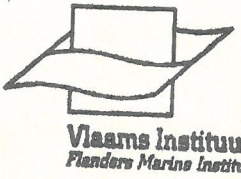
Chapter 8

On the Male Copulatory Organ of some Polycystididae and Its Importance for the Systematics of the Family

Ernest R. Schockaert
State University of Ghent, Belgium



Since 1956 an important diagnostic character for the family Polycystididae Graff, 1905 has been the fact that the seminal duct opens separately from the prostatic vesicle into the male genital canal (so-called *divisa* type). *Koinocystella inermis* Karling, 1952 and *Phonorhynchoides flagellatus* Beklemischev, 1927 were the only exceptions, but neither species was recognized as Polycystididae at the time of their description. Karling (1953, p. 361), studying the genus *Rogneda* Uljanin, 1870, modified very slightly the family diagnosis. In his work on the male atrial organs of the Kalyptorhynchia, Karling (1956) described several new species and genera of polycystidids in which the or-

ganization of the male copulatory organ deviated in one point or another from that described in the original diagnosis, and he wrote (loc. cit., p. 217): "Ein für Polycystididen gemeinsames diagnostisches Merkmal hinsichtlich des Baues der männliche Atrialorganen kann heute noch nicht formuliert werden."

An important fact that required an adaptation of the old diagnosis (Karling, 1964) was the presence in many newly described species of a copulatory organ of the *conjuncta* type, i.e., with an interposed prostatic bulb. At this moment the anatomy of the proboscis and of the pharynx gives us the main characters to recognize an eukalyptorhynchid turbellarian as a polycystidid.

For our discussion we have mainly been guided by the ideas of Karling (1956). The most important points of his theory on which our conclusions are based are the following:

1 All glands of the male genital canal (prostatic glands, accessory glands) are derived from differentiated cells of the epithelium of the male genital canal (Karling, 1956, pp. 216–217).

2 The stylet in Polycystididae (stylet of the prostatic vesicle and accessory stylets) are derivations of cirrus spines (Karling, 1956, pp. 204–206, 216–218) (*Hakenstilett*).

3 A stylet can also originate from the cuticularization of a penis papilla (Karling, 1940, pp. 192–193; 1956, pp. 206–207) (*Papillenstilett*).

COPULATORY ORGANS WITH SECONDARY INTERPOSED PROSTATIC VESICLE

In the genera *Annulorhynchus* Karling, 1956, *Psammopolycystis* Meixner, 1938, *Phonorhynchella* Karling, 1956, and *Gallorhynchus* Schockaert and Brunet, 1971 the male copulatory organ is composed of an unpaired seminal vesicle, an interposed prostatic vesicle, and a double-walled stylet. In *Annulorhynchus adriaticus* Karling, 1956 and in *Gallorhynchus mediterraneus* Schockaert and Brunet, 1971 the sperm-conducting stylet is accompanied by an accessory cuticular organ; in *Psammopolycystis* and in *Phonorhynchella* this accessory cuticular organ is provided with an accessory secretion reservoir.

On the other hand, a rather similar situation has been described for the *Scanorhynchus* species Karling, 1955, *Danorhynchus gösoeensis* Karling, 1955, and *Neopolycystis tridentata* Karling, 1965. In these species there is an interposed prostatic part, but a free prostatic vesicle occurs as well, and the seminal duct enters freely the male genital canal (but see below).

In both his publications of 1955 and 1956 Karling discussed the matter whether the interposed prostatic vesicle in the species known at that time was a primary or a secondary acquisition. In all above-mentioned polycystidids the interposed prostatic part is evidently a secondary acquisition. Its relative importance differs from species to species: in *Neopolycystis tridentata*

the interposed prostatic part is weakly developed; in the *Scanorhynchus* species interposed and free prostatic vesicles have the same importance, while the free prostatic vesicle is rudimentary in *Danorhynchus gösoeensis*. The stylet is associated with the free prostatic vesicle and accompanied by an accessory cuticular organ.

