

# Chitons (Mollusca, Polyplacophora) from Rapa, the southernmost island of Polynesia

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## ABSTRACT

The RAPA 2002 workshop permitted the first comprehensive collection of polyplacophorans from the island of Rapa (Austral Islands, South Pacific) to be made. The collection includes three genera and three species, two of the species being new to science. The isolation of Rapa may explain the uniqueness of this small polyplacophoran fauna. The two new species are: *Leptochiton hiriensis* n. sp. and *Chiton (Rhyssoplax) rapaitiensis* n. sp. The latter species, which is the most common (83% of the specimens), is a brooder. *Leptochiton hiriensis* n. sp. differs from congeneric species of the same size in the sculpture of the valves, which show concentric growth marks in the central area and concentrically arranged nodules in the head valve, postmucronal region of the tail valve and the lateral areas. *Chiton (Rhyssoplax) rapaitiensis* n. sp. is compared to the related species *C. (R.) linsleyi* (Burghardt, 1973), *C. (R.) rhynchotus* (de Rochebrune, 1884), and *C. (R.) maldivensis* (E. A. Smith in Gardiner, 1903). In addition to its smaller size, the new species differs in tegmental sculpture and in the ornamentation of the dorsal girdle scale. *Onithochiton lyellii* (Sowerby, 1832), a species also known from the Gambier Islands and Pitcairn Islands, is restricted herein to the Polynesian region. In addition to the descriptions of the new species, characters relevant in identification of *O. lyellii* are described and illustrated for the first time in scanning electron micrographs.

**KEY WORDS**  
Mollusca,  
Polyplacophora,  
French Polynesia,  
Rapa,  
brooding species,  
new species.

## RÉSUMÉ

*Chitons (Mollusca, Polyplacophora) de Rapa, l'île la plus méridionale de Polynésie.*  
L'atelier RAPA 2002 a permis de récolter la première collection complète de Polyplacophora de l'île de Rapa (archipel des Australes). Trois genres et trois

**MOTS CLÉS**  
Mollusca,  
Polyplacophora,  
Polynésie française,  
Rapa,  
espèce incubatrice,  
espèces nouvelles.

espèces, dont deux nouvelles pour la science, sont représentés. L'isolement de l'île de Rapa peut expliquer l'originalité de cette petite faune de Polyplacophora. Les deux nouvelles espèces sont : *Leptochiton hiriensis* n. sp. et *Chiton (Rhyssoplax) rapaitiensis* n. sp. *Chiton (Rhyssoplax) rapaitiensis* n. sp., l'espèce la plus commune (83 % des spécimens), est incubatrice. *Leptochiton hiriensis* n. sp. diffère de ses congénères de la même taille par la sculpture des valves, qui comporte des stries de croissances concentriques dans la zone centrale et des nodules disposés de façon concentrique dans la valve de tête, la région postmucronale de la valve de queue, et les zones latérales. *Chiton (Rhyssoplax) rapaitiensis* n. sp. est comparé aux espèces voisines *C. (R.) linsleyi* (Burghardt, 1973), *C. (R.) rhynchotus* (de Rochebrune, 1884), et *C. (R.) maldivensis* (E. A. Smith in Gardiner, 1903). En plus de sa petite taille, la nouvelle espèce diffère par la sculpture tegmentaire et par l'ornementation de l'écaille de la ceinture dorsale. *Onithochiton lyellii* (Sowerby, 1832) est connue des îles Gambier et Pitcairn. Les radulas de *Chiton rapaitiensis* n. sp. et *O. lyellii* sont décrites et figurées au microscope électronique à balayage.

## INTRODUCTION

The species presented herein were collected during a workshop on Rapa (27°37'S, 144°20'W), the most isolated island of French Polynesia. This small island (40 km<sup>2</sup>; Fig. 1) is the southernmost of the Austral Islands, an archipelago situated south of the Society Islands. The island, of volcanic origin, is estimated to be 5-3 Myr old (Brousse & Gelugne 1987). The RAPA 2002 workshop formed part of a concerted research program "Fauna and Flora of Rapa" involving the Université de Polynésie française, École pratique des hautes Études (EPHE), Institut de Recherche pour le Développement (IRD) and MNHN. It took place between October 27 and December 10, 2002 (Lozouet *et al.* 2004, 2005).

This is the first study of chitons from Rapa. Previously, just a single record of *Onithochiton lyellii* (Sowerby, 1832) had been provided by Salvat & Rives (1975: 187). Thus, although a relatively small number of chiton species was collected, the material is of utmost interest.

## MATERIAL AND METHODS

During RAPA 2002 a total of 92 stations were sampled between high tide mark and 52 m depth. Of these, 21 stations yielded specimens of Poly-

placophora. The material was collected by intertidal collecting, scuba diving and dredging. During the dives, different techniques were deployed, including hand picking, collecting bottom samples by suction sampling, and brushing stones and dead corals (see Bouchet *et al.* 2002).

The chitons were fixed and preserved in 75% ethanol. Preparation of SEM material followed the procedure described by Schwabe & Ruthensteiner (2001). Eggs were prepared following the method described by Laforsch & Tollrian (2000).

Most specimens are in MNHN, two specimens of each species are in ZSM.

## ABBREVIATIONS

MNHN Muséum national d'Histoire naturelle, Paris;  
NHM Natural History Museum, London (formerly British Museum [Natural History]);  
ZSM Zoologische Staatssammlung München, Munich;  
pd partly disarticulated (specimens used for scanning electronic microscopy);  
spm(s) specimen(s);  
stn(s) station(s).

## SYSTEMATICS

Class POLYPLACOPHORA Gray, 1821  
Order NEOLORICATA Bergenhayn, 1955  
Family LEPTOCHITONIDAE Dall, 1889



FIG. 1. — Map of Rapa Island showing the stations cited in the text. Symbols: ●, intertidal; ★, scuba diving and dredging.

### Genus *Leptochiton* Gray, 1847

TYPE SPECIES. — *Chiton cinereus* sensu Montagu, 1803 (*non* Linnaeus, 1767) = *Leptochiton asellus* (Gmelin, 1791), by subsequent designation (Gray 1847).

DISTRIBUTION. — Members of the genus distributed worldwide, Eocene-Recent.

#### *Leptochiton hiriensis* n. sp. (Figs 2-4; 10A)

TYPE MATERIAL. — Holotype: type locality (MNHN).

Paratypes: type locality, 7 paratypes (MNHN). — Stns 16 and 30, 2 paratypes (ZSM).

TYPE LOCALITY. — French Polynesia, archipel des Australes, Rapa, Baie de Hiri, RAPA 2002, stn 9, 27°37.3'S, 144°22.2'W, 3-24 m, coral bottom.

ETYMOLOGY. — From the type locality.

MATERIAL EXAMINED. — A total of 25 specimens (3 lots). **French Polynesia.** Rapa Island, Baie de Hiri, 27°37.3'S, 144°22.2'W, RAPA 2002, stn 9, 3-24 m, coral bottom, 8 spms. — W of Tauna islet, 27°36.3'S, 144°18.4'W, RAPA 2002, stn 16, 5 m, dead corals, 13 spms. — Pointe Mei, 27°38.2'S, 144°18.2'W, RAPA 2002, stn 30, 16-20 m, dead corals, 4 spms.

