

## THE SYSTEMATIC POSITION OF *TRIGONIA NEPOS* PAULCKE, 1903, AND *PAULCKELLA*, A NEW GENUS FOR THE APTIAN OF CHILE

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### ABSTRACT

*Trigonia nepos* Paulcke is a poorly known bivalve from the late Aptian of northern Chile. Although the syntypes are lost, believed destroyed, topotype material shows it to represent a new genus of Pterotrigoniinae for which the name *Paulckella* gen. nov. is proposed. A neotype is designated and the systematic position of *Paulckella* gen. nov. discussed. At present it is a South American endemic bivalve.

Key words: Systematics, Bivalvia, Trigoniidae, Pterotrigoniinae, *Paulckella* gen. nov., Aptian, Chile.

### RESUMEN

*Trigonia nepos* Paulcke es un bivalvo poco conocido, recolectado en estratos del Aptiano superior, norte de Chile. El análisis de la descripción original, complementado con el estudio de topotipos reveló que, si bien pertenece a la subfamilia Pterotrigoniinae, posee características morfológicas ausentes en los géneros conocidos. Se propone la creación de un taxón nuevo, *Paulckella* gen. nov., hasta ahora endémico de Sudamérica, basado en *T. nepos* como especie tipo. Se designa un neotipo y se discute la posición sistemática del nuevo género.

Palabras claves: Sistemática, Bivalvia, Trigoniidae, Pterotrigoniinae, *Paulckella* gen. nov., Aptiano, Chile.

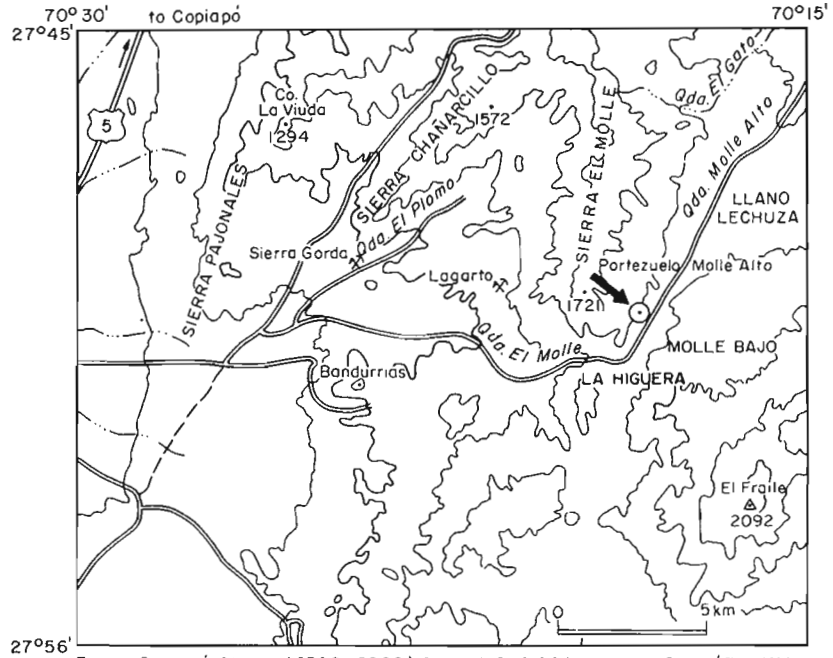
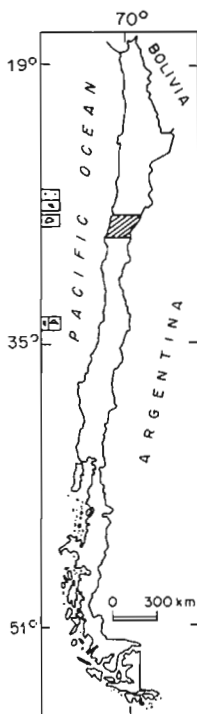
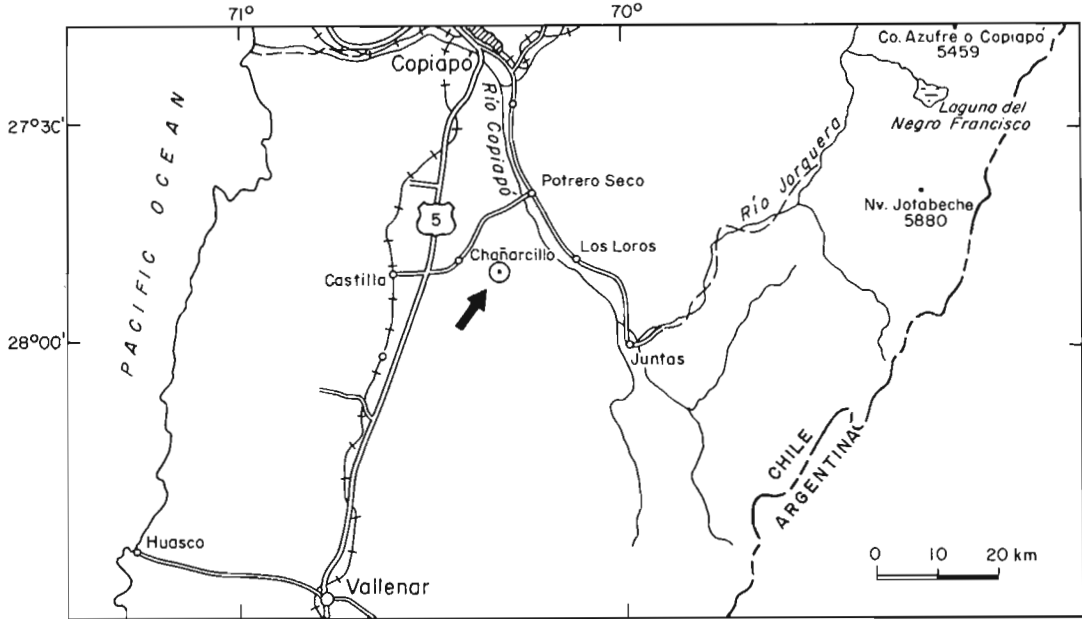
### INTRODUCTION

