Revision of the Verrucidae (Crustacea, Cirripedia) from the Atlantic Ocean studied by Abel Gruvel (*Travailleur* and *Talisman* scientific expeditions)

Paulo S. YOUNG
Museu Nacional / UFRJ,
Quinta da Boa Vista,
20940-040 Rio de Janeiro RJ (Brazil)
psyoung@acd.ufrj.br

Young P. S. 2002. — Revision of the Verrucidae (Crustacea, Cirripedia) from the Atlantic Ocean studied by Abel Gruvel (*Travailleur* and *Talisman* scientific expeditions). *Zoosystema* 24 (4) : 771-797.

ABSTRACT
The verrucids from the Atlantic Ocean studied by Gruvel are redescribed, including their appendages. *Altiverruca erecta* (Gruvel, 1900), *A. longicarinata* (Gruvel, 1900), *Metaverruca imbricata* (Gruvel, 1900), *M. radiata* (Gruvel, 1901) and *M. trisulcata* (Gruvel, 1900) are considered valid species. *Metaverruca imbricata* and *M. radiata* are transferred to this genus because in both the fixed scutum has a well-developed adductor ridge and an enlarged basal margin. *Verruca striata* Gruvel, 1900 is considered to be a synonym of *Metaverruca trisulcata*, and *Verruca linearis* Gruvel, 1900 and *V. magna* Gruvel, 1901 are synonyms of *Metaverruca recta* (Aurivillius, 1898). *Metaverruca sensibilis* Young, 1998 is a synonym of *M. imbricata.* All these species have their distributions limited to the Northern Atlantic. The samples considered as *Verruca stroemia* (Müller, 1776) by Gruvel from deep-water stations off the Azores (*Talisman* Expedition 1883) are indeed empty shells of *Verruca spengleri* Darwin, 1854.

KEY WORDS
Crustacea,
Cirripedia,
Verrucidae,
revision,
A. Gruvel,
North Atlantic,
deep-sea.

RÉSUMÉ
Révision des Verrucidae (Crustacea, Cirripedia) de l'océan Atlantique, étudiés par Abel Gruvel (expéditions scientifiques du Travailleur *et du* Talisman*).*
Les Verrucidae de l'océan Atlantique, étudiés par Gruvel, sont redécrits, y compris leurs appendices. *Altiverruca erecta* (Gruvel, 1900), *A. longicarinata* (Gruvel, 1900), *Metaverruca imbricata* (Gruvel, 1900), *M. radiata* (Gruvel, 1901) et *M. trisulcata* (Gruvel, 1900) sont considérées comme des espèces valides. Les espèces *Metaverruca imbricata* et *M. radiata* sont transférées dans le genre *Metaverruca* Pilsbry, 1916 car leur scutum fixe présente une crête adductrice développée et une marge basale élargie. *Verruca striata* Gruvel, 1900 est synonyme de *Metaverruca trisulcata*, et *Verruca linearis* Gruvel, 1900 et *V. magna* Gruvel, 1901 sont synonymes de *Metaverruca recta* (Aurivillius, 1898). *Metaverruca sensibilis* Young, 1998 est synonyme de *M. imbricata.* Toutes les espèces présentent une répartition limitée à l'Atlantique Nord. Les échantillons identifiés par Gruvel comme *Verruca stroemia* (Müller, 1776), des stations d'eaux profondes des Açores (Expédition du *Talisman* 1883) sont en fait des tests vides de *Verruca spengleri* Darwin, 1854.

MOTS CLÉS
Crustacea,
Cirripedia,
Verrucidae,
révision,
A. Gruvel,
Atlantique Nord,
mer profonde.

INTRODUCTION

In a series of studies, including the monographs of the expeditions of the *Talisman* and *Travailleur* and of the S. A. S. Le Prince de Monaco, Gruvel (1900, 1901, 1902, 1903, 1905, 1911, 1912a, b, 1920) described 10 species of verrucids from the Atlantic Ocean: *Verruca erecta* Gruvel, 1900, *V. imbricata* Gruvel, 1900, *V. linearis* Gruvel, 1900, *V. longicarinata* Gruvel, 1900, *V. striata* Gruvel, 1900, *V. trisulcata* Gruvel, 1900, *V. magna* Gruvel, 1901, *V. radiata* Gruvel, 1901, *V. grimaldi* Gruvel, 1912 and *V. joubini* Gruvel, 1912.
Most of these species were recorded from the Azores region, and they were described mostly by the external characters of the shell. Subsequently, some of these species were considered synonyms and for other their generic status uncertain due to the lack of any description of the internal parts.
Of these 10 species from Atlantic, eight are deposited in the collection of the Muséum national d'Histoire naturelle, Paris (MNHN) and two are in the collection of the Musée océanographique, Monaco. The species in the collection of the Muséum national d'Histoire naturelle, Paris are redescribed including their appendages and the internal structures of the shell. Other verrucid collections, many having odd geographic distribution records cited by Gruvel, were also reexamined. Gruvel did not designate holotypes, so lectotypes and paralectotypes are designated herein following the rules of the International Code of Zoological Nomenclature (ICZN 1999: Article 74).
The last species included in the collection of the MNHN described by Gruvel (1911) was *Verruca spongicola*, which was considered subsequently the type species of *Spongoverruca* Zevina, 1987. Unfortunately, this sample was not located, and is probably lost.

ABBREVIATIONS

MNHN Ci	Muséum national d'Histoire naturelle, Paris, Cirriped collection;
rc	rostro-carinal length;
spec.	specimen.

SYSTEMATICS

VALID SPECIES

Order SESSILIA Lamarck, 1818
Suborder VERRUCOMORPHA Pilsbry, 1916
Family VERRUCIDAE Darwin, 1854
Genus *Altiverruca* Pilsbry, 1916

Altiverruca erecta (Gruvel, 1900)
(Figs 1-4)

Verruca erecta Gruvel, 1900: 243; 1902: 93, pl. 5, figs 7, 8; 1905: 172, figs 188, 189. — Hoek 1907: 9. — Nilsson-Cantell 1955: 219. — Zevina 1976: 1155.

Verruca erecta, sec. D – *Altiverruca* – Pilsbry 1916: 40.

Altiverruca erecta – Zevina 1988: 39. — Buckeridge 1994: 93. — Young 1998a: 77; 1998c: 111, figs 3, 4; 2001: 744, fig. 27; 2002: 6.

TYPE MATERIAL. — Holotype by monotypy: Expédition du *Talisman*, S of Azores, stn 118, 34°46'N, 36°11'W, 3175 m, 1883, 1 spec. rc 2.5 mm (MNHN Ci 62).

DIAGNOSIS. — Shell with growth lines prominent, without longitudinal ridges. Rostrum-carina suture nearly straight. Rostrum nearly rectangular, with a low articular ridge that separates upper crested surface directed toward base of scutum from the main parietal plate. Carina higher than rostrum. Tergum only with axial ridge prominent. Scutum with three articular ridges, apex strongly curved toward tergum. Mandible with three teeth, second and third tooth strongly cuspidate. Cirrus I with unequal rami, anterior ramus slightly smaller than posterior. Cirrus II with anterior ramus about 0.5 length of posterior. Intermediate articles of cirrus VI with three pairs of setae on anterior margin. Caudal appendage slightly shorter than protopodite.

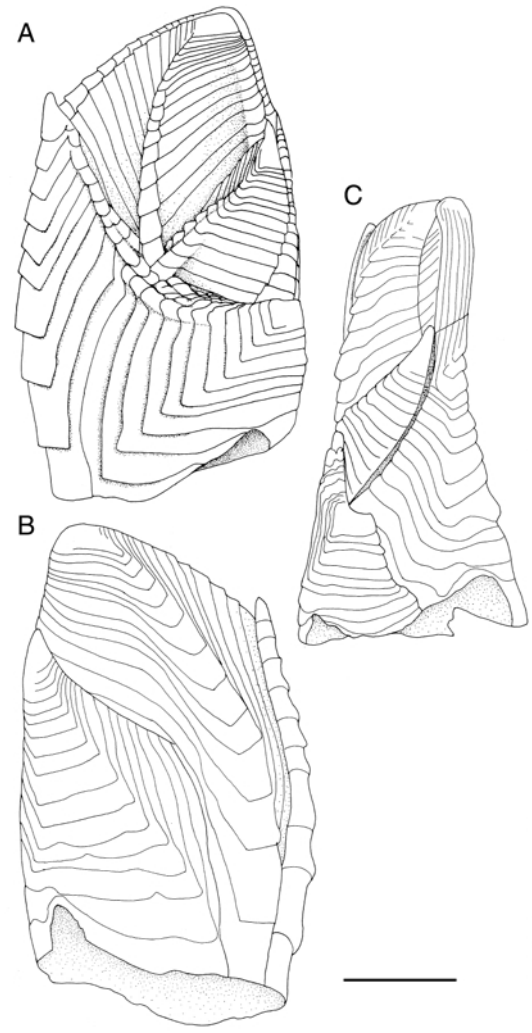

FIG. 1. — *Altiverruca erecta* (Gruvel, 1900), lectotype; **A**, rostro-carinal view; **B**, fixed-tergum and fixed-scutum views; **C**, rostrum-fixed-scutum view. Scale bar: 1 mm.

DESCRIPTION

Shell (Fig. 1) white, opercular valves nearly perpendicular to base of wall, with growth lines prominent on all plates; shell plates without longitudinal ridges; basal margin not thickened. Cuticle not persistent on wall and opercular valves. Rostrum-carina suture nearly straight except for the upper part, which is rounded to receive the rostrum ridge. Rostrum (Fig. 1A, C) nearly rectangular, a low articular ridge separates the upper crested surface directed toward base of scutum from the main smooth parietal portion of plate; rostrum and fixed scutum articulation without radius-like projection, apex not projected, straight. Carina (Fig. 1A, B) elongated, higher than rostrum, without radius-like projection toward fixed tergum; apex slightly projected, straight, one small ridge directed toward tergal axial ridge above single articular ridge. Fixed tergum (Fig. 1B) higher than fixed scutum, both

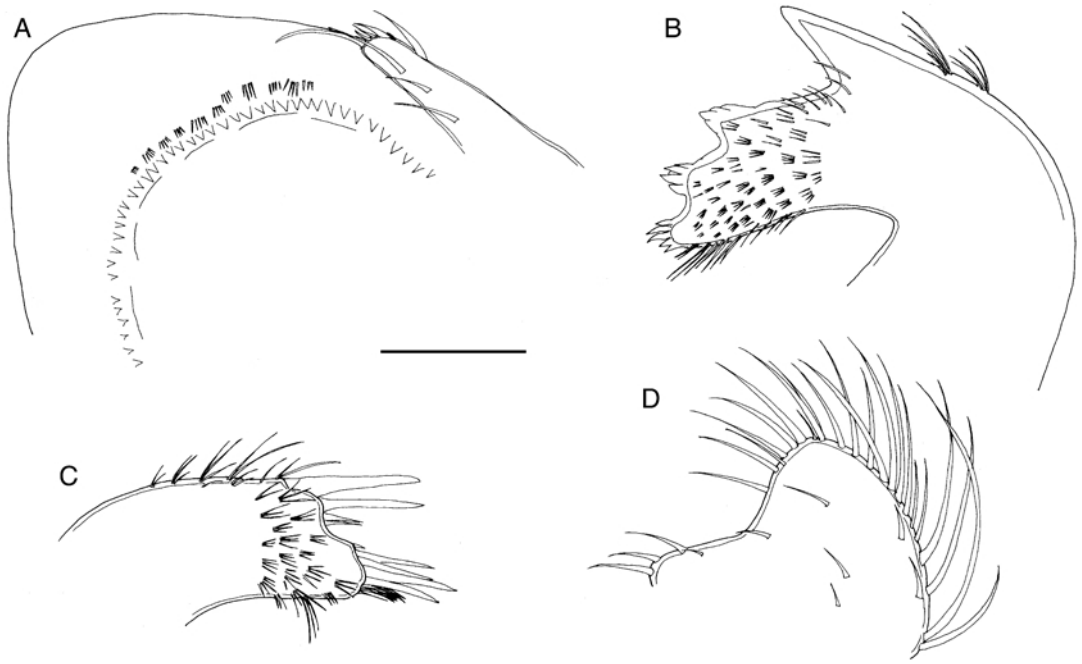

FIG. 2. — *Altiverruca erecta* (Gruvel, 1900), lectotype; **A**, labrum and palp; **B**, mandible; **C**, maxilla I; **D**, maxilla II. Scale bar: 0.1 mm.

sides with well-developed alar-like projections; apex curved toward fixed scutum. Fixed scutum (Fig. 1B) with alar-like process directed toward rostrum not differentiated and a wide radii-like process directed toward fixed tergum, apex slightly curved toward fixed tergum; internally, without adductor pit or ridge.

Tergum (Fig. 1A) quadrangular, with only axial ridge prominent and a slightly thickened occludent margin, with a wide and shallow depression below occludent margin; carinal area smooth. Scutum (Fig. 1A) smaller than tergum; with three articular ridges; axial ridge conspicuous, but well-marked at tergal border, and curving continuously toward rostral surface; second ridge thin and little developed; third ridge as a flat surface at apical portion; rostral area smooth, apex strongly curved toward tergum.

Labrum (Fig. 2A) with a series of about 41 simple teeth. Palp (Fig. 2A) short, thin, with few simple setae on inner margin and distal region. Mandible (Fig. 2B) with three teeth, distance between first and second twice the distance between second and third, second and third tooth strongly cuspidated; lower angle strongly denticulate. Maxilla I (Fig. 2C) with lower part projected; two large followed by two small spines at upper border, and four median and five smaller spines on lower projected border. Maxilla II (Fig. 2D) triangular, anterior margin with conspicuous concavity medially; covered by long simple setae, except in the concavity.

