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A NEW EARLY DANIAN GASTROPOD ASSEMBLAGE FROM NORTHERN PATAGONIA, RÍO NEGRO PROVINCE, ARGENTINA

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ABSTRACT—A new early Danian gastropod assemblage contained in the Roca Formation of Río Negro Province was analyzed. Eleven species are described and illustrated, the new genus *Rocalaria* is created, and six new species are recognized: *Gyroscala daniana*, *Heteroterma carmeloi*, *Microfulgur concheyroae*, *Sulcobuccinum prominentum*, *Cidarina lenzaniyeuensis*, and *Rocalaria alani*. The present research includes the first mention of *Sulcobuccinum* d'Orbigny, 1850, *Priscoficus* Conrad, 1866, *Cavoscala* Whitfield, 1892, *Microfulgur* Finlay and Marwick, 1937, and *Cidarina* Dall, 1909, for the Danian of Southern South America; the new record of *Austrophaera* Furque and Camacho, 1949, *Fusinus* Rafinesque, 1815 and *Heteroterma* Gabb, 1869 in northern Patagonia; and the oldest Paleogene record for the genus *Gyroscala* de Boury, 1887. The presence of the study assemblage in northern Patagonia indicates a more complex paleobiogeographic pattern for the area than previously thought, as shown by the record of endemic genera, cosmopolitan taxa, elements with Tethyan/ Indo-Pacific affinities, and genera related with "Wangaloan" faunas of the Paleocene of New Zealand.

INTRODUCTION

As with New Zealand, the Chatham Islands and Antarctica, Patagonia is a key area to understand the biotic changes that took place in high southern latitudes during earliest Paleocene. Its geographic situation at the southernmost tip of South America makes the Patagonian marine Danian faunas of outstanding importance. Their study contributes to the understanding of paleogeographic patterns and development of paleobiographic units at the beginning of Paleogene times for the region. Compared with recently updated revisions of the New Zealand and Antarctic Paleocene faunas (Stilwell, 2003; Stilwell et al., 2004; Beu and Raine, 2009), the gastropod assemblage of Patagonia is still poorly known, and although it has been described in old paleontological literature (Ihering, 1903, 1907; Feruglio, 1936; Furque and Camacho, 1949), only a few taxa have been revised in recent decades (Griffin and Hünicken, 1994; Zinsmeister and Griffin, 1995).

The fossil gastropods analyzed in the present paper are rather poorly preserved specimens recovered from the Roca Formation exposed in northern Patagonia (Fig. 1). Previous studies are restricted to those by Ihering (1903, 1907) who described only five species based on internal molds. The new assemblage studied herein is dominated by cosmopolitan taxa such as *Heteroterma* Gabb, 1869, *Euspira* Agassiz in Sowerby 1838, *Gyroscala* de Boury, 1887, *Fusinus* Rafinesque, 1815, *Sulcobuccinum* d'Orbigny, 1850, and *Priscoficus* Conrad, 1866, followed by the endemic genera *Austrophaera* Furque and Camacho, 1949 and *Rocalaria* new genus, while only one gastropod with austral affinities has been recorded (*Microfulgur* Finlay and Marwick, 1937). Except for *Rocalaria,* the studied association shares all the genera with that contained in the Salamanca Formation, also exposed in northern Patagonia along the Atlantic coast of Chubut Province, but affinities with the fauna contained in the Dorotea Formation (southwestern Patagonia) are restricted to the presence of *Austrophaera* and *Heteroterma*. The presence of cosmopolitan warm-water genera such as *Sulcobuccinum* and *Priscoficus*, the similarities stated by Davies (1934) early on with the congeneric Californian Paleogene species of *Heteroterma* and *Priscoficus,* and the presence of the North American genus *Cavoscala* Whitfield, 1892 indicate that the inclusion of the fauna under study in the Weddellian Province (Zinsmeister, 1982; Stilwell, 2003) must be reviewed in order to clarify relationships with other coetaneous assemblages of the Southern Hemisphere (del Río, unpublished data). It is for this reason that a comprehensive analysis of northern Patagonian faunas is of utmost importance. This study points to a more complex origin than previously thought for these high latitude assemblages, where the incoming warm-water species played an important role as already claimed by Camacho (1992).

STRATIGRAPHIC SETTING

Fossil material analyzed in the present paper was recovered from the Roca Formation in its type area exposed in the surroundings of the city of General Roca, and from the region located northwards from Los Menucos (Neuquen Basin, Río Negro Province) (Fig. 1). This unit belongs to the uppermost part of the Malargüe Group and comprises deposits of the final sedimentation of the Atlantic transgressive-regressive phase of the sea that flooded Patagonia during the Cretaceous–Paleogene interval (Uliana and Dellapé, 1981).

Area of General Roca.—Pioneering geological studies in this region are those by Rhode (in Döring, 1882), Roth (1899), Windhausen (1914) and Schiller (1922). A detailed stratigraphic analysis was recently provided by del Río et al. (2011) who, based on the calcareous nannofossils content, placed the Roca Formation from its type area in the early Danian (NP2–NP4 Zones) (see del Río et al., 2011 for previous works and age discussion). The Roca Formation overlies the marine marlstones of the Jagüel Formation and is covered by lacustrine deposits of the Carrizo Formation. It is represented by an intercalation of 24–28 m thick greenish, gypsy marls and highly fossiliferous limestones, capped by a dolomite bed and gypsum strata. According to Uliana and Dellapé (1981), this represents an upward-shallowing carbonate sedimentary sequence deposited in open outer- to inner-shelf environments to hypersaline lagoons. Fossiliferous beds result from the amalgamation of thin single-event deposits and constitute massive, highly bioturbated tabular or lenticular bodies that usually display erosional lower contacts (del Río et al., 2011). They were deposited by storm events or by gradient currents from near-shore to shelf settings (Barrio, 1990).

The fossiliferous sections studied and their acronyms are: Zanjón Roca (ZR) (S 38°55′, W 67°32′), Picada Sísmica (PS) (S 38°56′, W 67°33′), Cantera Cholino (CH) (S 38°53′, W 67°40′), and Horno de Cal (HC) (S 38°56′, W 67°35′) (Fig. 2). All

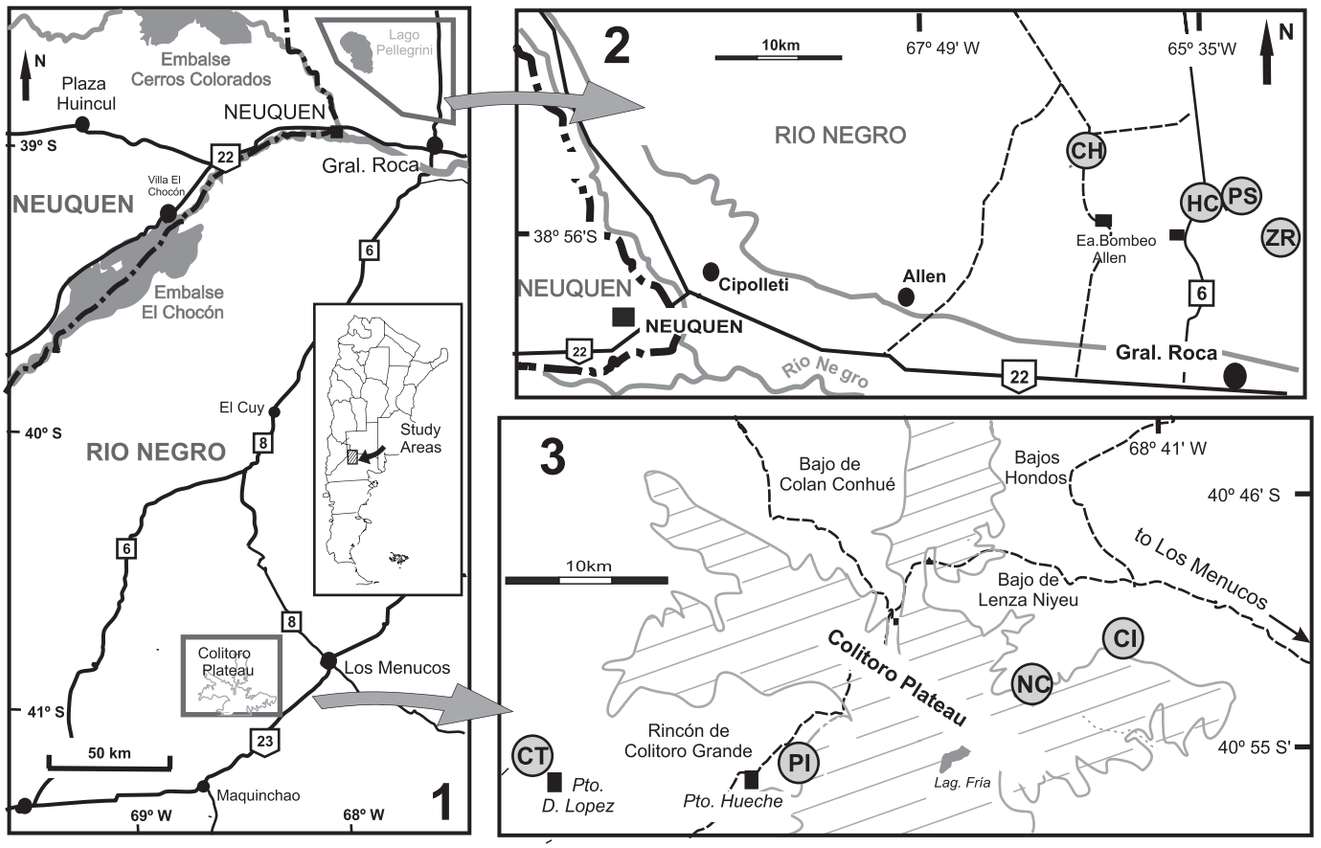

FIGURE *1—1*, general locations of study areas; *2*, fossiliferous sites at General Roca; *3*, fossiliferous sites at Colitoro Plateau. CH=Cantera Cholino, HC=Horno de Cal, PS=Picada Sísmica, ZR=Zanjón Roca, CT=Cerro Tiltilco, PI=Puesto Intermedio, NC=Puesto Nahuel Cheo, CI=Puesto Carmelo Ibañez.

localities are located in the yellowish cliffs that run in an east-west direction, 10 km north of General Roca. Also is material collected by R. Wichmann from Lago Pellegrini where the Roca Formation comprises 40 m thick of an intercalation of marls and fossiliferous limestones and sandstones.