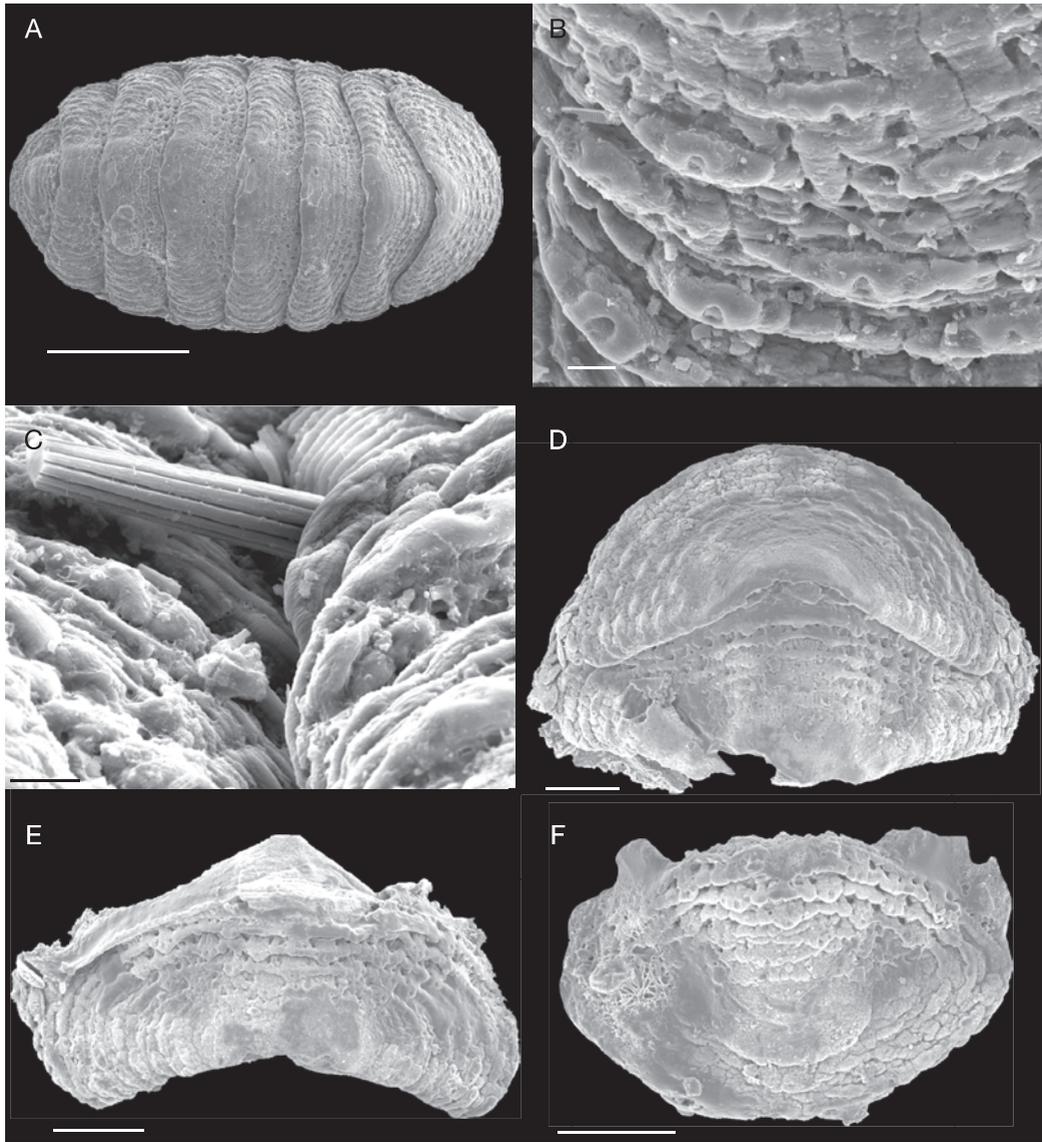


FIG. 2. — *Leptochiton hiriensis* n. sp., Rapa Island, RAPA 2002: **A-C**, holotype, stn 9, 5.5 mm; **A**, complete specimen in dorsal view, anterior region on the right side; **B**, detail of valve ii, left side; **C**, sutural region of valves vi-vii, left side; **D-F**, paratype, stn 16, 1.3 mm; **D**, head and second valve *in situ*, dorsal view; **E**, valve vii, dorsal view; **F**, tail valve, dorsal view. Scale bars: A, 400  $\mu$ m; B, C, 10  $\mu$ m; D-F, 100  $\mu$ m.

**DIAGNOSIS.** — Elongate-oval animal, minute. Tegmentum strongly sculptured with comarginal ridges. Dorsal girdle with strongly ribbed scales and long needles. Ventral girdle with smooth, elongate-rectangular scales. Radula

with *c.* 80 rows, about 365  $\mu$ m in length. Central tooth broad rectangular with a simple inwardly directed blade, second lateral with an elongate-rectangular, tridentate head. Ctenidia unknown.

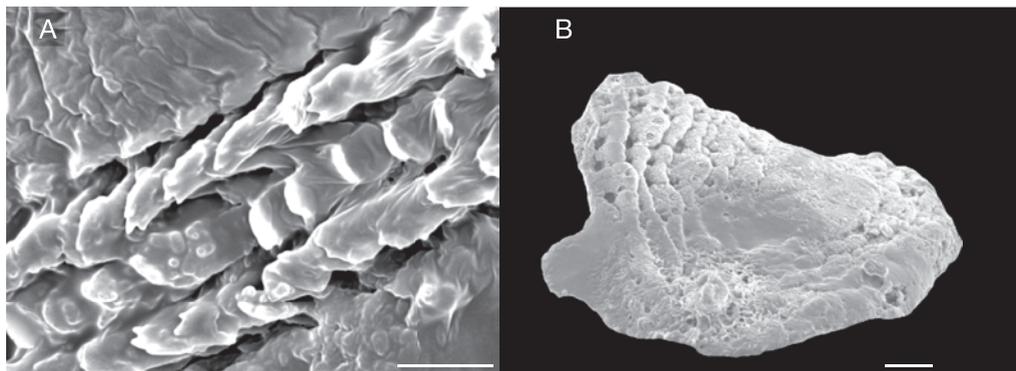


FIG. 3. — *Leptochiton hiriensis* n. sp., paratype, Rapa Island, RAPA 2002, stn 16, 1.3 mm: **A**, anterior part of the radula; **B**, tail valve, left lateral view. Scale bars: A, 10  $\mu$ m; B, 30  $\mu$ m.

#### DESCRIPTION

Minute, to 1.4 mm in length, with an elongate-oval outline. Dorsum evenly convex. Head valve comparatively large, posterior margin widely V-shaped with a shallow notch in the centre. Intermediate valves rectangular, without apex, posterior margin concave. Tail valve semicircular with a central, slightly elevated, posteriorly directed mucro. Postmucronal slope flat and straight. Lateral areas of intermediate valves moderately elevated.

Tegumentum sculptured with relatively prominent, comarginal ridges (12 in the head valve of the holotype), which are stronger towards the outer margin and lateral areas. Central part of the valves more or less distinctly sculptured and appears partly smooth, except for concentric granulated growth marks. Ridges bearing inconspicuous granules. Each granule with a central macropore of 3.5  $\mu$ m in diameter. Micropores seem to be present among the granules, on their bases.

Articulamentum builds thin apophyses, triangular in intermediate valves, rectangular in tail valve. They are widely separated and not connected by a sutural lamina.

Perinotum (Fig. 2) very narrow. Dorsally covered with strongly ribbed (with up to 15 ribs), imbricated, rectangular scales, which are 34.5  $\times$  20  $\mu$ m in size (*in situ*). There are also long, smooth needles (78.3  $\times$  8.4  $\mu$ m), which are irregularly arranged among

the scales. Sutorally, there are longitudinal-ribbed (probably up to 12 ribs) needles, which reach c. 50  $\times$  8.3  $\mu$ m. Ventral girdle scales (Fig. 4E) smooth, rectangular to oval (24-30  $\times$  11.3-12.7  $\mu$ m) with a small nipple-like tip. Marginal girdle elements consist of: finely ribbed (up to 12 ribs), rectangular scales (57.3  $\times$  18.7  $\mu$ m) with a sharply pointed distal end; and long, slender, smooth needles, attaining 48.5  $\times$  3.8  $\mu$ m.