Cirrus I (Fig. 3A) with unequal rami, anterior ramus slightly shorter than posterior, covered with several long simple setae. Cirrus II (Fig. 3B) with anterior ramus about 0.5 length of posterior, articles little more protuberant; both rami covered by numerous long, simple and finely pinnate setae. Rami of cirri III-VI equal in length. Setal-article ratio about 7:1. Intermediate articles of cirrus VI (Fig. 3C) with width 0.4 length; three pairs of setae on anterior margin and a thin small setula between larger pair, longer setae finely pinnate; one long and

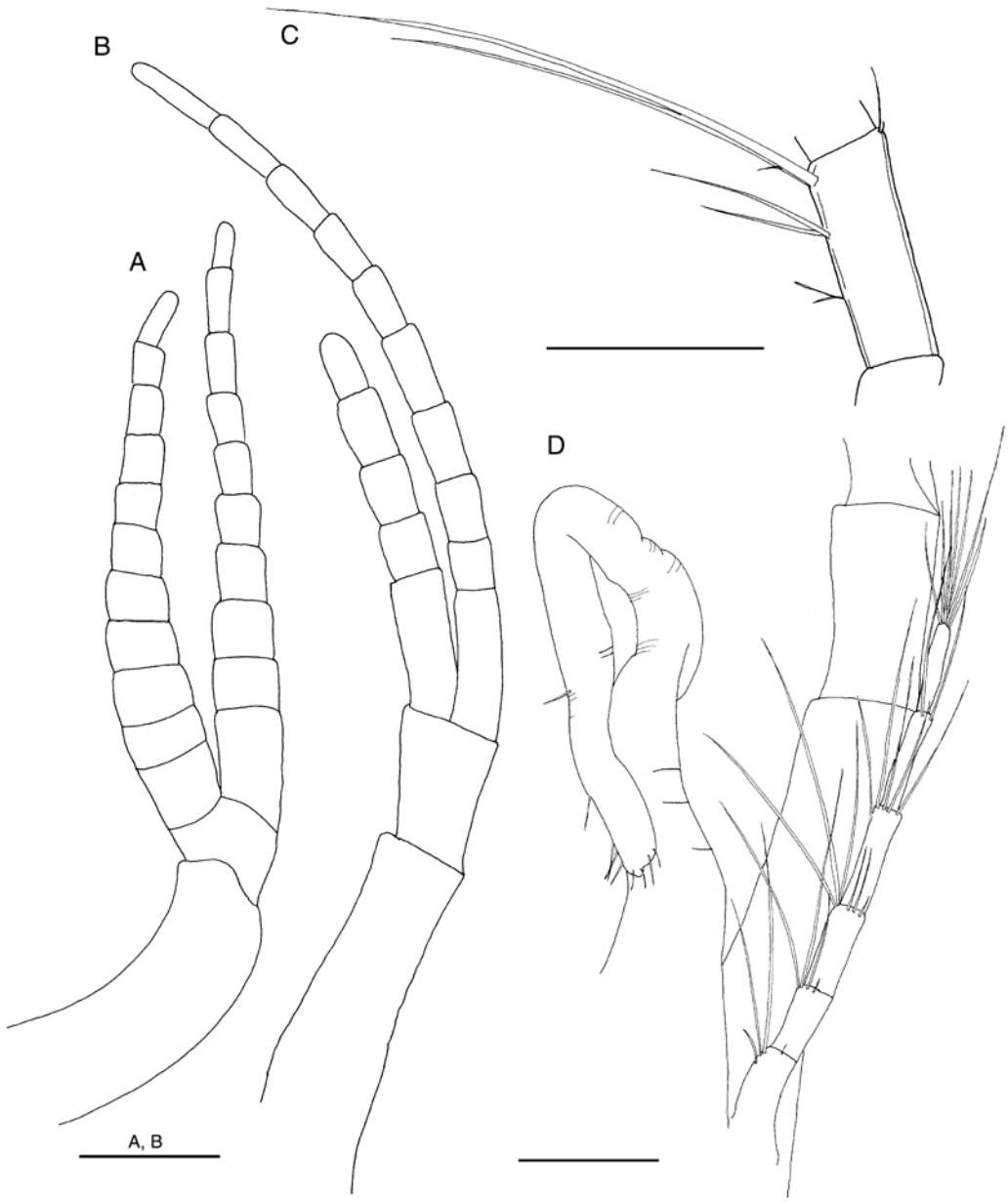

FIG. 3. — *Altiverruca erecta* (Gruvel, 1900), lectotype; **A**, cirrus I; **B**, cirrus II; **C**, median article of cirrus VI; **D**, protopodite of cirrus VI, penis and caudal appendage. Scale bars: 0.2 mm.

one small simple setae on posterior angle. Caudal appendage (Fig. 3D) with six articles, slightly shorter than protopodite; long simple setae on antero-distal margins of articles. Penis (Fig. 3D) long, 1.5 of protopodite, with few thin setulae at point. Number of articles of cirri I-VI and caudal appendage is presented in Table 1.

TABLE 1. — Number of articles on cirri I-VI, and caudal appendage of *Altiverruca erecta* (Gruvel, 1900). Abbreviations: **I-VI**, cirri I to VI; **ca**, caudal appendage; **lc**, left cirri; **rc**, right cirri.

	I	II	III	IV	V	VI	ca
rc	11/10	5/10	12/15	15/16	17/18	18/19	6
lc	9/9	5/9	14/14	15/16	16/16	18/19	6

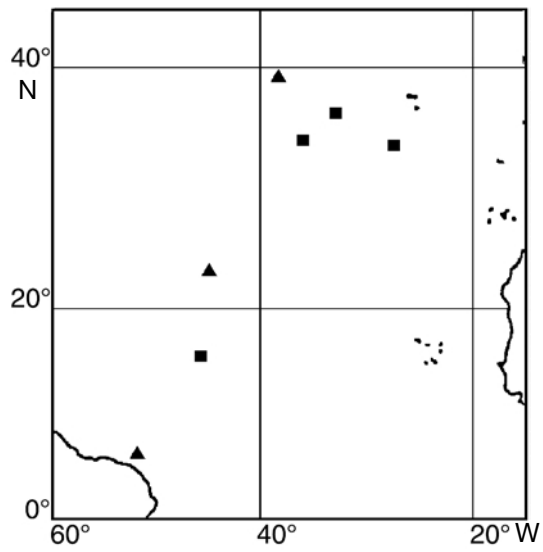

FIG. 4. — Geographic distribution of *Altiverruca erecta* (Gruvel, 1900) (■) and *A. longicarinata* (Gruvel, 1900) (▲).

REMARKS

Altiverruca erecta was based on a single specimen from the Azores region (Gruvel 1900, 1902) and subsequently recorded again from the Azores and the Mid-Atlantic Ridge (Young 1998c, 2001) (Fig. 4).

The sample examined from the Mid-Atlantic Ridge (Young 1998c) varies somewhat with the type species: the rostrum-carinal suture is a little more undulated, cirrus I has rami of equal length and the median article of cirrus VI has only two pairs of setae on the anterior margin. The range from a straight to an undulation of the rostrum-carinal suture was also observed in the material studied by Young (2001). But the presence of only two pairs of setae on the anterior margin of cirrus VI may indicate it is another species. There is variation in the number of pairs of setae along the length of a ramus, but usually the median ones attain the maximum number for their species. The specimens examined by Young (2001) were taller than the type specimen and have their carina more elongated.

Altiverruca erecta, together with the next species, *A. longicarinata*, are included in *Altiverruca* s.s. as reviewed by Young (2002), which encompasses those verrucids with a delicate erect shell, the opercular plates perpendicular to the basis and no developed articular ridges between the rostrum and carina. They are usually deep-sea species, commonly being found deeper than 2000 m. *A. erecta* was dredged between 890-925 and 3375-3947 m.

Altiverruca longicarinata (Gruvel, 1900) (Figs 4-7)

Verruca longicarinata Gruvel, 1900: 242; 1902: 91, pl. 5, figs 3, 4; 1905: 172, fig. 190. — Hoek 1907: 9. — Nilsson-Cantell 1955: 219. — Zevina 1976: 1155.

Verruca longicarinata, sec.D – *Altiverruca* – Pilsbry 1916: 40.

Verruca (*Altiverruca*) *longicarinata* – Zevina 1987: 1305, fig. 1.

Altiverruca longicarinata – Zevina 1988: 39. — Buckeridge 1994: 93. — Young 1995: 244; 1998a: 77; 1998c: 113; 2002: 6.

TYPE MATERIAL. — Lectotype by present designation: Expédition du *Talisman*, Sargasso Sea, drag. 117, 3432 m, 1883, rc 2.7 mm (MNHN Ci 73); paralectotypes: same locality, 2 spec., rc 2.5 and 1.4 mm (MNHN Ci 73).

DIAGNOSIS. — Shell with growth lines not prominent, without longitudinal ridges. Rostrum-carina suture difficult to discern. Rostrum nearly rectangular, with a straight rostro-carinal articulation; a low articular ridge separates upper flat surface directed toward base of scutum from the main parietal plate. Carina higher than rostrum. Tergum with three articular ridges, intermediate ridge wider than axial ridge. Scutum with two articular ridges. Cirrus I with unequal rami, anterior ramus slightly smaller than posterior. Cirrus II with anterior ramus about 0.5 length of posterior. Intermediate articles of cirrus VI with two pairs of setae on anterior margin. Caudal appendage with same length as protopodite.

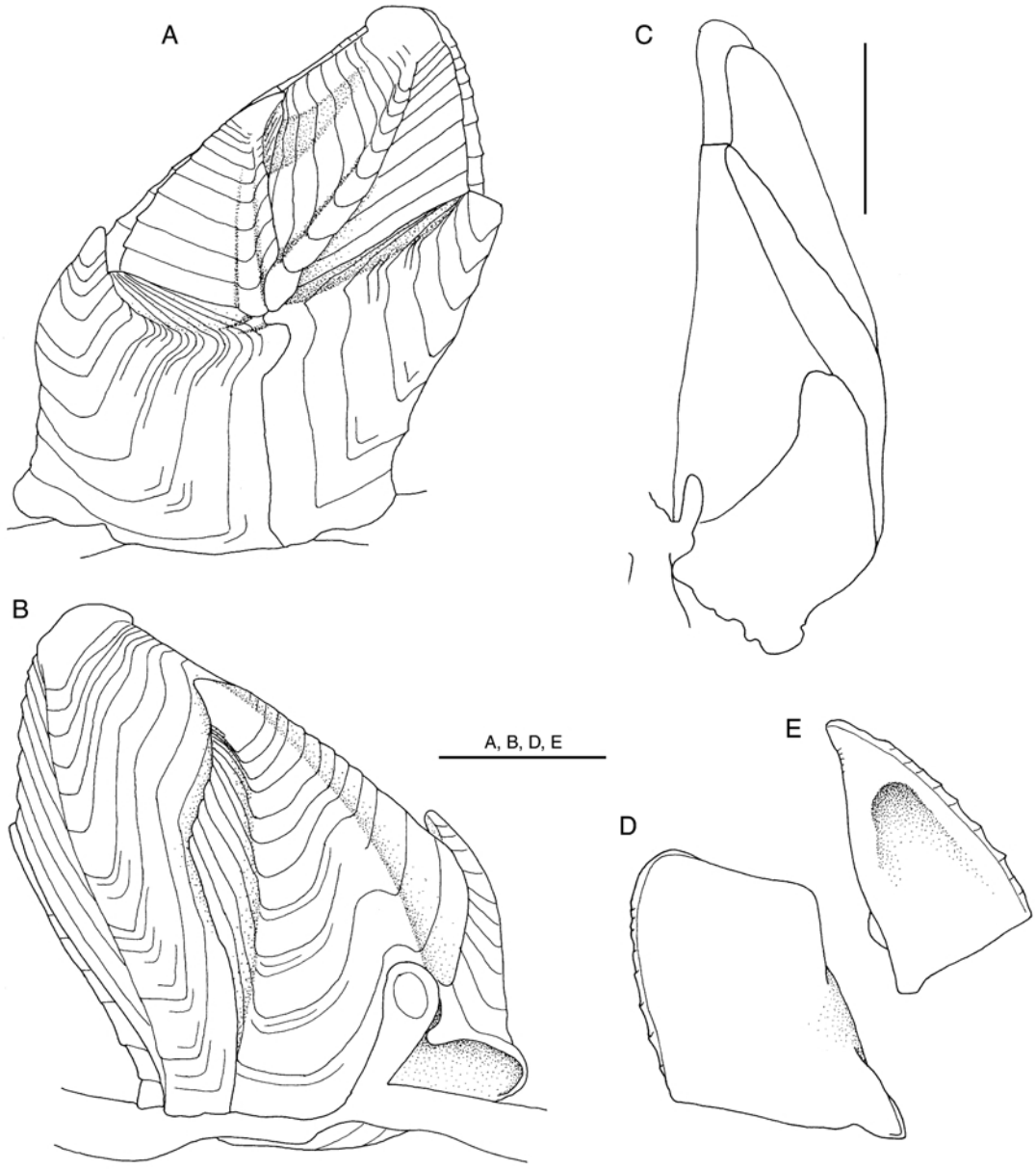

FIG. 5. — *Altiverruca longicarinata* (Gruvel, 1900), lectotype; **A**, rostro-carinal view; **B**, fixed-tergum and fixed-scutum view; **C**, rostrum-fixed-scutum view; **D**, tergum, internal view; **E**, scutum, internal view. Scale bars: 1 mm.

DESCRIPTION

Shell (Fig. 5A-C) white, opercular valves nearly perpendicular to base of wall, with growth lines not prominent on all plates; shell plates without longitudinal ridges; basal margin not thickened. Cuticle not persistent on wall and opercular valves. Rostrum-carina suture difficult to discern, very similar to growth lines. Rostrum (Fig. 5A, C) nearly rectangular, with a straight rostro-carinal articulation, except for the tooth

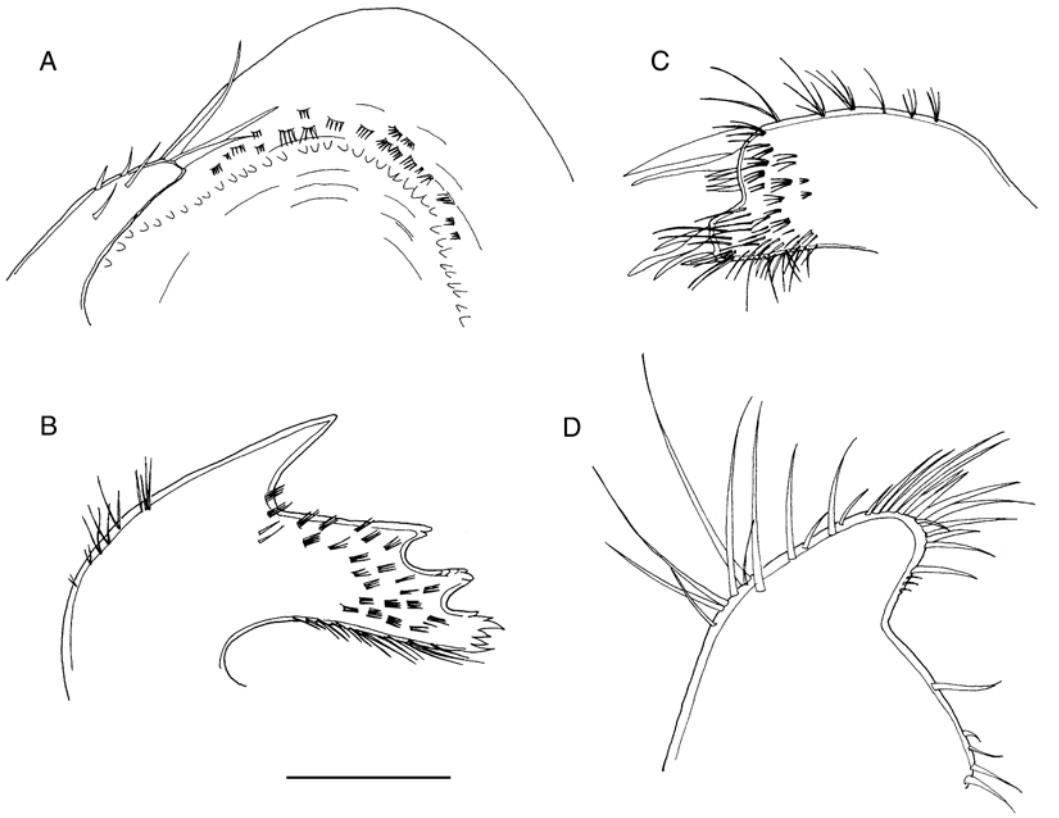

FIG. 6. — *Altiverruca longicarinata* (Gruvel, 1900), lectotype; **A**, labrum and palp; **B**, mandible; **C**, maxilla I; **D**, maxilla II. Scale bar: 0.1 mm.

on upper part, a low articular ridge separates the upper flat surface directed toward base of scutum from the main parietal plate; rostrum and fixed scutum articulation without radius-like projection, apex projected, incurved. Carina (Fig. 5A) elongated, higher than rostrum, without radius-like projection toward fixed tergum; apex broken (in original description it is strongly retroverted [Gruvel 1900]). Fixed tergum (Fig. 5B) higher than fixed scutum, both sides with well-developed alar-like projections; apex slightly curved toward fixed scutum. Fixed scutum (Fig. 5B) with wide alar-like process directed toward rostrum and a wide radii-like process directed toward fixed tergum, apex curved toward fixed tergum; internally, without adductor pit or ridge.