Trigoniacean bivalves are characteristic elements of most Mesozoic shallow-marine deposits. Whereas their hinge morphology has remained unchanged, they display a bewildering and unsurpassed diversity of external ornament as an adaptation to shallow burrowing. External morphology, therefore, is the prime character on which the taxonomy of the group is based.

In this paper, the late early Cretaceous *Trigonia nepos*, coming from Pabellón Formation strata, in the Molle Alto locality (text-Fig. 1), is analyzed, and a new genus of trigoniid bivalve, with *T. nepos* as type species, is described. Unfortunately, the syntypes of *T. nepos* are lost, presumed destroyed by fire in the Strassburg Museum after World War II. Due to the systematic importance of this

species, that has a peculiar anterior flank ornamentation, a neotype is chosen based on a topotype. Three specimens, besides the neotype, collected from the type locality by one of the authors (E.P.) have served to make a complementary description of *T. nepos* and to discuss the forms coming from other localities of Chile, which have been identified as *T. nepos* by previous authors. The presence of the ammonite genus *Parahoplites* in the associated fauna allows to postulate a late Aptian age for this species (Pérez and Covacevich, 1988).

*T. nepos* Paulcke has been cited in northern Chile, out of Molle Alto, in Quebrada El Way and Calizas La Viuda, Antofagasta Region, and in Quebrada de Los Cóndores, Atacama Region (Reyes



From: Copiapó Sheet (2700-6900) Scale 1:250 000 Instituto Geográfico Militar, Chile. Contour line equidistance 200 m. Altitude meters

Text-FIG. 1. Maps showing the type locality (Molle Alto: 27°50'S; 70°19'W) of *Paulckella nepos* (Paulcke), sited about 50 km south of Copiapó city, Atacama Region, northern Chile.

and Pérez, 1978, p. 13); besides Chile, it has only been mentioned in the Neocomian of Cerro de Pasco, Central Perú (Salfeld, 1911, p. 219).

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stratigraphic importance of Trigoniidae in Chile' sponsored by the Servicio Nacional de Geología y Minería (Chile).

