

A new Neritopsidae (Mollusca, Gastropoda, Neritopsina) from French Polynesia

Pierre LOZOUET

Muséum national d'Histoire naturelle, Département Systématique et Évolution,
case postale 51, 57 rue Cuvier, F-75231 Paris cedex 05 (France)
lozouet@mnhn.fr

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ABSTRACT

Neritopsis richeri n. sp., the fourth Recent species of a group of “living fossil” molluscs, is described from the Austral Islands (French Polynesia). Most of the material was collected during the BENTHAUS cruise. This species differs from its congeners in teleoconch sculpture, which has 1 to 4 secondary cords in the interspaces between the primary cords. The spiral ribs are also weakly beaded. In addition, and in contrast to the common species *N. radula* (Linnaeus, 1758), *N. richeri* n. sp. has a multispiral protoconch that implies a planktotrophic larval development. Its relationship to *N. aqabaensis* Bandel, 2007 described from an immature specimen is difficult to assess, the sculpture of adults suspected to be *N. aqabaensis* being identical to that of *N. radula*. *Neritopsis richeri* n. sp. appears to be restricted to French Polynesia but possibly has been confused with *N. radula* in previous publications.

KEY WORDS

Mollusca,
Gastropoda,
Neritopsina,
Indo-West Pacific,
living fossils,
new species.

RÉSUMÉ

Un nouveau Neritopsidae (Mollusca, Gastropoda, Neritopsina) de Polynésie française. *Neritopsis richeri* n. sp., la quatrième espèce actuelle d'un groupe de mollusques « fossiles vivants », est décrite des îles Australes (Polynésie française). La plupart des spécimens ont été recueillis au cours de la campagne BENTHAUS. Cette espèce se distingue de ses congénères par la sculpture de la téléoconque munie de 1 à 4 cordons secondaires dans l'espace entre les cordons primaires. Les cordons primaires sont également peu perlés et de manière irrégulière. En outre, contrairement à l'espèce commune, *N. radula* (Linnaeus, 1758), *N. richeri* n. sp. possède une protoconque multispirale qui implique un développement larvaire planctotrophique. La relation avec l'espèce à *N. aqabaensis* Bandel, 2007 décrite à partir d'un spécimen immature est difficile à préciser ; la sculpture des adultes, soupçonnés par Bandel d'être *N. aqabaensis*, est décrite comme identique à celle de *N. radula*. *Neritopsis richeri* n. sp. semble être limité à la Polynésie française, mais peut avoir été confondu avec *N. radula* dans des publications antérieures.

MOTS CLÉS

Mollusca,
Gastropoda,
Neritopsina,
Indo-ouest Pacifique,
fossiles vivants,
espèce nouvelle.

INTRODUCTION

The Neritopsidae Gray, 1847 first appeared in the Middle Devonian more than 350 million years ago, and the Neritopsina can be traced since Lower Carboniferous. They decrease so drastically at the beginning of the Tertiary that the extant species are now considered to be “living fossil” molluscs (Batten 1984).

Extant Neritopsidae constitute a very small family represented by three species: *Neritopsis radula* (Linnaeus, 1758) a relatively common species throughout the Indo-West Pacific, *N. aqabaensis* Bandel, 2007 from the Red Sea and *N. atlantica* Sarasua, 1973, a rare caribbean species known only by a few empty shells (Sarasua 1973; Hoerle 1975). The genus *Neritopsis* Grateloup, 1832 is the only genus of Neritopsidae known from post-Cretaceous time. The genus first appeared in the Middle Triassic (Batten 1984). At least 100 fossil species of *Neritopsis* have been recognized: seven from the Triassic, 80 from the Jurassic and Cretaceous of the Tethyan province, 11 from the early Cenozoic and one from the Miocene (Batten 1984). Therefore, this clade flourished particularly in the Mesozoic time and proliferated on the continental shelves of the Jurassic-Cretaceous Tethys, becoming prominent gastropods of reefs and near-shore mounds. Kase & Maeda (1980) regarded *Neritopsis* as one of the most common gastropods in the Jurassic and Cretaceous periods.

A new species of Neritopsidae with a distinct type of sculpture has been recognized among the material collected during the BENTHAUS campaign in French Polynesia. Additional specimens were recognised in other MNHN collections.

Like other Pacific Ocean islands the Austral Islands all have a volcanic origin. This arc is between 19 Ma (Mangaia) and 1.2-0 Ma (Macdonald) in age. The southeastern island, Rapa, is Pliocene in age, whereas Rimatara (in the northwest) dates from middle Miocene, about 15 Ma (Brousse & Gelugne 1987). The studied area (Fig. 1) is characterised by a narrow continental shelf and very steep slopes which made sampling difficult and explain why some stations have large depth ranges (500-1200 m for CP 1965; 690-1800 m for DW 2005). Most specimens are abraded empty shells.

