

## Morphological studies on some Polygordiidae and Saccocirridae (Polychaeta) from the Indian Ocean

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Abstract : The paper reports on the results of morphological investigations, some of them carried out with SEM, on three species of *Saccocirrus*, viz. *S. minor* Aiyar and Alikunhi, *S. orientalis* Alikunhi and *S. krusadensis* Alikunhi and two species of *Polygordius* viz., *P. eschaturus* Marcus and *Polygordius* sp., collected from coarse intertidal sediments on Andaman islands (Bay of Bengal) and Laccadive islands (Arabian Sea) in the Indian Ocean. The subspecies *P. eschaturus brevipapillosus* is described as new to science. The results on *Saccocirrus* are compared with those obtained on materials from other parts of the world and discussed.

Résumé : Trois espèces de *Saccocirrus*, *S. minor* Aiyar et Alikunhi, *S. orientalis* Alikunhi et *S. krusadensis* Alikunhi, et deux espèces de *Polygordius*, *P. eschaturus* Marcus et *P. sp.*, récoltées dans les sédiments grossiers de la zone intertidale des îles Andaman (golfe du Bengale) et Laccadive (mer d'Oman) dans l'océan Indien, sont étudiées. Une sous-espèce nouvelle, *P. eschaturus brevipapillosus*, est décrite. Concernant les espèces de *Saccocirrus*, certains caractères taxonomiques, examinés à l'aide du microscope électronique à balayage, sont comparés à ceux d'individus de même espèce récoltés dans d'autres régions géographiques et sont discutés.

### INTRODUCTION

The taxonomy, ecology and distribution of the so-called archiannelids (Westheide, 1985) inhabiting the marine intertidal sediments have been investigated during the recent decades in several parts of the Indian Ocean. Some of these studies have also thrown valuable light on the wide geographical distribution of these worms on shores of the Indo-Pacific region from the east coast of Africa to the Galapagos Islands (Jouin, 1970, 1975; Schmidt and Westheide, 1977; Rao, 1980, 1983; Rao and Ganapati, 1968; Brown, 1981, Sasaki, 1981). The specimens were collected by one of us (GCR) during the faunistic surveys of Andaman and Laccadives in the Indian Ocean. The results of the morphological observations on the genera *Saccocirrus* and *Polygordius* were compared with those obtained on specimens obtained (by CJ) from other geographical areas.

### MATERIALS AND METHODS

The worms collected from Andaman islands (Bay of Bengal) and Laccadive islands (Arabian Sea), generally occurred in coarse sandy sediments between low

and half-tide levels on exposed beaches. The sediments were stirred with magnesium chloride solution isotonic with sea water, then filtered through a metallic sieve, 62  $\mu\text{m}$  in mesh size. The collected worms were fixed and preserved in 5 % neutral formalin containing 2 % glycerine. For SEM studies, the fixed specimens were dried by the critical point method, coated with gold palladium and examined with a Cameca 07 electron microscope.

