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northern Chile.
Part I. Subclasses Palaeotaxodonta,
Pteriomorpha, and Isofilibranchia**

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MARTIN ABERHAN

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Abstract. Seventy-seven taxa of bivalves from the Early Jurassic of northern Chile, belonging to the orders Nuculoida, Arcoidea, Pterioidea, Limoida, Ostreoida, Pectinoidea, and Mytiloida are described and discussed. Three species are new: *Palaeonucula cuevitana*, *Grammatodon (Grammatodon) sulcatus*, and *Modiolus (Modiolus) chilensis*. Many taxa, which are also known from the Jurassic of Europe, are for the first time recorded and illustrated from the South American subcontinent. The study is based on several thousand specimens from more than 50 fossiliferous localities in northern Chile. An excellent biostratigraphic control of the bivalves based on associated ammonites greatly improves our knowledge of the stratigraphic range of many species.

■ *Jurassic, bivalves, taxonomy, northern Chile*

Zusammenfassung. Aus dem Unterjura von Nordchile werden 77 Muscheltaxa beschrieben und diskutiert. Sie gehören den 7 Ordnungen Nuculoida, Arcoidea, Pterioidea, Limoida, Ostreoida, Pectinoidea und Mytiloida an. Drei Arten werden neu aufgestellt: *Palaeonucula cuevitana*, *Grammatodon (Grammatodon) sulcatus* und *Modiolus (Modiolus) chilensis*. Viele der Taxa sind bereits aus dem europäischen Jura und anderen Regionen bekannt und werden zum erstenmal aus Südamerika beschrieben und abgebildet. Die Untersuchung basiert auf mehreren tausend Exemplaren aus über 50 fossilreichen Lokalitäten Nordchiles. Mit Hilfe von Ammoniten, die mit der Muschelfauna vergesellschaftet sind, lassen sich die stratigraphischen Reichweiten der Arten detailliert ermitteln.

■ *Jura, Bivalven, Taxonomie, Nordchile*

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Introduction

The marine Early Jurassic of northern Chile is well known for its rich, diverse, and reasonably well preserved macrobenthic fauna. The bivalves form the numerically most important group and, since the middle of the 19th century, have been repeatedly documented in the literature. Extensive field work of the Berlin group led by A. v. HILLEBRANDT since the 1960s and own sampling in 1988 resulted in extensive new collections, which are now available for taxonomic analysis. At the same time, in the context of palaeoecological and palaeobiogeographic studies (e.g. ABERHAN 1993a, b), the need for a modern documentation of the group became apparent. While a

major part of Early Jurassic bivalves from Argentina recently has been thoroughly revised by DAMBORENEA (1987a, b), an appropriate revision of the Early Jurassic bivalves from Chile was still lacking. The present study therefore aims at revising the bivalve fauna and at documenting new species from the Early Jurassic of northern Chile.

The first part of this monograph deals with the subclasses Palaeotaxodonta, Pteriomorpha, and Isofilibranchia. Three further parts, partly in collaboration with other colleagues, are in preparation and will treat the trigoniids, Heterodonta, and Anomalodesmata respectively.

Jurassic sediments, palaeogeography, and localities

In northern Chile, Jurassic rocks crop out over large areas. Two main, north-south trending facies belts can be recognized (Text-fig. 1): An eastern belt consists mainly of marine sediments, which comprise sandstones, siltstones, marlstones, carbonates, and mixed carbonate/siliciclastics. The western facies belt is developed as a thick volcanic sequence with intercalations of marine sediments being of subordinate importance (e.g. RICCARDI 1983). The volcanic sequence is interpreted to represent an active volcanic arc, while the dominantly marine sediments to the east are regarded as the fill of the corresponding back arc basin (e.g. HEVRÉ et al. 1987, RICCARDI et al. 1993, PRINZ et al. 1994, SCHEUBER 1994). Although

the volcanic arc formed a barrier between the Jurassic marginal sea and Panthalassa, narrow connections to the open ocean obviously existed during most of the Jurassic (e.g. HILLEBRANDT et al. 1986, QUINZIO 1987, GRÖSCHKE et al. 1988).

The localities, which yielded Jurassic bivalves studied in the present monograph, are shown in Text-fig. 1. As the majority of the locations have not been visited by the author and most of them are adequately described and figured in the literature they are not presented in detail here. Rather, the localities are listed according to their geographic position from north to south in Tab. 1 and, where available, the main references are given for each section.

Material and methods

Extensive collections of macrobenthic faunas, dominated by bivalves and brachiopods, were made during 1988 from the sections Salar de Pedernales, Quebrada Asientos, Quebrada La Totorá and Quebrada Pinte. The fauna was identified during 1989-1990 as part of a Ph. D. project (ABERHAN 1992). Additional material was made available by HILLEBRANDT, Berlin and QUINZIO, Antofagasta. In particular, the HILLEBRANDT collection contains abundant and very well preserved bivalves from a large number of localities, covering a considerable area of Jurassic outcrops of northern Chile (Text-fig. 1). Several thousand specimens have been identified. As most sections contain ammonites, there exists an excellent biostratigraphic control of the studied material. For the purpose of this study the following subdivisions of the Early Jurassic have been used: Early, Middle, and Late Hettangian; Early and Late Sinemurian; Early and Late Pliensbachian; Early, Middle, and Late Toarcian. In several cases it also deemed appropriate to include specimens from the Aalenian.

Most specimens were prepared mechanically. In some of the material the shells are silicified, while the attached rock matrix is not or less silicified. In these cases, the rock matrix was dissolved using diluted acetic acid. This technique yielded isolated valves with complete hinge structures.

Many species could be identified on the basis of the relevant literature on bivalves from South America. However, some of the studied species hitherto have

not been described from South America, but are known from outside the region, for example from Europe. Here, identification was greatly aided by the Jurassic bivalve catalogue, which is housed at the Institut für Paläontologie, Würzburg. This catalogue contains xerox copies of most figured specimens of Jurassic bivalves and, at present, is about 85 % complete.

The synonymy lists are focussing on the most important references only. They basically contain first references of a particular taxon and those referring to South American records with illustrations. Additional references are given where it appeared necessary or where a modern revision of the taxon under discussion is available. In order to facilitate comparisons with previous palaeoecological studies, the synonymy lists also contain the names of taxa used in ABERHAN (1992). The latter are based on quantitative data obtained during field work. In the present monograph abundant new taxonomic data from the HILLEBRANDT collection has been incorporated. Consequently, some taxa now are also listed from localities and time slices, from which they were not reported in ABERHAN (1992). In addition, the systematic allocation of some taxa has been updated. This monograph is based on specimens collected in the field and now housed in repositories. Quantitative data, merely obtained by counting of specimens in the field, cannot be considered in a monograph like this. This explains minor differences in the stratigraphic distribution of some taxa when the

Tab. 1. List of localities which yielded Jurassic bivalves treated in this monograph and main references.

1	Moctezuma	PÉREZ & LEVI (1961: figs. 1-4)
2	Cerros de Cuevitas	HILLEBRANDT (1990: 30, figs. 1, 2)
3	Aguada Alto de Varas	HILLEBRANDT et al. (1986: fig. 2); QUINZIO (1987: 45, figs. 20-21)
4	Quebrada Bonita	QUINZIO (1987: 54, figs. 24-25)
5	Quebrada Chaco Sur	CHONG & HILLEBRANDT (1985: fig. 2)
6	Quebrada Incaguasi	HILLEBRANDT (1971: 76, fig. 3)
7	Quebrada south of Quebrada Incaguasi	HILLEBRANDT (1971: 76, fig. 3); HILLEBRANDT (1977: 38, fig. 1)
8	Posada de los Hidalgos	QUINZIO (1987: 17, figs. 7-9)
9	north of Quebrada Oreganito	not described; for location see NARANJO & PUIG (1984) on map sheet "Exploradora" (1:100.000)
10	Quebrada de los Burros	CHONG & HILLEBRANDT (1985)
11	Quebrada Doña Ines Chica	CHONG & HILLEBRANDT (1985: fig. 2); HILLEBRANDT et al. (1986: fig. 2)
12	Quebrada Cachina	not described
13	south of Sierra Minillas	QUINZIO (1987: 36, figs. 12, 16); HILLEBRANDT (1990: 30, figs. 1, 3)
14	Salar de Pedernales	HILLEBRANDT & SCHMIDT-EFFING (1981: 6, fig. 1); ABERHAN (1992: 9)
15	Quebrada San Juan	CHONG & HILLEBRANDT (1985: fig. 2); HILLEBRANDT (1990: 40, figs. 1, 6)
16	north of Portezuelo de Pedernales	HILLEBRANDT & SCHMIDT-EFFING (1981: 8, fig. 2)
17	Portezuelo de Pedernales	HILLEBRANDT & SCHMIDT-EFFING (1981: 8, fig. 2)
18	Quebrada Asientos	HILLEBRANDT & SCHMIDT-EFFING (1981: 8, figs. 2-3); ABERHAN (1992: 9, figs. 3-4, app. I)
19	Quebrada Caballo Muerto	HILLEBRANDT & WESTERMANN (1985: 7, fig. 2)
20	Quebrada El Peñon	HILLEBRANDT & SCHMIDT-EFFING (1981: 11, figs. 1, 3a)
21	Quebrada de Paipote	HILLEBRANDT & SCHMIDT-EFFING (1981: 14, figs. 1, 4)
22	Quebrada El Bolito	HILLEBRANDT & SCHMIDT-EFFING (1981: 14, figs. 1, 5) (= Quebrada La Tola in HILLEBRANDT 1973: fig. 1)
24	Quebrada El Patón	HILLEBRANDT & WESTERMANN (1985: 9, fig. 3)
24	east of Quebrada El Carbon	SEPÚLVEDA & NARANJO (1982: fig. 2)
25	Quebrada San Pedrito	HILLEBRANDT (1973: 176, fig. 1)
26	Quebrada Yerbas Buenas	HILLEBRANDT (1973: 175, fig. 1); HILLEBRANDT & SCHMIDT-EFFING (1981: 16, figs. 1, 6)
27	Quebrada Vaca Muerta	HILLEBRANDT (1973: fig. 1)
28	Quebrada Potrerillos	HILLEBRANDT (1973: fig. 1); HILLEBRANDT & SCHMIDT-EFFING (1981: 18, fig. 1)
29	Quebrada Larga	HILLEBRANDT (1973: fig. 1); HILLEBRANDT & SCHMIDT-EFFING (1981: 18, figs. 1, 7)
30	Quebrada Noria	HILLEBRANDT (1973: fig. 1); HILLEBRANDT & SCHMIDT-EFFING (1981: 20, figs. 1, 8)
31	Quebrada San Miguel	HILLEBRANDT & SCHMIDT-EFFING (1981: 21)
32	Río Figueroa	HILLEBRANDT (1973: fig. 1)
33	Río Jorquera	HILLEBRANDT & SCHMIDT-EFFING (1981: 21, figs. 1, 9)
34	Quebrada Calquis	HILLEBRANDT & SCHMIDT-EFFING (1981: 23, fig. 1)
35	Quebrada Los Eucaliptos	HILLEBRANDT (1973: 183)
36	between Río Copiapó and Quebrada Amolanas	HILLEBRANDT & SCHMIDT-EFFING (1981: fig. 1)
37	Manflas	HILLEBRANDT (1977: 40, figs. 2-3); HILLEBRANDT & WESTERMANN (1985: 10, fig. 4)
38	Río Pulido	HILLEBRANDT & SCHMIDT-EFFING (1981: 24, figs. 1, 10)
39	west of Quebrada de la Iglesia	HILLEBRANDT & SCHMIDT-EFFING (1981: fig. 1)
40	Río Manflas	HILLEBRANDT & SCHMIDT-EFFING (1981: 24, fig. 1)
41	Cerro Salto del Toro	HILLEBRANDT & SCHMIDT-EFFING (1981: 25, figs. 1, 10)
42	north of Juntas del Tolar	HILLEBRANDT & SCHMIDT-EFFING (1981: fig. 10)
43	Río del Toro	HILLEBRANDT & SCHMIDT-EFFING (1981: 27, figs. 1, 10)
44	Quebrada La Totora	(= south of Quebrada El Corral in HILLEBRANDT & SCHMIDT-EFFING 1981: 28, fig. 1); HILLEBRANDT (1973: fig. 2); ABERHAN (1992: 9, figs. 3-4, app. I)
45	Quebrada Chancoquin	HILLEBRANDT & SCHMIDT-EFFING (1981: 30, figs. 1, 11)
46	west of Quebrada de las Pircas	HILLEBRANDT (1973: 184)
47	Quebrada Pinte	HILLEBRANDT (1973: fig. 2); ABERHAN (1992: 9, figs. 3-4, app. I)
48	Vega Redonda	HILLEBRANDT (1973: 184, fig. 3)
49	Río Plata	HILLEBRANDT (1973: 191, fig. 3)
50	Quebrada La Plata	HILLEBRANDT (1973: 184, fig. 3)
51	Quebrada La Papa	HILLEBRANDT (1973: 189)
52	Quebrada Matahuaico	DEDÍOS (1967)
53	Mina Los Pingos	MPODOZIS et al. (1973)

present work is compared with ABERHAN (1992). Actual range charts of Early Jurassic bivalves from South America are in preparation.

The classification of higher taxa follows the scheme of CARTER (1990), which is largely based on shell microstructure. The type specimens of the newly erected species have been measured and the following abbreviations have been used:

H	height
L	length
I	inflation per valve
H/L	height/length ratio
I/L	inflation/length ratio
lv	left valve

rv right valve

2v articulated specimen

Numbers in brackets refer to approximate values.

All figured specimens have been deposited with the Servicio Nacional de Geología y Minería (acronym SNGM), Santiago under the catalogue numbers listed in the text and figure captions. In addition, a reference collection is housed in the collections of the Paläontologisches Institut der Universität, Würzburg (acronym PIW). For figured specimens from the HILLEBRANDT collection also original field numbers are given in the explanation of the Plates and Text-figures.

Taxonomy

Class Bivalvia LINNAEUS 1758

Subclass Palaeotaxodonta KOROBKOV 1954

Order Nuculoida DALL 1889

Family Nuculidae GRAY 1824

Genus *Palaeonucula* QUENSTEDT 1930

Type species. *Nucula hammeri* DEFRANCE 1825.

Palaeonucula cuevitana sp. nov.

Pl. 1, Figs. 1-4, Text-fig. 2

Type specimens. Holotype: SNGM 7975 (left valve), figured in Pl. 1, Figs. 1a-c; paratypes: SNGM 7976 (left valve), SNGM 7977 (left valve), and SNGM 7978 (right valve).

Type locality. All type specimens are from the Late Hettangian of Cerros de Cuevitas, section 1400 m west of point 1309, topographic map 1:100.000, Palestina.

Type horizons. 2-3 m of nodular carbonates, bed thickness 5-15 cm, with silicified solitary corals, bivalves, gastropods, and ammonites (*Badouxia*).

Additional material. 1 left valve, 2 right valves, and 1 articulated specimen preserved as internal mould from the Late Hettangian of Cerros de Cuevitas (PIW 1994VI 1-4).

Measurements.

Specimen	material	H (mm)	L (mm)	I (mm)	H/L	I/L
SNGM 7975	lv	7.0	9.0	2.7	0.78	0.30
SNGM 7976	lv	6.1	-	2.5	-	-
SNGM 7977	lv	5.9	7.6	2.4	0.78	0.32
SNGM 7978	rv	(0.5)	-	2.1	-	-

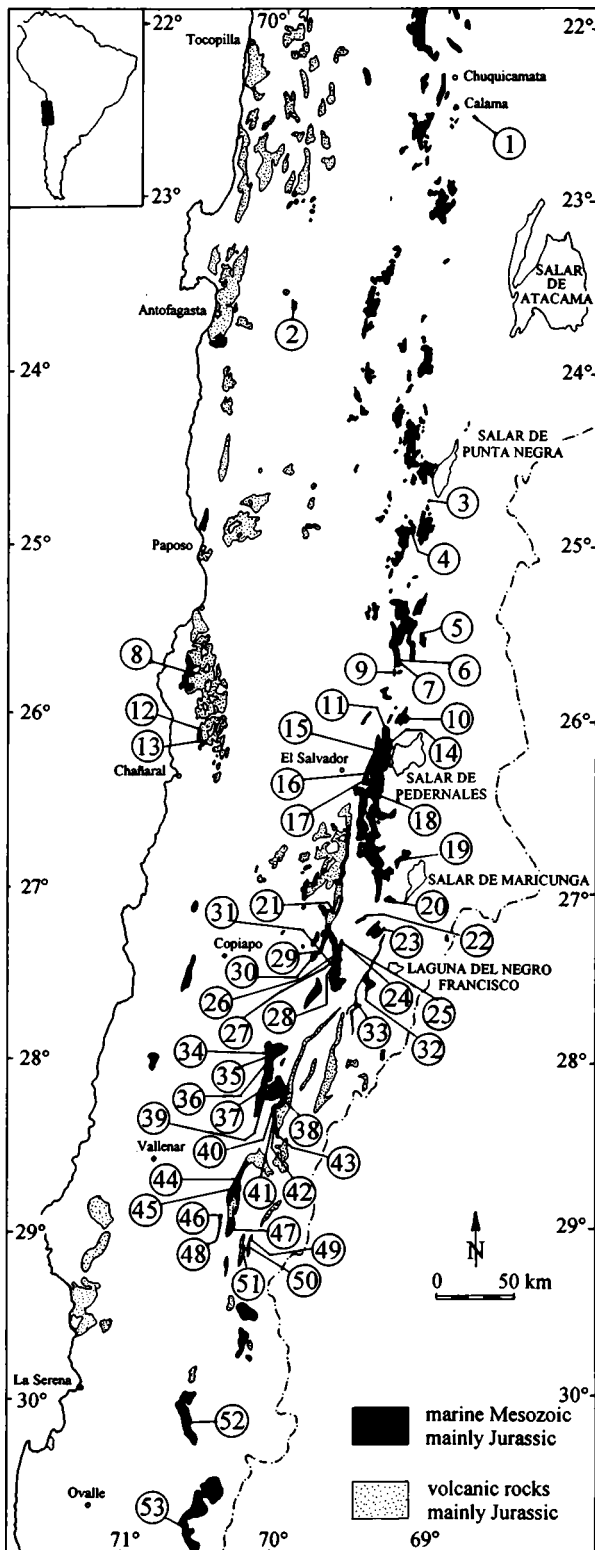
Derivation of name. From Cerros de Cuevitas, the type locality.

Diagnosis. Moderately inflated *Palaeonucula* with rounded-triangular outline. Umbones located only slightly posterior to midlength; lunule and escutcheon absent.

Description. Shell small, rounded-triangular, moderately inflated. Height about four-fifth of length, umbones small and prominent, slightly opisthogyrate, situated only slightly posterior to median; posterior part of antero-dorsal margin straight to weakly convex, forming an obtuse angle with anterior part of antero-dorsal margin, which is straight; ventral margin evenly convex, not sinuate; posterior margin sharply rounded, postero-dorsal margin slightly concave. Shell devoid of a distinct lunule or escutcheon. Ornament consisting of faint commarginal growth lines.

Hinge with up to 15 anterior teeth and at least up to 10 posterior teeth; hinge-teeth chevron-shaped with convexity directed towards the resilifer, which is slightly oblique (Text-fig. 2).

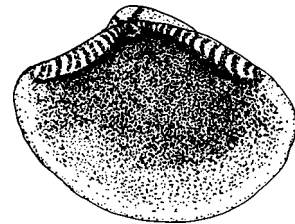
Remarks. *Palaeonucula cuevitana* can be distinguished from the Middle and Late Jurassic *P. menkii* (ROEMER 1836) from Europe and Asia by its rounded-triangular outline and umbones situated only slightly posteriorly in contrast to the elongate-ovate and distinctly inequilateral shell of the latter. Only rarely recorded end members of morphological variants of *P. menkii* as figured, for example, by FÜRSICH & WERNER (1988: pl. 1, fig. 2) resemble *P. cuevitana* in general outline. However, the anteriorly placed rounded carina followed by a shallow sulcus towards the dorsal margin, as described for *P. menkii*



Text-fig. 1. Outcrops of marine Mesozoic sediments and Jurassic volcanites in northern Chile and location of sections (1-53). For key of sections see Tab. 1. Map based on HILLEBRANDT (1971), RICCARDI (1983), and PRINZ et al. (1994).

(FÜRSICH & WERNER 1988: 109) is consistently lacking in the Chilean form. *Palaeonucula*

triangularis DUFF (1978: 23, pl. 1, figs. 6-13, 17, 23; text-fig. 6) from the Callovian of England differs from *P. cuevitana* by its strongly inflated shell and a well-developed escutcheon. IMLAY (1964a: 23, pl. 1, figs. 1-3) figures a *Nucula* sp. from the Middle Jurassic of Utah, United States, which has great affinities in overall shape to the species described here, but it generally appears to be more rounded in outline.



Text-fig. 2. *Palaeonucula cuevitana* sp. nov. Reconstruction of interior view of left valve. Approximately x 4.

Several nuculids have been described from the Late Triassic of central Chile (e.g. CECIONI & WESTERMANN 1968, ESCOBAR 1980) and Peru (e.g. JAWORSKI 1923, KÖRNER 1937). While most of the figured specimens and those unfigured specimens, which refer to illustrations in BITTNER (1895) can readily be separated from *P. cuevitana* on the basis of differences in shape, general outline, and hinge features, certain affinities exist with *Phaenodesmia peruana* JAWORSKI (1923: 116, pl. 5, figs. 1-3) and *Phaenodesmia* n. sp. ind. KÖRNER (1937: 176, pl. 11, fig. 10a-b, text-fig. 3). Both species are, however, more elongated and more strongly inequilateral as compared to *P. cuevitana*.

Family Nuculanidae ADAMS & ADAMS 1858

Genus *Nuculana* LINK 1807

Type species. *Arca rostrata* CHEMNITZ 1774.

Subgenus *Praesaccella* COX 1940

Type species. *Nuculana (Praesaccella) juriana* COX 1940.

Nuculana (Praesaccella) ovum (J. DE C. SOWERBY 1825)

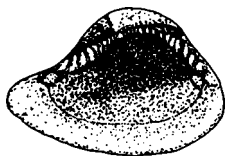
Pl. 1, Figs. 5-12, Text-fig. 3

1825 *Nucula ovum* sp. nov. - J. DE C. SOWERBY: 118, pl. 476, fig. 1.

- 1987a *Nuculana* cf. *ovum* (J. DE C. SOWERBY) - DAMBORENEA: 59, pl. 1, figs. 7-9; text-fig. 9 (see for synonymy list).
 1992 *Nuculana* (*Nuculana*) cf. *ovum* (SOWERBY 1824) - ABERHAN: 18.
 1992 *Nuculana* cf. *ovum* (J. SOWERBY) - DAMBORENEA: pl. 115, fig. 15.

Material. 58 articulated specimens from the Late Pliensbachian of Quebrada Calquis (SNGM 7979-7984, PIW 1994VI 5-56) and 2 left valves and 1 right valve from the Late Toarcian of Salar de Pedernales (SNGM 7986, PIW 1994VI 57-58) showing internal shell features; several poorly preserved valves from the Late Pliensbachian and Early Toarcian of Quebrada Asientos (PIW 1994VI 1494-1502).

Remarks. The species has been described recently as *Nuculana* cf. *ovum* from the Pliensbachian and Early Toarcian of Argentina (DAMBORENEA 1987a). The present specimens from Chile are conspecific with the Argentine material and allow a more fully identification due to the observation of internal characters. In particular, the observation of an entire pallial line in combination with the general external morphology and relatively few hinge-teeth permit the assignment to the subgenus *Praesacella* (see also Pl. 1, Fig. 12b; Text-fig. 3).



Text-fig. 3. *Nuculana* (*Praesacella*) *ovum* (J. DE C. SOWERBY 1825). Reconstruction of left hinge characters and pallial line. Approximately x 3.

Praesacella was erected as a new subgenus of *Nuculana* by COX (1940: 32). It is characterized by an outline that closely resembles that of the Tertiary and Recent *Sacella*, but can be distinguished from the latter by an entire pallial line as well as larger and less numerous hinge-teeth. As an entire pallial line was also described for *N. ovum* by COX (1940: 27) and the Chilean material correlates well with specimens of *Nuculana ovum* figured in the literature (e.g. PHILLIPS 1829: pl. 12, fig. 4; CASTELL 1962: pl. 12, fig. 4) it appears justified to include the specimens from South America in the synonymy of *N. (P.) ovum*.

Nuculana (P.) belongs to the oldest known species of the subgenus *Praesacella* together with *Nuculana (Praesacella) camolorum* from the Toarcian or Bajocian of East Africa (COX 1965: 28, pl. 2, fig. 10a-b) and the Early Jurassic of South Tibet (GOU & LI 1983: pl. 1, figs. 1, 2) and *N. (P.)* cf. *camolorum* from the Toarcian to Bajocian of Spitsbergen (BIRKENMAJER & PUGACZEWSKA 1975: 27, pl. 1, fig. 3).

Subclass Pteriomorphia BEURLÉN 1944

Order Arcoidea STOLIZKA 1871

Family Parallelodontidae DALL 1898

Genus *Parallelodon* MEEK & WORTHEN 1866

Type species. *Macrodon rugosus* BUCKMAN 1845.

Parallelodon groeberi DAMBORENEA 1987

Pl. 1, Figs. 13-14

- 1987a *Parallelodon groeberi* sp. nov. - DAMBORENEA: 62, pl. 2, figs. 1-8; text-figs. 11, 13c.
 p 1992 *Parallelodon* sp. A - ABERHAN: 18.

Material. 1 internal mould of a left valve from the Early/Late Pliensbachian of Río Jorquera (SNGM 7988); 5 left valves, 6 right valves, and 30 articulated specimens, all preserved as internal moulds, from the Late Pliensbachian of Quebrada Pinte (SNGM 7987, PIW 1994VI 59-98).

Remarks. *Parallelodon groeberi* has been figured and described in detail recently by DAMBORENEA (1987a: 62, pl. 2, figs. 1-8) from the Pliensbachian of Argentina. The time-equivalent specimens from Chile are identical to the Argentine species, as far as can be judged from the poorly preserved Chilean material. For affinities of *P. groeberi* with other species of *Parallelodon*, in particular those from South America see DAMBORENEA (1987a).

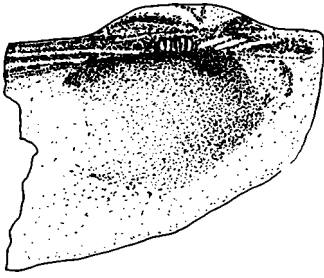
Parallelodon aff. *groeberi* DAMBORENEA 1987

Pl. 1, Fig. 16, Text-fig. 4

- aff. 1987a *Parallelodon groeberi* sp. nov. - DAMBORENEA: 62, pl. 2, figs. 1-8; text-figs. 11, 13c.

Material. 1 left valve from the Late Hettangian of Cerros de Cuevitas (SNGM 7989).

Remarks. Only a single, fragmented specimen with the hinge partly preserved was available for study. The hinge plate is very narrow and carries three anterior teeth, six very short and oblique medium teeth, and at least two elongate posterior teeth (Text-fig. 4). In this respect the specimen has strong affinities to *P. groeberi*. However, its number of medium teeth appears to be lower and the anterior teeth are not bending downwards as is illustrated by DAMBORENEA (1987a: text-fig. 13c). Furthermore, the anterior part of the shell is less developed as in *P. groeberi* and more resembles that of *P. hirsonensis*.



Text-fig. 4. *Parallelodon* aff. *groeberi* DAMBORENEA 1987. Interior view of left valve. Late Hettangian of Cerros de Cuevitas. SNGM 7989. x 1.

Parallelodon hirsonensis (D'ARCHIAC 1843)

Pl. 1, Figs. 15, 17-20, Text-fig. 5

1843 *Cucullaea hirsonensis* sp. nov. - D'ARCHIAC: 374, pl. 27, figs. 5, 5a.

1969 *Parallelodon hirsonensis* (D'ARCHIAC) - FISCHER: 78, pl. 9, fig. 3a-b (see for extensive synonymy list).

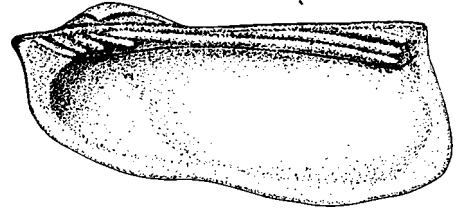
p 1992 *Parallelodon* sp. A - ABERHAN: 18.

Material. 21 left valves, 17 right valves, and 5 articulated specimens, all preserved as internal moulds, from the Late Sinemurian of Quebrada Pinte (SNGM 7991-7994, PIW 1994VI 99-137); 1 right valve from the Late Pliensbachian of Quebrada Asientos (SNGM 7990).

Remarks. *Parallelodon hirsonensis* is a very variable species, known from the Middle Jurassic of Europe. One end member of the morphological range, represented by the holotype (D'ARCHIAC 1843: pl. 27, figs. 5, 5a), is characterized by the lack of radial costae on the flanks and an obtuse postero-dorsal angle. In contrast, the other common end member exhibits an acute postero-dorsal angle, produced by a posterior prolongation of the hinge-line, and a distinct radial ornament (e.g. MORRIS & LYCETT 1853: 49, pl. 5, figs. 1, 1a-b; ARKELL 1930b: 298, pl. 14, figs. 1-4; text-fig. 1; FISCHER 1969: 78, pl. 9, fig. 3a-b). This latter variant has been identified previously as *P. rugosum* (BUCKMAN 1844) (e.g. by ARKELL 1930b). Subsequently it has been taken into the synonymy of *P. hirsonensis* by COX & ARKELL (1948: 1), who referred to the considerable morphological variation of the species.

The Chilean specimens agree well with the morphological end member represented by the holotype. They are generally lacking the rostrate posterior extremity (for the only exception see Pl. 1, Fig. 17) and are devoid of a radial ornament except for fine radial striae. Also, the number of hinge-teeth and the width of the hinge-plate match well with the forms from Europe (e.g. D'ARCHIAC 1843: pl. 27, fig. 5a; MORRIS & LYCETT 1853: pl. 5, fig. 1b; ARKELL 1930b: pl. 14, figs. 1-2; text-fig. 1).

A very similar form has been described and figured as *Parallelodon* sp. by DAMBORENEA (1987a: 66, pl. 1, figs. 10-12; text-fig. 13b) from the Pliensbachian and Early Toarcian of Argentina. It has strong affinities to *P. hirsonensis* with regard to the external characters of the shell, but differs in its wider hinge-plate and more numerous teeth (see DAMBORENEA 1987a: pl. 1, fig. 11; text-fig. 13b; compare with Text-fig. 5). However, little is known about the intraspecific variability of hinge characters of *Parallelodon*. If hinge characters are as variable as the general outline, the two taxa might well be conspecific.



Text-fig. 5. *Parallelodon hirsonensis* (D'ARCHIAC 1843). Reconstruction of interior view of right valve. Approximately x 1.

In *Parallelodon groeberi* the anterior half of the shell is more developed, resulting in a more rectangular outline as compared to *P. hirsonensis*.

Genus *Grammatodon* MEEK & HAYDEN 1861

Type species. *Arca (Cucullaea) inornata* MEEK & HAYDEN 1859.

Subgenus *Grammatodon* s. s.

Grammatodon (Grammatodon) concinnus (PHILLIPS 1829)

Pl. 2, Figs. 1-5, Text-fig. 6A, B

1829 *Cucullaea concinna* sp. nov. - PHILLIPS, pl. 5, figs. 9, 31.

1978 *Grammatodon (Grammatodon) concinnus* (PHILLIPS, 1829) - DUFF: 36, pl. 2, figs. 7, 11-17, 19; text-fig. 11 (see for synonymy list).

Material. 1 poorly preserved right valve from the Early Toarcian of Moctezuma (PIW 1994VI 138); 5 right valves, 6 left valves and 3 articulated specimens from the Late Toarcian of Salar de Pedernales (SNGM 7999-8003, PIW 1994VI 139-147).

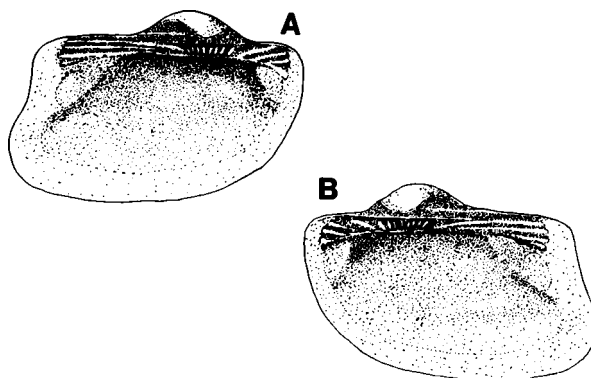
Remarks. The Early Jurassic material from Chile agrees well with specimens of *Grammatodon (G.) concinnus* from the Middle and Late Jurassic of Europe described and figured, for example, in

CHOFFAT (1888: 52, 54, pl. 11, fig. 24), DUFF (1978: 36, pl. 2, figs. 7, 11-17, 19), FÜRSICH & WERNER (1988: 116, pl. 2, figs. 4-5), and CLAUSEN & WIGNALL (1990: 103, pl. 1, fig. G). The species is characterized by a sharply defined, straight to slightly curved posterior umbonal carina. The anterior part is ornamented with four to eight radial ribs and fine radial striae between the ribs. The postero-dorsal part is covered with several faint radial riblets, which sometimes produce a fine cancellate pattern together with intersecting growth lines. The flanks of the shell are covered with fine to distinct commarginal growth lines.

The taxodont hinge (Pl. 2, Figs. 1b, 2b, 3b; Text-fig. 6A, B) consists of two series of teeth, which radiate upwards and sideways from a point immediately below the umbo. The anterior series is made up of up to seven short, opisthocline teeth, straight to slightly curved, being parallel to the hinge-line close to the anterior margin. The posterior series consists of up to seven short to elongate teeth, the posterior ones recurved in a posterior direction and running subparallel to the hinge-margin. The adductor scars are clearly visible in some specimens, both the anterior and the posterior being more or less circular and equal in size. In one specimen, the attachment of the anterior adductor is clearly formed by two distinct scars, the more anterior part having more than double the size of the more posteriorly placed scar. They are interpreted to refer to the attachment of the "nacreous" and "vitrous" bundle of muscle fibers, which are responsible for the rapid and more slowly closing of the two valves respectively (see COX 1969: N35, fig. 32). The pallial line is entire. The shell margins are not crenulate.

Grammatodon concinnus can be distinguished from the Middle to Late Jurassic *G. hersilius* (D'ORBIGNY 1850) from Europe by a more regular ornament of radial ribs on the flanks of the latter (see also DUFF 1978: 38, pl. 2, figs. 18, 20, 24; FÜRSICH & WERNER 1988: 117, pl. 2, fig. 1). This applies also to *G. costulatus* (LEANZA 1942) from the Pliensbachian of Argentina (see LEANZA 1942: 152, pl. 1, figs. 5-6; DAMBORENEA 1987a: 69, pl. 2, figs. 16-17; text-fig. 16b; DAMBORENEA 1992: pl. 115, fig. 13), a form that is closely related to *G. hersilius*. *Grammatodon clathratus* (LECKENBY 1859) from the Callovian of England differs from *G. concinnus* in the type of dentition and the lack of strengthened radial striae in the anterior and posterior region of the valve (e.g. DUFF 1978: 40, pl. 2, figs. 21-23, 25-27). *Grammatodon schourovskii* (ROUILLIER & VOSSINSKY 1847) from the Middle and Late Jurassic of England,

eastern Greenland, Russia, and the Arctic has a rounded carina and completely lacks a radial ornament.



Text-fig. 6. *Grammatodon (Grammatodon) concinnus* (PHILLIPS 1829). A. Reconstruction of interior view of left valve. B. Reconstruction of interior view of right valve. Approximately x 2.

Grammatodon (Grammatodon) sulcatus sp. nov.

Pl. 1, Figs. 21-24, Text-fig. 7

Type specimens. Holotype: SNGM 7997 (articulated specimen), figured in Pl. 1, Figs. 23a-c; paratypes: SNGM 7995 (right valve), SNGM 7996 (right valve), and SNGM 7998 (left valve).