Radula of a 1.3 mm specimen from stn 16 about 365  $\mu$ m in length, consists of c. 80 rows. Central tooth rectangular, 5.6  $\times$  5.2  $\mu$ m, with a simple inwardly directed blade. Second lateral tooth about 12.4  $\mu$ m in length, with an elongate-rectangular tridentate head, measuring 7.2  $\times$  4  $\mu$ m. Central denticle sharp-pointed and longest. Radula cartilage 104  $\mu$ m in length.

Due to the condition and the small size of the specimens the number of ctenidia could not be determined.

#### REMARKS

The species was found at 3-24 m depth on corals, but probably reaches its highest density at about 5 m. The high number of growth marks, the constant size and the relatively "thick" valves lead us to assume that this species is full-grown. The minute size, in combination with the strong sculpture make it easy to distinguish it from other Indo-Pacific shallow-water species so far known.

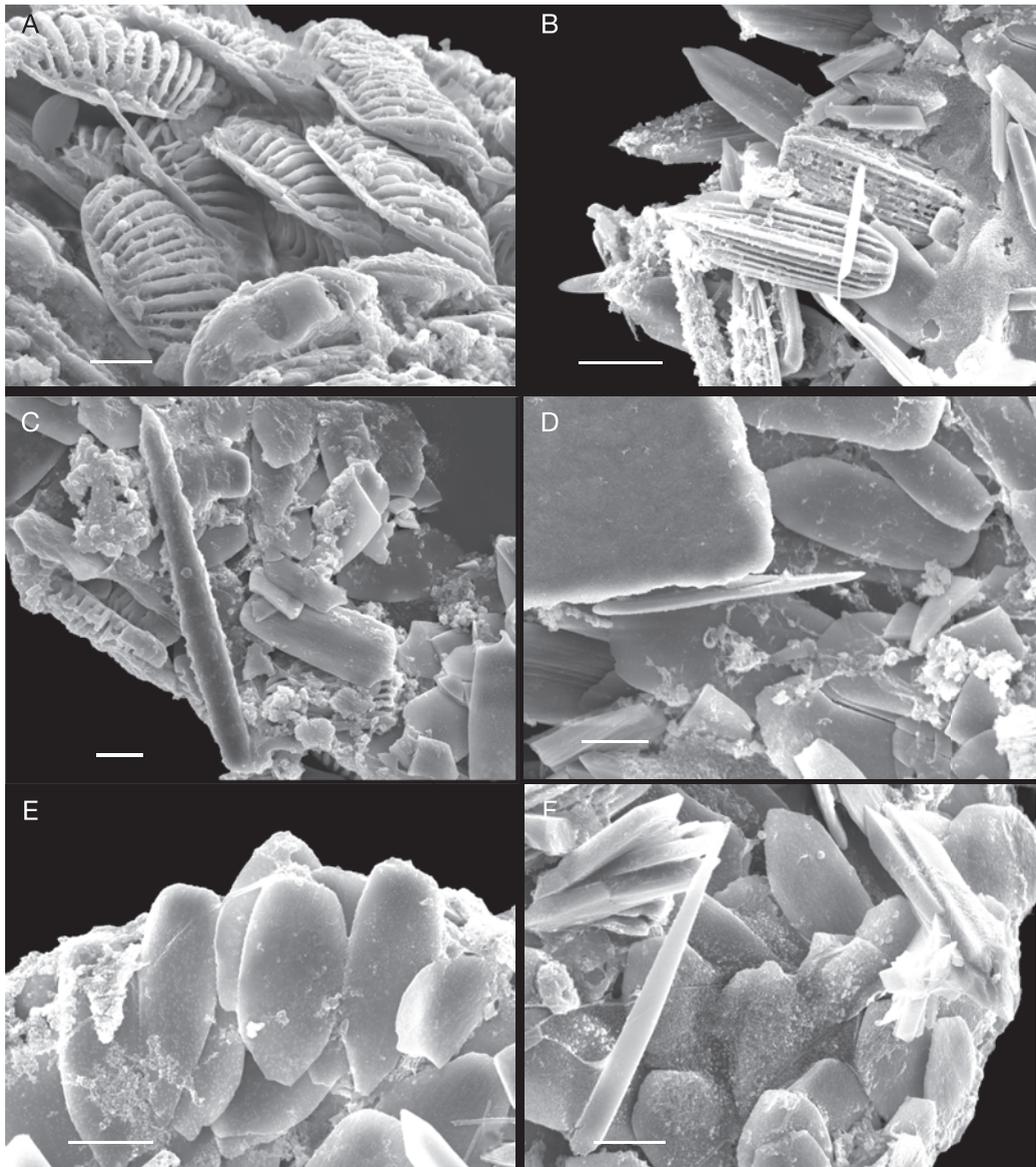


FIG. 4. — *Leptochiton hiriensis* n. sp., Rapa Island, RAPA 2002: **A**, holotype, stn 9, 5.5 mm, dorsal girdle scales, next to the suture; **B-F**, specimen, stn 30, 1.2 mm; **B**, ribbed marginal scales; **C**, dorsal girdle needle; **D**, **F**, marginal girdle needle, among ventral girdle scales; **E**, ventral girdle scales. Scale bars: A, C-F, 10  $\mu$ m; B, 20  $\mu$ m.

Family CHITONIDAE Rafinesque, 1815

Genus *Chiton* Linnaeus, 1758

TYPE SPECIES. — *Chiton tuberculatus* Linnaeus, 1758,

by subsequent designation (Dall 1879).

DISTRIBUTION. — Members of the genus are distributed worldwide, mainly in tropical waters, Cretaceous–Recent.