Area of Colitoro Plateau.—The region is situated 350 km south of General Roca and although the fossiliferous strata of the Roca Formation studied herein were discovered some time ago (Wichman, 1927), the geology of the area remained almost unknown until recently. Bertels (1969), Getino (1995), and Labudía and Bjerg (1994) included the marine sedimentites exposed in the lower part of the sections under study in the Colitoro Formation (correlated with the Jagüel Formation), and the upper part in the Roca Formation. This unit is overlain by the Bajada de los Ingleses Formation or by the Meseta Colitoro Formation. Forams recovered from the Roca Formation exposed at Puesto Carmelo Ibañez, one of the studied fossiliferous localities, placed it in the Danian (Nañez, 1998; Cuchi et al., 2001), while ostracod assemblages restricted the age of the Roca Formation to the early Danian (Echevarría, 1995).

Contrasting with the carbonatic composition in exposures near General Roca, the Roca Formation in the Colitoro Plateau region is mainly constituted by a silicoclastic sedimentary sequence that shows a gradual upward increase from fine to medium-coarse pinkish, reddish, ochre, yellowish and grayish sandstones with thin intercalations of hard, massive fossiliferous grainstones, packstones and wackestones. Some fossiliferous beds display an upward increase in shell-packing density, grading from shell-supported to matrix-supported. Others are constituted by amalgamated, multi-event shell beds with internal discontinuities, such as those bearing the gastropods studied herein. Spalletti (1988) proposed that these sediments could have been deposited in an open inner littoral or sublittoral environment or in a shallow shelf dominated by fair-weather and storm waves. These sedimentites would be comparable with the lower part of the Roca Formation exposed in the Neuquen Basin, suggesting that these clastic facies would represent only the transgressive phase of the sea, while the carbonatic-dolomitic sequence exposed in General Roca represent the regressive event.

Lithological sections sampled and their acronyms are Puesto Carmelo Ibañez (CI) (S 40°51′, W 68°44′), Puesto Nahuel Cheo (NC) (S 40°52′, W 68°47′), Puesto Intermedio (PI) (S 40°54′, W 68°56′), and Cerro Tiltilco (CT) (S 40°55′, W 69°10′) (Fig. 2). This paper also includes the description of the material collected by R. Wichmann in the area, labeled as Bajo Hondo in the collections of the Museo Argentino de Ciencias Naturales (Buenos Aires). The composition of the fauna and the preservation of the material recorded from Puesto Carmelo Ibañez, suggests that this may the locality of R. Wichmann.

SYSTEMATIC PALEONTOLOGY

The material described is housed in the Museo Argentino de Ciencias Naturales B. Rivadavia (MACN-Pi) and in the Cátedra de Paleontología de la Facultad de Ciencias Exactas y Naturales-Universidad de Buenos Aires (CPBA). The present paper also includes material used for comparison housed in Museo La Plata (MLP) (Buenos Aires, Argentina) and in the Muséum National d'Histoire Naturelle (MNHN) (Paris, France).

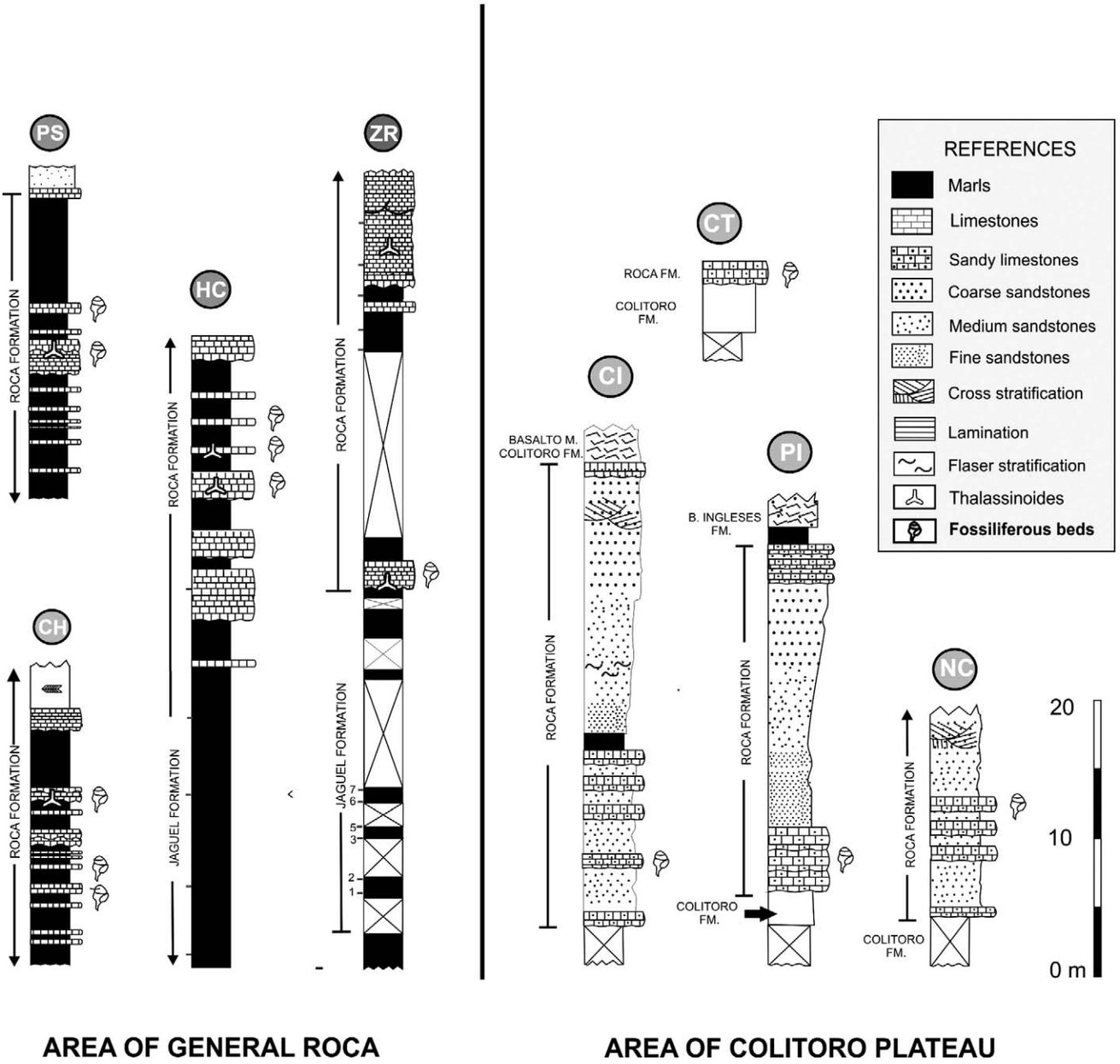

FIGURE 2—Lithological sections at General Roca (after del Río et al., 2011) and Colitoro Plateau. CH=Cantera Cholino, HC=Horno de Cal, PS=Picada Sísmica, ZR=Zanjón Roca, CT=Cerro Tiltilco, PI=Puesto Intermedio, NC=Puesto Nahuel Cheo, CI=Puesto Carmelo Ibañez.

Class GASTROPODA Cuvier, 1797
Subclass ORTHOGASTROPODA Ponder and Lindberg, 1997
Superorder VETIGASTROPODA Salvini-Plawen, 1980
Superfamily EUCYCLOIDEA Koken, 1897
Family CALLIOTROPIDAE Hickman and McLean, 1990
Genus CIDARINA Dall, 1909

Type species.—*Margarita cidaris* H. A. Adams in Carpenter, 1864. Early Pleistocene-Recent, northeastern Pacific (by original designation).

CIDARINA LENZANIYEUENSIS new species
Figure 3.1–3.3

Diagnosis.—Shell small, narrowly umbilicated; whorls with rounded periphery; sculpture of last whorl restricted to six faintly nodose spiral cords becoming narrower from periphery to suture and up to nine narrower and closer spaced cords at the base.

Description.—Shell trochiform, small (up to 6 mm in height) with narrow umbilicus partially covered by a thin reflexed collumelar callus. Protoconch with one and a half smooth whorls. Spire short (25% of total height) consisting of up to three convex whorls with narrow, faintly concave smooth ramps; spire angle 88°–93°; suture slightly impressed. Last whorl with convex base and rounded periphery; aperture subcircular, oblique. Shell surface sculptured with fine growth lines and finely beaded spiral cords; spire whorls with three equal-sized spiral cords; last whorl sculptured with a thick peripheral cord and six thick rounded spiral cords becoming slightly narrower adapically; base of whorl with nine cords much thinner and more closely than those situated above periphery (six in 1 mm).