They cannot be considered to be *in situ*, and probably fell down-slope from shallower water. I suspect that most of these specimens are Quaternary in age (Pleistocene/Holocene).

MATERIAL AND METHODS

The BENTHAUS Expedition to the Austral Islands took place between October 28 and November 28, 2002, and was named using a combination of the words “BENTHos” and “AUstral”. It was organized by the Institut de Recherche pour le Développement (IRD formerly ORSTOM) and the MNHN.

During BENTHAUS a total of 161 stations were sampled between 50 and 1300 m depth. Of these, 20 stations yielded specimens of Neritopsidae. The material was collected by dredging (DW for Warén dredge) and trawling (CP for beam trawl, “chalut à perche” in French).

All specimens are in MNHN.

ABBREVIATIONS

MNHN Muséum national d’Histoire naturelle, Paris;
spm specimen(s);
stn station.

Coding for spiral cords on shells follows Marshall (1988) in part, where P, primary spiral cords; S, secondary spiral cords; and S', additional secondary cords. The primary cords are numbered in series from the adapical suture. The secondary spiral cords are numbered as soon as they are detectable.

SYSTEMATICS

Class GASTROPODA Gray, 1821

Order NERITOPSINA Cox & Knight, 1960

Family NERITOPSIDAE Gray, 1847

Genus *Neritopsis* Grateloup, 1832

Neritopsis Grateloup, 1832: 126, figs 1-3.

TYPE SPECIES. — *Neritopsis moniliformis* Grateloup, 1832 by monotypy. Lower Miocene of Aquitaine Basin (Aquitainian stage).

It is worth to note that the type species is *N. moniliformis* from the Miocene of southwestern France, rather than *N. radula* as was accepted in some monographs (e.g., Moore 1960).