## SYSTEMATICS

Subclass Palaeoheterodonta Newell, 1965

Order Trigonioida Dall, 1899

Superfamily Trigoniacea Lamarck, 1819

Family Trigoniidae Lamarck, 1819

Subfamily Pterotrigoniinae van Hoepen, 1929

**Diagnosis.** Shell small to moderately large, strongly inequilateral, club shaped to lunate, with umbones commonly prominent; anteriorly inflated, posteriorly produced and often rostrate; respiratory margin commonly rounded. Escutcheon wide, sunken, with transverse costellae. Carinae pre-

sent only in nepionic stages. Area narrow. bipartite, usually unornamented in maturity. Middle and adult growth stages with conspicuously tuberculate, oblique flank costae, which may be divided into a robust, coarsely tuberculate anterior set and a more gracile posterior set.

### Genus *Paulckella* gen. nov.

**Type species:** *Trigonia nepos* Paulcke, 1903, p. 293, Pl. 17, Figs. 7, 8, by original designation herein.

**Etymology.** In honour of W. Paulcke, the German paleontologist who described the type species.

**Diagnosis.** A Pterotrigoniinae with weakly concave to straight posterodorsal margin and obliquely truncate respiratory margin. Shell anteriorly inflated with prominent umbones and strongly incurved prosogyrous beaks. Escutcheon wide, with oblique costellae. Area moderately narrow, smooth except in early growth stages. Flank costae conspicuously tuberculate, with subumbonal ribs bifurcating and curving upwards on the flattened anterior face.

**Discussion.** The presence of oblique, strongly tuberculate flank costae, and strong anterior inflation places *Paulckella* gen. nov. in the Pterotrigoniinae. Kobayashi and Nakano (1957, p. 230) put *T. nepos* with doubts in the subgenus *Rinetrigonia* van Hoepen, pointing out that the flank branching anterior costae could place this species in a genus not yet defined. In the same context, Levy (1967, p. 102) preferred to emend the diagnosis of *Rinetrigonia* instead of proposing a new genus. *Trigonia nepos* Paulcke was also assigned to *Pterotrigonia* van Hoepen (1929, p. 9) (type species: *P. cristata* van Hoepen) by Reyes and Pérez (1978, 1979),

but its characters are not those of the type species. *P. cristata* van Hoepen (1929, p. 10, Pl. 4, Figs. 3-6) (Pl. 1, Figs. 9-15) differs in being club-shaped and strongly rostrate posteriorly, so that it is relatively much longer and narrower. It also has a narrowly rounded respiratory margin, transverse costellae to the escutcheon, and lacks the characteristic bifurcating anterior costae found in *Paulckella* gen. nov., a diagnostic feature that has not been previously described in any known *Pterotrigonia* species.

*Pisotrigonia* van Hoepen (1929, p. 20) (type species: *P. salebrosa* van Hoepen) is widely regarded as a synonym of *Rinetrigonia* van Hoepen (type species: *Lyrodon ventricosa* Krauss) (Kobayashi and Nakano, 1957; Skwarko, 1966; Nakano, 1974); but, in fact, has page priority over the latter genus. *Paulckella* resembles *Pisotrigonia* in being strongly inflated anteriorly, with a tendency for the anterior face to be flattened and subvertical, and in having prominent umbones and strongly incurved beaks. All known species of *Pisotrigonia*, however, are relatively higher, with a deeply concave posterodorsal margin, and have simple anterior ribs which never bifurcate. Typically, *Pisotrigonia* shows better discrimination between the anterior and posterior sets of flank costae, with coarser, more robust anterior costae bearing fewer, larger nodes.

In shell outline, tuberculation and rigidity of flank costation, *Paulckella* gen. nov. is close to *Acanthotrigonia* van Hoepen (1929, p. 14) (type species: *Trigonia shepstonei* Griesbach). The latter taxon is a Late Cretaceous (Coniacian to Maastichtian) genus known only from South Africa, Angola and Argentina. It differs from *Paulckella* gen. nov. in being weakly inflated anteriorly, with inconspicuous umbones and simple anterior flank costae which do not bifurcate.