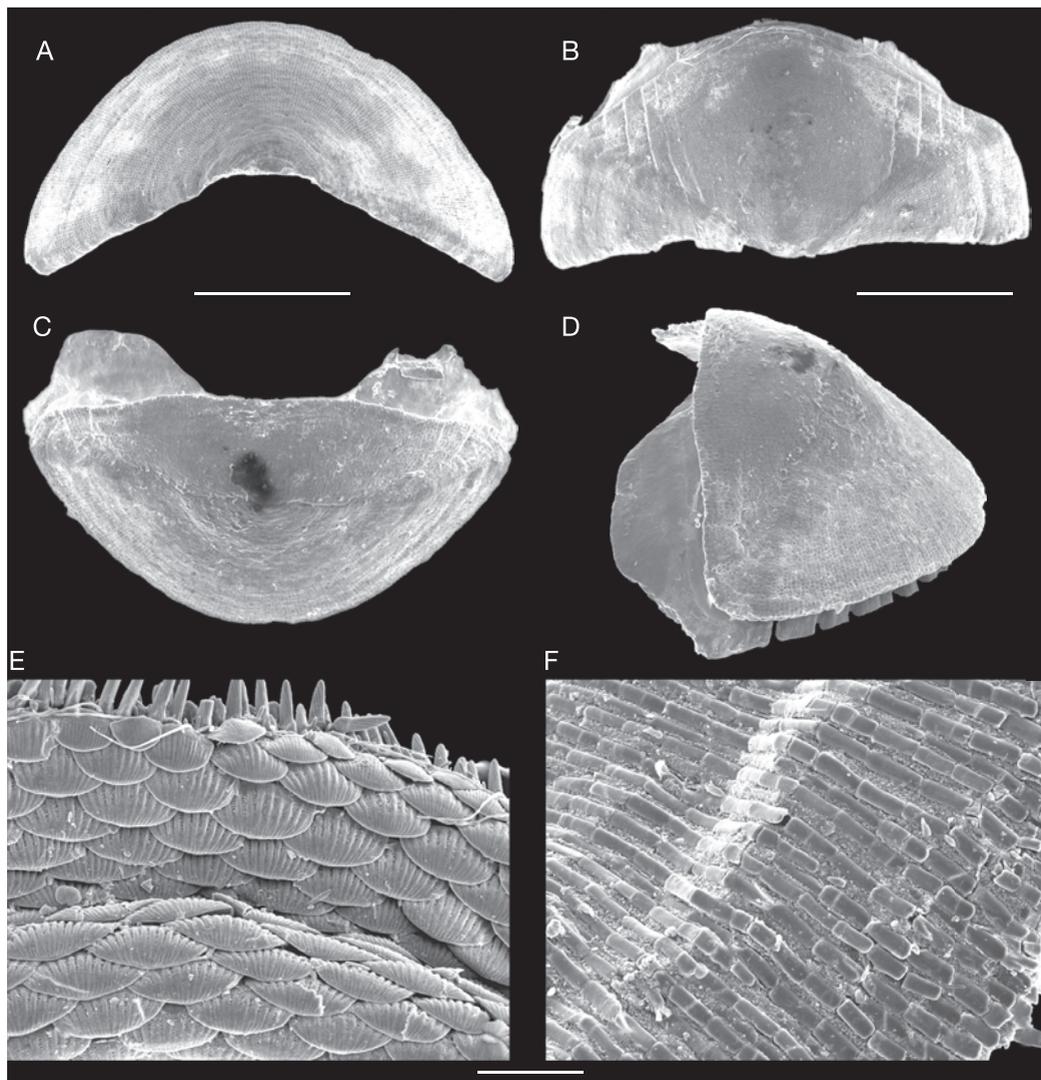


FIG. 5. — *Chiton (Rhyssoplax) rapaitiensis* n. sp., holotype, Rapa Island, RAPA 2002, stn 10, 4.7 mm: **A**, head valve, dorsal view; **B**, valve ii, dorsal view; **C**, tail valve, dorsal view; **D**, tail valve, lateral view; **E**, dorsal girdle scales and marginal elements; **F**, ventral girdle scales. Scale bars: A-D, 400  $\mu$ m; E, F, 80  $\mu$ m.

#### Subgenus *Rhyssoplax* Thiele, 1893

TYPE SPECIES. — *Chiton affinis* Issel, 1869, by subsequent designation (Thiele 1909). Members of the subgenus are distributed in the Indo-Pacific (except of the East Pacific) and East Atlantic, Oligocene-Recent.

#### *Chiton (Rhyssoplax) rapaitiensis* n. sp. (Figs 5-7; 10C, D)

TYPE MATERIAL. — Holotype: type locality, pd (MNHN). Paratypes: type locality and stns 25 and 30, 47 paratypes (MNHN). — Stns 25 and 30, 2 paratypes (ZSM).

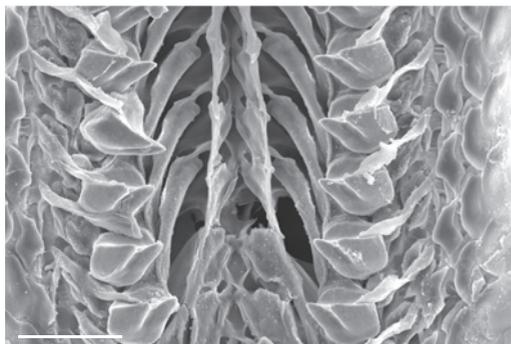


FIG. 6. — *Chiton (Rhyssoplax) rapaitiensis* n. sp., holotype, Rapa Island, RAPA 2002, stn 10, radula, anterior part. Scale bar: 500  $\mu$ m.

**TYPE LOCALITY.** — French Polynesia, archipel des Australes, Rapa, Pointe Komiré, RAPA 2002, stn 10, 27°34.8'S, 144°22.8'W, 16–18 m.

**ETYMOLOGY.** — From Rapa Iti (little Rapa), one of the Polynesian names of Rapa, as opposed to Rapa Nui (big Rapa) applied to Easter Island.

**MATERIAL EXAMINED.** — A total of 228 specimens (16 lots).

**French Polynesia.** Rapa Island, Baie de Hiri, 27°37.3'S, 144°22.2'W, RAPA 2002, stn 9, 3–24 m, corals, 44 spms. — Pointe Komiré, 27°34.8'S, 144°22.8'W, RAPA 2002, stn 10, 16–18 m, boulders covered by brown algae, 1 spm (MNHN) (Figs 5; 6). — W of Pointe Aukura, 27°38.1'S, 144°21.1'W, RAPA 2002, stn 15, 20 m, boulders on sand bottom, 1 spm. — W of Tauna islet, 27°36.3'S, 144°18.4'W, RAPA 2002, stn 16, 5 m, dead corals, 67 spms. — E of Baie Tupuaki, 27°34.2'S, 144°20.6'W, RAPA 2002, stn 21, 5 m, sand bottom associated with dead corals, 11 spms. — Baie Anatakuri Nako (N of Rapa Iti islet), 27°38.4'S, 144°18.9'W, RAPA 2002, stn 25, 3 m, 42 spms. — SW of Pointe Gotenaonao, 27°38.7'S, 144°19.2'W, RAPA 2002, stn 27, 6 m, boulders covered by algae, 1 spm. — Pointe Taekateke, 27°38.4'S, 144°20.6'W, RAPA 2002, stn 28, 30 m, boulders covered by algae, 3 spms. — N of Aturapa islet, 27°34.3'S, 144°21.0'W, RAPA 2002, stn 29, 2–4 m, dead corals, 30 spms. — Pointe Mei, 27°38.2'S, 144°18.2'W, RAPA 2002, stn 30, 16–20 m, dead corals, 7 spms. — Entrance of submarine cave, SE of Pointe Tematatu, 27°34.8'S, 144°19.0'W, RAPA 2002, stn 35, 2 m, stones, 2 spms. — West of Area, 27°36.8'S, 144°19.9'W, RAPA 2002, stn 52, 23–25 m, mud bottom associated with corals, 2 spms. — Far end of Baie de Haurei, 27°36.6'S, 144°20.5'W, RAPA 2002, stn 62, 20 m, mud bottom associated with corals, 2 spms. — Baie Tupuaki, Pointe Kotuaie, 27°34.6'S, 144°20.6'W, RAPA 2002, stn 93, intertidal zone, 2 spms. — Pointe Komire, 27°34.8'S, 144°22.8'W, RAPA 2002, stn 98, 16–18 m, 3 spms.

**HABITAT.** — The species was found on stones from the intertidal zone down to 30 m depth, with a preference for the upper zone (2–5 m).

**DIAGNOSIS.** — Animal elongate oval, moderately highly elevated, with a subcarinated back. Coloration highly variable. Tegmentum surface smooth, appearing pitted to the naked eye. Pleural and antemucronal areas with very faint longitudinal grooves, which occur from diagonal ridge towards the anterior valve margin. Growth marks present, distinctly elevated. Mucro situated centrally.

Dorsal girdle scales imbricated, sculptured with 11–14 rather coarse longitudinal ribs. Ventrally with rectangular, smooth scales. Radula with a bidentate head of the major lateral tooth.

Ctenidia arranged holobranchially and adanally.

#### DESCRIPTION

**Holotype (pd)** 4.7 × 3.2 mm, elongate oval. Head valve semicircular, posterior margin widely V-shaped, unnotched in centre. Intermediate valves broadly rectangular, posterior margin straight, on either side of the slightly protruding apex. Lateral areas clearly elevated. Jugal area not defined. Tail valve semicircular, anterior margin straight, mucro central, slightly elevated. Postmucronal area straight, moderately steep.