Type locality. All type specimens are from the Late Sinemurian between Río Copiapó and Quebrada Amolanas, ca. 2 km NE of point 2164 (DK 032-016), map sheet Iglesia Colorada 2800-6945, 1:50,000.

Additional material. 1 left valve from the Late Sinemurian of the type locality (PIW 1994VI 148).

Measurements.

Specimen	material	H (mm)	L (mm)	I (mm)	H/L	I/L
SNGM 7997	2v	8.3	14.3	3.5	0.58	0.24
SNGM 7995	rv	9.3	-	5.1	-	-
SNGM 7996	rv	10.5	-	5.2	-	-
SNGM 7998	lv	11.1	-	4.7	-	-

Derivation of name. *sulcatus* (lat.): adjective of *sulcus* (lat.) = groove.

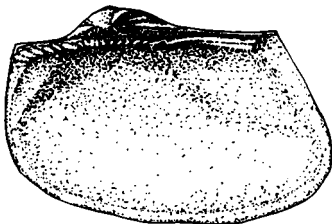
Diagnosis. Small *Grammatodon* with sharp, radially ribbed carina; conspicuous sulcus anterior to carina in right valve, becoming less pronounced towards older growth stages.

Description. Small, moderately inflated shell, subtrapezoidal in outline. Height about two-thirds of length, umbones broad with beaks slightly prosogyrate and situated about one-third of shell length from the anterior. Dorsal margin straight, occupying about three-fourth to four-fifth of total shell length; anterior margin straight to slightly concave dorsally, very weakly projecting beyond anterior of hinge-line and curving backwards to meet convex ventral margin;

posterior margin obliquely truncated, forming a more or less right angle with ventral margin and an obtuse angle with the dorsal margin. Sharply defined, straight to weakly curved carina running from umbo to postero-dorsal corner and becoming less prominent with age of shell. Carina of right valve preceded by narrow sulcus, which is most conspicuous in the umbonal region, but continuously becomes shallower and finally disappears while approaching the postero-ventral margin of adult specimens. Left valve devoid of sulcus.

Postero-dorsal part ornamented with numerous, tightly spaced radial riblets, two to four of them being more prominent than others; interspaces between riblets about half the width of riblets; radial ornament of riblets continued on carina, but lacking on flanks of shell and in sulcus of right valve; ornament of flanks consisting of very fine radial striae and commarginal growth lines, which are more distinct than the striae; anterior part of both valves with radial striae and with up to six riblets in left valve; no riblets observed in anterior part of right valve. Ligament duplivincular, cardinal area narrow and elongate.

Hinge consisting of up to eight small anterior teeth, which are vertical to slightly oblique towards the umbo and become successively more horizontal towards anterior margin (Text-fig. 7). Posterior teeth numerous, most of them being short and oblique teeth below the beak; following in a posterior direction are three elongate pseudolaterals, which are recurved in a posterior direction to occupy a horizontal to subhorizontal position; all teeth converge towards a point slightly anterior to beaks.



Text-fig. 7. *Grammatodon (Grammatodon) sulcatus* sp. nov. Reconstruction of interior view of right valve. Approximately x 3.

Remarks. The known species of the subgenus *Grammatodon* commonly can be assigned to one of three morphotypes. These can be defined as being (1) smooth on the flanks except for fine radial striae, with radial ornament anteriorly and posteriorly (exemplified by *G. concinnus* (PHILLIPS 1829)), (2) subrectangular in outline and radially ribbed also on flanks (represented by *G. hersilius* (D'ORBIGNY

1850)), and (3) subquadrate in outline and completely smooth (e.g. *G. schourovskii* (ROUILLIER & VOSSINSKY 1847)). *Grammatodon sulcatus* can be separated from all of these groups by the presence of a narrow sulcus anteriorly of the carina of the right valve. With regard to the style of radial ornament, *G. sulcatus* has most affinities to the first group. Besides the presence of a sulcus it can be distinguished from *G. concinnus* by being less inflated compared to the latter.

Family Cucullaeidae STEWART 1930

Genus *Cucullaea* LAMARCK 1801

Type species. *Cucullaea auriculifera* LAMARCK 1801.

Subgenus *Idonearca* CONRAD 1862

Type species. *Cucullaea tippiana* CONRAD 1858.

Cucullaea (Idonearca) cf. rothi A. LEANZA 1940

Pl. 2, Figs. 6-8

- cf. 1940 *Cucullaea rothi* sp. nov. - LEANZA: 212, pl. 2, figs. 1-6.
- cf. 1942 *Cucullaea rothi* LEANZA - LEANZA: 153, pl. 1, fig. 7.
- cf. 1987a *Cucullaea (Idonearca) rothi* A. LEANZA - DAMBORENEA: 75, pl. 1, figs. 15a-c, 16a-c, 18; text-figs. 1a-c, 16d-f.
- cf. 1987a *Cucullaea (Idonearca) cf. rothi* A. LEANZA - DAMBORENEA: 77, pl. 1, fig. 17.
- cf. 1992 *Cucullaea rothi* LEANZA - DAMBORENEA: pl. 117, fig. 7 (copy from DAMBORENEA 1987a: pl. 1, fig. 15c).
- 1992 *Cucullaea (Idonearca) cf. rothi* LEANZA 1940 - ABERHAN: 18.

Material. 1 internal mould from the Early Toarcian of Quebrada Pinte (SNGM 8006); 2 left and 1 right internal mould and 2 internal moulds from the Early Toarcian of Quebrada La Totorá (SNGM 8004-8005, PIW 1994VI 149-151).

Remarks. *Cucullaea rothi* is known from the Pliensbachian and Early Toarcian of Argentina (LEANZA 1940, 1942, DAMBORENEA 1987a, 1992). The Chilean specimens resemble those from Argentina in overall shape and occur in strata of the same age. However, the poor preservation of the Chilean material renders a more precise identification impossible.

Another *Cucullaea* from the Pliensbachian of Argentina is *Cucullaea (Ashroftia?) jaworskii* LEANZA (1940: 209, pl. 1, figs. 1-3; DAMBORENEA 1987a: 73, pl. 2, figs. 9-13). In ABERHAN (1992), a poorly preserved specimen has been doubtfully referred to this species. Since no further specimens

became available for study and given the rather poor preservational state, it now appears appropriate not to include the specimen in the present taxonomic revision.

Order Pterioida NEWELL 1965

Suborder Pteriina NEWELL 1965

Family Pteriidae GRAY 1847

Genus *Pteria* SCOPOLI 1777

Type species. *Mytilus hirundo* LINNAEUS 1758.

Pteria? sp.

Pl. 2, Fig. 15

Material. 1 left valve from the Middle or Late Hettangian of Quebrada Cachina (SNGM 8013).

Remarks. The only available specimen is characterized by a fairly oblique, slightly convex, alate shell, covered with distinct commarginal growth lines. The dorsal margin of the well developed posterior wing is straight and forms an angle of roughly 90° with the posterior margin of the wing, which is concave. An anterior auricle cannot be observed in the studied specimen.

Since internal characters, especially hinge and ligamental pits, are unknown and the availability of a single specimen excludes the evaluation of intraspecific variability, the specimen is only tentatively referred to *Pteria*.

Family Bakevelliidae KING 1850

Genus *Aguilerella* CHAVAN 1951

Type species. *Perna kobyi* LORIOLO 1901.

Remarks. According to MUSTER (1995), *Aguilerella* is characterized by a weakly inflated, rhombic shell, which lacks an anterior auricle. The posterior wing is obtuse and not strongly demarcated. The beaks are prosogyrate and do not protrude beyond the dorsal margin. The hinge consists of one to two posterior teeth behind the ligament, which are subparallel to the dorsal margin. The anterior teeth, one to two in number, originate in the antero-dorsal corner and are directed towards the postero-ventral margin. MUSTER (1995) recognizes three species of *Aguilerella*:

Aguilerella kobyi (LORIOLO), which is discussed below, *A. anabarensis* (KRYMGOLTS), and *A. sabaicalica* (OKUNEVA). The last two are unknown from South America.

Aguilerella kobyi (LORIOLO 1901)

Pl. 2, Fig. 9

- ? 1899 *Plagia andina* sp. nov. - PHILIPPI: 42, pl. 22, fig. 4.
- 1901 *Perna kobyi* sp. nov. - LORIOLO: 99, pl. 7, figs. 5-6.
- 1987b *Aguilerella neuquensis* sp. nov. - DAMBORENEA: 122, pl. 2, figs. 6, 7a-b, 8; text-fig. 3.
- 1992 *Aguilerella neuquensis* DAMBORENEA - DAMBORENEA: pl. 116, fig. 3 (copy from DAMBORENEA 1987b: pl. 2, fig. 7a).
- 1992 *Aguilerella neuquensis* DAMBORENEA 1987 - ABERHAN: 18.
- 1995 *Aguilerella kobyi* (LORIOLO 1901) - MUSTER: pl. 1, figs. 1-4 (see for extensive synonymy list).

Material. 1 left valve and 2 articulated specimens, preserved as internal moulds from the Late Sinemurian of Quebrada Pinte (SNGM 8007, PIW 1994VI 152-153).

Remarks. The specimens from northern Chile show the characteristic external features of the genus. Internal characters cannot be observed. However, *Aguilerella neuquensis* from the Pliensbachian of Argentina exhibits well-preserved hinge-teeth (DAMBORENEA 1987b: 122, pl. 2, fig. 6; text-fig. 3). As the Argentine specimens agree very well with the Chilean material in general shape, they are regarded to belong to the same species. *Aguilerella neuquensis* was regarded as junior synonym of *A. kobyi* by MUSTER (1995), a view, which is also shared here. *Aguilerella kobyi* is known from the Early to Late Jurassic of South America, eastern Asia, and Europe.

According to MUSTER (1995), *A. kobyi* can be separated from *A. anabarensis* (KRYMGOLTS et al. 1953: 51, pl. 23, figs. 8-10; pl. 24, figs. 2-4) by being more rectangular and less elongated in outline. Furthermore, the ligamental pits in *A. kobyi* are separated by spaces of equal width, in contrast to *A. anabarensis*, which has ligamental pits broader than the interspaces. *Aguilerella anabarensis* occurs from the Early to Late Jurassic of eastern Asia, northern Africa, and Siberia (see MUSTER (1995) for an extensive synonymy list).

The general shape of *A. sabaicalica* (OKUNEVA 1960: 59, pl. 1, figs. 3-5; 1973: 39, pl. 2, fig. 11; pl. 3, figs. 1, 3, 4) from the Toarcian to Aalenian of eastern Asia is similar to that of *A. kobyi*. The former can be distinguished by the presence of a sharp groove, which is visible in the interior of the shell and runs from the umbo to the anterior shell margin.

Genus *Bakevellia* KING 1848

Type species. *Avicula antiqua* MÜNSTER 1836.

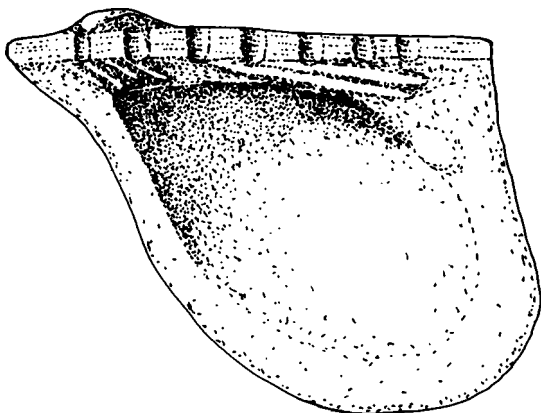
Subgenus *Bakevellia* s. s.*Bakevellia (Bakevellia) waltoni* (LYCETT 1863)

Pl. 2, Figs. 10-14, Text-fig. 8

- 1863 *Gervillia waltoni* sp. nov. - LYCETT: 110, pl. 32, figs. 4, 4a-b.
 1987b *Bakevellia (Neobakevellia?) pintadae* sp. nov. - DAMBORENEA: 126, pl. 1, figs. 1a-d, 2-5; text-fig. 4.
 1992 *Bakevellia (Neobakevellia?) pintadae* DAMBORENEA 1987 - ABERHAN: 18.
 1995 *Bakevellia (Bakevellia) waltoni* (LYCETT 1863) - MUSTER: pl. 5, figs. 1-13 (see for extensive synonymy list).

Material. 20 left, 6 right, and 2 articulated specimens, all preserved as internal moulds from the Late Sinemurian of Quebrada Pinte (SNGM 8008-8012, PIW 1994VI 154-176); 1 left valve from the Late Pliensbachian of Quebrada Asientos (PIW 1994VI 177).

Remarks. As the specimens of *Bakevellia* from Chile agree very well in shape and outline, they are certainly conspecific with *B. pintadae* DAMBORENEA (1987b: 126, pl. 1, figs. 1-5; text-fig. 4). The only difference is the consistently smaller size of adult forms from the Late Sinemurian of Chile as compared to the Pliensbachian specimens from Argentina.



Text-fig. 8. *Bakevellia (Bakevellia) waltoni* (LYCETT 1863). Reconstruction of interior view of right valve. Approximately x 2.

In a recent revision of Jurassic bakevelliids, MUSTER (1995) recognizes six species of *Bakevellia* (*B.*), based on the shape of the anterior auricle, the direction of the oblique anterior teeth and the number of ligamental pits in adult forms. Other features such as obliquity of the shell and shape of the posterior wing are considered as being very variable within species and also vary during ontogeny. Following

MUSTER (1995), *B. pintadae* DAMBORENEA is regarded as junior synonym of *B. waltoni* (LYCETT). *Bakevellia waltoni* is a long ranging (Middle Triassic to Early Cretaceous), cosmopolitan species, which has been reported from South America, Europe, Asia, and possibly also from northern Africa.

Genus *Gervillaria* COX 1954

Type species. *Modiola? alaeformis* J. SOWERBY 1819.

Remarks. MUSTER (1995) distinguishes five species of *Gervillaria*: *Gervillaria alaeformis*, *G.? ashcroftensis*, *G. hartmanni*, *G. miyakoensis*, and *G. pallas*. Their diagnosis is based on general outline, the degree of shell torsion, the presence or absence of a prominent carina, the size of the anterior wing, and the shape of the ligamental area. Four of the species, *G. alaeformis*, *G.? ashcroftensis*, *G. hartmanni*, and *G. pallas* are represented in the Early Jurassic of northern Chile.

Gervillaria alaeformis (J. SOWERBY 1819)

Pl. 3, Figs. 1-2, Text-fig. 9

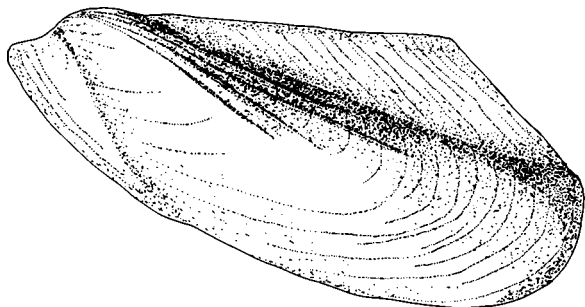
- 1819 *Modiola? alaeformis* sp. nov. - J. SOWERBY: 93, pl. 251.
 1931 *Gervillia alaeformis* (SOWERBY) - WEAVER: 201, pl. 15, figs. 61-63.
 1931 *Gervillia leufuensis* sp. nov. - WEAVER: 199, pl. 15, fig. 60.
 1992 *Gervillaria* sp. nov. - ABERHAN: 18.
 1995 *Gervillaria alaeformis* (J. SOWERBY 1819) - MUSTER: pl. 7, figs. 5-7; pl. 8, figs. 1-4 (see for extensive synonymy list).

Material. 1 left valve and 1 articulated specimen from the Toarcian of Quebrada Pinte (SNGM 8014, PIW 1994VI 178); 1 articulated specimen from the Toarcian of Quebrada Asientos (SNGM 8015).

Remarks. The twisted shells of *G. alaeformis* are strongly inequivalve, the left valve being moderately convex and the right valve being only weakly convex to nearly flat. The main body of the shell exhibits a very low ridge and is covered by fine, irregularly placed, radial ribs, which are not continued on the posterior wing. The ribs are always narrower than the interspaces between them. Although the hinge characters cannot be observed, the highly inequivalve and twisted shell, together with its general shape, allow the assignment of the specimens to *G. alaeformis* with high reliability.

Gervillaria alaeformis is similar in outline to *G. hartmanni*, but can be distinguished from the latter by the presence of radial ribs and a more inequivalve and

twisted shell. Both species have a long stratigraphic range (Triassic to Cretaceous) and are known from Europe, Asia, eastern Africa, and South America, in contrast to the endemic and short-ranging *G? ashcroftensis* and *G. pallas*, which are discussed below.



Text-fig. 9. *Gervillaria alaeformis* (J. SOWERBY 1819). Reconstruction of exterior view of left valve. Approximately x 1.

Gervillaria? ashcroftensis (CRICKMAY 1930)

Pl. 3, Figs. 3-4, Text-figs. 10-11

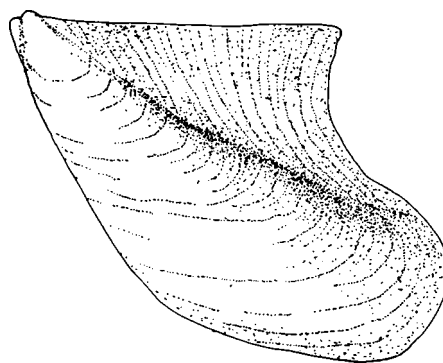
- 1930 *Gervillia ashcroftensis* sp. nov. - CRICKMAY: 48, pl. 3, fig. a-c.
 1992 *Gervillia (Gervillia) ashcroftensis* CRICKMAY 1930 - ABERHAN:18.
 1995 *Gervillaria ? ashcroftensis* (CRICKMAY 1930) - MUSTER: pl. 9, figs. 1-2 (copy of Pl. 3, Figs. 3-4, this volume).

Material. 1 left valve from the Late Pliensbachian of Quebrada Asientos (SNGM 8017); 1 left valve from the Toarcian of Quebrada Pinte (SNGM 8016).

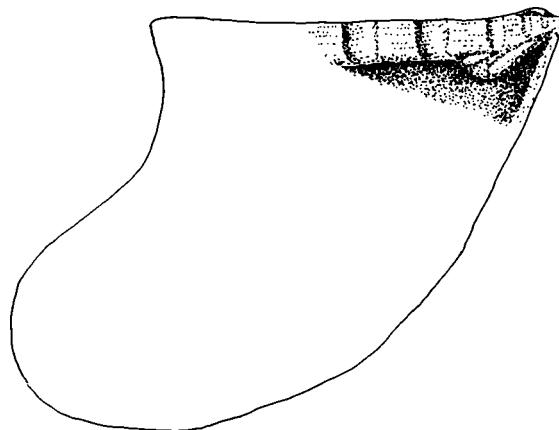
Remarks. The Chilean specimens from the Early Jurassic exhibit a striking similarity to the specimens of *Gervillia ashcroftensis* from the Bajocian of British Columbia, Canada as figured by CRICKMAY (1930: pl. 3a-c). Up to now, only very few specimens of this species are known so that little can be said about intraspecific variation and ontogenetic development of the hinge. In particular, the posterior part of the hinge is unknown. Due to the observable hinge characters and shell torsion the species most likely belongs to *Gervillaria* (see also MUSTER 1995).

The Chilean material is characterized by a slightly twisted shell with a terminal, prosogyrate beak, the lack of an anterior auricle, and a relatively narrow main body of the shell. The posterior wing is large and pointed at its postero-dorsal corner as can be reconstructed from the growth lines. The hinge consists of two anterior teeth, pointing downwards in a posterior direction (Text-fig. 11). A crenulation of the hinge, as it is typical of *Gervillaria*, has not been

observed; however, the studied specimen is a juvenile and crenulation only occurs later during ontogeny.



Text-fig. 10. *Gervillaria? ashcroftensis* (CRICKMAY 1930). Reconstruction of exterior view of left valve. Approximately x 1.3.



Text-fig. 11. *Gervillaria? ashcroftensis* (CRICKMAY 1930). View of anterior part of left hinge and ligament characters. Toarcian of Quebrada Pinte. SNGM 8016. x 1.7.

"Gervillia" chilensis PHILIPPI (1899: 43, pl. 22, fig. 7) from Valle de Tinguiririca?, central Chile, exhibits a superficial similarity to *G.? ashcroftensis* by sharing a relatively narrow main body of the shell. However, it differs from *G.? ashcroftensis* by a considerably shorter posterior wing and the presence of several oblique costae on the flank. According to DAMBORENEA (personal communication), who has studied PHILIPPI's material, it is very doubtful that both species can be referred to the same group. Affinities to other Mesozoic species of *Gervillaria* are discussed in MUSTER (1995).

Gervillaria hartmanni (MÜNSTER 1835)

Pl. 3, Figs. 5-7

- 1835 *Gervillia hartmanni* sp. nov. - MÜNSTER in GOLDFUSS: 122, pl. 115, figs. 7a-f.

1992 *Gervillia (Virgellia?) hartmanni* GOLDFUSS 1835 - ABERHAN: 18.

1995 *Gervillaria hartmanni* (MÜNSTER 1835) - MUSTER: pl. 9, figs. 3-5; pl. 10, figs. 1-2 (see for extensive synonymy list).

Material. 1 articulated internal mould from the Late Sinemurian and 4 articulated specimens in shell preservation from the Early and Late Toarcian of Quebrada La Totorá (SNGM 8018-8020, PIW 1994VI 179-180); 2 articulated specimens from the Late Toarcian of Quebrada Pinte (PIW 1994VI 181-182); 1 left valve from the Toarcian of Quebrada Chancoquin (PIW 1994VI 183).

Remarks. The Chilean specimens of *G. hartmanni* are characterized by a fairly oblique, longitudinally elongated and slightly twisted shell. The left valve is more convex than the right one. The umbones are slightly prosogyrate. The anterior auricle is relatively large; the posterior wing is large and obtuse. In this respect, the material agrees well with the diagnosis of *G. hartmanni* as given in MUSTER (1995).

Gervillaria pallas (A. LEANZA 1942)

Pl. 4, Figs. 1-3

1942 *Gervillia pallas* sp. nov. - LEANZA: 155, pl. 4, fig. 1.

1987b *Gervillaria? pallas* (A. LEANZA) - DAMBORENEA: 135, pl. 2, figs. 1a-c, 2, 3a-b, 4, 5a-c; text-fig. 7.

1992 *Gervillaria(?) pallas* (LEANZA) - DAMBORENEA: pl. 116, fig. 1a-b (copy from DAMBORENEA 1987b: pl. 2, figs. 5a, 5c).

1992 *Gervillaria?* - THOMSON & SMITH: pl. 1, fig. 8.

p 1992 *Gervillaria? pallas* (LEANZA 1942) - ABERHAN: 18.

1995 *Gervillaria pallas* (LEANZA 1942) - MUSTER: pl. 10, figs. 3, 5 (copy of Pl. 4, Figs. 1 and 3, this volume) and 4.

Material. 1 left valve and 1 articulated specimen from the Late Sinemurian and 17 articulated specimens from the Pliensbachian of Quebrada Pinte (PIW 1994VI 184-202); 5 left valves and 2 articulated specimens from the Late Pliensbachian of Quebrada Asientos (SNGM 8024-8025, PIW 1994VI 203-207); 1 left valve from the Late Pliensbachian between Quebrada Acevedo and Quebrada Chancoquin (SNGM 8026).

Remarks. *Gervillaria pallas* is trapezoidal in outline and the shell is strongly inequivalve and twisted. The species lacks an anterior auricle and is the only *Gervillaria*, which exhibits a pair of carinae on the left valve. By these features, *G. pallas* can be separated from all other bakevelliids. *Gervillaria pallas* is restricted to the Late Sinemurian to Late Pliensbachian and is endemic to the western margin of both Americas (ABERHAN in prep.). The affinities to related genera and species have been discussed at length by DAMBORENEA (1987b: 137) and MUSTER (1995).

Genus *Gervillella* WAAGEN 1907

Type species. *Perna aviculoides* J. SOWERBY 1814.

Gervillella araucana DAMBORENEA 1987

Pl. 3, Figs. 8-10

1987b *Gervillella araucana* sp. nov. - DAMBORENEA: 133, pl. 1, figs. 6, 7a-c, 8a-b, 9a-c, 10; text-fig. 6.

1992 *Gervillia (Gervillella) araucana* DAMBORENEA 1987 - ABERHAN: 18.

1995 *Gervillella araucana* DAMBORENEA 1987 - MUSTER: pl. 12, figs. 3 (copy of Pl. 3, Fig. 8, this volume) and 4.

Material. 30 left valves and 4 articulated specimens from the Late Sinemurian and 1 left valve from the Pliensbachian of Quebrada Pinte (SNGM 8021-8023, PIW 1994VI 208-239); 1 left valve and 1 right valve from the Pliensbachian of Quebrada Asientos (PIW 1994VI 240-241); preservation is mainly as internal moulds.

Remarks. In her revision of Jurassic bakevelliids MUSTER (1995) separates five species of *Gervillella*, mainly based on the ratio of diagonally measured shell length to dorsal length of the posterior wing, the ratio of height to length, and the shape of the wing. The distinguished species are *G. aviculoides*, *G. siliqua*, *G. lanceolata*, *G. monotis*, and *G. araucana*. From these only one species, the endemic *G. araucana*, is known to occur in the Early Jurassic of Chile and Argentina.

Gervillella araucana is characterized by the presence of a carina in the left valve, and has a more inequivalve and twisted shell compared to other species of *Gervillella*. *Gervillella araucana* has been described in detail by DAMBORENEA (1987b: 133) and MUSTER (1995).

Family *Inoceramidae* GIEBEL 1852

Genus *Parainoceramus* COX 1954 (ex VORONETZ 1936)

Type species. *Parainoceramus bulkuriensis* VORONETZ 1936.

Parainoceramus apollo (A. LEANZA 1942)

Text-fig. 12

1942 *Inoceramus apollo* sp. nov. - LEANZA: 157, pl. 2, fig. 1.

1987b *Parainoceramus apollo* (A. LEANZA 1942) - DAMBORENEA: 143, pl. 4, figs. 1-6, text-fig. 11.

1992 *Parainoceramus apollo* (LEANZA) - DAMBORENEA: pl. 115, fig. 9 (same specimen as in DAMBORENEA 1987b: pl. 4, fig. 1).

Material. Several left and right valves, preserved as internal and external moulds on a slab from the Sinemurian of Quebrada San Pedrito (SNGM 8233).

Remarks. *Parainoceramus apollo* has been recently described and its affinities discussed by DAMBORENEA

(1987b) so that no further taxonomic comments are needed here. In addition to Argentina, its geographic distribution now also includes northern Chile. Its stratigraphic range is from the Late Sinemurian to Late Pliensbachian.



Text-fig. 12. *Parainoceramus apollo* (A. LEANZA 1942). Latex cast of slab with many specimens. Sinemurian of Quebrada San Pedrito (HILLEBRANDT 711214/5). SNGM 8233. x 3.

Family Isognomonidae WOODRING 1925

Genus *Isognomon* SOLANDER in LIGHTFOOT 1786

Type species. *Ostrea perna* LINNAEUS 1767.

Subgenus *Isognomon* s. s.

Isognomon (Isognomon) jupiter (A. LEANZA 1942)

Pl. 5, Figs. 1-4; Pl. 6, Fig. 1

1942 *Perna jupiter* sp. nov. - LEANZA: 154, pl. 2, figs. 2-4.

1987b *Isognomon (Isognomon) jupiter* (A. LEANZA) - DAMBORENEA: 147, pl. 4, figs. 8, 9a-b, 10, pl. 5, figs. 1a-b, 2-5; text-figs. 12-13.

1992 *Isognomon (Isognomon) jupiter* (LEANZA 1942) - ABERHAN: 18.

Material. 2 articulated specimens with shell and 6 articulated internal moulds from the Pliensbachian of Quebrada Pinte (SNGM 8033, 8035; PIW 1994VI 242-247); 1 left valve and 1 right valve from the Toarcian/Aalenian of Quebrada Caballo Muerto (SNGM 8032, 8034).

Remarks. *Isognomon jupiter* is a very variable species, ranging from mytiliform to oval in outline. In general

shape and size, width of the ligamental area, and the number of ligamental grooves, it corresponds well with the specimens described and figured by LEANZA (1942) and DAMBORENEA (1987b) from Argentina. The presence of a posterior auricle, which is not delimited from the main shell, serves to distinguish it from many species from the Middle and Late Jurassic of Europe (e.g. *I. isognomonoides* (STAHL) as figured by GREPPIN (1900: pl. 13, fig. 7, pl. 15, fig. 2), *I. promytiloides* ARKELL (1933: 207, pl. 27, figs. 2-3), and *I. flambarti* (DOLLFUS 1863: pl. 13, fig. 5)).

Genus *Gervilleioperna* KRUMBECK 1923

Type species. *Gervilleioperna timoriensis* KRUMBECK 1923

Remarks. Following COX (1969), CARTER (1990), and MUSTER (personal communication), *Gervilleioperna* is here included in the Isognomonidae. This is in contrast to DAMBORENEA (1987b), who includes *Gervilleioperna* in the Bakevelliidae.

Subgenus *Gervilletia* DAMBORENEA 1987b

Type species. *Gervillia? turgida* A. LEANZA 1942.

Gervilleioperna (Gervilletia) turgida (A. LEANZA 1942)

Pl. 4, Figs. 4-8, Text-fig. 13

1942 *Gervillia (?) turgida* sp. nov. - LEANZA: 156, pl. 3, figs. 1-3.

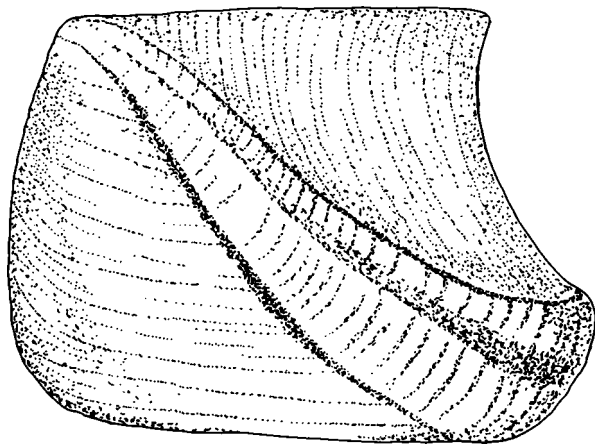
1987b *Gervilleioperna (Gervilletia) turgida* (A. LEANZA) - DAMBORENEA: 140, pl. 3, figs. 1a-b, 2a-b, 3a-d; text-fig. 9.

1992 *Gervilleioperna (Gervilletia) turgida* (LEANZA 1942) - ABERHAN: 18.

Material. 1 left valve from the Late Sinemurian of Quebrada La Papa (PIW 1994VI 248); 1 left valve from the Early Pliensbachian of Quebrada El Peñon (SNGM 8030); 2 articulated specimens from the Early/Late Pliensbachian of Río Jorquera (SNGM 8027-8028); 6 left valves and 2 articulated specimens from the Pliensbachian of Quebrada Asientos (SNGM 8029, PIW 1994VI 249-255); 5 left valves and 4 articulated specimens from the Pliensbachian of Quebrada Pinte (SNGM 8031, PIW 1994VI 256-263).

Remarks. The trapezoidal shell of *G. turgida* is highly inequivalve and twisted. The left valve exhibits an oblique double carina. Early Jurassic bakevelliids with a carina on the left valve are *Gervillaria pallas* and *Gervillella araucana* (see above). Apparently, during the Early Jurassic, carinate pteriods seem to have been relatively common in Argentina and Chile as compared to other parts of the world.

Gervilleioperna turgida can easily be distinguished from *Gervillaria pallas* by its shell outline, which shows a well-developed, pointed antero-ventral corner, and by being much more inflated. For a discussion of affinities to other species of *Gervilleioperna* see DAMBORENEA (1987b: 141).



Text-fig. 13. *Gervilleioperna (Gervilletia) turgida* (A. LEANZA 1942). Reconstruction of exterior view of left valve. Approximately x 1.

Family Posidoniidae FRECH 1909

Genus *Bositra* DE GREGORIO 1886

Type species. *Posidonia ornati* QUENSTEDT 1851.

Bositra ornati (QUENSTEDT 1851)

Pl. 6, Figs. 2-4

- 1851 *Posidonia ornati* sp. nov. - QUENSTEDT: 517, pl. 42, fig. 16.
 1881 *Posidonomya* cf. *ornati* QU. - STEINMANN: 257, pl. 10, figs. 3-4 (only).
 1899 *Posidonomya bronni* GOLDF. - PHILIPPI: 41, pl. 22, fig. 3 (only).
 p 1899 *Posidonomya ornati* QUENST. - PHILIPPI: 41, pl. 22, fig. 9 (copy from STEINMANN 1881: pl. 10, figs. 3-4).
 1900 *Posidonia opalina* QUST. - BURCKHARDT: 29, pl. 20, fig. 8.
 1903 *Posidonomya alpina* A. GRAS. - BURCKHARDT: 20, pl. 2, fig. 11.
 1931 *Posidonomya* from the group of *P. alpina* GRASS-WEAVER: 216, pl. 18, fig. 80.
 1945 *Posidonomya* sp. - LEANZA: 86, fig. 9.
 1980 *Bositra buchi* (ROMER) - HILLEBRANDT: pl. 1, fig. 6.
 1987b *Bositra ornati* (QUENSTEDT) - DAMBORENEA: 164, pl. 4, fig. 7; text-fig. 16 (see for extensive synonymy list).
 1992 *Bositra buchii* (ROMER 1836) - ABERHAN: 18.

Material. Several tens of specimens, concentrated as shell pavements from the Late Toarcian north of Quebrada Oreganito (SNGM 8073), the Aalenian of Mina Los Pingos (SNGM 8038-8039), and the

?Bathonian of Quebrada south of Quebrada Incaguasi (PIW 1994VI 264).

Remarks. *Bositra ornati* has been regarded as a synonym of *B. buchi* (ROEMER 1836) by some authors (e.g. JEFFERIES & MINTON 1965, DUFF 1978). However, the holotype of *B. buchi* as described and figured by ROEMER (1836: 81, pl. 9, fig. 8) is very different from the holotype of *B. ornati*, the former being much more elongated in shape and more evenly rounded in the antero-ventral part of the shell. For this reason the two species are kept separate here.

Bositra ornati is a long-ranging species, known from the Toarcian to Callovian and possibly ranging into the Late Jurassic. It has a cosmopolitan distribution with records from South America (see above), North America (IMLAY 1955: pl. 10, fig. 21; 1963: 102, pl. 14, figs. 10-13; 1964b: pl. 1, fig. 22), Europe (e.g. QUENSTEDT 1851: pl. 42, fig. 16; RAVN 1911: pl. 33, figs. 2-3; RADULOVIC & JOVANOVIC 1988: pl. 1, fig. 4), Africa (WEIR 1930: pl. 10, figs. 14-21; 1938: pl. 3, fig. 6), India (COX 1940: pl. 7, figs. 10-11) and China (GOU & LI 1983: pl. 4, figs. 2-3).

The evolutionary size increase from the Early to the Middle Jurassic, mentioned by DAMBORENEA (1987b: 165), can also be observed on the Chilean material, if specimens from the Late Toarcian, Aalenian, and ?Bathonian are compared with each other.

Genus *Posidonotis* LOSACCO 1942

Type species. *Posidonotis dainellii* LOSACCO 1942.

Posidonotis semplicata (HYATT 1894)

Pl. 6, Figs. 5-6

- 1894 *Monotis semplicata* sp. nov. - HYATT: 414.
 1933 *Entolium semplicatum* (HYATT) - CRICKMAY: 52, pl. 14, figs. 4-7.
 1943 *Pectinula cancellata* sp. nov. - LEANZA: 244, pl. 1, figs. 1-6.
 1980 *Pectinula cancellata* LEANZA - HILLEBRANDT: 126, pl. 1, fig. 2.
 1982 *Pectinula cancellata* LEANZA - PÉREZ: pl. 20, figs. 2-3.
 1987b *Posidonotis cancellata* (A. LEANZA) - DAMBORENEA: 193, pl. 14, figs. 1-12; text-figs. 28-29.
 1992 *Posidonotis cancellata* (LEANZA 1943) - ABERHAN: 18.
 1992 *Posidonotis cancellata* (LEANZA) - DAMBORENEA: pl. 117, figs. 9-11 (copy from DAMBORENEA 1987b: pl. 14, figs. 3b, 5, 12).
 1993a *Posidonotis cancellata* (LEANZA) - DAMBORENEA: fig. 31.