## RESULTS

### Genus *Saccocirrus* Bobretzky, 1871

#### *Saccocirrus minor* Aiyar and Alikunhi, 1944 (PL I).

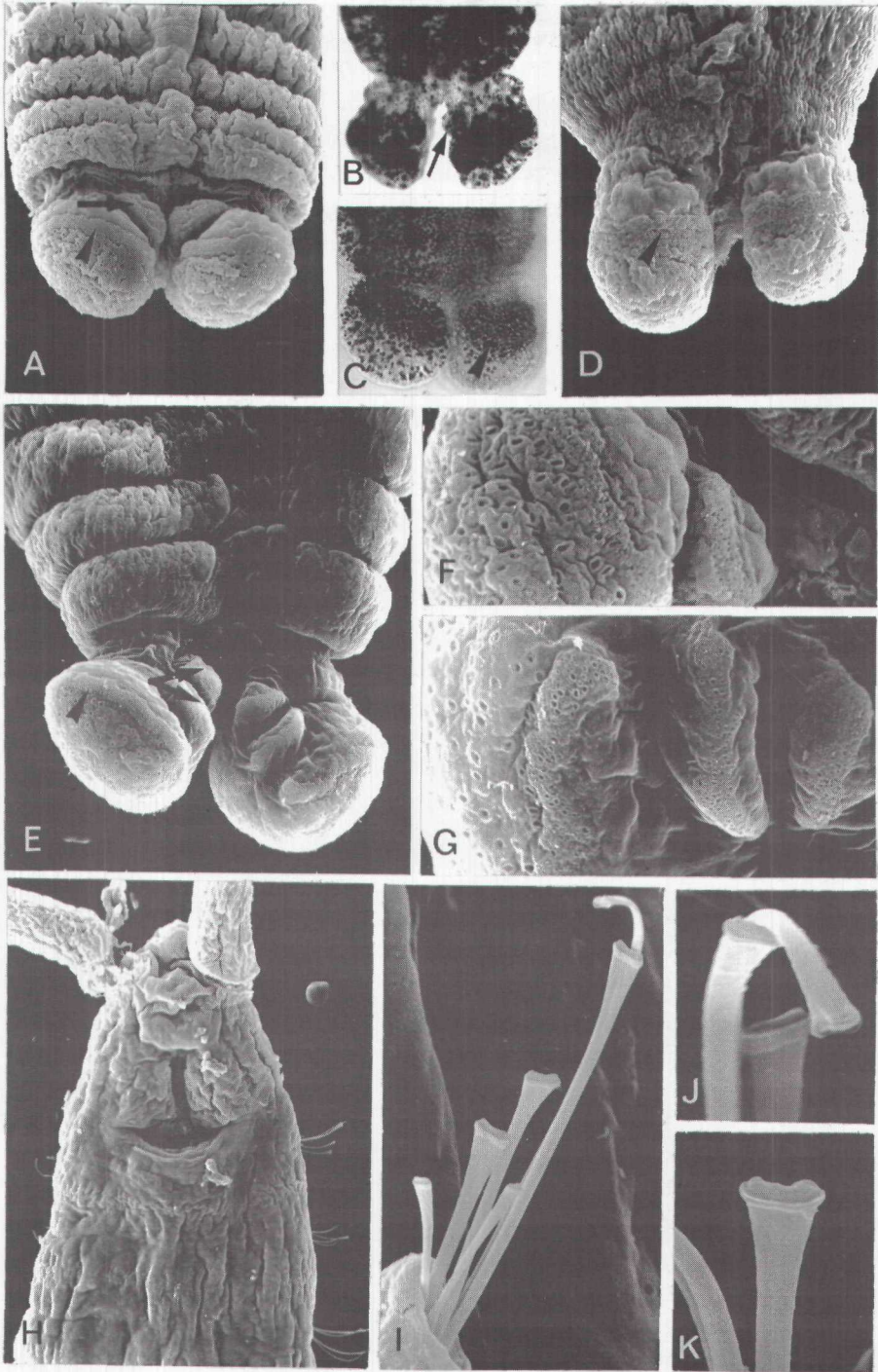
*Localities:* (1) medium coralline sand (300-500  $\mu\text{m}$  in mean diameter) with few detritus, 5 cm below surface between low and half tide levels, Chiriapapu beach (Lat. 11° 29'34" N and Long. 92° 46' 18" E), South Andaman, India 2 May 1973, coll. G.C. Rao. Sand temperature : 31° C and water salinity : 35 ‰. (2) Clean coralline sand (200-500  $\mu\text{m}$ ) 5 cm below surface near half tide level, intertidal zone, Agatti beach (Lat. 10° 51' 18" N and Long. 72° 11'34" E), Laccadives, India, 24 February 1983, coll. G.C. Rao. Sand temperature : 30° C and water salinity : 36 ‰.

*Material examined:* 11 females, 2 males and about 50 juveniles.

*Observations:* the mature specimens, 5 mm long in fixed condition, have about 70-85 segments of which the last ten are generally achaetous and sterile. Two conspicuous dark brown eyes are present on the head. The cephalic tentacular ampullae extend to the level of the first setigerous bulbs. The posterior margin of the mouth is situated at the posterior part of the first setigerous segment.

#### PLATE I : *Saccocirrus minor* and *S. orientalis*.

A- pygidium of *S. minor*, ventral view showing on each lobe the subterminal row of adhesive glands (arrow head) and the small papilla (arrow) : SEM  $\times$  400. B- ventral view of the pygidium of *S. minor*. The arrow points on one small papilla :  $\times$  230. C- another specimen showing the subterminal rows of gland openings (arrow head), no papillae :  $\times$  230. D- a specimen of *S. minor* similar to that shown in C, ventral view : SEM  $\times$  400. E-pygidium of *S. orientalis*, ventral view showing on each lobe the subterminal row of gland openings (arrow head) and two papillae (arrows) : SEM  $\times$  400. F- details of a pygidial lobe of *S. minor* showing the small apertures of the adhesive glands and larger apertures of another epidermal gland : SEM  $\times$  1200. G- similar details of a pygidial lobe of *S. orientalis* : SEM  $\times$  1200. H- ventral view of the head showing the margins of the mouth and of three setigers of *S. minor* (specimen shown in A) : SEM  $\times$  200. I- parapodium of *S. minor* (specimen shown in A) SEM  $\times$  2500. J- three setae of *S. orientalis* (specimen shown in E). The curvature of the long seta around a median one is an artifact : SEM  $\times$  4000. K- medium seta of the specimen shown in E and J. Note that the tips of the median setae shown in J and K may be different in details according to the orientation : SEM  $\times$  4000.



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PLATE I

There are neither ciliated patches ventrally on the head nor midventral band of cilia (pl. I, H). There is no muscular pharyngeal bulb. As in the original description there are three types of setae in each parapodium all with smooth tips (Pl. I, I). The almost entire pygidium has two rounded lobes, each with a subterminal row of adhesive glands and two additional small adhesive papillae situated ventrally at the base of the lobes (Pl. I, A, B, F). These small papillae are sometimes hardly visible with the light microscope. In the collection, we found two specimens with the ventral row of adhesive glands but without adhesive papillae (Pl. I, C, D). The animals were generally mature during the summer months, when temperature and salinity were high. The reproductive organs in both sexes are developed on both sides of the digestive tract. In mature females, the reproductive organs (ovaries and spermathecae) occur from segments 30-35 extending backwards. In each fertile segment the spermathecae are yellow-white in color in fixed specimens and measure about 45  $\mu\text{m}$  x 60  $\mu\text{m}$ . The larger oocytes observed are 45  $\mu\text{m}$  in diameter, they number 2-4 in each fertile segment in addition to the several young oocytes in the ovary. The males have reproductive organs (testes, sperm sacs and penes) from segments 25-33 extending backwards. The extruded penes, 30  $\mu\text{m}$  long in fixed specimens, have about 4 supporting rods in their walls.