We call this kind of organization of the copulatory organ the Scanorhynchus type (Fig. 1*a–c*).

Although the stylet in this type is associated with the free prostatic vesicle, it also helps to conduct sperm, e.g., as in *Polycystis riedli* Karling, 1956, *Polycystis dolichocephala* (Pereyaslawseva, 1895), *Gyratrix hermaphroditus* Ehrenberg, 1831, *Phonorhynchus helgolandicus* (Mecznikov, 1865). (See also Karling, 1956, pp. 205, 212.)

When the free prostatic vesicle has now completely disappeared, and the stylet (with double wall!) is used only for transport of sperm and secretion of the interposed prostatic bulb, we have an organization of the male copulatory organ that can be called the Gallorhynchus type (Fig. 1*d–f*). It is found in its typical form in *Gallorhynchus mediterraneus* and *Annulorhynchus adriaticus*. Two modifications occur: the accessory cuticular organ is lost (*Gallorhynchus simplex* Schockaert and Brunet, 1971) or provided with an accessory secretion reservoir (*Psammopolycystis*, *Phonorhynchella*). The organization of the male copulatory organ of the latter two genera is termed the Psammopolycystis type. The occurrence of an accessory secretion reservoir can be observed in other, not necessarily closely related Polycystididae such as *Phonorhynchus helgolandicus*, *Typhlopolycystis coeca* Karling, 1956, *Polycystis nägelii* Kölliker, 1845.

What are the conclusions for the taxonomy? We are convinced that *Neopolycystis*, *Scanorhynchus*, *Danorhynchus gösoeensis*, *Annulorhynchus*, and *Gallorhynchus* are closely related to each other. In addition to the similarity of the organization of the male copulatory organ, they all possess a single ovary (most of them a single testis as well), a common genital pore in terminal position, and a comparable organization of the female atrial organs. This group can be connected with *Gyratrix* and *Gyratricella* Karling, 1955 through *Danorhynchus duplostylis* Karling, 1955. *Psammopolycystis* and *Phonorhynchella* are probably not so closely related to the above-mentioned group: the genital pore is not terminal in position and the organization of the female atrial organs is different.

COPULATORY ORGANS WITH PRIMARILY INTERPOSED PROSTATIC BULB

In the genus *Parachrorhynchus* Karling, 1956 and in *Koinocystella inermis* Karling, 1952 the interposed prostatic vesicle is evidently a primary situation. The same is true for the Duplacrorhynchinae Schockaert and Karling,