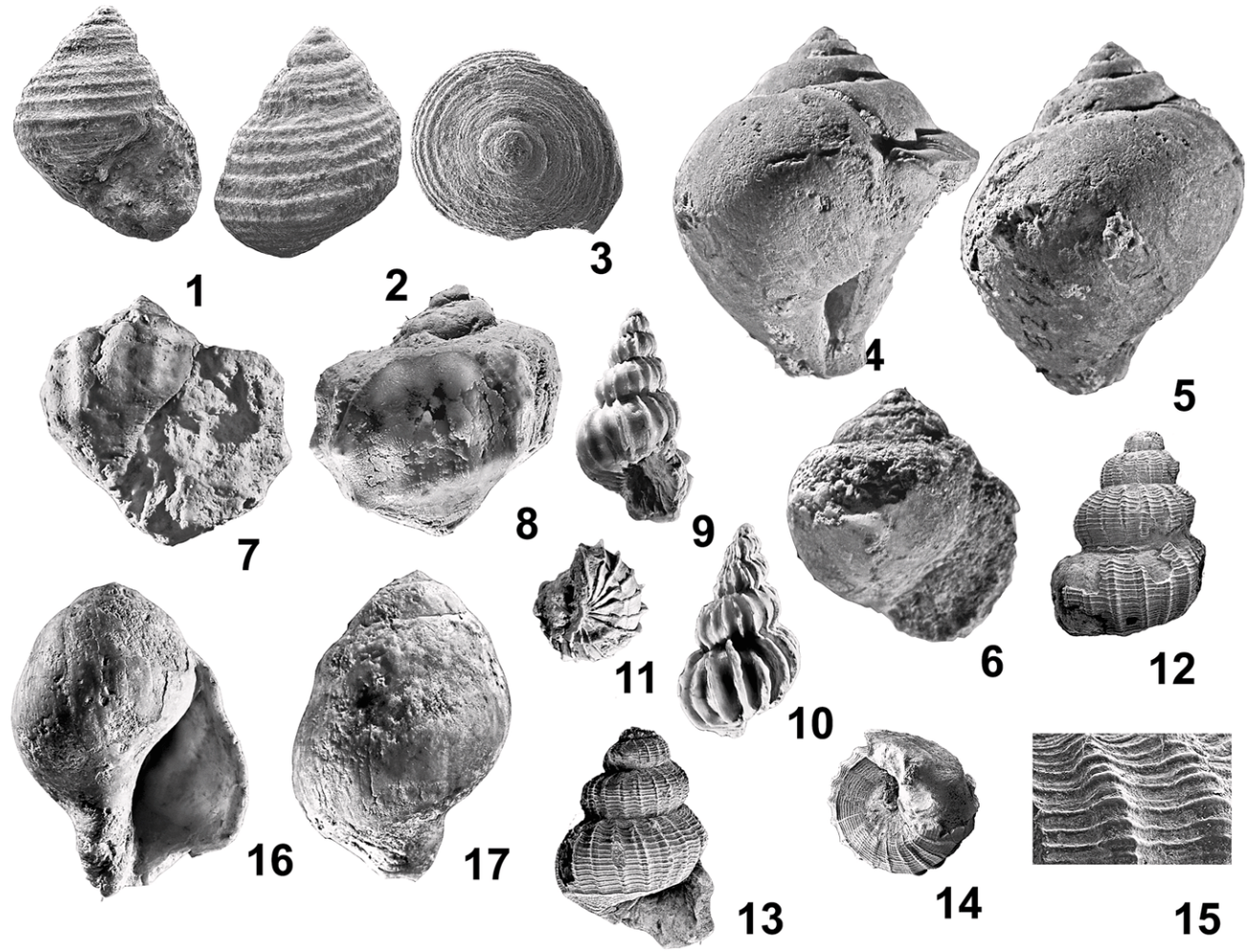

FIGURE 3—*1–3, Cidarina lenyaniyeuensis* n. sp. from Puesto Carmelo Ibañez: *1, 2*, ventral and dorsal views of holotype MACN 5295, ×6; *3*, ventral view of paratype MACN-Pi 5297 ×6; *4–6, Euspira* sp.: *4, 5,* ventral and dorsal views of MACN-Pi 5247a from Cerro Tiltilco, ×2; *6,* ventral view of MACN-Pi 5245 from Puesto Nahuel Cheo, ×2; *7, 8,* ventral and dorsal views of *Priscoficus* cf. *P. gracilis* (Wilckens, 1905), MACN-Pi 5235 from Cerro Tiltilco, ×2; *9–11*, ventral, dorsal and basal views of *Gyroscala daniana* n. sp., holotype MACN-Pi 5275 from Puesto Carmelo Ibañez, ×2; *12–15,Cavoscala* sp. MACN-Pi 5274 from Puesto Carmelo Ibañez; *12–14*, ventral, dorsal and basal views, ×2; *15*, detail of sculpture, ×6.5; *16, 17*, ventral and dorsal views of *Austrophaera patagonica* (Feruglio, 1936) MACN-Pi 5237 from Puesto Carmelo Ibañez, ×2.

Etymology.—For its provenance from Bajo Lenza Niyeu.

Types.—Holotype MACN-Pi 5295 from Puesto Carmelo Ibañez, total height 5.6 mm; height of last whorl 3.9 mm, maximum diameter of last whorl 4.6 mm; paratypes from Puesto Carmelo Ibañez, MACN–Pi 5296 total height 6 mm, height of last whorl 4.1 mm, maximum diameter of last whorl 4.4 mm; MACN-Pi 5297 height 5 mm, height of last whorl 3 mm, maximum diameter of last whorl 4.4 mm

Other material.—Eight specimens MACN-Pi 5298 from Puesto Carmelo Ibañez.

Occurrence.—Roca Formation, early Danian.

Remarks.—The genus *Cidarina* Dall, 1909, along with related genera such as *Calliomphalus* Cossmann, 1888 and *Calliotropis* Seguenza 1903, was recently placed in the Superfamily Eucycloidea by Bandel (2010) as it is no longer considered a trochid as formerly classified (Hickman and McLean, 1990).

Cidarina is a poorly diversified small genus that ranges from Cretaceous to Recent times in North America, being represented by its type species (Recent) and by three fossil taxa included in *Cidarina* by Squires and Saul (2003a). Diagnosis of the genus was based on the Recent and fossil species and is characterized by "shell small to medium, thin, trochiform, spire relatively elevated, ornamentation of coarse nodes or beads formed at intersections of spiral and collabral sculpture; ornamentation weakest anterior to body whorl periphery, aperture nearly circular and oblique, umbilicus covered by thin columellar callus, interior shell nacreous" (Squires and Saul, 2003a, p. 52).

Cidarina can be compared with *Calliotropis* Seguenza, 1903 (Cretaceous–Recent) and with the Cretaceous–Eocene *Calliomphalus,* a genus placed with doubts in the Family Calliotropidae by Bandel (2010). Although similar in shell size and shell shape, and pattern of ornamentation, representatives of *Calliomphalus* (type species=*Turbo squamulosus* Lamarck, 1804, Eocene, Paris; Cossmann and Pisarro (1910–1913), pl. 3, fig. 18.1; Hickman and McLean (1990), fig. H), differ from *Cidarina* by having more rounded and shorter whorls, deep sutures, a less convex base and a wider umbilicus that is surrounded by a ridge bearing nodes (see Sohl, 1960 for illustrations of Cretaceous North American species). According to the diagnosis of *Calliotropis* (type species=*Trochus ottoi* Philippi, 1844, Pleistocene, Italy; Recent,

Northern Atlantic Ocean) provided by Bandel (2010), this genus mainly differs from *Cidarina* by the development of shouldered and strongly sculptured whorls with flattened sides, a strong spiral cord around the basal angulation, a base that is only gently convex and sculptured with fewer and coarser spiral cords than in *Cidarina*, and a wide, conical and open umbilicus.

The Patagonian Danian material described herein is placed in *Cidarina* because of the small trochiform shells with a rather elevated spire with rounded whorls, a subcircular and oblique aperture, a narrow umbilicus covered by a thin columellar callus and the characteristic pattern of ornamentation given by the presence of much narrower and weaker spiral cords anterior to body whorl periphery than adapically.

Cidarina lenzaniyeuensis n. sp. differs from the type species *C. cidaris* (A. Adams, in Carpenter, 1864) (Hickman and McLean, 1990, fig. 44, G), a living species ranging from Alaska to Mexico, by having a smaller shell with a much less stepped spire sculptured with faintly beaded spiral cords and rather visible growth lines.

Cidarina lenzaniyeuensis has a shell shape similar to that of *C. cretacea* Squires and Saul (2003a, p. 52, fig. 2.1–2.3, Cretaceous, California) but differs by having smaller shells sculptured with thinner cords on spire whorl and by fewer and more widely spaced cords on the base of last whorl than does the North American species. *Cidarina beta* Squires and Saul (2003a, p. 52, figs. 2, 5–7; Cretaceous, California) differs from *C. lenzaniyeuensis* by having taller and larger shell and much fewer and strongly nodose spiral cords than the Argentinean species.

Cidarina lenzaniyeuensis is distinguished from the Eocene *C. antiqua* Squire and Goedert (1995, p. 264, figs. 9–11; Washington) by lacking the cancellate ornamentation that characterizes to the North American taxon and because the peripheral cord is only faintly nodose.

The most important difference between the type species and *Cidarina lenzaniyeuensis* and the Cretaceous species described by Squires and Saul (2003a) is the strength of the spiral nodose cords; those in *Cidarina cidaris* are strongly developed.

Cidarina lenzaniyeuensis closely resembles *Gegania (Tubena) antarctodema* Stilwell and Zinsmeister (1992; p. 95, pl. 11, figs. m, n; La Meseta Formation, Eocene) but the Argentinean species can be differentiated by the presence of a much narrower umbilicus and slightly more convex whorls that are sculptured with up to nine cords in the last whorl that become slightly narrower from periphery to suture, while in the Antarctic species there are up to 20 cords of at least two different width intercalated.

Superorder Caenogastropoda, Cox 1960
Order Sorbeoconcha Ponder and Lindberg, 1997
Superfamily Naticoidea Gray, 1847
Family Naticidae Gray 1847
Genus Euspira Agassiz in Sowerby 1838

Type species—Natica glaucinoides Sowerby, 1812. Paleogene, France and England (subsequent designation by Bucquoy, Dautzenberg and Dollfus, 1883).

?Euspira sp.
Figure 3.4–3.6

Description.—Shell globose, large (up to 33 mm in height). Protoconch not known. Spire very short (15%–20% of total height) consisting of four convex, narrowly shouldered whorls, quickly increasing in diameter during growth; spire angle 90° to 95°. Suture impressed. Last whorl strongly convex, with thin, narrow and moderately open umbilicus throughout ontogeny. Aperture semicircular and widening abapically; inner lip almost straight with a thick inductura; outer lip moderately sinuous and strongly prosocline, inclining 30° to shell axis. Sculpture of prosocline growth lines.

Material.—Ten specimens from Bajo Hondo MACN-Pi 5249; Puesto Carmelo Ibañez MACN-Pi 5246; Cerro Tiltilco MACN-Pi 5247a, total height 25.5 mm; height of last whorl 20.5 mm; maximum diameter last whorl 22 mm; Puesto Intermedio MACN-Pi 5248a, total height 34 mm; height of last whorl 29.5 mm; maximum diameter last whorl 26.5 mm; Puesto Nahuel Cheo MACN-Pi 5245, total height 18.4 mm; height of last whorl 16 mm.

Occurrence.—Roca Formation, early Danian.

Remarks.—It differs from *Euspira pueyrredonensis* Stanton (1901, pl. 6, fig. 12; Cretaceous, Pueyrredon Lake) in having a taller spire, the last whorl less inflated and aperture ovoidal and not oblique. *Euspira* cf. *E. pueyrredonensis* illustrated by Griffin and Hünicken (1994; Cerro Dorotea Formation, Paleocene) and *Natica* sp. (Feruglio, 1936, p. 212, pl. 21, figs. 16, 18, Danian, Lefipán Formation) have similar shell and apertural outlines but are smaller in size, and have much lower spires and less marked shoulders than ?*Euspira* sp.

Superfamily Ficoidea Meek, 1864
Family Ficidae Meek, 1864
Genus Priscoficus Conrad, 1866

Type species.—*Ficula intermedia* (Melleville, 1843). Paleocene, France (subsequent designation by Stewart, 1927).

Priscoficus cf. P. gracilis (Wilckens, 1905)
Figure 3.7, 3.8

1905 *Pyropsis gracilis* Wilckens, p. 23, pl. 3, fig. 16.
1949 *Pyropsis gracilis* Wilckens, Furque and Camacho, p. 290, lam. 4, fig. 11.

Description.—Shell pyriform, robust, rather large for genus. Protoconch unknown. Spire (broken) moderately high with up to three flat sided whorls that conceal previous ones, with an almost horizontal, wide, flat shoulder; spire angle 110°–115°. Last whorl large, quadrate, gently contracted to form an anterior siphonal canal (broken); aperture (broken) subquadrate, strongly flaring; columella not preserved. Surface of spire whorls sculptured with thick, flat spiral cords; last whorl with three equidistant spiral rows of 12 to 14 elongated tubercles, placed in the periphery of ramp, in the middle, and in the basal portion of whorls respectively; adapical row with stronger tubercles than those of the middle and basal ones.