*Remarks:* the specimens are similar to those described from the type locality. The pygidium is originally described as having a ventral median groove and two fleshy pads with adhesive glands. These are probably identical with the two subterminal rows of adhesive glands we mentioned here and it is possible that the two small proximal adhesive papillae were overlooked in the original description.

*Saccocirrus orientalis* Alikunhi, 1946 (Pl. I)

*Localities:* (1) clean and medium coralline sand (200-400  $\mu\text{m}$ ) with fine shell gravel, 10 cm below surface between low and half-tide levels, Havelock beach (Lat. 12° 04' 10" N and Long. 92° 59' 20" E), South Andaman, India, 8 May 1973, coll. G.C. Rao. Sand temperature : 30° C and water salinity : 34 ‰. (2) Coralline sand (300-600  $\mu\text{m}$ ) with few detritus, 5 cm below surface near half-tide level Kavarathi beach (Lat. 10° 33' 12" N and Long. 72° 38' 24" E), Laccadive, India, 18 February 1983, coll. G.C. Rao. Sand temperature : 31° C and water salinity : 35 ‰.

*Material examined :* three females, one male.

*Observations :* these specimens, similar in most of their morphological characters to *S. minor*, only differ from this species by their size and by the morphology of the pygidium. The mature specimens, measuring about 12 mm long in fixed conditions, have up to 170 segments of which the last 15-20 segments are sterile and the last 7 one achaetous. The setae are similar to those of *S. minor* (Pl. I, J, K). Each of the two rounded pygidial lobes possess two ventral adhesive papillae in addition to the subterminal row of adhesive glands (Pl. I, E). The reproductive organs in both sexes are developed on both sides of the digestive tract. In mature females the

reproductive organs extend from segments 50-65 backwards. In the observed specimens the small oocytes (20  $\mu\text{m}$  in diameter) were at the beginning of vitellogenesis. The spermathecae measure 70 x 45  $\mu\text{m}$ . In the observed male, which has 165 segments, the reproductive organs extend from segment 55 to segment 150. The penes which open dorso-laterally in front of the parapodia have supporting rods.