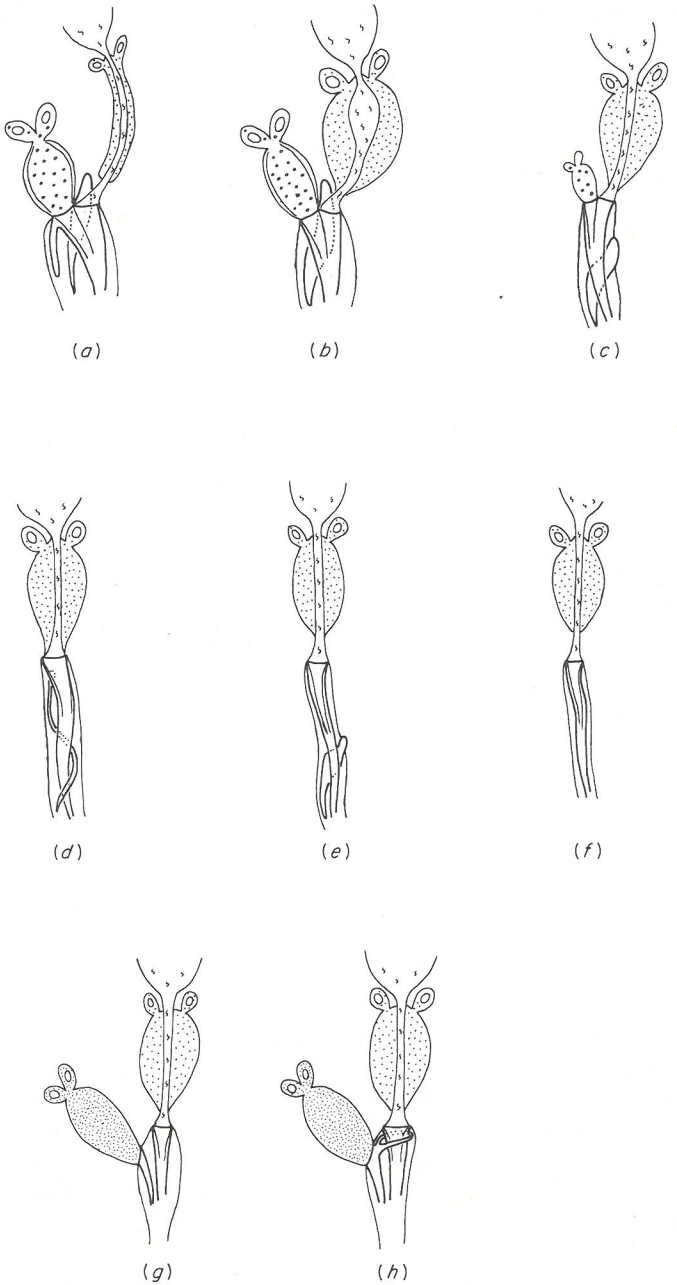


Figure 1 (a) *Neopolycystis*; (b) *Scanorhynchus*; (c) *Danorhynchus gösoeensis*; (d) *Annulorhynchus*; (e) *Gallorhynchus mediterraneus*; (f) *Gallorhynchus simplex*; (g) *Phonorhynchella*; (h) *Psammopolycystis*.

1970. In this subfamily a muscle septum is differentiated around the male duct to form a copulatory organ of the duplex type.

Recently another polycystidid has been described with a *conjuncta* copulatory organ that is to be considered as primitive: *Djeziraia pardii* Schockaert, 1971. The interposed prostatic vesicle contains two kinds of prostatic secretions and bears a simple single-walled stylet. It is difficult to see a relation of such a stylet with the so-called *Hakennatur* of the stylet of Polycystididae, and it is therefore considered as a *Papillenstilett*. Moreover, the similarity to the copulatory organ of *Yaquinaia microrhynchus* Schockaert and Karling, 1970 is striking. In this species the stylet is rudimentary and lies in an eversible cirrus, but here the copulatory organ is clearly of the duplex type, for the cirrus is enclosed in a cirrus sac. For a copulatory organ with a stylet it is often impossible to state whether it is built according to the duplex or simplex system (Karling, 1956, p. 192), and this is indeed the case for *Djeziraia pardii*. However, a copulatory organ of the type of *Djeziraia* can easily be derived from one as found in *Yaquinaia*, the stylet protractors being the incompletely formed muscle septum.

Within the group of species with a *conjuncta* copulatory organ, and where this situation is to be considered as a primary one, we can distinguish three categories:

1 The *Parachrorhynchus* type: a *conjuncta* type with a cirrus not enclosed in a cirrus sac (Fig. 2*a*).

2 The *Duplacrorhynchus* type: as the first type, but the cirrus enclosed in a cirrus sac (Fig. 2*b*, *c*). The organization as it is found in *Yaquinaia microrhynchus* can be considered as a transition to the next type.

3 The *Djeziraia* type: a *conjuncta* type with a *Papillenstilett*, the male genital canal not surrounded by a muscle septum (Fig. 2*d*).

It must be stressed that all species with a copulatory organ of the *Duplacrorhynchus* or *Djeziraia* type have been found on the coasts of the Indo-Pacific ocean and that this area is practically unexplored for turbellarians.