Material. About 200 specimens, mainly preserved as internal moulds and concentrated as shell pavements from the Late Pliensbachian of Quebrada de los Burros (PIW 1994VI 265) and Cerro Salto del Toro

(PIW 1994VI 266), the Late Pliensbachian to Early Toarcian of Quebrada Asientos (SNGM 8040, PIW 1994VI 267-272) and Quebrada de Paipote (SNGM 8041), and the Early Toarcian of Quebrada El Peñon (PIW 1994VI 273), Quebrada Yervas Buenas (PIW 1994VI 274), and Río del Toro (PIW 1994VI 275).

Remarks. The three nominal species of *Posidonotis* from the Late Sinemurian to Early Toarcian of western North America - *Posidonotis balteata* (CRICKMAY 1928: 62, pl. 4, figs. e-g), *P. semiplicata* (HYATT) as figured in CRICKMAY (1933: pl. 14, figs. 4-7), and *P. symmetrica* (HYATT), figured in CRICKMAY (1933: pl. 14, figs. 1-3) - have been studied by the author (ABERHAN in prep.). As already taken into consideration by various authors (e.g. CRICKMAY 1933, DAMBORENEA 1989, 1993a, PÁLFY et al., in press) the three taxa are now considered to belong to a single, relatively variable species, *P. semiplicata*. Furthermore, a comparison of *P. semiplicata* with *P. cancellata* from the Pliensbachian-Toarcian boundary beds of Chile and Argentina (see synonymy list) reveals that they are conspecific (ABERHAN in prep.). Therefore, the studied specimens from northern Chile are here assigned to *P. semiplicata*, which is the oldest available name.

Family Cercomyidae CRICKMAY 1936

Genus *Cercomya* AGASSIZ 1843

Type species. *Cercomya pinguis* AGASSIZ 1843.

Remarks. The genus *Cercomya* and its subgenus *Capillimya* are traditionally placed in the family Laternulidae of the order Pholadomyoidea (see COX et al. 1969: N845). However, comparative analysis of shell microstructure in the Late Triassic *Cercomya? gladius* (LAUBE) suggests affinity with the order Pterioidea rather than with the Pholadomyoidea. Therefore, in the classification scheme of CARTER (1990), which is followed in the present monograph, the ?superfamily Cercomyoidea CRICKMAY 1936 is placed within the order Pterioidea, suborder Pteriina.

Subgenus *Cercomya* s. s.

Cercomya (Cercomya) undulata (J. DE C. SOWERBY 1827)

Pl. 6, Figs. 7-9

- 1827 *Sanguinolaria undulata* sp. nov. - J. DE C. SOWERBY: 91, pl. 548, figs. 1-2.
1894 *Cercomya iglesia* sp. nov. - MÖRICKE: 58, pl. 2, fig. 8.

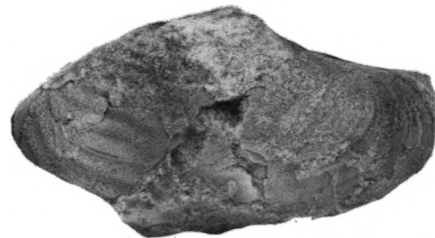
1936 *Cercomya undulata* (J. de C. Sowerby) - ARKELL: 351, pl. 50, figs. 2-5 (see for synonymy list).

1992 *Cercomya (Cercomya) undulata* (SOWERBY 1827) - ABERHAN: 20.

Material. 9 articulated specimens from the Early Toarcian of Quebrada La Titora (SNGM 8042-8043, PIW 1994VI 276-282), 3 articulated specimens from the Early Toarcian of Quebrada Pinte (SNGM 8044, PIW 1994VI 283-284), and 1 from the Toarcian of Salar de Pedernales (PIW 1994VI 285), all preserved as internal or composite moulds. The species ranges at least into the Aalenian at Salar de Pedernales (PIW 1994VI 286, hor. 6-3 in ABERHAN (1992)), Quebrada Asientos (PIW 1994VI 287), and Quebrada La Titora (PIW 1994VI 288-291, hor. 5-6 in ABERHAN (1992)).

Remarks. *Cercomya undulata* is well-known from the Middle and Late Jurassic of Europe (e.g. ARKELL 1936) and the Chilean forms correspond well with their European counterparts as figured, for example, by J. DE C. SOWERBY (1827: pl. 548, figs. 1-2), PHILLIPS (1829: pl. 5, fig. 1), QUENSTEDT (1852: pl. 47, fig. 1), and ARKELL (1936: pl. 50, figs. 2-5). Reports from other parts of the world's Jurassic are very rare. The oldest occurrences of the species are from the Chilean late Early Jurassic and the lower Middle Jurassic as documented here and by MÖRICKE (1894: 58, pl. 2, fig. 8). As in the case of many other marine molluscs of Jurassic age, *C. undulata* appears to have originated in the Chileno-Argentine region and migrated from there to Europe.

An articulated specimen from the Late Pliensbachian of Quebrada Asientos is here doubtfully included and referred to as *Cercomya? cf. undulata* (see Text-fig. 14). The posterior part of the specimen is broken off; the characteristic upcurved shape of the posterior end, as is developed on *Cercomya undulata*, therefore cannot be observed. In contrast to all other studied material, which is preserved as moulds, this specimen still exhibits original shell material. In addition to an ornament of coarse, rounded, commarginal folds, which fade towards the posterior end, the posterior part of the shell surface of both valves bears minute, radially aligned pustules as is typical of the genus.



Text-fig. 14. *Cercomya? cf. undulata* (J. DE C. SOWERBY 1827). View of left valve. Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-61). SNGM 8234. x 1.

Suborder *Pinnina* WALLER 1978

Family *Pinnidae* LEACH 1819

Genus *Pinna* LINNAEUS 1758

Type species. *Pinna rudis* LINNAEUS 1758.

Subgenus *Pinna* s. s.

Remarks. The taxonomy of a large number of species of Jurassic *Pinna* is based on fragmentary material and little is known about intraspecific variability of, for example, general outline, number and regularity of radial ribs, and the width of interspaces between ribs. A revision of *Pinna* certainly will reduce the large number of ill-defined nominal species. Due to poor preservation, the available material from the Early Jurassic of northern Chile can be referred only with reservation to two species, *Pinna (Pinna)* cf. *folium* YOUNG & BIRD and *Pinna (Pinna)* cf. *radiata* MÜNSTER.

Pinna (Pinna) cf. *folium* YOUNG & BIRD 1822

Pl. 7, Figs. 3-4

- cf. 1822 *Pinna folium* sp. nov. - YOUNG & BIRD: 243, pl. 10, fig. 6.
 1987a *Pinna (Pinna)* cf. *folium* YOUNG & BIRD - DAMBORENEA: 95, pl. 4, figs. 6, 11a-b, 12a-b, 13-14; text-fig. 24.
 1992 *Pinna (Pinna)* cf. *folium* YOUNG & BIRD 1822 - ABERHAN: 18.

Material. 5 poorly preserved steinkerns from the Early Toarcian of Quebrada Pinte (SNGM 8049-8050, PIW 1994VI 292-294).

Remarks. The studied specimens are characterized by an acute apical angle, a straight to slightly convex dorsal margin, and a straight to slightly concave ventral margin. The surface ornament is unknown. As far as can be judged from the poorly preserved material they correspond well with specimens assigned to *P.* cf. *folium* by DAMBORENEA (1987a: 95, pl. 4, figs. 6, 11-14; text-fig. 24) from Pliensbachian to Toarcian sediments of Argentina. DAMBORENEA (1987a: 95) also discusses at length the affinities to related species of *Pinna*.

Pinna (Pinna) cf. *radiata* MÜNSTER 1837

Pl. 7, Figs. 1-2

- cf. 1837 *Pinna radiata* sp. nov. - MÜNSTER in GOLDFUSS: 165, pl. 125, figs. 6a-d.
 1982 *Trichites* (?) sp. - PÉREZ: pl. 12, fig. 12.

1992 *Pinna (Pinna)* sp. nov. - ABERHAN: 18.

Material. 4 fragmentary specimens from the Late Pliensbachian of Quebrada Asientos (SNGM 8048, PIW 1994VI 295-297) and 2 fragmentary specimens from the Late Pliensbachian of Quebrada Pinte (SNGM 8047, PIW 1994VI 298), all articulated and, at least in part, with shell preservation.

Remarks. The specimens are characterized by a relatively wide apical angle. The shell ornament consists of 9 to 13 radial ribs dorsally of a well-developed median carina. The ventral part carries 13 to 15 ribs, which fade away towards the ventral margin. The radial ribs are straight, but more often undulating; intercalated ribs occur only very rarely. The interspaces between the ribs are irregular, ranging from one to four times the width of the ribs. Commarginal growth rugae are well-developed over all of the shell surface, giving rise to rounded nodes where they cross with radial ribs.

General shape and style of ribbing correspond closely to that of *P. (P.)* cf. *radiata* as discussed by FÜRSICH & WERNER (1988: 133, pl. 12, figs. 2-3) from the Late Jurassic of Portugal.

The analysed specimens are certainly conspecific with *Trichites* (?) sp. as figured by PÉREZ (1982: pl. 12, fig. 12). This specimen has been collected from the same locality as most of the material studied here. The assignment to *Pinna* instead as to *Trichites* is based on the observation of a median carina separating the shell into two almost equal halves. Furthermore, the median division of the inner nacreous layer of the shell into two lobes can be observed on steinkerns.

Order *Limoida* RAFINESQUE 1815

Family *Limidae* RAFINESQUE 1815

Genus *Antiquilima* COX 1943

Type species. *Lima antiquata* J. SOWERBY 1818.

Subgenus *Antiquilima* s. s.

Antiquilima (Antiquilima) cf. *nagatoensis* HAYAMI 1959

Pl. 8, Figs. 1-3

- cf. 1959 *Antiquilima nagatoensis* sp. nov. - HAYAMI: 66, pl. 7, fig. 4a-c.
 cf. 1975 *Antiquilima nagatoensis* HAYAMI - HAYAMI: 86, pl. 4, fig. 1 (copy from HAYAMI 1959: pl. 7, fig. 4b).
 1942 *Lima succincta* SCHLOTH. - LEANZA: 178, pl. 10, fig. 7.
 1984 *Antiquilima* sp. - MANCENIDO & DAMBORENEA: 425, pl. 1, fig. 18.
 1992 *Antiquilima* sp. - ABERHAN: 19.

Material. 1 right valve, 3 articulated specimens and 1 fragmentary valve from the Late Sinemurian of Quebrada Pinte (SNGM 8051-8053, PIW 1994VI 299, 299a).

Remarks. The Chilean specimens show all diagnostic features of the subgenus, that is, an obliquely ovate, rather compressed and only slightly inflated shell, the absence of an anterior umbonal ridge as well as a lunule, a well differentiated and relatively large anterior auricle, and an ornament consisting of sinuous radial riblets of 2 orders of strength and irregularly spaced commarginal growth rugae. The primary ribs are prominent, between 40 and 45 in number; their tops are strongly jagged. The interspaces between primary ribs are either devoid of a radial ornament or bear one to three intercalated second order riblets. Towards the shell margin second order riblets may or may not reach the size of the primary ribs.

In style of ornamentation, in particular the presence of imbricate lamellae on top of the primary ribs, the studied specimens correspond well with *Antiquilima* (*A.*) *nagatoensis* from the Sinemurian of Japan. However, in the only figured specimen, the holotype of *A.* (*A.*) *nagatoensis* (see HAYAMI 1959: pl. 7, fig. 4a-b; 1975: pl. 4, fig. 1) the height to length ratio is higher than in the specimens from Argentina (LEANZA 1942: 178, pl. 10, fig. 7) and Chile. As the range of intraspecific variability is unknown at present, the forms from South America are assigned to *A.* (*A.*) *nagatoensis* with reservation.

A related species is *A.* (*A.*) *succincta* (SCHLOTHEIM 1813) and its junior synonym *A.* (*A.*) *antiquata* (J. SOWERBY 1818) from the Liassic of Europe. The style of ornamentation in *A.* (*A.*) *succincta* is very variable (e.g. see illustrations in J. SOWERBY 1818: 25, pl. 214, fig. 2; BRONN 1836: 338, pl. 15, fig. 10; QUENSTEDT 1856: 78, pl. 9, fig. 11; DUMORTIER 1867: 212, pl. 48, fig. 1), but this species appears to lack the imbricate lamellae typical of *A.* (*A.*) *nagatoensis*.

The incomplete specimen of *Lima radula* PHILIPPI (1899: 20, pl. 11, fig. 2) from the ?Early Jurassic near Vallenar, northern Chile, also exhibits ribs of different strength, but the ribs are rather straight instead of sinuous as it is typical of *Antiquilima* s. s. Therefore and because the umbonal region as well as the shape of the auricles are unknown, the generic identity of this specimen must remain uncertain.

Antiquilima (*Antiquilima*) sp. indet.

Pl. 6, Figs. 10-11

Material. 1 left valve from the Late Hettangian of Aguada Alto de Varas (SNGM 8046); 1 left valve from the Late Hettangian of Quebrada Chaco Sur (SNGM 8045).

Remarks. This *Antiquilima* has a relatively large, moderately inflated shell. The posterior auricle is very large, hardly differentiated from the rest of the shell, and is covered with about 10 radial riblets. The ornament of the main body of the shell consists of slightly sinuous first order ribs; the interspaces between these regularly spaced primary ribs bear one to several second order riblets.

Due to differences in general shape and style of ribbing these specimens are treated separately from *A.* (*A.*) *nagatoensis*, which is discussed above. As their preservational state is rather poor, they cannot be identified more precisely than at the subgeneric level.

Genus *Ctenostreon* EICHWALD 1862

Type species. *Ostracites pectiniformis* SCHLOTHEIM 1820.

Ctenostreon cf. *rugosum* (SMITH 1817)

Pl. 8, Figs. 4-7

- cf. 1817 *Ostrea rugosa* sp. nov. - SMITH: 92, 106.
- cf. 1820 *Lima proboscidea* sp. nov. - J. SOWERBY: 115, pl. 264.
- cf. 1820 *Ostracites pectiniformis* sp. nov. - SCHLOTHEIM: 231.
- cf. 1948 *Ctenostreon rugosum* (W. SMITH) - COX & ARKELL: 18 (see for synonymy list).
- cf. 1952 *Ctenostreon proboscideum* (J. SOWERBY) - COX: 64, pl. 5, figs. 13-14 (see for extensive synonymy list).
- cf. 1975 *Ctenostreon pectiniforme* (SCHLOTHEIM, 1820) - YAMANI: 72, pl. 4, fig. 4 (see for extensive synonymy list).
- 1992 *Ctenostreon proboscideum* (SOWERBY 1820) - ABERHAN: 19.

Material. 1 articulated specimen from the Late Pliensbachian between Quebrada Acevedo and Quebrada Chancoquin (SNGM 8057); 1 specimen from the Early Toarcian of Quebrada Asientos (PIW 1994VI 300); 2 left valves from the ?Pliensbachian west of Quebrada de las Pircas (PIW 1994VI 301-302); 1 left valve and 1 right valve from the Pliensbachian/Toarcian of Quebrada La Plata (PIW 1994VI 303-304); 1 left valve and 6 fragmented valves from the Early Toarcian of Quebrada Pinte (SNGM 8054-8056, PIW 1994VI 305-308); 2 fragmented valves from the Late Toarcian of Salar de Pedernales (PIW 1994VI 309-310); 1 left valve, 1 fragmented valve, and 1 articulated specimen from the Late Toarcian of Quebrada La Totorá (PIW 1994VI 311-313); the species is also present in the Aalenian of Río del Toro (PIW 1994VI 314).

Remarks. The Chilean specimens assigned with reservation to *C. rugosum* are subcircular in outline, the height slightly exceeding the length. The shell surface is ornamented with 11 to 13 strong radial ribs. The ribs are straight, broadly rounded, and in uneroded specimens they bear coarse tubular spines and occasionally become squamose. The interspaces between the ribs are of about the same width or narrower than the ribs.

The problem of discriminating various species of Jurassic *Ctenostreon* has been repeatedly discussed in the literature (e.g. ARKELL 1932: 145; COX 1952: 65; YAMANI 1975: 73). In particular, these authors refer to the great resemblance of *C. rugosum* (SMITH), *C. pectiniforme* (SCHLOTHEIM), and *C. proboscideum* (J. SOWERBY). After thorough analysis of the Chilean material and the large number of available descriptions and figures of the three species (e.g. J. SOWERBY 1820: 115, pl. 264; ZIETEN 1832: 62, pl. 47, fig. 1a-c; GOLDFUSS 1835: 88, pl. 103, fig. 2a-c; BRONN 1836: 336, pl. 19, figs. 9, 10a-b; CHAPUIS & DEWALQUE 1853: 202, pl. 31, fig. 1; MORRIS & LYCETT 1853: 26, pl. 6, fig. 9; LYCETT 1863: 39, pl. 36, fig. 1; THURMANN & ETALLON 1863: 236, pl. 32, fig. 1; DAMON 1880, pl. 9, fig. 11; GREPPIN 1893: 74, pl. 6, fig. 1; LISSAJOUS 1910: 350, pl. 9, figs. 10-11; COSSMANN 1924: 30, pl. 4, figs. 4-5; ARKELL 1932: 145, pl. 15, fig. 3; 1936: pl. 54, figs. 2-4; COX 1935a: 14, pl. 1, fig. 16; 1952: 64, pl. 5, figs. 13-14; ANDREEVA 1966: 64, pl. 20, figs. 1-4; BEHMEL & GEYER 1966: pl. 5, fig. 2; PARNES 1981: 33, pl. 4, figs. 28-29, and many others) I came to the conclusion that it is impossible to distinguish between them. There are no clearly defined morphological differences, but rather a continuous spectrum of variations in shell outline, size of auricles, and ornament exists. In particular, the number of ribs is a highly variable feature and appears to be of little diagnostic value in the specific discrimination of these three species. Therefore, part of the Chilean specimens have been referred to as *C. cf. rugosum*, since this is the earliest available name. An open nomenclature has been preferred here, as a final statement on the specific identity of the three species requires careful examination of original material and museum collections.

Ctenostreon wrighti BAYLE 1878

Pl. 8, Fig. 8; Pl. 9, Figs. 1-2

1878 *Ctenostreon wrighti* sp. nov. - BAYLE: pl. 125, fig. 1.

1934 *Ctenostreon cf. wrighti* - FERUGLIO: 45, pl. 4, fig. 7.

1992 *Ctenostreon wrighti* BAYLE 1878 - ABERHAN: 19.

Material. 1 articulated specimen from the Late Sinemurian of Quebrada Yervas Buenas (PIW 1994VI 315); 2 left valves, 5 right valves, and 3 articulated specimens from the Late Sinemurian, 4 left valves, 3 right valves and 3 specimens from the Early Pliensbachian, and 2 right valves and 4 specimens from the Late Pliensbachian of Quebrada Pinte (SNGM 8058-8060, PIW 1994VI 316-338); 2 fragmentary valves from the Late Pliensbachian of Quebrada Asientos (PIW 1994VI 339-340); 1 right valve from the Toarcian/Aalenian north of Portezuelo de Pedernales (PIW 1994VI 341).

Remarks. The shell of *C. wrighti* is obliquely ovate with the height exceeding the length. The studied specimens carry 8 to 14, slightly curved radial ribs. The ribs are prominent, relatively narrow and strongly rounded. They bear numerous tubular spines at irregular intervals, which tend to become larger from the umbo towards the ventral margin. The width of the interspaces between ribs can be very variable even on the same specimen. However, the interspaces are wider than the ribs on most of the shell surface. The interspaces are smooth to weakly squamose and in some very well preserved specimens several very fine radial striae are visible. Occasionally the ribs become weaker and more closely spaced on the anterior region of the shell (e.g. Pl. 9, Fig. 2a-b). There, the interspaces become narrower and are of about the same width as the ribs.

Ctenostreon paucicostatum LEANZA (1942: 179, pl. 11, fig. 3; pl. 13, figs. 1-2) from the Pliensbachian and Toarcian of Argentina can be distinguished from *C. wrighti* by a low number (6 to 7) of tuberculate ribs, which become wider towards the ventral margin. The ribs are separated by very wide interspaces, which are of about three times the width of the ribs in the central part of an adult specimen.

Ctenostreon wrighti can be distinguished from *C. cf. rugosum* by having narrower and more prominent ribs. Furthermore, in the former the interspaces are distinctly wider than the ribs on most of the shell surface. By contrast, in *C. cf. rugosum* the interspaces are of about the same width or narrower than the ribs.

Lima raricostata BAYLE & COQUAND (1851: 26, pl. 6, figs. 3-4) from the Middle Jurassic of northern Chile also carries a low number (9) of narrow, prominent ribs with relatively wide interspaces between the ribs, but the ribs appear to lack spines and scales. Whether this is due to poor preservation or represents an original feature of *L. raricostata* cannot be decided on the basis of the description and figured material provided by BAYLE & COQUAND (1851). Therefore, the comparison with *C. wrighti* must remain preliminary.

Genus *Plagiostoma* J. SOWERBY 1814

Type species. *Plagiostoma giganteum*; STOLICZKA 1871.

Remarks. A huge number of species names exists for Jurassic *Plagiostoma*. However, many of them are poorly defined and figured and may be junior synonyms of earlier described species. Important available features for the identification of species of

Plagiostoma are the general outline and inflation of the shell, the umbonal angle, the depth and width of the lunule, the presence, number, strength and cross-section of radial ribs, and the width and ornament of the interspaces between the ribs. However, most of these features can be very variable both within individuals and between individuals of a population.

Records of *Plagiostoma* from the Early Jurassic of South America most commonly are descriptive (e.g. in JAWORSKI 1926a, WEAVER 1931). Figured specimens only have been provided by PHILIPPI (1899). He also erected a considerable number of new species of *Lima*, which either are ill-defined or clearly do not belong to *Plagiostoma*. Based on the studied material, two well known species of *Plagiostoma* have been recognized in the Early Jurassic of northern Chile, which also occur in the Jurassic of Europe: *Plagiostoma giganteum* and *P. punctatum*.

Most of the studied specimens cannot be referred to either of the two above mentioned species. As a rule these are poorly preserved, due either to fragmentation, abrasion, diagenetic dissolution of shell material and crushing, weathering or to a combination of these processes. The matter is further complicated by the high variability in shell ornamentation, even if specimens from a single bed are examined. Therefore no specific identification can be attempted here and specimens have been preliminarily assigned to *Plagiostoma* sp. A, *Plagiostoma* sp. B, and *Plagiostoma* sp. C respectively.

Plagiostoma giganteum J. SOWERBY 1814

Pl. 9, Figs. 8-10

- 1814 *Plagiostoma gigantea* sp. nov. - J. SOWERBY: 176, pl. 77.
 ? 1899 *Lima (Plagiostoma) gigantea* Sow. - PHILIPPI: 18, pl. 10, figs. 1-2.
 1935a *Lima (Plagiostoma) gigantea*, J. SOWERBY - COX: 4, pl. 1, fig. 6 (see for synonymy list).
 1992 *Plagiostoma giganteum* SOWERBY 1812 - ABERHAN: 19.

Material. 1 articulated specimen from the Early Toarcian of Quebrada Calquis (PIW 1994VI 342); 1 left valve from the Middle Toarcian of Río del Toro (SNGM 8067); 1 right valve from the Middle Toarcian between Quebrada Acevedo and Quebrada Chancoquin (SNGM 8068); 1 articulated specimen from the Middle Toarcian of Río Jorquera (PIW 1994VI 343); 1 articulated specimen from the Late Toarcian of Quebrada La Totora (SNGM 8066); 6 articulated specimens from the Late Toarcian of Quebrada Pinte (PIW 1994VI 344-349).

Remarks. *Plagiostoma giganteum* has been repeatedly recorded from the Liassic of Europe (e.g. J. SOWERBY 1814: 176, pl. 77; ZIETEN 1833: 67, pl. 51, fig. 1a-c; CHAPUIS & DEWALQUE 1853: 199, pl. 28, fig. 2;

pl. 29, fig. 1; BAYLE 1878, pl. 123, figs. 1-2) and the observed Chilean specimens lie well within the morphological range of their European counterparts. The most characteristic feature of *P. giganteum* is its smooth to very faintly radially ribbed surface of the shell. Only at the postero-dorsal region of the shell distinct radial riblets are developed in some large specimens. Adults commonly exhibit a rather large size, which in the studied specimens reaches up to 13 cm in length.

From the Early Jurassic of South America only PHILIPPI (1899: 18 pl. 10, figs. 1-2) described and figured *P. giganteum*. While one of his specimens (PHILIPPI 1899: pl. 10, fig. 1) exhibits the typical obliquely ovate shape, the other specimen (PHILIPPI 1899: pl. 10, fig. 2) is more elongate in outline and may have been deformed by compaction. JAWORSKI (1926a: 161) briefly described *P. giganteum* from the early Early Jurassic of Portezuelo Ancho, Argentina, also referring to the high similarity of his specimen with those figured in the European literature, but an illustration of his material is lacking.

Plagiostoma punctatum J. SOWERBY 1815

Pl. 9, Figs. 3-5

- 1815 *Plagiostoma punctata* sp. nov. - J. SOWERBY: 25, pl. 113, figs. 1-2.
 1936 *Plagiostoma punctata* SOWERBY - DECHASEAUX: 14 (see for synonymy list).

Material. 3 left valves and 6 right valves from the Late Pliensbachian of Quebrada Pinte (SNGM 8061-8063, PIW 1994VI 350-355).

Remarks. *Plagiostoma punctatum* has an obliquely ovate shell, the ventral margin being slightly asymmetrical and of moderate convexity. A diagnostic feature is the high number (100 to 140) of very low riblets, which are separated by linear to slightly undulating, punctate grooves. The ribs are of variable width, the tops being flat to slightly convex. The umbonal angle varies between 90° and 120°. Besides the holotype, specimens from the Liassic of Europe, which closely correspond to the Chilean material, have been illustrated, for example, by GOLDFUSS (1835: 81, pl. 101, fig. 2a-b), CHAPUIS & DEWALQUE (1853: 201, pl. 30, fig. 4), and LISSAJOUS (1910: 348, pl. 9, fig. 3).

In general outline *P. punctatum* resembles *Plagiostoma* sp. A, which is discussed below. From this *P. punctatum* can be easily distinguished by the presence of more numerous and less pronounced riblets. BURCKHARDT's (1900: 25) poorly preserved specimen of *Lima (Plagiostoma) cf. punctata* and JAWORSKI's (1926a: 161) record of a specimen of *P.*

punctatum from the Early Jurassic of Argentina unfortunately are without illustration.

Plagiostoma sp. A

Pl. 10, Figs. 1-6

p 1992 *Plagiostoma laeviusculum* SOWERBY 1822 - ABERHAN: 19.

Material. 2 left valves and 1 right valve from the Middle/Late Hettangian of Quebrada Cachina (SNGM 8071, PIW 1994VI 356, 356a); 7 left valves, 5 right valves and 2 articulated specimens from the Late Sinemurian, 2 right valves from the Early Pliensbachian, 2 left valves, 1 left valve, 3 right valves, and 1 articulated specimen from the Late Pliensbachian, and 1 left valve and 5 right valves from the Toarcian of Quebrada Pinte (SNGM 8072, PIW 1994VI 357-385); 1 left valve from the Early Pliensbachian of Quebrada La Titora (PIW 1994VI 396); 1 left valve and 1 articulated specimen from the Early/Late Pliensbachian of Río Jorquera (SNGM 8070, PIW 1994VI 386); 2 left valves, 3 right valves, and 3 articulated specimens from the Late Pliensbachian of Quebrada Asientos (SNGM 8073-8074, PIW 1994VI 387-392); 1 left valve from the Late Pliensbachian of Portezuelo de Pedernales (PIW 1994VI 393); 1 articulated specimen from the Middle Toarcian of Río del Toro (SNGM 8069); 1 left valve and 1 articulated specimen from the Late Toarcian of Quebrada San Miguel (PIW 1994VI 394-395).

Remarks. *Plagiostoma* sp. A has a medium-sized, weakly to moderately inflated, broadly trapezoidal shell. The main surface of the shell bears numerous low, slightly sinuous ribs. The number of ribs ranges from 56 to 90 (most commonly around 65). The ribs are flat-topped to broadly rounded and considerably wider than the interspaces during most of the ontogeny. At older growth stages, however, ribs sometimes become more angular and narrower, but - apart from few exceptions - remain wider than the interspaces. The interspaces are punctate during early growth stages and grade into delicate transverse threads as the interspaces become wider towards the ventral margin. The umbonal angle varies between 100° and 125°.

With regard to overall shape and the style of ribbing the Chilean specimens correspond fairly well to European representatives of *Plagiostoma semicircularis* as figured, for example, by GOLDFUSS (1835: 83, pl. 101, fig. 6a-c), CHAPUIS & DEWALQUE (1853: 202, pl. 30, fig. 5), GREPPIN (1900: 127, pl. 15, fig. 6, 6a), and COX (1943: 160, pl. 10, figs. 13-14). The number of ribs, however, is larger in the latter (80 to 100) and the ribs are more prominent. WEAVER (1931: 290) described *P. cf. semicircularis* from late Early Jurassic beds at Cañada Colorada, Argentina. Since the Argentine material is not illustrated, comparisons are difficult.

In the style of ribbing that is number, prominence, width, and cross-section of ribs, *Plagiostoma* sp. A

agrees very well with *Plagiostoma truncatifrons* BAYLE & COQUAND (1851: 25, pl. 6, fig. 5) from the Middle Jurassic of northern Chile. Marked differences exist, however, regarding the general outline. In particular, *P. truncatifrons* has a strongly truncated antero-dorsal region of the shell, in such a way that the dorsal margin becomes parallel to the long axis of the shell. According to the description of the authors, the antero-dorsal region is separated from the rest of the valve by a very prominent umbonal ridge. Both features have not been observed on specimens referred to *Plagiostoma* sp. A.

Plagiostoma sp. B

Pl. 10, Figs. 7-10

p 1992 *Plagiostoma laeviusculum* SOWERBY 1822 - ABERHAN: 19.

Material. 8 left valves, 20 right valves, and 3 articulated specimens from the Late Sinemurian, 5 left valves and 4 right valves from the Early Pliensbachian, 1 left valve from the Late Pliensbachian, and 1 left valve, 1 right valve, and 1 articulated specimen from the Toarcian of Quebrada Pinte (SNGM 8075, PIW 1994VI 397-439); 4 left valves and 1 right valve from the Late Pliensbachian of Quebrada Larga (PIW 1994VI 440-444); 2 left valves from the Pliensbachian and 2 articulated specimens from the Early Toarcian of Quebrada El Peñón (SNGM 8078, PIW 1994VI 445-447); 3 left valves and 4 right valves from the Late Pliensbachian or Early Toarcian of Quebrada La Plata (SNGM 8077, PIW 1994VI 448-453); 2 right valves and 1 articulated specimen from the Late Pliensbachian or Early Toarcian of Vega Redonda (SNGM 8076, PIW 1994VI 454-455).

Remarks. The shells of *Plagiostoma* sp. B are medium-sized, subovate to trapeziform in outline, slightly to moderately inequilateral, and moderately inflated. The ornament is highly variable. It consists of 45 to 60 prominent, straight to slightly sinuous radial riblets. The ribs are often jagged-topped, their flanks usually steep, in some specimens almost perpendicular-sided, but occasionally also lower and more angular ribs occur. The interspaces between ribs are narrower than the ribs and punctate during early growth stages, but reach about the same width as the ribs or are even wider at older growth stages. Towards the ventral margin they become concave in cross-section and are covered by fine commarginal threads.

Plagiostoma sp. B is a relatively common faunal element in Late Sinemurian and Early Pliensbachian beds of Quebrada Pinte. The available material, however, is not sufficiently well preserved to allow a more detailed description and precise identification. Regarding the ornament some resemblance exists with *Plagiostoma alticostum* (CHAPUIS & DEWALQUE) (1853: 203, pl. 28, fig. 3a-c; DECHASEUX 1936: 37, pl. 3, figs. 1-5; COX 1943: 168, pl. 18, figs. 46, 47,

48a-b), but it differs from the latter in being less inflated and by a less prominent and rounded umbonal region. From all other Chilean species of *Plagiostoma* described here, *Plagiostoma* sp. B can be distinguished by its radial ribs being very prominent. It must be mentioned, however, that some specimens exhibit an ornament, which is intermediate between *Plagiostoma* sp. A and *Plagiostoma* sp. B. Therefore it cannot be completely ruled out that both belong to one, highly variable species.

Plagiostoma sp. C

Pl. 9, Figs. 6-7

Material. 2 articulated specimens from the Late Sinemurian of Quebrada Pinte (SNGM 8064-8065).

Remarks. The shells of *Plagiostoma* sp. C are small, only slightly inequilateral, weakly inflated and slightly higher than long. The two specimens available for study bear 90 and 120 radial riblets respectively, if counted at the ventral margins. The riblets are of different strength and increase during ontogeny by intercalation or bifurcation. With only two specimens available it is impossible to evaluate the range of morphological variation and a precise specific designation is impossible at present. The species is therefore referred to as *Plagiostoma* sp. C.

Genus *Pseudolimea* ARKELL
in DOUGLAS & ARKELL 1932

Type species. *Plagiostoma duplicata* J. DE C. SOWERBY 1827.

Pseudolimea duplicata (J. DE C. SOWERBY 1827)

Pl. 11, Figs. 1-2

- 1827 *Plagiostoma duplicata* sp. nov. - J. DE C. SOWERBY: 114, pl. 559, fig. 3.
 ? 1878 *Lima* cf. *duplicata* SOW. - GOTTSCHKE: 22, pl. 5, fig. 15.
 ? 1925 *Lima* cf. *duplicata* SOW. - GOTTSCHKE: pl. 5, fig. 15 (copy of GOTTSCHKE 1878: pl. 5, fig. 15).
 1944 *Pseudolimea duplicata* (J. DE C. SOWERBY) - COX: 84 (see for extensive synonymy list).
 p 1992 *Pseudolimea* cf. *duplicata* (SOWERBY 1827) - ABERHAN: 19.

Material. 1 left valve from the Late Sinemurian of Quebrada Yerbas Buenas (PIW 1994VI 456); 8 left valves, 4 right valves, and 1 articulated specimen from the Late Sinemurian, and 1 articulated specimen and 3 incomplete valves from the Early Pliensbachian of Quebrada Pinte (PIW 1994VI 457-471); 1 left valve and 1 right valve from the Late Sinemurian between Quebrada Acevedo and Quebrada Chancoquin (SNGM 8079-8080).

Remarks. As is already known from European representatives, *P. duplicata* is a very variable and long ranging species (e.g. COX 1944, FÜRSICH & WERNER 1989). The Chilean specimens are trapezoidal in outline and exhibit 21 to 23 angular main radial ribs. The anterior and posterior end of the shell bears additional weak riblets. The strongly concave to V-shaped interspaces are always narrower than the ribs and are occupied by a well developed riblet of secondary order.

Pseudolimea hettangiensis (TERQUEM) from the Early Jurassic of Europe (e.g. TERQUEM 1855: 320, pl. 23, fig. 1; COX 1944: 77, pl. 2, figs. 1, 3, 4) and Chile (see below) can be distinguished by being less inequilateral, by a lower number (15-18) of main ribs and by a more prominent secondary riblet in each interspace. *Pseudolimea pectinoides* (J. SOWERBY) (e.g. COX 1944: 79, pl. 2, figs. 5-6) from the Hettangian to Aalenian of Europe can be separated from *P. duplicata* by having obtuse and depressed main ribs, one (or more) very weak radial threads occupying the interspaces, and smooth to nearly smooth anterior and posterior areas.

Figured specimens from the Early and Middle Jurassic of South American have been repeatedly referred to as *Lima* (*Plagiostoma*) *duplicata* SOW. (PHILIPPI 1899: 21, pl. 11, fig. 5; LEANZA 1942: 178, pl. 10, figs. 4-6) or *Lima* cf. *duplicata* SOW. (GOTTSCHKE 1878: 22, pl. 5, fig. 15). Due to poor descriptions and figures, however, their specific affinities remain poorly known. In particular, the style of second and third order ribbing, which allowed the separation of the Chilean specimens into two distinct species (see below), can only be evaluated by studying the original material.