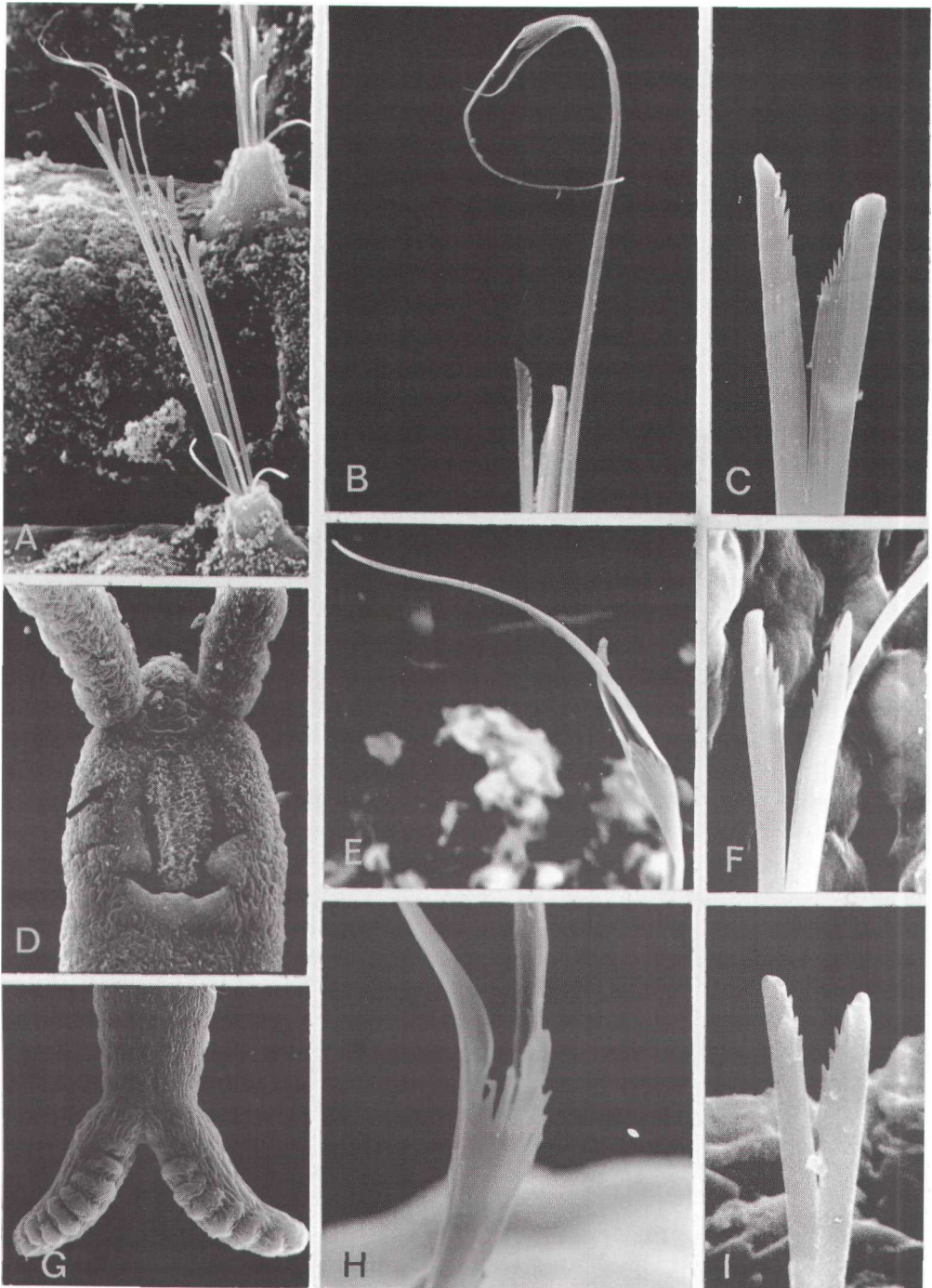
*Remarks:* the specimens from Laccadive and Andaman islands differ from the Madras specimens by several features. The number of segments is 50-70 and the gonads extend from about segment 20 backwards in the Madras specimens, while the number of segments is 160-170 and the gonads extend from about segment 55 backwards in the present specimens. In a female from a Durban beach (Indian Ocean), with 110 segments, the bilateral genital organs extend into segments 32 to 97 and each pygidial lobe has four adhesive papillae (Jouin, 1975). The pygidium is originally described as having rather long anal lobes, provided each with 4-6 ventral adhesive papillae, but is represented (Alikunhi 1946, Fig. 1) with only three papillae on each lobe. In our specimens the only differences in pygidial morphology between *S. minor* and *S. orientalis* are the more pronounced lobes in *S. orientalis* (Pl. I, E, G) and the number of adhesive pads which are, besides the pair of terminal adhesive row, one pair in *S. minor* and two pairs in *S. orientalis*. These differences appear of minor importance as it is likely that the pygidium may transform during the growth of the specimens. Alikunhi also noticed the similarity of this species with *S. minor*. We did not see the differences reported by this author about the shape of the tentacles of the two species : all of our specimens had tentacles which were not moniliform. In the genus *Saccocirrus* the setae are reliable specific criteria. On account of their similar morphology in the specimens of *S. minor* and *S. orientalis* as well as for the other morphological similarities mentioned here, the validity of the species *S. orientalis* seems questionable.

*Saccocirrus krusadensis* Alikunhi, 1942 (Pl. II)

*Localities :* (1) coarse silicious sand (300-700  $\mu\text{m}$ ) with few detritus, 5 cm below surface between low and half-tide levels, Hut Bay beach (Lat. 10° 34' 08" N and Long. 92° 36' 24" E), Little Andaman, 28 April 1973, coll. G.C.Rao. Sand temperature : 30° C and water salinity : 34 ‰ (2) Clean and coarse coralline sand (300-600  $\mu\text{m}$ ), 10 cm below surface between low and half-tide levels, Androth beach (Lat. 10° 49' 32" N and Long. 73° 41' 14" E), Laccadive, India, 28 February 1983, coll. G.C. Rao. Sand temperature : 31° C and water salinity : 36 ‰.

*Material examined :* two females, three males and about 90 juveniles.

*Observations :* the mature specimens, about 13 mm long in fixed condition, have 120-130 segments of which the last two are achaetous. Two conspicuous brown eyes occur on the head. The cephalic tentacular ampullae extend into a large achaetous buccal segment on which the posterior margin of the mouth is situated.



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A muscular pharyngeal bulb extends in the setigers 1 to 4 and there are two small peristomial patches of cilia on each side of the mouth. As in the type specimens, three types of setae occur in each parapodium (Pl. II, A) : (1) 1 or 2 unequally bifid setae in which the longer arm measures 15-21  $\mu\text{m}$  and the shorter arm about 5  $\mu\text{m}$  (Pl. II, A, B, E). Observations with the SEM show that between the two arms there is a median triangular tooth with several small teeth on both sides ; (2) 3 to 4 sturdy setae of medium size, incised, with fine serrations along the internal border (Pl. II, C) ; (3) generally 3 small and fine setae with blunt tips. The elongated pygidial lobes, which are highly adhesive in living condition, show 5 to 8 ventral papillae on each lobe. The worms were mature mostly in summer. The reproductive organs in both sexes are developed only on the left side of the digestive tract. In a female with 107 segments the ovaries and spermathecae extend from the segments 24 to 104. The oocytes reach about 40  $\mu\text{m}$  in diameter and their number in each segment is about 10. In a male with 124 segments, reproductive organs extend in segments 24 to 112.