Tegmentum smooth, with microscopic perforations. Comarginal growth marks on terminal valves and lateral areas. Pleural areas with four or five fine, longitudinal ribs, reaching from diagonal ridges to anterior valve margin. Antemucronal area with only two of these ribs. Lateral areas, head valve and postmucronal area sculpturless, except for growth marks.

Articulamentum rather thin, with short triangular apophyses on valve ii and large trapezoid on tail valve. Insertion plates short, with deep slits. Slit formula: 9 (2 undeveloped close to posterior margin)/1–1/11. Slit rays present in all valves. Insertion teeth broad, with pectinate sharpened outer edges.

Perinotum dorsally covered with imbricate, elongate, convex scales, each measuring 84.2–100 × 42–52.6  $\mu$ m (Fig. 5 E). They are sculptured with 10–12 convex, rather flat, radial ribs, the distal end of which is less distinctly ribbed than the proximal end. Ventral girdle scales elongate-rectangular, 30.4–39 × 13  $\mu$ m in size (Fig. 5 F). Girdle margin with short, straight needles, which measure 47.4–52.6 × 15.8  $\mu$ m, and are distorted distally.

Radula of holotype (Fig. 6) c. 1.5 mm long, with 42 teeth rows, of which 33 are mineralized. The

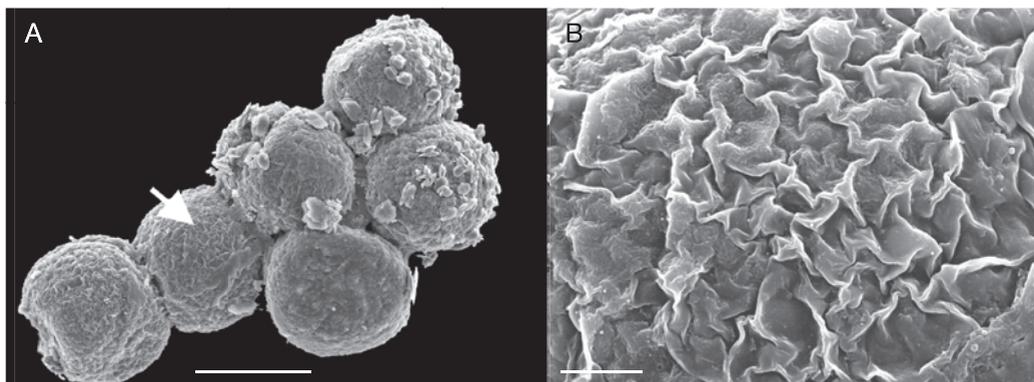


FIG. 7. — *Chiton (Rhyssoplax) rapaitiensis* n. sp., paratype, Rapa Island, RAPA 2002, stn 25, 2.7 mm: **A**, cluster of eggs, HMDS dried, from the right mantle cavity side; **B**, dorsal surface of an egg (marked by an arrow in A). Scale bars: A, 100  $\mu$ m; B, 10  $\mu$ m.

central tooth is relatively short (214.3  $\mu$ m), tulip-shaped, with a single, slightly inward-directed blade. The first lateral tooth has a slender upper half and a roundish wide extension on the basal half. The second lateral has a long (643  $\mu$ m), slender, and slightly keeled shaft. The head of the second lateral is nearly square and has two strong denticles, of which the inner is the longer. Major uncinial tooth spoon-like and 476  $\mu$ m long.

Ctenidia of holotype arranged holobranchially and adanally, 18 on the left and 17 on the right side.

#### REMARKS

In one specimen from stn 25, eggs were found in the mantle cavity (Fig. 10D). According to Strack (1987: 184, 185), the only other Pacific species of this subgenus that broods its eggs is *C. (R.) linsleyi* (Burghardt, 1973) (as *C. (R.) perviridis* Carpenter, 1865 – which Bullock 1988 [pp. 688-689] has shown is a distinct species). The larger size (up to 16 mm) and the distinctive tegmentum sculpture, namely the large number (up to 15) of longitudinal grooves in the central areas, the grooved lateral areas, head valve and tail valve, and smooth girdle scales differentiate *C. (R.) linsleyi* from *Chiton (Rhyssoplax) rapaitiensis* n. sp.

The new species is close to *C. (R.) rhynchotus* (de Rochebrune, 1884) from New Caledonia. The latter is up to 16 mm long, has up to 12 ribs in the pleural areas, has dorsal girdle scales with up to 21

broad, close-packed ribs, and has insertion plates that appear smooth. The Indian Ocean species *C. (R.) maldivensis* (E. A. Smith in Gardiner, 1903) is also similar, but is 3-4 times larger, the pleural areas are sculptured with up to 12 rather wide and deep grooves, which do not reach the anterior valve margin, and has dorsal girdle scales with up to 20 mostly very faint grooves.

#### Genus *Onithochiton* Gray, 1847

TYPE SPECIES. — *Chiton undulatus* Quoy & Gaimard, 1835, by subsequent designation (Gray 1847) (*non Chiton undulatus* G. Fischer, 1807) = *Onithochiton neglectus* de Rochebrune, 1881, replacement name after Iredale (1914).

DISTRIBUTION. — Members of the genus are distributed in the Indo-Pacific (except of the East Pacific), Pleistocene-Recent.

#### *Onithochiton lyellii*

(Sowerby in Broderip & Sowerby, 1832)  
(Figs 8; 9; 10B)

*Chiton lyellii* Sowerby in Broderip & Sowerby, 1832: 26. — Sowerby 1833: fig. 7, p. 5 species n° 60. — Reeve 1847: pl. 3, fig. and species 12.

*Onithochiton lyelli* [sic] – Nierstrasz 1905a: 106. — Ashby 1922: 582. — Dautzenberg & Bouge 1933: 419. — Berghayn 1933: 34. — Leloup 1974: 7.

*Onithochiton* (*Chiton*) *lyellii* – Ashby 1924: 333 (partly).

*Anisochiton* (*Enoplochiton* [section *Ornithochiton* (*sic*)] *lyellii* – Fischer 1885: 882.

*Onithochiton* cf. *lyellii* – Salvat & Rives 1975: 187, text fig.

*Onithochiton lyellii* – Adams & Angas 1858: 476. — Tryon 1883: 345, pl. 86, fig. 82. — Pilsbry 1893: 247, 248 (partly), pl. 55, figs 1-7. — Cox 1894: 710. — Iredale 1911: 105. — Leloup 1981: 4 (partly). — Kaas & Van Belle 1980: 78; 1998: 115. — Strack 1993: 22, pl. 5, fig. 3 (lectotype designated and figured). — Slieker 2000: 96, pl. 36, fig. 25 (lectotype figured). — Gowlett-Holmes 2001: 41. — Schwabe 2004: 3160.

*Chiton* (*Onithochiton*) *lyellii* (*sic*) – Chenu 1859: 382, fig. 2874 (7-valved). — Clessin 1903: 48, pl. 17, fig. 7.

*Chiton* (*Onitochiton* [*sic*]) *lyellii* (*sic*) – Couturier 1907: 175.

?*Onithochiton* cf. *societatis* – Preece 1995: 351.

TYPE MATERIAL. — Lectotype (designated by Strack 1993: 22), 3 paralectotypes, dried (NHM 1985064).

TYPE LOCALITY. — Polynesia, Pitcairn Island; in small round hollows formed by sea urchins in exposed situations at low water mark.

MATERIAL EXAMINED. — A total of 21 specimens (5 lots).

