

THE GENUS *CHAMA* LINNÉ (BIVALVIA) IN THE MARINE QUATERNARY OF NORTHERN PATAGONIA, ARGENTINA

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ABSTRACT—*Chama iudicai* n. sp. is described from the Pleistocene of San Antonio Oeste, Rio Negro Province, Argentina. It is characterized by its large size, thick shell, and crenulated inner margin. Externally it has weak comarginal lamellae. It is indicative of a clear, stenohaline, warm-water environment. This is the first record for the family Chamidae in the Argentine Quaternary.

INTRODUCTION

IN ANOTHER paper I reported one valve of the genus *Chama* Linné from the Quaternary of the San Antonio Oeste region, northern Patagonia (Pastorino, in press). New collections from the same region and same stratigraphic levels have provided more and better preserved specimens that allow recognition of a new species. The material is housed in the Division Paleozoología Invertebrados, Museo de Ciencias Naturales, La Plata, Buenos Aires, Argentina (MLP).

GEOGRAPHIC AND STRATIGRAPHIC SETTING

The material described below was obtained from three different localities (Figure 1).

1) San Antonio Oeste: most and the best preserved specimens were found in a beach ridge exposed at low tide in the Baliza San Matias area. This beach ridge consists of a pebble conglomerate including gastropods and bivalves strongly cemented by calcium carbonate (Angulo et al., 1979). The conglomerates have been referred to the upper Pleistocene (Angulo et al., 1979; Rutter et al., 1989).

2) Puerto Lobos: two right valves were found in a beach deposit, about 40,000 years old (Bayarsky and Codignotto, 1982), parallel to the coastline and about one kilometer inland.

3) Intersection of Ruta Provincial (state road) 304 and Ruta Nacional (national road) 251 (Pastorino, in press): Rutter et al. (1989) dated this beach ridge as upper Pleistocene.

The presence of *Chama* in Quaternary deposits of the area around San Antonio Oeste suggests warmer water temperatures than those recorded today in the same area (about 17°C in summer, according to Pascual et al., 1989). This variation probably corresponds to Interstadial periods, and is in agreement with Feruglio's (1950) previous conclusions. Feruglio (1950) numbered the marine terraces along the coast from 1 to 6 according to their age, the last three being the youngest. Mollusks present in these three terraces differ from each other. Terrace 4 includes species that today are living farther north, terrace 5 has species from the Magellanic province, and terrace 6 has a faunal composition identical to the one presently recorded in the area (Argentine Province). Cionchi (1987) correlated terraces 4 and 5 of Feruglio and the interior series of Puerto Lobos (Bayarsky and Codignotto, 1982) with the Baliza San Matias Formation (see Figure 2).

SYSTEMATIC PALEONTOLOGY

The systematic arrangement of the higher taxa is taken from the "Treatise on Invertebrate Paleontology" (Moore, 1969).

Superfamily CHAMACEA Lamarck, 1809

Remarks.—The affinities of this superfamily were discussed by several authors (Böhm, 1891; Odhner, 1919; Newell, 1965;

Yonge 1967). On the basis of anatomic and microstructural studies Kennedy et al. (1970) concluded that the Chamacea are closely related to the byssate carditaceans.

Family CHAMIDAE Blainville, 1825 (=Camacea, ICZN Opinion 484)

Remarks.—Reeve (1846) pointed out that, like the oysters, Chamidae show much morphologic variation that is ecologically controlled. Therefore, taxonomic discrimination at the species level should be based on a large number of specimens (Odhner 1919; Delsaerdt, 1986).

The Chamidae originated in the Cenomanian. During the Tertiary, and especially since the Eocene, they became relatively abundant, reaching a maximum in the Pliocene tropical and subtropical faunas. Three genera are living today in tropical seas: *Chama* Linné, *Pseudochama* Odhner, and *Arcinella* Schumacher. *Arcinella* is geographically restricted to Central America and the other two are found in all tropical seas.

Genus CHAMA Linné, 1758

Type species.—*Chama lazarus* Linné, 1758, by subsequent designation of Children (1823) (ICZN, 1957, Opinion 484). The type material is in the collection of the Linnean Society, London, and in the Zoological Museum of the Uppsala University, Sweden.