*Remarks* : these specimens have been compared with those from a collection of a Durban beach (Indian Ocean) and with those from the Moorea island beaches (French Polynesia) (Jouin, 1975). The two peristomial patches of cilia on each side of the mouth are also present on the specimens from Moorea (Pl. II, D) as on those from Sydney (Brown, 1981). The pygidial morphology (Pl. II, G) is similar in the specimens from the different localities. The medium setae show only minor variations (Pl. II C, F, I). The long bifid setae have a long and a short arm which, in the type specimens from Madras and Krusadai island (Alikunhi, 1948), measure respectively 34  $\mu\text{m}$  and 10  $\mu\text{m}$  in length, whereas in the specimens from Andaman, Laccadive, Moorea and Natal beaches, the long arm measures 15-21  $\mu\text{m}$  and the short one 3-5.5  $\mu\text{m}$ . Similarly, in the specimens from Sydney (Brown, 1981), the long arm reaches 22  $\mu\text{m}$  long and the short arm 6  $\mu\text{m}$ . Observations with the SEM revealed that the long setae bear a serrated area between the two arms (Pl. II B, E), which has also been observed on the specimens from Moorea (Pl. II, H) and Natal. This area can be compared to the third arm observed in the setae of *S. tridentiger* Brown, 1981, although it is much less developed here. The dehydration of the specimens produces some deformations in the curvature of the setae. Nevertheless we think that the fine serration observed is not artifactual and that SEM observations may provide interesting features on the finer details of setal structures.

PLATE II : *Saccocirrus krusadensis* SEM micrographs.

A- parapodium of *S. krusadensis* from Laccadive : x 680. B- long seta of the same specimen. The curvature of the seta is an artifact due to dehydration : x 2400. C- medium seta of the same specimen : x 4000. D- ventral view of the head of a specimen from Moorea, showing the buccal ciliation, the two peristomial patches of cilia (arrow) and the margins of the mouth : x 300. E- long seta of a specimen from Laccadive. Note the serrated area between the two unequal arms : x 4000. F- medium seta of a specimen from Moorea : x 4000. G- ventral view of the pygidium of a specimen from Moorea : x 240. H- detail of a long seta of a specimen from Moorea : x 8000. I- medium seta of a specimen from Durban : x 4000.

Genus *Polygordius* Schneider, 1868

*Polygordius eschaturus* Marcus, 1948, *brevipapillosus* n. subsp. (Pl. III).

*Locality*: coarse silicious sand (400-700  $\mu\text{m}$ ) with fine shell gravel and few detritus, 5 cm below surface, near low water mark, Sound Island beach (Lat. 12° 58' 06" N and Long. 92° 59' 17" E), North Andaman, India, 28 April 1974, coll. G.C. Rao. Sand temperature : 30° C and water salinity : 35 ‰.

*Material examined* : 110 fixed specimens.

*Holotype* : one male specimen, about 50 mm long with 205 segments, from the Sound Island beach locality, deposited in the Museum national d'histoire naturelle, Paris, France, Regd. N° UB 567.

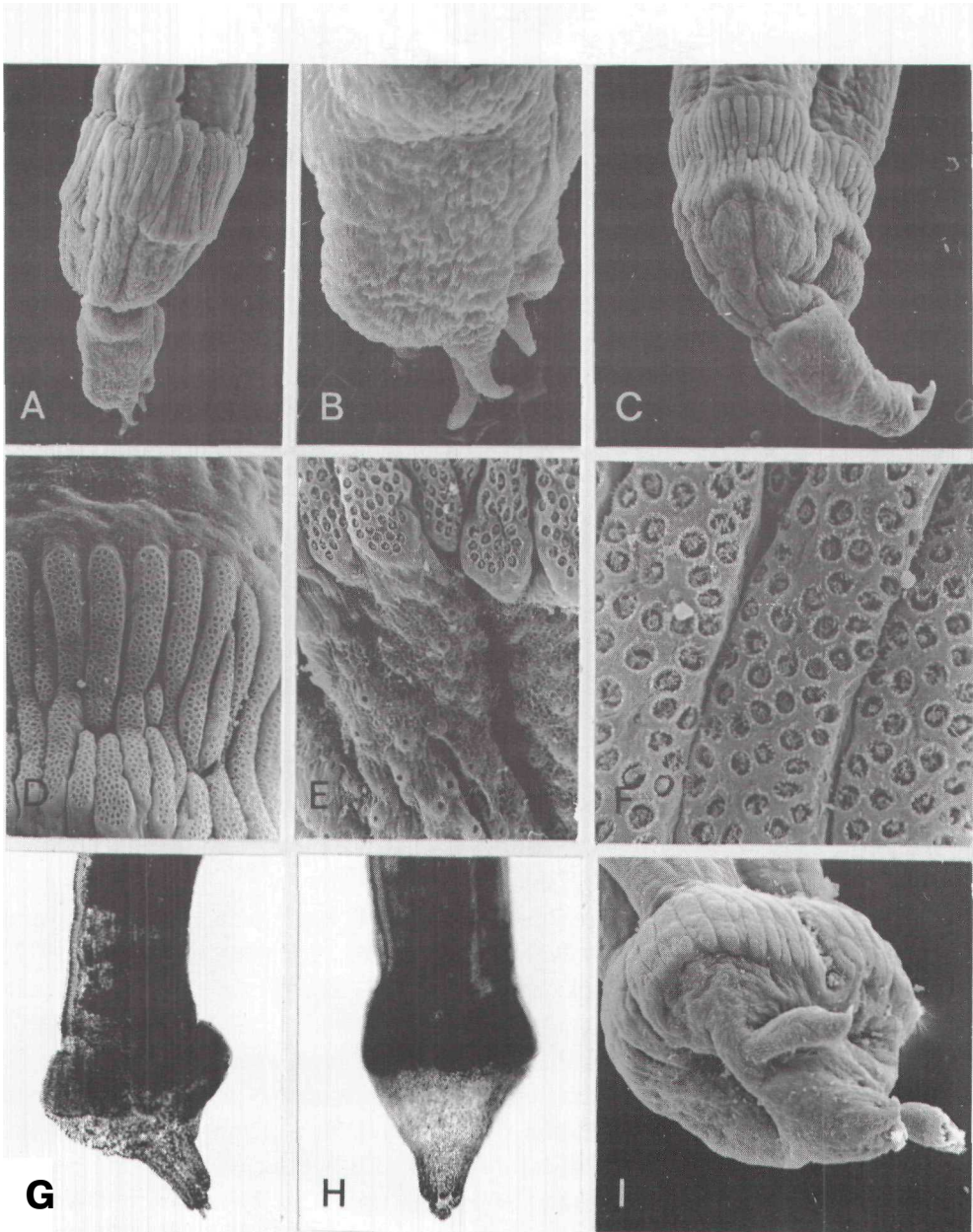
*Paratypes* : about 70 fixed specimens of both sexes from the same locality, deposited in the MNHN, Paris, France, Regd. N° UB 568.