Pseudolimea hettangiensis (TERQUEM 1855)

Pl. 11, Fig. 6

- 1855 *Lima hettangiensis* sp. nov. - TERQUEM: 320, pl. 23, fig. 1.
 1944 *Pseudolimea hettangiensis* (TERQUEM) - COX: 77, pl. 2, figs. 1, 3, 4 (see for synonymy list).

Material. 1 right valve from the Late Hettangian of Cerros de Cuevitas (SNGM 8084); 3 left valves and 2 right valves from the Late Hettangian of Aguada Alto de Varas (PIW 1994VI 472-475 and 1 valve on same specimen as *Antiquilima* sp. indet., SNGM 8046).

Remarks. *Pseudolimea hettangiensis* is characterized by a slightly inequilateral shell with an almost symmetrical ventral margin. The ornament of complete specimens consists of 17 to 18 angular ribs with a well developed angular secondary riblet in the interspaces and numerous radial striae, which cover

the surface of the ribs. Additional riblets occur on the posterior portion of the shell, which lacks secondary riblets. In these specific characters, the specimens from northern Chile agree well with specimens from the Early Lias of Europe (e.g. TERQUEM 1855: 320, pl. 23, fig. 1; COX 1944: 77, pl. 2, figs. 1, 3, 4).

Pseudolimea cf. *roemeri* (BRAUNS 1871)

Pl. 11, Figs. 3-5

- cf. 1836 *Lima pectinoides* sp. nov. - ROEMER: 75, pl. 3, fig. 21 (non *Pseudolimea pectinoides* (J. SOWERBY 1815)).
 cf. 1871 *Lima roemeri* sp. nov. - BRAUNS: 469; 1874: 409.
 p 1992 *Pseudolimea* cf. *duplicata* (SOWERBY 1827) - ABERHAN: 19.

Material. 2 left valves from the Late Pliensbachian and 2 left valves and 6 right valves from the Toarcian of Quebrada Pinte (SNGM 8083, PIW 1994VI 476-484); 2 left valves, 2 right valves and 1 articulated specimen from the Toarcian of Quebrada La Totorá (SNGM 8082, PIW 1994VI 485-488); 1 right valve from the Middle Toarcian of Río Jorquera (PIW 1994VI 489); 3 left valves and 3 right valves from the Late Toarcian of Salar de Pedernales (SNGM 8081, PIW 1994VI 490-494); the species ranges into the Aalenian at Quebrada Asientos (PIW 1994VI 495-500).

Remarks. The specimens referred to as *P.* cf. *roemeri* are very inequilateral. The number of primary ribs, which range from angular to rounded in cross-section is between 19 and 24. The interspaces are concave and of about the same width or wider than the main ribs. The middle of the interspaces bears one, very rarely two, secondary riblets. In addition the rib flanks and the interspaces are covered with numerous (up to 8 if counted from the crest of a main rib to the next secondary riblet) fine radial striae. In some specimens with well preserved ornament these striae give rise to a delicate reticulate pattern where they cross fine commarginal growth lines. The posterior auricle bears 3 weak radial riblets.

In general outline and style of ribbing the specimens from the Early Jurassic of northern Chile correspond well with *P. roemeri* from Europe (e.g. COX 1944: 82, pl. 3, fig. 16). With regard to the ribbing pattern a very similar species is *P. mandawaensis* COX (1965: 64, pl. 8, fig. 3) from the Late Jurassic of East Africa. This species, however, is larger, less inequilateral and the secondary riblets are only slightly more prominent than the radial striae.

FÜRSICH & WERNER (1989: 150, pl. 16, figs. 5-6; text-fig. 23) described and figured *P. duplicata* with a highly variable ornament, the number of secondary riblets ranging from 0 to 3 in number. In this respect their material seems to represent intermediate forms between *P. duplicata* and *P.* cf. *roemeri*. Based on this observation, specimens of both groups have been

listed as *P. duplicata* in ABERHAN (1992). However, as the Chilean material can be readily separated in specimens with a single secondary riblet ranging from Late Sinemurian to Early Pliensbachian (*P. duplicata*) and a second species with numerous higher order riblets from the Late Pliensbachian to Toarcian (*P.* cf. *roemeri*) a distinction appears to be justified. Since the intraspecific range of Jurassic *Pseudolimea* is far from fully understood an open nomenclature has been adopted here.

Order **Ostreoida** FÉRUSAC 1822

Family **Plicatulidae** WATSON 1930

Genus *Plicatula* LAMARCK 1801

Type species. *Spondylus plicatus* LINNAEUS 1758.

Subgenus *Plicatula* s. s.

Plicatula (*Plicatula*) *armata* GOLDFUSS 1835

Pl. 11, Figs. 7-14, Text-fig. 15A, B

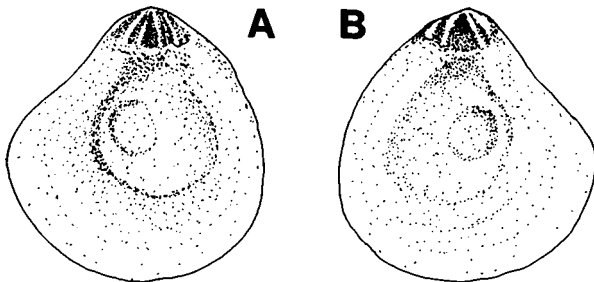
- 1835 *Plicatula armata* sp. nov. - GOLDFUSS: 101, pl. 107, fig. 5.
 1899 *Plicatula caracolensis* sp. nov. - PHILIPPI: 22, pl. 12, fig. 5.
 1989 *Plicatula* (*Plicatula*) *armata* GOLDFUSS, 1835 - FÜRSICH & WERNER: 146, pl. 15, figs. 8-11 (see for extensive synonymy list).
 1992 *Plicatula* (*Plicatula*) cf. *armata* GOLDFUSS 1835 - ABERHAN: 19.

Material. 12 left valves, 6 right valves and 7 articulated specimens from the Late Sinemurian of Quebrada Yervas Buenas (SNGM 8086, 8088-8092; PIW 1994VI 501-519); 9 articulated specimens and 9 fragmented valves from the Late Sinemurian of Quebrada Pinte (SNGM 8085, 8087; PIW 1994VI 520-535).

Remarks. The studied specimens exhibit prominent radial plicae, which range from 9 to 25 in number. The cross-section of the plicae is very variable ranging from strongly angular to very broadly rounded even in specimens from a single population. The tops of the plicae carry numerous spines, which, if broken off, give the exterior of the shell a scaled appearance. This is further accentuated by commarginal growth rugae, which are arranged at irregular intervals and which also can vary considerably in strength between specimens.

The studied specimens exhibit hinge characters typical of the genus (see also Text-fig. 15A, B). The ligamental pit of the left valve is bordered by narrow raised ridges. In anterior and posterior directions, these are followed by sockets and finally by prominent

crura. In the right valve, the crura are placed adjacent to the ligamental pit and in an anterior and posterior direction are followed by one socket each. The slightly to moderately divergent crura are straight and narrow and in specimens with well preserved internal shell features crenulation of the crura can be observed. The adductor scar of both valves is subcircular and situated in a relatively posterior position.



Text-fig. 15. *Plicatula (Plicatula) armata* GOLDFUSS 1835. Reconstruction of interior view with hinge characters and adductor scar. A. Left valve. B. Right valve. Approximately x 1.

FÜRSICH & WERNER (1989: 147) grouped those species of *Plicatula* with *P. armata*, which exhibit "numerous spines and radial plicae, the latter often only present at the free shell margin". According to them, *P. armata* possibly has a continuous stratigraphic record ranging from the late Early Jurassic to the Kimmeridgian. As the Chilean specimens fit well within this diagnosis they can be assigned confidently to this species.

Plicatula caracolensis PHILLIPI (1899: 22, pl. 12, fig. 5) from the Jurassic of Chile lies also within the morphological range of *P. armata* and therefore has been taken into synonymy.

Subgenus *Harpax* PARKINSON 1811

Type species. *Harpax parkinsoni* BRONN 1824.

Remarks. In COX et al. (1969), *Harpax* has been regarded as a junior synonym of *P. (Plicatula)*. Based on hinge characteristics and style of ornamentation it recently has been treated as a subgenus of *Plicatula* (e.g. DAMBORENEA & MANCENIDO 1992, DAMBORENEA 1993a) or even as a separate genus (e.g. POULTON 1991). Here, *Harpax* is placed as a subgenus of *Plicatula*.

Plicatula (Harpax) rapa BAYLE & COQUAND 1851

Pl. 11, Figs. 15-18

1851 *Plicatula rapa* sp. nov. - BAYLE & COQUAND: 16, pl. 5, figs. 8-10.

- 1899 *Plicatula rapa* BAYLE et COQ. - PHILIPPI: 22, pl. 12, fig. 4.
 1992 *Plicatula (Plicatula) rapa* BAYLE & COQUAND 1851 - ABERHAN: 19.
 1992 *Plicatula rapa* BAYLE & COQUAND - DAMBORENEA: pl. 116, figs. 13-14.
 1992 *Plicatula (Harpax) rapa* BAYLE & COQUAND - DAMBORENEA & MANCENIDO: pl. 1, fig. 7a.
 1993a *Plicatula (Harpax) rapa* BAYLE & COQUAND - DAMBORENEA: fig. 3h (copy from DAMBORENEA & MANCENIDO 1992: pl. 1, fig. 7a).

Material. 1 right valve and 6 articulated specimens from the Late Sinemurian of Quebrada Larga (SNGM 8094-8095, PIW 1994VI 536-540); 1 articulated specimen from the Sinemurian of Río Manflas (PIW 1994VI 541); 1 articulated specimen from the Late Sinemurian of Quebrada east of Hacienda Manflas (SNGM 8093); 2 articulated specimens from the Late Sinemurian between Río Copiapó and Quebrada Amolanas (SNGM 8096, PIW 1994VI 542); 1 articulated specimen and 2 valves from the Early Pliensbachian and 3 articulated specimens and 2 fragmented valves from the Late Pliensbachian of Quebrada Pinte (PIW 1994VI 543-547); 1 left valve from the Late Pliensbachian of Quebrada Asientos (PIW 1994VI 548).

Remarks. The characteristics of *P. (H.) rapa* are an ornament consisting of a high number of spines and/or scales and the lack or only very poor development of radial plicae. The right valves of the Chilean specimens exhibit a smooth attachment area, which can cover up to one half of the shell surface. The remaining area is ornamented with elongate, relatively coarse spines. The ornament of the left valve consists of numerous scales and spines, which are more delicate than in the right valve and conspicuous commarginal growth rugae are present.

Apart from the original figures provided by BAYLE & COQUAND (1851) and their reproduction in PHILIPPI (1899), which agree very well with the studied specimens, *P. rapa* from South America was recently figured by DAMBORENEA (1993a: fig. 3h). Her specimen exhibits a less dense ornament of scales and spines, but its morphological differences are thought to lie within the range of intraspecific variation. As already mentioned by DAMBORENEA (1993a) some specimens from the Early Jurassic of the boreal realm, repeatedly being referred to as *Harpax* (cf.) *spinus* (e.g. POLUBOTKO 1968, POULTON 1991) are very similar to the specimens from South America and most likely are conspecific.

A very similar species is *Plicatula (Harpax) spinosa* J. SOWERBY (1821: 79, pl. 245, figs. 1-4) from the Early Jurassic of Europe and Asia. The dominance of spines and the lack of well developed plicae can be clearly seen in the original material figured by J. SOWERBY (1921: pl. 245, figs. 1-4). However, in *P. spinosa* the ornament appears to be very similar in both valves and the spines are far less densely arranged than in the studied specimens of *P. rapa*. Other related species are *Plicatula*

semicircularis HAYAMI (1959: 60, pl. 6, figs. 14-16) from the Early Jurassic of Japan and *Plicatula vermiculata* EUDES-DESLONGCHAMPS (1858: 76, pl. 14, figs. 1-3) from the Liassic of northern France, but a revision of Jurassic *Plicatula* is beyond the scope of this paper.

Family Palaeolophidae MALCHUS 1990

Genus *Actinostreon* BAYLE 1878

Type species. *Ostrea solitaria* J. SOWERBY 1824.

Remarks. Based on phylogenetic considerations and shell microstructure MALCHUS (1990) erected a new family Palaeolophidae to accommodate Mesozoic species exhibiting a *Lopha*-like shape. He also raised *Actinostreon* BAYLE, which until recently was regarded as a subgenus of *Lopha* to the generic level.

Actinostreon costatum (J. DE C. SOWERBY 1825)

Pl. 12, Figs. 1-4

- 1825 *Ostrea costata* sp. nov. - J. DE C. SOWERBY: 143, pl. 488, fig. 3.
1992 *Lopha (Actinostreon) costata* (SOWERBY 1825) - ABERHAN: 19.

Material. 9 articulated specimens from the Late Sinemurian of Quebrada east of Hacienda Manflas (SNGM 8100, PIW 1994VI 549-556); 8 articulated specimens from the Sinemurian of Quebrada Chanchoquin (SNGM 8099, PIW 1994VI 557-563); 6 left valves, 2 right valves, and 10 articulated specimens from the Late Sinemurian of Quebrada Pinte (SNGM 8097, PIW 1994VI 564-580); 1 left valve and 8 articulated specimens from the Late Sinemurian of Quebrada Yerbas Buenas (SNGM 8098, PIW 1994VI 581-588); 1 articulated specimen from the Early Pliensbachian of Quebrada Vaca Muerta (PIW 1994VI 589); 1 articulated specimen from the Early Pliensbachian of Portezuelo de Pedernales (PIW 1994VI 590).

Remarks. The studied specimens of *A. costatum* are generally small, crescentically curved, and distinctly inequivalve. The cemented left valve is moderately to strongly convex, the attachment area covering one-fourth to more than one-half of the shell surface. The surrounding flanks are steeply raised and almost perpendicular to the plane of commissure in some specimens. The right valve is very weakly convex to flat.

The irregularly arranged, sometimes bifurcating costae, ranging from 10 to more than 20 in number, are angular to well rounded. The deep interspaces between the costae are of about the same width as the costae and are moderately to strongly rounded. Occasionally, commarginal growth rugae are well developed, in particular towards the shell margin, where they produce a squamous ornament.

Actinostreon costatum is well known from the Middle Jurassic of Europe, Africa and Asia (e.g. MORRIS & LYCETT 1853: 3, pl. 1, fig. 5, 5a; LORIOLO & SCHARDT 1883: 77, pl. 11, figs. 8-18; COX 1935b: 173, pl. 17, fig. 13; ROMANOV 1973: 97, pl. 9, figs. 2,3; FISCHER 1969: 96, pl. 10, figs. 23-27). The oldest records are from the Toarcian of East Africa (COX 1965: 66, pl. 9, fig. 1a-c) and the late Early Jurassic of Madagascar. The specimen from Madagascar has been identified as *Ostrea subserrata* GOLDFUSS by THEVENIN (1908: 125, pl. 4, fig. 10, 10a), but according to COX (1965) it most likely belongs to *A. costatum*, a view, which is shared here. Therefore, the specimens from Chile, ranging from the Late Sinemurian to the Early Pliensbachian, are the earliest record of the species.

Actinostreon longistriatum (JAWORSKI 1915)

Pl. 12, Figs. 5-7

- 1915 *Alectryonia (Ostrea) marshii* LAM. var. *longistriata* var. nov. - JAWORSKI: 441.
? 1934 *Alectryonia keideli* sp. nov. - FERUGLIO: 47, pl. 5, fig. 7a-c.
1942 *Alectryonia longistriata* JAW. - LEANZA: 159, pl. 4, figs. 4-6.
1992 *Lopha (Actinostreon) longistriata* (JAWORSKI 1915) - ABERHAN: 19.

Material. 4 articulated specimens and 1 valve from the Late Sinemurian, 2 articulated specimens and 2 valves from the Early Pliensbachian, and 17 articulated specimens and 6 valves from the Late Pliensbachian of Quebrada Pinte (PIW 1994VI 591-622); 3 articulated specimens from the Early Pliensbachian of Quebrada Vaca Muerta (SNGM 8103, PIW 1994VI 623-624); 1 articulated specimen from the Early Pliensbachian of Río del Toro (SNGM 8102); 1 articulated specimen from the Early/Late Pliensbachian and 1 articulated specimen and 2 valves from the Late Pliensbachian of Quebrada Asientos (SNGM 8101, PIW 1994VI 625-627).

Remarks. As already pointed out by LEANZA (1942), *A. longistriatum* is rather variable with regard to general outline, prominence and shape of the radial ribs, and distribution and density of radial striae. However, the diagnostic radial striae are consistently present in all studied specimens and allow the separation of *A. longistriatum* from all other species of *Actinostreon*.

Actinostreon solitarium (J. DE C. SOWERBY 1824)

Pl. 12, Figs. 8-10

- 1824 *Ostrea solitaria* sp. nov. - J. DE C. SOWERBY: 105, pl. 468, fig. 1.
1851 *Ostrea pulligera* GOLDF. - BAYLE & COQUAND: 21, pl. 5, figs. 4, 4^{bis}, 5.
1854 *Ostrea encarpifera* sp. nov. - HUPÉ: 286, pl. 4, fig. 6.

- 1899 *Ostrea encarpifera* HUPÉ - PHILIPPI: 7, pl. 1, fig. 7 (copy from HUPÉ 1854: pl. 4, fig. 6).
 1899 *Ostrea pulligera* GOLDF. - PHILIPPI: 8, pl. 3, fig. 5 (copy from BAYLE & COQUAND 1851: pl. 5, figs. 4, 4^{bis}, 5).
 1933 *Lopha solitaria* (J. SOWERBY) - ARKELL: 185, pl. 22, fig. 4; pl. 23, figs. 5-7 (see for synonymy list).
 1992 *Lopha (Actinostreon) solitaria* (SOWERBY 1824) - ABERHAN: 19.

Material. 3 left valves, 1 right valve, and 1 articulated specimen from the Early Pliensbachian, 5 left valves, 1 right valve, and 5 articulated specimens from the Late Pliensbachian, and 10 left valves, 11 right valves, and 8 articulated specimens from the Toarcian of Quebrada Pinte (PIW 1994VI 628-672); 1 left valve from the Late Pliensbachian of Quebrada Asientos (PIW 1994VI 673); 1 articulated specimen from the Late Pliensbachian of Río Figueroa (PIW 1994VI 674); 10 left valves, 4 right valves, and 22 articulated specimens from the Toarcian of Quebrada La Totorá (SNGM 8104, 8106; PIW 1994VI 675-708); 1 left valve and 14 articulated specimens from the Toarcian between Quebrada Acevedo and Quebrada Chancoquin (SNGM 8105, PIW 1994VI 709-722); 1 right valve and 5 articulated specimens from the Toarcian/Aalenian of Salar de Pedernales (PIW 1994VI 723-728).

Remarks. The species has been thoroughly treated by ARKELL (1933) and no further descriptions are needed. *Actinostreon gregareum* J. SOWERBY is a closely related species, but according to the diagnostic differences between both species provided by ARKELL (1933) the Chilean specimens clearly belong to *A. solitarium*. In particular, *A. solitarium* exhibits a more rounded overall shape and a lower number of ribs (10 to 25 instead of 30 to 40), which are also shorter and less dichotomous than in *A. gregareum*.

Family Gryphaeidae VYALOV 1936

Genus *Gryphaea* LAMARCK 1801

Type species. *Gryphaea arcuata* LAMARCK 1801.

Subgenus *Gryphaea* s. s.

Remarks. Non-lophate oysters as a whole and Early Jurassic gryphaeids of Argentina and Chile in particular are in an urgent need of revision. This can be only performed after extensive analysis of type material, study of internal features, and the examination of populations, which is beyond the scope of this monograph. Especially, the poorly described and figured specimens of *Ostrea* and *Gryphaea* in PHILIPPI (1899), which have been assigned to a large number of different species including several new ones, have to be carefully evaluated. For this reason, the classification presented herein must be regarded as preliminary.

Gryphaea (Gryphaea) darwini FORBES 1846

Pl. 12, Fig. 11; Pl. 13, Figs. 1-2

- 1846 *Gryphaea darwini* sp. nov. - FORBES: 388, pl. 5, fig. 7.
 1894 *Gryphaea darwini* FORB. - MÖRICKKE: 32, pl. 4, figs. 3-4 (only).
 1929 *Gryphaea Darwini* FORBES - STEINMANN: 72, fig. 80a-b.
 1931 *Gryphaea darwini* E. FORBES - WINDHAUSEN: 237, fig. 95.

Material. 2 left valves from the Late Hettangian of Aguada Alto de Varas (PIW 1994VI 729-730); 2 articulated specimens from the Early Sinemurian of Cerros de Cuevitas (PIW 1994VI 731-732); 1 left valve from the Early Sinemurian of Quebrada Doña Ines Chica (PIW 1994VI 733); 3 left valves from the Late Sinemurian of Quebrada Matahuaico (PIW 1994VI 734-735); 3 articulated specimens from the Late Sinemurian east of Quebrada El Carbon (SNGM 8107, PIW 1994VI 736-737); 1 left valve and 1 articulated specimen from the Late Sinemurian of Quebrada Larga (PIW 1994VI 738-739); 3 left valves from the Late Sinemurian between Río Copiapó and Quebrada Amolanas (SNGM 8108, PIW 1994VI 740-741); 2 articulated specimens from the Late Sinemurian of Río Manflas (PIW 1994VI 742-743); 1 left valve from the Late Sinemurian of Quebrada Los Eucaliptos (SNGM 8109).

Remarks. The left valves of the studied specimens of *G. (G.) darwini* are characterized by a very minute to almost evanescent attachment scar. They are suboval in outline, strongly inflated, and the umbo is protruding well beyond the ligamental area. The posterior sulcus is very shallow. Commarginal growth rugae are very weakly developed. The right valve is ovate in outline, moderately concave, and carries distinct growth lines or imbricate lamellae.

According to MÖRICKKE (1894), *G. darwini* is an extremely variable species. He recognized several morphological varieties. Here, only specimens, which closely resemble the original material figured by FORBES (1846: pl. 5, fig. 7) have been assigned to *G. darwini*. Specimens from the Late Sinemurian to Late Pliensbachian, which are characterized by a large attachment area and a relatively deep posterior sulcus, are here referred to *G. (Bilobissa) latior* STEINMANN.

MÖRICKKE (1894: 32) also included *Ostrea cymbium* DESHAYES in BAYLE & COQUAND (1851: 13, pl. 4, figs. 1-7) from the Early Jurassic of northern Chile in the list of synonyms, but the figured specimens more closely resemble *Gryphaea* sp. A, which is discussed below.

Closely related species from the Liassic of Europe are *G. arcuata* (e.g. BUVIGNIER 1852: 25, pl. 5, figs. 1-2; QUENSTEDT 1867: 598, text-fig. 136; 1884: 763, text-figs. 267-268), which has a larger height to length ratio and a more strongly inrolled umbo, *G. cymbium* (e.g. BUVIGNIER 1852: 25, pl. 5, figs. 5-7; CHAPUIS & DEWALQUE 1853: 223, pl. 33, figs. 1a-d,

2, pl. 34, fig. 1a-b) with an umbonal region that is less inflated, and *G. obliqua* (e.g. GOLDFUSS 1833: 30, pl. 85, fig. 2a-b), which, according to MÓRICKE (1894), exhibits a more acute umbonal region than *G. darwini*.

Gryphaea (Gryphaea) cf. dumortieri JOLY 1907

Pl. 13, Figs. 9-10; Pl. 14, Figs. 1-8

- cf. 1907 *Gryphaea dumortieri* sp. nov. - JOLY: 66, pl. 1, fig. 4-7.
 cf. 1934 *Liogryphaea dumortieri* JOLY - DECHASEAUX: 204, fig. 2.
 1982 *Gryphaea (Gryphaea)* sp. A - PÉREZ: pl. 12, figs. 7-8.
 1982 *Gryphaea cf. beaumonti* RIVIÈRE - PÉREZ, pl. 12, figs. 13-14.
 1982 *Gryphaea* sp. - PÉREZ: pl. 14, figs. 1-2.
 1982 *Gryphaea cf. cymbium* var. *elongata* GOLDFUSS - PÉREZ: pl. 14, figs. 12-13.
 1992 *Gryphaea (Gryphaea) cf. cymbium* GOLDFUSS 1833 - ABERHAN: 19.
 1992 *Gryphaea (Gryphaea) cf. arcuata* LAMARK 1801 - ABERHAN: 19.

Material. 5 left valves and 13 articulated specimens from the Late Sinemurian of Cerro Salto del Toro (SNGM 8122-8124, PIW 1994VI 744-758); 2 left valves from the Late Sinemurian of Río Plata (PIW 1994VI 759-760); 1 articulated specimen from the Late Sinemurian of Manflas (PIW 1994VI 761); 3 left valves and 1 articulated specimen from the Early Pliensbachian of Quebrada Pinte (PIW 1994VI 762-765); 2 left valves and 8 articulated specimens from the Early Pliensbachian of Quebrada Vaca Muerta (SNGM 8116-8119, PIW 1994VI 766-771); 18 left valves and 9 articulated specimens from the Early Pliensbachian north of Juntas del Tolar (PIW 1994VI 772-798); 15 left valves and 3 articulated specimens from the Early Pliensbachian and 61 left valves and 14 articulated specimens from the Late Pliensbachian of Quebrada Asientos (SNGM 8120-8121, PIW 1994VI 799-887); 3 left valves and 32 articulated specimens from the Pliensbachian west of Quebrada de la Iglesia (SNGM 8125, PIW 1994VI 888-920).

Remarks. *Gryphaea (G.) cf. dumortieri* is a small to medium-sized *Gryphaea* with a relatively variable shape. The examined left valves are weakly to moderately inflated, moderately to strongly inequilateral, and the umbo is relatively weakly inrolled. The umbonal area is pointed, the attachment area tiny to moderately large, and a radial posterior sulcus is missing or only very poorly developed. The resilifer is small. The shell exterior is covered with commarginal growth lines and rugae. The right valve is flat to moderately concave and also bears commarginal growth lines and rugae.

From the large number of Jurassic species of *Gryphaea* the Chilean material most closely resembles *G. (G.) dumortieri* JOLY from the Hettangian of Europe and is here tentatively referred to this species. Several other species are possibly synonyms and may have priority, but too little is known to make a clear statement at this point.

Gryphaea (Gryphaea) sp. indet.

Pl. 16, Figs. 1-6

- ? 1851 *Gryphaea cymbium* DESHAYES - BAYLE & COQUAND: 13, pl. 4, figs. 1-7.
 ? 1942 *Gryphaea darwini* FORBES - LEANZA: 160, pl. 5, figs. 4-5.
 p 1992 *Gryphaea (Gryphaea) darwini* FORBES 1846 - ABERHAN: 19.

Material. 38 left valves, 1 right valve, and 39 articulated specimens from the Toarcian of Quebrada Pinte (SNGM 8133-8135, PIW 1994VI 921-995); 1 left valve and 4 articulated specimens from the Late Toarcian of Salar de Pedernales (PIW 1994VI 996-1000); 3 left valve and 18 articulated specimens from the Toarcian of Quebrada La Totorá (SNGM 8132, 8136-8137; PIW 1994VI 1001-1018).

Remarks. The left valve of *Gryphaea (G.) sp. indet.* is moderately to strongly convex and oval to suborbicular in outline. The radial posterior sulcus is evanescent to shallow. The umbo is only slightly prominent and not inrolled; the attachment area is small to moderately large. The ligamental area of the left valve is figured on Pl. 16, Fig. 6b. Other internal characters are unknown. The right valve is flat to moderately concave. The surface of both valves is foliate to squamose and occasionally covered with commarginal growth rugae.

Gryphaea (G.) sp. indet. can be distinguished from all other species of *Gryphaea* from northern Chile treated in the present monograph by the lack of an inrolled umbo, the presence of an evanescent to only shallow posterior sulcus, and a relatively rounded outline. Its stratigraphic range appears to be restricted to the Toarcian, where it is the only gryphaeid oyster found in northern Chile.

Based on the identifications of poorly preserved specimens in LEANZA (1942: pl. 5, figs. 4-5) and the ?Sinemurian to Early Toarcian stratigraphic range of *G. darwini* given in RICCARDI et al. (1990), several Pliensbachian and Toarcian specimens of *Gryphaea* have been misinterpreted as *G. darwini* in ABERHAN (1992). According to present knowledge, in Chile, the stratigraphic distribution of *G. darwini* is confined to the Late Hettangian to Late Sinemurian. As no name is readily available from the literature for the species under discussion and as the taxonomic notes on gryphaeid oysters must remain preliminary, an open nomenclature has been adopted here.

Subgenus *Bilobissa* STENZEL 1971

Type species. *Gryphaea bilobata* J. DE C. SOWERBY 1840.

Gryphaea (Bilobissa) latior STEINMANN 1929

Pl. 14, Fig. 9; Pl. 15, Fig. 1

- non 1823 *Gryphaea gigantea* sp. nov. - J. DE C. SOWERBY: 127, pl. 391 (= *Ostrea (Gryphaea) latior* ROLLIER 1917)
- 1894 *Gryphaea darwini* FORB. - MÓRICKE: 32, pl. 4, figs. 1a-b, 2 (only).
- non 1917 *Ostrea (Gryphaea) latior* sp. nov. - ROLLIER 1917: 574.
- 1929 *Gryphaea darwini* FORBES var. *latior* STEINM. - STEINMANN: 72, fig. 79.
- non 1934 *Liogryphaea latior* ROLLIER - DECHASEAUX: 206, pl. E, fig. 3.
- p 1992 *Gryphaea (Gryphaea) darwini* FORBES 1846 - ABERHAN: 19.

Material. 2 articulated specimens from the Late Sinemurian of Manflas (PIW 1994VI 1019-1020); 1 articulated specimen from the Late Sinemurian of Quebrada Yerbas Buenas (PIW 1994VI 1021); 1 articulated specimen from the Late Sinemurian of Río Manflas (PIW 1994VI 1022); 2 articulated specimens from the Late Sinemurian and 3 left valves and 3 articulated specimens from the Late Pliensbachian of Quebrada Pinte (SNGM 8127, PIW 1994VI 1023-1029); 2 left valves from the Late Pliensbachian of Quebrada Asientos (SNGM 8126, PIW 1994VI 1030).

Remarks. In order to resolve the homonymy between *Ostrea gigantea* J. SOWERBY (1814: 143, pl. 64) and *Gryphaea gigantea* J. SOWERBY (1823: 127, pl. 391), ROLLIER (1917: 574) introduced the new name *Ostrea (Gryphaea) latior* for *Gryphaea gigantea* J. SOWERBY (1823: 127, pl. 391). Not recognizing the homonymy with *Gryphaea latior* ROLLIER, STEINMANN (1929: 72, fig. 79) figured a specimen from the lower Early Jurassic of La Ternera, northern Chile, as *Gryphaea darwini* FORBES var. *latior*. Referring to the figured specimen he only mentioned that the shell is rather thick and the lower valve is cemented in juveniles. The following description and discussion refers to STEINMANN's species. In order to avoid further confusion and since the classification of gryphaeid oysters in the present monograph is preliminary, no new name is introduced here to replace *Gryphaea (Bilobissa) latior* STEINMANN.

Gryphaea (Bilobissa) latior STEINMANN has a moderately inflated left valve, which is broadly rounded to subcircular in outline. The attachment area is conspicuously large (up to 25 cm²) and forms a pronounced angle, most commonly of about 90°, with the rest of the shell. The beak does not protrude beyond the ligamental area. The radial posterior sulcus is moderately deep to deep. The posterior flange bears well developed growth lamellae.

Based on the presence of a relatively deep sulcus and a detached posterior flange the studied material has been assigned to the subgenus *Bilobissa*. The specimens have strong affinities (due to their large attachment area and the development of a distinct sulcus) to forms included in *Gryphaea darwini* by

MÓRICKE (1894). However, as no specimens are available which exhibit intermediate morphological features between *G. darwini* as discussed above and *G. (B.) latior* STEINMANN, the two are treated separately here. It cannot be ruled out completely, however, that they belong to a single, highly variable species with the shape of the shell depending to a large extent on the size of the attachment area of the left valve.

Gryphaea (Bilobissa) tricarinata PHILIPPI 1899

Pl. 13, Figs. 3-7

- 1899 *Gryphaea tricarinata* sp. nov. - PHILIPPI: 12, pl. 5, fig. 3.
- ? 1899 *Gryphaea rostrata* sp. nov. - PHILIPPI: 11, pl. 3, fig. 3.
- 1992 *Gryphaea (Gryphaea) tricarinata* PHILIPPI 1899 - ABERHAN: 19.

Material. 3 left valves and 1 right valve from the Late Sinemurian of Quebrada Matahuaico (PIW 1994VI 1031-1034); 8 left valves and 4 articulated specimens from the Late Sinemurian of Quebrada Yerbas Buenas (SNGM 8113, PIW 1994VI 1035-1045); 1 left valve from the Late Sinemurian of Manflas (PIW 1994VI 1046); 1 articulated specimen from the Sinemurian of Río Manflas (SNGM 8112); 5 left valves and 5 articulated specimens from the Late Sinemurian of Quebrada Chancoquin (SNGM 8111, PIW 1994VI 1047-1055); 1 left valve and 1 articulated specimen from the Late Sinemurian between Quebrada Acevedo and Quebrada Chancoquin (PIW 1994VI 1238); 11 left valves from the Late Sinemurian of Quebrada Noria (SNGM 8115, PIW 1994VI 1056-1065); 1 left valve and 1 articulated specimen from the Late Sinemurian of Quebrada Pinte (PIW 1994VI 1066-1067); 11 left valves, 2 right valves, and 8 articulated specimens from the Late Sinemurian of Quebrada Larga (SNGM 8110, 8114; PIW 1994VI 1068-1086).

Remarks. The almost equilateral shell of *G. (B.) tricarinata* is rather narrow, subtriangular in outline, the height considerably exceeding the length. The left valve is very strongly convex. The size of its attachment area is small to moderately large (up to 2 cm²). The shell surface carries three more or less rounded radial carinae, the posterior and medium carinae being more prominent than the anterior one. The medium and the posterior carina are separated by a deep radial sulcus. The surface of the shell is covered with irregular, commarginal, rather sinuous growth welts, which may become very squamose, especially on top of the carinae. The resilifer of the left valve is large, elongate and well excavated. The right valve is concave and exhibits irregularly spaced growth squamae.

Gryphaea tricarinata can be distinguished from all other Jurassic species of *Gryphaea* on the basis of three more or less prominent carinae. In the studied material, the medium carina is not as acute as indicated in the specimen figured by PHILIPPI (1899: pl. 5, fig. 3). However, PHILIPPI's specimen appears to

be laterally compressed, which would have resulted in an accentuation of the medium carina. The fragmented specimen defined as *G. rostrata* PHILIPPI (1899: pl. 3, fig. 3) very likely comes from the same locality as the type material of *G. tricarinata*. It may be synonymous with the latter representing a morphological variety with relatively poorly developed carinae. Unfortunately, the age of PHILIPPI's species cannot be determined from his text. Due to the fragmentary nature and poor description of the type material of both species a clear statement is impossible at this point.

Genus *Exogyra* SAY 1820

Type species. *Exogyra (Exogyra) costata* SAY 1820.

Subgenus *Exogyra* s. s.

Exogyra (Exogyra) sp. indet.

Pl. 15, Figs. 2-5

1992 *Exogyra* sp. A - ABERHAN: 19.

Material. 5 articulated specimens from the Late Sinemurian east of Quebrada El Carbon (SNGM 8131, PIW 1994VI 1087-1090); 15 left valves and 9 articulated specimens from the Late Sinemurian and 11 left valves and 2 articulated specimen from the Early Pliensbachian of Quebrada Pinte (SNGM 8128-8130, PIW 1994VI 1091-1124); 2 left valves from the Late Pliensbachian of Quebrada El Peñon (PIW 1994VI 1125-1126).

Remarks. The shell of *Exogyra (E.)* sp. indet. is medium-sized, suborbicular to suboval in outline, and regularly spiral throughout ontogeny. The left valve is moderately to strongly convex and exhibits a very variable attachment area ranging from evanescent to more than 10 cm² in size. The right valve is flat to slightly concave. The ornament of both valves consists of foliaceous growth squamae, which, in the right valve, are upturned at the anterior margin; radial elements are lacking.