Material.—Eleven specimens from Zanjón Roca MACN-Pi 5232, total height (broken) 35 mm; maximum diameter of last whorl 37 mm; Cerro Tiltilco MACN-Pi 5235 height (broken) 18.2 mm; maximum diameter of last whorl 18.7 mm; Cantera Cholino MACN-Pi 5231; Horno de Cal MACN-Pi 5233; Lago Pellegrini MACN-Pi 5236.

Occurrence.—Roca Formation, early Danian.

Remarks.—With the exception of some specimens that have part of the original shell preserved, the material available mainly consists of internal molds, in which the anterior siphonal canal and columella are broken. The quadrate outline of the capacious last whorl, the large flaring aperture, short stepped spire and the development of three strong spiral nodose rows in the last whorl could place our material in *Priscoficus* Conrad, 1866, a cosmopolitan genus known from Paleogene deposits of New Zealand, Europe, United States and perhaps also from Australia.

The material under study closely resembles the Argentinean *Pyropsis gracilis* Wilckens, 1905, from the Cerro Cazador Formation (Cretaceous, Santa Cruz Province) and the Leticia Formation (Paleocene, Tierra del Fuego) described by Furque and

Camacho (1949). This species, as early noticed by Finlay and Marwick (1937), would be related to *Proficus* (=*Priscoficus* according to Beu and Maxwell, 1990). Only minor differences are observed between our material and *Priscoficus gracilis* (Wilckens, 1905, p. 119, pl. 3, fig. 16; holotype MLP 9582; Furque and Camacho, 1949, p. 291, lam. 4, fig. 11), such as the development of more elongated tubercles and almost horizontal shoulders in *P.* cf. *P. gracilis*, although this last character is probably due to the fact that the material recovered by us consists of internal molds.

Priscoficus cf. *P. gracilis* differs from the type species of the genus, *P. intermedia* (Melleville) (Farchad, 1936, p. 65, pl. 4, fig. 15a, 15b; holotype J01737; Paleocene, France) by having a larger shell, stepped and lower spire, broader and less inclined shoulders, a subquadrate aperture and equidistant spiral rows of 12 to 14 tubercles, while *P. intermedia* has a pyriform aperture, the middle and basal rows are much closer than in *P.* cf. *P. gracilis*, the middle one is placed below the central sector of the whorl, and the three rows have up to 17 tubercles that are smaller and narrower than in *P.* cf. *P. gracilis*.

The middle Eocene New Zealand *Priscoficus* sp. A (Finlay and Marwick, 1937; p. 119 pl. 16, fig. 18) strongly resembles the Patagonian species in having a similar spire height and almost horizontal shoulders. Among the differences, it can be noted that in the New Zealand material, the adapical row has 14 tubercles, the middle one has 17, and the basal one, according to Finlay and Marwick's description "has twice as many weak tubercles" (p. 119). It can be distinguished from *Priscoficus obtusa* (Marshall, 1917) (Beu and Maxwell, 1990, p. 82, pl. 2, fig. w; Paleocene, New Zealand) because spire of this taxon has a shorter dome-shape with strongly clasping whorls, a less convex last whorl with stepped shoulders, the adapical spiral row with up to 25 tubercles, the middle row is placed very close to the abapical one, and the number and position of tubercles on the middle and basal rows are different from those of the the adapical one. *Priscoficus alectodens* (Marwick, 1942, p. 275, pl. 25, figs. 33, 34; middle Eocene, New Zealand) differs from *Priscoficus* cf. *P. gracilis* by having a higher spire with more inclined shoulders, a pyriform aperture, and spiral rows of smaller and sharp tubercles that are more numerous on the shoulder row.

Priscoficus caudatus (Gabb, 1869) (Zinsmeister, 1983, p. 1293, fig. 3c–3e, late Paleocene, California) has a shorter spire with successive whorls that partially cover previous ones, the middle and posterior spiral rows have 22 tubercles and has an anterior angulated keel sculptured with weak nodes.

Superfamily Janthinoidea Lamarck, 1812
Family Epitoniidae Berry, 1910
Genus Gyroscala de Boury, 1887

Type species.—*Scalaria lamellosa* Lamarck, 1819. Recent, cosmopolitan (by original designation).

Remarks.—Although abundant and widely distributed, systematics of Recent and fossil representatives of Epitoniidae is little known, except for the revisions of Recent taxa in specific regions performed by Clench and Turner (1950, 1951, 1952), Dushane (1979), and Kilburn (1985). Cenozoic species are very common elements of shallow marine sediments but generic and specific assignments must be revised since most of the global studies have been carried out by de Boury (1890, 1911, 1917) and Cossmann (1912), among others. *Gyroscala* de Boury, 1887, is characterized by the presence of non-umbilicate shells with a basal plate and peripheral keel, sculptured with axial lamellae and hardly visible spiral threads which separate it from *Epitonium* Röding, 1798 (s.s.), a genus with shells openly umbilicate and with unattached whorls (Clench and Turner, 1950; Kilburn, 1985). Except for the doubtful record of a Danian representative of "*Epitonium*" in La Pampa Province (del Río et al., 2007), no references to this family exist from Paleocene strata in Patagonia.

Gyroscala daniana new species
Figure 3.9–3.11

Diagnosis.—Spire short; basal plate and peripheral keel moderately developed and crossed by axial cords; convex whorls, sculptured with microscopic spiral threads and non-reflected axial lamellae that form spines on shoulders.

Description.—Shell thin, conical, medium sized. Protoconch unknown. Spire 61% of total height with up to six convex whorls; spire angle 35°; suture impressed. Last whorl with moderately defined basal plate and strong peripheral keel, sometimes visible in sutures; aperture circular with thick labrum. Surface sculptured with numerous microscopic spiral threads only visible in interspaces and with 14 to 17 slightly prosocline, sharp, equally spaced, non-reflected axial lamellae, not continuous through whorls, forming a spine projected in front of the suture and overriding the peripheral keel and basal plate.

Etymology.—As the first Danian species of *Gyroscala* described for Patagonian strata.

Types.—Holotype MACN-Pi 5275 from Puesto Carmelo Ibañez, total height 15.4 mm; height of last whorl 8.5 mm, diameter of last whorl 9 mm; paratype MACN-Pi 5276 from Puesto Carmelo Ibañez, height 18 mm; height of last whorl 10 mm, diameter of last whorl 7 mm.

Other material.—Seven specimens from Bajo Hondo MACN-Pi 4139; Picada Sísmica, MACN-Pi 5294; Zanjón Roca MACN-Pi 5284; MACN-Pi 5293.

Occurrence.—Roca Formation, early Danian.

Remarks.—The development of non-umbilicate shell, basal plate, peripheral keel, axial lamellae and hardly visible spiral threads place the studied material in *Gyroscala* de Boury, 1887. *Gyroscala daniana* n. sp. differs from *G. lamellosa* (Lamarck, 1822), the type species, in having discontinuous lamellae forming spines on the whorl shoulders.

The Eocene Antarctic *Epitonium* (*E.*) *charitopolos* Stilwell and Zinsmeister (1992, p. 100, pl. 12, figs. i, j) is not a representative of *Epitonium* s.s. since it has a non-umbilicate shell, a basal keel and attached whorls, all characters that place it in *Gyroscala. Gyroscala daniana* may be differentiated from the Antarctic taxon in having shorter shells and whorls connected by axial lamellae that form spines on shoulders.

Gyroscala daniana differs from *G. cionei* Brunet (1995, p. 36, lam. 3, fig. 4; late Miocene, Argentina) by having axial lamellae instead of the moderately coarse rounded costae of *G. cionei*.

Several Paleogene European species were included in *Gyroscala* by de Boury (1890, 1911) and Cossmann (1912) but these taxa remain in need of revision. *Gyroscala daniana* differs from *G. stueri* de Boury 1890 (p. 142, pl. 3, fig.1; Eocene, France) in having shells that are slightly elongated, the axial lamellae are more numerous and shoulder spines are less developed.

Genus Cavoscala Whitfield, 1892

Type species.—*Cavoscala annulata* (Morton, 1834). Lower Eocene, New Jersey, U.S.A. (by original designation).

Remarks.—According to the description of the type species *Cavoscala annulata* provided by Whitfield (1892), this genus is characterized by the development of umbilicus, basal cord, and by the presence of axial costae and spiral threads throughout the shell surface. *Cavoscala* is a rare genus used by Wanner (1902) to include some species from the Maastrichtian of Libya, and by Cossmann (1912) to place some poorly known species from the Paleocene of Europe, the specific validity and generic assignment of which should be discussed, since illustrations show non-umbilicate shells and therefore should not be related to *Cavoscala*.

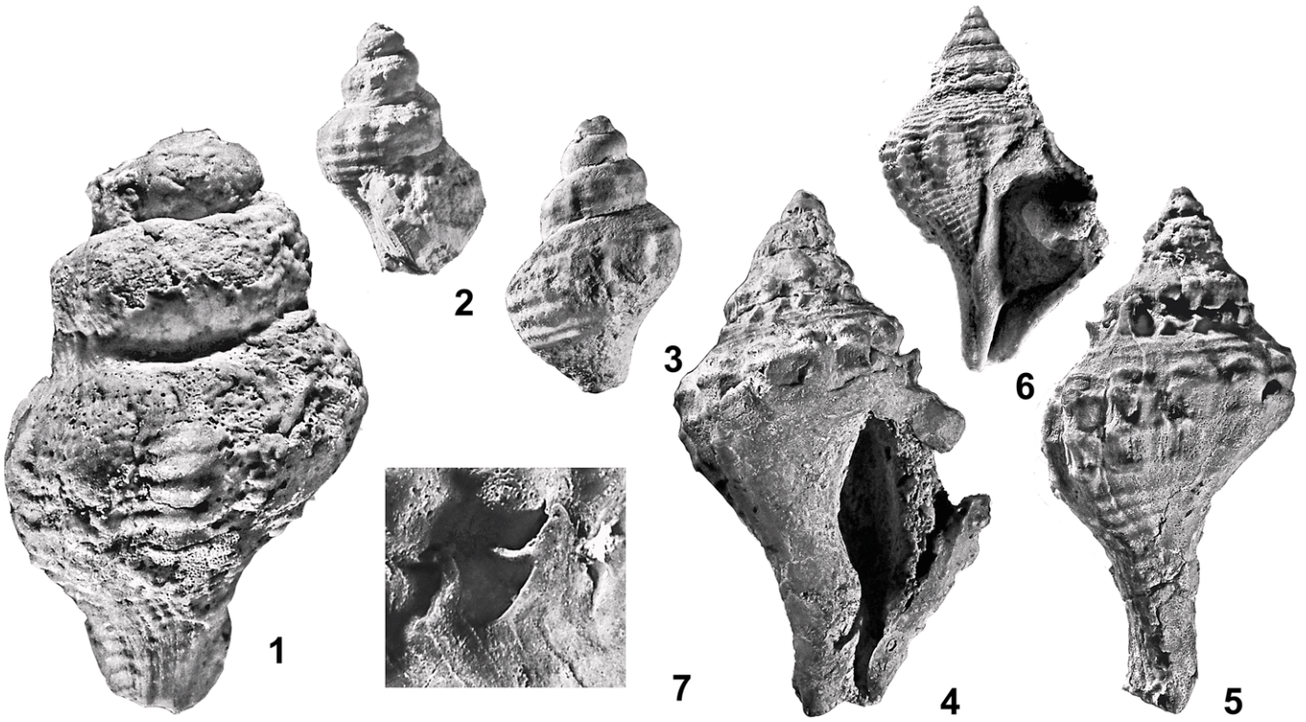

FIGURE *4—1–3, Fusinus* sp. from Picada Sísmica: *1*, dorsal view of MACN-Pi 5242 a, ×2; *2, 3,* ventral and dorsal views of MACN-Pi 5241, ×2; *4–7*, *Rocalaria alani* n. gen. n. sp.: *4, 5*, ventral and lateral views of holotype MACN-Pi 5306 from Puesto Intermedio, ×2; *6,* ventral view of paratype MACN 5307, a young specimen from Puesto Carmelo Ibañez, ×2; *7*, detail of a spine of holotype MACN-Pi 5306, ×10.