*Etymology*: the subspecific name *brevipapillosus* is referable to the presence of short anal papillae at the tip of the pygidium.

*Description* : most of these specimens generally have 120-160 segments and measure about 30-40 mm in length and 0.25-0.50 mm in width in fixed condition. The larger mature specimens however attain 205 segments and reach about 50 mm in length and 0.30-0.50 mm in width. The color of the body is white in living condition. The cephalic tentacles measure 0.20-0.25 mm in length. There are no eyes or pigment spots. The pygidium sometimes is bulb-shaped (Pl. III, G) and may attain 0.53 mm in diameter. Its shape however depends on muscular contraction as it is often more cylindrical with a diameter of 0.35-0.20 mm (Pl. III, A, C, H). It has a large adhesive girdle about 108  $\mu\text{m}$  wide, formed by longitudinal clusters of glands (Pl. III A, C, D, E, F) whose openings at the cuticle surface show a peripheral border of microvilli. The pygidium is highly adhesive in living condition. The anus is bordered by 6-8 lobes of which 2 or 3 are elongated to form short anal papillae, about 30  $\mu\text{m}$  long, which are characteristic of this subspecies (Pl. III, A, B, G). Sometimes these short appendages are not easily seen, being turned down and closing the anus (Pl. III, C, H). The animals were mature mostly during the premonsoon season. The gonads develop from segments 20-30 to the last ones. The females have numerous small oocytes (about 50-70 in one genital segment) attaining 35-40  $\mu\text{m}$  in diameter. The oocytes are probably not fully grown in the specimens investigated. The males were not fully mature, the coelomic spaces being filled with cells in the process of spermatogenesis.

In the same collection, we found some specimens much thinner, measuring 18-20 mm long and 0.15-0.20 mm wide with about 110-120 segments. The cephalic tentacles measure 0.09-0.14 mm in length. The gonads occur from the twentieth to the last segments. Owing to the similar morphology of the pygidium, we consider that these specimens belong to the same subspecies *P. eschaturus brevipapillosus*.





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PLATE III : *Polygordius eschaturus brevipapillosus* (A to H).

A and C- pygidium of two specimens showing the glandular girdle, the post-girdle region and the perianal appendages : SEM x 120. B- detail of the perianal appendages of the specimen presented in A : SEM x 400. D- glandular girdle of the pygidium : SEM x 400. E- the rounded openings of the glands are tightly packed in the pygidial girdle whereas behind, isolated holes of other epidermal glands open at the cuticle surface : SEM x 800. F- details of glandular openings with microvillous border : SEM x 3200. G- pygidium of the holotype specimen coloured and mounted, as that of a paratype specimen in H : x 140. I- pygidium of *Polygordius* sp. SEM x 150.

*Pofygordius* sp. (PL III,1)

One specimen was differing from the others in having two lateral appendages inserted on the pygidium, midway between the posterior margin of the glandular girdle and the perianal papillae. These appendages are broken on this specimen but it is unlikely that they could have been lost in the specimens of *P. eschaturus brevipapillosus*. We consider that this specimen belongs to another species, but its detailed morphological characters cannot be described here, owing to the lack of additional specimens.

