

**Differentiation in the Pteropod *Clio pyramidata* L., 1767
forma *sulcata* (Pfeffer, 1879)**

by

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Pteropods are hermaphrodite animals. The reproductive system is composed of a hermaphrodite gland (gonad), a gonoduct, an accessory gland with one genital opening, a seminal groove and a penis.

KNOWER (1894), however, discovered in *Cavolinia longirostris* (Lesueur, 1821), two separate sexual openings and a closed ciliated tube running from the accessory gland to the penis, in which this species differs from all other Pteropods, in KNOWER's opinion. The closing of the seminal groove, by which a ciliated tube is formed, causes a better transport of the male products and on the other hand a female opening (vagina) becomes a necessity.

Pteropods are pelagic animals, a ciliated feeding mechanism enables the feeding on plankton. This special food has caused differentiations in the alimentary duct.

The differentiations in the genital and alimentary system of *Clio pyramidata* Linnaeus, 1767 forma *sulcata* (Pfeffer, 1879) will be discussed with regard to the above-mentioned facts. The animals investigated were collected on January 1, 1960, at 54°30'S 10°00'E and stained with haemalum-eosine.

The forma *sulcata* is a very differentiated form of the polytypic species *Clio pyramidata* Linnaeus, 1767, as is shown by the shells (VAN DER SPOEL, 1962). As to the anatomy the forms of this polytypic species usually do not differ so very much, but when two widely divergent forms are compared, the differences become evident. This will not rule out the theory that all the forms belong to one polytypic species, as there is a gradual change into one another. This change is parallel to their distribution; they form a cline (VAN DER SPOEL, 1962).

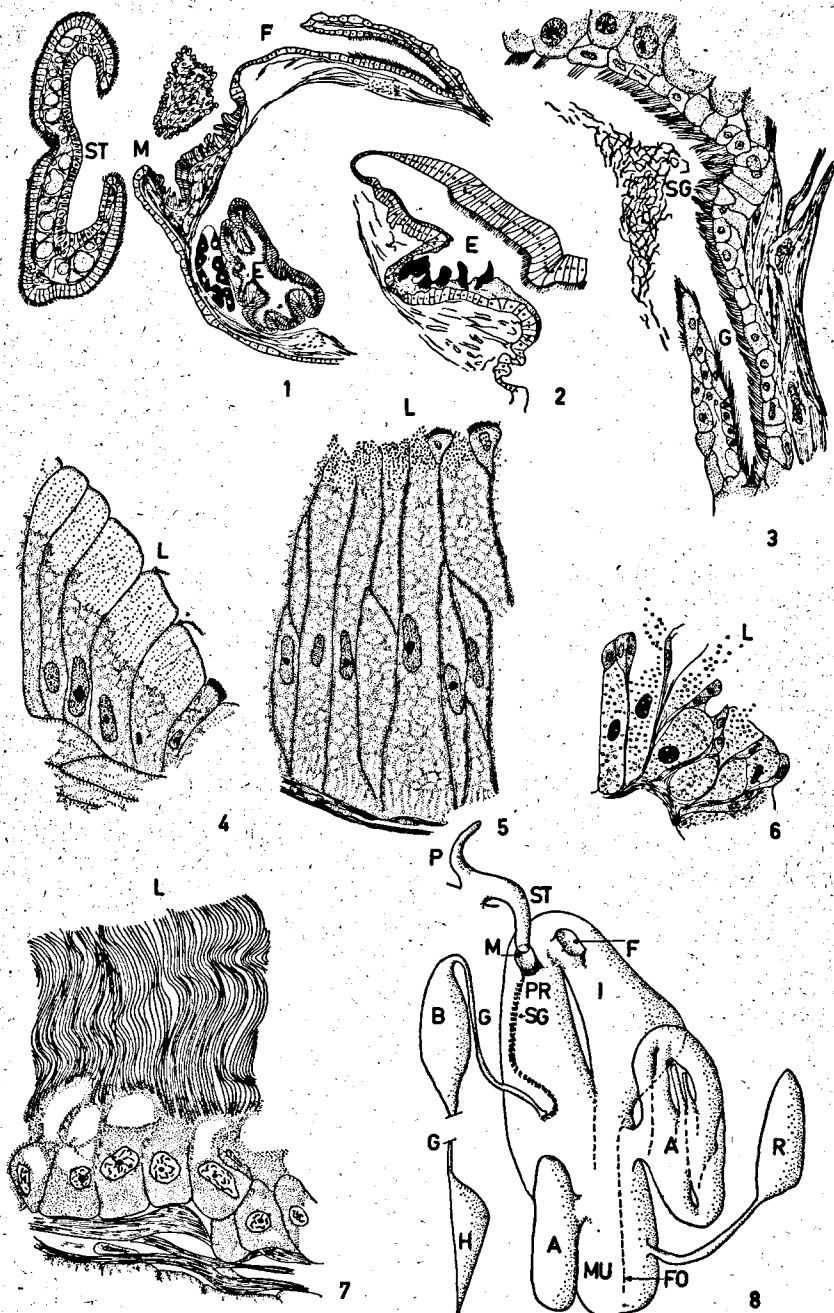
The first striking difference between the forms *pyramidata* Linnaeus, 1767 and *sulcata* (Pfeffer, 1879) is the presence of a rather well developed radula in the first in contrast to the latter which has

only some five rows of badly developed teeth (Fig. 2), indicating the place where the radula should be. The disappearance of the radula is an adaptation to the specialized feeding of these pelagic animals on plankton. The gizzard is taking over the mechanical part of the digestion, heavy musculature and a teeth-armed wall make this possible. In the forma *pyramidata* this differentiation has not yet gone so far, the armed gizzard is present, but the radula, though unfit for assisting in ciliary feeding, has not yet disappeared.