CAVOSCALA sp.
Figure 3.12–3.15

Description.—Shell small (broken), thick. Protoconch unknown. Spire with strongly rounded and wider than high whorls; spire angle 39°; sutures impressed. Last whorl with a basal, thin spiral cord and narrow umbilicus with a steep smooth wall; aperture broken. Surface of spire whorls sculptured with spiral threads of two different widths (five in 1 mm of last whorl) and with 19 rounded, slightly prosocline axial costae, wider and more rounded in the middle sector of the whorl, overridden by spiral cords, and separated by flat-bottomed interspaces; basal cord crossing over axial costae, and sector between basal cord and edge of umbilicus sculptured with up to ten flat spiral threads of the same width.

Material.—One specimens from Puesto Carmelo Ibañez MACN-Pi 5274, total height 15 mm; diameter of last whorl 10 mm.

Occurrence.—Roca Formation, early Danian.

Remarks.—The presence of a wide umbilicus, basal cord and development of axial and spiral threads place the Patagonian species in *Cavoscala* Whitfield, 1892. *Cavoscala* sp. differs from the type species *C. annulata* (Whitfield, 1892, p.177, pl. 22, figs. 1–4; lower Eocene, New Jersey) because it has fewer and rounded axial costae, which are only slightly prosocline, and by the development of thicker spiral threads of two different widths.

Cavoscala sp. can be separated from *C. fasciata* Wanner (1902, p. 127, pl. 18, fig. 19; Maastrichtian, Libya) by having fewer axial costae set apart by wider interspaces and underlain by the basal cord and the spiral threads.

Superfamily MURICOIDEA Rafinesque, 1815
Family BUCCINIDAE Rafinesque, 1815
Genus AUSTROSPHAERA Camacho in Furque and Camacho, 1949

Type species.—*Austrosphaera glabra* Camacho (in Furque and Camacho, 1949). Eocene, Tierra del Fuego, Argentina (by original designation).

Remarks.— This genus is comparable to *Seymourosphaera* Olenik and Zinsmeister, 1996; type species, *S. bulloides* Oleinik and Zinsmeister; early paleocene, Antarctica, by original designation.

AUSTROSPHAERA PATAGONICA (Feruglio, 1936)
Figure 3.16, 3.17

1936 *Cominella patagonica* Feruglio, p. 267, pl. 26, figs. 11–13 (non *Austrosphaera patagonica* in Griffin and Hünicken, 1994, p. 265, fig. 5.2–5.6).

Description.—Shell elongated to ovate, solid, medium sized (up to 38 mm in height). Protoconch with one and a half rounded smooth whorls. Spire short (25% of total height) with up to four flat-sided to slightly rounded whorls; spire angle 95°; suture channeled. Last whorl with well-developed spiral depression at posterior quarter, more impressed in large specimens; aperture large, oval, widening towards middle of whorl; columella smooth, excavated; inner lip covered by a narrow, thick inductura restricted to last whorl; interior of labrum of juveniles specimens smooth but finely crenulated in adult ones; moderately wide posterior siphonal notch; anterior siphonal canal short, twisted dorsally towards left; fasciole poorly to fairly well developed. Shell surface nearly smooth except for very fine spiral threads only visible in non-abraded specimens and stronger on posterior sector of whorl.

Material.—Fourteen specimens from Cerro Tiltilco MACN-Pi 5240; Bajo Hondo MACN-Pi 5266; Puesto Carmelo Ibañez MACN-Pi 5239, MACN-Pi 5237 total height 22.8 mm; height of last whorl 17 mm, maximum diameter of last whorl 15.5 mm; MACN-Pi 5238, total height 15.8 mm, height of last whorl 13 mm, maximum diameter of last whorl 12 mm.

Occurrence.—Roca Formation, early Danian.

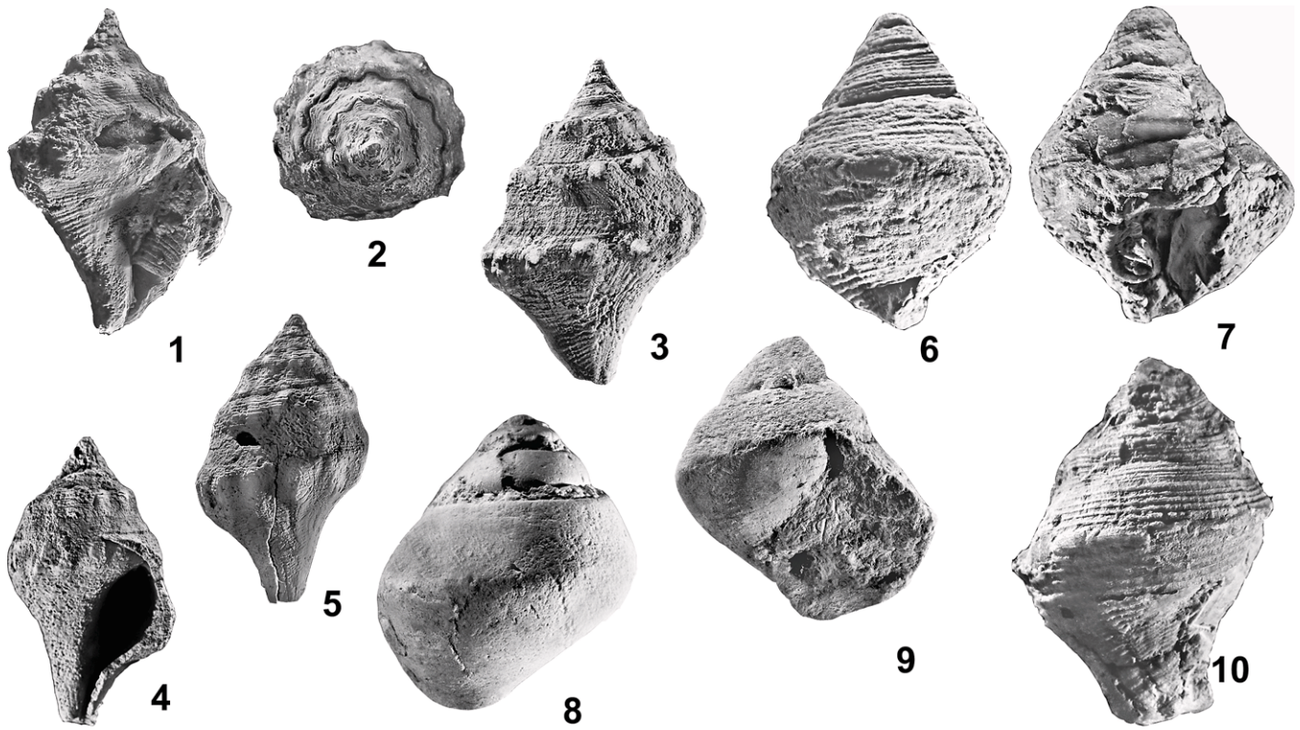

FIGURE 5—*1–5, Heteroterma carmeloi* n. sp. from Puesto Intermedio: *1–3,* ventral, apical and dorsal views of holotype MACN-Pi 5250, ×2; *4, 5,* ventral and dorsal views of paratype MACN-Pi 5251, ×2; *6–10, Microfulgur concheyroae*n. sp.: *6, 7*, dorsal and ventral views of holotype MACN-Pi 5253 from Zanjón Roca, ×2; *8, 9*, dorsal and ventral views of MACN-Pi 5254a from Lago Pellegrini; *10*, dorsal view of paratype MACN-Pi 5255 from Puesto Carmelo Ibañez, ×1.5. All specimens coated with magnesium.

Remarks.—Camacho (in Furque and Camacho, 1949) introduced this genus based on only one broken specimen, which is now lost, from the Eocene of Tierra del Fuego (Río Bueno Formation), proposing to include the Danian *Cominella patagonica* Feruglio, 1936 in *Austrophaera*. The type species *A. glabra* Camacho, 1949 "has a spire almost enveloped by the last whorl, aperture wide (wider in the middle of the whorl), columella excavated and covered by a thick inductura. Posterior canal poorly noticeable and the anterior one narrow, short and slightly curved. Basal fasciole poorly developed. Outline of labrum slightly convex. Surface smooth with growth lines" (translated from Camacho, 1949, p. 289). No information is provided on the development of crenulations on the interior side of the labrum, the aperture and siphonal notch of the figured type species are broken, and the surface of the shell is so abraded that we cannot infer if spiral sculpture has ever been present.

When creating *Seymourosphaera*, a Danian genus of Antarctica, Oleinik and Zinsmeister (1996) stated that this genus is characterized by having smooth or sculptured shells with fine spiral cords, by the absence of a posterior siphonal notch and the absence or poorly developed fasciole. However, Oleinik and Zinsmeister (1996) stated that *Seymourosphaera* could be separated from *Austrosphaera* in having prominent spiral sculpture, a more concave columella, broader and thicker callus, narrower and shallower parietal and siphonal canals, and by lacking a fasciole. Analysis of the Danian Antarctic specimens, as well as of *A. patagonica* and the congeneric species described by Griffin and Hünicken (1994) (Paleocene, Cerro Dorotea), shows that the development of spiral sculpture, fasciole and posterior siphonal notch, and length of anterior siphonal canal do not seem to be very constant characters. For these reasons, and in agreement with Bandel and Stinnesbeck (2000), *Seymourosphaera* is considered a synonym of *Austrosphaera*. This taxon is an endemic genus restricted to the Maastrichtian–Danian interval of a small area that comprises Chile-Patagonia and the Antarctic Peninsula.