## DISCUSSION

The specific characters in *Pofygordius* are mainly based on the morphology of the pygidium. The specimens of Andamans belong to a group of species which all possess a pygidium with a large girdle of epidermal glands. Among these species, *P. pacificus* Uchida, 1935 and *P. pacificus floreanensis* Schmidt and Westheide, 1977, do not bear any pygidial appendages while *P. leo* Marcus, 1955, bears several rather long ones, inserted at the posterior margin of the glandular girdle and *P. eschaturus* only two perianal appendages 50-70  $\mu\text{m}$  long, twice the size of those of *P. eschaturus brevipapillosus*. All other morphological characters of this subspecies are in agreement with those of the original species described from Brasil. The present discovery of *P. eschaturus* from Andaman extends its geographical distribution to the shores of the Indian Ocean.

The two distinct groups of species which have been recognized by several authors in the genus *Saccocirrus* (Wu and Yang, 1962 ; Jouin, 1971 ; Martin, 1977 ; Brown, 1981 ; Sasaki, 1981 ; Sasaki & Brown, 1983) are present in the Andaman and Laccadive Islands :

(1) the *krusadensis* group (from the name of the oldest species of this type, *S. krusadensis* Alikunhi, 1942) is characterized by the presence of a pharyngeal bulb, a ventral ciliation at least lateral to the mouth, a unilateral arrangement of the genital organs, medium sized setae distally divided with fine serrations at the internal border and long setae with deeply bifurcated tips. This group of herbivorous browser species, represented here by *S. krusadensis*, is considered as an Indo Pacific cluster (Brown, 1981) ;

(2) the *papillocercus* group (from the name of the oldest species of this type, *S. papillocercus* Bobretzky, 1871) is characterized by the absence of a pharyngeal bulb and a ventral ciliation, by a bilateral arrangement of the genital organs, medium sized setae distally smooth and long setae with slightly notched tips. This group of carnivorous species, represented here by *S. minor* and *S. orientalis*, has a world wide distribution (Brown, 1981). For the list of species of each group and more details, see Brown (1981) and Sasaki (1981).

Concerning the first group of species, it must be noted that *S. gabriellae* Marcus, 1946, should be included in that group since a recent examination of specimens from Cabo Frio (Brasil, about 280 km from the type locality), revealed the presence of two ciliated patches lateral to the mouth. Moreover, in all the mature specimens examined (3 males and 7 females), the gonads and genital organs were situated on the left side of the digestive tract, as indicated by Marcus (1946) (see Plate II), although this author also mentioned that the unilateral gonads could be on the right or on the left side. Consequently, the species *S. uchidai* Sasaki, 1981, should not be considered as valid, because of the similarity with *S. gabriellae* concerning the presence of ciliated patches lateral to the mouth and the left side development of the male and female genital organs. *S. gabriellae* having a world wide distribution, the *krusadensis* group cannot be considered anymore as an Indo Pacific cluster. From these new data on *S. gabriellae* it becomes clear that *S. sonomacrus* Martin, 1977, differs from *S. gabriellae* by only one character: the right side position of the male genital organs.

The absence of a pharyngeal bulb in the *papillocercus* group does not correspond to a regressive evolution related to a small size of the species, since the largest species *S. major* Pierantoni, 1907, belongs to this group. Likewise the unilateral arrangement of the genital organs is not related to a decrease of the body diameter, since the species with unilateral genital organs and those with bilateral genital organs have similar body sizes. Conversely, in the species *S. heterochaetus* Jouin, 1975, which belongs to the *papillocercus* group (bilateral genital organs), the distinction of two successive regions in the genital part of the males (one with testes, the other with seminal vesicles and penes) and the differentiation of genital setae, unknown in the other species, are probably adaptative features related to the small size.

In *Saccocirrus* the two groups of species have each several characters which appear to be linked. Using the principle of parsimony one can say that such linked characters in each group did not evolve several times but only once, in the ancestral form of each group. The two groups probably arose from two ancestral species which evolved from a common stem species which likely had a pharyngeal organ and a bilateral arrangement of the genital organs. The two ancestral species would have each inherited a group of characters, which were mainly those of the pharyngeal region (with loss of the pharyngeal bulb in one of the ancestral species), the ventral epidermal ciliation, the arrangement of the genital organs (with loss of the bilateral arrangement in the other ancestral species) and probably also the type of setae. The tendency for these characters to remain together in each group suggests that they depend on linked genes. Concerning the setal characters, it must be noted that, although a special type of setae appear to characterize each of the two groups (see Sasaki 1981 Table 1), some species do not fit in with this scheme. Three new species for example (C. Jouin, personal observations on material yet undescribed, from various collections), appear to belong to the *papillocercus* group (with bilateral genital organs and no pharyngeal bulb) but have setae rather similar to those of the *krusadensis* group (medium setae slightly incised distally and long setae with a bifurcated tip). This indicates that further studies are necessary to investigate the distribution of these specific characters in the two groups of this surprising genus *Saccocirrus*.

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**Zusammenfassung :** Drei *Saccocirrus* -Arten, *S. minor* Aiyar und Alikunhi, 5. *Orientalis* Alikunhi und 5. *krusadensis* Alikunhi, und zwei *Polygordius* -Arten, *P. eschaturus* Marcus und *P. sp.*, wurden in den groben Sedimenten der Gereiten Zone der Andamanen (golf von Bengalen) und der Laccadiven (Arabisches Meer) gesammelt und mit dem Rasterelektronenmikroskop untersucht. Eine neue Unterart, *P. eschaturus brevipapillosus* wird beschrieben. Die Tiere werden mit Individuen derselben Arten von anderen Fundorten verglichen.

