

The overlooked species of sipunculans commensal of solitary corals (Sipuncula)

par José Ignacio SAIZ SALINAS

Abstract. — Several species of sipunculans (Sipuncula), often overlooked in the literature, are reviewed ; they are *Sipunculus cochlearius* Valenciennes, 1854, *Sipunculus heterocyathi* McDonald, 1862, *Aspidosiphon heteropsammiarum* (Deshayes, 1863) and *A. michelini* (Deshayes, 1863). Only the original material of BOUVIER (1895), founded on the two last names, is redescribed and illustrated. The systematic position of all four names shows they are the same species which inhabits a solitary coral and which are currently known as *Aspidosiphon (Aspidosiphon) jukesii* Baird, 1873. As the four names were published accompanied by an indication according to the article 12 of the rules of the International Code of zoological nomenclature, they are four senior synonyms of *A. jukesii*. Since the law of priority cannot be applied to this case directly, it is here maintained that the existing usage of *A. jukesii* is valid.

Résumé. — Plusieurs espèces de sipunculien (Sipuncula), oubliées souvent dans la littérature, ont été révisées ; il s'agit de *Sipunculus cochlearius* Valenciennes, 1854, *Sipunculus heterocyathi* McDonald, 1862, *Aspidosiphon heteropsammiarum* (Deshayes, 1863) et *A. michelini* (Deshayes, 1863). Seul le matériel original de BOUVIER (1895), fondé sur les deux derniers noms, a été redécrit et illustré. La position taxinomique des quatre noms montre qu'ils représentent la même espèce habitant un corail solitaire, connue à présent comme *Aspidosiphon (Aspidosiphon) jukesii* Baird, 1873. Étant donné que ces quatre noms furent publiés accompagnés d'une indication conforme, ils doivent être considérés, d'après l'article 12 du Code international de nomenclature zoologique, comme synonymes plus anciens de *A. jukesii*. Puisque la loi de priorité ne peut pas être appliquée dans ce cas d'une façon directe, *A. jukesii* doit être considéré comme le nom valide pour ce taxon en application de ces règles internationales.

J. I. SAIZ SALINAS, *Muséum national d'Histoire naturelle, Laboratoire des Vers associé au CNRS, 61, rue Buffon, F-75231 Paris cedex 05. Adresse actuelle : Departamento de Biología, Facultad de Ciencias, Universidad del País Vasco/Euskal Herriko Unibertsitatea, E-48080 Bilbao, Apdo. 644, Espagne.*

INTRODUCTION

According to the recent reviews about the mutualistic association between sipunculans and scleractinian corals of YONGE (1975) and RICE (1976), only one species of sipunculan is known to be associated with a living solitary coral. However, the published literature on this association is both extensive and sometimes confused and unfortunately it has been overlooked by many specialists of sipunculan taxonomy.

As it was related in detail by BOUVIER (1894*a*, 1894*b*, 1894*c*, 1894*d*, 1895), especially in his last work, the idea of an association between some species of solitary corals and what

was thought like gastropod molluscs; was first noted by H. MILNE-EDWARDS and J. HAIME (1848*a*, 1848*b*, 1857, 1860).

It was not until 1854 that the association between the solitary corals, *Heterocyathus aequicostatus* and *Heteropsammia cochlea*, and a sipunculan named *Sipunculus cochlearius* was observed by VALENCIENNES (in ROBERT, 1854). As the sipunculan had only just been named, DIESING (1859) in his "Revision der Rhyngodeen", placed this taxon in the species of the genus *Sipunculus* considered by him as *species inquirendae*.

After this date, the association continued to be observed by several naturalists such as McDONALD (1862), DESHAYES (1863), SEMPER (1872, 1880), VERRILL (1870), MOSELEY (1881), ALCOCK (1893, 1902) and KÜKENTHAL (1896). Some of the most interesting observations are those of McDONALD (1862), who proposed a new species of sipunculan, *Sipunculus heterocyathi*, without a referring to the preceding literature, and SEMPER (1880), who correctly placed the sipunculan in the genus *Aspidosiphon* Diesing, 1851. DESHAYES (1863) also overlooked the previous references concerning this association and named a new genus of what he thought was a mollusc, *Cryptobia*, in his "Catalogue des Mollusques de l'île de la Réunion (Bourbon)". He named two species, *C. heteropsammarum* and *C. michelini*, the first one living inside the solitary coral *Heteropsammia* and the second inside *Heterocyathus*. The diagnosis proposed by DESHAYES was based on the presence of a tube secreted by *Cryptobia* in *Heterocyathus*, and the absence of it in *Heteropsammia*. Also BAIRD (1873) briefly described a new species of sipunculan from the Lee Sandbanks (Great Barrier Reef), which was imbedded in a piece of coral, as *Aspidosiphon jukesii*. BOUVIER (1894*a*) changed literally the generic name *Cryptobia* for *Aspidosiphon* Diesing, 1851, trying to avoid any nomenclatural problem, since the gastropod molluscs of DESHAYES were two species of sipunculans which he named *Aspidosiphon heteropsammarum* and *A. michelini*. BOUVIER (1895 : 15) quoted the species of solitary corals of DESHAYES as *Heterocyathus aequicostatus* and *Heteropsammia michelini* and provided an additional differential diagnosis for *Heteropsammia cochlea* and *H. michelini*. BOUVIER himself recognized an error in his work published in the "Académie des Sciences" of Paris in which he thought that the solitary corals from Aden were *Heterocyathus aequicostatus* and *Heteropsammia michelini*, each one with its particular commensals as noted previously by DESHAYES. After a careful study of the specimens from Aden he arrived at a very different conclusion with regard to the solitary corals, *Stephanocерis rousseaui* and *Heteropsammia cochlea*, observing also that the same species of aspidosiphonid could have as commensal either of the two species of corals and vice versa. However BOUVIER (1895) retained the two names for the aspidosiphonids proposed in his work of 1894*a*, adding that several specimens of *A. heteropsammarum* were associated either with *Heteropsammia* or with *Stephanocерis*, and the single specimen of *A. michelini* with a specimen of the coral *Heteropsammia cochlea*.

Although JOUSSEAUME in the note enclosed by BOUVIER (1895 : 16) added that the types of *Cryptobia*, housed in the "École des Mines", were examined by him, DESHAYES (1863 : 68) regretted that the molluscs associated with the coral were not studied, either alive or preserved in alcohol. Hence it is very probable that DESHAYES had only dried material and he was able to observe the canals and major opening in which *Cryptobia* would be found. In this sense, the International Code of zoological nomenclature in its article 23-f (iii) considers valid the description of DESHAYES of the two species of the genus *Cryptobia*, because his two names were founded on the work of an animal (canals and opening of

Cryptobia) before another author had proposed a name for the animal itself (the corresponding species of sipunculan), constituting therefore an indication.

On the other hand, SLUITER (1902) in identifying the collection of sipunculans from the "Siboga-Expeditie" proposed a new species, *Aspidosiphon corallicola*, for the aspidosiphonids which he had found associated with solitary corals. According to this author, his proposed species differed from *A. heteropsammiarum* and *A. michelini* in several characteristics.