Tergum (Fig. 5A, D) quadrangular, with three articular ridges; axial ridge prominent, intermediate ridge wider than axial ridge; upper ridge thin and marginal to occludent margin, with a conspicuous depression between upper and intermediate ridges; carinal area smooth. Internally smooth and flat; scutal margin nearly straight. Scutum (Fig. 5A, E) smaller than tergum; with two articular ridges; axial ridge conspicuous, thin; second ridge as wide as axial ridge; rostral area smooth, apex slightly curved toward tergum, thickened. Internally with a concavity for adductor muscle conspicuous on upper portion; tergal margin nearly straight, a small tooth projecting at lower portion.

Labrum (Fig. 6A) with a series of about 35 simple teeth. Palp (Fig. 6A) short, thin, with

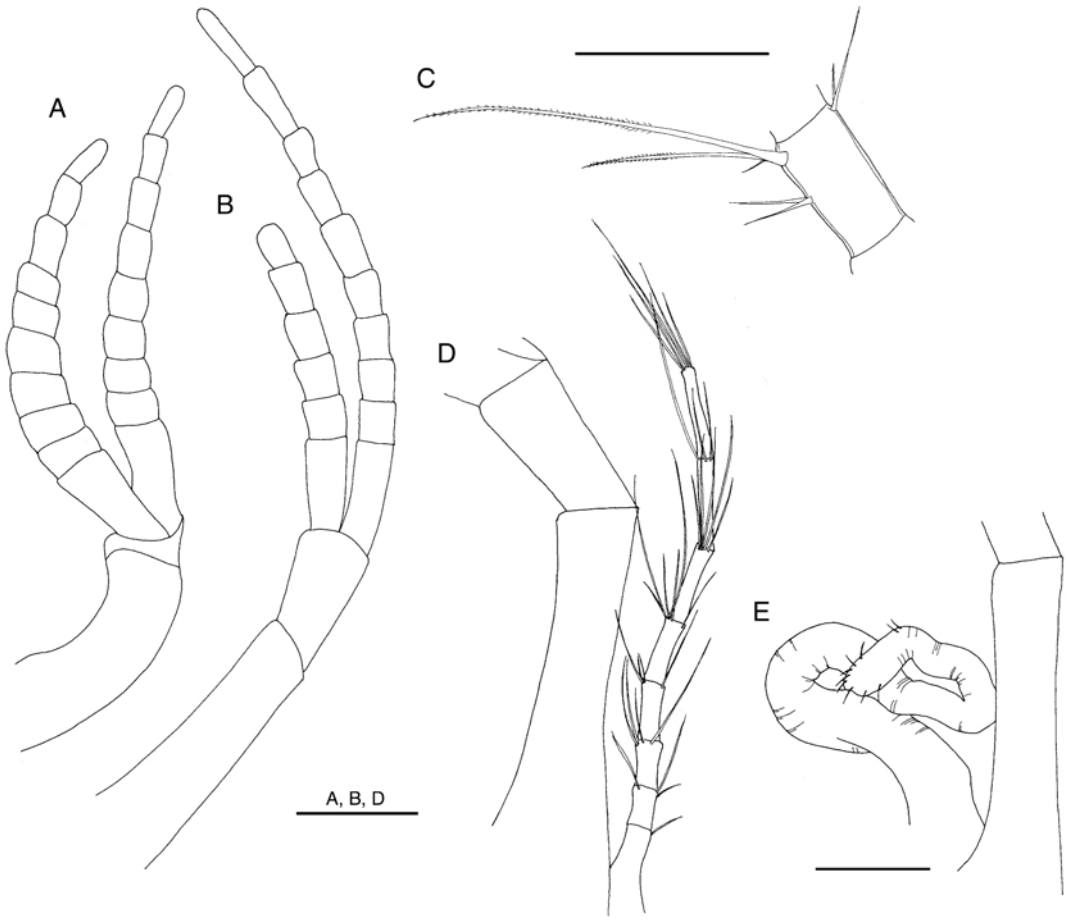

FIG. 7. — *Altiverruca longicarinata* (Gruvel, 1900), lectotype; **A**, cirrus I; **B**, cirrus II; **C**, median article of cirrus VI; **D**, protopodite of cirrus VI and caudal appendage; **E**, coxopodite of cirrus VI and penis. Scale bars: 0.2 mm.

few simple setae on outer margin and distal region. Mandible (Fig. 6B) with three teeth, distance between first and second twice distance between second and third, second and third tooth with subsidiary cusps; lower angle strongly denticulate. Maxilla I (Fig. 6C) with lower part strongly projected; two large followed by four smaller spines at upper border and four intermediate spines on lower projected border. Maxilla II (Fig. 6D) triangular, anterior margin with conspicuous concavity medially; covered by long simple setae, except on the concavity.

Cirrus I (Fig. 7A) with unequal rami, anterior ramus slightly shorter than posterior, covered with several long simple setae. Cirrus II (Fig. 7B) with anterior ramus about 0.5 length of posterior, articles little more protuberant than those from cirri III; both rami covered by numerous long, simple and finely pinnate setae. Rami of cirri III-VI equal in length. Setal-article ratio about 5:1. Intermediate articles of cirrus VI (Fig. 7C) with width 0.6 length; two pairs of setae on anterior margin and a thin small setula between large pair, longer setae finely pinnate; two or three fine simple setae on posterior

TABLE 2. — Number of articles on cirri I-VI, and caudal appendage of *Altiverruca longicarinata* (Gruvel, 1900). Abbreviations: **I-VI**, cirri I to VI; **ca**, caudal appendage; **lc**, left cirri; **rc**, right cirri.

	I	II	III	IV	V	VI	ca
rc	9/9	6/10	15/15	17/18	18/19	21/22	8
lc	10/9	6/11	15/16	17/18	21/20	21/21	8

angle. Caudal appendage (Fig. 7D) with eight articles, same length as protopodite; long simple setae on antero-distal margins of articles. Penis (Fig. 7E) short, same length as protopodite, with few thin setulae at point. Number of articles of cirri I-VI and caudal appendage is presented in Table 2.

REMARKS

The remarkable projected apex of the carina cited by Gruvel (1900), in which the main one characterizes this species, was broken in all the type specimens examined except for the smallest one. Although this long apex probably can be broken even in nature, this character is a diagnostic one. The low growth lines with the undistinguishable rostro-carinal suture, the straight suture and the upper surface of the rostrum directed toward the scutum are better characters for distinguishing this species. Foster & Buckeridge (1995b: 367) considered *V. longicarinata* to be synonymous with *V. quadrangularis* Hoek, 1883, but I consider the above described characters to be sufficient to distinguish the species.

The two paralectotypes are smaller than the lectotype (rc 2.5 and 1.4 mm). The larger paralectotype has the articular ridge of the rostrum more conspicuous than the lectotype and, the smaller specimen has the tergum with only the axial ridge conspicuous; the apex of carina is projected but not so long as that figured by Gruvel (1902: pl. 5, figs 3, 4).

Altiverruca longicarinata has a wide distribution in the North Atlantic occurring from the Guayama Basin and Sargasso Sea to the Mid-Atlantic Ridge between depths of 2490 and 3432 m (Fig. 4).

Genus *Metaverruca* Pilsbry, 1916

Metaverruca imbricata (Gruvel, 1900) n. comb. (Figs 8-11)

Verruca imbricata Gruvel, 1900: 244; 1902: 105, pl. 5, figs 13, 14; 1903: 100; 1905: 188, fig. 187.

Verruca trisulcata – Foster & Buckeridge 1995a: 177, figs 10-12 [non *Metaverruca trisulcata* (Gruvel, 1900)].

Newmaniverruca imbricata – Young 1998a: 77.

Metaverruca sensibilis Young, 1998b: 39, figs 26-28.

TYPE MATERIAL. — Lectotype by present designation: Expédition du *Travailleur*, drag. 32, 36°36'N, 9°46'W, 441 m, rc 5.3 mm (MNHN Ci 67); paralectotypes: Expédition du *Talisman*, drag. 52, 28°33'N, 15°39'W, 946 m, 1 spec. rc 6.1 mm (MNHN Ci 63) ; Canary Ids, 31°34'N, 12°41'W, 912 m, on *Dallina septigera*, 1 spec. rc 5.8 mm (MNHN Ci 64).

OTHER MATERIAL EXAMINED. — No locality, 1 spec., rc 5.3 mm (MNHN Ci 65).

Morocco. Expédition du *Travailleur*, drag. 30, 35°24'45"N, 10°19'7"W, 1205 m, on sea urchin spines, 1884, 7 spec. rc 2.6 to 5.0 mm (MNHN Ci 69). Expédition du *Talisman*, 1084 m, on *Neptunia sinistrosa*, 1883, 2 spec. and fragments rc 6.8 to 7.2 mm (MNHN Ci 68) (all samples were identified by Gruvel previously but not published to my knowledge).

BALGIM stn CP90, 34°214'N, 7°236'W, 890 m, on volcanic rocks, 3 spec. rc 3.6 to 5.8 mm (MNHN Ci 2195); stn CP 91, 34°223'N, 7°251'W, 948 m, unknown substrate, fragments (MNHN Ci 2158); stn CP 92, 34°243'N, 7°303'W, 1182 m, on volcanic rocks, 50+ spec. rc up to 6.1 mm (MNHN Ci 2164); stn CP 95, 34°240'N, 7°393'W, 1378 m, calcareous rocks, 9 spec. and fragments rc 4.0 to 4.9 mm (MNHN Ci 2188); stn CP 156, 36°200'N, 7°527'W, 1135 m, unknown substrate, 1 spec. and fragments rc 2.6 mm (MNHN Ci 2204); same stn, on sea urchin spines, 100+ spec. rc up to 5.5 mm (MNHN Ci 2152); stn CP 160, 36°146'N, 8°009'W, 1350 m, on sea urchin spines, 8 spec. rc 2.5 to 6.1 mm (MNHN Ci 2193) (all BALGIM samples were identified as *V. trisulcata* by Foster & Buckeridge 1995a).

DIAGNOSIS. — Shell surface slightly undulated, not forming conspicuous longitudinal ridges. Carina and rostrum similar in size, former with two strong articular ridges and an indentated margin below. Rostrum with two well-developed articular ridges and two small ridges directed toward axial ridge of scutum. Tergum with five articular ridges, rarely only one or two developed; axial ridge prominent on both sides, and widest. Scutum with four articular ridges; axial ridge conspicuous, thin, apex curving toward tergum.

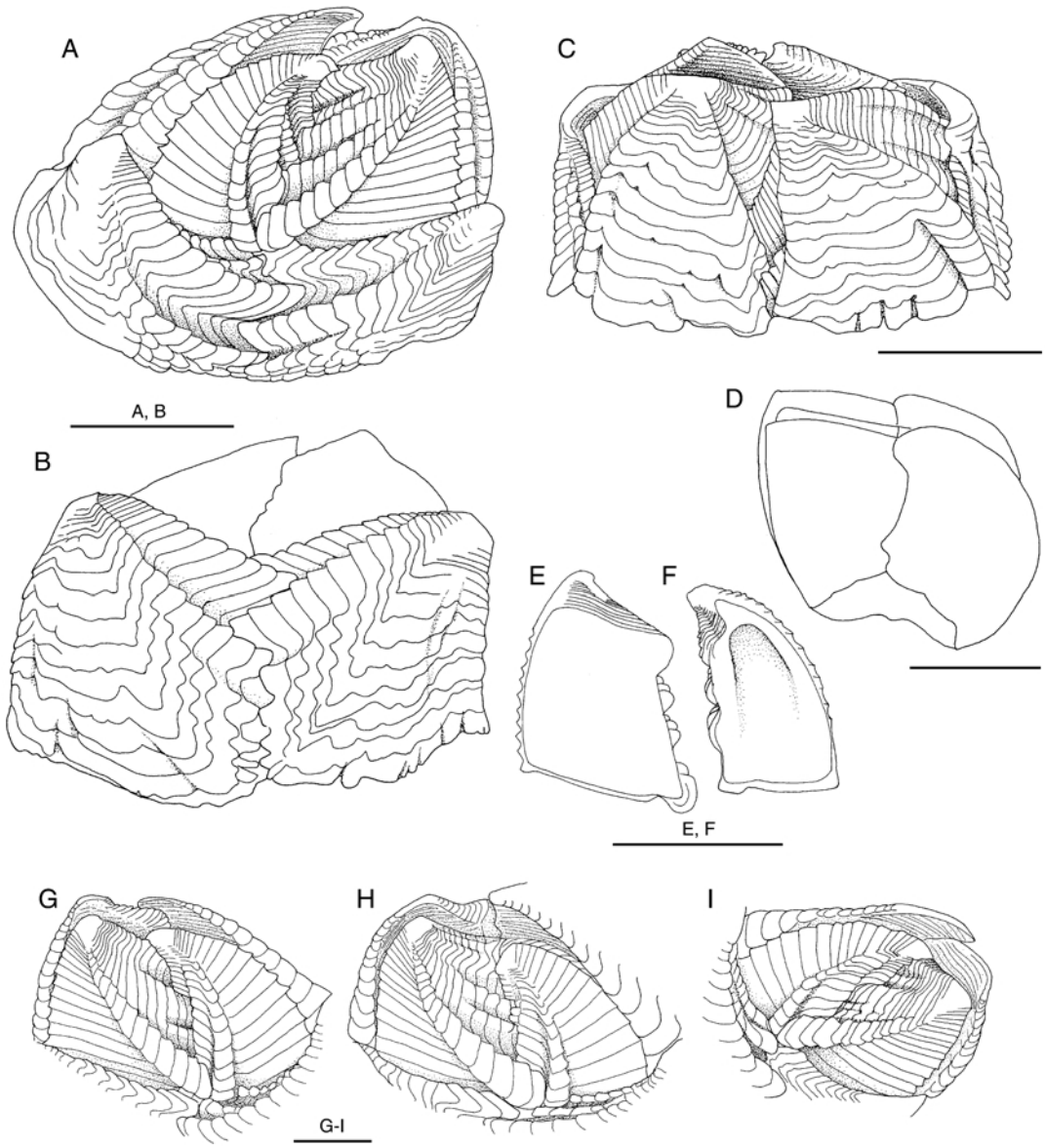

FIG. 8. — *Metaverruca imbricata* (Gruvel, 1900); **A**-**F**, lectotype (MNHN Ci 67); **A**, scuto-tergal view; **B**, rostro-carinal view; **C**, fixed-tergum and fixed-scutum views; **D**, rostrum-fixed-scutum view; **E**, tergum, internal view; **F**, scutum, internal view; **G**-**I**, specimen MNHN Ci 2152, tergum and scutum, showing the variation on the development of the articular ridges. Scale bars: A-F, 2 mm; G-I, 1 mm.