*Scabrotrigonia* Dietrich (1933, p. 330) (type species: *Trigonia scabra* Lamarck) differs from *Paulckella* gen. nov. in being less inflated anteriorly, with denser, more finely tuberculate flank costae which curve anteriorly and are not separated into an anterior and posterior set. In addition, the costae of the flank and escutcheon are continuous onto the area of *Scabrotrigonia*, forming a chevron at the median longitudinal groove.

*Ptilotrigonia* van Hoepen (1929, p. 22) (type species: *P. lauta* van Hoepen) differs from *Paulckella* gen. nov. in being less inflated anteriorly, with less prominent umbones and a rounded respiratory margin. In addition, it has curved flank costae which do not bifurcate and are ornamented by crowded nodes besides having a deeply concave posterodorsal margin.

*Arabitrigonia* Nakano (1973, p.66) (type species: *Trigonia pseudocrenulata* Noetting) is an Aptian taxon known only from the Middle East. It resembles *Paulckella* gen. nov. in its prominent umbones, strong ribs and obliquely truncate respiratory margin, but has sinuous flank costae which do not bifurcate anteriorly and have finer tuberculation. In addition, *Arabitrigonia* has radial costellae to the area, a feature which led Nakano (1973) to place it in the Myophorellinae, close to *Pseudomyo-*

*phorella* Nakano. The similarities seem to be due to convergence and *Arabitrigonia* has to be considered a good Pterotrigoniinae.

In its bifurcating anterior costae *Paulckella* gen. nov. closely resembles some forms of *Apiotrigonia* Cox, e.g. *A. (Microtrigonia) postonodosa* Nakano (Tashiro, 1972, Pl. 40, Figs. 20-23). Although the similarities are the result of convergence, bifurcating anterior flank costae are also encountered in species of *Heterotrigonia* Cox (Tashiro, 1979) and this character is thus widespread within the Apiotrigoniinae. *Paulckella* differs from *Apiotrigonia* in its prominent umbones and strongly incurved beaks, its unornamented area in maturity, and its strongly oblique flank costae with coarse tuberculation. At all growth stages it lacks the V-shaped flank costae of typical *Apiotrigonia*. In all these characters it is closer to the Pterotrigoniinae. Another trigoniid which displays bifurcating anterior flank costae is the Jurassic *Scaphorella* Leanza, Pérez and Reyes (1987, p. 83) (type species: *Trigonia leanzai* Lambert), but the latter is a Myophorellinae and the similarities are due to convergence.

The upward curvature of the anterior flank costae seen in *Paulckella* gen. nov. is also found in *Buchotrigonia* Dietrich. The latter genus differs in being subovate and relatively higher, with a very short posterodorsal margin. It also lacks the coarse tuberculation of *Paulckella* gen. nov. and is less inflated anteriorly with the result that the strong curvature of anterior costae is conspicuous in lateral view.

Large individuals of *Paulckella* gen. nov. (e.g. Paulcke, 1903, Pl. 17, Fig. 7) bear a marked resemblance to Permo-Triassic *Costatoria* Waagen (Newell and Boyd, 1975, p. 153, Figs. 94, 95) but the similarities are due to convergence.

### ***Paulckella nepos* (Paulcke, 1903)**

(Pl. 1, Figs. 1-8; text-Fig. 2)

*Trigonia nepos* Paulcke, 1903, p. 293, Pl. 17, Figs. 7-8

non *Trigonia nepos* Paulcke, 1903. Leanza and Castellaro, 1955, p. 186-188, Pl. 1, Fig. 9, Pl. 2, Figs. 1, 5.