HERUBEL (1907) omitted most of the data above introduced, although perhaps most surprising was his mention, both in this work and in a previous one (HERUBEL, 1903) that *Aspidosiphon ravus* Sluiter, 1886, inhabits a bivalve shell in commensalism with a coral of the genus *Heterocyathus*. This statement seems to be an error on the part of HERUBEL, since neither SLUITER (1886), nor BOUVIER (1895) described this type of association for this species of sipunculan.

From the publication of the SLUITER's work till now it is hard to explain why the two names introduced by DESHAYES and later described by BOUVIER, have been scarcely used or mentioned in the relevant literature in spite of the fact that some of his papers have been mentioned many times as describing a good example of biological mutualism (see for instance the recent accounts of YONGE, 1975, and RICE, 1976). A list of papers, in which I have been able to find all those names quoted, are given in detail in the corresponding synonymies of each taxon discussed.

When STEPHEN and EDMONDS (1972) monograph on sipunculans appeared, the VALENCIENNES' species was included in the section of species "incertae sedis" or "species inquirendae" and the two species of DESHAYES, later described by BOUVIER, were not listed like that of McDONALD's. Only in the third appendix of parasites and commensals of Sipuncula, do they mention as a *species ignota* of *Aspidosiphon*, not only the records of BOUVIER, but also some of the records of SHIPLEY (1903).

It is not clear to me why *Aspidosiphon corallicola* Sluiter, 1902, has been better accepted by the taxonomists of sipunculans. However the situation related here became more complicated, when RICE and STEPHEN (1970) submitted the junior synonym *Aspidosiphon corallicola* Sluiter, 1902, under its senior synonym *A. jukesii* Baird, 1873, a name not used in the literature of Sipuncula previously. SELENKA *et al.*, (1883-1884 : xxvii) did not consider the name of this species in their monograph on sipunculans due to the fact that it was poorly described.

The object of this paper is : (1) to consider the published descriptions of *Sipunculus cochlearius* and *S. heterocyathi* ; (2) to redescribe the original material on which BOUVIER based his redescriptions of *A. heteropsammiarum* (Deshayes, 1863) and *A. michelini* (Deshayes, 1863) ; (3) to place them in the actual system of classification of Sipuncula. Unfortunately the type material of all those species has not been found either in the collections of Paris Museum or in those of British Museum and Hunterian Museum of London.

SYSTEMATIC SECTION

Sipunculus cochlearius Valenciennes, 1854

- 1854 — *Sipunculus cochlearius* Valenciennes (in ROBERT, 1854), p. 640.
1859 — *Sipunculus cochlearius* : DIESING, p. 758.
not 1865 — *Sipunculus (Phymosomum) cochlearius* : DE QUATREFAGES, p. 623.
1868 — *Phascolosoma cochlearium* Baird, p. 94.
1883-1884 — *cochlearius* Selenka *et al.*, p. v.
1972 — *Phascolosoma cochlearium* : STEPHEN and EDMONDS, p. 339.

As the attempts to locate the type specimen of this species were unfruitful, it can only be considered under the original statements of VALENCIENNES about the peculiar habitat of his proposed species. According to the literature there is little doubt that he was referring to the association between the sipunculan, *Aspidosiphon (Aspidosiphon) jukesii* Baird, 1873, and the solitary corals recorded by VALENCIENNES. Based on these comments it is possible to consider VALENCIENNES' name, rather as a senior synonym of *A. jukesii* than as a *species inquirenda*. However *S. cochlearius* is denoted as senior synonym of the mentioned species with some reservations since the author has not been able to examine the type specimen of VALENCIENNES.

In addition to VALENCIENNES' indication of his species, there is only one original record of this species. DE QUATREFAGES (1865) placed one specimen from "Mer des Indes" (an old French name for the Indian Ocean) located in the Paris Museum (no. 404 a) under this name. However the reexamination of this single specimen shows that it is a *Phascolosoma* species, possibly *P. vermiculum* (de Quatrefages, 1865) redescribed in SAIZ SALINAS (1984).

Sipunculus heterocyathi McDonald, 1862

- 1862 — *Sipunculus heterocyathi* McDonald, p. 78-81, fig. 1-3.
1958 — *Sipunculus heterocyathi* : SCHINDEWOLF, p. 265.

This species was erected on the basis of numerous specimens which McDONALD found associated with solitary corals of the genus *Heterocyathus*. After describing them briefly, he concluded that *S. heterocyathi* was closely allied to *Lithodermis cuneus* of CUVIER. The type specimens of the McDONALD's collection, upon which this species was based, could not be located. However the illustrations of the external anatomy of his species show that they are clearly referable to genus *Aspidosiphon* Diesing, 1851. The similarity of *S. heterocyathi* to *A. jukesii* is readily apparent, namely in its peculiar habitat, and there can be little doubt that the two species are identical. *S. heterocyathi* is here regarded as a senior synonym of *A. jukesii* with some reservations, since the decision is made without the reexamination of the type material.

Aspidosiphon heteropsammiarum (Deshayes, 1863)

(Fig. 1, A-N)

- 1863 — *Cryptobia heteropsammiarum* Deshayes, p. 65-68 (after BOUVIER's papers).
1863 — *Cryptobia heteropsammiarum* : CROSSE, p. 396-397.
1894a — *Aspidosiphon heteropsammiarum* : BOUVIER, p. 98.
1894b — *Aspidosiphon heteropsammiarum* : BOUVIER, p. 172.
1894d — *Aspidosiphon heteropsammiarum* : BOUVIER, p. 314.
1895 — *Aspidosiphon heteropsammiarum* : BOUVIER, 19-22, pl. 1, figs. 1-14.
1902 — *Aspidosiphon heteropsammiarum* : SLUITER, p. 20.
1910 — *Aspidosiphon heteropsammiarum* : SHIPLEY, p. 428.
1931 — *Aspidosiphon heteropsammiarum* : BALTZER, p. 53.
1934 — *Aspidosiphon heteropsammiarum* : HARMS, p. 98.
1936 — *Aspidosiphon heteropsammiarum* : LEROY, p. 426.
1952 — *Aspidosiphon heteropsammiae* : GERTH, p. 121.
1958 — *Aspidosiphon heteropsammiarum* : SCHINDEWOLF, p. 267.
1958 — *Aspidosiphon heteropsammiarum* : FÜLLER, p. 135.
1970 — *Aspidosiphon heteropsammiarum* : MURINA, p. 65.
1975 — *Aspidosiphon heteropsammiarum* : HALDER, p. 71, 85.

MATERIAL EXAMINED : 1 vial lodged in the Mus. natn. Hist. nat. Paris, with 9 specimens (4 damaged, and some pieces of another) and 5 labels. Two of them are : "*Aspidosiphon heteropsammiarum* E. L. Bouvier", the third one is : "*Aspidosiphon heteropsammiarum*. M^r Jousseau. Mer Rouge. 1893", the fourth is : "Mer Rouge", and the fifth : "*Aspidosiphon heteropsammiarum*".