## REFERENCES

- AIYAR, R.G. & K.H. ALIKUNHI, 1944. On some Archiannelids of the Madras Coast. *Proc. natl. Inst. Sci. India*, 10: 113-140.
- ALIKUNHI, K.H., 1942. Note on the occurrence of Archiannelids at Krusadai together with a description of an undescribed species of *Saccocimis*. *Proc. Ind. Sci. Congr. Baroda* sect. 7, part 3, Zool: 149.
- ALIKUNHI, K.H., 1946. On a new species of *Saccocirrus* from the Madras Beach. *Curr. Sci.*, 15: 140.
- ALIKUNHI, K.H., 1948. On some archiannelids of the Krusadai Island. *Proc. natl. Inst. Sci. India*, 14: 373-383.
- BROBRETZKY, N., 1871. *Saccocirrus papillocercus* n. gen. n. sp. *Mem. Soc. Natur. Kiew*, 2: 211-259.
- BROWN, R., 1981. Saccocirridae (Annelida: Archiannelida) from the Central Coast of New South Wales. *Aust. J. Mar. Freshwater Res.*, 32: 439-456.
- JOUIN, C., 1970. Archiannelides interstitielles de Nouvelle-Calédonie. In: Expédition Française sur les récifs coralliens de la Nouvelle-Calédonie 1960-1963. Ed. Fondation Singer-Polignac, Paris, 4: 149-167.
- JOUIN, C., 1971. Status of the knowledge of the systematics and ecology of Archiannelida. In: Proc. First Intern. Conf. Meiofauna. (Ed. N.C. Hulings). Smithsonian Contr. Zool., 76: 47-56.
- JOUIN, C., 1975. Étude de quelques Archiannelides des côtes d'Afrique du Sud; description de *Saccocirrus heterochaetus* n. sp. (Archiannelide Saccocirridae). *Cah. Biol. Mar.*, 16: 97-110.
- MARCUS, E., B.-R., 1946. On a new Archiannelid *Saccocimis gabriellae* from Brazil. *Commun. Zool. Mus. Hist. Nat. Montevideo*, 2: 1-6.
- MARCUS, E. B.-R. 1948. Further Archiannelids from Brazil. *Ibid.*, 2: 1-17.
- MARCUS, E. B.-R., 1955. On Turbellaria and *Polygordius* from the Brazilian Coast. *Bol. Zool. Univ. S. Paulo Fac. Fil. Ci. Letr.*, 207, 20: 19-65.
- MARTIN, G.C., 1977. *Saccocirrus sonomacus* n. sp., a new archiannelid from California. *Trans. Amer. Microsc. Soc.* 96: 97-103.

- PIERANTONI, U., 1907. Il genere *Saccocirrus* Bobretzky e le sue specie. *Ann. Mus. zool. R. Univ. Napoli*, 2 : 1-11.
- RAO, G.C., 1980. On the zoogeography of the interstitial meiofauna of the Andaman and Nicobar Islands, Indian Ocean. *Rec. Zool. Surv. India*, 77: 153-178.
- RAO, G.C., 1983. Meiofauna from Lakshadweep, Indian Ocean. *Cah. Biol. Mar.*, 24: 51-68.
- RAO, G.C. & P.N. GANAPATI, 1968. On some archiannelids from the beach sands of Waltair Coast. *Proc. Indian Acad. Sci.*, 67 : 24-30.
- SASAKI, S., 1981. A new species of the genus *Saccocimis* (Archiannelida) from Hokkaido, Northern Japan. *Annot. zool. Japon.* 54 : 259-266.
- SASAKI, S. & R. BROWN, 1983. Larval development of *Saccocimis uchidai* from Hokkaido, Japan and *Saccocirrus krusadensis* from New South Wales, Australia (Archiannelida, Saccocirridae). *Annot. zool. Japon.* 56, 4 : 299-314.
- SCHMIDT, P. & W., WESTHEIDE, 1977. Interstitielle Fauna von Galapagos 17. Polygordiidae, Saccocirridae, Protodrilidae, Nerillidae, Dinophilidae (Polychaeta). *Mikrofauna Meeresbodens.* 62 : 1-38.
- SCHNEIDER, A., 1868. Ueber Bau und Entwicklung von *Polygordius*. *Arch. Anat. Physiol.* 10 : 51-60.
- UCHIDA, T., 1935. Eine Neue Urannelidenart, *Polygordius pacificus* n. sp. *Proc. Imp. Acad. Japan*, 11 : 119-120.
- WESTHEIDE, W., 1985. The systematic position of the Dinophilidae and the archiannelid problem. In : The origin and relationships of lower invertebrates. Conway Morris, S., George, J.S., Gibson, R., Platt, H.M. (eds). Oxford University Press.
- Wu, B.-L. & D.-J. YANG, 1962. On systematics and geographical distribution of genus *Saccocimis* Bobretzky 1871 (Archiannelida). *Oceanol. Limnol. Sin.* , 4: 169-179. (In Chinese with Russian summary).