Specimens of *A. patagonica* described in this paper mainly differ from *A. glabra*, (Camacho, 1949, p. 289, pl. 4, figs. 6, 7) by having less globose shells with higher spires. The holotype of *A. patagonica* (Feruglio, 1936, p. 267, pl. 26, fig. 11a, 11b; MACN-Pi 5281; Paleocene, Salamanca Formation, Chubut Province, Argentina) is an exceptionally well preserved adult specimen characterized by having very faint spiral grooves over the whole surface, with a weak spiral sulcus and well developed crenulations on the inner labrum. Griffin and Hünicken (1994, p. 265, fig. 5.2–5.6; MLP 25886–25890) assigned to *A. patagonica* numerous spirally sculptured specimens from the Paleocene Cerro Dorotea Formation that probably belongs in other species since the general outline, particularly of the last whorl, the short spire, the last whorl with no spiral sulcus and the sculpture of well developed spiral grooves, the absence of anterior siphonal notch, and a poorly developed fasciole, separate it from *A. patagonica*.

Austrophaera elevata (Oleinik and Zinsmeister, 1996) (p. 931, figs. 5, 18, 19, 22–27, Danian, Antarctica) has more slender shell with higher spire and shorter siphonal canal than *A. patagonica*; the aperture in the Antarctic species narrows progressively towards the anterior end while in *A. patagonica* it becomes wide anteriorly. *Austrophaera depressa* (Oleinik and Zinsmeister, 1996) (p. 930, fig. 5.7, 5.8) also from the Danian of Antarctica, closely resembles *A. patagonica* by having almost the same general outline of shell and shape of aperture, but *A. patagonica* differs from *A. depressa* by having a less stepped and slightly

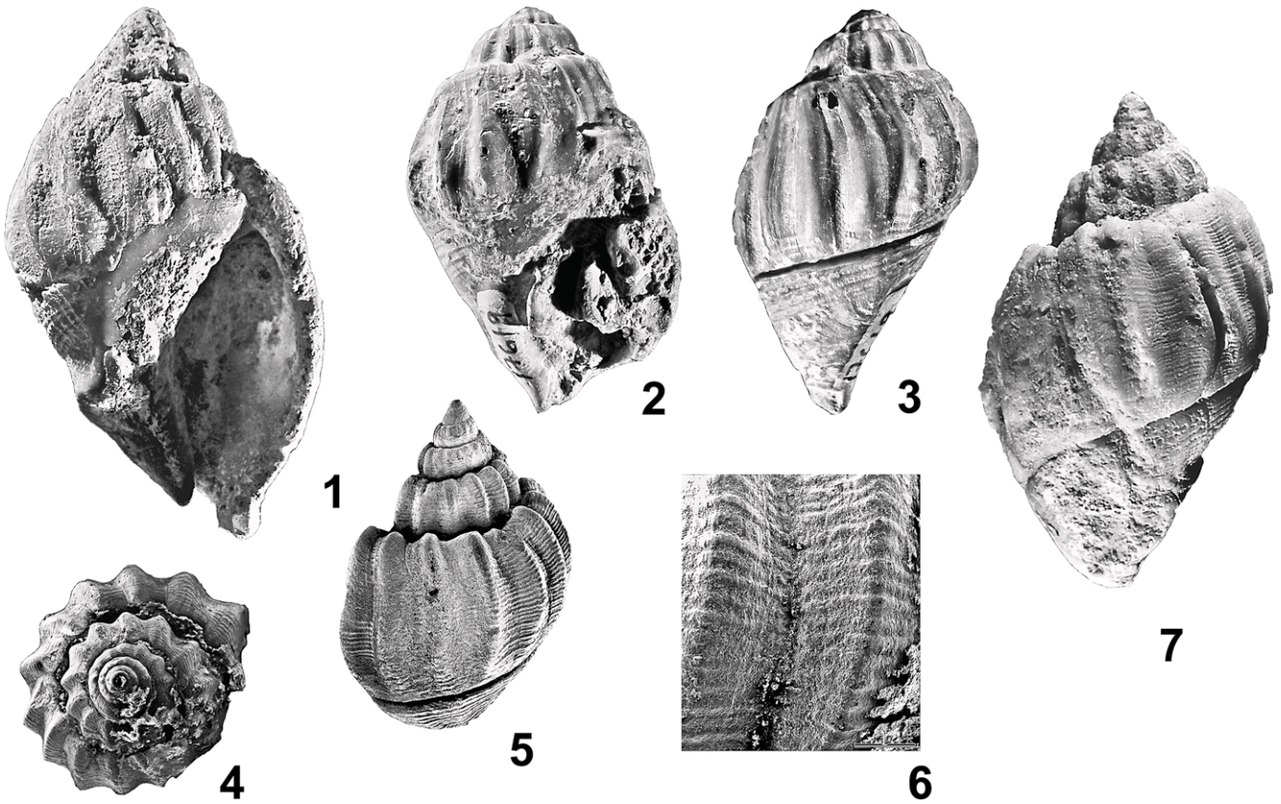

FIGURE 6—*1–7*, *Sulcobuccinum prominentum* n. sp.: *1*, *7*, ventral and dorsal views of paratype MACN-Pi 5257 from Puesto Carmelo Ibañez, ×2; *2, 3*, ventral and dorsal views of holotype CPBA 17619b from Cerro Tiltilco, ×2; *4–6*, paratype MACN-Pi 5256 from Puesto Carmelo Ibañez: *4, 5,* apical and dorsal views, ×4; *6,* detail of sculpture, ×14.

higher spire, an anteriorly more contracted last whorl and a well developed siphonal notch.

?Family FASCIOLARIIDAE Gray, 1853
Genus ROCALARIA new genus

Type species.—*Rocalaria alani* new species. Roca Formation, early Danian (by monotype).

Diagnosis.—As for type species.

Etymology.—For its occurrence in the Roca Formation and for its relationship to Fasciolariidae.

Occurrence.—Roca Formation, early Danian.

Remarks.—At present the Family Fasciolariidae Gray, 1853 comprises the subfamilies Fasciolariinae Gray, 1853, Fusiniane Wrigley, 1927 and Peristerniinae Tryon, 1880 (Snyder, 2003). The presence of two columellar plaits in *Rocalaria* and its similarity to the Cretaceous–Paleocene fasciolariines *Hercorhyncus* Conrad 1869, *Boltenella* Wade 1917, *Saxituberosa* Squires and Saul, 2006, and *Mylecoma* Squires and Saul 2003b would place the Patagonian new genus in the family Fasciolariidae. However, a recent unpublished study of the subfamily Fasciolariinae (M. A. Snyder, G. J. Vermeij and W. G. Lyons, in prep.) indicates that none of the Cretacous–Paleocene genera previously considered to belong to Fasciolariinae, would belong there. Instead, these genera may belong to a stem-group of fasciolariidae. Whereas true fasciolariines have three columellar plaits (including the entrance fold to the siphonal canal), *Rocalaria* n. gen., as well as the other Cretaceous–Paleocene genera have only two folds (G. J. Vermeij, personal commun.).

Rocalaria closely resembles *Saxituberosa* Squires and Saul, 2006 from the Paleocene of California (type species *S. titan* (Waring, 1917), =*Penion titan* in Zinsmeister, 1983, p. 1294, fig. 3h, 3i; Squires and Saul, 2006, p. 73, figs. 12–16, 22), but the two genera may be distinguished because, apart from the characteristic spines of the subsutural belt in *Rocalaria*, the new genus has a smaller shell, shorter spire, ramps are flat and sculptured with spiral cords, spiral and axial sculpture are more delicate, spiral cords on neck are more numerous and, instead of the spiral row of tubercles of *Saxituberosa, Rocalaria* develops true axial nodose costae with interspaces that are smooth or weakly sculptured with spiral cords.

Hercorhyncus Conrad, 1869 and *Boltenella* Wade, 1917 (Late Cretaceous, southeastern U.S.A.) resemble *Rocalaria* because of the development of biconical shells with short, stepped spires and short siphonal canals. However, *Hercorhyncus* (type species *H. tippanus* Conrad, 1860; Sohl, 1964, p. 220, pl. 30, figs. 8–10, 13–16) can be distinguished from *Rocalaria* by having more prominent axial and spiral sculptures, fewer spiral cords on neck, more concave and usually wider ramp, crenulate outer lip, and by lacking spines on the subsutural belt. *Boltenella* (type species *B. excellens* Wade, 1917; Sohl, 1964, pl. 31, figs. 31, 32) differs from *Rocalaria* because the North American genus has a shorter spire, ovate aperture and stronger spiral cords than in *Rocalaria*, providing a cancellate sculpture to the shell.

Rocalaria differs from *Mylecoma* Squires and Saul, 2003b (p. 155, figs. 33–37; Turonian, California) by having a rather shorter spire, a more contracted last whorl, weaker axial costae, two columellar plaits and a row of spines in front of sutures.

General outline of *Rocalaria* resembles that of the Miocene fusinid *Falsicolus* Finlay, 1930 (type species *Fusinus kaiparaensis* Suter, 1917, p. 21, pl. 12, fig. 2, =*Fusinus morgani* Suter, 1917, p. 22, pl. 3, fig. 13) but this New Zealand genus lacks columellar

plaits, has a higher spire, periphery of whorls are strongly delimited by prominent tubercles, sutures do not have projecting spines and the columella is much straighter than in *Rocalaria*.

ROCALARIA ALANI new species
Figure 4.4–4.7

Diagnosis.—Shell biconic, medium sized, sculptured with rounded, short axial beaded plicae. Ramp of whorls and base of last whorl with fine spiral cords. Spire short. Teleoconch whorls with subsutural belt and prominent spines formed by growth lines that project in front of suture. Columella concave with two plaits; siphonal canal short, notched, slightly twisted dorsally and towards the left.

Description.—Shell biconic, medium sized (up to 60 mm in height). Protoconch of one and a half smooth whorls. Spire short (up to 19% to 21% of total height) with up to six whorls; spire angle 61°–65°; suture encroaching previous whorls, with weak subsutural belt sculptured with strong prosocline projecting spines formed by growth lines. Last whorl rounded, with rapid basal constriction and with steep, rather broad, concave subsutural sector sculptured by three or four fine spiral cords; central sector with 13 to 14 rounded beaded axial plicae that extend from angulated periphery to neck sector where they fade out rapidly and overridden by four spiral cords that in adults form delicate tubercles; neck sculptured by spiral cords wider than those on subsutural sector and of the same width as interspaces; growth lines sinuous, prosocline on subsutural belt to form the spines, opisthocline on subsutural sector, with wide sinus situated on periphery, prosocline on central sector of whorl and almost orthocline on base and neck areas; aperture pyriform with very shallow posterior notch; columella moderately concave with two plaits situated at the beginning of the canal, the abapical plait much more prominent than the adapical one; anterior canal notched, short, slightly twisted to left and gently turned dorsally; interior of outer lip smooth.