REDESCRIPTION

Trunk 7,83-14,04 mm long and 2-3,33 mm wide. Introvert 3,33-17,6 mm long and 0,84-1,24 mm wide. The introvert is 0,28-2,24 times the trunk length. Colour varies from cream to light brown, with some small browner and darker spots near the anal shield. Shape of the trunk cylindrical but curved in some specimens (fig. 1, A). Body wall thick and opaque, but in some regions it may be thinner and translucent. Surface of the skin smooth, but sometimes a few transverse wrinkles are visible. Anal shield thick, from rectangular to more properly semicircular and with well defined margins (fig. 1, B-D). In the anal shield are 11 up to 18 furrows to be found. In the marginal area of the central part are rectangular or polygonal units to be observed. In some specimens they are also in the central region visible. In the ventral margin are small blunt points (= spines?) not well defined in all cases. Its surface is composed of polygonal platelets, which are sometimes not well defined due to the strong chitinization. Caudal shield is conical in shape, being less chitinized, with margins not well defined and much less distinct in some specimens (fig. 1, E-G). There are 4 to 15 radial furrows of various lengths, which can be very vague. The caudal shield surface is composed of polygonal scale-like platelets, which are more pigmented and noticeable in the middle of the shield in some specimens. Surface of the trunk contains oval papillae, 0,03-0,086 mm in diameter, each of which bears a small opening in its centre surrounded by small polygonal platelets (fig. 1, N). Most of these papillae show coalescence of their platelets, and in some cases the platelets are absent. Adjacent to the anal shield the papillae are more prominent, 0,056-0,19 mm in diameter, and more closely placed. Introvert armed anteriorly with several rows of single-

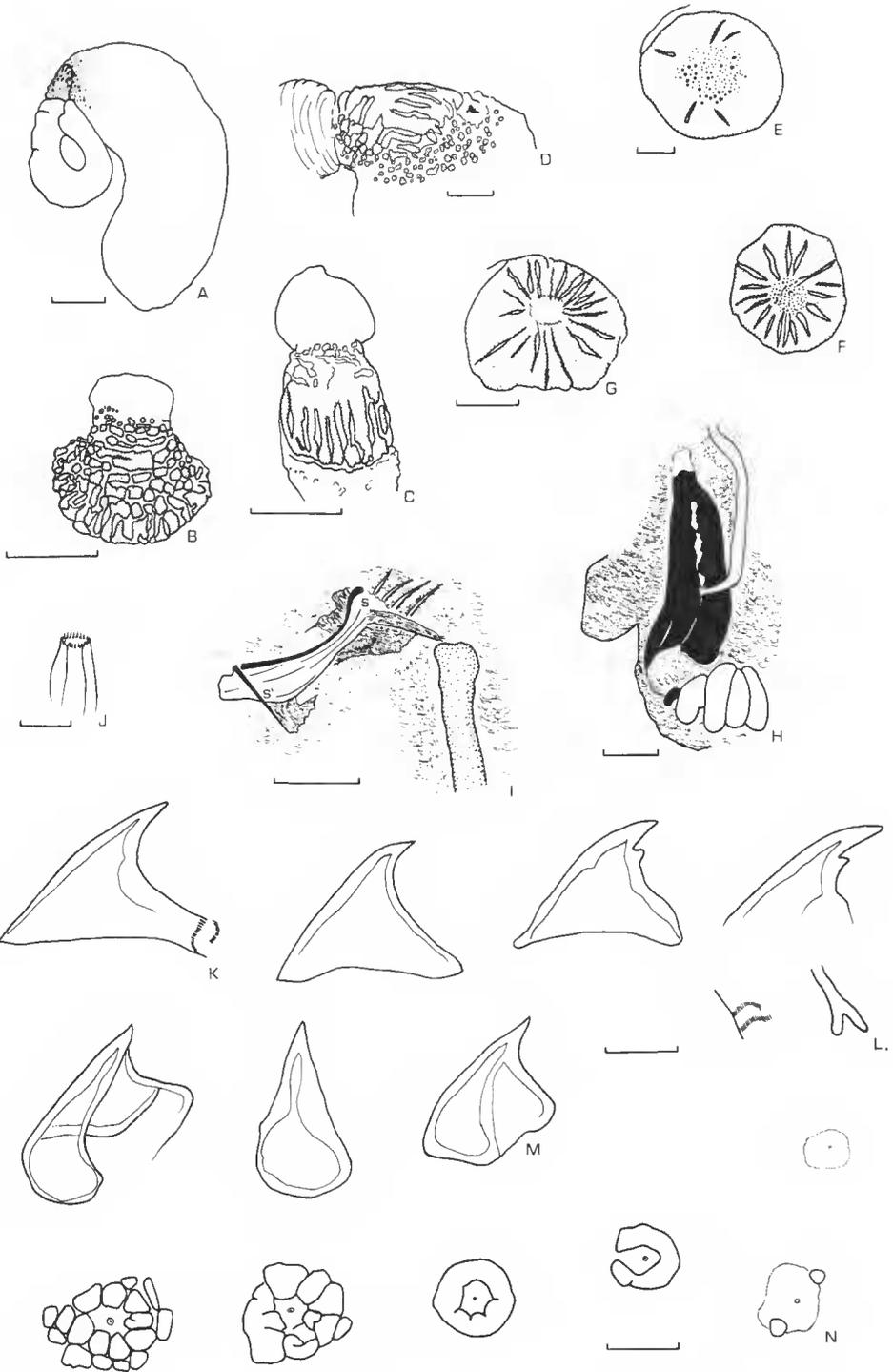


FIG. 1. — *Aspidosiphon heteropsammiarum* (Deshayes, 1863) : A, entire specimen showing the anal shield (scale bar : 1,5 mm) ; B & C, anal shields from two different specimens (scale bar : 1 mm) ; D, side view of the anal shield represented in C (scale bar : 0,5 mm) ; E, F & G, caudal shields from three specimens (scale bar : 0,5 mm) ; H, posterior region dissected, showing the attachment of the spindle muscle (scale bar : 1 mm) ; I, anterior region dissected showing the split of the spindle muscle in two fine strands, s : dorsal to rectum and s' : with the extension of rectum to body wall (scale bar : 1 mm) ; J, tubular papilla from introvert (scale bar : 0,05 mm) ; K, single-pointed and double-pointed hooks from introvert ; L, accessory spinelets (left) and a split (right) at anterior bases of some hooks ; M, spines from posterior region of the introvert (K, L & M to same scale : 0,01 mm) ; N, different views of papillae of the trunk, showing both coalescence of platelets and absence of them (scale bar : 0,05 mm).