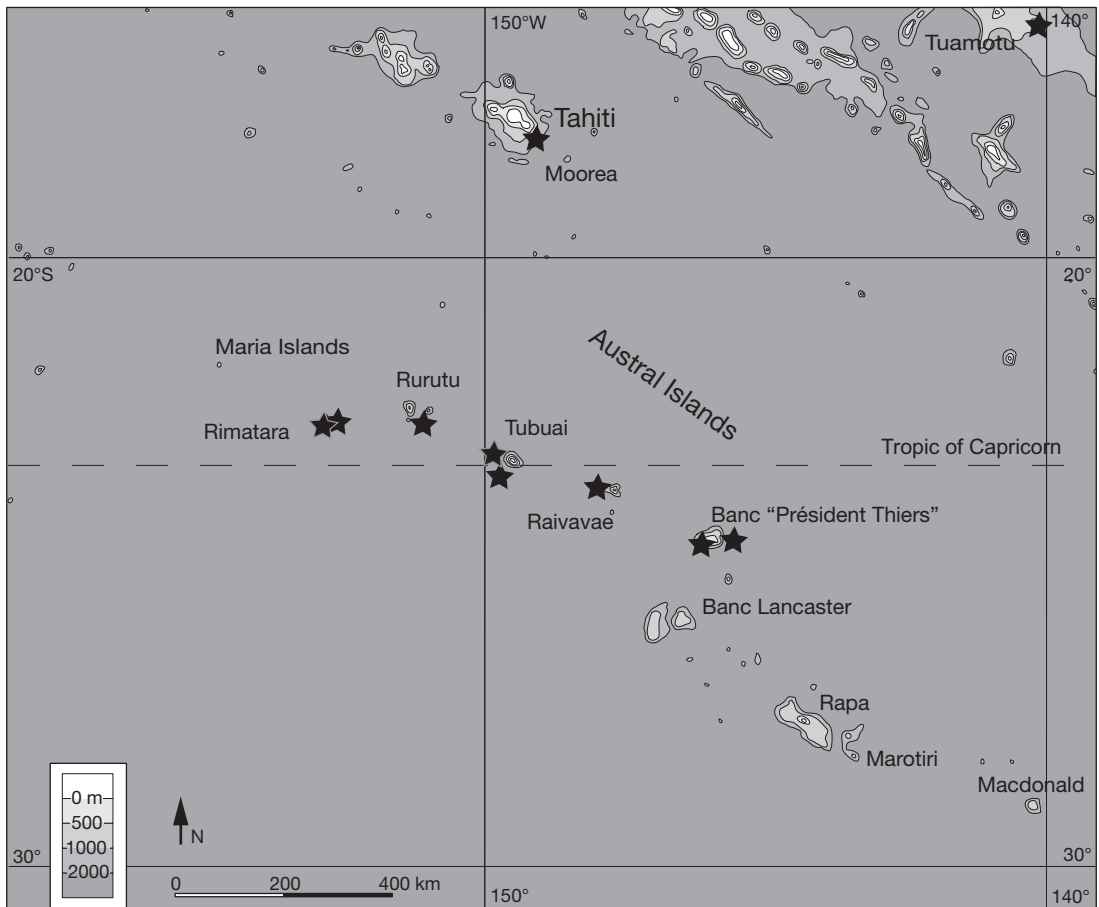


FIG. 1. — Geographic distribution of *Neritopsis richeri* n. sp. in the Austral Islands, showing the stations cited in the text (★). Courtesy of Benoît Fontaine.

REMARKS

Relationships among the *Neritopsina* are in the course of study. The slug genus *Titiscania* Bergh, 1975 which previously had an uncertain systematic position, has been included in this clade (Kano *et al.* 2002). The ecological radiation of the *Neritopsina* is remarkable. Originating from shallow water, *Neritopsina* have invaded fresh water and terrestrial environments, and live also in brackish waters and in anchialine waters (defined by Kano & Kase [2004] as “bodies of haline water with more or less extensive subterranean connections to the sea, and showing noticeable marine as well as terrestrial influences”). They have colonised deep-sea hydrothermal vents and seeps, and the *Neritopsidae* take refuge in submarine

caves. Preliminary results based on partial 28S rRNA sequence (Kano *et al.* 2002) demonstrate that the *Neritopsidae* is a very distinct, archaic clade.

Neritopsis richeri n. sp. (Figs 2; 3A-D; 4)

?*Neritopsis radula* – Salvat & Rives 1975: 262, fig. 36.
Not *N. radula* (Linnaeus, 1758).

TYPE MATERIAL. — Holotype (MNHN 21374) and 6 paratypes (MNHN 21375) from BENTHAUS stn DW 1996.

TYPE LOCALITY. — French Polynesia, Austral Islands, Rurutu (Avera).

ETYMOLOGY. — Dedicated to Bertrand Richer de Forges who has carried out French Pacific explorations for more than a quarter of a century.

MATERIAL EXAMINED. — A total of 128 specimens (23 lots): 103 specimens, from Austral Islands; 20 specimens from Marquesas; 1 specimen from Moorea; 4 specimens from Tuamotu (Takapoto).

Austral Islands. BENTHAUS, Tubuai, 23°21'S, 149°34'W, stn CP 1965, 500-1200 m, 19.XI.2002, 1 spm. — Banc "Président Thiers", 24°41'S, 146°01'W, stn DW 1932, 500-800 m, 14.XI.2002, 4 spm. — Banc "Président Thiers", 24°40'S, 146°01'W, stn DW 1933, 500-850 m, 14.XI.2002, 3 spm. — Nord de Raivavae, 23°48'S, 147°39'W, stn DW 1943, 950 m, 15.XI.2002, 2 spm. — Tubuai, 23°19'S, 149°25'W, stn DW 1953, 280-390 m, 18.XI.2002, 1 spm. — Tubuai, 23°19'S, 149°29'W, stn DW 1957, 558-1000 m, 18.XI.2002, 3 spm. — Tubuai, 23°25'S, 149°33'W, stn DW 1961, 470-800 m, 19.XI.2002, 1 spm. — Banc Arago, 23°22'S, 150°43'W, stn DW 1972, 500-1020 m, 20.XI.2002, 1 spm. — Banc Arago, 23°26'S, 150°44'W, stn DW 1985, 100 m, 21.XI.2002, 2 spm. — Rurutu, Avera, 22°29'S, 151°22'W, stn DW 1995, 212-450 m, 23.XI.2002, 2 spm. — Rurutu, Avera, 22°29'S, 151°21.9'W, stn DW 1996, 489-1050 m, 23.XI.2002, 7 spm. — East coast of Rurutu, 22°27'S, 151°19'W, stn DW 2003, 250-330 m, 24.XI.2002, 2 spm. — East coast of Rurutu, 22°28'S, 151°19'W, stn DW 2004, 430-850 m, 24.XI.2002, 4 spm. — East coast of Rurutu, 22°28'S, 151°18'W, stn DW 2005, 690-1800 m, 24.XI.2002, 3 spm. — Rimatarā, 22°28'S, 152°49'W, stn DW 2012, 270-320 m, 25.XI.2002, 2 spm. — Rimatarā, 22°39'S, 152°50'W, stn DW 2013, 80-93 m, 25.XI.2002, 6 spm. — Rimatarā, 22°38'S, 152°49'W, stn DW 2015, 250-280 m, 25.XI.2002, 6 spm. — Rimatarā, 22°37'S, 152°49'W, stn DW 2018, 770 m, 25.XI.2002, 21 spm. — Rimatarā, 22°37'S, 152°49'W, stn DW 2020, 920 m, 25.XI.2002, 19 spm. — Rimatarā, 22°36.6'S, 152°49'W, stn DW 2021, 1200 m, 25.XI.2002, 13 spm.