Etymology.—In honor of Alan Beu for his contribution to the knowledge of Cenozoic New Zealand molluscan faunas.

Types.—Holotype MACN–Pi 5306 from Puesto Intermedio, total height 36 mm, height of last whorl 28.7 mm, maximum diameter of last whorl 22 mm; paratype MACN-Pi 5307 from Puesto Carmelo Ibañez, total height 25.5 mm, height of last whorl 21 mm, maximum diameter of last whorl 17.7 mm; paratype MACN-Pi 5310 from Cerro Tiltilco, total height 35 mm (broken); maximum diameter of last whorl 26.7 mm.

Other material.—MACN-Pi 5308 from Puesto Carmelo Ibañez.

Occurrence.—Roca Formation, early Danian.

Remarks.—*Paleosephaea*? *nodoprosta* Stilwell et al., 2004 (p. 45, pl. 9, figs. 6, 7, 11–16) described from the early Paleocene of Antarctica can be separated from *Rocalaria alani* n. sp. because the Patagonian species has biconic shells with a much shorter spire than *P. nodoprosta* and develops spirally sculptured concave ramps, with spines on the subsutural belt. The inclusion *P. nodoprosta* in *Paleosephaea* Wade, 1926 should be revised because the Antarctic taxon differs from the type species of the genus, *P. mutabilis* Wade, 1926 (Sohl, 1964, p. 209, pl. 28, figs. 1–5; Cretaceous, Eastern North America) by having shorter spire, shorter axial tubercles, smooth ramps, weaker spiral cords and three columellar plaits.

Subfamily FUSININAE Wrigley, 1927
Genus FUSINUS Rafinesque, 1815

Type species.—*Murex colus* Linné, 1758. Recent, Indo-Pacific (by original designation).

?*Fusinus* sp.
Figure 4.1–4.3

Description.—Shell fusiform, solid, large. Protoconch unknown. Spire slender, high, conical, steeped, with up to eight rapidly increasing whorls that become more convex through ontogeny, with a well defined wide, flat sutural ramp; spire angle 55°–60°; suture impressed. Last whorl rounded, contracted to form anterior siphonal canal (broken); aperture ovate (broken). Surface sculptured with 11 to 13 axially elongated strong tubercles placed in the periphery of ramp, becoming more rounded and less marked towards last whorl; spiral sculpture of equally spaced rounded cords (three to four in 5 mm), separated by interspaces that are twice as wide as cords.

Material.—Eleven specimens from Cantera Cholino MACN-Pi 5243, Zanjón Roca MACN-Pi 5244, Lago Pellegrini MACN-Pi 5264–5265; Picada Sísmica MACN-Pi 5241 total height 19 mm; height of last whorl (siphonal canal broken) 13 mm, maximum diameter of last whorl 12.4 mm; MACN-Pi 5242a total height (broken) 40 mm, maximum diameter of last whorl 19 mm.

Occurrence.—Roca Formation, early Danian.

Remarks.—Fossils representatives of *Fusinus* Rafinesque, 1815 are easily confused with those of *Penion* Fischer, 1884, since the main diagnostic characters separating these genera are not usually preserved (i.e., protoconch and the siphonal canal, straight in *Fusinus* and curved in *Penion*). Because these specimens lack the diagnostic features they are referred doubtfully to *Fusinus*. The only other record of a probable representative of *Fusinus* in Argentina corresponds to *Fusinus*? sp. from the Maastrichtian Cerro Cazador Formation (Griffin and Hünicken, 1994, p. 266, fig. 5.1) which differs by having more slender shell with higher whorls than the Danian specimens described here.

The shell outline and sculpture of juvenile specimens of ?*Fusinus* sp. are surprisingly similar to adults of *Penion australocapax* Stilwell and Zinsmeister, 1992 (p. 128, pl. 17, figs. h–j) from the Eocene of Antarctica, but when comparing adults, ?*Fusinus* sp. has more slender shells, with more markedly convex whorls, weaker axial tubercles and sutural ramps not as well developed as in *P. australocapax*.

The Eocene Antarctic *Fusinus graciloaustralis* Stilwell and Zinsmeister (1992, p. 132, pl. 18, figs. c, d), is based on an incomplete specimen in which the siphonal canal is missing, and its assignment to *Fusinus* raises some doubt since it lacks the protoconch and siphonal canal. ?*Fusinus* sp. differs from ?*F. graciloaustralis*, because shoulders of whorls are less stepped, adults have more rounded and less developed tubercles, and spiral cords on sutural ramp are slightly thinner than those on the base of the whorl.

Family TUDICLIDAE Cossmann, 1901
(emend. by Finlay and Marwick, 1937)
Genus HETEROTERMA Gabb, 1869

Type species.—*Heteroterma trochoidea* Gabb, 1869. Paleocene, California (by monotypy).

HETEROTERMA CARMELOI new species
Figure 5.1–5.5

Diagnosis.—Shell with concave, strongly clasping whorls, prominent subsutural belt and one peripheral keel consisting of short and rounded tubercles.

Description.—Shell biconic, moderate-sized (up to 23.5 mm in height). Protoconch with one and a half smooth, rounded whorls. Spire conic, short (22% of total height) with up to four strongly clasping, concave-sided whorls partially covering previous whorls, with a broad, steep, concave sutural ramp, and prominent subsutural belt that reflects the underlying peripheral tubercles of the previous whorl; suture wavy; spiral angle 76°. Last whorl strongly angulated by a peripheral nodose keel, moderately contracted anteriorly; aperture lenticular; columella slightly concave, smooth; inner lip with a thin, narrow callus; labrum not known; anterior siphonal canal narrow, long, rather straight.

Axial sculpture of last whorl of 13 to 14 strong, short rounded tubercles appearing abruptly on peripheral keel, not reaching basal angulation; spiral sculpture of 35 thin, subequal ribs evenly distributed on surface, separated by interspaces twice wider than ribs; growth lines with antispiral sinus across the ramp and spiral antisinus at base of whorl.

Etymology.—In honor of Carmelo Ibañez, owner of Puesto Carmelo Ibañez, who kindly helped and supported our field work.

Types.—Holotype MACN–Pi 5250 from Puesto Intermedio, total height 22.6 mm, height of last whorl 17.6 mm; maximum diameter of last whorl 15 mm; paratype MACN-Pi 5251 from Puesto Carmelo Ibañez, total height 15.6 mm height of last whorl 13.7 mm, diameter of last whorl 11.6 mm.

Other material.—Bajo Hondo MACN 4134; MACN-Pi 4141, total height 18.7 mm, height of last whorl 10 mm, maximum diameter of last whorl 11 mm.

Occurrence.—Roca Formation, early Danian.

Remarks.—Although Saul (1988a, 1988b) provided clear diagnostic characters to distinguish *Pyropsis* Conrad, 1860 and *Heteroterma* Gabb, 1869, the generic placement of some species is still controversial. This is true for ?*Heteroterma acrita* Saul, 1988a and ?*Pyropsis gabbi* (Stanton, 1896) from the Paleocene of California, and for the group of taxa distributed in the Paleocene of South America, Antarctica and New Zealand. Some authors stated that these austral species all should be retained in *Pyropsis* (Stilwell et al., 2004; Beu and Raine, 2009) while others included some of them in *Heteroterma* (Beu and Maxwell, 1990; Griffin and Hünicken, 1994). Moreover, even the family placement of *Heteroterma* was matter of discussion, having been placed in Turbinellidae (Beu and Maxwell, 1990), referred to Perissityidae (Saul, 1988b; Beu and Raine, 2009), but considered to belong in Tudiclidae by most authors (Zinsmeister, 1983; Saul, 1988a; Griffin and Hünicken, 1994; Stilwell et al., 2004; del Río et al., 2007).

Paleocene tudiclids from the Southern Hemisphere are represented by the New Zealand *Pyropsis zinsmeisteri* Stilwell, 1993 and *Heteroterma zelandica* Marshall, 1917, the Antarctic *Pyropsis*? *australis* Stilwell et al., 2004 and *Heteroterma*? sp., and the Argentinean *H. elegans* Griffin and Hünicken, 1994. Only one Maastrichtian tudiclid has been mentioned for Argentina, *Heteroterma*? *tumida* (Wilckens, 1905), a species closely related to *H. carmeloi* n. sp. and that has been related with *H. zelandica* (Stewart, 1927; Finlay and Marwick, 1937) and with the Paleocene ?*H. acrita* and ?*Pyropsis gabbi* from California (Saul,1988a, 1988b).

Although it is beyond the scope of this paper to discuss affinities between *Pyropsis* and *Heteroterma*, the type species *Pyropsis perlata* (Conrad, 1860) and all congeneric Cretaceous species of the United States described by (Sohl, 1964) strongly differ from Southern Hemisphere species by having shells with a strong and abruptly contracted last whorl, lack of axial ribs and the development of strong spiral cords sculptured with strong projected spines. Therefore, *H. carmeloi* n. sp. is not included in *Pyropsis* but referred to *Heteroterma*, and it mainly differs from *H. trochoidea* Gabb, 1869, the type species of the genus, (hypotype figured by Saul, 1988b, p. 13, figs. 72, 74) by having a single peripheral nodose keel.

Heteroterma carmeloi n. sp. strongly resembles the Maastrichtian Argentinean *Heteroterma*? *tumida* (Wilckens, 1905, p. 20, pl. 4, figs. 3, 4; holotype MLP 6188; =*Cominella*? *praecursor* Wilckens, 1905, p. 21, pl. 3, figs. 14, 15; syntype MLP 9583) but both species may be separated because *H. carmeloi* has a more prominent sutural belt, spiral cords of two different sizes, a more markedly concave sutural ramp, and shorter peripheral axial tubercles than *H.*? *tumida. Heteroterma.carmeloi* is distinguished from the Paleocene Californian *H. acrita* (Saul, 1988b, p. 14, figs. 77–84; =*H. gabbi* in Zinsmeister, 1983, p. 1299, fig. 3q) and from ?*Pyropsis gabbi* (Saul 1988a, p. 885, fig. 3.26–3.30, 3.33, 3.34; =*H. gabbi* in Zinsmeister, 1983, p. 1299, fig. 3o, 3p) in having a more stepped spire, shorter peripheral nodes and stronger subsutural belt than the Californian species.

Heteroterma elegans (Griffin and Hünicken, 1994, p. 267, fig. 7.1, 7.2; Paleocene, Argentina) and *H. zelandica* (Beu and Maxwell, 1990, p. 84, pl. 2, fig. p; Paleocene, New Zealand) differs from *H. carmeloi* by having a different profile with a shorter spire with narrower and less stepped ramps, and in lacking a swollen subsutural belt, that reflects the strong peripheral tubercles of the covered preceding whorl in *H. carmeloi*. Moreover, *H. elegans* has much weaker tubercles than *H.carmeloi* and in *H. zelandica*, nodes extend down to the angulation forming true axial ribs.