pointed hooks, although on some cases a small secondary tooth can be observed (fig. 1, K). Hooks are 0,01-0,022 mm in height and 0,016-0,032 mm in width. Accessory spinelets and splits are visible at anterior bases of some hooks (fig. 1, L). Scattered spines, 0,02-0,036 mm high and 0,023-0,035 mm wide, occur posteriorly on the introvert (fig. 1 M). Tubular papillae 0,01-0,014 mm high are present between rows of hooks and over most surface of introvert (fig. 1, J). Longitudinal musculature continuous, except under the anal shield where 9 small bands are present. In some specimens there is a tendency to develop some weak bundles in the dorsal region of the body wall. Two retractors have their origins near the caudal shield. They remain separate for 0,11 to 0,4 times the length of the trunk before fusing to form a single retractor. A wing muscle is present, with two lateral extensions reaching over the nephridiopores to each side of nerve cord. A fixing muscle, arising from left side of nerve cord, sometimes from a wide base, even splitted in 3 fine strands, runs between the retractors to intestine. A spindle muscle is present (fig. 1, I), attached anteriorly dorsal to rectum, splitting in 2 strands, one (s') runs with the extension of rectum to body wall and the other (s) runs dorsal to rectum. In most times the split is not conspicuous, although the 2 strands are well discernible. An extension of rectum is fixed to the body wall by a strand of fine tissue to 1,3-1,8 mm under the anus (fig. 1, I). Posteriorly the spindle muscle is attached to body wall in the marginal limit of the caudal shield (fig. 1, H). There are 28 to 35 intestinal spirals. Rectum varies from very short to 4 mm. A rectal caecum is present in 3 specimens and a contractile vessel in 2 specimens. Nephridia are attached to the body wall for 0,54 to 0,84 times their length and are about 0,38-0,86 times the trunk length. Nephridiopores are slightly posterior to the anus, but in one specimen they are at the same level.

***Aspidosiphon michelini* (Deshayes, 1863)**

(Fig. 2, A-F)

- 1863 — *Cryptobia michelini* Deshayes, 65-68 (after BOUVIER's papers).
1863 — *Cryptobia michelini* : CROSSE, p. 396-397.
1894a — *Aspidosiphon michelini* : BOUVIER, p. 98.
1894b — *Aspidosiphon michelini* : BOUVIER, p. 172.
1894d — *Aspidosiphon michelini* : BOUVIER, p. 22-24, pl. 1, figs. 16-23.
1902 — *Aspidosiphon michelini* : SLUITER, p. 20.
1910 — *Aspidosiphon michelini* : SHIPLEY, p. 428.
1931 — *Aspidosiphon michelini* : BALTZER, p. 53.
1934 — *Aspidosiphon michelini* : HARMS, p. 98.
1952 — *Aspidosiphon michelini* : GERTH, p. 121.
1952 — *Aspidosiphon michelini* : DAWYDOFF, p. 267.
1958 — *Aspidosiphon michelini* : SCHINDEWOLF, p. 267.
1958 — *Aspidosiphon michelini* : FÜLLER, p. 153.
1964 — *Aspidosiphon michelini* : MURINA, p. 56.
1975 — *Aspidosiphon michelini* : HALDER, p. 71, 85.

MATERIAL EXAMINED : 1 vial lodged in the Mus. natn. Hist. nat. Paris, with 2 specimens and 3 labels. On two first labels : "*Aspidosiphon Michelini* Bouv. Mer Rouge. M. Jousseume. 1893", and on the third one : "*Aspidosiphon Michelini*. M. Jousseume. Aden. 8 m.". Only one of the two specimens, with spines on the anal shield, is considered as original according to BOUVIER (1895 : 19).

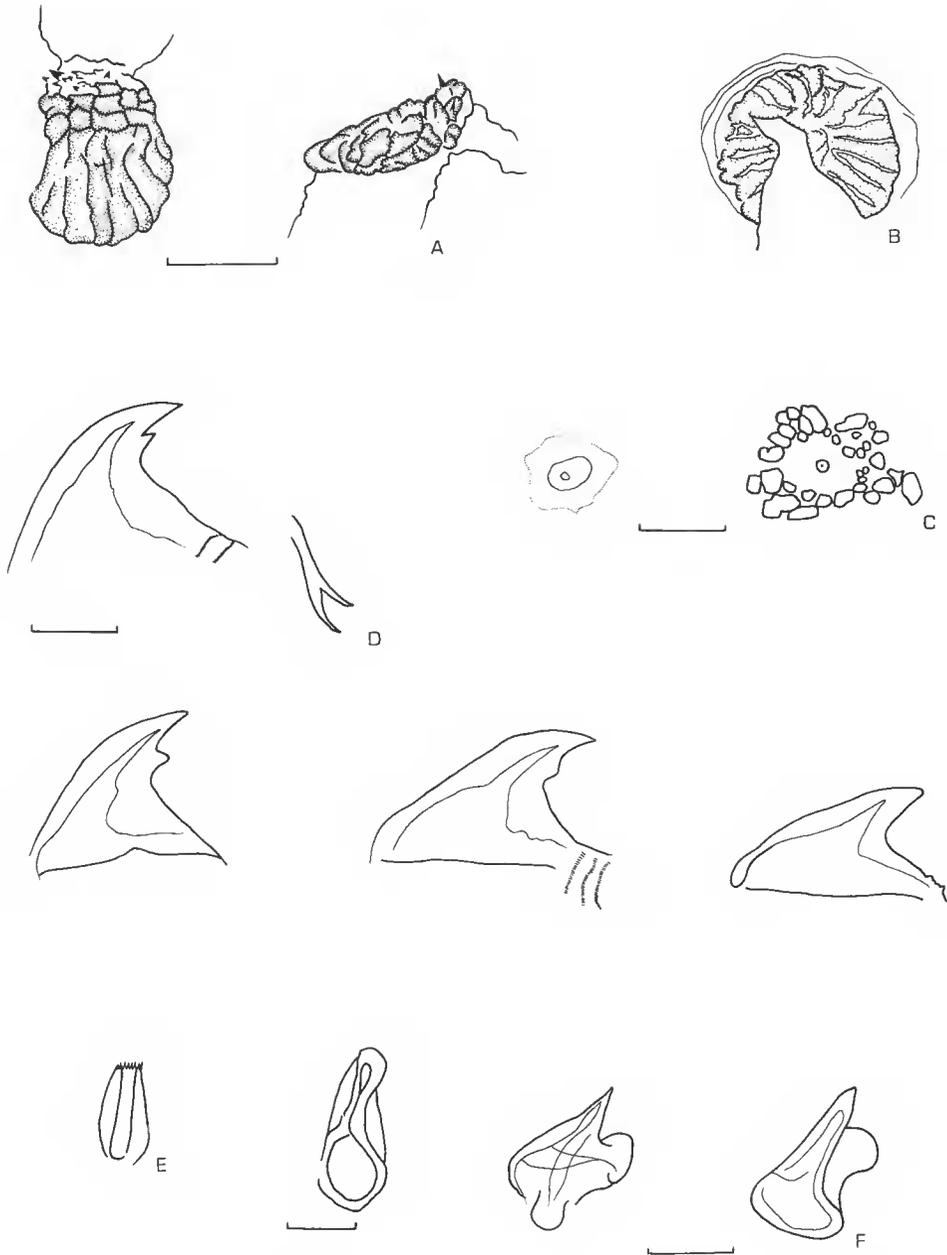


FIG. 2. — *Aspidosiphon michelini* (Deshayes, 1863) : A, front and side views of the anal shield, showing the spine-like structures (scale bar : 1 mm) ; B, caudal shield (same scale as A) ; C, two different papillae from the trunk showing from the absence of platelets to the typical arrangement (scale bar : 0,025 mm) ; D, double-pointed and single-pointed hooks from the introvert showing spinelets and a split at the anterior base of some of them (scale bar : 0,01 mm) ; E, tubular papilla from the introvert (same scale as D) ; F, spines from posterior region of the introvert (left scale bar : 0,01 mm and right one : 0,025 mm).