**French Polynesia.** Rapa Island, Pointe Autea (station not numbered), 27°35.2'S, 144°18.4'W, RAPA 2002, intertidal zone, on rocks, 4 spms. — N of Pointe Pukitarava, 27°35.8'S, 144°18.5'W, RAPA 2002, stn 58, 2-3 m, sand bottom with boulders and corals, 1 spm. — Baie Ahurei (Tauna islet), 27°36.5'S, 144°18.2'W, RAPA 2002, stn 80, intertidal zone, on rocks, 7 spms. — Baie Akatanui, 27°35.9'S, 144°18.5'W, RAPA 2002, stn 81, intertidal zone, on rocks, 3 spms. — Baie Anarua, 27°36.4'S, 144°22.6'W, RAPA 2002, stn 87, intertidal zone, on rocks, 6 spms.

DISTRIBUTION. — Rapa (Salvat & Rives 1975); Rikitea, Makapou (both Gambier Islands), Pitcairn Island (Couturier 1907).

HABITAT. — *Onithochiton lyellii* is an intertidal species, inhabiting crevices and holes on solid rocks.

#### DESCRIPTION

Animal moderately large (largest specimen examined is 33 mm long), elongate-oval and surrounded by a rather thick and wide perinotum, which appears

velvety. Tegmentum coloration variable, ranging from blackish olive to bright green. Uneroded animals with a pattern of longitudinal undulated lines, and with fine brownish lines along the growth ridges. Jugal area wedge-shaped, generally white with a smaller, darker triangle within. Dorsally the animal is slightly subcarinated. Dorsal elevation of valve iv 0.38 (5.2 mm high/13.6 mm wide) in a specimen (29.7 × 15.4 mm) from Pointe Autea.

Large ocelli present in head valve, lateral areas and postmucronal area, with a diameter of 38 µm, surrounded by small apical pores with caps 14 µm in diameter. Subsidiary pores occur randomly around the other pores, with highest concentration around ocelli. Head valve semicircular with posterior margin straight and unnotched. Intermediate valves (excluding the second) wider than long with protruding apex. Second valve largest. Lateral areas slightly elevated and clearly separated from central areas by sculpture. Fine, comarginally directed, wavy growth ridges also occur along part of the diagonal ridge in the pleural areas. General tegmentum surface smooth, except for the growth ridges and pits in the jugal-pleural areas. Sculpture of lateral areas homologous with that of head valve and postmucronal area. Tail valve triangular, width more than twice length; mucro terminal, slightly elevated, forward-directed. Postmucronal slope steep and very short.

Articulamentum thick, shiny, with dark brown coloration in central area and white margins. Apophyses wide, long, triangular in valve ii to trapezoidal in tail valve, widely separated but connected by a short lamina, which shows minute teeth. Slits between them correspond to rows of transverse holes. Insertion plates rather short, with long, sharp, sawed teeth, roughly pectinate on outside. Slit formula: 8/1-1/0 (callus). Slitrays present in all valves, except for tail valve. They consist of transverse to round (innermost) holes. Callus with series of large transverse holes on its inner side. A very conspicuous thickening of the articulamentum results in two diagonal bridges.

Cuticle of perinotum thick, dorsally beset with very fine spicules (121-147.4 µm × 47-53 µm), giving the whole girdle a velvety appearance. Spicules sculptured with about nine longitudinal ribs, which are less distinct in the basal part. Among

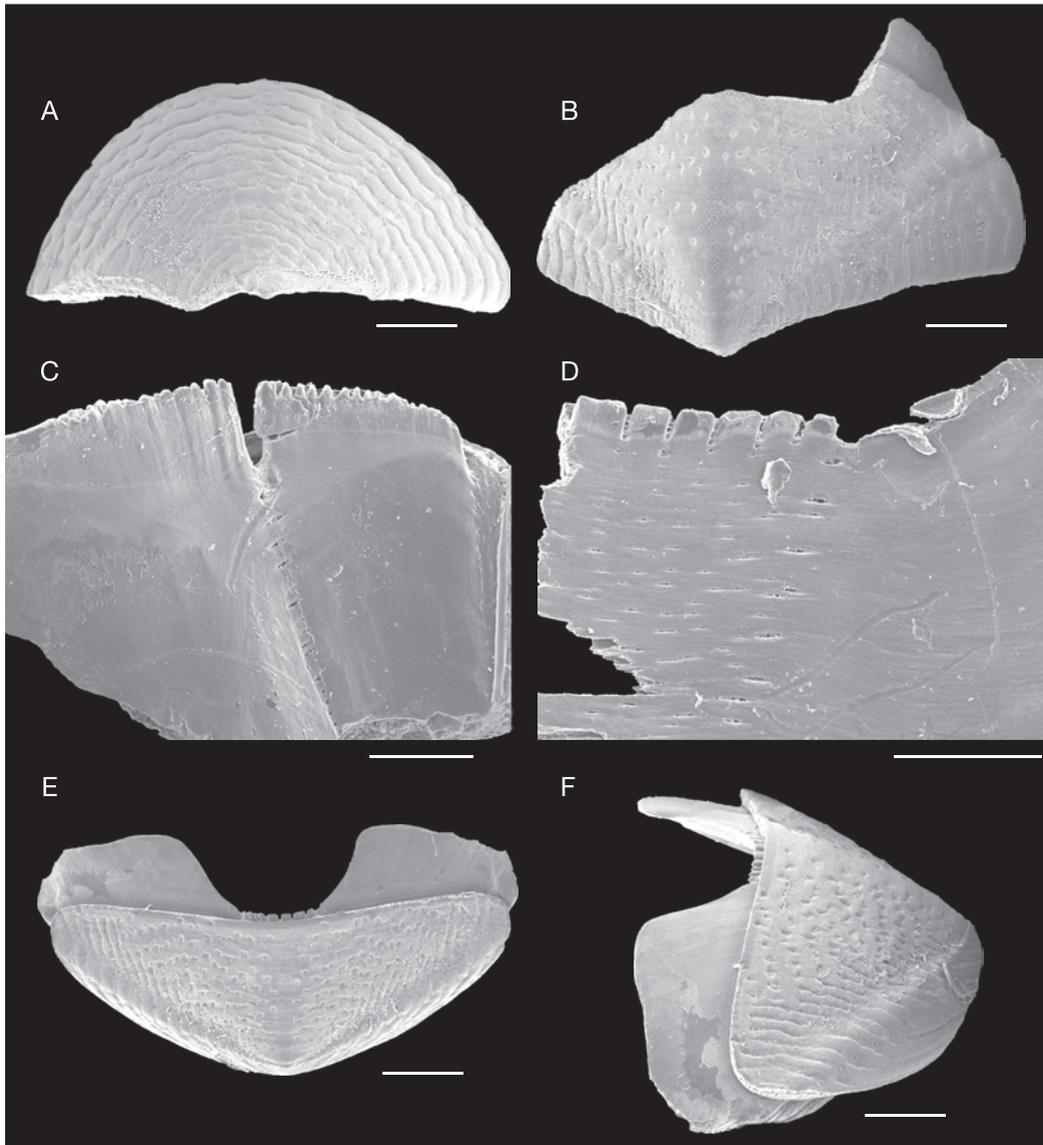


FIG. 8. — *Onithochiton lyellii* (Sowerby, 1832), specimen, Rapa Island, RAPA 2002, stn 80, 17.4 mm: **A**, head valve dorsal view; **B**, valve ii, dorsal view; **C**, valve ii, left side, ventral view, detail of slit; **D**, valve ii, detail of sutural laminae, ventral view; **E**, tail valve, dorsal view; **F**, tail valve, lateral view. Scale bars: A, B, E, F, 800  $\mu$ m; C, D, 400  $\mu$ m.

the spicules, smooth, sharp-pointed needles were found,  $95 \times 16 \mu$ m in size. Ventrally there are radial rows of squarish to rectangular scales, measuring 24-30  $\mu$ m. They are obtusely pointed and a little concave. There are about 7-10 shallow, longitudinal grooves on their visible side.