Pyropsis zinsmeisteri (Stilwell, 1993, p. 365, fig. 4.1–4.6; Paleocene, New Zealand) clearly differs from *H. carmeloi* by having a shorter spire, subrhomboidal aperture, and a biangulated periphery sculptured with two keels with up to 16 strong tubercles.

Pyropsis? *australis* (Stilwell et al., 2004, p. 38, pl. 7, figs. 9, 10; Paleocene, Antarctica) is only known from a single, broken and badly preserved specimen which has a larger shell sculptured with more prominent spiral cords, peripheral tubercles are not as marked, and aperture is wider than in *H. carmeloi*.

Genus MICROFULGUR Finlay and Marwick, 1937

Type species.—*Microfulgur longirostris* (Marshall, 1917), Paleocene, New Zealand (by original designation).

MICROFULGUR CONCHEYROAE new species
Figure 5.6–5.10

Diagnosis.—Shell medium sized. Spire short. Periphery of whorls sculptured by a single smooth peripheral keel.

Description.—Shell biconic, medium sized (up to 35 mm in height). Protoconch not known. Spire short (27%–32% of total height) with up to four slightly concave whorls that conceal the previous ones, with broad, steep sutural ramp; spire angle 68° to 72°. Last whorl angulated by a prominent smooth peripheral keel at the middle of whorl, moderately contracted anteriorly to form a siphonal canal (broken); aperture pyriform; columella not visible. Surface of shell sculptured with very thin, spiral cords of equal width (10 to 12 in 5 mm), much narrower than interspaces, being the six cords placed immediately below peripheral keel slightly thicker than the remaining ones.

Etymology.—In honor of Dr. Andrea Concheyro for her contributions to the Maastrichtian–Danian stratigraphy of Patagonia.

Types.—Holotype MACN-Pi 5253 from Zanjón Roca, total height (broken) 21.9 mm; maximum diameter of last whorl 17.7 mm; paratype MACN-Pi 5255 from Puesto Carmelo Ibañez, total height (broken) 25.6 mm; maximum diameter of last whorl 18 mm.

Other material.—Seven specimens from Lago Pellegrini MACN-Pi 5254a; Picada Sísmica MACN-Pi 5252 total height (broken) 20.5 mm; maximum diameter of last whorl 18.1 mm.

Occurrence.—Roca Formation, early Danian.

Remarks.—*Microfulgur* Finlay and Marwick, 1937 is a little diversified and scarcely known genus. Apart from its type species, it includes the Antarctic Paleogene *Tudiclana byrdi* Stilwell and Zinsmeister, 1992 and *Serrifusus binodosum* Stilwell et al., 2004, both taxa recently placed in *Microfulgur* by Beu and Raine (2009), *M.*(?) *carinatus* Ponder, 1970 (Recent, New Zealand), a species that should be doubtfully assigned to *Microfulgur* (Beu and Maxwell, 1990), and *Microfulgur*? sp. from the Paleocene of Australia (Darragh, 1997).

Specimens available for study have broken siphonal canals, but spire and sculpture are rather well preserved. *Microfulgur concheyroae* n. sp. differs from the type species *M. longirostris* Finlay and Marwick (1937, p. 73, pl. 9, figs. 1, 2, 7; Beu and Maxwell, 1990, p. 83, pl. 2, figs. q, r) by having a larger shell, shorter spire, and whorls sculptured with more numerous spiral cords that are narrower and more closely spaced below periphery than in the type species. It can be distinguished from the Eocene *Microfulgur byrdi* (Stilwell and Zinsmeister, 1992, p. 140, pl. 19, figs. j, k; Antarctica) by having a larger shell, a more conical and shorter spire, and a single smooth peripheral keel instead of two keels as *M. byrdi*.

Microfulgur concheyroae differs from the Danian *M. binodosum* (Stilwell et al., 2004, p. 42, pl. 9, figs. 1–5; 8–10; Antarctica) by having a shorter spire, only one peripheral keel placed in the middle of whorls, and a narrower sutural ramp.

The Australian Paleocene *Microfulgur*? sp. (Darragh, 1997, p. 78, fig. 4k, 4l) can be distinguished from *M. concheyroae* by having a smaller shell, ovate aperture and a more rounded last whorl than the Argentinean species, sculptured with much coarser cords below periphery than on sutural ramp.

Family Pseudolividae de Gregorio, 1880
Genus Sulcobuccinum d'Orbigny, 1850

Type species.—*Buccinum fissuratum* Deshayes, 1835. Thanetian, France (subsequent designation by Vermeij, 1998)

Sulcobuccinum prominentum new species
Figure 6.1–6.7

1946 *Cominella* cf. *praecursor* Wilckens, 1905, Petersen, p. 133, pl. 11, fig. 21.

Diagnosis.—Spire high with slightly rounded whorls sculptured with well developed spiral cords and 13 to 16 orthocline to slightly prosocline elongated, straight axial costae; one row of prominent, curved tubercles situated at the periphery of ramp.

Description.—Shell fusiform, medium sized (up to 45 mm high). Protoconch paucispiral, low, dome shaped, with two and a half smooth whorls. Spire high (about 29% to 41% of total height), with up to seven shouldered rounded juveniles whorls and tabulated older ones; spire angle 75°–80°; sutures canaliculated. Last whorl not umbilicate and not constricted at base, with well defined, narrow, deep pseudolivid groove placed at the anterior third of last whorl; aperture narrowly elongated with thick, parietal callus not extending over spire; inner side of labrum smooth except for a well developed labral tooth and three or four weak ondulations corresponding to outer cords; posterior siphonal notch present; anterior notch narrow, deep and twisted; fasciole developed; siphonal fasciolar ridge present and bounded by keel. Axial sculpture of 13 to 16 thick, straight, orthocline to sligthly prosocline, angulated axial plicae that run from periphery of ramp to the pseudolive groove, rising above sutural ramp to form angulated and strongly curved tubercles; spiral sculpture of slightly rounded spiral cords (40 in 5 mm), twice the width of interspaces and becoming thinner towards base.

Etymology.—From the Latin *prominentis-prominens* in reference to well developed axial and spiral sculptures.

Types.—Holotype CPBA 17619b from Cerro Tiltilco, total height 29.4 mm, height of last whorl 23.2 mm, diameter of last whorl 20 mm; paratypes from Puesto Carmelo Ibañez: MACN-Pi 5256, total height 12 mm; height of last whorl 9.5 mm, maximum diameter of last whorl 8.7 mm; MACN-Pi 5257, total height 38.8 mm, height of last whorl 25 mm, maximum diameter of last whorl 23.8 mm; MACN-Pi 5258, total height 26.9 mm, height of last whorl 21.4 mm, diameter of last whorl 17.6 mm.

Other material.—Twenty specimens from Cerro Tiltilco CPBA 17169a, MACN-Pi 5262; Puesto Carmelo Ibañez MACN-Pi 5261; Bajo Hondo MACN-Pi 5259; Picada Sísmica MACN-Pi 5260; Lago Pellegrini MACN-Pi 5263.

Occurrence.—Roca Formation, early Danian.

Other occurrences.—Cerros Bayos, La Pampa Province (Roca Formation); Puesto Crettón, Chubut Province (Lefipán Formation); Danian.

Remarks.—*Sulcobuccinum* d'Orbigny, 1850 is a cosmopolitan warm-water taxon widely distributed from the Late Cretaceous to Eocene of the Northern Hemisphere. It is poorly diversified in the Southern Hemisphere where it has been recorded in Campanian–Maastrichtian rocks of Brazil and Perú (Vermeij, 1998) and is represented by only two Paleocene species in Australia and Brazil (Darragh,1997; White, 1887) and by one Chilean species of undetermined age (Nielsen and Frassinetti, 2003).

Sulcobuccinum is characterized by a wide variation in the strength of axial and spiral sculptures. Axially strongly sculptured species were placed in *Pegocomptus* Zinsmeister, 1983, *Colorebama* Squires, 1989, and *Popenoeum* Squires, Zinsmeister and Paredes-Mejía, 1989, all genera synonymized with *Sulcobuccinum* by Vermeij (1998). In turn, Pacaud and Schnetler (1999) synonymized *Sulcobuccinum* with *Pseudoliva* Swainson, 1840. As Vermeij (1998) stated, *Pseudoliva* differs from *Sulcobuccinum* "by having the pseudolivid groove and labral tooth situated lower on the whorl, by the presence of a rounded parietal rib at the adapical end of inner lip, and by being essentially smooth, there being no trace of axial sculpture" (Vermeij, 1998, p. 59).

The material analyzed is included in *Sulcobuccinum* d'Orbigny, 1850 based on the development of a paucispiral protoconch, smooth inner side of outer lip, a thick parietal callus, the pseudolivid groove placed in the anterior sector of the last whorl, the development of a siphonal fasciole, a deep siphonal notch and by the presence of shouldered whorls sculptured with axial and spiral cords.

Sulcobuccinum prominentum n. sp. differs from the type species of the genus, *S. fissuratum* (Deshayes, 1835) by having a more tabulated shell, higher spire, wider sutural ramp and well developed axial and spiral sculptures.

The Patagonian species strongly resembles *Pseudoliva* (*Buccinorbis*) sp. (Darragh, 1997, p. 81, fig. 4g–4l) from the Pebble Point Formation (Paleocene, Australia), a taxon that should be placed in *Sulcobuccinum* since *Pseudoliva* Swainson, 1840 mainly differs from *Sulcobuccinum* by having almost smooth shells with the pseudolivid groove placed in a lower position than in *Sulcobuccinum. Sulcobuccinum prominentum* differs from the Australian species by having straight axial costae that develop prominent tubercles at the sutural ramp, in addition to wider and more numerous spiral cords.

Sulcobuccinum dechordata (White, 1887, p. 136, est. 13, figs. 7, 8) from the Paleocene Maria Farinha Formation (Brazil), differs from *S. prominentum* by having shorter axial costae, lower tubercles and because it lacks spiral cords.

The axially sculptured *Sulcobuccinum primus* (Defrance, 1827) from the Paleocene of the Paris Basin (Villate, 1970, p. 23, pl. 1, figs. 1–10) differs from *S. prominentum* by having a higher spire with flat whorls, 10 to 12 much shorter axial costae and two rows of strong tubercles.

Sulcobuccinum prominentum differs from the early Paleocene *S. curvicostatum* (Briart and Cornet, 1870) of Belgium (Glibert, 1973, p. 72, pl. 8, fig. 13a, 13b) by having a larger shell, lower spire, orthocline to slightly prosocline axial costae and the pseudolive groove in a lowermost position than in *P. curvicostata*.

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