REDESCRIPTION

Trunk 7 mm long and 2.5 mm wide. Introvert 10 mm long and 1 mm wide. Body wall cream except at anal and caudal shields where it is light brown. Near the anal shield there is a zone with brown spots. Shape of the trunk cylindrical, with a thick and opaque skin and with scattered transverse wrinkles. Anal shield thick, oval, and with distinct borders (fig. 2, A). There are eight longitudinal furrows on the anal side, a central zone with transverse and longitudinal furrows, and a ventral zone with spine-like structures. Surface of the anal shield has small closely placed polygonal platelets each with a small clear spot in the middle. The caudal shield is more weakly chitinized, conical in shape with defined borders, and with 16 radial furrows of various length (fig. 2, B). Its surface is composed of polygonal scale-like platelets. The surface of trunk consists of oval papillae, 0.043-0.056 mm in diameter, each bearing a small opening in its centre surrounded by small polygonal platelets (fig. 2, C). Adjacent to the anal shield the papillae are more prominent, 0.07-0.1 mm in diameter, and more closely placed. Introvert armed anteriorly with several rows of double pointed hooks, 0.016-0.022 mm high and 0.026-0.029 mm wide (fig. 2, D). Some hooks in the posterior rows are either single pointed or with a very small second point. Accessory spinelets and splits are seen at anterior base of some hooks. Scattered spines, 0.026-0.054 mm high and 0.023-0.04 mm wide, occur posteriorly on the introvert (fig. 2, F). Tubular papillae, 0.01-0.017 mm high, are present between the rows of hooks and over most of surface of the introvert (fig. 2, E). Longitudinal musculature is continuous except anteriorly where muscles tend to split into 8 bands in the dorsal region. Two retractors arise very close to the caudal shield, and are fused to 3.5 mm from their bases. A wing muscle, fixing muscles and spindle muscle are present, but damaged. There are almost 20 intestinal coils and a rectum 6 mm long. Neither the rectal caecum, nor the contractile vessel were observed. One nephridium 4 mm long with distal 1 mm part not attached to body wall. Nephridiopore is at the same level as anus.

DISCUSSION

Aspidosiphon heteropsammiarum and *A. michelini* were the names used by BOUVIER (1894a, 1894b, 1894c, 1894d, 1895) for the aspidosiphonids he found associated with solitary corals from Aden. As has already been related in the introduction, the specific names were proposed by DESHAYES (1863), when he had the opportunity to observe the canals and major opening in the solitary corals from Is. Réunion and thought that these perforations were produced by the action of a mollusc which he named *Cryptobia*.

BOUVIER (1895) founded somewhat circumstantially a different diagnosis for the two species of sipunculans from solitary corals based on the nature of the shields. According to his published observations, *A. heteropsammiarum* had a caudal shield bigger than the anal shield, and the longitudinal furrows in the anal shield were shorter and less regular in *A. michelini*. In his published drawings, he illustrated some spine-like structures on the

ventral margin of the anal shield in *A. michelini* (not observed in *A. heteropsammiarum*). BOUVIER was not able to observe the second point in the concave side of some hooks from the two species, nor to distinguish between a hook and a spine on the introvert. The descriptions of BOUVIER, brief and inadequate in several points, were misunderstood some years later by SLUITER (1902) when he proposed a new species of aspidosiphonid from solitary corals of Indonesia and Malaysia, *A. corallicola*. He founded its differential diagnosis explicitly as follows : (1) position of retractors ; (2) shape of hooks (illustrating double-pointed hooks) ; (3) presence of spines in the posterior half of introvert ; (4) arrangement of nephridia.

Both *Aspidosiphon heteropsammiarum* and *A. michelini* fall into the group of species of the subgenus *Aspidosiphon* with : (1) hooks and spines on the introvert ; (2) retractor muscle attached to the caudal shield ; (3) spindle muscle attached posteriorly ; (4) caudal shield weakly developed ; (5) anal shield very distinct. According to STEPHEN and EDMONDS' monograph (1972) on sipunculans, there are several species of aspidosiphonids with these characteristics, which were separated in their key (p. 218-219) after considering the following taxonomic characteristics : (1) the number of hook points ; (2) the presence or absence of spine-like structures on the anal shield. The recent works of RICE and STEPHEN (1970) and CUTLER and CUTLER (1979) questioned in part the validity of this key, when they enclosed several interesting results about the variability of some structures of the aspidosiphonids from solitary corals, as exemplified either in the variable presence of a second tooth in the hook concave side, or in the changing nature of the anal shield, or finally in the weak development of bands in the longitudinal musculature of the dorsal anterior region. The published descriptions of *Aspidosiphon (Aspidosiphon) jukesii* Baird, 1873, presented in the works of these authors, are more flexible than the ones compiled by STEPHEN and EDMONDS (1972), and allow one to relate the specific names proposed by DESHAYES (1863) (properly described by BOUVIER, 1895) with the current name of this species after contrasting the remaining characteristics.

All these names being subjective synonyms of the same species, and in spite of the fact that the names proposed by DESHAYES (1863) like those by VALENCIENNES (*in* ROBERT, 1854) and McDONALD (1862), were published previously, *A. jukesii* continued to be maintained as the valid name for this species according to the present rules of the ICZN. The junior name *A. jukesii* Baird, 1873, has been applied to a particular taxon in ten different publications during the immediately preceding fifty years, as follows : RICE and STEPHEN (1970), STEPHEN and EDMONDS (1972), SMALDON and WATT (1974), ARNAUD and THOMASSIN (1976, in a footnote on p. 367), RICE (1976), KONOPKA (1978), CUTLER and CUTLER (1979), EDMONDS (1980), GRYGIER (1981), GRUNER (1982) and CUTLER *et al.* (1984).