Remarks.—Linné's (1758) indication that the type species is restricted to the Mediterranean area is incorrect, as it is only found in the Indo-Pacific Province (Delsaerdt, 1986). The oldest records of *Chama* belong to *Chama haueri* Zittel, 1865, and *C. toeroeki* Petho, 1906, from the Late Cretaceous of Austria and Hungary.

Paleocene species of *Chama* are known from Georgia (Palmer and Brann, 1965–1966). In the Eocene this genus became relatively more frequent as suggested by the presence of *Chama calcarata* Deshayes in the Lutetian of France, *Chama piriensis* Squires in the Early Eocene from southern California, and another species described from the Oligocene of California (Loel and Corey, 1932). The oldest record of this genus in South America is from the Miocene of the Puerto Madryn region (Brunet, 1986).

Bernard (1976) mentioned the presence of *Chama pellucida* Broderip (= *C. chilensis* Philippi, 1887) in the Pliocene of Laguna de Cahuil, Chile, although Philippi (1887) believed that the specimens of "*C. chilensis*" came from Quaternary deposits.

Since Odhner's work (1919), species cemented by the left valve have been included in *Chama*, and those cemented by the right valve have been included in *Pseudochama*. Yonge (1967) questioned the taxonomic importance of this distinction. Bernard (1976) studied the ontogeny of both genera and concluded that there is genetic control on which valve cements to

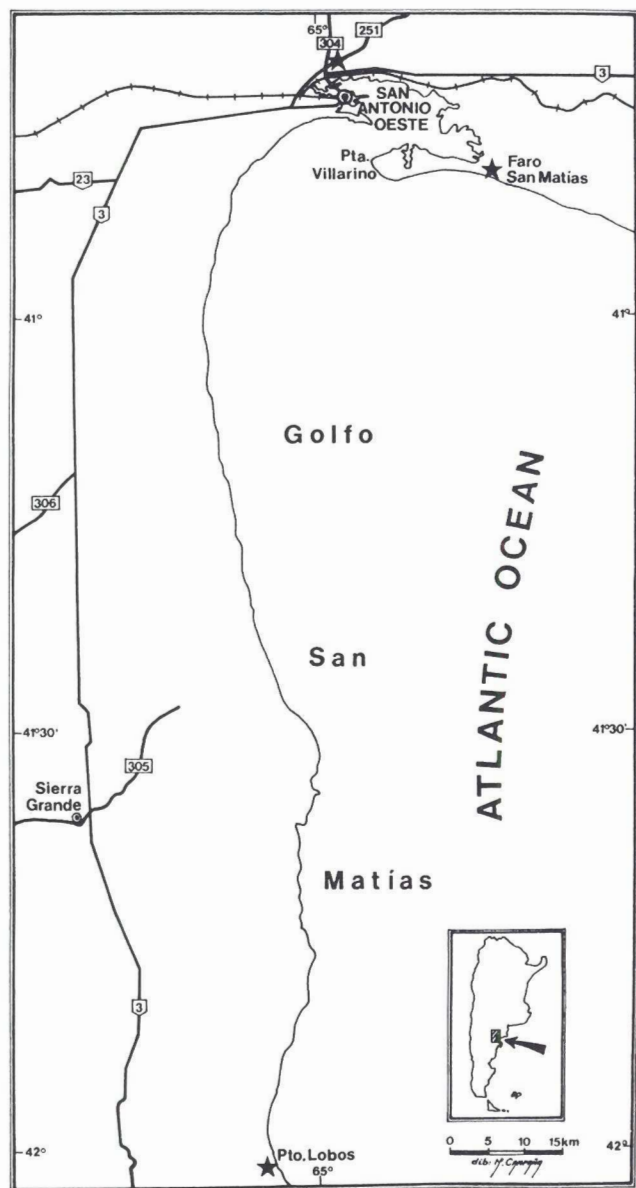


FIGURE 1—Index map showing the type locality for *Chama iudicai* n. sp. and other collecting localities.

the substratum. Any deviation is due to teratologic causes or misidentification.

CHAMA IUDICAI n. sp.
Figure 3.1–3.10

Chama congregata Conrad. PASTORINO, in press.

Diagnosis.—Large and subcircular species of *Chama*; thick shell; crenulated inner margins; both valves with weak comarginal lamellae.