Marquesas Islands. MUSORSTOM 9, Hiva Oa, 9°48'S, 139°09'W, stn DW1208, 117 m, 28.VIII.1997, 20 spm.

Moorea. Tiahura, pente externe, 33 m, 1 spm.

Tuamotu. Takapoto, 1 spm, Hereheretue, 4 spm.

MEASUREMENTS (holotype). — Height 21.5 mm; maximum width 23.2 mm.

DESCRIPTION

Shell of relatively large size, heavy, globose, consisting of 3.25 convex teleoconch whorls, rapidly expanding, last whorl shouldered. Protoconch (abraded on the holotype), smooth, of at least 2 whorls delimited from teleoconch by obvious line; embryonic shell is

partially eroded. Spire protruding weakly, occupying about 22% of the total shell height. Penultimate whorl with 4 strong nodulose spiral cords with 1 or 2 subordinate cords in the interspaces. Last whorl, a little wider than high, occupying 78% of the total height; sculpture consisting of 8 prominent, nodulose, unevenly spaced, primary cords, with 1 to 4 fine secondary spiral cords in each interspaces. Surface between spiral cords bearing numerous scabrous axial costae. Irregular growth lines cover entire surface, more rugose near aperture than elsewhere. Aperture subcircular; outer lip strongly prosocline, sharp, thickened within, bearing numerous coarse lirae, with a long semilunar ridge representing inner limit of the operculum retraction. Inner lip is strongly concave, thick, bearing elongate right-angled notch at centre. Umbilicus represented by shallow depression.

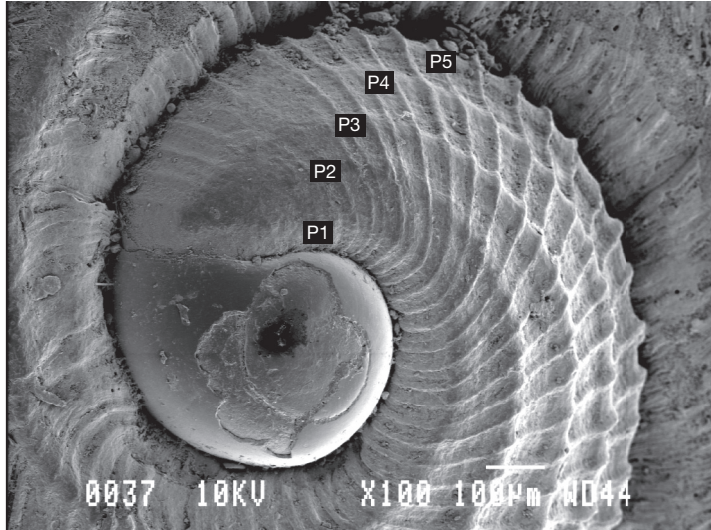
ONTOGENY OF SPIRAL CORDS (Fig. 2)

Relatively prominent, oblique axial costae commence at the beginning of the teleoconch and cross primary cords, forming regular square meshwork on the first 0.75 whorl. After 1 whorl, axial costae broader, scabrous, restricted to the interspaces between spiral cords. Four primary spiral cords detectable after 0.25 whorl (P1, P2, P3, P4), then P5, P6 detectable after 1.5 whorl. Secondary cords (S1-S3) detectable only after the first whorl: S1 between P3 and P4, S2 between P4 and P5, S3 between P2 and P3. After 1.5 whorl: S4 added between P1 and P2, S6 and S5 added between suture and P1. After 1.7 whorl, additional secondary cords (S1', S2', S3') detectable, forming double row of spiral cords between primary cords.