However there is a fifth junior synonym, *A. corallicola* Sluiter, 1902, involved in the tortuous history of this species. This name was frequently used in the literature as the valid name for this species and was considered by RICE and STEPHEN (1970) as a junior synonym of *A. jukesii*. On grounds of priority, these authors unfortunately revived the last name as valid for this species, according to the interpretations they made of the obsolete article 23 (b) of the ICZN. *A. corallicola* has appeared many times in the literature. In the past fifty years alone, it has been recorded in VAUGHAN and WELLS (1943), RIOJA-LO BIANCO (1947, erroneously as *A. carolinus*), ALLOITEAU (1952), DAWYDOFF (1952), GERTH (1952), STEPHEN and ROBERTSON (1952), SCHINDEWOLF (1958), CUTLER (1965), FEUSTEL

(1965), LEGENDRE (1966), GOREAU and YONGE (1968), THOMASSIN (1971), PICHON (1972), YONGE (1975), RICE (1975), HALDER (1975), PATTON (1976), ANON (1976), ARNAUD and THOMASSIN (1976), SCHUMACHER (1978), KONOPKA (1978), and VERON and PICHON (1979). A protective decision for the name *A. jukesii* from the International Commission on Zoological Nomenclature would contribute to avoid the possible confusion on the names usage for this species.

Some characteristics observed in one of the specimens named by BOUVIER are not to be found (or are not well defined) in the others, such as the spine-like structures of the anal shield and a higher rate of double-pointed hooks than single-pointed ones present in the single specimen of *A. michelini*. Because of the internal damage of this specimen, the details of the wing muscle, fixing muscle and spindle muscle in comparison with the other specimens of *A. heteropsammiarum* have not been stated. Only a nephridium has been observed in the single specimen of *A. michelini*, the other has probably been lost in the previous dissections, since BOUVIER (1895) illustrated its zootomy with the typical arrangement. Finally a tendency to the coalescence of polygonal platelets in the trunk papillae has been noted in most specimens of *A. heteropsammiarum* but not clearly in *A. michelini*.

The most important of the above mentioned characteristics is the presence of spine-like structures on the anal shield which has been used as differential diagnosis to separate species of aspidosiphonids. In the literature of this species, there is a suggestion published in STEPHEN and ROBERTSON (1952), compiled also by STEPHEN and EDMONDS (1972), which states that the anal shield of the Zanzibar specimens showed some differences from the Malaysian and Indonesian specimens described by SLUITER (1902). Most important however, is that spine-like structures on the anal shield were noted for this species by BOUVIER (1895) in the single *A. michelini* specimen, STEPHEN and ROBERTSON (1952), CUTLER and CUTLER (1979) and in the SHIPLEY's drawing (1903). Nothing about these structures appears in the works of SLUITER (1902), CUTLER (1965), RICE and STEPHEN (1970), STEPHEN and EDMONDS (1972) and EDMONDS (1980). CUTLER and CUTLER (1979) describe 3 stages of an interesting sequence in the anal shield which changes with age. Most of the situations here related are simply accidents of the specimens damage, the remaining others can be better interpreted or explained as common variations of the same species, after contrasting the various morphological data of the taxonomic literature of this species.

In the redescriptions exposed here, mainly of *A. heteropsammiarum* specimens, there are some structures not compiled or only partially registered in the literature of this species. Spinelets at the concave base of the hook are temptingly illustrated by RICE and STEPHEN (1970) in *A. jukesii*. Neither the splits at the base of the hook, nor the lateral extensions of the wing muscles have been related previously in the literature. Nothing is compiled about the split of the spindle muscle in its anterior part and the presence of 2 fine strands. However the literature has scarcely registered an extension of the rectum to body wall or attachment of it through mesenteries in BOUVIER (1895) and SLUITER (1902). The posterior attachment of the spindle muscle to a marginal point of the caudal shield (not in the middle!) has been well illustrated in the drawing of the *A. michelini* specimen by BOUVIER (1895). All these structures are very difficult to interpret from a taxonomic point of view in the actual context of our knowledge about this species or even the aspidosiphonids in general. As a rule it can be said that they have not been registered in the literature or if so, indirectly represented, illustrated, or not commented on. Qualitative additional obser-

variations on different specimens of this species would be of great value in order to weigh the possible importance of these characteristics in the systematic of aspidosiphonids.

A final note about the distribution of this species : *A. jukesii* (formerly known as *A. corallicola*) has been quoted as a member of the Indian Ocean shallow water fauna by CUTLER and CUTLER (1979). The records of this species are from the following localities : Moorea Is. (French Polynesia), Australia, Indonesia, Malaysia, Vietnam, Gulf of Manaar, Sri-Lanka, Gulf of Oman, Madagascar, Zanzibar, Is. Réunion, Mozambique and South Africa. The findings of this species in Aden, Red Sea, by BOUVIER (1894a, 1894b, 1894d and 1895) are an expansion of its western limit towards the Red Sea (as represented in MURINA, 1970).

Acknowledgements

The author wishes to thank Dr. Jeanne RENAUD-MORNANT (Worms Laboratory, Paris Museum) for helping and providing me with this collection during my stay in Paris Museum, where this study was performed. The author is also indebted to Dr. R. W. SIMS (British Museum Natural History) for the informations concerning the type material of *S. heterocyathi*. Initial funds for this study was provided by a grant of the Department of Education, Universities and Research of the Basque government. The completion of the work was supported by a grant of the German Academic Exchange Service.

REFERENCES

- ALCOCK, I., 1893. — On some newly-recorded Corals from the Indian Seas. *J. Asiat. Soc. Beng.*, **62** : 138-149, pl. 5.
- 1902. — Report of the Deep-Sea Madreporaria of the Siboga Expedition. *Siboga Exped.*, **16a** : 1-51, 5 pls.
- ALLOITEAU, J., 1952. — Madréporaires post-paléozoïques. *In* : *Traité de Paléontologie*. Tome 1, Les stades inférieurs d'organisation du Règne animal (Dir. J. PIVETEAU). Paris, Masson et C^{ie} : 539-684.
- ANON, 1976. — Symbiose koraal en worm. *Vita mar.*, **26** (11) : 20.
- ARNAUD, P. M., & B. A. THOMASSIN, 1976. — First records and adaptative significance of boring into a Free-Living Scleractinian Coral (*Heteropsammia michelini*) by a Date Mussel (*Lithophaga lessepsiana*). *Veliger*, **18** (4) : 367-374.
- BAIRD, W., 1868. — Monograph of the species of Worms belonging to the subclass Gephyrea, with a Notice of such species as are contained in the Collection of the British Museum. *Proc. zool. Soc. Lond.*, 1868 : 76-114, pls. 9-11.
- 1873. — Description of some new species of Annelida and Gephyrea in the Collection of the British Museum. *J. Linn. Soc., Zoology*, **11** : 94-97.
- BALTZER, F., 1931. — Sipunculida. *In* : *Handbuch der Zoologie. Eine Naturgeschichte der Stämme des Tierreiches* (eds. W. KÜKENTHAL & T. KRUMBACH). Berlin, De Gruyter : 15-61.
- BOUVIER, E. L., 1894a. — Un nouveau cas de commensalisme : association de Vers du genre *Aspidosiphon* avec des Polypes madréporaires et un Mollusque bivalve. *C. r. hebd. Séanc. Acad. Sci., Paris*, **119** (1) : 96-98.
- 1894b. — Un cas nouveau de commensalisme. *Naturaliste*, 2^e sér., **8** (178) : 171-173.

