freshwater planarians in Australia (1982-1984) has recorded specimens of macrostomids from caves in Yanchep National Park, Western Australia but not in surface water. Therefore, it is

interesting that the first unequivocal record of a macrostomid turbellarian in Australia, *Promacrostomum palum* sp. nov., is also from a specialized habitat, viz. freshwater springs. Whether this situation represents an artifact or a real phenomenon remains an open question since in Australia scarcity of serious records for both freshwater and marine macrostomids also results from a lack of specialized interest in this group of animals.

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ABBREVIATIONS IN THE FIGURES

- bpo bursal pore
 cgl cement gland
 cod common oviduct
 fa female antrum
 fgo female genital pore
 fsv false seminal vesicle
 gl gland
 gv granular vesicle
 in intestine
 ivd intervesicular duct
 lf lateral flexure
 mgo male gonopore
 od oviduct
 ov ovary
 ph pharynx
 ps penis stylet
 sb seminal bursa
 se secretion
 sp sperm
 sv seminal vesicle
 te testes
 vd vas deferens