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***Sukashitrochus* sp., a scissurellid with heteropod-like locomotion (Mollusca, Archaeogastropoda)**

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(With 3 figures)

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Abstract

A (new?) scissurellid of uncertain source, *Sukashitrochus* sp. is described. The species has a very peculiar, laterally depressed, fin-like foot, a condition which is very rare among archaeogastropods, but resembles those of heteropods. Also its mode of locomotion is similar to that of heteropods, although normal creeping is also possible. Most probably *Sukashitrochus* sp. uses its so-called struggling mode of locomotion to escape from presumed predators such as sea-stars. The mode of evolution of this peculiar type of locomotion is discussed.

Zusammenfassung

Eine (neue?) Scissurellidae, *Sukashitrochus* sp. mit unsicherer Herkunft wird beschrieben. Die Art besitzt einen sehr eigenartigen, lateral zusammengedrückten, flossenförmigen Fuß, welcher jenem der Heteropoden ähnelt, ein sehr seltener Fall unter den Archaeogastropoden. Auch der Fortbewegungsmodus gleicht jenem der Heteropoden, obwohl auch normales Kriechen möglich ist. Sehr wahrscheinlich benützt *Sukashitrochus* sp. diese sogenannte „zappelnde“ Fortbewegungsart, um vor Feinden wie etwa Seesternen zu flüchten. Die mögliche Evolution eines solchen Fortbewegungstyps unter den Scissurelliden wird diskutiert.

Introduction

Whereas the anatomy of the archaeogastropod family Scissurellidae has been known for nearly a century (PELSENEER 1899, BOURNE 1910), there is still little knowledge of their biology and habit. Whereas the European species generally occur in subtidal depths (FRETTER & GRAHAM 1962: 488), those of the Red Sea are known from all depths (YARON 1983), and tropical forms have been found mainly in sea weeds of the tidal zone (e. g. BOURNE 1910, MONTOUCHET 1972, HERBERT

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1986, pers. obs.). Their habit resembles that of typical trochids (FRETTER & GRAHAM 1962, 1976, pers. obs.). A "slit-limpet", which likewise belongs to the Scissurellidae (McLEAN, pers. comm.), has recently been collected from the rock surface of a hydrothermal vent of the East Pacific Rise, suggesting that the adaptation capacity of the family might be much greater than previously thought. The species described herein represents another case of scissurellid specialization.

In October 1985 a single specimen of *Sukashitrochus* sp. was found alive in a pet-fish shop in Vienna (see acknowledgements), where it was introduced together with various corals from Sri Lanka waters. When observing the animal under the stereomicroscope, I was curious about the very peculiar and quick mode of locomotion of the animal apart from normal crawling. The movements of the foot resembles those known in heteropods and also a similar morphological specialization was found. A consultation of the respective literature revealed that such a mode of locomotion has never been observed in any zeugobranch archaeogastropod. However, it is very similar to the "swimming" behaviour of the Solariellinae (Trochoidea) recently reported by HERBERT (1987: 289).

Results

Genus: *Sukashitrochus* HABE & KOSUGE, 1964 (for generic status see HERBERT 1986).

Species: *Sukashitrochus* sp.

Source: Tropical, the animal was probably introduced from Sri Lanka waters (EHRMANN, pers. comm.).

Shell: The shell is delicate, of white colour with a brownish periostracum. The shell is hemispherical and consists of 2.5 whorls which expand very rapidly. The spire is depressed so that the upper whorls are not visible in a lateral view. The apex is composed of the protoconch which appears smooth as typical for the genus (HERBERT 1986). The next (juvenile) whorl lacks a slit and bears transverse ribs only, followed by the teleoconch with the slit which runs about a whole whorl. The foramen is closed in a sharp angle. Aside from the slit-band a sharp, longitudinal crest forms the periphery of the shell. The sculpture of the teleoconch consists of ribs, the apical ends of which lie at right angles to the suture; they then turn up the spire to produce a curved L-shape which coalesces with the edge of the slit-band. They are equal at both sides of the slit-band. Between them there are very fine longitudinal ridges. The aperture is rather large, oval, and oblique. A trace of the closed selenizone is still visible.