There is certainly a close relationship between the Polycystididae with a copulatory organ with primary interposed prostatic vesicle, but at the present state of our knowledge we cannot draw definitive conclusions on the taxonomy.

THE GENUS Phonorhynchoides

A special situation occurs in the genus *Phonorhynchoides* Beklemischev, 1927, with two species known so far: *P. flagellatus* Beklemischev, 1927 and *P. somaliensis* Schockaert, 1971. The organization resembles very much that of *Phonorhynchus helgolandicus*, but the sperm-conducting apparatus is of the *conjuncta* type.

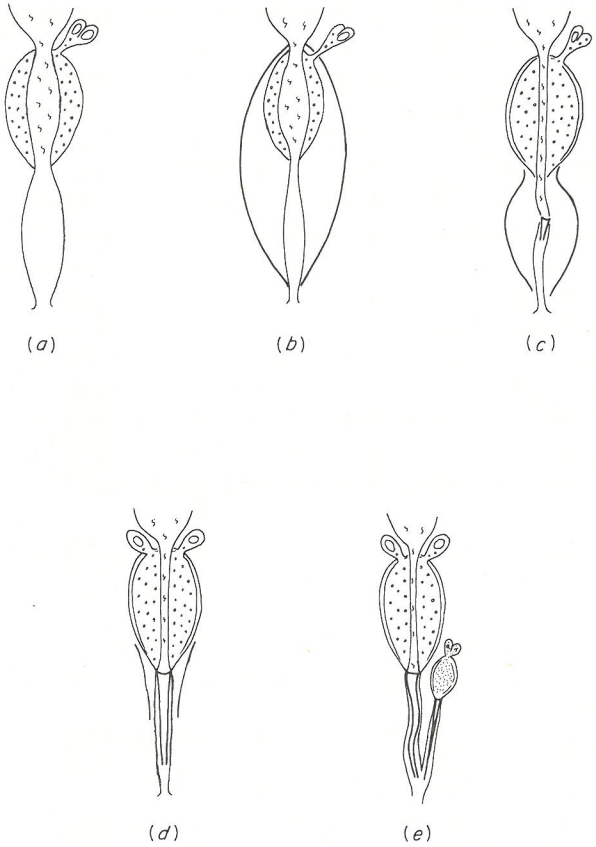


Figure 2 (a) *Parachrorhynchus*; (b) *Duplacrorhynchus*; (c) *Yaquinaia*; (d) *Djeziraia*; (e) *Phonorhynchoides*.

Typologically the male apparatus of *Phonorhynchoides* is comparable with those of *Psammopolycystis* and *Phonorhynchella*. For these two genera we have good evidence to consider the *conjuncta* condition as derived, but this is not the case for *Phonorhynchoides*. With the discovery of *Djeziraia* and *Yaquinaia* the possibility of a primary interposed prostatic vesicle with stylet must be taken into consideration. The stylet is apparently single-walled in *Phonorhynchoides somaliensis*, and it might be a penis derivation as it is in *Djeziraia*. However, an accessory cuticular stylet with secretion reservoir is also present.

We only include *Phonorhynchoides* in the discussion to have an all-

round survey of Polycystididae with a male copulatory organ with interposed prostatic bulb. We call this kind of organization the Phonorhynchoides type, but for the moment we are unable to give indications about the origin of this type. Taking other features into consideration, such as proboscis, female atrial organs, and number of gonads (paired in *Phonorhynchoides*), it becomes quite difficult to indicate any relationship of *Phonorhynchoides* with other representatives of the family with similar organization of the male atrial organs.

CONCLUSIONS

A male copulatory organ with interposed prostatic bulb is not at all an exceptional condition in the family Polycystididae. It is very difficult, however, and sometimes impossible to say whether this *conjuncta* condition is a primary or secondary one. Closely related to this problem is the origin of the stylet: can this be considered as derived from a cuticularized penis or from cirrus spines? A thorough morphological study and the discovery of new forms will bring us the solution for at least some cases.

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