Description.—Subcircular valves, maximum size up to 50 mm long and 80 mm high; umbones prosogyrous, external parivincular ligament; external ornamentation of comarginal lamellae, unevenly spaced; projecting up to 3 mm above shell surface; inner margins faintly crenulated; muscle scars well developed; integripalliate.

Left valve strongly concave; hinge with large cardinal tooth

| SERIES EPOCH | PUERTO LOBOS BAYARSKY AND CODIGNOTTO (1982) | SAN ANTONIO OESTE ANGULO ET AL (1979) | MARINE TERRACES FERUGLIO (1950) | |
|-----------------|---|---|------------------------------------|----|
| HOLOCENE | Exterior Series | San Antonio Formation | Postglacial | VI |
| PLEISTOCENE | Interior Series | Baliza San Matias Formation | Interglacial | V |
| | | | | IV |

FIGURE 2—Stratigraphic correlation of the marine Quaternary in the San Antonio Oeste–Puerto Lobos region.

with oval base and striated on its upper side; posterior to cardinal tooth is a socket and two crests with a weak furrow between them; weak lateral tooth behind ligament.

Right valve subcircular, flat; umbo rotated rightwards; hinge with one laterally elongated cardinal tooth; below, a furrow with striated socket for left valve cardinal tooth located on lower area of hinge.

Holotype.—Left valve illustrated in Figure 3.1–3.3; MLP 25071a.

Type locality.—Baliza San Matias, San Antonio Oeste, Rio Negro Province, Argentina.

Stratum typicum.—Baliza San Matias Formation.

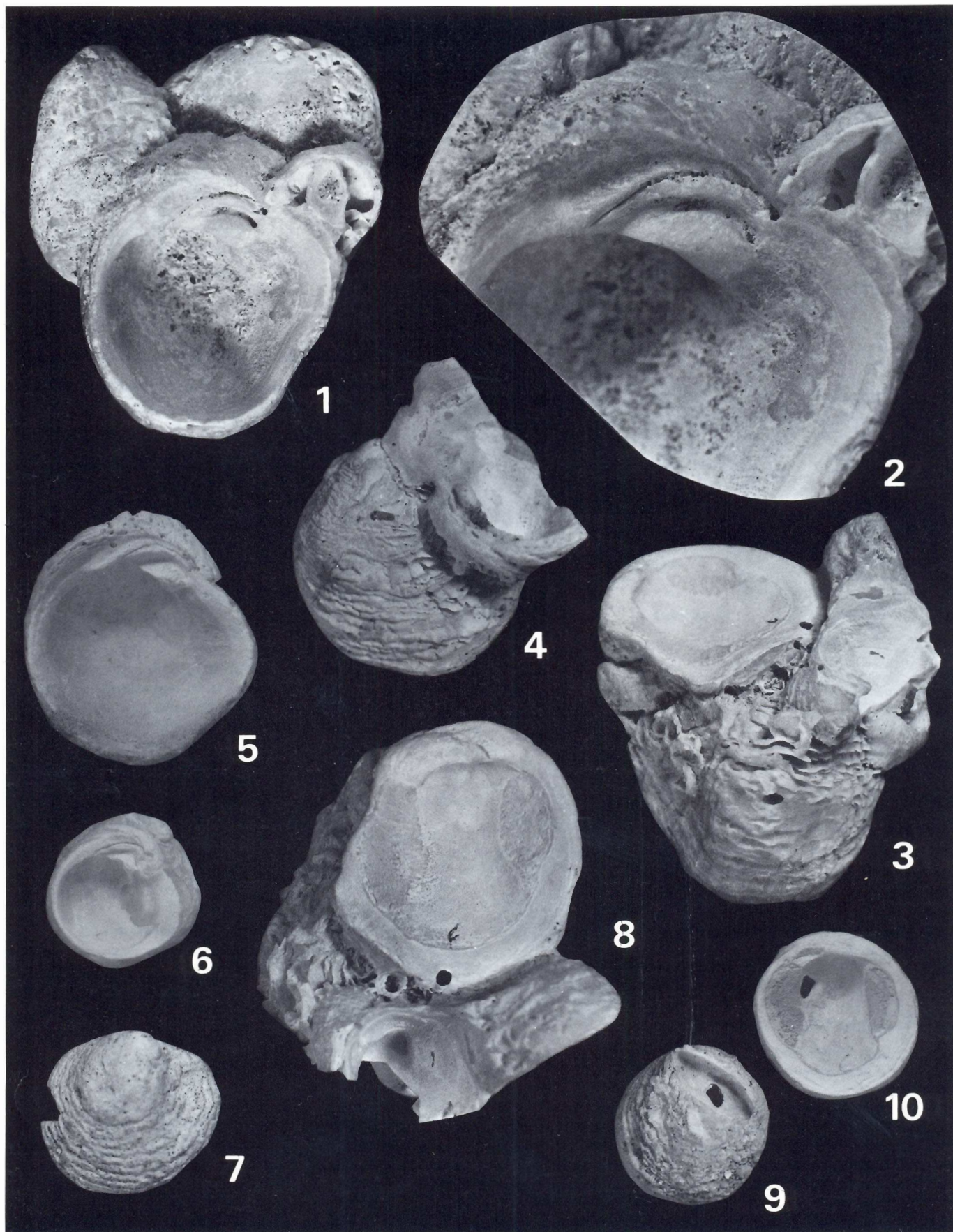
Remarks.—*Chama iudicai* n. sp. is characterized by its large size and thickness of its valves. The paratypes are fairly worn, a fact that accounts for their smooth surface. Bernard (1976), however, suggested that the lack of ornamentation on some specimens of different species studied by him is due to the fact that they are gerontic individuals. Most specimens are bored by *Lithophaga patagonica* (d'Orbigny).