Mandible with three teeth. Cirrus I with anterior ramus 0.6 length of posterior. Cirrus II with anterior ramus about 0.3 length of posterior. Intermediate articles of cirrus VI with three pairs of setae on anterior margin. Caudal appendage four times length of protopodite.

DESCRIPTION

Shell (Fig. 8A-D) white, box-like, opercular valves parallel to base of wall, with growth lines projecting mostly near base of plates, slightly undulated, not forming conspicuous longitudinal

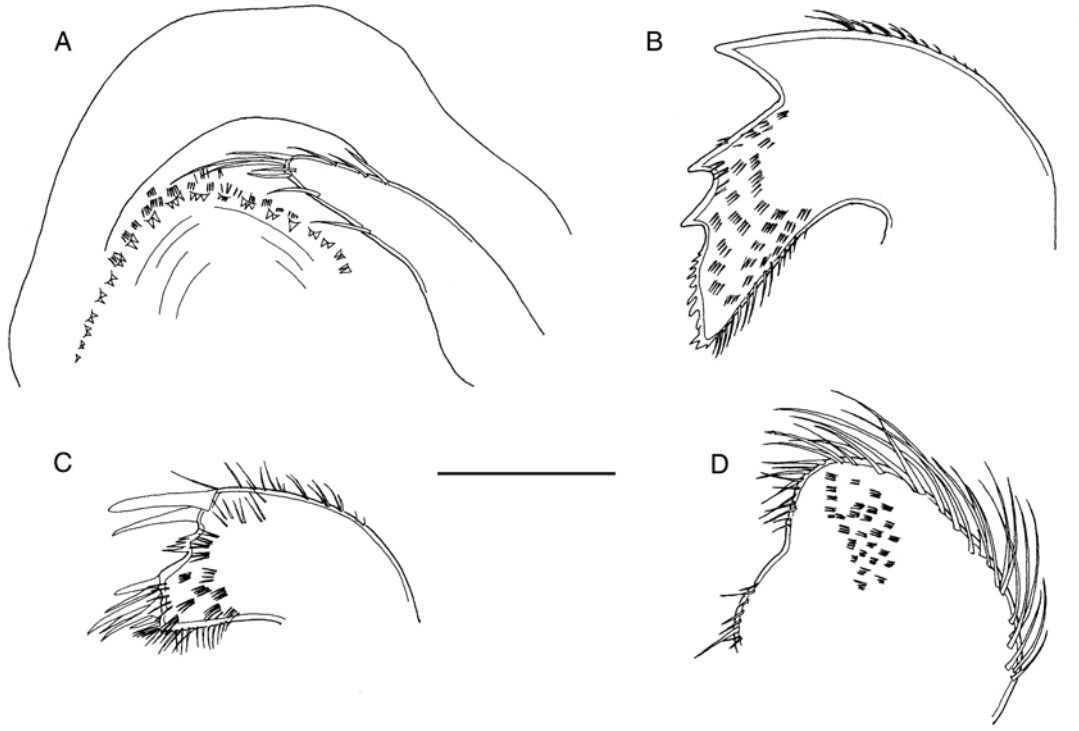

FIG. 9. — *Metaverruca imbricata* (Gruvel, 1900), lectotype; **A**, labrum and palp; **B**, mandible; **C**, maxilla I; **D**, maxilla II. Scale bar: 0.2 mm.

ridges; basal margin thickened. Cuticle absent. Carina (Fig. 8A, B) and rostrum similar in size, former with two strong articular ridges and an indentated margin below, deep grooves between articular ridges, with small radius-like projection toward fixed tergum; apex truncated not projected. Rostrum (Fig. 8A, B) with two well-developed articular ridges and deep grooves between them on the rostro-carinal articulation and two small ridges directed toward axial ridge of scutum; rostrum and fixed scutum articulation with a small radius-like projection, apex incurved. Fixed tergum (Fig. 8C) same size as fixed scutum, both sides with well-developed alar-like projections; apex straight. Fixed scutum (Fig. 8C) with wide alar-like process directed toward rostrum and a radius-like process directed toward fixed tergum, forming two ridges, apex slightly curved toward fixed tergum; internally, with developed adductor ridge projecting downwards.

Tergum (Fig. 8A, E) quadrangular, with five articular ridges, rarely with one or two less developed (Fig. 8G-I); axial ridge prominent on both sides, and widest, second and third with similar width, fourth small and thin, and fifth marginal to occludent margin, with conspicuous depressions between them; carinal area smooth. Internally, smooth; scutal margin straight, except by convex upper portion, with series of teeth produced by growth lines along margin. Scutum (Fig. 8A, F) triangular, smaller than tergum; with four articular ridges; axial ridge conspicuous, thin, well-marked, second ridge widest, twice width of axial ridge, third and fourth ridges small, apex curving toward tergum. Internally with a concavity for adductor muscle conspicuous on upper portion; tergal margin undulated.

Labrum (Fig. 9A) with a series of about 60 teeth. Palp (Fig. 9A) long and thin, with few simple setae on inner margin and distal region. Mandible (Fig. 9B) with three teeth, distance

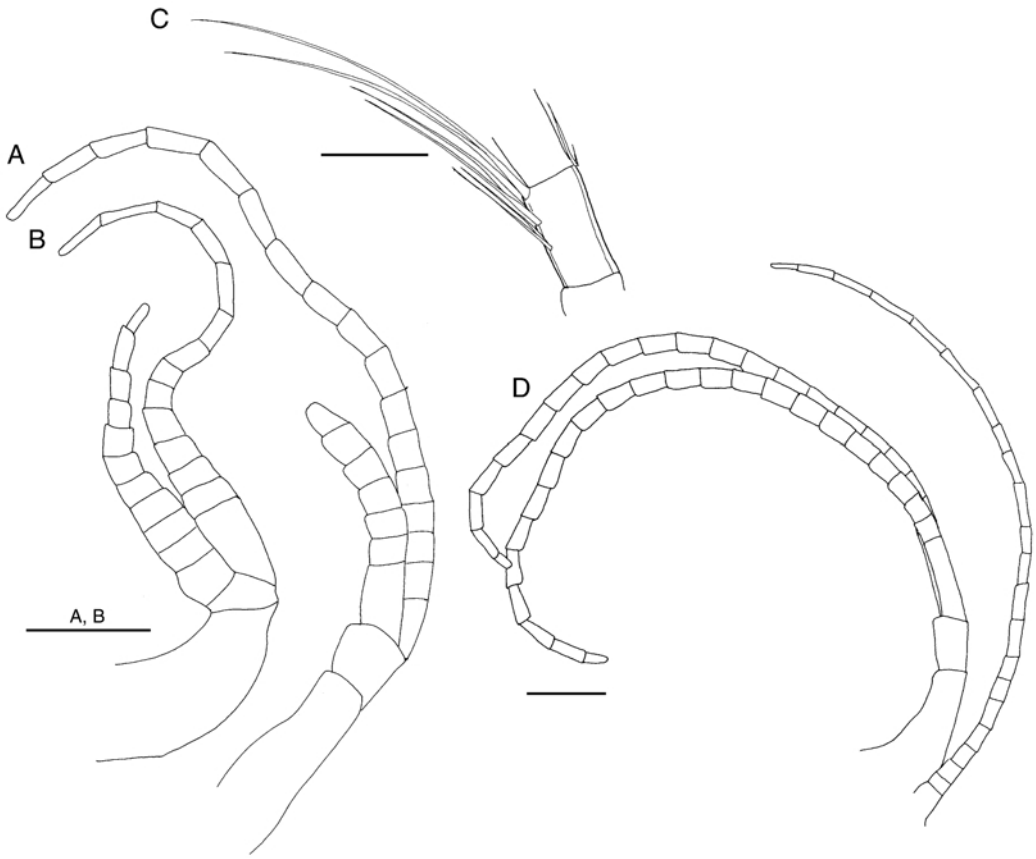

FIG. 10. — *Metaverruca imbricata* (Gruvel, 1900), lectotype; **A**, cirrus I; **B**, cirrus II; **C**, median article of cirrus VI; **D**, cirrus VI and caudal appendage. Scale bars: A, B, D, 0.5 mm; C, 0.2 mm.

between first and second a little larger than distance between second and third, upper margin of third tooth denticulate; lower angle denticulate. Maxilla I (Fig. 9C) with lower part projecting; two large spines at upper angle, four small spines between upper large spines and lower projecting part, and six unpaired median and thin and six smaller spines on basal portion. Maxilla II (Fig. 9D) triangular, anterior margin with shallow concavity medially; covered by long simple setae, except on the shallow concavity.

Cirrus I (Fig. 10A) with unequal rami, anterior ramus 0.6 length of posterior, covered with several long simple setae. Cirrus II (Fig. 10B) with anterior ramus about 0.3 length of posterior, articles more protuberant; both rami covered by numerous long, simple setae and distal article of anterior rami with bipectinate setae. Rami of cirri III-VI equal in length (Fig. 10D). Setal-article ratio about 6:1. Intermediate articles of cirrus VI (Fig. 10C) with width 0.6 length; three pairs of setae on anterior margin, longer setae finely pinnate; two or three fine simple setae on posterior angle. Caudal appendage (Fig. 10D) with 22 articles, four times length of protopodite; long simple setae on antero-distal margins of articles. Penis not observed. Number of articles of cirri I-VI and caudal appendage is presented in Table 3.

REMARKS

Besides the type series, there are in the collection of MNHN several samples, which were previously

TABLE 3. — Number of articles on cirri I-VI, and caudal appendage of *Metaverruca imbricata* (Gruvel, 1900). Abbreviations: **I-VI**, cirri I to VI; **ca**, caudal appendage; **lc**, left cirri; **rc**, right cirri.

	I	II	III	IV	V	VI	ca
rc	-/-	7/15	16/19	21/23	23/24	22/25	22
lc	11/15	7/16	13/19	23/23	23/24	23/23	23

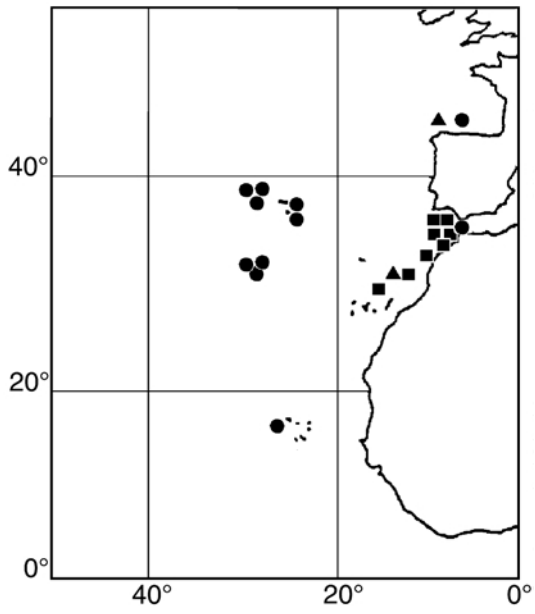

FIG. 11. — Geographic distribution of *Metaverruca imbricata* (Gruvel, 1900) (■); *M. radiata* (Gruvel, 1901) (▲) and *M. trisulcata* (Gruvel, 1900) (●).

identified by Gruvel but he did not publish on these. They occurred on a wide variety of substrates: *Dallina septigera* (Lovén, 1846), *Neptunia sinistrosa* (Deshayes, 1832), sea urchin spines, and dead corals. Most of these specimens do not exhibit differences with the lectotype, but differences were observed: specimen comprising Ci 65 (no locality) did not possess the fifth small ridge on the tergum and the specimens from Ci 69 (drag. 30, 35°24'45"N, 10°19'7"W, 1205 m) had the number of ridges on the tergum varying from three to five and for the scutum from three to four. Therefore, this species shows some differences in the number of articular ridges on both opercular plates, these being added during growth. Externally, this species can be distinguished easily by the two large ridges on the suture zone of the rostrum and carina followed by the zigzag suture below and also by the characteristically two small ridges of the rostrum directed toward the axial ridge of scutum. Furthermore, the long caudal appendage is very conspicuous.

Foster & Buckeridge (1995a: 177) considered *Verruca imbricata* to be a synonym of *Verruca trisulcata* Gruvel, 1900, but herein, both species are considered valid. All the material they studied should be considered as *M. imbricata.* The examination of these samples shows these vary greatly in shell form, which is likely related to the substrate. When on flat surfaces like rounded rocks, they are more erect with the opercular plates oblique to the base and parallel to the rostro-carinal plane; specimens growing on sea urchin spines have the shell box-like with the opercular valves parallel to the basis. The specimens with a more vertical growth have the rostrum with less developed ridges directed toward the scutum basis, sometimes even absent, but all of these have the typical rostro-carinal suture and a large number of articular ridges on the opercular valves. All the samples examined have very long caudal appendage, at least four times the protopodite length, and this is very distinct from the short caudal appendages of *M. radiata* and *M. trisulcata.*

Young (1998b: 39) described *Metaverruca sensibilis* from the Moroccan coast. The specimens have four ridges on the opercular plates and also the typical rostro-carinal suture. Despite the absence of the secondary ridges on the rostrum this species should be considered a synonym of *M. imbricata. Metaverruca imbricata* has its distribution mainly along the northern African coast but with records in the Canary and Azores islands, between depths of 441 and 1378 m (Fig. 11).

Metaverruca radiata (Gruvel, 1901) n. comb. (Figs 11-14)

Verruca radiata Gruvel, 1901: 262; 1902: 94, pl. 2, figs 19, 20; 1903: 99; 1905: 180, fig. 198. — Hoek 1907: 9.