COMPARISON

The calcareous operculum of *Neritopsis* were described since long time from fossil deposits. For instance Eudes-Deslongchamps & Eudes-Deslongchamps (1858) described some opercula of *Neritopsis* from Jurassic deposits as new genus *Peltarion* Deslongchamps & Deslongchamps, 1858. Living specimens of *Neritopsis radula* were collected in abundance only recently. The operculum of *N. moniliformis* has not been described previously, it is illustrated here for the first time (Fig. 5). Batten (1984) considered that

A



B

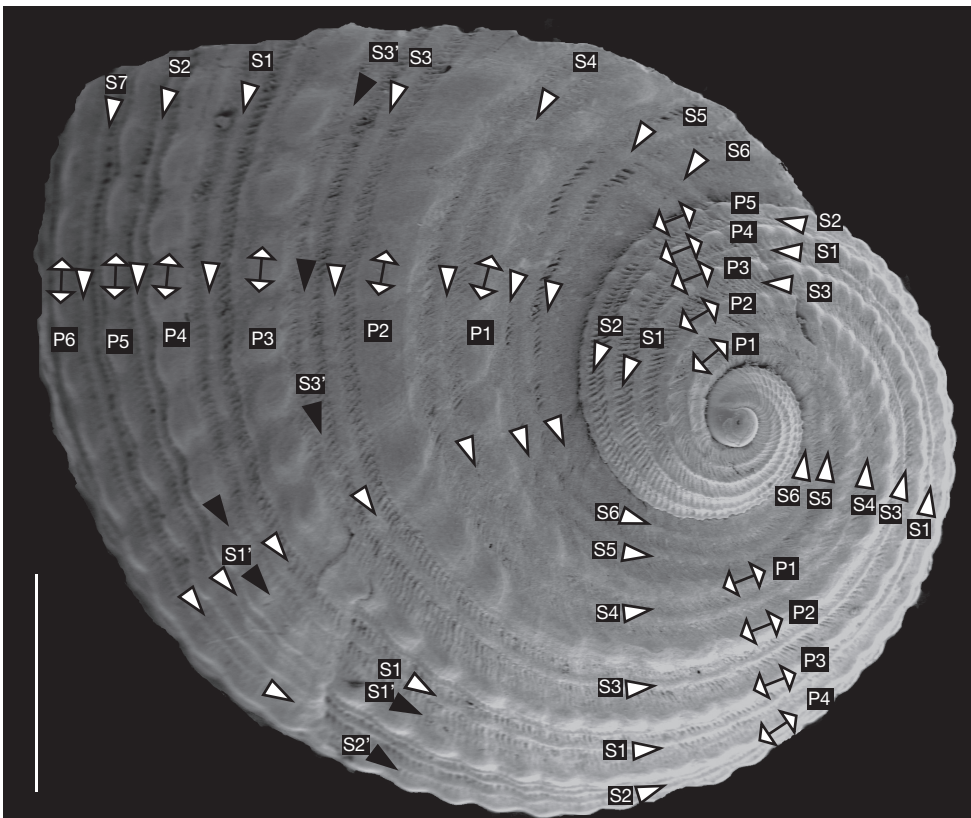


FIG. 2. — *Neritopsis richeri* n. sp., paratype MNHN 21375, BENTHAUS stn DW 1993, maximum width 8.8 mm: **A**, protoconch; **B**, ontogeny of sculpture on teleoconch whorls. Scale bars: A, 200 µm; B, 2 mm.