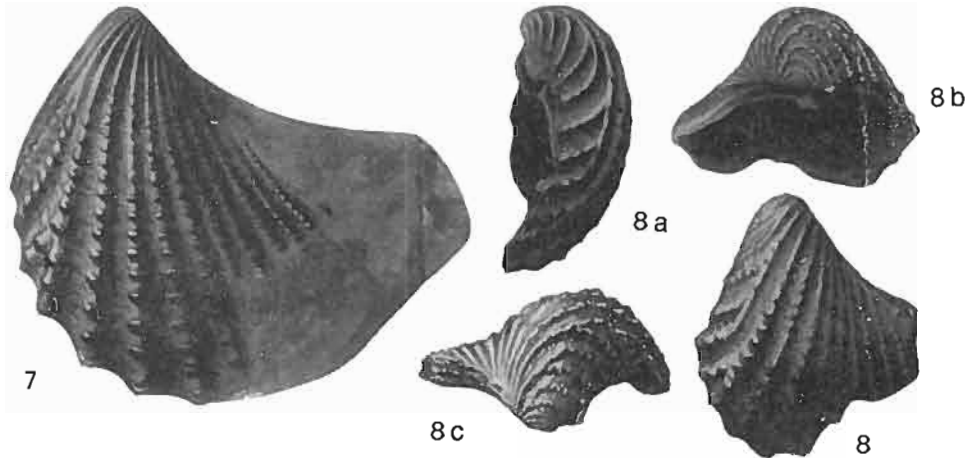
non *Trigonia nepos* Paulcke, 1903. Tavera in Alarcón and Vergara, 1964, p. 114, Pl. 4, Fig. 9.

*Pterotrigonia nepos* (Paulcke). Reyes and Pérez, 1978, p. 13, Pl. 2, Fig. 4.

*Pterotrigonia (P.) nepos* (Paulcke). Reyes and Pé-

rez, 1979, Pl. 3.

**Neotype.** Specimen SNGM-7146 (Pl. 1, Figs. 1,2). Paulcke (1903, p. 193-195, Pl. 17, Figs. 7, 8) based his description of *T. nepos* on five syntypes (text-Fig. 2) deposited in the Strassburg Collection. This collection is missing, presumably destroyed by fire after World War II. Due to the systematic importance of *T. nepos*, the specimen SNGM-7146, of the topotype material, is here designated as the neotype.



Text-FIG. 2. Reproductions of the original illustrations of *T. nepos* Paulcke, 1903 (Pl. 17, Figs. 7, 8), x 1.

**Type locality.** Molle Alto (ca. 27°50'S; 70°19' W), 50 km south of Copiapó city, Atacama Region (text-Fig. 1).

**Complementary material and occurrence.** The silicified topotype material studied here (Pl. 1, Figs. 1-8) was collected from the type locality Molle Alto (by E.P., 1965, samples FCH-45-A) (text-Fig. 1), from the upper part of the Pabellón Formation (Biese *in* Hoffstetter *et al.*, 1957). It includes specimens SNGM-7147 (Pl. 1, Figs. 4, 8), SNGM-7148 (Pl. 1, Fig. 3) and SNGM-7149 (Pl. 1, Figs. 5-7).

**Repository.** Museo Geológico, Servicio Nacional de Geología y Minería (SNGM), Santiago, Chile.

**Associated fauna.** This includes *Parahoplites* gr. *nutfieldiensis* (J. Sowerby), *Steinmannella* gr. *transitoria* (Steinmann), *Paulckella* sp. nov., *Chlamys* cf. *discors* (Philippi) [non *Pecten discors* Philippi], *Idonearca* sp., and *Ptychomya* sp., together with indeterminate bryozoans, serpulids and gastropods.

**Age.** The presence of the ammonite *Parahoplites* gr. *nutfieldiensis* (J. Sowerby) at the type locality of *P. nepos* dates this species, and also the upper part of the Pabellón Formation, as late Aptian, instead of late Barremian (Corvalán 1974, p. 33).

**Description.** The shell is medium to moderately large, thick, trigonally ovate, very inequilateral, and posteriorly produced. It is strongly inflated anteriorly, with prominent subterminal umbones and strongly incurved, prosogyrous beaks. The anterior margin is steep, weakly convex to flat; the ventral margin is strongly convex; the respiratory margin, obliquely truncate; and the posterodorsal mar-

gin, shallowly concave to straight.