Measurements: Shell length: 1.6 mm; Shell breadth: 1.26 mm; Length of juvenile shell (portion lacking a slit): 0.42 mm; Diameter of protoconch: about 0.16 mm; Length of foramen: 0.49 mm. The specimen will be deposited at the Naturhistorisches Museum Wien (Moll. Coll.).

Animal: The head bears a typical snout. The tip of the snout is truncated and shows a slightly thickened margin. At the base of the snout a setose tentacle is set laterally at each side, being fused with the eye stalk. The eyes are unusually large when compared with other scissurellids (Fig. B). In the mantle cavity of the expanded animal the slit and the two ctenidia are visible.

The foot of *Sukashitrochus* sp. is highly specialized and peculiar (Figs. B, C). The organ is laterally depressed and the posterior part of the foot (metapodium) forms a fin. However, a narrow pedal sole is still present in the medium zone of the foot, thus being somewhat reduced. The operculum is situated at the left side of the foot. These unusual conditions are associated with the distinct mode of retraction of the animal's foot into the shell. In most other archaeogastropods the foot is bent transversely when being retracted into the shell. In *Sukashitrochus* sp., however, this is not possible, since the foot is laterally compressed and thus cannot be folded transversely. Here the foot is folded mainly longitudinally and the degree of transverse folding is low. There are 4 epipodial tentacles at each side: One is situated behind the eye, two halfway along the foot, and one at the level of the operculum. Whereas the anterior tentacles are rather small and smooth, all other epipodial tentacles are setose like the cephalic ones. The mantle edge bears small papillae, a slit-tentacle could not be detected.

Mode of locomotion: Like the external morphology, the mode of locomotion of *Sukashitrochus* sp. resembles conditions found in the Trochoidea-Solariellinae (HERBERT 1987) and in the heteropods. The animal lies upside down with the shell against the bottom, the foot is fully expanded. The so-called "struggling" mode of locomotion starts with one or two single abrupt movements of the fin-like portion of the foot, then the whole foot is moved laterally (two to three times per second), giving an impression of struggling. Each active swimming phase lasts about five or six seconds, after which the animal rests, while coasting a distance of about four to five centimeters (if the bottom is smooth). Due to the fact that the operculum is positioned at the left side of the body, the movements to the right side are somewhat more powerful than those to the left side. During locomotion the shell slides above the bottom, thus this mode of movement is not a true swimming.

Besides this type of locomotion, *Sukashitrochus* sp. is also able to move by creeping with its pedal sole, which is thus still functional. When the animal was found, it had climbed up a vertical glasswall of about twenty centimeters in the aquarium, feeding on a thin film of algae.

Discussion

Remarks on the species status: The smooth protoconch and the closed and elongated slit forming a foramen probably places the new species in the genus *Sukashitrochus* HABE & KOSUGE, 1964 which was separated from *Sinezona* FINLAY, 1927 by HERBERT (1986). Up to now no species of these genera has been described including the soft body. In addition, the source of the species described in not

exactly known. Moreover, it might be a juvenile of a species, which has been already described as a *Scissurella* species. This problem could only be solved, if comparative SEM-studies of the protoconch of the respective forms are undertaken. (MONTOUCHET 1972, BATTEN 1975, YARON 1983, SCHIRO 1986, HERBERT, 1986). In the light of a single specimen of unknown source it seems wisest not to name it and to classify it provisionally among the genus *Sukashitrochus*.

Ecological considerations: Obviously the struggling mode of locomotion in *Sukashitrochus* sp. cannot be used to transverse large distances. However, this mechanism appears very useful to escape from presumed predators such as sea-stars. This is also assumed by HERBERT (1987) for the Solariellinae. Thus, this peculiar mode of escape reaction can be compared ecologically with those known from pectinacean bivalves.