Radula of pd specimen ( $17.4 \times 10.2$  mm) consists of 48 teeth rows, 40 of them already mineralized. Central tooth slender,  $80 \times 40 \mu$ m, with a single inward-curved blade, which is slightly wider in the upper part. First lateral tooth (142  $\mu$ m long) has a thickened head with a simple edge.

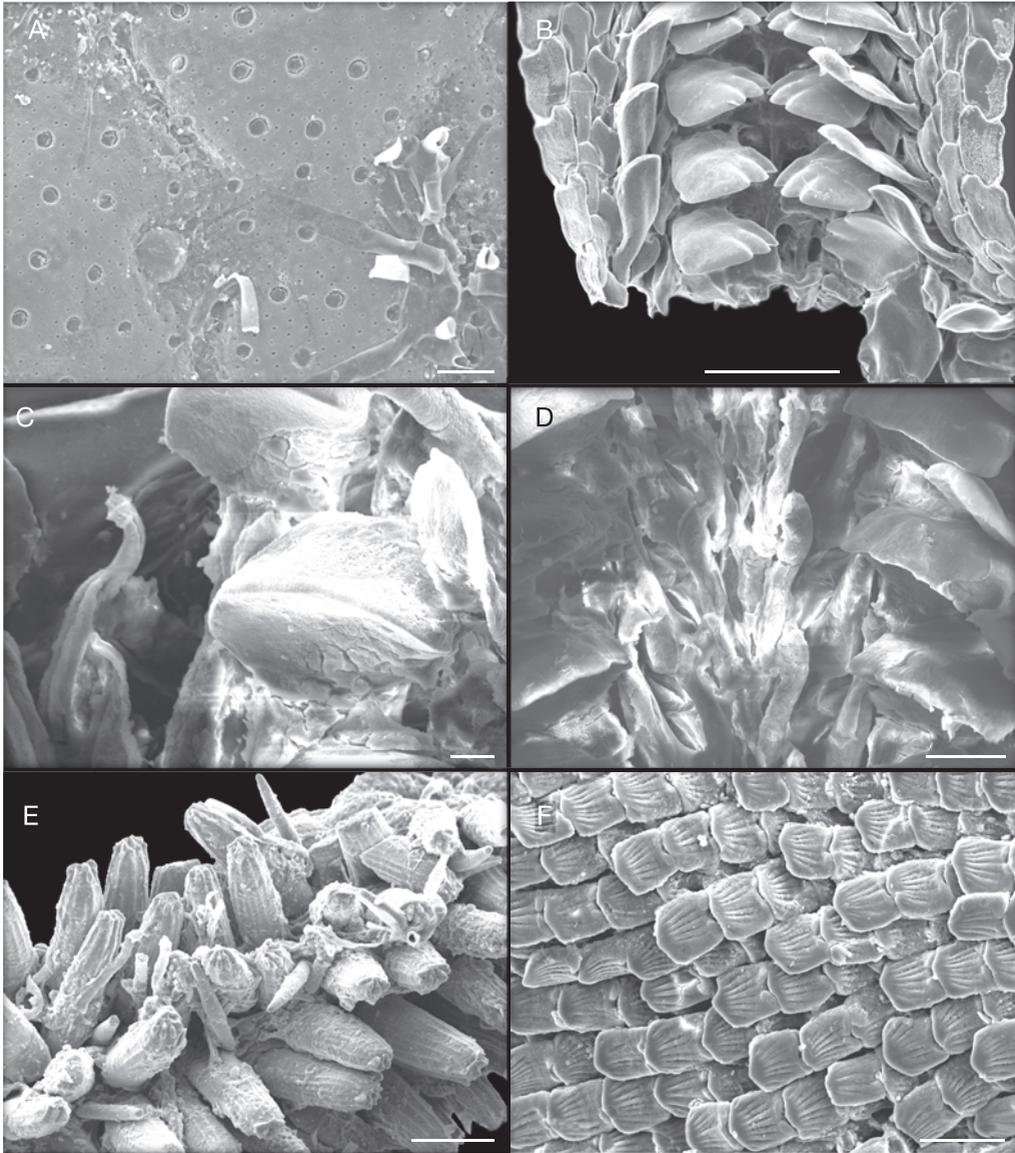


FIG. 9. — *Onithochiton lyellii* (Sowerby, 1832), specimen, Rapa Island, RAPA 2002, stn 80, 17.4 mm: **A**, detail of area lateralis, valve ii; **B**, radula, c. rows 7-10; **C**, detail of the major lateral tooth head showing a denticleless blade, second row; **D**, radula, rows 4-6; **E**, dorsal girdle elements; **F**, ventral girdle scales. Scale bars: A, F, 40  $\mu$ m; B, 100  $\mu$ m; C, 20  $\mu$ m; D, 60  $\mu$ m; E, 80  $\mu$ m.

Shaft of second lateral tooth slightly keeled, with nearly square head ( $125 \times 100 \mu\text{m}$ ). Blade simple, without denticles in the anterior part of the radula. A few rows later, cutting edges have four finger-like denticles. Innermost extremely short,

outermost triangular with a wide edge. Major uncinal tooth, 192  $\mu\text{m}$  long, spoon-like, upper part 58  $\mu\text{m}$  wide.

Thirty-seven holobranchial, adanal ctenidia both sides of the foot in the pd specimen.