The escutcheon is concave, slightly narrower than the area, and ornamented with finely tuberculate costellae which are twice narrower than the interspaces, with four costellae in a centimeter on the central portion of the neotype. The costellae are oblique, cutting the growth striae at right and oblique angles, and meet the posterodorsal commissure to form an obtuse, posteriorly directed chevron. The position of the inner carina is marked in the nepionic stages by a row of spaced tubercles, one for each costella of the escutcheon.

The area is moderately narrow, almost flat, and broadens posteriorly. It is ornamented with fine, regular, transverse costellae in the nepionic stages, but later only by growth striae. There is a distinct median longitudinal furrow which persists to the respiratory margin, and is situated closer to the escutcheon than the flank. The marginal carina is fine and sharp near the umbo, becoming rounded later. In both valves the flank costae join this carina at acute angles.

The flank costae are rigid, about as wide as the interspaces, and broaden ventrally. Close to the area they are finely crenulated by small pointed tubercles which may develop into spines (text-Fig. 2). Distally, however, the tubercles become well spaced, exaggerated, and bluntly rounded, resembling the condition observed in *Acanthotrigonia*. Although the flank costae are separated into an anterior and posterior set, this is not as marked as *Pisotrigonia*. The first 3-4 umbonal costae are concentric to subconcentric, after which they be-

come strongly oblique. The subumbonal 3-4 costae bifurcate at the anterolateral shoulder (text-Fig. 2) and curve upwards, extending across the anterior face to meet the commissure in an acute angle. The posterior 3-4 ribs of the anterior set are straight, and posteriorly inclined. The posterior set comprises 11-12 straight, simple costae which are narrower than those of the anterior. They are inclined strongly to the posterior and are crowded and finer at their contact with the carina, forming an angle which becomes progressively acute posteriorly.

#### Measurements (in mm)

No.	L	H	T	H/L	T/L
SNGM-7146 (RV) (neotype)	45 *	41 *	21 *	0,91 *	0,47 *
SNGM-7147 (RV)	70	50 *	21	0,71 *	0,30
SNGM-7148 (RV)	74 *	54 *	-	0,73 *	-
SNGM-7149 (RV)	52 *	42	21	0,81 *	0,40

RV: right valve; L: length; H: height; T: thickness.

\* Approximate values.

**Discussion.** *Trigonia nepos* Leanza and Castellaro (*non* Paulcke) (1955, p. 186, Pl. 1, Fig. 9, Pl.

2, Figs. 1, 5) from Quebrada El Way, Antofagasta Region, northern Chile, represents another species of *Paulckella*. It differs from *P. nepos* in having a more acute umbonal angle, a more steep anterior region, and flank subumbonal costae with finer branches that fail to reach the anterior commissure (Pérez and Reyes, in prep.).

Among the associated fauna of *T. nepos* neotype (Molle Alto locality) there are some specimens considered, in this paper, as *Paulckella* sp. nov. (Pérez and Reyes, in prep.). The new species bears a superficial resemblance to *P. nepos* (Paulcke) but differs in being elongated pyriform; with the anterior border strongly convex and the dorsal, slightly concave. Moreover, the area is very narrow and convex and the flank posterior costae are fairly thin and not tuberculated.

The other mentions of *T. nepos* Paulcke, Quebrada de Los Cóndores, Atacama Region (Corvalán in Reyes and Pérez, 1978, p. 13) and Cerro de Pasco, Central Perú (Salfeld, 1911, p. 219) do not give enough information, about the ornamentation of the flank anterior region, to evaluate if the identification as *T. nepos* corresponds to the diagnosis of species.

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**PLATE 1**

(All figures in natural size)

Figures 1-8

*Paulckella nepos* (Paulcke)

p. 54

Molle Alto, about 50 km south of Copiapó city, Atacama Region, northern Chile. Pabellón Formation, upper part. Late Aptian.

- 1, 2      Lateral and anterior view of the neotype, SNGM 7146. Note the bifurcating subumbonal costae.
- 3        Lateral view of SNGM 7148.
- 4, 8     Dorsal and lateral views of SNGM 7147
- 5 - 7    Lateral, anterior and umbonal views of SNGM 7149.