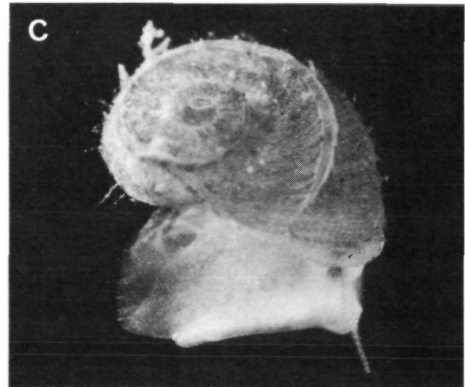
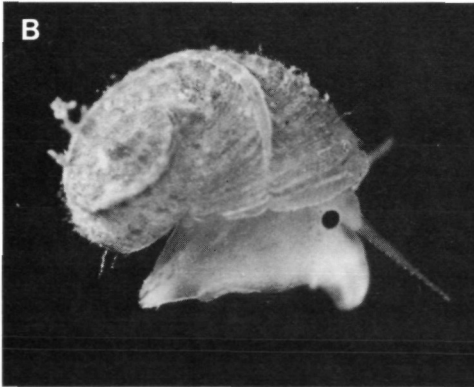
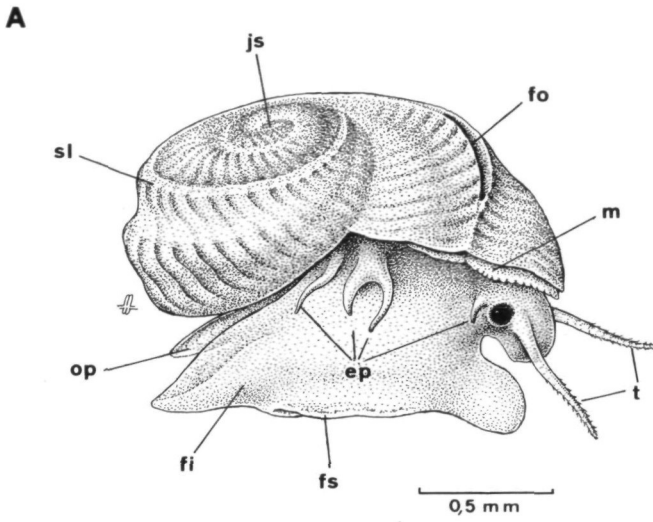
Evolutionary considerations: So far, about 60 species of scissurellids have been described. However, there are five or six species only, where also the morphology of the soft body is known (e. g. VAYSSIERE 1894, PELSENEER 1899, BOURNE 1910, THIELE 1912, FRETTER & GRAHAM 1962, MONTOUCHET 1972), all other descriptions depend on shell and radula morphology only. Thus, it is still unknown whether this mode of locomotion is typical for a genus or for *Sukashitrochus* sp. alone. Up to now a struggling mode of moving has not been reported from any other scissurellid. However, the figures on *Scissurella costata* presented by PELSENEER (1899: figs. 108–114) clearly show that the foot sole of this species is likewise longitudinally folded as in *Sukashitrochus* sp., and the same condition have been found in an undetermined tropical *Scissurella* (pers. observ.). These conditions might be preadaptive to the higher degree of specialization found in *Sukashitrochus* sp. This case might also be used as a model to explain the evolution of the pelagic habit and specialization of the heteropods.

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Plate 1

Figs. A–C. *Sukashitrochus* sp. (drawings and photographs by M. Mizzaro-Wimmer). A. Drawing of the living animal from the right side. – B. Photograph of the living animal from the right side showing the expanded fin. – C. Photograph of the living animal from the right side showing the foramen of shell, the large eye, and the reduced foot sole.

Abbreviations: ep – epipodial tentacles; fi – metapodial fin; fo – foramen of shell; fs – pedal sole; js – juvenile shell (lacking slit); m – mantle margin; op – operculum; sl – closed slit; t – tentacles.