Etymology.—Dedicated to Carlos A. Iudica.

Material.—See Table 1.

TABLE 1—Measurements (in mm) of *Chama iudicai* n. sp.

| MLP | | Length | Height | Width | Valve | Figure |
|--------|----------|--------|--------|-------|-------|-----------|
| 25071a | holotype | 50 | 62 | 35 | left | 3.1–3.3 |
| 25072 | paratype | 43 | 45 | 18 | left | 3.5 |
| 25073 | paratype | 23 | 24 | 14 | left | 3.6 |
| 25071c | paratype | 42 | 55 | 22 | left | — |
| 25074 | paratype | 41 | 45 | 18 | left | — |
| 25075 | paratype | 52 | 62 | 26 | left | — |
| 25076 | paratype | 33 | 33 | 16 | left | — |
| 25084 | paratype | 68 | 79 | 35 | left | — |
| 25071b | paratype | 47 | 49 | 12 | right | 3.8 |
| 25077 | paratype | 31 | 26 | 12 | right | 3.7 |
| 25078 | paratype | 27 | 28 | 10 | right | 3.9, 3.10 |
| 25079 | paratype | 48 | 51 | 10 | right | 3.4 |
| 25080 | paratype | 28 | 31 | 9 | right | — |
| 25081 | paratype | 22 | 27 | 6 | right | — |
| 25082 | paratype | 50 | 47 | 18 | right | — |
| 25083 | paratype | 47 | 52 | 19 | right | — |



DISCUSSION

Chama iudicai n. sp. resembles, in size, some large specimens of *Chama sinuosa* Broderip, a Recent species ranging from Bermuda to Bahia, Brazil. *Chama sinuosa*, however, as figured by Bayer (1943, Pl. 13, figs. 9–11), Abbott and Dance (1986, p. 323), and Rios (1985, Pl. 84, fig. 1176), differs by its generally smaller size and lack of crenulations in the internal margin of the shells.

Chama macerophylla Gmelin, a Recent species known from North Carolina to Rio de Janeiro, Brazil (see Odhner, 1919, Pl. 1, fig. 4; Bayer, 1943, Pl. 13, fig. 12c; Abbott, 1954, Pl. 37, fig. 3; Abbott, 1974, Pl. 21; Abbott and Dance, 1986, p. 323), differs in its smaller size, the better developed lamellae forming true foliations on the shell surface, and the narrower base of the left valve cardinal tooth.