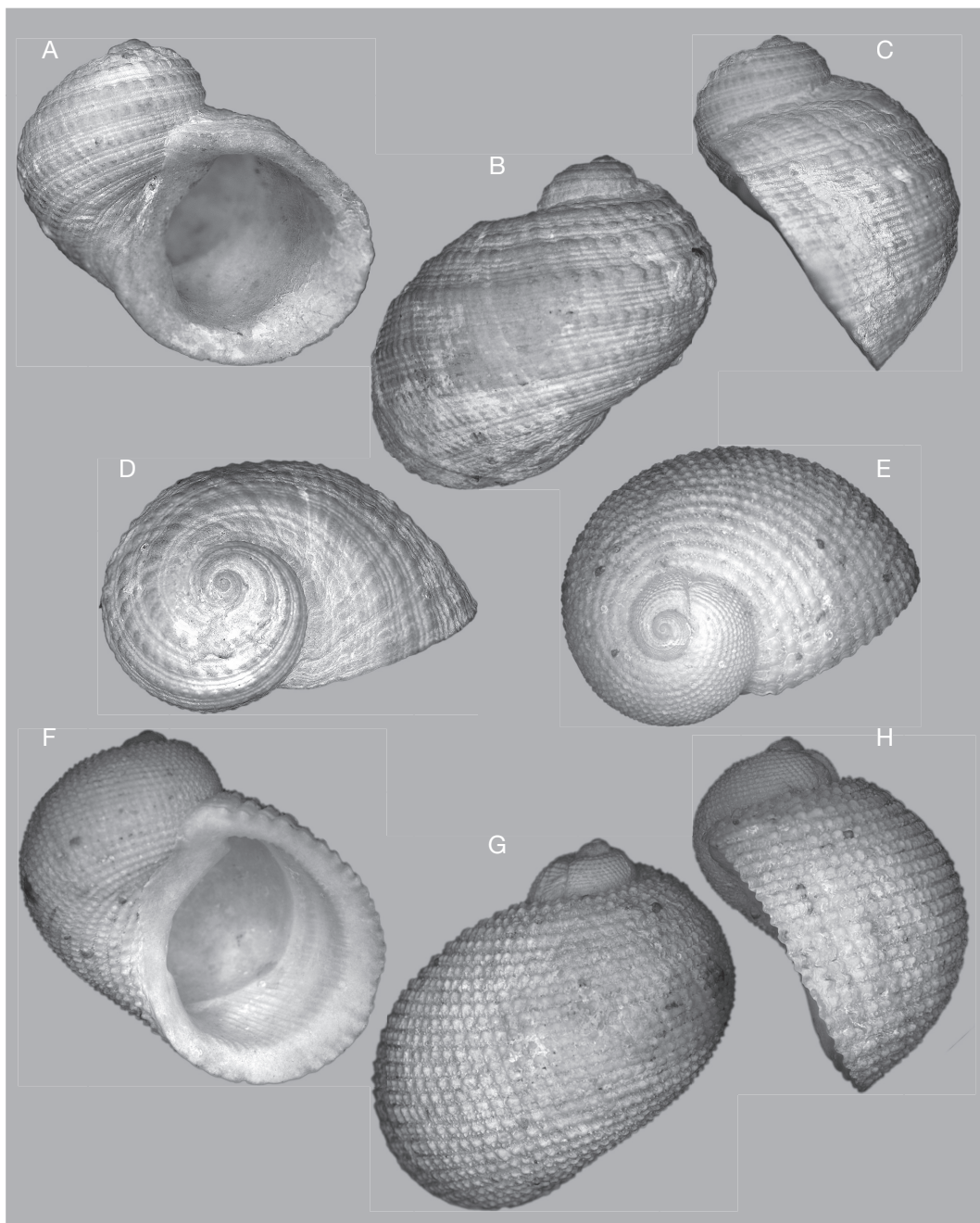


FIG. 3. — **A-D**, *Neritopsis richeri* n. sp., holotype MNHN 21374, BENTHAUS stn DW 1993, maximum width 23.2 mm; **E-H**, *N. radula* (Linnaeus, 1758), specimen from New Caledonia, Touho, Montrouzier expedition stn 1272 (10 m), maximum width 29 mm.