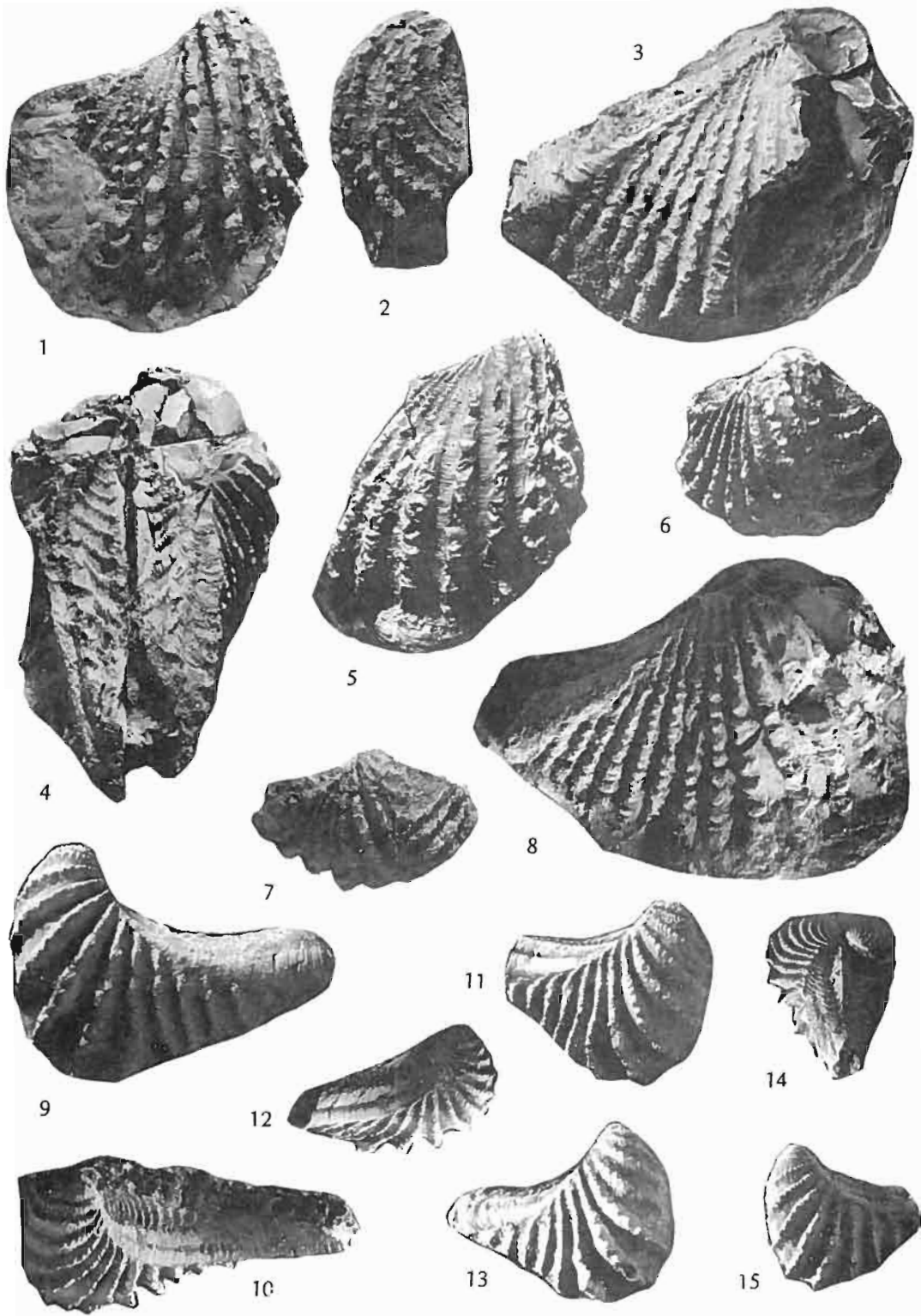
Figures 9-15

*Pterotrigonia cristata* van Hoepen

Zululand, South Africa; all in the South African Museum.

- 9, 10    The holotype, SAM D1404.
- 11, 12   A paratype, SAM D1409.
- 13      A plesio-type, SAM D533.
- 14, 15   A paratype, SAM D1410.





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