Morphologically and geographically the most closely related species is *Chama congregata* Conrad, living from Bermuda to Santa Catarina, Brazil. Comparisons with this species were based on specimens illustrated by Bayer (1943, Pl. 12, fig. 3), Abbott (1954, Pl. 37, fig. d; 1974, Pl. 21, fig. 5385), and Abbott and Dance (1986, p. 323), and on material from Porto Belo, Santa Catarina, housed in Museu Oceanografico do Rio Grande, Rio Grande do Sul, Brazil. The main difference with *C. iudicai* n. sp. lies in the smaller size of *C. congregata*, which never is over 35 mm in length. Also, in *C. congregata*, the ornamentation consists of axially corrugated lamellae and the left valve cardinal tooth is displaced forward.

Chama pellucida Broderip ranges on the eastern Pacific coast from Paita, Peru, to Chile down to 22° S, and, as figured by Bernard (1976, p. 30, fig. 4c) and Abbott (1954, Pl. 37, fig. a; 1974, Pl. 21, fig. 538), differs by its smaller size and the presence of spines and a small palial sinus.

All these are living species, with a stratigraphic range in South America probably going back to the Holocene (sensu lato), and in the case of *C. pellucida* to the Pliocene.

PALEOECOLOGY

Several authors (Odhner, 1919; Newell, 1965; Yonge, 1967; Bernard, 1976) considered that the Chamidae have affinities with the rudists (Hippuritacea), occupying the ecological niche left by their extinction at the end of the Cretaceous (Munier-Chalmas, 1882).

Following their present ecological requirements, the Chamidae are included in the "warm waters" mollusk fauna (Roger, 1980). They are found as far south as 27°S in warm waters of the Atlantic Ocean (24–30°C, Boltovskoy, 1979). However, on the eastern coast of South America two temperate-water species are known to live up to 22°S (i.e., *Chama arcana* Bernard and *Chama pellucida* Broderip).

When summarizing morphological characteristics of the Pacific species, Bernard (1976) concluded that there are two groups. One group consists of species with large, thick, and poorly ornamented valves, living cemented to a hard substratum in the shallow intertidal zone. The second group includes species with small and highly ornamented valves with a restricted cementation area, living in depths greater than 20 m, attached to corals

and in rock crevices and cracks. *Chama iudicai* n. sp. belongs in the first group.

Chama iudicai n. sp. occurs together with the gastropods *Olivancillaria carcellesi* Klappenbach, *O. urceus* (Röding), and *Buccinanops globulosum* (Kiener) and the bivalves *Amiantis purpuratus* (Lamarck), *Lithophaga patagonica* (d'Orbigny), and *Mactra* sp. All of these are living today in the adjacent area.

Members of the Chamidae are stenohaline and there is no Recent species tolerant of estuarine conditions. Their anatomy indicates that they are adapted to clear water (with a very small amount of material in suspension); the feeding system is modified for the intake of very small particles (Bernard, 1976). No specimen of *Chama iudicai* n. sp. is known with both valves articulated. Field observations on Recent colonies of *Chama congregata* Conrad show that all the dead specimens are represented by the left valve only. This is probably due to the high energy of the intertidal environment in which the right valve was disarticulated soon after death. Specimens of *Chama iudicai* n. sp. appear cemented to each other in large numbers, suggesting a restriction in the availability of adequate cementation surfaces.

ACKNOWLEDGMENTS

Special thanks are due to A. C. Riccardi for reading early versions of the manuscript. M. Griffin offered valuable suggestions. D. J. Davies reviewed the paper and his comments are thankfully acknowledged. R. Brunet helped in the field work and J. C. Tarasconi was very helpful in providing good specimens of Brazilian *Chama*. This work was carried out during the tenure of a scholarship granted by the Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET), Argentina.

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FIGURE 3—1–10, *Chama iudicai* n. sp. 1–3, holotype MLP 25071a; 1, left valve, interior view; 2, detail showing hinge teeth $\times 2$; 3, left valve, exterior view; 4, paratype MLP 25079, right valve, exterior view; 5, paratype MLP 25072, left valve interior view; 6, paratype MLP 25073, left valve interior view; 7, paratype MLP 25077, right valve exterior view; 8, paratype MLP 25071b, right valve, interior view; 9, 10, MLP 25078, right valve exterior and interior views. All $\times 1$ except Figure 3.2. All from type locality.

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ACCEPTED 8 MARCH 1991