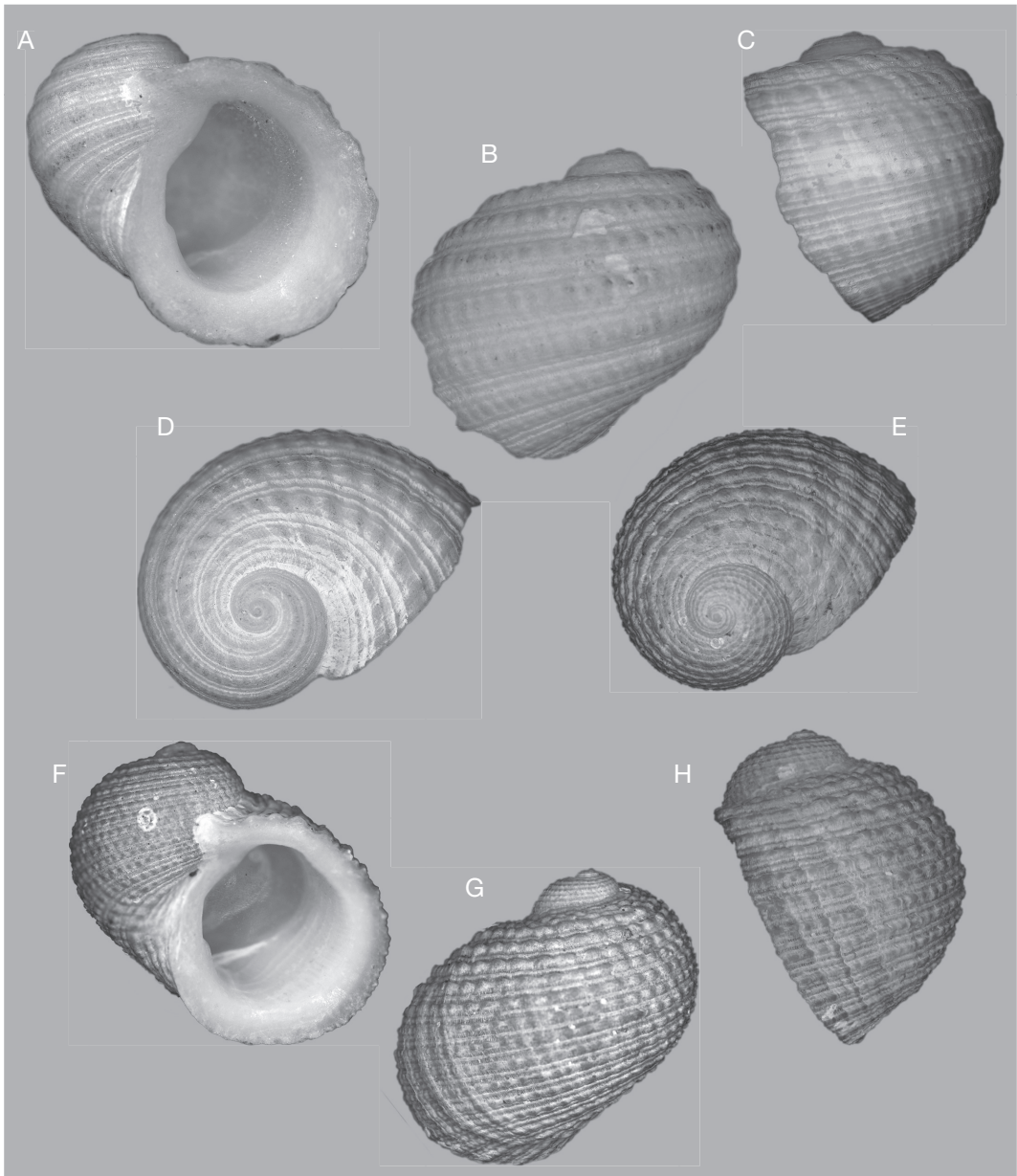


FIG. 4. — *Neritopsis richeri* n. sp.: **A-D**, paratype MNHN 21375, BENTHAUS stn DW 1993, maximum width 12 mm; **E-H**, specimen from Marquesas Islands, Hiva Ova, MUSORSTOM 9, stn DW 1208, maximum width 13.8 mm.

Neritopsis radula occurred since Eocene time in the Paris Basin and was present in Miocene rocks of the Paratethys but, in fact, the Paris Basin species is *N. parisiensis* Deshayes, 1864 and the Paratethys

species is closer to *N. moniliformis*, a species that ranges from lower Oligocene to lower Miocene in the Aquitaine Basin (Lozouet & Maestrati 1982). However, it is clear that these three species are

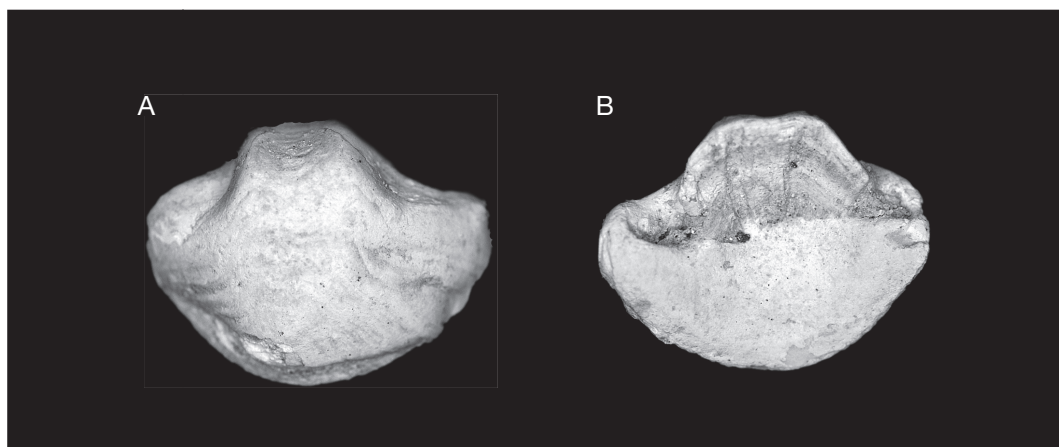


FIG. 5. — Operculum of *Neritopsis moniliformis* Grateloup, 1832, type species of the genus, from the upper Oligocene of France (Aquitaine Basin), Peyrehorade, showing the outer (A) and the inner (B) surfaces; width 7.7 mm.

closely related and can be included in the *Neritopsis radula* species group.

All specimens were collected dead, and hence lacked the unusual trapezoidal calcareous operculum (Fig. 5). *Neritopsis* specimens collected in the Marquesas (Fig. 4E-H), Tuamotu and Moorea have a multispiral protoconch, but have only one secondary spiral cord in the interspaces between the primary cords; the primary cords are also beaded. Compared with the Austral Islands population, they are also smaller and have a narrower sutural ramp. These specimens are only tentatively included in *N. richeri* n. sp.