Apart from the posterior adductor muscle insertion, which is orbicular in outline, the internal features are poorly known. The ligamental area can be observed on two left valves and consists of a spiral resilifer flanked anteriorly by a relatively wide, flattish bourrelet. The posterior bourrelet is a narrow and short, rounded spiral ridge. Chomata have not been observed.

Closely related to *Exogyra (Exogyra)* sp. indet. is a group of species of *Exogyra* from the Bajocian to Oxfordian of eastern Africa and India. They have been described as the nominal species *E. fourtani*

STEFANINI (1925: 168, pl. 29, figs. 3a-b, 4a-b; WEIR 1929: 20, pl. 1, figs. 6-10; DIAZ-ROMEREO 1931: 38, pl. 3, figs. 6-10; COX 1935a: 13, pl. 2, fig. 5a-b; COX 1935b: 174, pl. 17, fig. 14), *E. rivelensis* LORIOL (STEFANINI 1929: 210, pl. 23, figs. 13-16), and *E. vinassai* DIAZ-ROMERO (1931: 35, pl. 2, figs. 17-20; pl. 3, figs. 1-2; STEFANINI 1939: 205, pl. 22, fig. 18a-d; pl. 23, figs. 1-11). Likewise, *E. coulomi* D'ORBIGNY var. *leufuensis* WEAVER (1931: 228, pl. 19, fig. 93a-b) is very similar in general outline and ornamentation. Pending the availability of more material with well preserved internal features the Chilean material is identified only down to the subgeneric level.

Order *Pectinoida* RAFINESQUE 1815

Family *Monotidae* P. FISCHER 1887

Genus *Otapiria* MARWICK 1935

Type species. *Pseudomonotis marshalli* TRECHMANN 1923.

Otapiria neuquensis DAMBORENEA 1987

Pl. 16, Figs. 7-9

1987b *Otapiria neuquensis* sp. nov. - DAMBORENEA: 156, pl. 6, figs. 1-5.

1992 *Otapiria neuquensis* DAMBORENEA - DAMBORENEA: pl. 115, figs. 5-6 (copy from DAMBORENEA 1987b: pl. 6, figs. 1, 3).

1992 *Otapiria neuquensis* DAMBORENEA - DAMBORENEA & MANCENIDO: pl. 1, fig. 3a.

Material. Several tens of densely packed shells from the Late Sinemurian of Quebrada Incaguasi (SNGM 8138-8140, PIW 1994VI 1127-1133).

Remarks. *Otapiria neuquensis* has an obliquely oval to subcircular outline. The umbones are situated about one-third to two-fifth of the shell length from the anterior end. The dorsal margin is straight, reaching more than half of the total shell length. Both valves exhibit an ornament of irregular radial riblets of variable width, which increase in number by intercalation and bifurcation.

Otapiria pacifica COVACEVICH & ESCOBAR from the Hettangian and Early Sinemurian of Chile (COVACEVICH & ESCOBAR 1979: 177, pl. 1, figs. 1-13; text-figs. 3a-d; ESCOBAR 1980: pl. 3, figs. 4-6; HILLEBRANDT 1980: pl. 1, figs. 4-5) and Argentina (e.g. RICCARDI et al. 1988: pl. 2, figs. 10-13; DAMBORENEA & MANCENIDO 1992: pl. 1, fig. 2a; DAMBORENEA 1992: pl. 115, figs. 3-4) can be distinguished from *O. neuquensis* by a more elongate

and oblique-ovate shell and umbones, which are situated in a more anterior position in adults.

The closely allied *Arctotis? frenguelli* (DAMBORENEA 1987b: 158, pl. 6, figs. 7-8; see also DAMBORENEA 1993a: 117) from Toarcian-Aalenian deposits of Argentina can be distinguished by a larger and more equilateral shell and a different style of ornamentation. Affinities to other species of *Otapiria* have been discussed in detail by DAMBORENEA (1987b).

Family Oxytomidae ICHIKAWA 1958

Genus *Oxytoma* MEEK 1864

Type species. *Avicula münsteri* BRONN 1830.

Subgenus *Oxytoma* s. s.

Oxytoma (Oxytoma) inequivalvis (J. SOWERBY 1819)

Pl. 17, Figs. 1-5

- 1819 *Avicula inequivalvis* sp. nov. - J. SOWERBY: 78, pl. 244, figs. 2-3.
 1878 *Pseudomonotis Münsteri* BRONN - GOTTSCHKE: 22, pl. 6, fig. 15.
 1925 *Pseudomonotis Muensteri* BRONN - GOTTSCHKE: 254, pl. 6, fig. 15 (copy of GOTTSCHKE 1978: pl. 6, fig. 15).
 non 1931 *Oxytoma inaequivalve* (SOWERBY) - WEAVER: 213, pl. 19, fig. 87.
 ? 1938 *Pseudomonotis* sp. - FUENZALIDA: 78, pl. 3, fig. 2.
 1942 *Pteria (Oxytoma) inaequivalvis* SOW. - LEANZA: 158, pl. 4, fig. 2; pl. 5, fig. 1.
 ? 1967 *Oxitoma* (sic) cf. *inequivalva* (sic) SOW. - THIELE-CARTAGENA: 32, pl. 6, fig. 23a-b.
 ? 1968 *Oxytoma* cf. *O. inaequivalvis* (SOW. 1819) - CECIONI & WESTERMANN: 72, pl. 4, fig. 2.
 1978 *Oxytoma (Oxytoma) inequivalve* (J. SOWERBY, 1819) - DUFF: 54, pl. 4, figs. 7, 9, 11, 13, 15-19, 21-23; text-fig. 17a-b (see for synonymy list).
 1980 *Oxytoma münsteri* (BRONN) - ESCOBAR: 53, pl. 3, fig. 1.
 1987b *Oxytoma (Oxytoma) inequivalvis* (J. SOWERBY) - DAMBORENEA: 160, pl. 6, figs. 9-12; text-fig. 15.
 1992 *Oxytoma (Oxytoma) inequivalve* (SOWERBY 1819) - ABERHAN: 18.

Material. Internal moulds of 2 right and 2 left valves and 1 external mould of a left valve from the Early Hettangian of Quebrada San Juan (SNGM 8145, PIW 1994VI 1134-1136); 4 left valves from the Middle Hettangian of Quebrada Bonita (SNGM 8142, PIW 1994VI 1137-1138); 4 left valves from the Early Sinemurian of Posada de los Hidalgos (SNGM 8143-8144, 8146; PIW 1994VI 1139); 2 left valves, preserved as internal moulds, from the Aalenian of Mina Los Pingos (PIW 1994VI 1140-1141).

Remarks. *Oxytoma inequivalvis* is a very common species around the world and has a particularly long stratigraphic range from the Late Triassic to the Early Cretaceous. It exhibits a considerable range of

intraspecific variability and many of the species described in the literature might turn out to be conspecific with *O. inequivalvis* after a thorough revision.

Oxytoma inequivalvis exhibits a different ornament on both valves. The left valve is covered with a moderate number (13 to 17) of thin and straight radial ribs; the intervals between the ribs bear second and third order riblets, which, according to some authors (e.g. ARKELL 1933: 194, COX 1940: 98, DUFF 1978: 55, DAMBORENEA: 1987b: 161), may be missing. This higher order ribbing is not preserved on internal moulds. The right valve carries only faint radial riblets.

The group of *O. costata* (J. SOWERBY 1819) from the Middle Jurassic of Europe can be distinguished from *O. inequivalvis* by having fewer and stronger radial ribs and smooth intervals on the left valve. The group of the boreal *O. jacksoni* (POMPECKJ 1900) from the Aalenian to Bajocian of Canada and northeastern Asia differs by having a larger shell and numerous ribs on both valves.

Subgenus *Palmoxytoma* COX 1961

Type species. *Pecten cygnipes* YOUNG & BIRD 1822.

Oxytoma (Palmoxytoma) cf. cygnipes (YOUNG & BIRD 1822)

Text-fig. 16

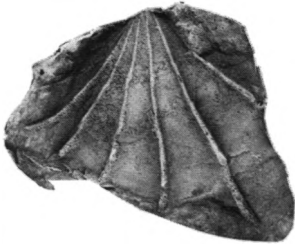
- cf. 1822 *Pecten cygnipes* sp. nov. - YOUNG & BIRD: pl. 9, fig. 6.
 cf. 1991 *Oxytoma (Palmoxytoma) cygnipes* (YOUNG and BIRD) - POULTON: 26, pl. 6, figs. 14-16; pl. 11, figs. 14-16 (see for a short synonymy list).

Material. 1 external mould of a left valve from the Early Hettangian of Quebrada San Juan (SNGM 8238).

Remarks. A latex cast from the external mould (Text-fig. 16) exhibits 7 narrow and prominent ribs and an additional weak riblet in the anterior part of the shell. The crests of ribs carry a small number of nodes, which are interpreted as the bases of spines, which broke off before final burial. The wide interspaces bear fine radial striations.

In general, the specimen corresponds closely to *O. (P.) cygnipes* from Europe (e.g. PHILLIPS 1829: 162, pl. 14, fig. 3; 1871: 136, pl. 8, fig. 13; QUENSTEDT 1884: 787, pl. 61, fig. 17), Asia (e.g. HAYAMI 1959: 48, pl. 5, fig. 14; EFIMOVA et al. 1968: 46, pl. 22, figs. 11-12), and Canada (e.g. POULTON 1991: 26, pl. 6, figs. 14-16; pl. 11, figs. 14-16). The Chilean specimen differs in a larger number of ribs (7-8 as

compared to 4-6) and therefore is referred to *O. (P.) cygnipes* with reservation.



Text-fig. 16. *Oxytoma (Palmoxytoma)* cf. *cygnipes* (YOUNG & BIRD 1822). Latex cast of a left valve. Early Hettangian of Quebrada San Juan (HILLEBRANDT 841115/7). SNGM 8238. x 1.

Oxytoma (Palmoxytoma) sp. indet.

Pl. 16, Fig. 10

Material. 1 left valve from the Middle or Late Hettangian of Quebrada Cachina (SNGM 8141).

Remarks. The available left valve is moderately convex and exhibits 6 prominent and slightly wavy radial ribs. However, as the anterior portion of the shell is broken off, the full number of ribs remains unclear. The interspaces between ribs are about four times the width of the ribs and smooth except for irregular commarginal growth lines. The assignment to the subgenus *Palmoxytoma* is based on the small number of ribs, the relatively wide interspaces between ribs and the lack of secondary and tertiary ribs and riblets.

The specimen differs from *O. (P.)* cf. *cygnipes* (see above) mainly by the lack of spines on the ribs and lack of radial striations between the ribs. In order to decide whether the two are ecophenotypic variations of a single species, clearly more material from large populations is needed.

A fragmented valve from the Late Hettangian of Argentina, which was identified as *Palmoxytoma* sp., has been figured repeatedly (RICCARDI et al. 1988: pl. 1, fig. 14; RICCARDI et al. 1991: fig. 4; DAMBORENEA & MANCENIDO 1992: pl. 1, fig. 1a; DAMBORENEA 1992: pl. 115, fig. 1). Due to its poor preservation, affinities to the species described here from Chile are difficult to establish.

Family *Terquemiidae* COX 1964

Genus *Placunopsis* MORRIS & LYCETT 1853

Type species. *Placunopsis fibrosa* LAUBE 1867.

Placunopsis radiata (PHILLIPS 1829)

Pl. 17, Figs. 6-8

- 1829 *Orbicula?* *radiata* sp. nov. - PHILLIPS: 130, pl. 4, fig. 12.
 1982 *Placunopsis radiata* (PHILLIPS 1829) - FÜRSICH: 56, fig. 24 K, M (see for extensive synonymy list).
 1992 *Placunopsis radiata* (PHILLIPS 1829) - ABERHAN: 19.

Material. 1 composite mould of a left valve and 1 external mould of a right valve from the Early Pliensbachian of Salar de Pedernales (SNGM 8147-8148); 1 left valve from the Late Pliensbachian and 1 valve from the Toarcian of Quebrada Asientos (SNGM 8149, PIW 1994VI 1142); the species ranges into the Aalenian at Quebrada Asientos (PIW 1994VI 1143).

Remarks. *Placunopsis radiata* has a thin, medium-sized shell with a suborbicular outline. The shell is covered with numerous fine, slightly wavy, divaricate striae and bears commarginal folds at irregular intervals.

According to FÜRSICH (1982: 57), who commented on the high variability in outline and ornamentation of *P. radiata*, all larger *Placunopsis*, as described in the literature, may belong to a single species, *P. radiata*. This view is also shared here.

Family *Propeamussiidae* TUCKER ABBOTT 1954

Genus *Propeamussium* DE GREGORIO 1884

Type species. *Pecten (Propeamussium) ceciliae* DE GREGORIO 1884.

Subgenus *Propeamussium* s. s.

Propeamussium (Propeamussium) pumilum
(LAMARCK 1819)

Pl. 17, Figs. 9-14

- 1819 *Pecten pumilus* sp. nov. - LAMARCK: 183. Lectotype designated by HÖLDER 1978: 4, text-fig. 2a.
 1878 *Pecten pumilus* LK. - GOTTSCHKE: 20, pl. 5, figs. 2, 4.
 1898 *Pecten (Amussium) andium* sp. nov. - TORNQVIST: 163.
 1900 *Amusium personatum* GOLDF. - BURCKHARDT: 32, pl. 21, fig. 1.
 1903 *Pecten (Amusium) personatus* ZIET. - BURCKHARDT: 22, pl. 2, fig. 7.
 1925 *Pecten pumilus* LK. - GOTTSCHKE: pl. 5, figs. 2, 4 (copy of GOTTSCHKE 1878: pl. 5, figs. 2, 4).
 1984 *Propeamussium (Propeamussium) pumilum* (LAMARCK 1819) - JOHNSON: 23, pl. 1, figs. 1-4, 7-9 (see for extensive synonymy list).
 1992 *Propeamussium (Variamussium) pumilum* (LAMARCK) - DAMBORENEA: pl. 117, figs. 13-15.
 1992 *Propeamussium (Propeamussium) pumilum* (LAMARCK 1819) - ABERHAN: 18.

Material. 14 valves from the Early Toarcian of Quebrada Asientos (SNGM 8150, 8154; PIW 1994VI 1145-1156); 1 right valve and 2 fragmentary valves from the Early Toarcian of Quebrada El Patón (PIW 1994VI 1157-1159); 1 valve from the Pliensbachian or Early Toarcian south of Vega Redonda (SNGM 8151); 1 valve from the Early Toarcian of Quebrada Calquis (PIW 1994VI 1160); 1 fragmentary valve from the Early Toarcian of Quebrada Pinte (PIW 1994VI 1161); 2 left valves from the Early Toarcian and 2 right valves from the Middle Toarcian of Río Jorquera (SNGM 8152-8153, PIW 1994VI 1162); 1 valve from the Early or Middle Toarcian of Río Pulido (SNGM 8155); the species ranges into the Aalenian at Quebrada Asientos (PIW 1994VI 1144).

Remarks. The studied specimens show a constant number of ten internal costae. These can also be observed on the valve's exterior as dark lines, especially if the surface has been moistened before. The exterior of the right valve is smooth, except for very fine growth lines; the auricles extend only slightly beyond the hinge-line. The exterior of the left valve is covered with numerous fine radial striae.

JOHNSON (1984) recognizes three species of *Propeamussium* (*P.*) in the Jurassic of Europe, *P. pumilum* (LAMARCK), *P. laeviradiatum* (WAAGEN), and *P. nonarium* (QUENSTEDT). They can be distinguished by the number and termination of the internal costae and the way, in which the dorsal margin of the right valve extends beyond the hinge-line. The material from Chile clearly lies within the morphological range of *P. pumilum*.

Another abundant pectinid from the Pliensbachian of Argentina, which previously has been assigned to the family Propeamussiidae is *Pecten* (*Variamussium*) *personatus* ZIETEN var. *coloradoensis* WEAVER (1931: 274, pl. 28, fig. 164) and *Pecten* (*Variamussium*) *coloradoensis* WEAVER in LEANZA (1942: 176, pl. 7, figs. 3, 5; pl. 10, fig. 3), which are conspecific according to the latter author. The species, as described by LEANZA (1942), was doubtfully included in the synonymy list of *P. (P.) laeviradiatum* (WAAGEN) by JOHNSON (1984: 28). Recently, DAMBORENEA (e.g. 1992: pl. 115, figs. 11-12; 1993b) recognized that both, WEAVER and LEANZA misinterpreted the morphology of this species and assigned it to the genus *Kolymonectes* MILOVA & POLUBOTKO (in BYCHKOV et al. 1976).

The best preserved out of a few specimens, which previously (ABERHAN 1992) have been identified as *Pseudopecten* (*Pseudopecten*) *equivalvis* (J. SOWERBY 1816) is figured in Text-fig. 17. It is of small size and exhibits about 15 radial ribs, which are angular in cross-section. The number of ribs increases by intercalation of secondary riblets during ontogeny. The auricles are poorly preserved, but a deep byssal notch appears to be absent. It cannot be excluded that the specimen belongs to the *Kolymonectes*

coloradoensis group, but clearly further material is needed to allow a more precise identification.



Text-fig. 17. Pectinid bivalve. Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-27). For discussion see text. SNGM 8235. x 3.

Family Entoliidae VON TEPPNER 1922

Genus *Entolium* MEEK 1865

Type species. *Pecten demissus* PHILLIPS 1829, as illustrated by QUENSTEDT (1858: 353, pl. 48, fig. 7).

Subgenus *Entolium* s. s.

Entolium (*Entolium*) *corneolum* (YOUNG & BIRD 1828)

Pl. 17, Figs. 15-19

- 1828 *Pecten corneolus* sp. nov. - YOUNG & BIRD: 234, pl. 9, fig. 5.
- 1878 *Pecten* sp. - GOTTSCHKE: 21, pl. 5, fig. 1.
- ? 1900 *Pecten* (*Entolium*) *disciformis* SCHUEBLER - BURCKHARDT: 32, pl. 21, fig. 2; pl. 19, fig. 11.
- 1925 *Pecten* sp. - GOTTSCHKE: pl. 5, fig. 1 (copy of GOTTSCHKE 1878: pl. 5, fig. 1).
- 1931 *Pecten* (*Entolium*) *disciformis* SCHUEBLER - WEAVER: 273, pl. 28, fig. 170.
- 1942 *Pecten* (*Entolium*) *disciformis* SCHLUEBLER - LEANZA: 174, pl. 11, fig. 1.
- ? 1942 *Pecten* (*Entolium*) *hehlii* D'ORB. - LEANZA: 175, pl. 9, fig. 4.
- 1942 *Pecten* (*Entolium*) sp. indet. - LEANZA: 176, pl. 9, fig. 5.
- 1982 *Entolium demissum* (PHILLIPS) - PÉREZ: pl. 14, fig. 7.
- 1984 *Entolium* (*Entolium*) *corneolum* (YOUNG and BIRD 1828) - JOHNSON: 45, pl. 1, figs. 24-26, ? figs. 20, 22, 27 (see for extensive synonymy list).
- 1992 *Entolium* (*Entolium*) *corneolum* (YOUNG & BIRD 1828) - ABERHAN: 18.

Material. 4 left valves, 1 right valve, and 1 articulated specimen from the Middle or Late Hettangian of Quebrada Cachina (SNGM 8160, PIW 1994VI 1163-1167); 1 left valve from the Sinemurian of Manflas (PIW 1994VI 1168); 1 left valve and 1 right valve from the Late Sinemurian of Río Manflas (PIW 1994VI 1169-1170); 2 left valves and 2 right valves, and several specimens from the Late Sinemurian, 2 right valves and 1 articulated specimen from the Pliensbachian and 3 right valves and several specimens from the Toarcian of Quebrada Pinte (SNGM 8157, 8159; PIW 1994VI 1171-1185); 1 left valve, 2

right valves, several valves, and 1 articulated specimen from the Early Pliensbachian, 4 left valves, 11 right valves, and several specimens from the Late Pliensbachian, and 1 articulated specimen and several further valves from the Early Toarcian of Quebrada Asientos (SNGM 8158, PIW 1994VI 1186-1211); 1 articulated specimen from the Early Pliensbachian of Quebrada Caballo Muerto (PIW 1994VI 1212); 1 right valve from the Early/Late Pliensbachian of Portezuelo de Pedernales (SNGM 8156); 1 right valve from the Pliensbachian and 1 right valve from the Toarcian of Río Jorquera (PIW 1994VI 1213-1214); 1 right valve from the ?Pliensbachian west of Quebrada de las Pircas (PIW 1994VI 1215); 1 valve from the Middle Toarcian of Río Pulido; 1 articulated specimen and 1 valve from the Middle Toarcian of Río del Toro (PIW 1994VI 1216-1217); 2 specimens from the Early Pliensbachian and 1 articulated specimen and 2 valves from the Toarcian of Salar de Pedernales (PIW 1994VI 1218-1222); 1 right valve from the Late Toarcian of Quebrada San Miguel (PIW 1994VI 1223); 1 left valve and 1 articulated specimen from the Toarcian of Quebrada La Totorá (PIW 1994VI 1224-1225).

Remarks. All studied specimens from the Early Jurassic of northern Chile can be grouped within a single species, *E. (E.) corneolum*. According to JOHNSON (1984), *E. (E.) corneolum* is essentially similar to *E. (E.) lunare* (ROEMER 1839). However, the former lacks the diagnostic byssal notch, which appears during early growth stages in *E. (E.) lunare*. The present material consistently lacks a byssal notch. If preserved, early growth lines of the anterior auricle of the right valve meet the disc at approximately the same acute angle as during later growth stages. This also indicates the lack of a byssal notch at the juvenile stage. Left and right valves can be distinguished by the auricles, which are dorsally extended beyond the hinge line in the right valve. In the left valve, their dorsal margins meet at an angle of approximately 180°.

Earliest records of *E. (E.) corneolum* in Europe are from the Toarcian. In northern Chile records are dating back to the Hettangian.

Family Pectinidae RAFINESQUE 1815

Genus *Agerchlamys* DAMBORENEA 1993

Type species. *Chlamys (Camptochlamys) wunschae* MARWICK 1953.

Agerchlamys wunschae (MARWICK 1953)

Pl. 18, Figs. 1-6

- 1953 *Chlamys (Camptochlamys) wunschae* sp. nov. - MARWICK: 98, pl. 10, figs. 23-24.
 1992 *Camptochlamys wunschae* (MARWICK) - DAMBORENEA: pl. 116, figs. 9-10 (also in DAMBORENEA 1993a: figs. 4b, h).
 1992 "*Camptochlamys*" *wunschae* (MARWICK) - DAMBORENEA & MANCENÍDO: pl. 1, fig. 6a-b (also in DAMBORENEA 1993a: figs. 4a-b).

1993a *Agerchlamys wunschae* (MARWICK) - DAMBORENEA: figs. 4a-j.

Material. 3 left valves, 5 right valves, and some fragmented specimens, all preserved as composite moulds, from the Middle Hettangian of Quebrada Cachina (SNGM 8161-8163, 8166; PIW 1994VI 1226); 1 left valve from the Late Hettangian of Aguada Alto de Varas (SNGM 8165); 1 left valve from the Late Hettangian of Quebrada Bonita (SNGM 8164).

Remarks. The thin, discoidal shells of *A. wunschae* are subequilateral with an umbonal angle slightly larger than 90°. The anterior auricle is distinctly longer than the posterior one; both auricles exhibit narrow radial riblets and commarginal lines of growth. The ornament of the remaining shell consists of numerous (55 to 80, measured at the shell margin) fine radial riblets and commarginal lamellae, which give rise to a reticulate pattern. The nearly straight radial riblets reach the ventral margin of the shell at all ontogenetic stages. Their number increases during ontogeny by intercalation. Within the same specimen they vary slightly in strength, but are always more prominent than the commarginal lamellae. The specimens consistently lack divaricate striae.

In most features the specimens from Chile correspond well with their counterparts from the Pliensbachian of Argentina and New Zealand as described by DAMBORENEA (1993a). The only exception is the lack of fine antimarginal (=divaricate) striae in the specimens from Chile, a feature that has been observed on the material studied by DAMBORENEA (1993a). As the Chilean specimens commonly are preserved as composite moulds this could be a matter of preservation quality. Due to their Hettangian age these are the oldest occurrences of the species and its stratigraphic range must be extended accordingly.

Closest affinities exist to *Camptonectes (Camptochlamys) clathratus* ROEMER from the Bajocian to Tithonian of Europe. According to JOHNSON (1984) this species is defined by radial striae, which reach the ventral margin at all ontogenetic stages and by the usual lack of divaricate striae. These features are also apparent in the material studied here. The main difference is the presence of distinctly lower commarginal lamellae in *A. wunschae* compared to *C. (Cc.) clathratus*. In the latter, the commarginal sculpture is more dominant than the radial elements, while in *A. wunschae* the opposite is true.

Genus *Camptonectes* AGASSIZ in MEEK 1864

Type species. *Pecten lens* J. SOWERBY 1818.

Subgenus *Camptonectes* s. s.*Camptonectes (Camptonectes) auritus*
(SCHLOTHEIM 1813)

Pl. 18, Figs. 7-9

- 1813 *Chamites auritus* sp. nov. - SCHLOTHEIM: 103.
 cf. 1878 *Pecten laminatus* SOW. - GOTTSCHKE: 21, pl. 5, fig. 5.
 cf. 1878 *Pecten* sp. - GOTTSCHKE: 40, pl. 5, fig. 16.
 cf. 1925 *Pecten laminatus* SOW. - GOTTSCHKE: pl. 5, fig. 5 (copy of GOTTSCHKE 1878: pl. 5, fig. 5).
 cf. 1925 *Pecten* sp. - GOTTSCHKE: pl. 5, fig. 16 (copy of GOTTSCHKE 1878: pl. 5, fig. 16).
 1984 *Camptonectes (Camptonectes) auritus* (SCHLOTHEIM 1813) - JOHNSON: 113, pl. 3, figs. 25-40 (see for extensive synonymy list).
 1992 *Camptonectes (Camptonectes) auritus* (SCHLOTHEIM 1813) - ABERHAN: 18.

Material. 5 left valves, 2 right valves, and 2 articulated specimens from the Toarcian of Quebrada Pinte (SNGM 8167, PIW 1994VI 1227-1233); 3 left valves and 1 articulated specimen from the Toarcian of Quebrada La Titora (SNGM 8168, PIW 1994VI 1234); 1 left valve from the Late Toarcian of Quebrada east of Hacienda Manflas (PIW 1994VI 1235); the species ranges into the Aalenian at Quebrada Asientos (PIW 1994VI 1236), Quebrada Pinte (SNGM 8169), and Salar de Pedernales (PIW 1994VI 1237).

Remarks. The Chilean specimens of *C. (C.) auritus* have a suborbicular disc and exhibit fine divaricate striae on all parts of the disc. These are the diagnostic features of *C. (Camptonectes) auritus* as given by JOHNSON (1984: 107) in his revision of European representatives of the genus. He described three further species of *C. (C.)*, which can be distinguished from *C. (C.) auritus* by having a more ovate disc (*C. (C.) viridunensis* (BUVIGNIER)), a coarser ornament of divaricate striae (*C. (C.) laminatus* (J. SOWERBY)), and fine divaricate striae, which are restricted to the anterior and posterior margins of the disc (*C. (C.) subulatus* (MÜNSTER)).

Pecten laminatus SOW. (GOTTSCHKE 1878: 21, pl. 5, fig. 5) and *Pecten* sp. (GOTTSCHKE 1878: 40, pl. 5, fig. 16) from the Middle Jurassic of Argentina most likely also belong to *C. (C.) auritus*.

Genus *Chlamys* ROEDING 1798

Type species. *Pecten islandicus* MÜLLER 1776.

Subgenus *Chlamys* s. s.*Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820)

Pl. 18, Fig. 10; Pl. 19, Figs. 1-6, Text-fig. 18

- 1820 *Pectinites textorius* sp. nov. - SCHLOTHEIM: 229.
 1900 *Pecten textorius* SCHLOTH. - BURCKHARDT: 24, pl. 19, fig. 10.

- 1917 *Pecten peruanus* sp. nov. - TILMAN: 673, pl. 24, figs. 4a-b, 5.
 1931 *Pecten textorius* SCHLOTHEIM var. *torulosa* QUENSTEDT - WEAVER: 271, pl. 28, figs. 165-166.
 1931 *Pecten* sp. indet. - WEAVER: 272, pl. 28, fig. 167.
 1942 *Pecten (Chlamys) textorius* SCHLOTH. - LEANZA: 172, pl. 7, fig. 2.
 1942 *Pecten (Chlamys) textorius* SCHLOTH. var. *torulosa* QUENST. - LEANZA: 173, pl. 7, fig. 4.
 1942 *Pecten textorius* (SCHLOTHEIM) - WANISH: 38, pl. 2, fig. 2 (erroneously figured as *Pecten (Entolium) disciformis* SCHUEBLER).
 1982 *Chlamys* cf. *textoria* (SCHLOTHEIM) - PÉREZ: pl. 16, fig. 5.
 1984 *Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820) - JOHNSON: 163, pl. 6, figs. 10-12; pl. 7, figs. 1-21; pl. 8, figs. 1-3, 5-20, ? fig. 4 (see for extensive synonymy list).
 1984 *Chlamys textoria* (SCHLOTHEIM) - MANCENÍDO & DAMBORENEA: 424, pl. 1, figs. 15-17.
 1992 *Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820) - ABERHAN: 19.
 1992 *Radulopecten fibrosus* (SOWERBY 1816) - ABERHAN: 19.
 1992 *Chlamys textoria* (SCHLOTHEIM) - DAMBORENEA: pl. 117, fig. 4.

Material. 1 left valve from the Middle or Late Hettangian of Quebrada Cachina (SNGM 8175); 1 right valve, 15 articulated specimens, and 4 fragmentary valves from the Late Sinemurian, 1 left valve, 3 right valves, 2 articulated specimens and 6 fragmentary valves from the Pliensbachian, and 5 fragmentary valves from the Middle Toarcian of Quebrada Pinte (SNGM 8170, 8172, 8176; PIW 1994VI 1239-1266); 1 articulated specimen from the Early Pliensbachian of Quebrada Larga (SNGM 8173); 1 articulated specimen from the Early Pliensbachian and 1 articulated specimen from the Late Toarcian of Río del Toro (PIW 1994VI 1267-1268); 1 left valve and 1 articulated specimen from the Early Pliensbachian of Quebrada Vaca Muerta (PIW 1994VI 1269); 1 right valve and 8 fragmentary valves from the Late Pliensbachian of Quebrada Asientos (SNGM 8174, PIW 1994VI 1270-1272); 2 left valves and 2 right valves from the Pliensbachian and 1 articulated specimen from the Early Toarcian of Río Jorquera (PIW 1994VI 1273-1274); 1 articulated specimen and 2 undeterminable valves from the Early Toarcian of Quebrada El Patón (PIW 1994VI 1275); 4 fragmentary valves from the Late Toarcian of Salar de Pedernales (PIW 1994VI 1276); 5 articulated specimens from the Toarcian/Aalenian north of Portezuelo de Pedernales (SNGM 8171, PIW 1994VI 1277-1278); 1 valve from the Late Pliensbachian or Early Toarcian of Quebrada La Plata (PIW 1994VI 1279); the species ranges into the Aalenian at Quebrada Asientos (PIW 1994VI 1280-1281), Quebrada Larga (PIW 1994VI 1282), Quebrada La Titora (PIW 1994VI 1283), and Río Pulido (PIW 1994VI 1284).

Remarks. According to JOHNSON (1984: 167) the diagnostic feature of *Ch. (Ch.) textoria* is the presence of imbricate lamellae on the plicae. The Chilean specimens are extremely variable with regard to the number and strength of radial plicae and the spacing of imbricate lamellae on the plicae. They are, however, well within the morphological range of the European representatives of the species as revised by JOHNSON (1984). Depending on the number of plicae, JOHNSON (1984: 175) defined three groups, which he regarded as ecophenotypic variations of a single species: the 'coarse' (17-26 plicae), 'intermediate' (27-

36 plicae), and the 'fine' phenotype (more than 36 plicae). This range of intraspecific variation also can be observed in the material from the Chilean Early Jurassic. Most common is the 'coarse' phenotype, which preferentially occurred in coarse-grained sandstones and skeletal limestones and the 'fine' phenotype dominating in siltstones and wackestones.

A few fragmented specimens from the Early Pliensbachian of Quebrada Pinte are characterized by coarse plicae and a particularly strong development of lamellae on top of the plicae (Text-fig. 18). These specimens have been listed as *Radulopecten fibrosus* (J. SOWERBY 1816) during an earlier palaeoecological study (ABERHAN 1992). In the present monograph, they are included in *Chlamys textoria* and are regarded as intraspecific variations, which are placed at the 'coarse' phenotype end of the morphological spectrum of *Ch. textoria*. This identification is corroborated by the fact that no valves have been found, which bear commarginal lamellae only in later stages of ontogeny or not at all, as it is typical of right valves of *Radulopecten*.



Text-fig. 18. *Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820). 'Coarse' phenotype sensu JOHNSON (1984). Early Pliensbachian of Quebrada Pinte. For discussion see text. SNGM 8236. x 1.

Chlamys (Chlamys) valoniensis (DEFRANCE 1825)

Pl. 19, Figs. 7-9

1825 *Pecten Valoniensis* sp. nov. - DEFRANCE: 507, pl. 22, fig. 6.

1984 *Chlamys (Chlamys) valoniensis* (DEFRANCE 1825) - JOHNSON: 179, pl. 9, figs. 1-6 (see for extensive synonymy list).

Material. 2 left valves, 3 right valves, and 1 articulated specimen from the Early Hettangian south of Sierra Minillas (SNGM 8177-8179, PIW 1994VI 1285-1286); 1 external mould of a right valve from the Early Hettangian of Quebrada San Juan (PIW 1994VI 1287).

Remarks. *Chlamys (Ch.) valoniensis* can be distinguished from *Ch. (Ch.) textoria* by lacking commarginal lamellae on the plicae. This diagnostic

feature characterizes all studied specimens from Chile. Except for closely spaced, fine, commarginal growth lines the radial plicae are smooth. Compared to the European forms figured by JOHNSON (1984: pl. 9, figs. 1-6), the present specimens exhibit generally broader and flatter ribs. However, given the enormous variability of Jurassic species of *Chlamys*, this is considered as part of the intraspecific range.

So far, the species has not been illustrated from the Jurassic of South America, but it has been mentioned in RICCARDI et al. (1991: 166) and DAMBORENEA & MANCENIDO (1992: 133), the latter pointing to its occurrence in the Hettangian to Early Sinemurian of the Andes and New Zealand. Apart from a questionable specimen from Iran (see JOHNSON 1984: 184), this is the first figured record of the species outside of Europe.

Genus *Eopecten* DOUVILLE 1897

Type species. *Hinnites tuberculatus* GOLDFUSS 1836 *errore pro Spondylus tuberculosus* GOLDFUSS 1836; DOUVILLE 1897.

Eopecten abjectus (PHILLIPS 1829)

Pl. 20, Figs. 1-2, 4, 7; Pl. 21, Figs. 1, 5

1829 *Pecten abjectus* sp. nov. - PHILLIPS: pl. 9, fig. 37.

1984 *Eopecten abjectus* (PHILLIPS 1829) - JOHNSON: 158, pl. 6, figs. 3, 5, 6, 8, 9, ? fig. 1 (see for extensive synonymy list).

1992 *Eopecten abjectus* (PHILLIPS 1829) - ABERHAN: 19.

Material. 1 articulated specimen from the Toarcian of Quebrada La Totorá (SNGM 8181); 6 left valves from the Toarcian of Quebrada Pinte (SNGM 8188, PIW 1994VI 1288-1289); 1 articulated specimen from the Late Toarcian of Quebrada southeast of Hacienda Manflas (SNGM 8187); the species is also known from the Aalenian at Cerro Salto del Toro (SNGM 8183), Quebrada Asientos (PIW 1994VI 1290), Quebrada Larga (SNGM 8182), Quebrada La Totorá (PIW 1994VI 1291-1292), Río Pulido (SNGM 8180, PIW 1994VI 1293), and north of Juntas del Tolar (PIW 1994VI 1294).

Remarks. The studied specimens are characterized by a convex left valve with an ornament of original costae and intercalary costae. The latter rapidly gain the same size as the original ones. Two of the original costae remain larger than the others and bear tubercles. The right valve is flat and carries a large number of irregular riblets, which increase in number by intercalation. In this respect, the Chilean material perfectly matches with the diagnosis given by JOHNSON (1984: 159) for left valves of *E. abjectus* from the Jurassic of Europe.