- 1894c. — (Note dans le Compte rendu, sans titre). *C. r. somm. Séanc. Soc. philomath. Paris*, 1894 (16) : 2.
- 1894d. — A new instance of commensalism : association of worms of the genus *Aspidosiphon* with madreporian polyps and a bivalve mollusc. *Ann. Mag. nat. Hist.*, 6 ser., 14 (82) : 312-314.
- 1895. — Le commensalisme chez certains polypes madréporaires. *Annls Sci. nat.*, Zoologie, 7^e sér., 20 : 1-32, pl. 1.
- CROSSE, H., 1863. — Catalogue des mollusques de l'île de la Réunion (Bourbon), par M. G. P. Deshayes. — Extrait des Notes sur l'île de la Réunion, par L. Maillard, ingénieur colonial en retraite. *J. Conch.*, Paris, 3^e sér., 11 (3) : 394-401.
- CUTLER, E. B., 1965. — Sipunculids of Madagascar. *Cah. ORSTOM, Océanogr.*, 3 (4) : 51-63.
- CUTLER, E. B., & N. J. CUTLER, 1979. — Madagascar and Indian Ocean Sipuncula. *Bull. Mus. natn. Hist. nat.*, Paris, 4^e sér., 1, sect. A, (4) : 941-990.
- CUTLER, E. B., N. J. CUTLER & T. NISHIKAWA, 1984. — The Sipuncula of Japan : their systematics and distribution. *Publs Seto mar. biol. Lab.*, 29 (4/6) : 249-322.
- DAWYDOFF, C., 1952. — Contribution à l'étude des invertébrés de la faune marine benthique de l'Indochine. *Bull. biol. Fr. Belg.*, Suppl. 37 : 1-158.
- DE QUATREFAGES, A., 1865. — Histoire Naturelle des Annelés marins et d'eau douce. Annelides et Géphyriens. Paris, Roret. 3 vol. : 558 p. + 794 p. + 24 p. + 20 pl.
- DESHAYES, G. P., 1863. — Catalogue des Mollusques de l'île de la Réunion (Bourbon). Extrait des notes sur l'île de la Réunion par L. Maillard. Paris, Dentu.
- DIESING, C. M., 1859. — Revision der Rhyngodeen. *Sber. Akad. Wiss. Wien*, Mathematisch-naturwiss. classe, 37 : 719-782, 3 pls.
- EDMONDS, S. J., 1980. — A revision of the systematics of Australian sipunculans (Sipuncula). *Rec. S. Aust. Mus.*, 18 (1) : 1-74.
- FEUSTEL, H., 1965. — Anatomische Untersuchungen zum Problem der *Aspidosiphon-Heterocyathus* Symbiose. *Zool. Anz.*, Suppl. 29 (Verh. dt. zool. Ges. 59. Jahresversammlung) : 131-143.
- FÜLLER, H., 1958. — Symbiose im Tierreich. Wittenberg-Lutherstadt, A. Zimsen Verlag. 227 p.
- GERTH, H., 1952. — Die von Sipunculiden bewohnten und jungtertiären Korallen und der würmförmige Körper von *Pleurodictyum. Paläont. Z.*, 25 (3/4) : 119-126, pl. 6.
- GOREAU, T. F., & C. M. YONGE, 1968. — Coral community on muddy sand. *Nature, Lond.*, 217 : 421-423.
- GRUNER, H.-E., 1982. — Stamm Sipunculida. In : Lehrbuch der Speziellen Zoologie. Band 1 : Wirbellose Tiere. 3. Teil : Mollusca, Sipunculida, Echiurida, Annelida, Onychophora, Tardigrada, Pentastomida (4. Aufl.) (ed. H.-E. GRUNER). Stuttgart, Gustav Fischer Verlag : 246-260.
- GRYGIER, M. J., 1981. — *Petrarca okadaï*, a new crustacean (Maxillopoda : Ascothoracica) from the Great Barrier Reef, the first shallow water record of the genus. *J. Crust. Biol.*, 1 (2) : 183-189.
- HALDER, B. P., 1975. — Sipuncula of the Indian Ocean in the Collections of the Zoological Survey of India. In : Proceedings of the International Symposium on the Biology of Sipuncula and Echiura (eds. M. E. RICE & M. TODOROVIĆ). Beograd, Naučno Delo. 1 : 51-92.
- HARMS, W., 1934. — Sipunculidea. In : Handwörterbuch der Naturwissenschaften (2. Aufl.) (eds. R. DITTLER, G. JOOS, E. KORSCHULT, G. LINCK, F. OLTMANN, K. SCHAUM). Jena, Gustav Fischer Verlag : 86-100.
- HÉRUBEL, M.-A., 1903. — Première contribution à la morphologie et à la physiologie comparées et à la biostatique des sipunculides. *Bull. Soc. zool. Fr.*, 28 : 111-125.
- 1907. — Recherches sur les sipunculides. *Mém. Soc. zool. Fr.*, 20 : 107-418, pls. 5-10.
- KONOPKA, H. P., 1978. — Endolithische Sipunculiden. *Natur. Mus. Frankf.*, 108 (5) : 137-143.
- KÜKENTHAL, W., 1896. — Ergebnisse einer zoologischen Forschungsreise in Molukken und Borneo. 1. Reisebericht. *Abh. senckenb. naturforsch. Ges.*, 22 : 1-321.