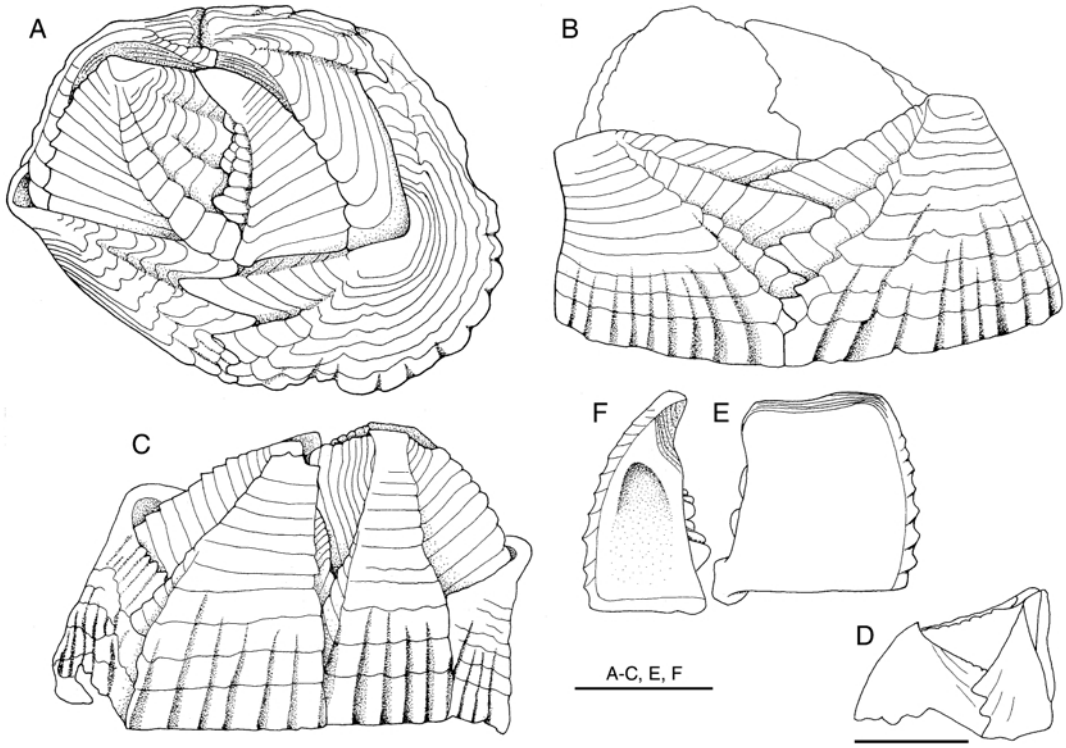

FIG. 12. — *Metaverruca radiata* (Gruvel, 1901), lectotype; **A**, scuto-tergal view; **B**, rostro-carinal view; **C**, fixed-tergum and fixed-scutum views; **D**, rostrum-fixed-scutum view; **E**, tergum, internal view; **F**, scutum, internal view. Scale bars: A-C, E, F, 1 mm; D, 2 mm.

Verruca radiata, sec. D – *Altiverruca* – Pilsbry 1916: 40.

Newmaniverruca radiata – Young 1998a: 77.

Altiverruca radiata – Buckeridge 1994: 93.

Cameraverruca radiata – Buckeridge 1994: 103.

TYPE MATERIAL. — Lectotype by present designation: Expédition du *Talisman* et du *Travailleur*, Canary Islands vicinity, rc 3.5 mm (MNHN Ci 75); paralectotype: same locality, 1 spec. rc 3.7 mm (MNHN Ci 75).

OTHER MATERIAL EXAMINED. — **Spanish coasts.** Expédition du *Travailleur*, drag. 3, on *Liothyrina sphenoidea*, 1882, 1 disarticulated spec. (MNHN Ci 3) (identified by Gruvel [1903]).

DIAGNOSIS. —Shell with crenulated growth lines; parietal plates with longitudinal ridges. Carina a little smaller than rostrum, the former with four articular ridges. Tergum with four articular ridges; all having the same width. Scutum with four articular ridges. Mandible with four teeth, fourth tooth strongly denticulate. Cirrus I with anterior ramus slightly longer than posterior. Cirrus II with anterior ramus about 0.6 length of posterior. Intermediate articles of cirrus VI with three pairs of setae on anterior margin. Caudal appendage 0.6 length of coxopodite.

DESCRIPTION

Shell (Fig. 12A-D) white, box-like, opercular valves slightly inclined toward base of wall, with crenulated growth lines projecting on all plates; parietal plates of shell with conspicuous longitudinal ridges; basal margin slightly thickened, but without calcareous base. Cuticle absent. Carina (Fig. 12A, B) a little smaller than rostrum, former with four articular ridges and deep grooves between them, without radius-like projection toward fixed tergum; apex blunt, slightly curved. Rostrum (Fig. 12A, B) with four well-developed articular ridges and deep grooves between them on the rostro-carinal articulation; rostrum and fixed scutum articulation without radius-like

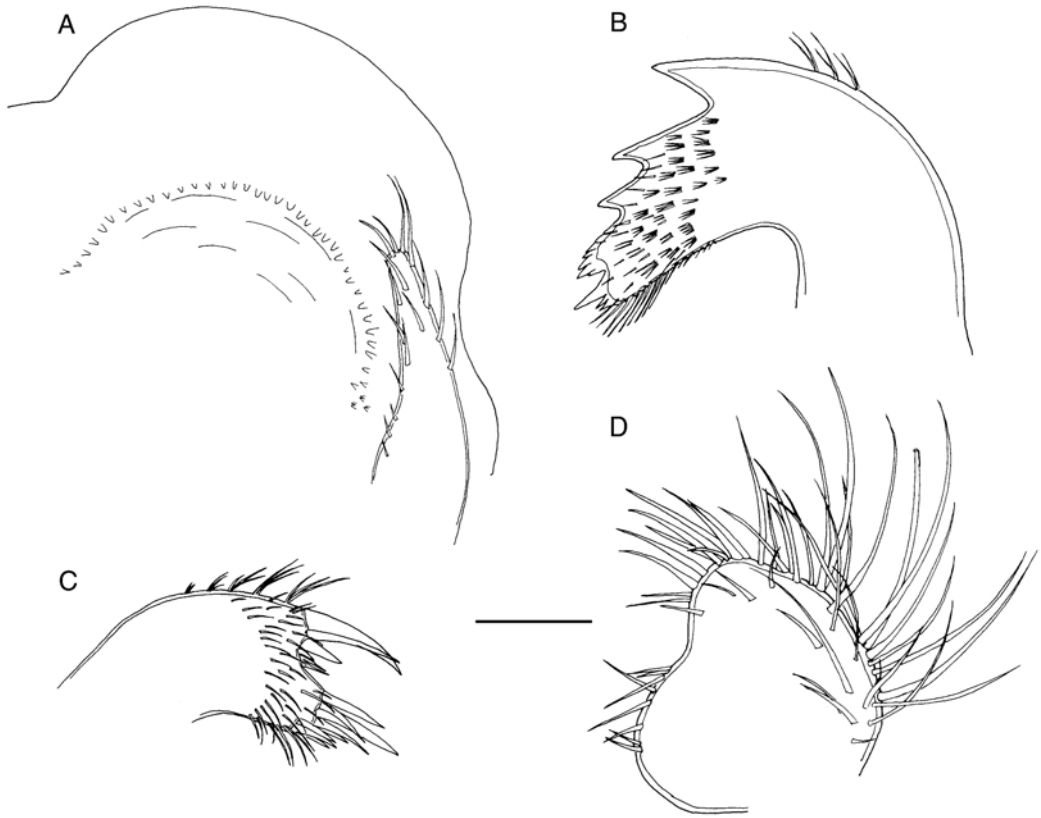

FIG. 13. — *Metaverruca radiata* (Gruvel, 1901), lectotype; **A**, labrum and palp; **B**, mandible; **C**, maxilla I; **D**, maxilla II. Scale bar: 0.1 mm.

projection, apex straight, slightly projected. Fixed tergum (Fig. 12C) with almost the same width of fixed scutum, both sides with well-developed alar-like projections, and a thin articular ridge directed toward fixed scutum; apex nearly straight. Fixed scutum (Fig. 12C) with wide alar-like process directed toward rostrum and turning toward scutum, and a narrow radius-like process directed toward fixed tergum, apex slightly curved toward fixed tergum; internally, with developed adductor ridge projecting downwards.

Tergum (Fig. 12A, E) quadrangular, with four articular ridges; all ridges approximately with same width and conspicuous depression between them; axial ridge prominent on both sides; carinal area smooth. Internally, smooth; scutal margin slightly concave, but with two teeth projecting below. Scutum (Fig. 12A, F) triangular, smaller than tergum; with four articular ridges; axial ridge conspicuous, thin, but only scutal side well-marked, rostral part evenly curving toward rostral side, other ridges narrow, uppermost only represented by a single tooth. Internally, with a conspicuous concavity for adductor muscle on upper portion; tergal margin nearly straight, with several projections from growth lines below, and curving at upper portion.

Labrum (Fig. 13A) with a series of about 40 teeth. Palp (Fig. 13A) long and thin, with few simple setae on inner margin and distal region. Mandible (Fig. 13B) with four teeth, distance between first and second twice distance between second and third, fourth tooth strongly denticu-

late; lower angle denticulate, including one large tooth on upper portion. Maxilla I (Fig. 13C) with lower part projecting; two large spines at upper angle, three small spines between upper large spines and lower projected part, and eight unpaired intermediate and strong spines on basal portion. Maxilla II (Fig. 13D) nearly triangular, anterior margin with shallow concavity medially; covered by long simple setae, except in the shallow concavity.

Cirrus I (Fig. 14A) with unequal rami, anterior ramus slightly longer than posterior, covered with several long simple setae. Cirrus II (Fig. 14B) with anterior ramus about 0.6 length of posterior, articles more protuberant; both rami covered by numerous long, simple setae, distal articles of anterior ramus with pectinate setae. Rami of cirri III-VI equal in length. Setal-article ratio about 5:1. Intermediate articles of cirrus VI (Fig. 14C) with width 0.5 length; three pairs of setae on anterior margin and a thin small setula between each pair, longer setae finely pinnate; one or two fine simple setae and small spinules on posterior angle. Caudal appendage (Fig. 14D) with six or seven articles, 0.6 length of coxopodite; long simple setae on antero-distal margins of articles. Penis (Fig. 14D) short, same length as protopodite, nude. Number of articles of cirri I-VI and caudal appendage is presented in Table 4.

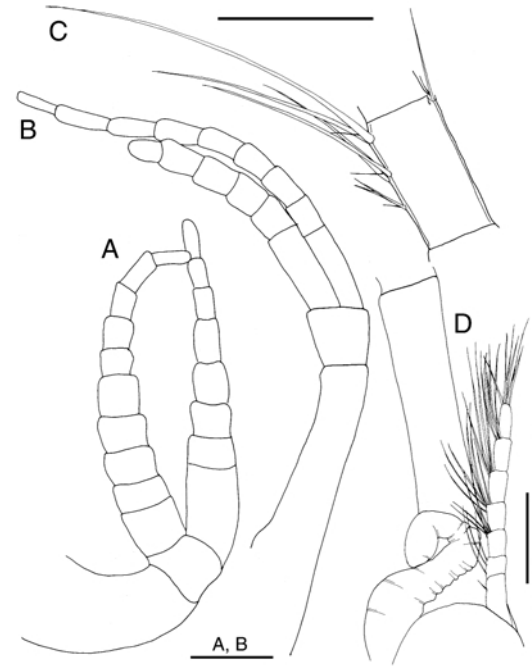

FIG. 14. — *Metaverruca radiata* (Gruvel, 1901), lectotype; **A**, cirrus I; **B**, cirrus II; **C**, median article of cirrus VI; **D**, basipodite of cirrus VI, penis and caudal appendage. Scale bars: 0.2 mm.

TABLE 4. — Number of articles on cirri I-VI, and caudal appendage of *Metaverruca radiata* (Gruvel, 1901). Abbreviations: **I-VI**, cirri I to VI; **ca**, caudal appendage; **lc**, left cirri; **rc**, right cirri; **+**, broken ramus.

	I	II	III	IV	V	VI	ca
rc	10/8	6/9	12/15	17/18	19/18+	22/19	7
lc	9/8	6/9	12/13	17/18	21/22	24/22	6

REMARKS

Gruvel (1901, 1902) described only the external characters of the shell of *M. radiata*, and did not describe the presence of an adductor ridge on the fixed scutum. Young (1998a) tentatively included this species in the genus *Newmaniverruca* Young, 1998 believing it did not have an adductor ridge. Nonetheless, the presence of this adductor ridge, besides the enlargement of the shell basis, indicates this species should be included in *Metaverruca.*

Foster & Buckeridge (1995a, b) considered *M. radiata* to be a synonym of *M. trisulcata* (Gruvel, 1900), but the number of articular ridges on the tergum and scutum, the teeth of the mandible and the spine distribution of maxilla I serve to distinguish both species.

Gruvel (1903) cited this species from the coast of Spain but did not give any other information. This record was ignored by other authors including Gruvel (1905). The material examined from the Expédition du *Travailleur* confirms this record. Therefore, this species is known to occur from Spain to Morocco (Fig. 11).

Metaverruca trisulcata (Gruvel, 1900) (Figs 11; 15-17)

Verruca trisulcata Gruvel, 1900: 243; 1902: 96, pl. 5, figs 9, 10; 1905: 184, fig. 203; 1912b: 348; 1920:

49. — Hoek 1907a: 9. — Cals & Cals-Usciati 1991: 223, fig. 2, pls 1, 2.

Verruca striata Gruvel, 1900: 244; 1902: 98, pl. 5, figs 5, 6, text figs 17, 18; 1905: 183, figs 186, 202. — Hoek 1907: 9. — Krüger 1940: 22. — Stubbings 1967: 25. — Young 1995: 244.

Non *Verruca trisulcata* – Foster & Buckeridge 1995a: 177, figs 10-12 (= *Metaverruca imbricata* (Gruvel, 1900)); 1995b: 363, fig. 9a, b (= *Gibbosaverruca nitida* (Hoek, 1883)).

Metaverruca trisulcata – Young 1998a: 54, figs 9, 13, 14; 2001: 748.

TYPE MATERIAL. — Lectotype by present designation: Expédition du *Talisman*, Azores, drag. 128, 38°7'N, 29°32'W, 960-998 m, rc 6.7 mm (MNHN Ci 79); paralectotype: Expédition du *Talisman*, Azores, drag. 129, no coordinates, 998 m, 1 spec. rc 6.2 mm (MNHN Ci 66).

OTHER MATERIAL EXAMINED. — **Morocco.** Expédition du *Talisman*, Cap Spartel, 622 m, 1883, 1 spec. rc 5.8 mm (MNHN Ci 80) (identified by Gruvel [1912b]).
Cape Verde. Expédition du *Talisman*, drag. 114, 16°51'N, 27°30'W, 598-633 m, 1883, 4 spec. rc 3.7 to 4.8 mm (MNHN Ci 77) (type series of *Verruca striata* Gruvel, 1900). — Expédition du *Talisman*, drag. 114, Cape Verde Islands vicinity, 698 m, 1883, 16 spec. rc 3.4 to 5.0 mm (MNHN Ci 76) (type series of *Verruca striata* Gruvel, 1900, one of this herein designated as lectotype).
No locality, 4 spec. rc 4.0 to 4.3 mm (MNHN Ci 78) (identified as *V. striata* by Gruvel).