With regard to the ornamental variation in left valves (which are the ones to be examined for identification of Jurassic *Eopecten* at the species level), JOHNSON (1984) distinguished two further species of *Eopecten*, *E. velatus* (GOLDFUSS) (see below) and *E. spondyloides* (ROEMER). The latter differs from *E. abjectus* by the presence of original costae, which are all similar in height.

Recently, specimens from the Pliensbachian and Toarcian of Argentina have been doubtfully referred to *Eopecten hartzi* (ROSENKRANTZ) by DAMBORENEA (1987b: 199, pl. 6, figs. 16-19; text-fig. 31). Like in the original material figured by ROSENKRANTZ (1934: pl. 8, fig. 1; 1957: figs. 1-7) the left valves can be distinguished from *E. abjectus* by having more numerous radial ribs and three of the original costae being more prominent than the others. Furthermore, the differentiation of the ornament into ribs of different orders of strength is present throughout all ontogenetic stages.

Eopecten velatus (GOLDFUSS 1833)

Pl. 21, Figs. 2, 6-7

- 1833 *Pecten velatus* sp. nov. - GOLDFUSS: 45, pl. 90, fig. 2.
 1931 *Velopecten velatus* (GOLDFUSS) - WEAVER: 284, pl. 28, figs. 172-173.
 1984 *Eopecten velatus* (GOLDFUSS 1833) - JOHNSON: 150, pl. 5, figs. 4, 5, 7, 8 (see for extensive synonymy list).
 1988 *Eopecten* cf. *velatus* (GOLDFUSS) - RICCARDI et al.: pl. 2, fig. 5.
 1991 *Eopecten* cf. *velatus* (GOLDF.) - RICCARDI et al.: fig. 4, number 15 (copy from RICCARDI et al. 1988: pl. 2, fig. 5).
 1992 *Eopecten* cf. *velatus* (GOLDFUSS) - DAMBORENEA: pl. 115, fig. 2 (copy from RICCARDI et al. 1988: pl. 2, fig. 5).

Material. 1 left valve from the Middle or Late Hettangian of Quebrada Cachina (SNGM 8190); 3 left valves from the ?Pliensbachian west of Quebrada de las Pircas (SNGM 8189, PIW 1994VI 1295); 1 left valve from the Aalenian of Quebrada Asientos (SNGM 8191).

Remarks. The examined left valves of *E. velatus* are covered with slightly sinuous costae and striae of different strength. In contrast to *E. spondyloides* and *E. abjectus*, where the intercalary costae rapidly gain the same height as the original ones, this differentiation of the ornament is evident at all ontogenetic stages except for very large specimens (see JOHNSON 1984).

One left valve from the Hettangian, largely preserved as composite mould (Pl. 21, Fig. 6), shows a variation of this ornamentation pattern. The specimen exhibits the diagnostic differentiation in costae and striae at all growth stages. In addition, the original costae, which all are similar in height, carry tubercles.

According to JOHNSON (1984), this feature is characteristic of the two enlarged original costae of *E. abjectus*. However, the discussed specimen clearly cannot be referred to *E. abjectus* as it lacks both, the diagnostic enlargement of two of the original costae and intercalary costae, which rapidly gain the size of the originals. From the Late Jurassic of Portugal, FÜRSICH & WERNER (1989: 140, pl. 13, figs. 1-3) also documented *E. velatus* bearing tubercles at irregular intervals. Therefore, the presence of tubercles is no longer regarded as diagnostic feature restricted to *E. abjectus*, but also is part of the morphological range of *E. velatus*.

The specimens of *Velopecten velatus* figured by WEAVER (1931: pl. 28, figs. 172-173) from the late Early Jurassic of Argentina show the diagnostic ornament typical of *E. velatus* and certainly belong to that species.

Eopecten? sp. indet.

Pl. 21, Figs. 3-4

1992 *Eopecten* sp. A - ABERHAN: 19.

Material. 2 fragmentary ?left valves from the Early Pliensbachian of Quebrada Pinté (SNGM 8192-8193).

Remarks. The ornament of the two available fragments of a very large-sized *Eopecten?* consists of very prominent, straight to sinuous, broad, rounded radial ribs of different strength, which are separated by interspaces of irregular width. The interspaces are covered with second and third order ribs and riblets. Most of them remain at low height, but a few increase in strength with age. The coarse and very irregular ornament and the unusual large size distinguish the specimens from others, which are described here. They have certain affinities to *Hinnites gigas* BOEHM (1881: 182, pl. 40, figs. 11-12) from the Late Jurassic of southern Germany, which is regarded as junior synonym of *E. velatus* by JOHNSON (1984: 150). However, the preservation quality is too poor to allow a more precise identification.

Genus *Radulonectites* HAYAMI 1957

Type species. *Radulonectites japonicus* HAYAMI 1957.

Radulonectites sosneadoensis (WEAVER 1931)

Pl. 20, Figs. 5-6

- 1931 *Pecten sosneadoensis* sp. nov. - WEAVER: 272, pl. 28, fig. 169.

- 1942 *Pecten (Camptonectes) lens* SOW. - LEANZA: 173, pl. 10, figs. 1-2.
 1992 *Radulopecten strictus* (MÜNSTER 1833) - ABERHAN: 19.
 1992 *Radulonectites sosneadoensis* (WEAVER) - DAMBORENEA: pl. 116, figs. 6-7.
 1993a *Radulonectites sosneadoensis* (WEAVER) - DAMBORENEA: fig. 3j (copy from DAMBORENEA 1992: pl. 116, fig. 7).

Material. 1 right valve from the Early Pliensbachian of Quebrada Vaca Muerta (PIW 1994VI 1296); 2 right valves from the Late Pliensbachian of Quebrada Pinte (SNGM 8185-8186).

Remarks. The examined right valves of *R. sosneadoensis* from Chile correspond well with those figured from Argentina by WEAVER (1931) and DAMBORENEA (1993a). The lower half of the shell has a semicircular outline, the upper half a triangular outline. The ornament consists of a high number (close to 80) of fine, flat-topped, tightly-spaced, and slightly sinuous radial riblets, which are crossed by fine commarginal striae. The anterior auricle of the right valve is large with a deep byssal sinus and is covered with radial riblets. Although no left valves are available, these features permit a specific identification with a high degree of certainty.

As it lacks a divaricate sculpture, *Pecten (Camptonectes) lens* SOW. in LEANZA (1942: 173, pl. 10, figs. 1-2) certainly does not belong to *Pecten lens* J. SOWERBY (1818: 3, pl. 205, figs. 2-3), which is regarded as junior synonym of *C. auritus* by JOHNSON (1984). DAMBORENEA in RICCARDI et al. (1990: 90) regards LEANZA's specimens as conspecific with *Radulonectites sosneadoensis*, a view, which is shared here.

Strong affinities exist to right valves of the Late Jurassic European *Radulopecten strictus* (MÜNSTER) (e.g. MÜNSTER in GOLDFUSS 1833: pl. 91, fig. 4c; JOHNSON 1984: pl. 10, figs. 4-5; FÜRSICH & WERNER 1989: pl. 11, fig. 14a-b). As no left valves are available, which in the case of *R. strictus* are the diagnostic ones, synonymy of the Chilean forms with *R. strictus* cannot be ruled out completely. However, as *R. strictus* is known from the Late Jurassic of Europe and *R. sosneadoensis* is described from Pliensbachian strata of Argentina an assignment of the studied specimens to the latter is highly plausible.

The number of radial riblets on the studied material also falls within the range of JOHNSON's (1984) 'fine' phenotype of *Chlamys (Ch.) textoria*. However, the Chilean forms lack the diagnostic imbricate lamellae on top of the plicae. Rather, the commarginal striae are equally developed on riblets and interspaces between riblets.

Radulonectites sosneadoensis differs from *A. wunschae*, which is described above, by having more numerous radial ribs, which are flat-topped, by very narrow interspaces between the ribs, and by the lack of commarginal lamellae.

pectinid gen. et sp. indet.

Pl. 20, Fig. 3

- 1992 *Chlamys (Chlamys) cf. tingensis* (TILMANN 1917) - ABERHAN: 19.

Material. 1 right valve from the Early Pliensbachian of Quebrada Larga (PIW 1994VI 1297); 1 articulated specimen from the Early Pliensbachian of Quebrada Pinte (SNGM 8184); 1 left and 1 right valve from the Late Pliensbachian of Quebrada Asientos (PIW 1994VI 1298-1299).

Remarks. All specimens are highly abraded shells with the outermost shell layer strongly reduced or lost. The specimens have a suborbicular disc shape. The auricles are well demarcated from the disc. Apart from commarginal growth lines they appear to be smooth except for one left valve anterior auricle, which shows relics of radial striae. The left valve anterior auricles exhibit a deep byssal sinus; those of the right valve have a deep byssal notch. The left valve is covered with a moderate number (around 50) of radial riblets. As can be judged from the poorly preserved material, the right valve is smooth.

Due to the poor preservation it is impossible to attribute the specimens to a particular genus or even species. The consistent lack of divaricate striae and commarginal lamellae prevent the assignment to *Camptonectes (C.)* and *Camptonectes (Camptochlamys)* respectively. The apparently smooth right valve and the common lack of a radial ornament on the auricles distinguish the specimens from species of *Agerchlamys*, *Chlamys (Ch.)*, and *Radulonectites* as discussed here.

The figured left valve of '*Pecten*' *tingensis* TILMANN (1917: 674, pl. 24, fig. 6) from the Hettangian and Sinemurian of northern Peru apparently has, apart from commarginal growth lines, a smooth shell. The specimens assigned to pectinid gen. et sp. indet. have been tentatively referred to as *Chlamys (Chlamys) cf. tingensis* (TILMANN 1917) in ABERHAN (1992). However, most of the syntypes of '*P.*' *tingensis* examined by JOHNSON (1984: 111) display a radial and, in some cases, a commarginal ornament. The generic position of '*P.*' *tingensis*, its possible synonymy with other species, and whether the Chilean material is conspecific with '*P.*' *tingensis*, remains unclear.

Genus *Weyla* J. BÖHM 1922

Type species. *Pecten alatus* VON BUCH 1838.

Subgenus *Weyla* s. s.

Remarks. Species of *Weyla* (*W.*) are the most conspicuous and by far the most common bivalves in the Early Jurassic of northern Chile (for a recent review of the group see DAMBORENEA 1987b: 167). They appear to be characteristic of the East Pacific faunal realm, although their occurrence is not restricted to that region. While *Weyla* (*W.*) *bodenbenderi* prevails in Argentina (DAMBORENEA 1987b: 180), in Chile *Weyla alata* is by far the most abundant representative.

A large number of ill-defined nominal species, often based on poorly preserved individuals and internal moulds exists in the literature. PHILIPPI (1899) alone erected 15 new species of '*Pecten*' what can be attributed to *Weyla* (*W.*). They are considered to represent morphological variations of only a few distinct species. Very likely most of them are junior synonyms of one of the three species of *Weyla* (*W.*) thought to occur in the Early Jurassic of Chile: *Weyla* (*W.*) *alata* (VON BUCH), *Weyla* (*W.*) *bodenbenderi* (BEHRENDSEN), and *Weyla* (*W.*) *titan* (MÖRICKÉ). However, for a thorough revision of the group, an evaluation of the original material is indispensable. For that reason, many dubious species are only listed with reservation in the synonymy lists.

Weyla (*Weyla*) *alata* (VON BUCH 1838)

Pl. 22, Figs. 1-3; Pl. 23, Figs. 1-2

- 1838 *Pecten alatus* sp. nov. - V. BUCH: 55.
 1839 *Pecten alatus* V. BUCH: 3, pl. 1, figs. 1-3.
 1843 *Pecten dufrenoyi* sp. nov. - D'ORBIGNY: 106, pl. 22, figs. 5-9.
 1851 *Pecten alatus* DE BUCH - BAYLE & COQUAND: 14, pl. 5, figs. 1-2.
 1855 *Pecten* ? *alatus* (VON BUCH) - CONRAD: 283, pl. 41, fig. 2.
 1899 *Pecten alatus* V. BUCH - PHILIPPI: 24, pl. 13, figs. 1 and 2 (right illustration).
 1899 *Pecten angustecostatus* PH. - PHILIPPI: 27, pl. 14, fig. 2; pl. 16, fig. 1.
 ? 1899 *Pecten excavatus* PH. - PHILIPPI: 31, pl. 18, fig. 1a-b.
 ? 1899 *Pecten curvicosta* PH. - PHILIPPI: 31, pl. 18, fig. 3.
 1899 *Pecten stolpi* PH. - PHILIPPI: 34, pl. 19, fig. 5.
 1899 *Pecten subcarinatus* PH. - PHILIPPI: 34, pl. 19, fig. 4a-b.
 1899 *Pecten commutatus* PH. - PHILIPPI: 38, pl. 41, figs. 1-2 (from BAYLE & COQUAND 1851).
 ? 1899 *Pecten compressus* PH. - PHILIPPI: 38, pl. 41, figs. 3-4.
 1914 *Vola alata* (V. BUCH) BAYLE & COQUAND - JAWORSKI: 276, figs. 1-7, 8b.
 1929 *Vola alata* (V. BUCH) - STEINMANN: 71, fig. 77a-c.

- p 1931 *Vola alata* (V. BUCH) BAYLE & COQUAND - WEAVER: 281, pl. 31, fig. 179; pl. 32, fig. 181.
 1964 *Vola alata* (V. BUCH) - HOLDER: 546, pl. 155, fig. 1 (reproduction from JAWORSKI 1914).
 1973 *Weyla alata* (BUCH) - GEYER: 44, fig. 15a-b.
 ? 1973 *Weyla* cf. *bodenbenderi* (BEHRENDSEN) - GEYER: 44, fig. 15c.
 1978 *Weyla alata* (V. BUCH) - RANGEL: 28, pl. 3, fig. 7; 32, pl. 5, figs. 4-5; pl. 6, fig. 1.
 1980 *Weyla alata* (V. BUCH) - HILLEBRANDT: pl. 1, fig. 1a-c.
 1982 *Weyla alata* (VON BUCH) - PÉREZ: pl. 19, figs. 3, 7, 9.
 1987b *Weyla* (*Weyla*) *alata alata* (VON BUCH 1838) - DAMBORENEA: 170, pl. 9, fig. 1; pl. 10, figs. 1a-b, 2-3, 4a-c, 5; text-figs. 18, 19-1, 22a (see for extensive synonymy list).
 1987b *Weyla* (*Weyla*) *alata angustecostata* (R. PHILIPPI 1899) - DAMBORENEA: 177, pl. 6, fig. 17b; pl. 7, figs. 1a-b, 2; pl. 8, figs. 1, 2a-b, 3a-b; pl. 9, figs. 2a-b, 3; text-figs. 2, 19-2, 21.
 1992 *Weyla* (*Weyla*) *alata* (V. BUCH 1838) - ABERHAN: 19.
 1992 *Weyla* (*Weyla*) *alata* (V. BUCH) - DAMBORENEA: pl. 115, fig. 17 (copy from DAMBORENEA 1987b: pl. 10, fig. 1a).
 1992 *Weyla* (*Weyla*) *alata angustecostata* (PHILIPPI) - DAMBORENEA: pl. 117, fig. 12a-b.

Material. 6 right valves, 1 left valve, and 24 articulated specimens from the Late Sinemurian, 21 articulated specimens from the Early and Late Pliensbachian of Quebrada Pinte (PIW 1994VI 1300-1340); 2 articulated specimens from the Late Sinemurian and 3 articulated specimens from the Pliensbachian of Quebrada east of Hacienda Manflas (SNGM 8195, PIW 1994VI 1341-1343, 1390); 1 right valve and 2 articulated specimens from the Sinemurian and 2 articulated specimens from the Late Pliensbachian of Quebrada La Totorá (PIW 1994VI 1344-1347); 1 right valve from the Sinemurian, 2 articulated specimens from the Late Pliensbachian, and 2 right valves and 1 articulated specimen from the Early Toarcian of Cerro Salto del Toro (PIW 1994VI 1348-1351); 1 articulated specimen from the Late Sinemurian or Early Pliensbachian of Río del Toro (SNGM 8194); 1 right valve and 1 articulated specimen from the Early Pliensbachian and 1 articulated specimen from the Early Toarcian of Río Jorquera (SNGM 8197, PIW 1994VI 1352-1353); 1 right valve and 2 articulated specimens from the Pliensbachian north of Juntas del Tolar (SNGM 8196, PIW 1994VI 1354-1355); 3 articulated specimens from the Early Pliensbachian of Quebrada Vaca Muerta (PIW 1994VI 1356-1357); 1 right valve and 2 articulated specimens from the Early Pliensbachian of Quebrada El Bolito (PIW 1994VI 1358-1359); 1 right valve and 28 articulated specimens from the Early and Late Pliensbachian of Quebrada Asientos (PIW 1994VI 1360-1370, 1391); 1 articulated specimen from the ?Pliensbachian of Quebrada Yerbas Buenas (PIW 1994VI 1371-1372); 1 articulated specimen from the Pliensbachian between Quebrada El Carbon and Quebrada de Paipote (SNGM 8198); 1 left valve and 5 articulated specimens from the Early and Late Pliensbachian of Quebrada Larga (PIW 1994VI 1373-1374); 2 articulated specimens from the Late Pliensbachian of Quebrada Calquis (PIW 1994VI 1375); 2 articulated specimens from the Early Toarcian of Quebrada El Peñón (PIW 1994VI 1376); 1 articulated specimen from the Early Toarcian of Río Manflas (PIW 1994VI 1377); 1 articulated specimen from the Toarcian of Quebrada Caballo Muerto (PIW 1994VI 1378).

Remarks. *Weyla* (*W.*) *alata* is a large-sized, pectiniform bivalve, reaching a height of up to 13 cm in the Chilean Early Jurassic. The shell is very inequivalve, the right valve being very convex and the

left valve slightly concave and flat to weakly convex in earlier growth stages. The right valve is covered with 13 to 15 strong and straight radial ribs. In transverse section, the ribs show almost flat tops and strongly to moderately steep flanks. Towards the anterior and posterior margins the ribs are more triangular in profile and become much lower. The slightly concave interspaces between the ribs are of the same width or wider than the ribs. Usually they are smooth except for distinct growth lines, which are strongly convex towards the ventral margin. More rarely, faint radial riblets may appear on interspaces or rib flanks.

The left valve always bears one rib less than the corresponding right valve. The ribs are much narrower and lower than those of the right valve and are always triangular in cross-section. Some are slightly more prominent than others. The rib crests are accompanied by a pair of minor riblets on the flanks. The gently concave interspaces between ribs are always wider than the ribs. As in the right valve they exhibit growth lines, which are convex towards the ventral margin. (For further details see DAMBORENEA (1987b: 170), who also refers to internal shell characters).

DAMBORENEA (1987b) recognized two subspecies of *W. alata*: *W. alata alata* (VON BUCH) and *W. alata angustecostata* (PHILIPPI). According to her, the latter can be distinguished by a thicker shell, narrower ribs in both valves with wider interspaces inbetween, and an almost smooth inner surface of the right valve, except near the ventral margin (see also DAMBORENEA 1987b: text-fig. 23). The studied Chilean material consists of many intergradational forms, particularly with regard to the type of ornamentation, that is strength, width, and profile of ribs, steepness of rib flanks, and width and concavity of interspaces. Because of a continuous morphological spectrum with numerous intermediate specimens that cannot be attributed clearly to one of the two subspecies, the separation of *W. alata* into two subspecies has been abandoned here. In the Argentinian Jurassic the two morphotypes apparently are clearly distinguishable (DAMBORENEA, personal communication).

Weyla (W.) titan, which is also described here, reaches a considerably larger adult size and has broad, rounded ribs, which characteristically are wider than the interspaces in the right valve. *Weyla mexicana* (JAWORSKI) from the Early Jurassic of Mexico can be separated from *W. alata* by the presence of V-shaped ribs and interspaces on both valves of the former. Moreover it exhibits a lamellose, V-shaped ornament on the left valve, which is most conspicuous on the

interspaces. The affinities of *W. alata* to the very similar *W. (W.) bodenbenderi*, are discussed below. Similarities to species grouped in *Weyla (W.)* from other parts of the world are discussed by DAMBORENEA (1987b: 175).

Weyla (Weyla) bodenbenderi (BEHRENDSEN 1891)

Pl. 23, Figs. 3-4

- 1891 *Pecten Bodenbenderi* sp. nov. - BEHRENDSEN: 391, pl. 22, fig. 3.
 ? 1899 *Pecten dilatatus* PH. - PHILIPPI: 30, pl. 17, fig. 4.
 ? 1900 *Pecten (Vola) alatus* v. BUCH - BURCKHARDT: pl. 19, fig. 12.
 1901 *Vola aff. alata* VON BUCH - BURCKHARDT: 20, pl. 4, figs. 1-2.
 1914 *Vola Bodenbenderi* (BEHR.) - JAWORSKI: 285, figs. 9-10.
 1922 *Pecten Bodenbenderi* BEHRENDSEN - BEHRENDSEN: 175, pl. 1, fig. 10.
 1926a *Vola simplex* - JAWORSKI: 163, pl. 1, fig. 1.
 1926b *Vola simplex* - JAWORSKI: 391, text-fig. 2 (copy from JAWORSKI 1926a: pl. 1, fig. 1).
 1931 *Vola bodenbenderi* BEHRENDSEN - WEAVER: 283, pl. 33, fig. 184.
 1931 *Pecten Bodenbenderi* BEHR. - WINDHAUSEN, pl. 22, fig. 6 (copy from BEHRENDSEN 1891: pl. 22, fig. 3).
 1931 *Vola simplex* JAW. - WINDHAUSEN, pl. 22, fig. 3 (copy from JAWORSKI 1926a: pl. 1, fig. 1; 1926b: text-fig. 2).
 1931 *Vola alata* v. BUCH - WINDHAUSEN, pl. 22, fig. 2 (copy from BURCKHARDT 1901: pl. 4, fig. 1).
 1934 *Vola alata* (v. BUCH) BAYLE & COQUAND - FERUGLIO: 45, pl. 5, fig. 1.
 ? 1934 *Vola aff. simplex* JAW. - FERUGLIO: 38, pl. 4, fig. 8.
 1942 *Pecten bodenbenderi* BEHRENDSEN - LEANZA: 168, pl. 7, fig. 6; pl. 8, figs. 1-2.
 1945 *Pecten bodenbenderi* BEHRENDSEN - LEANZA: 86, fig. 8a-b (copy from LEANZA 1942: pl. 8, figs. 1-2).
 1958 *Pecten bodenbenderi* BEHRENDSEN - LEANZA: 240, fig. 3 (copy from LEANZA 1942: pl. 8, fig. 2).
 1987b *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891) - DAMBORENEA: 178, pl. 7, fig. 3; pl. 10, fig. 6; pl. 11, figs. 1a-c, 2; pl. 12, figs. 1a-b, 2-3; text-fig. 22b-c (see for extensive synonymy list).
 1992 *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891) - ABERHAN: 19.
 1992 *Weyla (Weyla) bodenbenderi* (BEHRENDSEN) - DAMBORENEA: pl. 116, fig. 5a-b (copy from DAMBORENEA 1987b: pl. 11, figs. 1a, c).

Material. 1 left valve, 2 fragmentary right valves, and 7 articulated specimens from the Late Pliensbachian, and 1 articulated specimen from the Toarcian of Quebrada Pinte (SNGM 8199-8200, PIW 1994VI 1379-1384); 1 articulated specimen from the Late Pliensbachian of Quebrada La Totorá (PIW 1994VI 1385).

Remarks. Similar to *W. alata*, *W. bodenbenderi* is characterized by a large adult size (the studied specimens reach up to 14 cm in height), a pectiniform shape, and a very inequivalve shell. The right valve is strongly convex and is ornamented with 14 to 15 strong, radial primary ribs. The ribs are wider than

the interspaces and convex in cross-section with slightly flattened tops. The number of ribs increases considerably by intercalation of secondary ribs and by splitting or branching of primary ribs into two or more subequal ribs. The left valve is slightly concave. It carries simple, straight, primary ribs, which commonly are flanked by a pair of minor ridges along all their length. In addition, they may show a type of ribbing similar to that of right valves, that is appearance of additional ribs by intercalation, splitting, and/or branching. The primary ribs are lower and flatter than on the right valve and the interspaces are wider than the ribs (see also DAMBORENEA (1987b: 181) for a detailed documentation of variation in external ornamentation).

Weyla bodenbenderi has strongest affinities to *W. alata*, with which it occurs in the same beds at Quebrada Pinté. It can be distinguished from the latter by the presence of less prominent, broader ribs on the right valve, the ribs being wider than the interspaces. The left valve differs by the appearance of much broader and flat-topped primary ribs. While in *W. alata* the ribs of both valves are simple, they are frequently split in *W. bodenbenderi* and intercalation of secondary ribs is quite common.

Weyla (Weyla) titan (MÖRICKE 1894)

Pl. 24, Fig. 3; Pl. 25, Fig. 1

1894 *Vola alata* (v. BUCH) var. *titan* - MÖRICKE: 41.

1899 *Pecten titan* Mör. - PHILIPPI: 26, pl. 15.

1992 *Weyla (Weyla) titan* (MÖRICKE 1894) - ABERHAN: 19.

Material. 2 articulated specimens from the Early Pliensbachian and 1 articulated specimen from the Late Pliensbachian of Quebrada Pinté (PIW 1994VI 1386-1388); 1 right valve from the Early Pliensbachian of Quebrada El Peñón (SNGM 8204); 1 right valve and 1 articulated specimen from the Late Pliensbachian of Quebrada Asientos (SNGM 8205, PIW 1994VI 1389).

Remarks. *Weyla titan* is a rather rare, but, due to its extremely large adult size, very conspicuous faunal element in the Early Jurassic of northern Chile. Although incomplete, the largest studied specimen reaches a height of more than 17 cm and a length of 19 cm. The inequivalve pectiniform shell is clearly biconvex during early growth stages (at least up to 6 cm in height), but becomes plano-convex later on during ontogeny.

The right valve, which is convex throughout life time, bears 13 to 14 straight and simple radial ribs. The ribs are low and broad and are convex and somewhat flat-topped in transverse section. Towards the anterior and posterior margins the ribs become lower and have a more triangular profile. The width

of the concave interspaces between ribs is about one-third the width of the ribs.

The left valve is ornamented with 13 to 14 ribs, which are much narrower than those on the right valve. In transverse section they are moderately convex to triangular. The slightly concave interspaces are about three times as wide as the ribs and may carry very faint radial riblets.

The anterior auricles of both valves exhibit a well-developed byssal sinus. Their surfaces are covered with commarginal growth lines and carry up to six radial riblets. The posterior auricles are ornamented with up to two radial riblets, which are subparallel to the dorsal margin; the right valve posterior auricle is smooth.

Apart from its large size, *W. titan* can be distinguished from other representatives of the *Weyla* group by several diagnostic features. These are the presence of broad, rounded, never bifurcating ribs on the right valve with considerably narrower intervals; the presence of radial riblets on the anterior auricle of the right valve, and the relative convexity of the shells, changing from biconvex to plano-convex during ontogeny. This last aspect recalls the diagnosis of *Lywea*, a subgenus of *Weyla*, which is characterized by a biconvex shell. However, *W. titan* clearly belongs to *Weyla* s. s., since it lacks the V-shaped ribs of *Lywea* and the biconvexity is restricted to early growth stages. An early biconvex stage can be observed in most studied specimens of *Weyla* s. s. and this stage appears to be particularly well-developed in *W. titan*, possibly due to a high growth rate.

Weyla (Weyla?) sp. indet.

Material. 5 internal moulds and 2 fragmentary external moulds from the Early Hettangian south of Sierra Minillas (PIW 1994VI 1392-1393).

Remarks. Together with *Weyla (Lywea?)* sp. indet. from the Middle Hettangian, which is described below, the specimens assigned to *Weyla (Weyla?)* sp. indet. from the Early Hettangian represent the oldest records of the genus *Weyla* in South America. As only poorly preserved internal moulds and fragmentary external moulds are available, a more precise identification is impossible. All valves are slightly convex. The radial ribs, 15 in number, are flat-topped with steep flanks, a feature only known from right valves of *W. alata*.

Subgenus *Lywea* DAMBORENEA 1987

Type species. *Pecten uncus* PHILIPPI 1899.

Weyla (Lywea) unca (PHILIPPI 1899)

Pl. 23, Fig. 5; Pl. 24, Fig. 2; Pl. 25, Fig. 2

- p ? 1891 *Pecten Pradoanus* VERN. et COLL. - BEHRENDSEN: 391, pl. 22, fig. 1a-d.
1899 *Pecten uncus* PH. sp. nov. - PHILIPPI: 30, pl. 17, fig. 3a-c.
- ? 1899 *Pecten lycorrhynchus* PH. sp. nov. - PHILIPPI: 29, pl. 18, fig. 1.
- ? 1914 *Pecten pradoanus* VERNEUIL et COLL. - JAWORSKI: 289, fig. 11a-b.
- p ? 1922 *Pecten pradoanus* VERN. et COLL. - BEHRENDSEN: 175, pl. 1, fig. 1a-d.
- ? 1929 *Pecten Pradoanus* VERN. et COLL. - STEINMANN: 71, fig. 78a-c.
- p 1930 *Pecten pradoanus* (sic) VERN. et COLL. - RIGAL: pl. 1, fig. 3 (only).
1942 *Pecten cf. uncus* PHIL. - LEANZA: 170, pl. 9, figs. 1-3, 6.
1978 *Weyla* sp. - RANGEL: pl. 3, fig. 5.
1980 *Weyla cf. unca* (PHILIPPI) - ESCOBAR: 57, pl. 2, figs. 7-8.
1987b *Weyla (Lywea) unca* (R. PHILIPPI 1899) - DAMBORENEA: 187, pl. 12, fig. 4; pl. 13, figs. 1-4, 5a-b, 6a-b, 7a-c, 8, 9a-d, 10a-d, 11a-b; text-fig. 25 (see for extensive synonymy list).
1992 *Weyla (Lywea) unca* (PHILIPPI 1899) - ABERHAN: 19.
1992 *Weyla (Weyla) unca* (PHILIPPI) - DAMBORENEA: pl. 115, fig. 16a-b.

Material. 4 articulated specimens from the Early Pliensbachian of Quebrada Vaca Muerta (SNGM 8201, 8203, 8206; PIW 1994VI 1394); 5 deformed and partly abraded articulated specimens from the Early Pliensbachian of Quebrada Potrerillos (PIW 1994VI 1395); 2 right valves from the Late Pliensbachian of Quebrada Pinte (PIW 1994VI 1397); 1 left valve from the Late Pliensbachian of Quebrada Asientos (PIW 1994VI 1398).

Remarks. In contrast to other species of *Weyla*, which have been discussed above, *W. unca* is biconvex during all ontogenetic stages, the right valve being more inflated than the left valve. While the former is higher than long, the opposite is true of the left valve. Both valves are ornamented with 12 to 13 simple radial ribs. The ribs and interspaces are V-shaped in transverse section. Additional radial riblets and faint striae may occur on the rib flanks. The radial ribs are equal in size on the right valve; they merely become lower towards the anterior, ventral, and posterior margins of the shell. On the left valve some ribs, more precisely the second, fourth, seventh, and eleventh rib if counted from the anterior, are consistently more prominent than others. All auricles appear to be smooth, except for commarginal growth lines. On internal moulds, the ribs appear lower and rounded in transverse section.

Weyla ambongoensis (THEVENIN 1908: 128, pl. 4, figs. 2-3; DAMBORENEA 1987b: text-fig. 20) from the Toarcian of Africa and Asia can be distinguished from *W. unca* by exhibiting subtriangular ribs, which may bear tubercles or spines and by an originally concave-convex shell, which becomes biconvex only

in adults. *Weyla pradoana* (DE VERNEUIL & COLLOMB 1853: 163, pl. 3, fig. 4) from the Early Jurassic of Spain shares the V-shaped ribs on both valves with *W. unca*, but has a flat left valve (see also DAMBORENEA 1987b: 189).

Weyla (Lywea) aff. unca (PHILIPPI 1899)

Pl. 24, Fig. 1

- aff. 1899 *Pecten uncus* PH. sp. nov. - PHILIPPI: 30, pl. 17, fig. 3a-c.

Material. 2 articulated specimens from the Late Sinemurian or Early Pliensbachian of Rio del Toro (SNGM 8202, PIW 1994VI 1396).

Remarks. The studied specimens are characterized by an inequivalve biconvex shell. The right valve is more convex than the left one and bears 15 simple, straight, V-shaped ribs, which become lower towards the anterior, ventral, and posterior margins. The flanks may be covered with very faint radial striae. The ornament of the left valve is very similar except for exhibiting one rib less than the right one and by the presence of two ribs, which are higher than the others (the fifth and the ninth, counted from the anterior margin). All auricles are smooth except for commarginal growth lines.

On the basis of a biconvex shell and the development of V-shaped ribs the specimens clearly can be assigned to the subgenus *Lywea*. *W. (Lywea) aff. unca* can be distinguished from the very closely related *W. (L.) unca* by a larger number of radial ribs and by the number and mode of accentuated ribs in the left valve.

DAMBORENEA (1987b: text-fig. 26) figured two specimens from the Early Jurassic of Nevada, USA, and referred to them as *Weyla (Lywea) meeki* nov. nom. (= *Pecten acutiplicatus* MEEK 1864 non *P. acutiplicatus* ALTH 1850). They are housed in the British Museum and were identified by S. W. MULLER as "*Pecten acutiplicatus* MEEK". According to DAMBORENEA, disc and auricles, however, do not show the type of ornamentation as described by MEEK, that is 14-15 radial ribs and 2 riblets on the anterior auricle of the left valve. In fact, the holotype of *W. acutiplicata* (MEEK 1864: 46, pl. 8, fig. 3) is an external mould of an apparently left valve. The external mould is slightly convex, so that the original shell was slightly concave. Therefore, *W. acutiplicata* appears to belong to the concave-convex to plano-convex group of species of *Weyla*. In contrast, *W. meeki* clearly is biconvex and consequently cannot be regarded as a synonym for *W. acutiplicata*.

W. (Lywea) aff. unca can be separated from *W. acutiplicata* by its biconvex rather than concave-

convex shell and by the lack of riblets on all auricles. *W. (Lywea) aff. unca* can be distinguished from *W. meeki* by a larger number of ribs in the former and by two of the ribs in the left valve being more prominent than the others.

Weyla (Lywea?) sp. indet.

Pl. 25, Figs. 3-4

Material. 1 valve from the Middle Hettangian of Quebrada Cachina (PIW 1994VI 1399); 3 valves from the Middle Hettangian of Cerros de Cuevitas (SNGM 8207-8208, PIW 1994VI 1400).

Remarks. All studied specimens are single-valved and are of low to moderate convexity. Therefore, the species under discussion possibly belongs to the group of biconvex forms of *Weyla* and is referred to the subgenus *Lywea* with reservation. This is corroborated by the kind of ornamentation. The ribs (15 in number) and the interspaces appear to be relatively angular in cross-section, which is diagnostic of the subgenus. Due to the poor preservation of the available material, however, a more detailed description is not possible at present.

Subclass *Isofilibranchia* IREDALE 1939

Order *Mytiloida* FÉRUSAC 1822

Family *Mytilidae* RAFINESQUE 1815

Genus *Modiolus* LAMARCK 1799

Type species. *Mytilus modiolus* LINNAEUS 1758.

Subgenus *Modiolus* s. s.

Remarks. A huge number of nominal species of Jurassic *Modiolus*, often also described as "*Modiola*" or "*Mytilus*", exists in the literature, many of which are synonyms. Individuals of a single species may have quite different morphological appearances due to postmortal compactional distortion. This has led to a complex and often confusing nomenclature of this bivalve group. In particular, the general outline, shape and size of the antero-ventral area, the prominence of an umbonal ridge, or the depth of a sulcus may easily be modified due to compaction (see also FÜRSTICH & WERNER 1988: 131, figs. 10, 14; YIN & FÜRSTICH 1991: 135, text-fig. 6). For this reason, affinities and synonyms are often difficult to establish as it is impossible to estimate the degree of compactional distortion from figured material only. An urgently

needed revision of the group therefore must be based on careful examination of the original material.