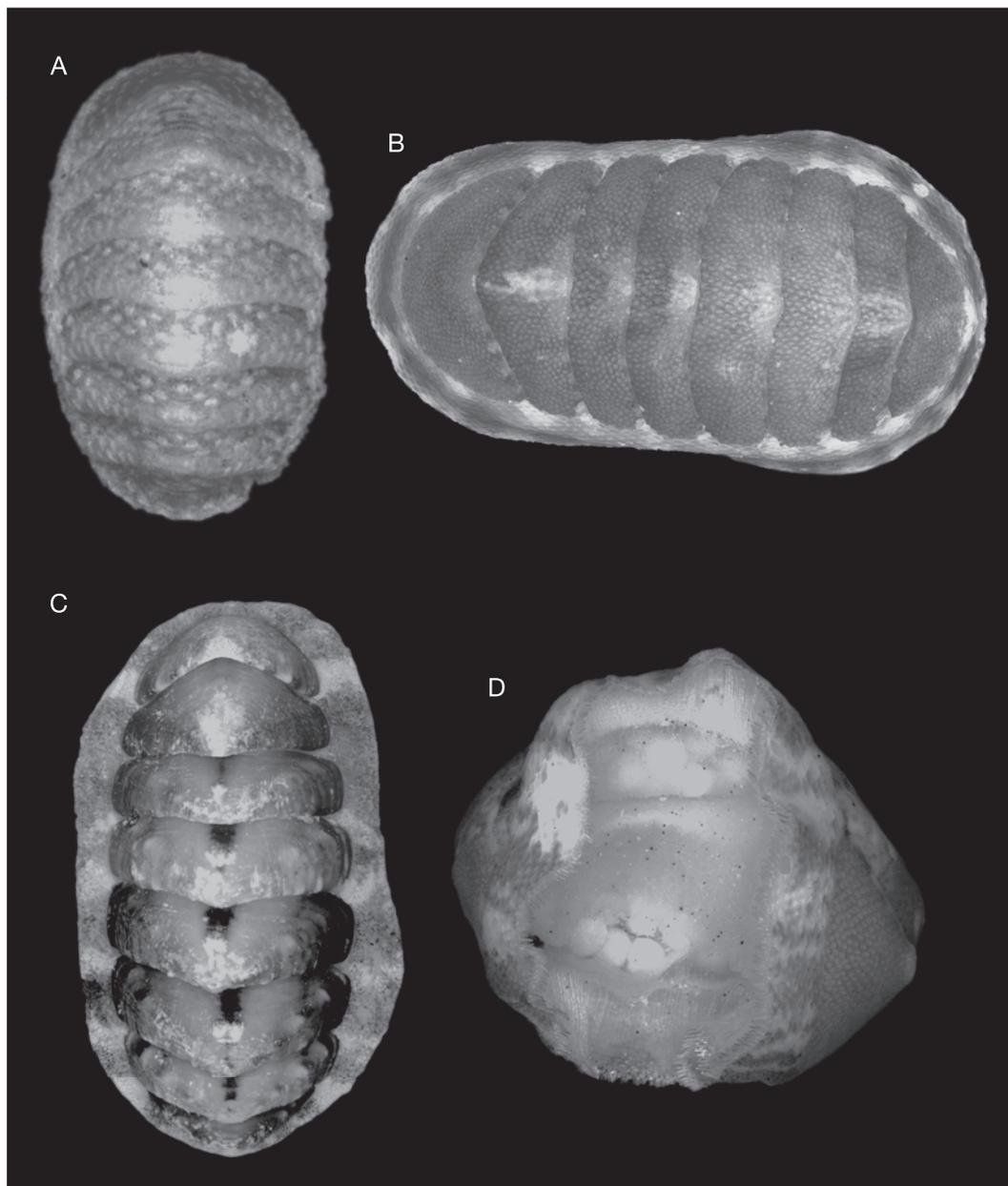


FIG. 10. — **A**, *Leptochiton hiriensis* n. sp., paratype, 1 mm, Rapa Island, RAPA 2002, stn 9, dorsal view; **B**, *Chiton (Rhyssoplax) rapaitiensis* n. sp.; **B**, specimen, 4.1 mm, Rapa Island, RAPA 2002, stn 15, dorsal view; **D**, Rapa Island, RAPA 2002, stn 25, paratype with eggs in the mantle cavity 2.7 mm, ventral view; **C**, *Onithochiton lyellii* (Sowerby, 1832), Rapa Island, RAPA 2002, stn 80, specimen, 19.2 mm, dorsal view.

#### REMARKS

Although often cited in the literature our knowledge of this species is very limited. A summary

of probable misidentifications is given herein. Iredale (1911: 104) noted that the records of *Onithochiton lyellii* from Australian waters most

TABLE 1. — Overview of the number of specimens of Polyplacophora collected per station during RAPA 2002, Rapa Island.

Station	<i>Leptochiton hiriensis</i> n. sp.	<i>Chiton rapaitiensis</i> n. sp.	<i>Onithochiton lyellii</i>	Total
Pointe Autea			4	4
9	8	44		52
10		1		1
11		10		10
15		1		1
16	13	67		80
21		11		11
25		42		42
27		1		1
28		3		3
29		30		30
30	4	7		11
35		2		2
52		2		2
58			1	1
62		2		2
80			7	7
81			3	3
87			6	6
93		2		2
98		3		3
Total	25	228	21	274

probably refer to *O. quercinus* (Gould, 1846), as he showed for the report of Pilsbry (1893: 248 partly). Following Iredale it seems logical that the records from Australia of Nierstrasz (1905b: 156, pl. 10, fig. 19), Ashby (1924: 333) and Smith (1960: 167, figs 42, 2a-c) may also refer to this species. Specimens cited from the Indonesian, Philippine and Papuan region by Nierstrasz (1905b: 156, pl. 10, fig. 19), Ang (1967: 410, pl. 10, figs 1-4), Way & Purchon (1981: 313) and Leloup (1981: 4) are probably misidentifications of a new species, which is currently under study by Hermann L. Strack (The Netherlands, pers. comm.). Ashby (1931: 50, as *O. lyalli* [sic]) pointed out that Odhner (1919: 40) misused *O. lyellii* for *O. literatus* (Krauss, 1848). After Strack (1993: 21), the specimens cited by Leloup (1960: 42, figs 7, 9-13) belong to several species and Leloup (1980: 12) misinterpreted *O. lyellii* for *O. erythraeus* Thiele, 1910. As no detailed study of its congeneric species is available, a restricted Polynesian distribution is assumed for *O. lyellii*. It would be interesting to know if the

species reported as *O. quercinus* from the Fiji Islands by Cernohorsky (1978) is correctly identified, or if it also belongs to *O. lyellii*.

## DISCUSSION

A moderately high number (274) of specimens was collected of the three species reported herein (Table 1). Table 1 shows that *Onithochiton lyellii* inhabits the intertidal zone only, whereas the other two species were found down to 24-30 m. The predominant species is *Chiton (Rhyssoplax) rapaitiensis* n. sp. It was found at nearly all stations where Polyplacophora were found, but the number of stations investigated in total is about 4 times higher. Locally it was found syntopically with *Leptochiton hiriensis* n. sp., which seems rather uncommon. *Chiton (Rhyssoplax) rapaitiensis* n. sp. is shown to be a brooding species and represents the second known species in this subgenus with this reproduction type. The two new species are known only from Rapa Island and are considered to be endemic. *Onithochiton lyellii* is for the time being considered to be restricted to Polynesia. Creese (1986) has shown that the endemic New Zealand species *Onithochiton neglectus* broods its eggs within the mantle cavity. The settlement of the trochophores occurs within a few hours and does not allow broad dispersal, as the presence of a suitable substratum (in general all kinds of hard substratum) is essential. If one infers the same larval development for *Onithochiton lyellii* and excludes a non-feeding, free-swimming larval stage, it explains why this species is restricted to Polynesia. The fact that two of the three species of Polyplacophora collected are new confirms the unique nature of the marine fauna of Rapa, suspected from previous knowledge of other molluscs. Thus, preliminary observations of the protoconchs of caenogastropods collected at Rapa show that a relatively high proportion of the species has non-planktotrophic development, indicating low dispersal abilities. Among these a large part probably consists of endemic species (Lozouet *et al.* 2004). In view of the isolated location of Rapa, the endemism found in the Polyplacophora is not surprising. At Easter

Island (Rapa Nui), where a high level of endemism is reported (42%; Rehder 1980), Dell'Angelo *et al.* (2004) reported three species of Polyplacophora, namely *Plaxiphora mercatoris* Leloup, 1936, *Rapanuia disalvoi* Dell'Angelo, Raines & Bonfitto, 2004, and *Weedingia cf. mooreana* Kaas, 1988, of which the first two are also considered endemic. This contrasts with the low level of endemism estimated in the marine molluscs of the Pitcairn Islands (about 2%) where only one polyplacophoran (*Onithochiton lyellii*) is known (Preece 1995, as *Onithochiton cf. societatis* Thiele, 1910).

Compared to the Gastropoda or Bivalvia, the Polyplacophora is a very minor class in terms of species richness, which makes it difficult to detect any clear trends in diversity. Even in some well-documented mollusc faunas the proportion of Polyplacophora is always extremely low. At Rapa (Lozouet *et al.* 2005) Polyplacophora accounted for 0.6% of species diversity; 0.6% in New Caledonia at Koumac (Bouchet *et al.* 2002), 0.3% at Enewetak Atoll (Kay & Scott 1987), 0.4% at Hawaii and 0.9% at Okinawa (Kay & Johnson 1987). Obviously, the Polyplacophora is not an appropriate group for estimating species richness gradients in the West Pacific. Indeed, more information is needed on the species richness of Polyplacophora within the Polynesian region alone (a study is in progress by the first author) before any attempt at evaluating such trends could be made.

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