- LEGENDRE, R., 1966. — Sipunculien et Échiuriens signalés des eaux littorales de Madagascar. *Bull. Acad. malgache*, **42** (1) : 101-104.
- LEROY, P., 1936. — Les Sipunculien du Muséum National d'Histoire Naturelle de Paris. *Bull. Mus. natn. Hist. nat., Paris*, 2^e sér., **8** (5) : 423-426.
- MCDONALD, J. D., 1862. — Observations on some Australian and Feegeean *Heterocyathus* and their parasitical *Sipunculus*. *Nat. Hist. Rev.*, 1862 : 78-81.
- MILNE-EDWARDS, H. (& J. HAIME), 1857-1860. — Histoire naturelle des Coralliaires ou Polypes proprement dits. Paris, Roret. 3 vol. : 326 p. + 633 p. + 560 p.
- MILNE EDWARDS, M., & J. HAIME, 1848a. — Recherches sur les Polypiers. II. Monographie des Turbinolides. *Annls Sci. nat., Zoologie*, 3^e sér., **9** : 211-344, pl. 7-10.
- MILNE EDWARDS, M., & J. HAIME, 1848b. — Recherches sur les Polypiers. III. Monographie des Eupsammides. *Annls Sci. nat., Zoologie*, 3^e sér., **10** : 65-114, pl. 1.
- MOSELEY, H. N., 1881. — On the deep sea Madreporaria. *In* : Report on the scientific results of the voyage of H.M.S. Challenger. **2** : 127-208, pls. 1-16.
- MURINA, V. V., 1964. — K faune sipunkulid Sredizemnogo morya. *Trudy sevastopol'. biol. Sta.*, **17** : 51-76.
- 1970. — Dopelnenie k faune sipunkulid Adenskogo zaliva. *Vést. Zool.*, **1970** (2) : 65-72.
- PATTON, W. K., 1976. — Animal Associates of Living Reef Corals. *In* : Biology and geology of coral reefs (eds. O. A. JONES & R. ENDEAN). New York, Academic Press. **3**, Biology 2 : 1-36.
- PICHON, M., 1972. — Les peuplements à base de scléactinaires dans les récifs coralliens de la baie de Tuléar (sud-ouest de Madagascar). *In* : Proceedings of the Symposium on corals and coral reefs (eds. C. MUKUNDAN & C. S. GOPINADHA). Cochin. The Marine Biological Association of India : 135-154.
- RICE, M. E., 1975. — Introduction. *In* : Proceedings of the International Symposium on the Biology of the Sipuncula and Echiura (eds. M. E. RICE & M. TODORVIĆ). Beograd, Naučno Delo. **1** : ix-xix.
- 1976. — Sipunculans associated with Coral communities. *Micronesica*, **12** (1) : 119-132.
- RICE, M. E., & A. C. STEPHEN, 1970. — The type specimens of Sipuncula and Echiura described by J. E. Gray and W. Baird in the collections of the British Museum (Natural History). *Bull. Br. Mus. nat. Hist., Zoology*, **20** (2) : 49-72, pls. 1-3.
- RIDE, W. D. L., G. W. SABROSKY, G. BERNARDI, & R. V. MELVILLE (eds.), 1985. — International Code of Zoological Nomenclature. Third edition adopted by the XXth general assembly of the international union of biological sciences. International trust for zoological nomenclature, London : 338 p.
- RIOJA LO-BIANCO, E., 1947. — Los Vermídeos. *In* : Historia Natural. Vida de los animales, de las plantas y de la tierra. Tomo II. Zoología (Invertebrados) (3^a edición) (dir. A. CABRERA). Barcelona, Publicaciones del Instituto Gallach de Librería y Ediciones : 347-355.
- ROBERT, E., 1854. — Action perforante d'une espèce d'Échinodermes ; lettre de M. Eug. Robert. *C. r. hebd. Séanc. Acad. Sci., Paris*, **39** (14) : 639-643.
- SAIZ SALINAS, J. I., 1984. — Los tipos de sipuncúlidos et De Cuatrefages del Museo de Paris. Bilbao, Servicio Editorial/Argitarapen Zerbitzua, UPV/EHU : 258 p.
- SEMPER, C., 1872. — Ueber Generationswchsel bei Steinkorallen, und über das Edwards'sche Wachstumsgesetz der Polypen (zugleich ein Betrag zur Fauna der Philippinen). *Z. wiss. Zool.*, **22** : 181-280, pls. 16-21.
- SEMPER, K., 1880. — Die natürlichen Existenzbedingungen der Thiere. Zweiter Theil. Leipzig, F. A. Brockhaus : 283 p.
- SCHINDEWOLF, O. H., 1958. — Würmer und Korallen als Synöken. Zur Kenntnis der Systeme *Aspidosiphon/Heterocyathus* and *Hicetes/Pleurodictyum*. *Abh. math.-naturw. Kl. Akad. Wiss. Mainz.*, **6** : 1-70.

- SCHUMACHER, H., 1978. — Arrecifes coralinos. Su extensión, mundo animal y ecología. Barcelona, Ediciones Omega, S.A. : 288 p.
- SELENKA, E., J. G. DE MAN, & C. BÜLOW, 1883-1884. — Die Sipunculiden. Reisen im Archipel der Philippinen von Dr. C. Semper. Zweiter Theil. Wissenschaftliche Resultate (4. Band, 1. Abtheilung). Wiesbaden, C. W. Kreidel : 131 p., 14 pls.
- SHIPLEY, A. E., 1903. — Report on the Gephyrea collected by Professor Hardman, at Ceylon, in 1902. *In* : Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Manaar. With Supplementary Reports upon the Marine Biology of Ceylon by other naturalists (part 1, no. 3) (ed. A. HERDMAN). London, The Royal Society : 169-176, 1 pl.
- 1910. — Gephyrea. *In* : The Cambridge Natural History (2nd. edition) (eds. S. F. HARMER & A. E. SHIPLEY). London, Mac Millan and Co. 2 : 411-449.
- SLUITER, C. Ph., 1886. — Beiträge zu der Kenntniss der Gephyreën aus dem Malayischen Archipel. Vierte Mittheilung. *Natuurk. Tijdschr. Ned.-Indië*, 45 : 472-517, pls. 1-4.
- 1902. — Die Sipunculiden und Echiuriden der Siboga-Expedition nebst Zusammenstellung der Ueberdies aus dem Indische Archipel bekannten Arten. *Siboga Exped.*, 25 : 1-53; 4 pls.
- SMALDON, G., & K. R. WATT, 1974. — A Catalogue of the Sipuncula, Echiura and Priapulida in the Collections of the Royal Scottish Museum, Edinburgh. *Inf. Ser. R. Scott. Mus. (N.H.)*, 3 : 1-31.
- STEPHEN, A. C., & S. J. EDMONDS, 1972. — The phyla Sipuncula and Echiura. Trustees of the British Museum (Natural History), London : 528 p.
- STEPHEN, A. C., & J. D. ROBERTSON, 1952. — A preliminary Report on the Echiuridae and Sipunculidae of Zanzibar. *Proc. R. Soc. Edinb.*, Sect. B, Biology, 64 (22) : 426-444, 1 pl.
- THOMASSIN, B. A., 1971. — Les faciès d'épifaune et d'épiflore des biotopes sédimentaires des formations coralliennes dans la région de Tuléar (sud-ouest de Madagascar). *In* : Regional Variation in Indian Ocean Coral Reefs. Symposia of the Zoological Society of London (no. 28) (eds. D. R. STODDART & M. YONGE). London, Academic Press : 371-396.
- VALENCIENNES, M. (*in* ROBERT, 1854).
- VAUGHAN, T. W., & J. W. WELLS, 1943. — Revision of the suborders, families and genera of the Scleractinia. *Spec. Pap. geol. Soc. Am.*, 44 : xv + 363 p.
- VERON, J. E. N., & M. PICHON, 1979 (1980). — Scleractinia of eastern Australia. Part. 3. Families Agariciidae, Siderastreidae, Fungiidae, Oculinidae, Merulinidae, Mussidae, Pectiniidae, Caryophyllidae, Dendrophylliidae. *Monograph. Ser. Aust. Inst. mar. Sci.*, 4 : i-x, 1-422 p.
- VERRILL, A. E., 1870. — Contributions to Zoology from the Museum of Yale College. No. 7. — Descriptions of new Corals. *Am. J. Sci. Arts*, 49 : 370-375.
- YONGE, C. M., 1975. — A Note on mutualism between sipunculans and scleractinian corals. *In* : Proceedings of the International Symposium on the Biology of Sipuncula and Echiura (eds. M. E. RICE & M. TODORVIĆ). Beograd, Naučno Delo. 1 : 305-311.