Despite these difficulties seven distinct species can be recognized in the Early Jurassic of northern Chile, which are referred to as *M. baylei*, *M. gerthi*, *M. giganteus*, *M. imbricatus*, *M. lonsdalei*, *M. cf. scalprum*, and a new species, *M. chilensis*. Another mytilid, *Lithophaga (Lithophaga) sp.*, which was listed in ABERHAN (1992: tab. 1), was recorded during field work in northern Chile. Its occurrence was reconstructed by the presence of characteristic borings in corals, stromatoporoids, oysters, and thick-shelled pectinids. Since body fossils of *Lithophaga* are not preserved, this taxon is not further treated in this monograph.

Modiolus (Modiolus) baylei (PHILIPPI 1899)

Pl. 26, Figs. 1-4

- 1851 *Mytilus scalprum* GOLDF. - BAYLE & COQUAND: 15, pl. 7, figs. 3-4.
 ? 1899 *Modiola andina* sp. nov. - PHILIPPI: 47, pl. 24, figs. 3, 5, 12.
 1899 *Modiola baylei* sp. nov. - PHILIPPI: 48, pl. 24, fig. 8 (copy from BAYLE & COQUAND 1851: pl. 7, figs. 3-4).
 1901 *Mytilus scalprum* BAYLE et COQUAND - BURCKHARDT: 21, pl. 4, fig. 9.
 1987a *Modiolus baylei* R. PHILIPPI 1899 ? - DAMBORENEA: 91, pl. 4, figs. 2, 3a-b, 4-5.
 p 1992 *Modiolus (Modiolus) imbricatus* SOWERBY 1818 - ABERHAN: 18.
 p 1992 *Modiolus* sp. A - ABERHAN: 18.

Material. 2 left valves, 3 right valves, and 8 articulated specimens from the Late Sinemurian of Quebrada Pinte (SNGM 8209-8212, PIW 1994VI 1401-1405).

Remarks. *Modiolus baylei* has a moderately inflated, subtrigonal, slightly elongated shell. It carries a very low and broad umbonal ridge; a sulcus ventrally to the carina is absent. The surface of the shell is covered with regular commarginal growth lines; the well-developed antero-ventral portion also carries fine radial striae.

The Chilean material corresponds well with *M. baylei* ? as described recently by DAMBORENEA (1987a: 91) from the late Early Jurassic of Argentina. DAMBORENEA (1987a: 88) also reviewed the history of the species in South America. The Chilean forms differ from DAMBORENEA's figured specimens mainly by a more obtuse postero-dorsal angle. However, given the enormous variability of Jurassic *Modiolus*, the differences are not regarded as significant enough to justify a distinction at the species level.

From *M. giganteus*, with which *M. baylei* is associated in the same beds in Late Sinemurian strata

of Chile, it can be distinguished by the more elongate shape of the latter, a better developed antero-ventral area, which is covered by fine radial striae, and the lack of a sulcus parallel to the carina.

Modiolus (Modiolus) chilensis sp. nov.

Pl. 26, Figs. 5-9

1982 *Modiolus* sp. A - PÉREZ: pl. 18, figs. 9-10.

1992 *Modiolus (Modiolus)* sp. nov. - ABERHAN: 18.

Type specimens. Holotype: SNGM 8217 (internal mould and shell of articulated specimen), figured in Pl. 26, Figs. 9a-d; paratypes: SNGM 8213 (internal mould and shell of articulated specimen), SNGM 8214 (internal mould and shell of articulated specimen), SNGM 8215 (internal mould and shell of articulated specimen), and SNGM 8216 (internal mould and shell of articulated specimen).

Type localities. The holotype is from the Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (section 7 in HILLEBRANDT & SCHMIDT-EFFING (1981: fig. 2)); paratypes SNGM 8213 and SNGM 8215 are from the Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (section 6 in HILLEBRANDT & SCHMIDT-EFFING (1981: fig. 2)); paratype SNGM 8214 is from the Early/Late Pliensbachian of Quebrada Asientos (section 3 in ABERHAN (1992: fig. 3)); paratype SNGM 8216 is from the Late Pliensbachian of Quebrada Pinte (section 6b in ABERHAN (1992: fig. 3)).

Type horizon. The holotype and paratypes SNGM 8213 and SNGM 8215 are from horizon 1 in HILLEBRANDT & SCHMIDT-EFFING (1981: fig. 3).

Additional material. 30 articulated specimens from the Early/Late Pliensbachian of Quebrada Asientos (PIW 1994VI 1406-1421, 1426); 8 articulated specimens from the Late Pliensbachian of Quebrada Pinte (PIW 1994VI 1422-1425); 1 articulated specimen from the Pliensbachian of Río Jorquera (PIW 1994VI 1427).

Measurements.

Specimen	material	H (mm)	L (mm)	I (mm)	H/L	I/L
SNGM 8217	2v	29.1	48.8	14.3	0.60	0.29
SNGM 8213	2v	24.6	41.5	12.0	0.59	0.29
SNGM 8214	2v	23.3	42.5	10.9	0.55	0.27
SNGM 8215	2v	23.1	45.0	12.0	0.51	0.27
SNGM 8216	2v	26.2	42.5	11.4	0.62	0.27

Derivation of name. From Chile, to which the species appears to be endemic.

Diagnosis. Trapeziform, vertically compressed, strongly inflated *Modiolus*. Area dorsally of umbonal carina is covered with regularly-spaced folds, which cross the commarginal growth lines at a very acute angle and do not reach the carina.

Description. Strongly inflated, medium-sized shell, vertically compressed, trapeziform in outline. Height about one-half of length; umbones small, subterminal, prosogyrate. Dorsal margin long and straight, forming a blunt angle with the posterior margin; posterior margin slightly to moderately convex, becoming more rounded towards the postero-ventral corner, and

forming an angle of about 90° with the ventral margin; ventral margin straight to slightly sinuous, running subparallel to the dorsal margin; anterior margin concave dorsally and convex ventrally, passing without break into the ventral margin.

Umbonal carina well-developed, straight and rounded, extending from the umbones to the postero-ventral end. Carina preceded ventrally by a shallow sulcus. Carina divides the shell in two subequal parts. Ventral part convex with well-developed anterior expansion. Area dorsal to the carina also convex, but becoming concave close to the dorsal margin.

Surface of shell covered with commarginal growth lines, which are more distinct on the part of the shell ventrally to umbonal ridge. This part also bears fine radial striae, which are most evident in slightly weathered specimens. Area dorsally of carina carries around 10 regularly-spaced conspicuous folds, which run slightly oblique to the growth lines and do not cross the carina. Shell lacks radial striae on this part of the shell.

Remarks. The specimens described here are certainly conspecific with the specimen figured by PÉREZ (1982: pl. 18, figs. 9-10) as *Modiolus* sp. A, which is from the same locality as part of the analysed material.

Modiolus gerthi can be distinguished by a much deeper sulcus, forming a marked sinus where it meets the ventral margin, the presence of radial striae along the postero-dorsal margin of the shell, and the lack of regularly-spaced folds on the dorsal half of the shell.

Modiolus glendayi (WEIR) in COX (1940: 69, pl. 5, figs. 8-10) from the Middle Jurassic of India shares the conspicuous folds on the area dorsally of the carina. However, the Indian species is more elongated and curved in general shape and, in contrast to the Chilean forms, the more numerous and accentuated commarginal rugae are also visible on the umbonal carina.

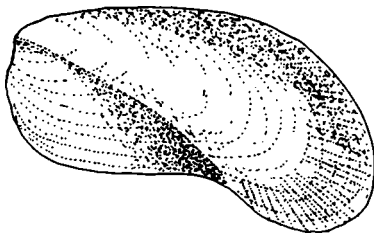
Modiolus (Modiolus) gerthi DAMBORENEA 1987

Pl. 27, Figs. 1-5, Text-fig. 19

- ? 1899 *Modiola contracta* sp. nov. - PHILIPPI: 47, pl. 24, fig. 4.
 1987a *Modiolus (Gibbomodiola?) gerthi* sp. nov. - DAMBORENEA: 93, pl. 4, figs. 7, 8a-c, 9-10, 15a-b; text-fig. 18i.
 1992 *Modiolus gerthi* DAMBORENEA - DAMBORENEA: pl. 117, fig. 8 (copy from DAMBORENEA 1987a: pl. 4, fig. 7).

Material. 2 articulated specimens from the Middle Toarcian of Río Jorquera (SNGM 8218-8219); 3 articulated specimens from the Middle Toarcian of Quebrada El Bolito (SNGM 8220-8222).

Remarks. The Chilean specimens are characterized by a rectangular-ovate, very inflated shell. A conspicuous rounded carina, ventrally preceded by a deep sulcus, divides the shell diagonally into two unequal parts. Where sulcus and carina meet the ventral margin a marked sinus is formed. The surface of the shell is covered by fine commarginal growth lines, some of which may be more pronounced giving rise to low commarginal lamellae. The postero-dorsal part of the shell, including the posterior part of the carina, is covered by distinct radial striae, which do not cross the sulcus (see also Text-fig. 19). The radial striae can be observed on well-preserved shells and composite moulds, but are not visible on abraded shells and internal moulds.



Text-fig. 19. *Modiolus (Modiolus) gerthi* DAMBORENEA 1987. Reconstruction of exterior view of left valve. Approximately x 1.5.

The Chilean forms agree very well with the figured type material from Argentina (DAMBORENEA 1987a: pl. 4, figs. 7-10, 15). A very diagnostic feature appears to be the radial striation along the postero-dorsal margin, which distinguishes this species from all other *Modiolus* known from South America. DAMBORENEA (1987a) referred the Argentine material tentatively to *Gibbomodiola*. This subgenus accommodates Tertiary to Recent *Modiolus*, which are characterized by "elongate-ovate shaped shells, transversely and arcuately gibbous in the dorsal region, originating a sort of smooth carina that in the anterior part of the shell produces a rounded step on the shell surface" (SACCO 1898: 41). In my opinion, the general appearance of *M. gerthi* does not differ significantly from that of other Jurassic *Modiolus* s. s. to allow separation at a subgeneric level; in addition, the original diagnosis of *Gibbomodiola* does not refer to the presence of a radial ornament along the postero-dorsal margin. Therefore, *M. gerthi* is placed in *Modiolus* s. s.

Modiolus contracta (PHILIPPI 1899: 47, pl. 24, fig. 4) from Peñon de Atacama, Chile, also has a deep sulcus, a very sinuous ventral margin, and an inflated shell and might well be a synonym of *M. gerthi*. In this case, PHILIPPI's *M. contracta* would have priority

over *M. gerthi*. However, description and figured material in PHILIPPI (1899) are too poor to allow a conclusive evaluation without examination of the original material. In particular, nothing is known about the presence of a radial striation.

In a previous study (ABERHAN 1992), *M. gerthi* was reported from the Toarcian of Quebrada Pinte and Quebrada La Totorá. In the light of additional material of *Modiolus* from the collection HILLEBRANDT, these specimens are now assigned to *M. imbricatus*.

Modiolus (Modiolus) giganteus QUENSTEDT 1857

Pl. 27, Figs. 6-9

- 1857 *Modiola gigantea* sp. nov. - QUENSTEDT: 439, unnumbered text-fig.
 ? 1899 *Mytilus lepidus* sp. nov. - PHILIPPI: 46, pl. 24, fig. 2.
 1942 *Modiolus gigantoides* sp. nov. - LEANZA: 182, pl. 11, fig. 3.
 1987a *Falcimytilus? gigantoides* (A. LEANZA 1942) - DAMBORENEA: 85, pl. 3, figs. 5, 6a-b, 7a-c; text-fig. 22.
 1992 *Falcimytilus(?) gigantoides* (LEANZA) - DAMBORENEA: pl. 117, fig. 3 (copy from DAMBORENEA 1987a: pl. 3, fig. 7b).
 p 1992 *Modiolus (Modiolus) imbricatus* SOWERBY 1818 - ABERHAN: 18.
 p 1992 *Modiolus* sp. A - ABERHAN: 18.

Material. 28 left valves, 40 right valves, and 36 articulated specimens from the Late Sinemurian and 2 right valves from the Early Pliensbachian of Quebrada Pinte (SNGM 8223-8226, PIW 1994VI 1428-1469, 1471); 1 left valve and 4 right valves from the ?Sinemurian south of Vega Redonda (PIW 1994VI 1470).

Remarks. The shells of *M. giganteus* are moderately inflated, rather variable, but basically subtriangular in outline, the height being almost equal to the length. The umbones are subterminal in adults, but almost terminal in younger individuals. This corresponds with the development of the antero-ventral area, which becomes more pronounced during ontogeny (see also DAMBORENEA 1987a: text-fig. 22). A low, slightly curved carina, ventrally followed by a shallow sulcus, extends from the umbones to the postero-ventral corner. The ventral margin reaches its strongest concavity at the point, where it meets with the sulcus.

Already LEANZA (1942: 182) referred to the strong resemblance of the described species to *M. giganteus* QUENSTEDT, which is known from the Bajocian of Germany (QUENSTEDT 1857: 439; 1884: 792, text-fig. 286; ROLLIER 1914: 334, pl. 22, figs. 1-3), France (COSSMANN 1912: 3, pl. 1, figs. 12-13), Switzerland (GREPPIN 1899: 105, pl. 11, fig. 4; 1900: pl. 14, figs. 1-2), and Israel (PARNES 1981: 29, pl. 3, fig. 36). Although LEANZA considered a case of evolutionary

size increase, he erected a new species, *M. giganteoides*, based on the distinctly smaller size of his material compared to QUENSTEDT's species. Difference in adult size by its own, however, is not regarded as a character to warrant a separation into different species. In particular, if evolutionary size increase is considered - a common phenomenon among Jurassic molluscs (e.g. HALLAM 1975, FÜRSICH & WERNER 1986) - this criterion becomes insignificant. Note that between the age of the South American specimens (Late Sinemurian from Chile, Pliensbachian from Chile and Argentina) and that of the European material (Bajocian) many millions of years have passed.

According to DAMBORENEA (1987a: 85), QUENSTEDT's species also differs by a better developed anterior portion of the shell and umbones, which are not terminal. As both features are rather variable in the studied material from Chile changing also during ontogeny, and as differing maximum size is not a valuable criterion to separate species, *M. giganteoides* is treated here as a junior synonym of *M. giganteus*.

Modiolus (Modiolus) imbricatus J. SOWERBY 1818

Pl. 27, Fig. 10; Pl. 28, Fig. 1

- 1818 *Modiola imbricata* sp. nov. - J. SOWERBY: 21, pl. 112, figs. 1, 3.
 non 1878 *Modiola imbricata* SOW. - GOTTSCHKE: 23, pl. 5, fig. 12.
 ? 1892 *Modiola imbricata* Sow. - BEHRENDSEN: 13, pl. 2, fig. 7.
 non 1925 *Modiola imbricata* SOWERB. - GOTTSCHKE: pl. 5, fig. 12 (copy of GOTTSCHKE 1878: pl. 5, fig. 12).
 1988 *Modiolus imbricatus* J. SOWERBY, 1818 - FÜRSICH & WERNER: 130, pl. 7, figs. 2-11 (see for synonymy list).
 p 1992 *Modiolus (Modiolus) imbricatus* SOWERBY 1818 - ABERHAN: 18.
 1992 *Modiolus (Gibbomodiola?) gerthi* (DAMBORENEA 1987) - ABERHAN: 18.

Material. 3 articulated specimens from the Toarcian of Quebrada Pinte (PIW 1994VI 1472); 16 articulated specimens from the Toarcian of Quebrada La Titora (SNGM 8227-8228, PIW 1994VI 1473-1478); 7 articulated specimens from the Late Toarcian of Salar de Pedernales (PIW 1994VI 1479); 1 articulated specimen from the Toarcian of Quebrada Chancoquin (PIW 1994VI 1480); the species was also found in the Aalenian of Quebrada Asientos (PIW 1994VI 1481) and Quebrada La Titora (PIW 1994VI 1482).

Remarks. The medium-sized, obliquely elongate shell of *M. imbricatus* is trapezoidal in outline, the length reaching about twice the height. The general shape and the length of the postero-dorsal margin are rather variable, even in samples representing a single population (e.g. see FÜRSICH & WERNER 1988: 131, pl. 7, figs. 2-11). The dorsal margin either forms an obtuse but distinct angle with the posterior margin or,

more rarely, gradually passes into it. A conspicuous, slightly curved umbonal ridge extends from the umbones to the postero-ventral corner, delimiting a moderately well developed antero-ventral area. Ventral to the umbonal ridge a weak sulcus runs parallel to it. The surface of the shell is covered with distinct commarginal growth lines, which often are imbricate on the postero-dorsal portion of the shell.

Modiolus cf. *scalprum*, which is described below, differs from *M. imbricatus* by a more elongated shell, the absence of a sulcus ventral to the umbonal ridge, and a less developed posterior part of the shell.

Modiolus (Modiolus) lonsdalei
(MORRIS & LYCETT 1853)

Text-fig. 20A-F

- 1853 *Mytilus lonsdalei* sp. nov. - MORRIS & LYCETT: 40, pl. 4, fig. 3.
 1961 *Modiola lonsdalei* (MORRIS et LYCETT 1853) - SIBIRYAKOVA: 106, pl. 14, figs. 4-5 (see for short synonymy list).
 1986 *Modiolus (Modiolus) lonsdalei* (MORRIS et LYCETT 1853) - PUGACZEWSKA: 53, pl. 17, fig. 6; pl. 18, fig. 7 (see for short synonymy list).
 1992 *Modiolus (Modiolus) lonsdalei* (MORRIS & LYCETT 1853) - ABERHAN: 18.

Material. 1 articulated specimen from the Late Pliensbachian of Quebrada Asientos (SNGM 8237); 4 articulated specimens from the Aalenian of Salar de Pedernales (SNGM 8239-8240, PIW 1994VI 1483).

Remarks. The available specimens exhibit a striking similarity to *Modiolus (M.) lonsdalei*, which is known from the Bajocian to Bathonian of Europe (e.g. MORRIS & LYCETT: 40, pl. 4, fig. 3; GREPPIN 1899: 104, pl. 9, fig. 8; PUGACZEWSKA 1986: 53, pl. 17, fig. 6; pl. 18, fig. 7) and Asia (e.g. SIBIRYAKOVA 1961: 106, pl. 14, figs. 4-5). It can be distinguished from *M. baylei*, *M. chilensis*, *M. giganteus*, and *M. imbricatus* by its elongate, rather narrow form. It can be separated from *M. gerthi* by the lack of radial striae on the postero-dorsal part of the shell, which are very diagnostic in the latter. It shares the elongate form with *M. cf. scalprum*. In contrast to the latter, however, it bears a pronounced umbonal ridge, which is preceded ventrally by a shallow sulcus.

Modiolus (Modiolus) cf. scalprum J. SOWERBY 1821

Pl. 28, Figs. 2-5

- cf. 1821 *Modiola scalprum* sp. nov. - J. SOWERBY: 87, pl. 248, fig. 2.
 cf. 1837 *Mytilus scalprum* sp. nov. - GOLDFUSS: 174, pl. 130, fig. 9.

- 1899 *Modiola plicata* Sow. - PHILIPPI: 48, pl. 24, fig. 7.
 1942 *Modiolus scalprum* SOW. - LEANZA: 181, pl. 12, fig. 4.
 ? 1982 *Modiolus scalprum* SOWERBY - PÉREZ: pl. 14, fig. 14.
 ? 1987a *Inoperna* sp. - DAMBORENEA: 82, pl. 4, fig. 1.
 1987a *Modiolus* cf. *thiollierei* (DUMORTIER 1869) -
 DAMBORENEA: 89, pl. 3, figs. 8, 9a-d, 10, 11a-b, 12,
 13a-b; text-fig. 23.
 1992 *Modiolus* cf. *thiollierei* (DUMORTIER) - DAMBORENEA:
 pl. 117, fig. 6 (copy from DAMBORENEA 1987a: pl. 3,
 fig. 13b).
 1992 *Modiolus (Modiolus) scalprum* SOWERBY 1821 -
 ABERHAN: 18.
 1992 *Modiolus (Modiolus)* cf. *virgulinus* (ETALLON 1863) -
 ABERHAN: 18.

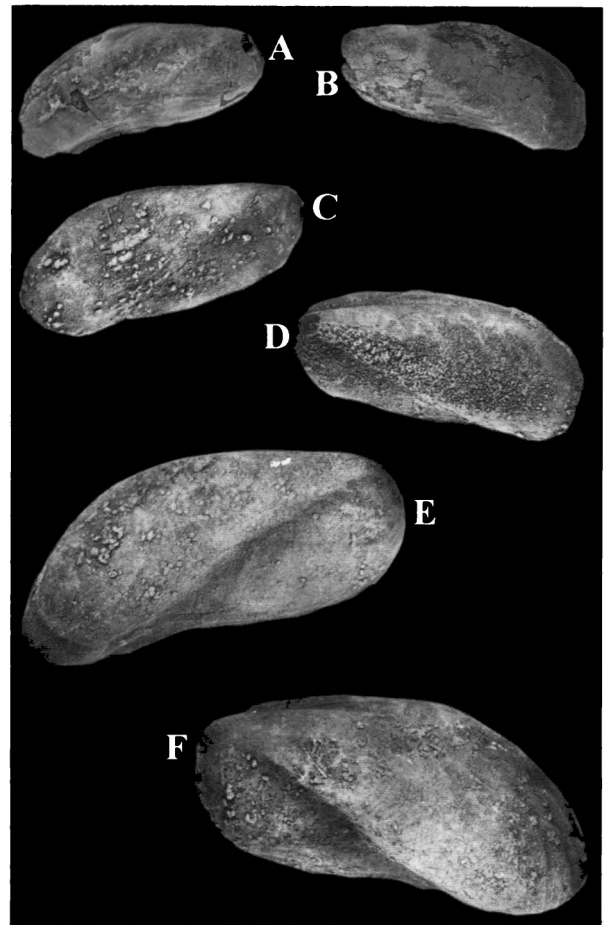
Material. 14 articulated specimens from the Late Pliensbachian of Quebrada Pinte (SNGM 8229, 8231; PIW 1994VI 1484-1491); 4 articulated specimens from the Early/Late Pliensbachian of Quebrada Asientos (SNGM 8230, 8232; PIW 1994VI 1492-1493).

Remarks. The very elongate shell, a low, rounded umbonal ridge, and the absence of a sulcus parallel to it serve to distinguish *M. cf. scalprum* from all other species of *Modiolus* described here. As appears to be typical of most Jurassic *Modiolus*, *M. cf. scalprum*, too, exhibits a fair amount of variability with regard to general shape and outline. Three morphological variants can be distinguished, which all have been found within single populations and therefore are thought to belong to a single species. The spectrum comprises distinctly arcuate specimens, as figured on Pl. 28, Fig. 4 (see also PHILLIPS 1829: pl. 14, fig. 2 for an European representative of this morphologic end member); slightly arcuate individuals (Pl. 28, Figs. 2-3; see also the holotype in SOWERBY 1821: pl. 248, fig. 2.); and finally shells exhibiting a particularly long and straight dorsal margin as depicted on Pl. 28, Fig. 5.

This last variant strongly resembles *M. virgulinus* (ETALLON) (e.g. THURMANN & ETALLON 1863: 224, pl. 29, fig. 6; FÜRSICH & WERNER 1988: 131, pl. 10, figs. 2-3) and related forms from the Late Jurassic of Europe and Africa in general outline. However, the Chilean specimens are more inflated than ETALLON's species and lack the distinct irregular folds near the dorsal margin. With regard to the South American material, an open nomenclature is preferred, as, due to a less obtuse postero-dorsal angle, some specimens are more oblique and exhibit a broader posterior part of the shell than the European forms.

The genus *Inoperna* is also characterized by elongated, faintly to distinctly curved shells. It can be distinguished from similarly shaped representatives of *Modiolus* by the presence of conspicuous bifurcating folds, which extend from the dorsal margin to the umbonal ridge. *Inoperna* sp. (DAMBORENEA 1987a: 82, pl. 4, fig. 1) from the Pliensbachian of Argentina, represented by an incomplete left valve only, lacks

this characteristic splitting of primary folds. Based on its elongate shape it is therefore doubtfully included in *M. cf. scalprum*.



Text-fig. 20. *Modiolus (Modiolus) lonsdalei* (MORRIS & LYCETT 1853). A. SNGM 8237, right valve view, B. SNGM 8237, left valve view, Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-61). C. SNGM 8239, right valve view of composite mould, D. SNGM 8239, left valve view of composite mould, Aalenian of Salar de Pedernales. E. SNGM 8240, right valve view of composite mould, D. SNGM 8240, left valve view of composite mould, Aalenian of Salar de Pedernales. All x 1.

Modiolus scalprum J. SOWERBY, which is here regarded as a senior synonym of *M. scalprum* GOLDFUSS (1837: 174, pl. 130, fig. 9), is known from the Sinemurian to Pliensbachian of Europe (e.g. J. SOWERBY 1821: 87, pl. 248, fig. 2; PHILLIPS 1829: 161, pl. 14, fig. 2; 1871: 136, pl. 8, fig. 22; MALLADA 1884: 90, pl. 43, fig. 4; RICHARDSON 1904: pl. 15, fig. 6; COSSMANN 1908: pl. 3, fig. 1; TRAUTH 1909: pl. 3, fig. 17; FAVRE 1916: pl. 2, fig. 7a-b; TROEDSSON 1951: pl. 14, figs. 9-10). Other closely related, characteristically elongated species from the Liassic of Europe are the Sinemurian *M. productus* (TERQUEM) (e.g. FAVRE 1916: pl. 2, fig. 8a-b) and the

Pliensbachian *M. thiollierei* (DUMORTIER 1869: 284, pl. 34, figs. 5-6). A careful evaluation of original material, if possible on whole populations, may reveal

that they are all conspecific. Here, preference is given to the oldest available name, that is *M. scalprum* J. SOWERBY.

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Plates 1-28

(all specimens are coated with magnesium oxide)

Plate 1

Figs. 1-4. *Palaeonucula cuevitana* sp. nov.

1. Holotype, left valve; a: exterior view; b: interior view; c: dorsal view; Late Hettangian of Cerros de Cuevitas; x 3. - SNGM 7975 (HILLEBRANDT 841107/4).
2. Paratype, left valve; a: exterior view; b: interior view; Late Hettangian of Cerros de Cuevitas; x 3. - SNGM 7976 (HILLEBRANDT 841107/4).
3. Paratype, left valve; Late Hettangian of Cerros de Cuevitas; x 3. - SNGM 7977 (HILLEBRANDT 841107/4).
4. Paratype, right valve; Late Hettangian of Cerros de Cuevitas; x 3. - SNGM 7978 (HILLEBRANDT 841107/4).

Figs. 5-12. *Nuculana (Praesacella) ovum* (J. DE C. SOWERBY 1825)

5. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7979 (HILLEBRANDT 670811/5).
6. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7980 (HILLEBRANDT 670811/5).
7. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7981 (HILLEBRANDT 670811/5).
8. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7982 (HILLEBRANDT 670811/5).
9. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7983 (HILLEBRANDT 670811/5).
10. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7984 (HILLEBRANDT 670811/5).
11. Right valve of articulated specimen; Late Pliensbachian of Quebrada Calquis; x 2. - SNGM 7985 (HILLEBRANDT 670811/5).
12. Left valve; a: exterior view; b: interior view; Late Toarcian of Salar de Pedernales; x 2. - SNGM 7986 (HILLEBRANDT 660714/3).

Figs. 13-14. *Parallelodon groeberi* DAMBORENEA 1987

13. Internal mould of left valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-25); x 1. - SNGM 7987.
14. Internal mould of left valve; Early/Late Pliensbachian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 9, hor. 3); x 1. - SNGM 7988 (HILLEBRANDT 720110/3).

Fig. 16. *Parallelodon* aff. *groeberi* DAMBORENEA 1987

16. Left valve; a: exterior view; b: interior view; Late Hettangian of Cerros de Cuevitas; x 1. - SNGM 7989 (HILLEBRANDT 841107/4).

Figs. 15, 17-20. *Parallelodon hirsonensis* (D'ARCHIAC 1843)

15. Right valve; a: exterior view; b: interior view; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-81 B3); x 1. - SNGM 7990.
17. Internal mould of left valve; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 7991 (HILLEBRANDT 670910/2).
18. Internal mould of right valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-31 B3); x 1. - SNGM 7992.
19. Internal mould of right valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-23 B2); x 1. - SNGM 7993.
20. Internal mould of left valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-23 B1); x 1. - SNGM 7994.

Figs. 21-24. *Grammatodon (Grammatodon) sulcatus* sp. nov.

21. Paratype, right valve; a: exterior view; b: interior view; c: dorsal view; Late Sinemurian between Río Copiapó and Quebrada Amolanas; x 2. - SNGM 7995 (HILLEBRANDT 670811/8).
22. Paratype, right valve; a: exterior view; b: interior view; c: dorsal view; Late Sinemurian between Río Copiapó and Quebrada Amolanas; x 2. - SNGM 7996 (HILLEBRANDT 670811/8).
23. Holotype, articulated specimen; a: right valve view; b: left valve view; c: dorsal view; Late Sinemurian between Río Copiapó and Quebrada Amolanas; x 2. - SNGM 7997 (HILLEBRANDT 670811/8).
24. Paratype, left valve; a: exterior view; b: interior view; Late Sinemurian between Río Copiapó and Quebrada Amolanas; x 2. - SNGM 7998 (HILLEBRANDT 670811/8).

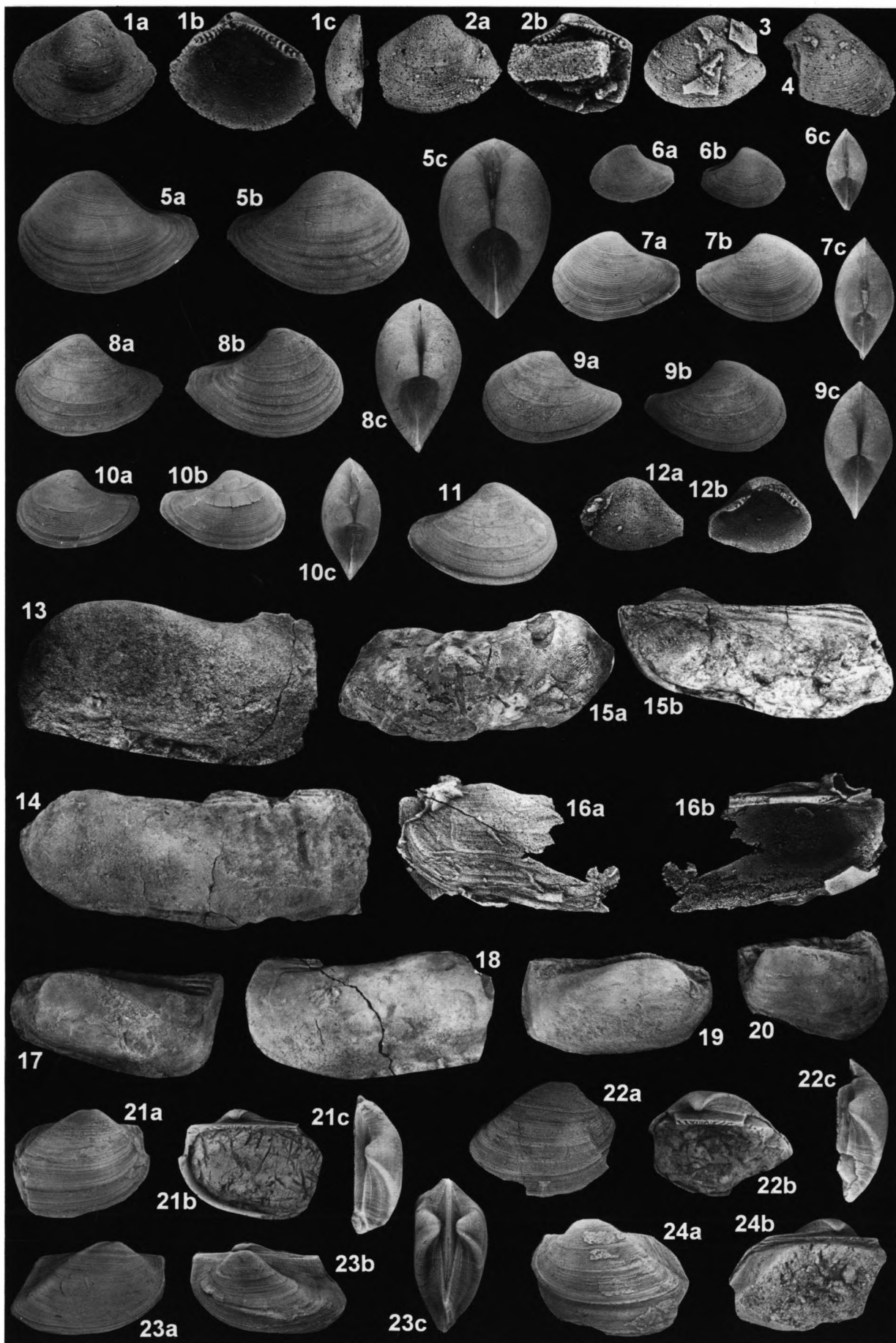


Plate 2

Figs. 1-5. *Grammatodon (Grammatodon) concinnus* (PHILLIPS 1829)

1. Right valve; a: exterior view; b: interior view; c: dorsal view; Late Toarcian of Salar de Pedernales; x 2. - SNGM 7999 (HILLEBRANDT 660714/3).
2. Left valve; a: exterior view; b: interior view; c: dorsal view; Late Toarcian of Salar de Pedernales; x 2. - SNGM 8000 (HILLEBRANDT 660714/3).
3. Right valve; a: exterior view; b: interior view; c: dorsal view; Late Toarcian of Salar de Pedernales; x 2. - SNGM 8001 (HILLEBRANDT 660714/3).
4. Articulated specimen; a: right valve view; b: left valve view; c: dorsal view; Late Toarcian of Salar de Pedernales; x 2. - SNGM 8002.
5. Left valve; Late Toarcian of Salar de Pedernales; x 2. - SNGM 8003 (HILLEBRANDT 660714/3).

Figs. 6-8. *Cucullaea (Idonearca) cf. rothi* A. LEANZA 1940

6. Internal mould of left valve; Early Toarcian of Quebrada La Tatora (ABERHAN 1992: app. I + III, hor. 5-1); x 1. - SNGM 8004.
7. Internal mould of articulated specimen; a: right valve view; b: left valve view; c: dorsal view; Early Toarcian of Quebrada La Tatora (ABERHAN 1992: app. I + III, hor. 5-1); x 1. - SNGM 8005.
8. Internal mould of articulated specimen; a: right valve view; b: left valve view; Early Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-45); x 1. - SNGM 8006.

Fig. 9. *Aguilerella kobyi* (LORIOLO 1901)

9. Internal mould of articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-18); x 2. - SNGM 8007.

Figs. 10-14. *Bakevellia (Bakevellia) waltoni* (LYCETT 1863)

10. Internal mould of left valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-21); x 1.5. - SNGM 8008.
11. Internal mould of left valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-21); x 1.5. - SNGM 8009.
12. Internal mould of left valve; Late Sinemurian of Quebrada Pinte; x 1.5. - SNGM 8010.
13. Internal mould of left valve; Late Sinemurian of Quebrada Pinte; x 1.5. - SNGM 8011.
14. Internal mould of left valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-23); x 1.5. - SNGM 8012.

Fig. 15. *Pteria?* sp.