DIAGNOSIS. — Shell with crenulated growth lines projecting on all plates; parietal plates of shell corrugated, forming rough longitudinal ridges. Carina and rostrum similar in size, former with four articular ridges, and one small and thin ridge above the upper articular ridge and directed toward tergum axial ridge. Tergum with three articular ridges; axial ridge slightly narrower than intermediate ridge. Scutum with three articular ridges, intermediate ridge twice width of axial ridge. Mandible with three teeth. Cirrus I with anterior ramus slightly longer than posterior. Cirrus II with anterior ramus about 0.7 length of posterior. Rami of cirri III-VI equal in length. Setal-article ratio about 4:1. Intermediate articles of cirrus VI with three pairs of setae on anterior margin. Caudal appendage 0.7 length of coxopodite.

DESCRIPTION

Shell (Fig. 15A-C) white, box-like, opercular valves parallel to base of wall, with crenulated growth lines projecting on all plates, better developed on the rostrum and carina; parietal plates of shell corrugated, forming rough longitudinal ridges; basal margin thickened forming a thin calcareous basis. Cuticle absent. Carina (Fig. 15A) and rostrum similar in size, former with four articular ridges and deep grooves between them, and one small and thin ridge above the upper articular ridge and directed toward tergum axial ridge, with small radius-like projection toward fixed tergum, forming two thin ridges; apex well-curved and projecting. Rostrum (Fig. 15A) with four well-developed articular ridges and deep grooves between them on the rostro-carinal articulation; rostrum and fixed scutum articulation with a conspicuous radius-like projection, apex straight and projecting. Fixed tergum (Fig. 15B) same width as fixed scutum, both sides with well-developed alar-like projections; apex projecting backwards. Fixed scutum (Fig. 15B) with wide alar-like process directed toward rostrum and a radius-like process directed toward fixed tergum, apex curved toward fixed tergum; internally, with adductor ridge projecting downwards.
Tergum (Fig. 15A, D) quadrangular, with three articular ridges; axial ridge prominent on both sides, and slightly narrower than intermediate ridge; intermediate ridge large, with the growth lines slightly crenulated, upper ridge thin and marginal to occludent margin, with a large conspicuous depression between upper and intermediate ridges; carinal area smooth. Internally, smooth; scutal margin slightly concave. Scutum (Fig. 15A, E) triangular, smaller than tergum; with three articular ridges; axial ridge conspicuous, thin, but only scutal side well-marked, rostral part evenly curving to rostral side, intermediate ridge twice width of axial ridge, and third ridge as a flat upper triangular projection. Internally with a concavity for adductor muscle conspicuous on upper portion; tergal margin nearly straight, but accentually curving at upper portion, projections from growth lines at median part of tergal margin.
Labrum (Fig. 16A) with a series of about 60 teeth. Palp (Fig. 16A) long and thin, with few simple setae on inner margin and distal region. Mandible (Fig. 16B) with three teeth, distance between first and second a little greater than dis-

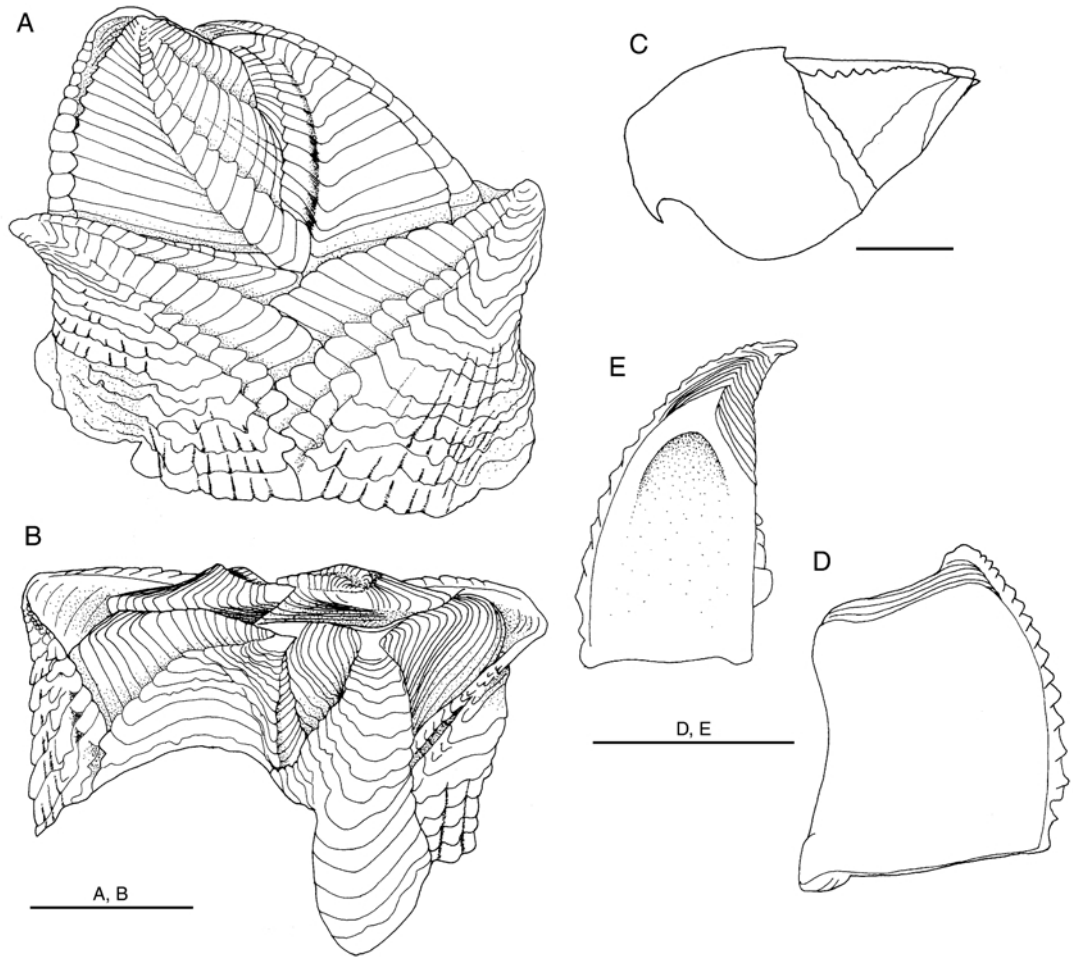

FIG. 15. — *Metaverruca trisulcata* (Gruvel, 1900), lectotype; **A**, rostro-carinal view; **B**, fixed-tergum and fixed-scutum view; **C**, rostrum-fixed-scutum view; **D**, tergum, internal view; **E**, scutum, internal view. Scale bars: 2 mm.

tance between second and third, upper margin of third tooth denticulate; lower angle denticulate. Maxilla I (Fig. 16C) with lower part projecting; two large spines at upper angle, four small spines between upper large spines and lower projected part, and six unpaired intermediate and thin and six small spines on basal portion. Maxilla II (Fig. 16D) triangular, anterior margin with shallow concavity medially; covered by long simple setae, except on the shallow concavity.

Cirrus I (Fig. 17A) with unequal rami, anterior ramus slightly longer than posterior, covered with several long simple setae. Cirrus II (Fig. 17B) with anterior ramus about 0.7 length of posterior, articles more protuberant; both rami covered by numerous long, simple setae. Rami of cirri III-VI equal in length. Setal-article ratio about 4:1. Intermediate articles of cirrus VI (Fig. 17C) with width 0.6 length; three pairs of setae on anterior margin and a thin small setula between each pair, longer setae finely pinnate; two or three fine simple setae on posterior angle. Caudal appendage (Fig. 17D) with eight articles, 0.7 length of coxopodite; long simple setae on antero-distal margins of articles. Penis (Fig. 17D) short, same

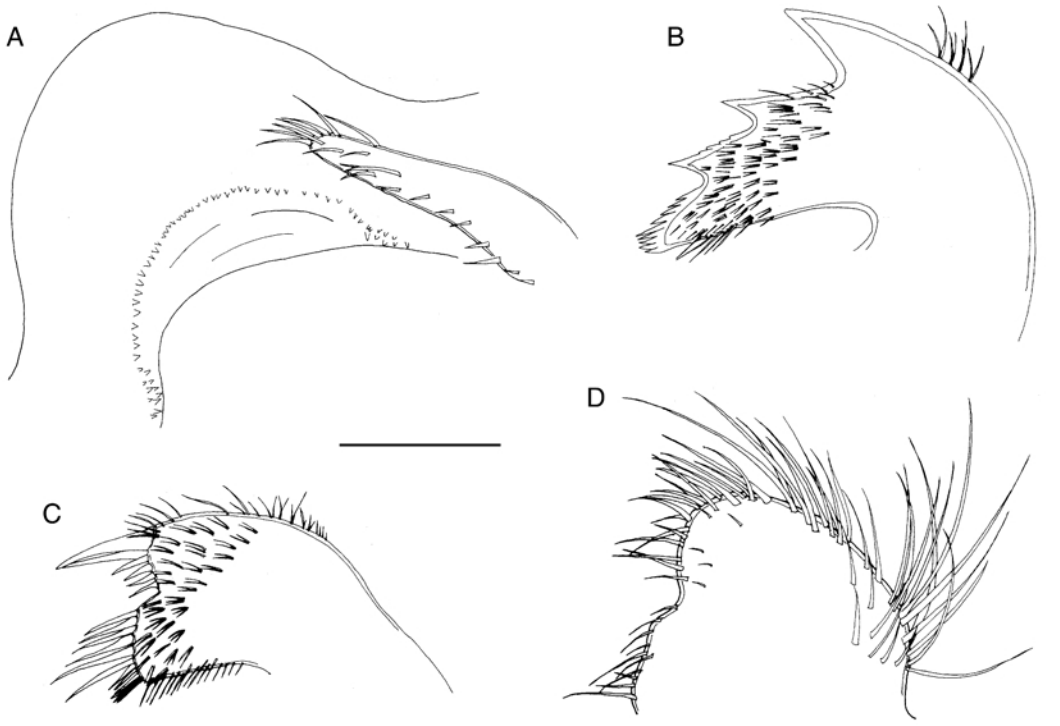

FIG. 16. — *Metaverruca trisulcata* (Gruvel, 1900), lectotype; **A**, labrum and palp; **B**, mandible; **C**, maxilla I; **D**, maxilla II. Scale bar: 0.2 mm.

TABLE 5. — Number of articles on cirri I-VI, and caudal appendage of *Metaverruca trisulcata* (Gruvel, 1900). Abbreviations: **I-VI**, cirri I to VI; **ca**, caudal appendage; **lc**, left cirri; **rc**, right cirri.

	I	II	III	IV	V	VI	ca
rc	15/11	9/13	18/18	21/25	26/26	29/29	8
lc	13/12	9/13	15/18	23/25	27/26	26/27	8

length as protopodite, with few thin setulae at point. Number of articles of cirri I-VI and caudal appendage is presented in Table 5.

REMARKS

The specimen from the Azores, drag. 129, no coordinates, 998 m included in the type series of Gruvel (1920) was erroneously labeled by him as *V. imbricata*. The examination of this specimen, and the citation of this locality in the list of material of *V. trisulcata* indicates that this material is from the type series of *V. trisulcata*. Otherwise, the specimen from drag. 128 was found, and herein is designated as the lectotype of *M. trisulcata.*

The specimen identified by Gruvel (1912b) from Cap Spartel, Morocco, is very similar to the lectotype in having only the longitudinal ridges more conspicuous, more articular ridges on the rostro-carinal suture (five on each side) and a fixed tergum a little narrower than the fixed scutum.

The *Verruca striata* described from Cape Verde Islands (Gruvel 1900, 1902) cannot be separated from *M. trisulcata* by any external characters. In the two samples I dissected, both had caudal appendages with seven articles, slightly smaller than the protopodite, but longer than coxopodite. I do not consider this single difference to be sufficient to separate this species from *M. trisulcata*.

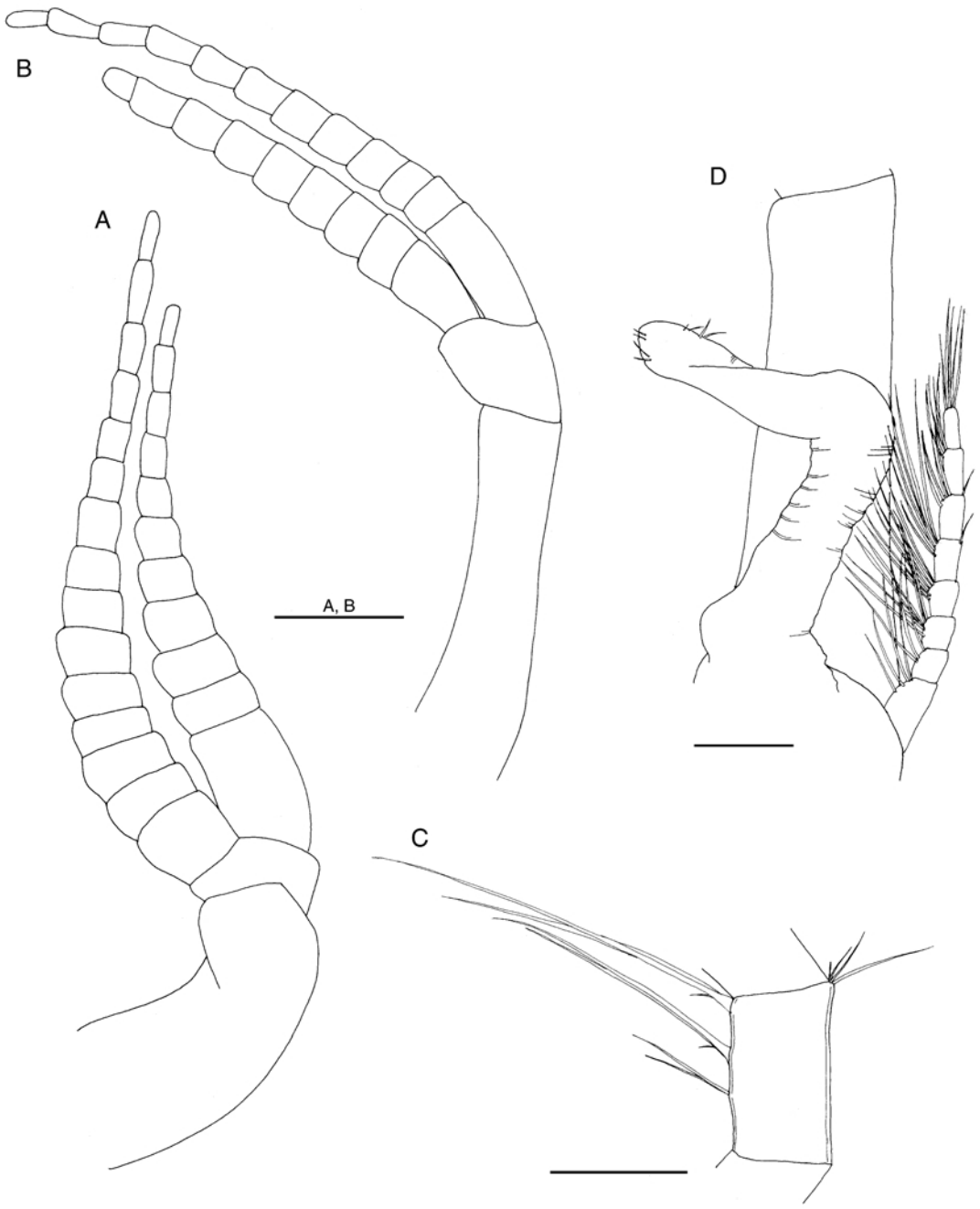

FIG. 17. — *Metaverruca trisulcata* (Gruvel, 1900), lectotype; **A**, cirrus I; **B**, cirrus II; **C**, median article of cirrus VI; **D**, basipodite of cirrus VI, penis and caudal appendage. Scale bars: 0.2 mm.