The differentiation of the genital system in the forma *sulcata* needs special attention. The forma *pyramidata* has one genital aperture on the right side of the body, and an open seminal groove between this opening and the penis (VAYSSIERE, 1915, Pl. V fig. 94; MEISENHEIMER, 1905, p. 161, Pl. I fig. 11). In *sulcata* two separate genital openings are found on the right side of the body. The one farthest to the right, the original one, is the male opening, the other one is the female. The separation of the apertures is not as distinct as in *Cavolinia longirostris*; in the forma *sulcata* we are dealing with a separation in its first stage (Fig. 1). The seminal groove on the surface of the body has disappeared and a partly closed tube has taken over its function. This tube is thus more primitive than in *Cavolinia longirostris* where it is closed all over its length. The forma *sulcata* is more specialized as compared with the forma *pyramidata* but not yet to such a degree as that of *Cavolinia longirostris*. From the outside no other differences than mentioned are found between the genital systems of *sulcata* and *pyramidata*.

The inner parts of the accessory gland, however, show a differentiation in a male and a female part. These differentiations are still primitive and nowhere a separation of the female and the male accessory gland appears; folds effect a primitive development into a female and a male section of the gland. The gonoduct debouches

Fig. 1-8, *Clio pyramidata* Linnaeus, 1767 forma *sulcata* (Pfeiffer, 1879). Fig. 1: Part of transversal section through body, to show separate sexual openings ($\times 10$ approx.). Fig. 2: Part of transversal section through oesophagus to show rudimentary radula ($\times 45$ approx.). Fig. 3: Transversal section through seminal groove at the point where the gonoduct opens into it ($\times 120$ approx.). Fig. 4: Part of transversal section through mucous gland ($\times 120$ approx.). Fig. 5: Part of transversal section through albumen gland ($\times 120$ approx.). Fig. 6: Part of transversal section through capsule gland ($\times 150$ approx.). Fig. 7: Part of transversal section through receptaculum seminis showing sperm inserted in feeding cells ($\times 290$ approx.). Fig. 8: Diagram of complete reproductive system. Abbreviations: A. albumen gland; B. bursa seminis; E. oesophagus; F. female opening; FO. folds in the gland; G. gonoduct; H. hermaphrodite gland; I. capsule gland; L. lumen of the gland; M. male opening; MU. mucous gland; P. penis; PR. prostate; R. receptaculum seminis; SG. seminal groove; ST. seminal tube.



dorsally in the central part of the accessory gland. From this point to the male opening a ciliated groove (seminal groove) is found (Fig. 3), which ends a little distance before the opening, here it communicates with a heavily muscled fold. Besides, a fold runs from this central part, between the female section (capsule gland, Fig. 6) and the male section (prostate) of the gland to the top of the organ. The male section, ending in the male opening is, therefore, primitively separated from the female section of the gland, ending in the female opening (vagina). The mucous gland (Fig. 4) is found at both sides of this fold and borders the prostate on one side and the capsule gland on the other side. Two albumen glands (Fig. 5) are found at the right and the left side of the mucous gland and they both are primitively separated from the male part of the gland by folds. The receptaculum seminis (Fig. 7) lined with feeding cells (cells of Sertoli) debouches in the female side of the accessory gland at its most caudal top, where no separating folds are present between male and female part of the system. The gonoduct shows a widening, lined with ciliated epithelium, which probably is the bursa seminis. The albumen gland is lined partly with secretory cells and partly with ciliated cells. The mucous gland is lined with secretory cells which develop from ciliated epithelial cells. The greater part of the lumen of the accessory gland is therefore provided with ciliated epithelial cells. The ciliated epithelium of the seminal groove is, however, nowhere in connection with other fields with cilia.

We may conclude that in *Clio pyramidata forma sulcata* a differentiation occurs of the accessory gland into a female and a male section. The specialization visible from the outside, is not as complete as in *Cavolinia longirostris* and the internal separation is also still a very primitive one.

It is clear that copulation will be difficult or even impossible between the forma *sulcata* and *pyramidata* and that, consequently, no interbreeding is possible. Both forms seem to be good species, but exchange of genes between them is in all probability still possible by means of gene-transport via the several forms linking them. So we must consider them as belonging to one polytypic species. As soon as linking forms disappear for some reason the polytypic species may, however, change into a species flock.

LITERATURE

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