Neritopsis richeri n. sp. from the Austral Islands is highly distinctive in having one to four secondary spiral cords in each interspaces between the primary cords and so is readily distinguished from all other *Neritopsis* species known since Oligocene time (35 Ma): the recent species *Neritopsis radula*, *N. aqabaensis* and *N. atlantica*, the European fossils *N. moniliformis* (lower Oligocene to lower Miocene), *N. vokesorum* Hoerle, 1972 (lower Miocene of Florida, Hoerle 1972) and *N. cf. moniliformis* (middle Miocene of Europe). Moreover, the New World *Neritopsis* are umbilicate (a slight umbilicus in the Florida species, a deep, narrow umbilicus in *N. atlantica*) whereas the others are not. Superficially, *N. richeri* n. sp. resembles some Cretaceous species of the genus *Hayamia* Kase, 1980 (see

Kase & Maeda 1980: pl. 35 fig. 9a, b). Among others differential characters, *Neritopsis richeri* n. sp. has a sutural ramp defined by a shoulder angle and a multispiral protoconch. The Indo-Pacific species *N. radula* has a paucispiral protoconch (Kano & Kase 2000: fig. 13) and a non-planktotrophic development can be inferred from its protoconch morphology (Kano 2006). Despite this, *N. radula* has a wide distribution in the Indo-West Pacific realm (from Japan, Okinawa to New Caledonia and Red Sea). In contrast, *Neritopsis richeri* n. sp. with a multispiral protoconch indicating planktotrophic development, with a high dispersal ability, apparently has a geographical distribution restricted to French Polynesia. I suspect that this is probably an artefact resulting from confusion in the literature between *N. richeri* n. sp. and *N. radula*. Indeed, Bandel & Frýda (1999) figured from Mauritius (Indian Ocean), under the name *Neritopsis radula*, a species that has a multispiral protoconch which may be close to *N. richeri* n. sp. Careful examination of all material identified as *N. radula* is required before we can exclude the possibility that *N. richeri* n. sp. extends from Polynesia to the Indian Ocean.

The relationship with *Neritopsis aqabaensis* from the Gulf of Aqaba (northern Red Sea) is more questionable. The protoconch of *N. aqabaensis* has two whorls (Bandel 2007) similar to that of *N. richeri* n. sp., but the embryonic shell is sculptured with

growth lines. Despite partially eroded embryonic and larval shells, the protoconch of *N. richeri* n. sp. appears clearly to be smooth and is regarded as a multispiral protoconch of the planktotrophic type (Kano 2006: figs A, D). Moreover, *N. aqabaensis* was described from a juvenile specimen with only a half whorl of teleoconch, and the adult shells collected in the same locality were indicated by Bandel (2007) as identical to *Neritopsis radula*. It is unclear whether they belong to one or the other species. Bandel (2007) did not mention the very characteristic secondary cords present in *N. richeri* n. sp.

DISCUSSION

Neritopsis radula, a species with non-planktotrophic development, was considered for a long time to be the sole Recent species of the family. The Recent Caribbean species was only described in 1973 and *N. aqabaensis* in 2007. Curiously, *N. aqabaensis* and *N. richeri* n. sp., the third and fourth Recent species to be described, respectively restricted to the Red Sea and French Polynesia, probably have planktotrophic larval development, implying a wide distribution in the Indo-West Pacific. Records of *Neritopsis* species in the Indo-West Pacific are not uncommon, but only empty shells are usually collected. The ecology of the Recent species, only recently clarified (Kase & Hayami 1992), explains this fact: *Neritopsis radula* inhabits cryptic environment. It has been recorded from marine caves on reef slopes in shallow water but is also found deeply embedded in coral rubble (Beesley *et al.* 1998).

The cause of the decline and inferred ecological shift of *Neritopsis* remains obscure. When did the group of *Neritopsis radula* take refuge on cryptic and submarine cave environment? The first answer is provided by the Tertiary species. *Neritopsis moniliformis* was recorded in upper Oligocene deposits in assemblages representing a submarine cave fauna (Lozouet 2004). In contrast, the Eocene *N. parisiensis* is very common in calcareous shallow-water facies (Le Renard pers. comm.) in the Lutetian (middle Eocene) of Normandy, France. The assemblage where it occurs comprises many groups that inhabit algae and sea grasses. There is no evidence that it inhabited

cryptic environments. In contrast with the previous discussion, we can only note the great extension of calcareous shelves of the Mesozoic Tethys (Jurassic, Lower Cretaceous) including numerous reefs, and the lesser development of these environments during the Tertiary. Therefore, we cannot rule out the possibility that a global environment shift was partly responsible for the decline of Neritopsidae.

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