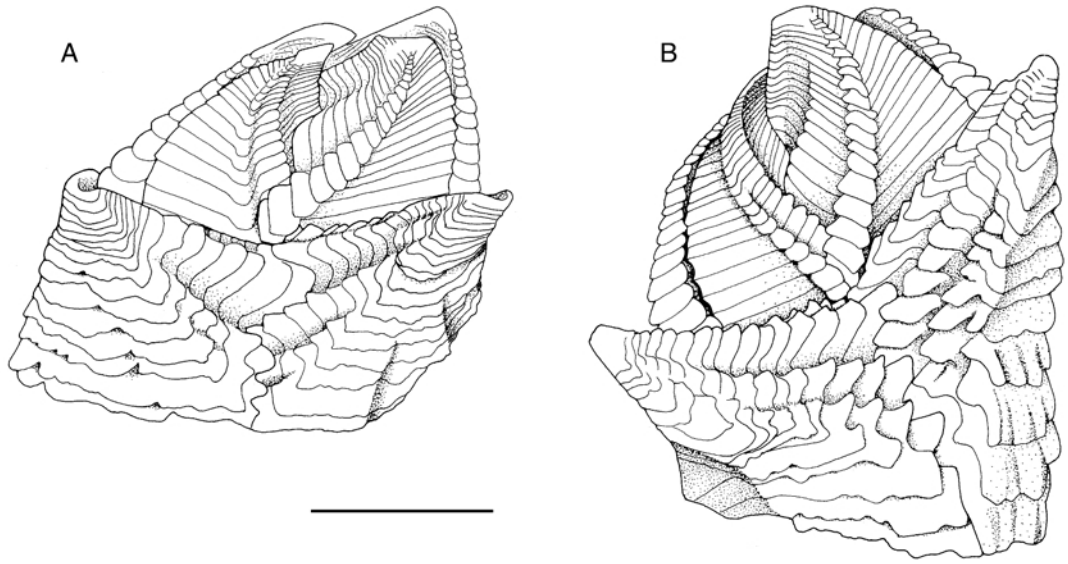

FIG. 18. — *Gibbosaverruca nitida* (Hoek, 1883); **A**, specimen from La Réunion, cruise MD32, stn DC 10 (MNHN Ci 2186), rostro-carinal view; **B**, specimen from stn CP 140 (MNHN Ci 2267), rostro-carinal view. Scale bar: 2 mm.

Young (1998a) redescribed *M. trisulcata* based on specimens from the Azores. These specimens have the longitudinal ridges of the parietal plates very conspicuous and the characteristic small caudal appendage, with seven articles.

M. trisulcata is distributed in the region between the Azores and Gibraltar (Fig. 11).

Genus *Gibbosaverruca* Young, 2002

Gibbosaverruca nitida (Hoek, 1883) (Figs 18-20)

Verruca nitida Hoek, 1883: 138, pl. 12, figs 6, 7.

Verruca trisulcata – Foster & Buckeridge 1995b: 363, fig. 9a, b [non *Metaverruca trisulcata* (Gruvel, 1900)].

Gibbosaverruca nitida – Young 2002: 20.

MATERIAL EXAMINED. — **La Réunion**. Cruise MD32, stn DC 10, 21.133°S, 55.520°E, 930-980 m, 2 spec. rc 4.5 and 4.6 mm (MNHN Ci 2186). — Stn CP 140, 20.412°S, 55.382°E, 1612-1690 m, 1 spec. rc 4.8 mm (MNHN Ci 2267) (identified as *Verruca trisulcata* by Foster & Buckeridge [1995b]).

DESCRIPTION

Shell (Fig. 18) white, opercular valves inclined toward base of wall, with growth lines prominent on all plates; shell plates with rough longitudinal ridges, especially on carina; basal margin not thickened. Cuticle not persistent on wall and opercular valves. Rostrum-carina suture indentated. Rostrum (Fig. 18) nearly rectangular, with two or three articular ridges, apex slightly projected, straight. Carina (Fig. 18) elongated, higher than rostrum, with three articular ridges; apex slightly to strongly projected, straight. Tergum (Fig. 18) quadrangular, with three articular ridges, axial ridge prominent as wide as intermediate ridge; and a small ridge marginal to occludent margin, with a conspicuous depression below; carinal area smooth. Scutum (Fig. 18) slightly smaller than tergum, strongly recurved backwards and toward tergum; with three articular ridges; axial ridge conspicuous, but well-marked at tergal border, and curving continuously to rostral surface; other ridges wide; rostral area smooth, apex strongly curved toward tergum.

Labrum (Fig. 19A) with a series of about 70 teeth, in groups of two to four teeth. Palp

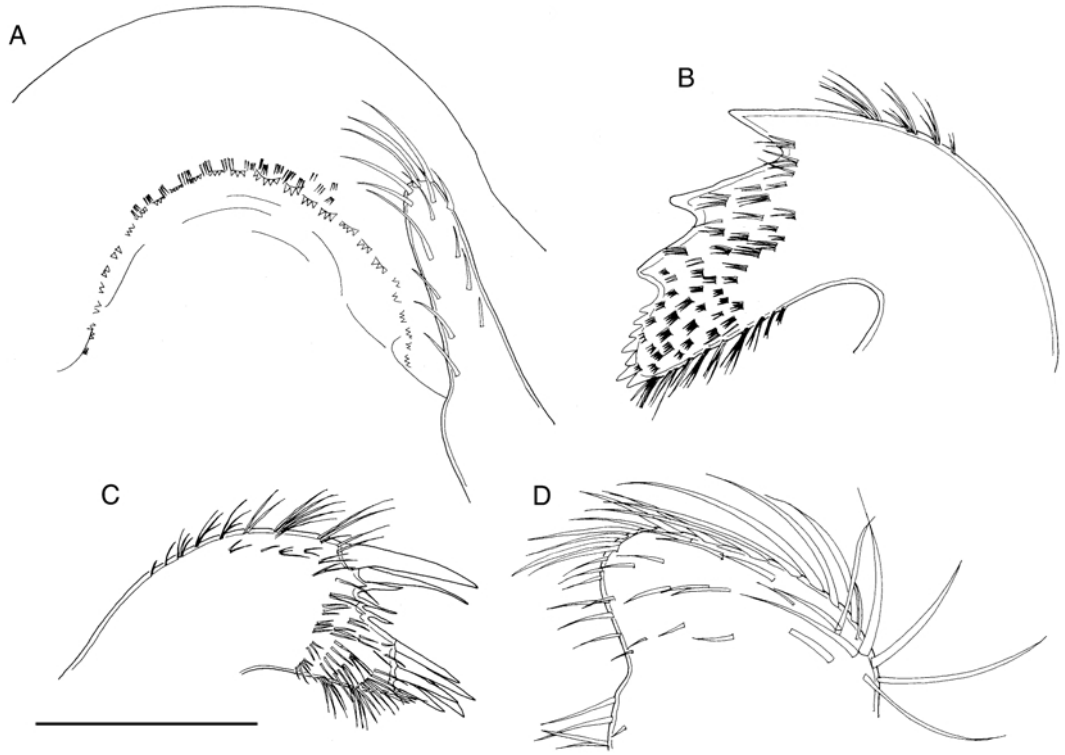

FIG. 19. — *Gibbosaverruca nitida* (Hoek, 1883), specimen from La Réunion, cruise MD32, stn DC 10 (MNHN Ci 2186); **A**, labrum and palp; **B**, mandible; **C**, maxilla I; **D**, maxilla II. Scale bar: 0.2 mm.

(Fig. 19A) long and thin, with few simple setae on margins and distal region. Mandible (Fig. 19B) with three teeth, distance between first and second a little larger than distance between second and third; lower angle denticulate. Maxilla I (Fig. 19C) with lower part projecting; two large spines at upper angle, two small spines between upper large spines and lower projected part, and five unpaired intermediate and three small spines on basal portion. Maxilla II (Fig. 19D) triangular, anterior margin with shallow concavity medially; covered by long simple setae, except on the shallow concavity. Cirrus I (Fig. 20A) with unequal rami, anterior ramus shorter than posterior, 0.6 length of posterior, covered with several long simple setae. Cirrus II (Fig. 20B) with anterior ramus about 0.4 length of posterior, articles more protuberant; both rami covered by numerous long, simple setae, and distal articles of anterior ramus with pinnate and bipectinate setae (Fig. 20C). Rami of cirri III-VI equal in length (Fig. 20E). Setal-article ratio about 6:1. Intermediate articles of cirrus VI (Fig. 20D) with width 0.7 length; two pairs of setae on anterior margin and a thin small setula between lower pair, longer setae finely pinnate; two or three fine simple setae on posterior angle. Caudal appendage (Fig. 20E) with 19 articles, three times length of protopodite; long simple setae on antero-distal margins of articles. Penis long, twice length of protopodite, clothed by thin setulae at mid-distal portion. Number of articles of cirri I-VI and caudal appendage is presented in Table 6.

REMARKS

Foster & Buckeridge (1995b) recorded *Verruca trisulcata* from La Réunion, which was known previously from the Northeastern Atlantic:

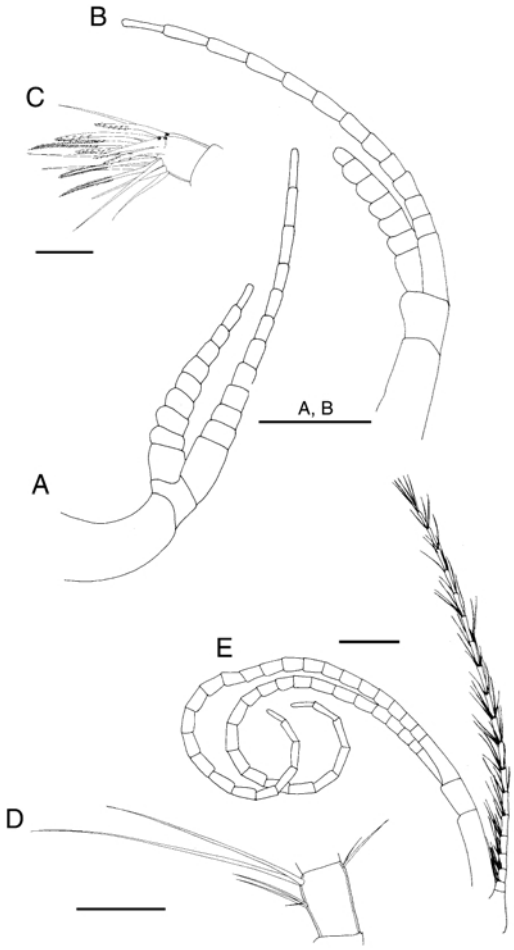

FIG. 20. — *Gibbosaverruca nitida* (Hoek, 1883), specimen from La Réunion, cruise MD32, stn DC 10 (MNHN Ci 2186); **A**, cirrus I; **B**, cirrus II; **C**, distal article of anterior ramus of cirrus II; **D**, median article of cirrus VI; **E**, cirrus VI and caudal appendage. Scale bars: A, B, E, 0.5 mm; C, 0.1 mm; D, 0.2 mm.

TABLE 6. — Number of articles on cirri I-VI, and caudal appendage of *Gibbosaverruca nitida* (Hoek, 1883). Abbreviations: **I-VI**, cirri I to VI; **ca**, caudal appendage; **lc**, left cirri; **rc**, right cirri.

	I	II	III	IV	V	VI	ca
rc	9/11	7/14	14/17	17/19	22/24	23/25	15
lc	10/12	7/13	14/17	19/21	23/23	23/25	19

Morocco, Azores, Canary, and Cape Verde islands. Young (1998a) commented on this discrepancy in the distribution record and suspected there was another species. Of the three samples cited by Foster & Buckeridge (1995b), I could find only two in the MNHN collection: cruise MD32, stn DC 10 and stn CP 140. A reexamination of these samples from La Réunion confirmed it is *Gibbosaverruca nitida*. *G. nitida* occurs only in the Indo-West Pacific (Hoek 1883, 1913; Rosell 1981; Ren 1984; Buckeridge 1994, 1997) and this record is included in its geographic distribution.

OTHER SPECIES CONSIDERED SYNONYMS

Verruca linearis Gruvel, 1900 [junior synonym of *Metaverruca recta* (Aurivillius, 1898)] (Fig. 21)

Verruca linearis Gruvel, 1900: 243; 1902: 107, pl. 5, figs 11, 12; 1905: 182, fig. 201. — Hoek 1907: 9.

TYPE MATERIAL. — Lectotype by present designation: Expédition du *Talisman*, Azores, drag. 128, 32°7'N, 29°32'W, 960-998 m, 1883, 1 spec. rc 4.9 mm (MNHN Ci 71).

OTHER MATERIAL EXAMINED. — No coordinates, 2018 m, on *Caryophyllia* sp., 1 spec. rc 9.2 mm (MNHN Ci 72).

REMARKS

Verruca linearis does not exhibit any characters that differentiate it from *Metaverruca recta* (Aurivillius, 1898), even in the appendages. Therefore, I have to confirm the synonymy presented by Gruvel (1920), Nilsson-Cantell (1929, 1938), Southward & Southward (1958), Buckeridge (1994), Foster & Buckeridge (1995a, b) and Young (1998a, b).

Verruca magna Gruvel, 1901 [junior synonym of *Metaverruca recta* (Aurivillius, 1898)] (Fig. 22)

Verruca magna Gruvel, 1901: 261; 1902: 109, pl. 5, figs 1, 2; 1905: 184, figs 204, 205. — Hoek 1907: 9. — Weisbord 1979: 98.

TYPE MATERIAL. — Holotype: Expédition du *Talisman*, Bay of Biscay, drag. 141, 45°59'N, 6°29'W, 1480 m, 1883, 1 spec. rc 10.4 mm (MNHN Ci 74).

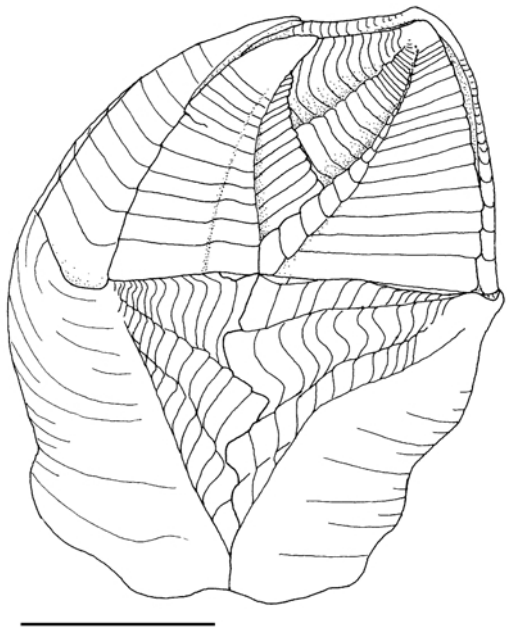

FIG. 21. — *Verruca linearis* Gruvel, 1900, lectotype, rostro-carinal view. Scale bar: 2 mm.

REMARKS

Verruca magna is simply a well-developed specimen of *Metaverruca recta*, and the specimen was damaged before or during collection. Its scutum has the second articular ridge broken and partially deformed; it has this ridge very wide and the third, upper ridge is lacking. Apart from the scutum, the single difference I could observe in this specimen is that the articular ridges of the rostro-carinal sutures are more pronounced, which is probably due to their large size. Therefore, I confirm the synonymy presented by Nilsson-Cantell (1929, 1938), Southward & Southward (1958), Buckeridge (1994), Foster & Buckeridge (1995a, b) and Young (1998a, b).

Verruca striata Gruvel, 1900
[junior synonym of *Metaverruca trisulcata* (Gruvel, 1900)]
(Fig. 23)

REMARKS

See discussion under *Metaverruca trisulcata*.

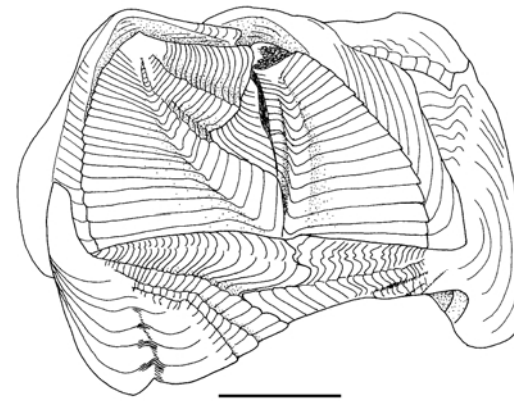

FIG. 22. — *Verruca magna* Gruvel, 1901, lectotype, rostro-carinal view. Scale bar: 3 mm.

OTHER SAMPLES

Gruvel cited *Verruca stroemia* (Müller, 1776) in four of his studies, but only in three did he list the material studied. The one from 1905 was the revision of the cirripeds, in which he cited the general distribution observed by Darwin (1854): coasts of France and England, Mediterranean, Red Sea. Otherwise, he cited the following samples:

– Gruvel (1902: 91): Expédition du *Talisman*, Azores, drag. 128, 38°7'N, 29°32'W, 960-998 m, on gorgonians;

– Gruvel (1903: 100): Mission de la Manche (1892), "Rey Riawick" (Reykjavik, Iceland on the original label) and "Patrix Fjord" (probably Patreksfjördur, Iceland) and Mission Pouchet (1896), "Vadso, Finmark" (probably Vadsø, Norway);

– Gruvel (1920: 50): Campagnes Scientifiques de S. A. S. le Prince de Monaco, stn 1043, 59°03'N, 1°47'45"W, 88 m and stn 2354, no coordinates, 2600 m on living *Neptunea antiqua* (Linnaeus, 1758), *Sipho gracilis* (da Costa, 1778), *Natica catena* da Costa, 1778. This last station is probably a label error because it does not appear at the "Tableaux des espèces recueillies aux différentes stations" at the end of his study.

In the collection of MNHN, there are four samples identified by Gruvel as *Verruca stroemia*, which were reexamined:

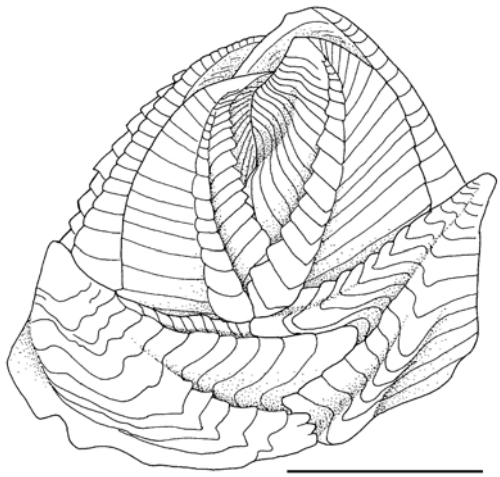

FIG. 23. — *Verruca striata* Gruvel, 1900, lectotype, rostro-carinal view. Scale bar: 2 mm.

– Expédition du *Talisman*, Azores, drag. 128, 38°7'N, 29°32'W, 998-960 m, 1883, five empty shells rc 1.7 to 2.7 mm (MNHN Ci 83), represents the information of Gruvel (1902). These specimens are represented only by shells and can be identified as *Verruca spengleri* Darwin, 1854, because their shells have no longitudinal ridges. The suture between the rostrum and carina is also very elaborate and large as figured by Young (1998a). Otherwise, the locality is well within the region of occurrence of *V. spengleri* and not *V. stroemia.* Probably, these specimens were not living at the depth recorded, but were transported from shallower waters. The known depth range of *V. spengleri* is shallower than 100 m;
– Reykjavik, Mission de la Manche, 6 spec. and fragments rc 2.9 to 3.8 mm (MNHN Ci 84). This sample represents *V. stroemia* as published by Gruvel (1903);
– Patrixfyord [sic], Mission de la Manche, 2 spec. and fragments rc 2.9 to 3.9 mm (MNHN Ci 82). This sample represents *V. stroemia* as published by Gruvel (1903);
– No locality, 1 spec. and fragments rc 3.4 mm (MNHN Ci 86). This sample contains specimens of *V. spengleri* instead of *V. stroemia*, but no data on locality are known.

Acknowledgements
I wish to acknowledge Danielle Defaye (MNHN) for allowing me to study Gruvel's historic collection, for the invitation and the grant to work at the MNHN and for comments on the manuscript; Arnold Ross (Scripps Institution of Oceanography, San Diego) and John Buckeridge (Auckland University of Technology). I would like also to acknowledge all the staff of the Laboratoire de Zoologie (Arthropodes) (MNHN), especially Dr Ho, for all the facilities during my work in Paris. I thank Dr Claude Lévi (MNHN) for allowing me to examine the samples of sponges from Gambier Island. This study was supported by the MNHN, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Fundação Universitária José Bonifácio (FUJB) and Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ).

REFERENCES

BUCKERIDGE J. S. 1994. — Cirripedia Thoracica: Verrucomorpha of New Caledonia, Indonesia, Wallis and Futuna Islands, *in* CROSNIER A. (ed.), Résultats des Campagnes MUSORSTOM, volume 12. *Mémoires du Muséum national d'Histoire naturelle* 161: 87-125.

BUCKERIDGE J. S. 1997. — Cirripedia Thoracica: New ranges and species of Verrucomorpha from the Indian and Southwest Pacific Oceans, *in* CROSNIER A. (ed.), Résultats des Campagnes MUSORSTOM, volume 18. *Mémoires du Muséum national d'Histoire naturelle* 176: 125-149.

CALS P. & CALS-USCIATI J. 1991. — Poralité et latéralité des plaques épidermiques palléales chez l'adulte du ciripède verrucomorphe bathyal *Verruca trisulcata*. *Vie et Milieu* 41 (4): 223-235.

DARWIN C. 1854. — *A Monograph on the Subclass Cirripedia, with Figures of all the Species. The Balanidae, the Verrucidae, etc*. Ray Society, London, 684 p.

FOSTER B. A. & BUCKERIDGE J. S. 1995a. — Barnacles (Cirripedia: Thoracica) of seas off the Straits of Gibraltar. *Bulletin du Muséum national d'Histoire naturelle* sér. 4, 17: 163-191.

FOSTER B. A. & BUCKERIDGE J. S. 1995b. — Barnacles (Cirripedia: Thoracica) of seas off Réunion Island and East Indies. *Bulletin du Muséum national d'Histoire naturelle* sér. 4, 16: 345-382.

GRUVEL A. 1900. — Sur les espèces nouvelles du genre *Verruca* provenants du "*Talisman*". *Bulletin du Muséum national d'Histoire naturelle* 6: 242-244.

GRUVEL A. 1901. — Diagnoses de quelques espèces nouvelles de Cirrhipèdes. *Bulletin du Muséum national d'Histoire naturelle* 7: 256-263.

GRUVEL A. 1902. — Cirrhipèdes. *Expéditions Scientifiques du "*Travailleur*" et du "*Talisman*", pendant les années 1880, 1881, 1882, 1883*. Masson, Paris, 178 p., 7 pls.

GRUVEL A. 1903. — Révision des Cirrhipèdes appartenant à la collection du Muséum d'Histoire Naturelle. Operculés. I. Partie systématique. *Nouvelles Archives du Muséum d'Histoire naturelle* sér. 4, 5: 95-170, pls 1-4.

GRUVEL A. 1905. — *Monographie des Cirrhipèdes ou Thécostracés*. Masson, Paris, 472 p.

GRUVEL A. 1911. — Sur deux espèces nouvelles de Cirrhipèdes appartenant à la collection du Muséum. *Bulletin du Muséum national d'Histoire naturelle* 17 (5): 290-291.

GRUVEL A. 1912a. — Note préliminaire sur les Cirrhipèdes recueillis pendant les campagnes de S. A. S. le Prince de Monaco. *Bulletin de l'Institut océanographique* 241: 1-7.

GRUVEL A. 1912b. — Mission Gruvel sur la côte occidentale d'Afrique (1909-1910) et collection du Muséum d'Histoire Naturelle. Les Cirrhipèdes. *Bulletin du Muséum national d'Histoire naturelle* 18 (6): 344-350.

GRUVEL A. 1920. — Cirrhipèdes provenant des campagnes scientifiques de S. A. S. le Prince de Monaco. *Résultats des Campagnes scientifiques accomplies sur son Yacht par Albert Ier, Prince Souverain de Monaco* 53: 1-89, pls 1-7.

HOEK P. P. C. 1883. — Report on the Cirripedia collected by H. M. S. *Challenger* during the years 1873-76. *Reports of the Scientific Results of the Voyage of H. M. S.* Challenger, *Zoology* part 25, 8: 1-169, 13 pls.

HOEK P. P. C. 1907. — The Cirripedia of the *Siboga* Expedition. A. Cirripedia Pedunculata. Siboga *Expeditie* 31a: 1-127, pls 1-10.

HOEK P. P. C. 1913. — The Cirripedia of the *Siboga* Expedition. B. Cirripedia Sessilia. Siboga *Expeditie* 31b: 129-275, pls 11-27.

ICZN 1999. — *International Code of Zoological Nomenclature*. 4th ed. International Trust for Zoological Nomenclature, London, 306 p.

KRÜGER P. 1940. — Cirripedia, *in* BRONNS H. G. (ed.), *Klassen und Ordnungen des Tierreichs* 5 (3): 1-391.

NILSSON-CANTELL C. A. 1929. — Cirripedien des Genus *Verruca* der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia* 1898-1899. *Zoologische Jahrbücher* 58: 459-480.

NILSSON-CANTELL C. A. 1938. — Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. *Memoirs of the Indian Museum* 13 (1): 1-81, 3 pls.

NILSSON-CANTELL C. A. 1955. — Cirripedia. *Reports of the Swedish Deep-Sea Expedition* 2 *Zoology* (17): 215-220.

PILSBRY H. A. 1916. — The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum; including a Monograph of the American species. *Bulletin of the United States National Museum* 93: 1-366.

REN X. 1984. — Studies on Chinese Cirripedia (Crustacea). IV. Family Verrucidae. *Studia marina sinica* 23: 165-179, pls. 1-2 (in Chinese).

ROSELL N. C. 1981. — Crustacea: Cirripedia, *in* Résultats des Campagnes MUSORSTOM, volume 1. Phillipines. *Mémoires ORSTOM* 9: 277-307.

SOUTHWARD A. J. & SOUTHWARD E. C. 1958. — On the occurrence and behaviour of two little-known barnacles, *Hexelasma hirsutum* and *Verruca recta*, from the continental slope. *Journal of the Marine Biological Association of United Kingdom* 37: 633-647.

STUBBINGS H. G. 1967. — The cirriped fauna of tropical West Africa. *Bulletin of the British Museum of Natural History, Zoology* 15 (6): 229-319, 1 pl.

WEISBORD N. E. 1979. — Lepadomorph and Verrucomorph barnacles (Cirripedia) of Florida and adjacent waters, with an addendum on the Rhizocephala. *Bulletin of American Paleontology* 76 (306): 1-156.

YOUNG P. S. 1995. — New interpretations of South American patterns of barnacle distribution, *in* SCHRAM F. R. & HOEG J. (eds), New frontiers in barnacle evolution. *Crustacean issues* 10: 229-253.

YOUNG P. S. 1998a. — Cirripedia (Crustacea) from the "Campagne Biaçores" in the Azores region, including a generic revision of Verrucidae. *Zoosystema* 20 (1): 31-92.

YOUNG P. S. 1998b. — The Cirripedia (Crustacea) collected by the Fisheries Steamer "*Meteor*" in the Eastern Atlantic. *Arquivos do Museu Nacional, Rio de Janeiro* 58: 1-53.

YOUNG P. S. 1998c. — Cirripeds (Crustacea) from the Mid-Atlantic Ocean Ridge collected by the submersible *Nautile*. *Cahiers de Biologie marine* 39: 109-119.

YOUNG P. S. 2001. — Deep sea Cirripedia Thoracica (Crustacea) from the northeastern Atlantic collected by French expeditions. *Zoosystema* 23 (4): 707-758.

YOUNG P. S. 2002. — The Verrucidae from the Western coast of North America, with a revision on the genus *Altiverruca*. *Arquivos do Museu Nacional, Rio de Janeiro* 60: 5-40.

ZEVINA G. B. 1976. — Abyssal species of barnacles (Cirripedia, Thoracica) of the North Atlantic. *Zoologicheskii Zhurnal* 55 (8): 1149-1156 (in Russian).

ZEVINA G. B. 1987. — Abyssal Cirripedia Verrucomorpha (Thoracica) of the Atlantic and Indian Ocean. *Zoologicheskii Zhurnal* 66 (9): 1304-1313 (in Russian).

ZEVINA G. B. 1988. — Deep-sea Verrucomorpha (Cirripedia, Thoracica) of the Pacific. 2. The South Pacific. *Zoologicheskii Zhurnal* 67 (1): 31-40 (in Russian).

Submitted on 28 September 2001;
accepted on 12 April 2002.