15. Left valve; Middle or Late Hettangian of Quebrada Cachina; x 1. - SNGM 8013 (HILLEBRANDT 860319/1).

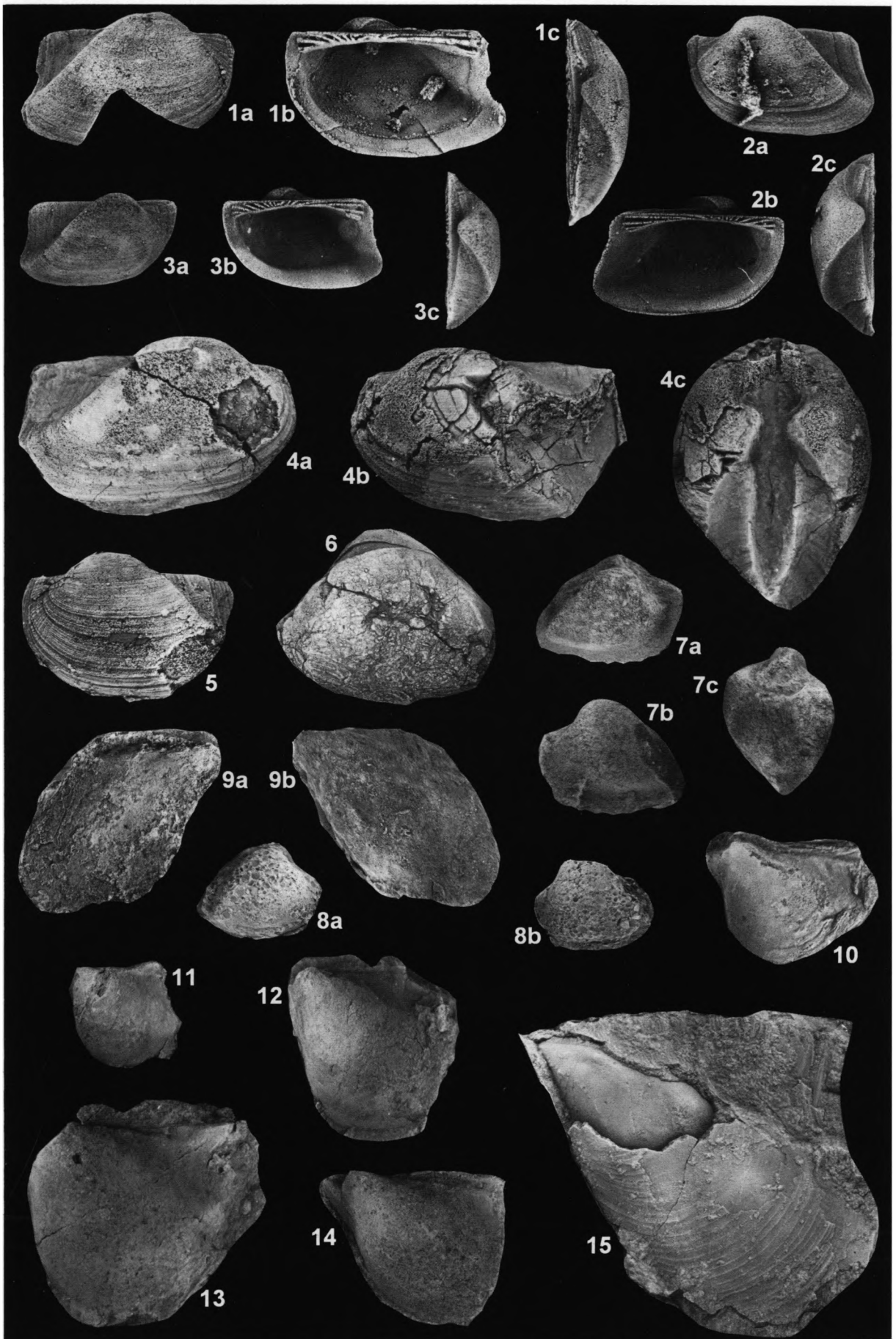


Plate 3

Figs. 1-2. *Gervillaria alaeformis* (J. SOWERBY 1819)

1. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Toarcian of Quebrada Pinté; x 1. - SNGM 8014.
2. Articulated specimen; a: left valve view; b: right valve view; Toarcian of Quebrada Asientos; x 1. - SNGM 8015.

Figs. 3-4. *Gervillaria? ashcroftensis* (CRICKMAY 1930)

3. Left valve; a: exterior view; b: interior view; Toarcian of Quebrada Pinté; x 1. - SNGM 8016.
4. Left valve; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-81 B2); x 1. - SNGM 8017.

Figs. 5-7. *Gervillaria hartmanni* (MÜNSTER 1835)

5. Articulated specimen, left valve view; Toarcian of Quebrada La Totorá (ABERHAN 1992: app. I + III, hor. 5-3); x 1. - SNGM 8018.
6. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Late Toarcian of Quebrada La Totorá; x 1. - SNGM 8019 (HILLEBRANDT 671010/8).
7. Articulated specimen; a: left valve view; b: right valve view; c: dorsal view; Toarcian of Quebrada La Totorá (ABERHAN 1992: app. I + III, hor. 5-2); x 1. - SNGM 8020.

Figs. 8-10. *Gervillia araucana* DAMBORENEA 1987

8. Left valve; Late Sinemurian of Quebrada Pinté; x 1,5. - SNGM 8021 (HILLEBRANDT 670910/2).
9. Left valve; Late Sinemurian of Quebrada Pinté; x 1,5. - SNGM 8022.
10. Left valve; Late Sinemurian of Quebrada Pinté; x 1,5. - SNGM 8023.



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Plate 4

Figs. 1-3. *Gervillaria pallas* (A. LEANZA 1942)

1. Left valve; a: exterior view; b: dorsal view; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I, hor. 2-69); x 1. - SNGM 8024.
2. Articulated specimen; a: left valve view; b: right valve view; Late Pliensbachian of Quebrada Asientos; x 1. - SNGM 8025.
3. Left valve of articulated specimen; a: exterior view; b: anterior view; Late Pliensbachian between Quebrada Acevedo and Quebrada Chancoquin; x 1. - SNGM 8026 (HILLEBRANDT 671008/6).

Figs. 4-8. *Gervilleioperna (Gervilletia) turgida* (A. LEANZA 1942)

4. Articulated specimen; a: left valve view; b: dorsal view; Early/Late Pliensbachian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 9, hor. 3); x 1. - SNGM 8027 (HILLEBRANDT 720110/3).
5. Articulated specimen; a: left valve view; b: dorsal view; Early/Late Pliensbachian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 9, hor. 3); x 1. - SNGM 8028 (HILLEBRANDT 720110/3).
6. Articulated specimen, left valve view; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-80 B2); x 1. - SNGM 8029.
7. Left valve; Early Pliensbachian of Quebrada El Peñon (see faunal list in HILLEBRANDT & SCHMIDT-EFFING 1981: 12); x 1. - SNGM 8030 (HILLEBRANDT 790118/2).
8. Left valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-24); x 1. - SNGM 8031.

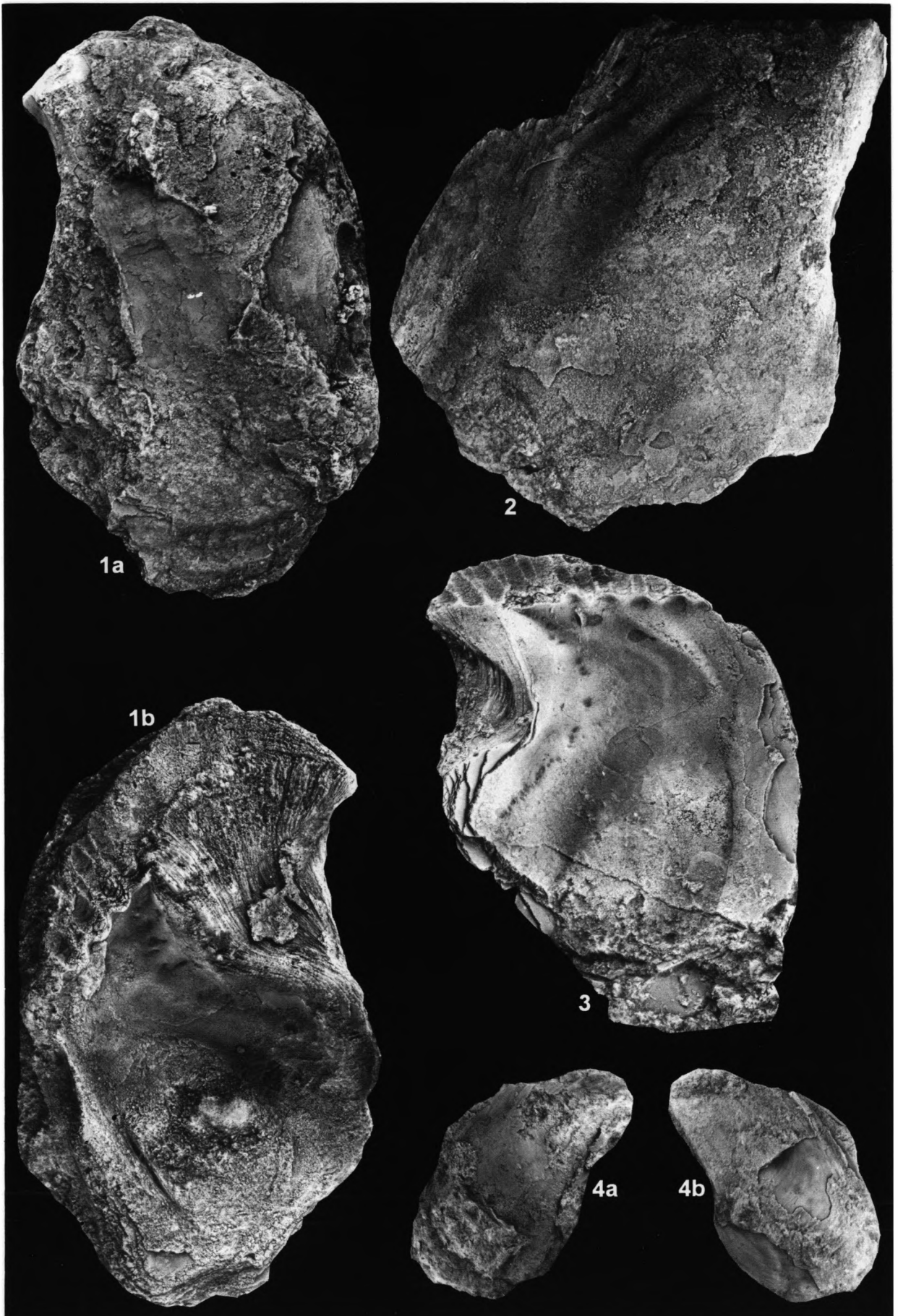


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Plate 5

Figs. 1-4. *Isognomon (Isognomon) jupiter* (A. LEANZA 1942)

1. Left valve; a: exterior view; b: interior view; Toarcian/Aalenian of Quebrada Caballo Muerto (HILLEBRANDT & WESTERMANN 1985: fig. 2, hor. 5); x 1. - SNGM 8032 (HILLEBRANDT 670304/5).
2. Articulated specimen, view of internal mould of right valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-27); x 1. - SNGM 8033.
3. Right valve, interior view; Toarcian/Aalenian of Quebrada Caballo Muerto (HILLEBRANDT & WESTERMANN 1985: fig. 2, hor. 5); x 1. - SNGM 8034 (HILLEBRANDT 670304/5).
4. Articulated specimen; a: right valve view; b: left valve view; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-20); x 1. - SNGM 8035.



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Plate 6

Fig. 1. *Isognomon (Isognomon) jupiter* (A. LEANZA 1942)

1. Articulated specimen, left valve view; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-20); x 1. - SNGM 8036.

Figs. 2-4. *Bositra ornati* (QUENSTEDT 1851)

2. Slab with several specimens; Late Toarcian north of Quebrada Oreganito; x 2. - SNGM 8037 (HILLEBRANDT 790311/3).
3. Right valve; Aalenian of Mina Los Pingos; x 2. - SNGM 8038 (HILLEBRANDT 790304/4).
4. Right valve; Aalenian of Mina Los Pingos; x 2. - SNGM 8039 (HILLEBRANDT 790304/4).

Figs. 5-6. *Posidonotis semiplicata* (HYATT 1894)

5. ?Right valve; Early Toarcian of Quebrada Asientos (ABERHAN 1992: app. I, hor. 2-85 B11); x 2. - SNGM 8040.
6. Slab with several specimens; Late Pliensbachian/Early Toarcian of Quebrada de Paipote (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 4, hor. 1); x 1. Figured by HILLEBRANDT (1980: pl. 1, fig. 2). - SNGM 8041 (HILLEBRANDT 661016/8).

Figs. 7-9. *Cercomya (Cercomya) undulata* (J. DE C. SOWERBY 1827)

7. Composite mould of articulated specimen; a: right valve view; b: left valve view; Early Toarcian of Quebrada La Titora (ABERHAN 1992: app. I + III, hor. 5-1); x 1. - SNGM 8042.
8. Internal mould of articulated specimen; a: right valve view; b: left valve view; Early Toarcian of Quebrada La Titora (ABERHAN 1992: app. I + III, hor. 5-1); x 1. - SNGM 8043.
9. Composite mould of articulated specimen; a: right valve view; b: left valve view; c: dorsal view; Early Toarcian of Quebrada Pinte; x 1. - SNGM 8044.

Figs. 10-11. *Antiquilima* sp. indet.

10. Left valve; Late Hettangian of Quebrada Chaco Sur; x 1. - SNGM 8045 (HILLEBRANDT 841102/12).
11. Left valve; Late Hettangian of Aguada Alto de Varas; x 1. - SNGM 8046 (HILLEBRANDT 720220/5).

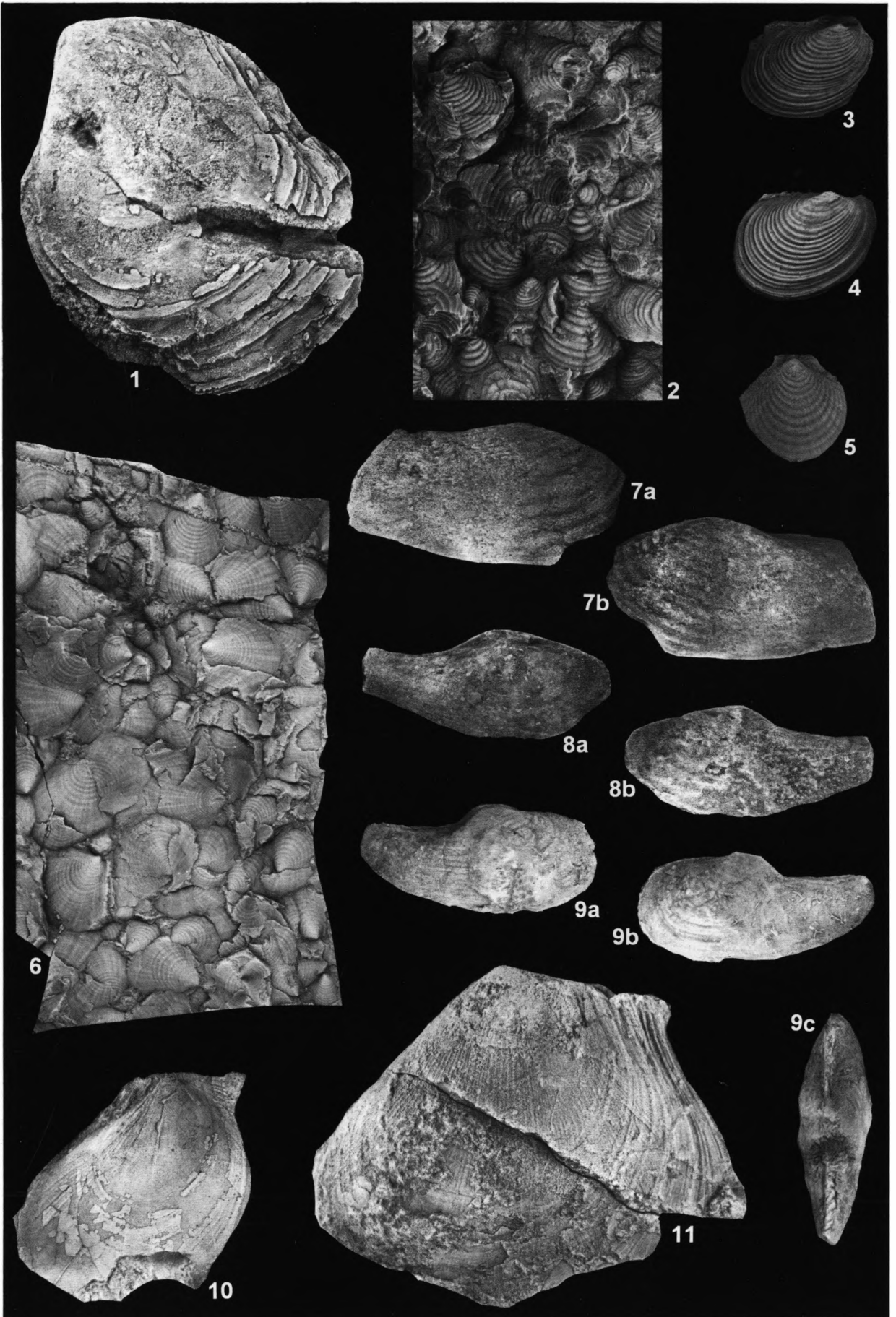


Plate 7

Figs. 1-2. *Pinna (Pinna) cf. radiata* MÜNSTER 1837

1. Articulated specimen; a: left valve view; b: right valve view; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-23); x 1. - SNGM 8047.
2. Articulated specimen; a: right valve view; b: left valve view; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-81 B2); x 1. - SNGM 8048.

Figs. 3-4. *Pinna (Pinna) cf. folium* YOUNG & BIRD 1822

3. Internal mould of articulated specimen; a: left valve view; b: right valve view; Early Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-43); x 1. - SNGM 8049.
4. Internal mould of articulated specimen; a: left valve view; b: right valve view; Early Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-43); x 1. - SNGM 8050.



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Plate 8

Figs. 1-3. *Antiquilima (Antiquilima) cf. nagatoensis* HAYAMI 1959

1. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-106); x 1. - SNGM 8051.
2. Right valve; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8052 (HILLEBRANDT 670910/6).
3. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-106); x 1. - SNGM 8053.

Figs. 4-7. *Ctenostreon cf. rugosum* (SMITH 1817)

4. Left valve; Early Toarcian of Quebrada Pinte; x 1. - SNGM 8054.
5. Right valve; Early Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-46); x 1. - SNGM 8055.
6. Left valve; Early Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-46); x 1. - SNGM 8056.
7. Left valve of articulated specimen; Late Pliensbachian between Quebrada Acevedo and Quebrada Chancoquin; x 1. - SNGM 8057 (HILLEBRANDT 671009/2).

Fig. 8. *Ctenostreon wrighti* BAYLE 1878

8. Right valve; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8058.



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Plate 9

Figs. 1-2. *Ctenostreon wrighti* BAYLE 1878

1. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8059 (HILLEBRANDT 670910/8).
2. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-106); x 1. - SNGM 8060.

Figs. 3-5. *Plagiostoma punctatum* J. SOWERBY 1815

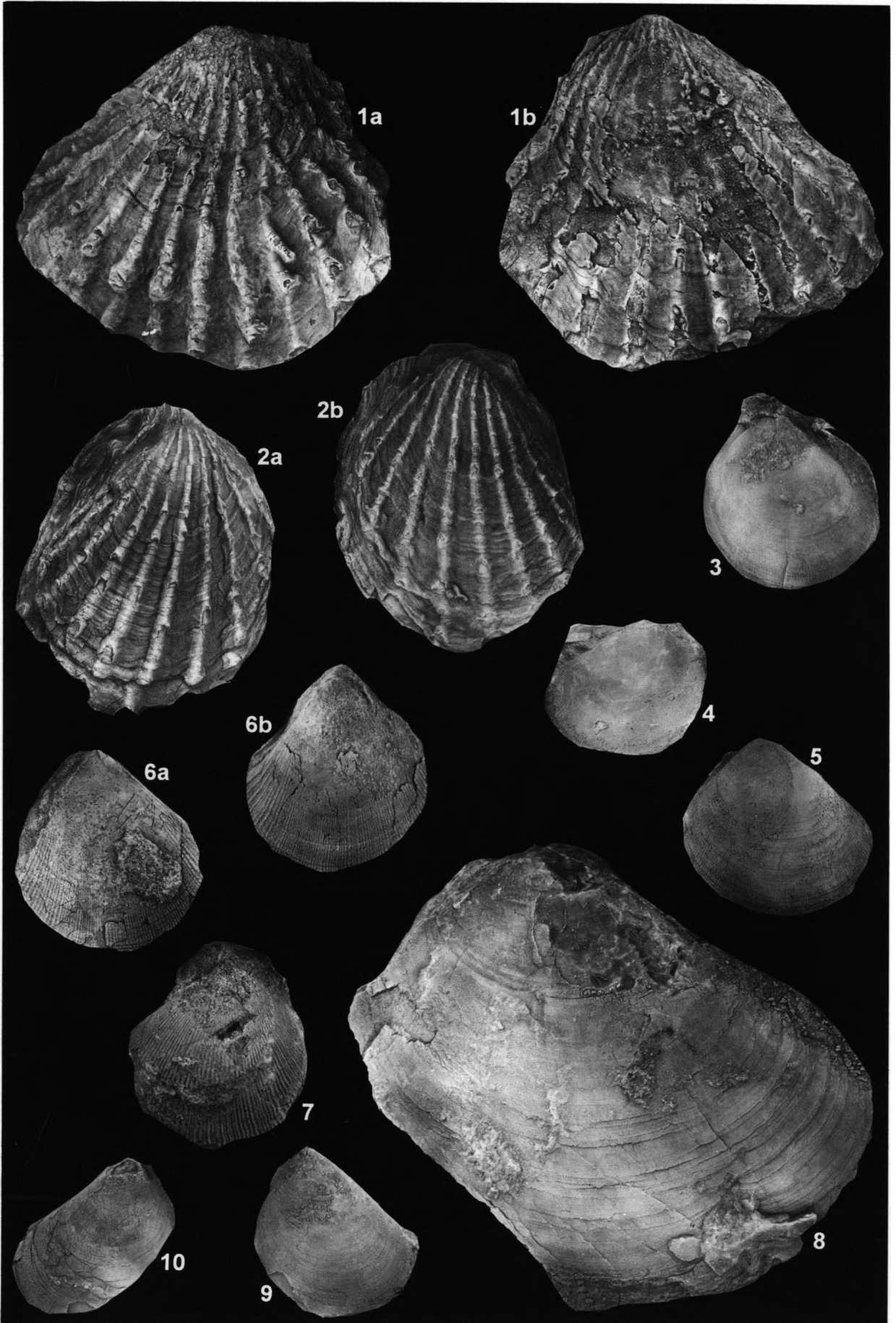
3. Right valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-25); x 1. - SNGM 8061.
4. Left valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-19); x 1. - SNGM 8062.
5. Right valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-25); x 1. - SNGM 8063.

Figs. 6-7. *Plagiostoma* sp. C

6. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8064 (HILLEBRANDT 670910/6).
7. Articulated specimen, left valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8065.

Figs. 8-10. *Plagiostoma giganteum* J. SOWERBY 1814

8. Articulated specimen, right valve view; Late Toarcian of Quebrada La Totorá; x 1. - SNGM 8066 (HILLEBRANDT 671010/8).
9. Left valve; Middle Toarcian of Río del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 7); x 1. - SNGM 8067 (HILLEBRANDT 670109/13).
10. Right valve; Middle Toarcian between Quebrada Acevedo and Quebrada Chancoquin; x 1. - SNGM 8068 (HILLEBRANDT 671009/4).



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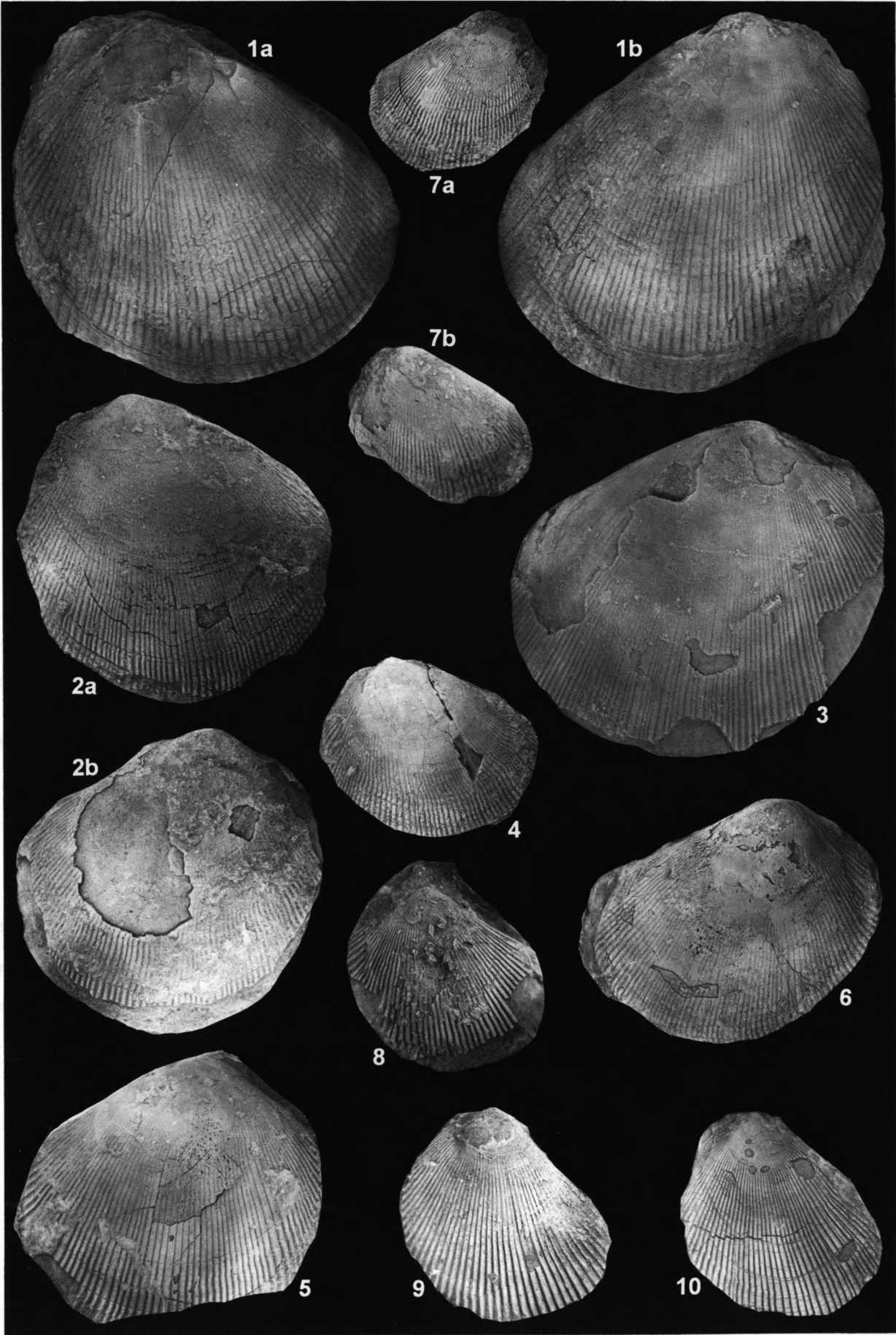
Plate 10

Figs. 1-6. *Plagiostoma* sp. A

1. Articulated specimen; a: right valve view; b: left valve view; Middle Toarcian of Río del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 7); x 1. - SNGM 8069 (HILLEBRANDT 670109/13).
2. Articulated specimen; a: right valve view; b: left valve view; Early/Late Pliensbachian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 9, hor. 3); x 1. - SNGM 8070 (HILLEBRANDT 720110/3).
3. Left valve; Middle/Late Hettangian of Quebrada Cachina; x 1. - SNGM 8071 (HILLEBRANDT 841112/4).
4. Right valve; Early Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-147); x 1. - SNGM 8072.
5. Left valve; Late Pliensbachian of Quebrada Asientos; x 1. - SNGM 8073.
6. Left valve; Late Pliensbachian of Quebrada Asientos; x 1. - SNGM 8074.

Figs. 7-10. *Plagiostoma* sp. B

7. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-49); x 1. - SNGM 8075.
8. Articulated specimen, right valve view; Late Pliensbachian or Early Toarcian of Vega Redonda; x 1. - SNGM 8076 (HILLEBRANDT 720130/3).
9. Right valve; Late Pliensbachian or Early Toarcian of Quebrada La Plata; x 1. - SNGM 8077 (HILLEBRANDT 720129/1).
10. Articulated specimen, right valve view; Early Toarcian of Quebrada El Peñon (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 3a, ± hor. 12); x 1. - SNGM 8078 (HILLEBRANDT 790118/3a).



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Plate 11

Figs. 1-2. *Pseudolimea duplicata* (J. DE C. SOWERBY 1827)

1. Right valve; Late Sinemurian between Quebrada Acevedo and Quebrada Chancoquin; x 1.2. - SNGM 8079 (HILLEBRANDT 671008/2).
2. Left valve; Late Sinemurian between Quebrada Acevedo and Quebrada Chancoquin; x 1.2. - SNGM 8080 (HILLEBRANDT 671008/2).

Figs. 3-5. *Pseudolimea* cf. *roemeri* (BRAUNS 1871)

3. Left valve; Late Toarcian of Salar de Pedernales; x 1.2. - SNGM 8081.
4. Left valve; Toarcian of Quebrada La Tora (ABERHAN 1992: app. I + III, hor. 5-3); x 1.2. - SNGM 8082.
5. Right valve; Toarcian of Quebrada Pinte; x 1.2. - SNGM 8083 (HILLEBRANDT 670912/3).

Fig. 6. *Pseudolimea hettangiensis* (TERQUEM 1855)

6. Right valve; Late Hettangian of Cerros de Cuevitas; x 1. - SNGM 8084 (HILLEBRANDT 841107/4).

Figs. 7-14. *Plicatula* (*Plicatula*) *armata* GOLDFUSS 1835

7. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-55); x 1. - SNGM 8085.
8. Left valve; a: exterior view; b: interior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8086 (HILLEBRANDT 711210/4).
9. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8087.
10. Left valve; a: exterior view; b: interior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8088 (HILLEBRANDT 711210/4).
11. Right valve, exterior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8089 (HILLEBRANDT 711210/4).
12. Right valve, interior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8090 (HILLEBRANDT 711210/4).
13. Left valve, interior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8091 (HILLEBRANDT 711210/4).
14. Right valve, interior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8092 (HILLEBRANDT 711210/4).

Figs. 15-18. *Plicatula* (*Harpax*) *rapa* BAYLE & COQUAND 1851

15. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada east of Hacienda Manflas; x 1. - SNGM 8093 (HILLEBRANDT 670104/1).
16. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian (HILLEBRANDT & SCHMIDT-EFFING 1981: 18) of Quebrada Larga; x 1. - SNGM 8094 (HILLEBRANDT 670219/3).
17. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Larga (HILLEBRANDT & SCHMIDT-EFFING 1981: 18); x 1. - SNGM 8095 (HILLEBRANDT 670219/3).
18. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian between Río Copiapó and Quebrada Amolanas; x 1. - SNGM 8096 (HILLEBRANDT 670811/8).

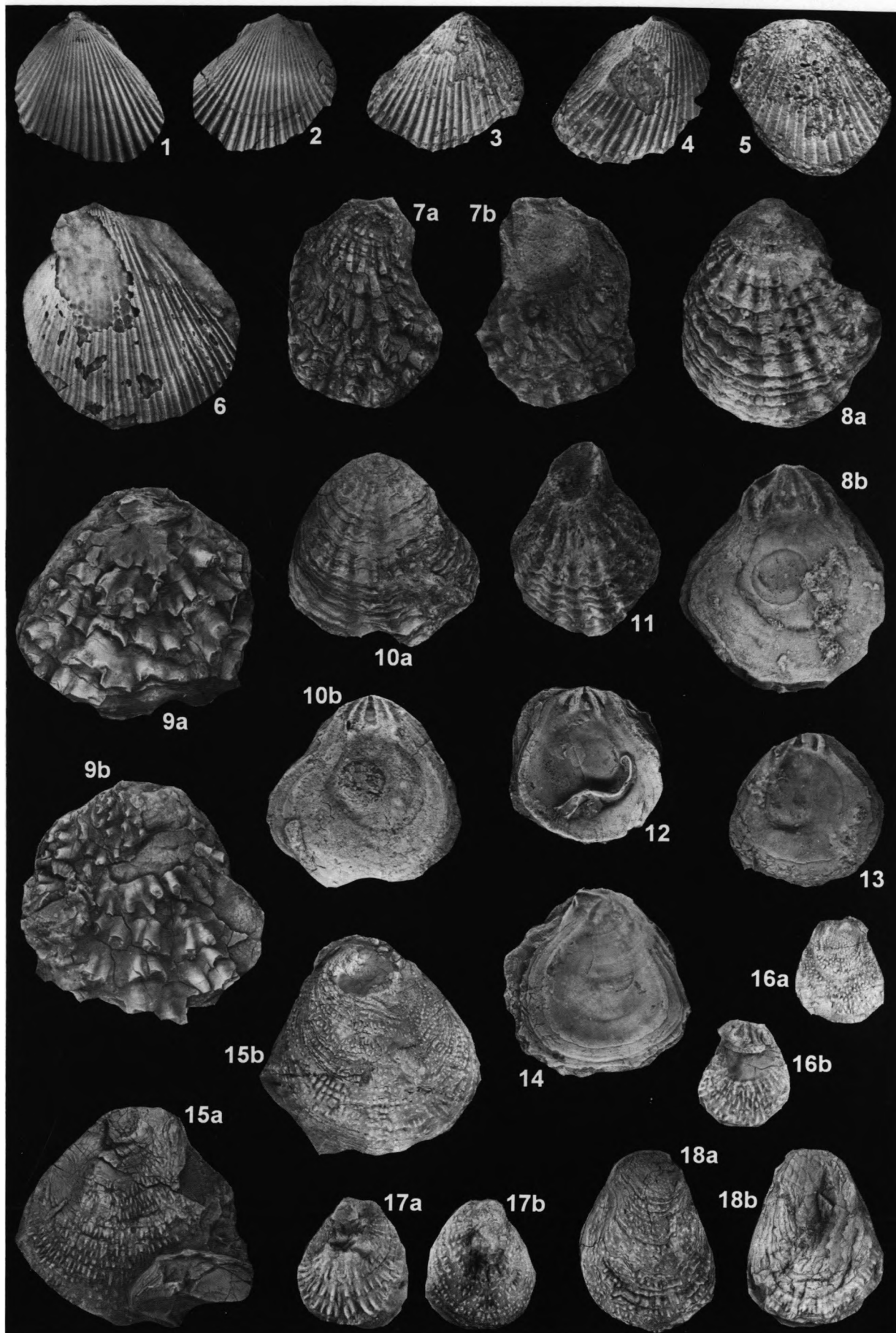


Plate 12

Figs. 1-4. *Actinostreon costatum* (J. DE C. SOWERBY 1825)

1. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte. x 1.6. - SNGM 8097 (HILLEBRANDT 670910/6).
2. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Yervas Buenas; x 1.6. - SNGM 8098 (HILLEBRANDT 711210/4).
3. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Chancoquin; x 1.6. - SNGM 8099 (HILLEBRANDT 671012/2).
4. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada east of Hacienda Manflas; x 1.6. - SNGM 8100 (HILLEBRANDT 670104/1).

Figs. 5-7. *Actinostreon longistriatum* (JAWORSKI 1915)

5. ?Right valve of articulated specimen; Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 3, hor. 1); x 1. - SNGM 8101 (HILLEBRANDT 660708/8).
6. Left valve of articulated specimen; Early Pliensbachian of Río del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 4); x 1. - SNGM 8102 (HILLEBRANDT 670109/10).
7. Articulated specimen; a: left valve view; b: right valve view; Early Pliensbachian of Quebrada Vaca Muerta; x 1. - SNGM 8103 (HILLEBRANDT 661126/3).

Figs. 8-10. *Actinostreon solitarium* (J. DE C. SOWERBY 1824)

8. Articulated specimen; a: left valve view; b: right valve view; Toarcian of Quebrada La Totorá (ABERHAN 1992: app. I + III, hor. 5-4); x 1. - SNGM 8104.
9. Articulated specimen; a: left valve view; b: right valve view; Toarcian between Quebrada Acevedo and Quebrada Chancoquin (see faunal list in HILLEBRANDT & SCHMIDT-EFFING 1981: 29); x 1. - SNGM 8105 (HILLEBRANDT 671009/6).
10. Articulated specimen; a: left valve view; b: right valve view; Toarcian of Quebrada La Totorá (ABERHAN 1992: app. I + III, hor. 5-4); x 1. - SNGM 8106.

Fig. 11. *Gryphaea (Gryphaea) darwini* FORBES 1846

11. Articulated specimen; a: left valve view; b: right valve view; c: posterior view; Late Sinemurian east of Quebrada El Carbon; x 1. - SNGM 8107 (HILLEBRANDT 661012/2).

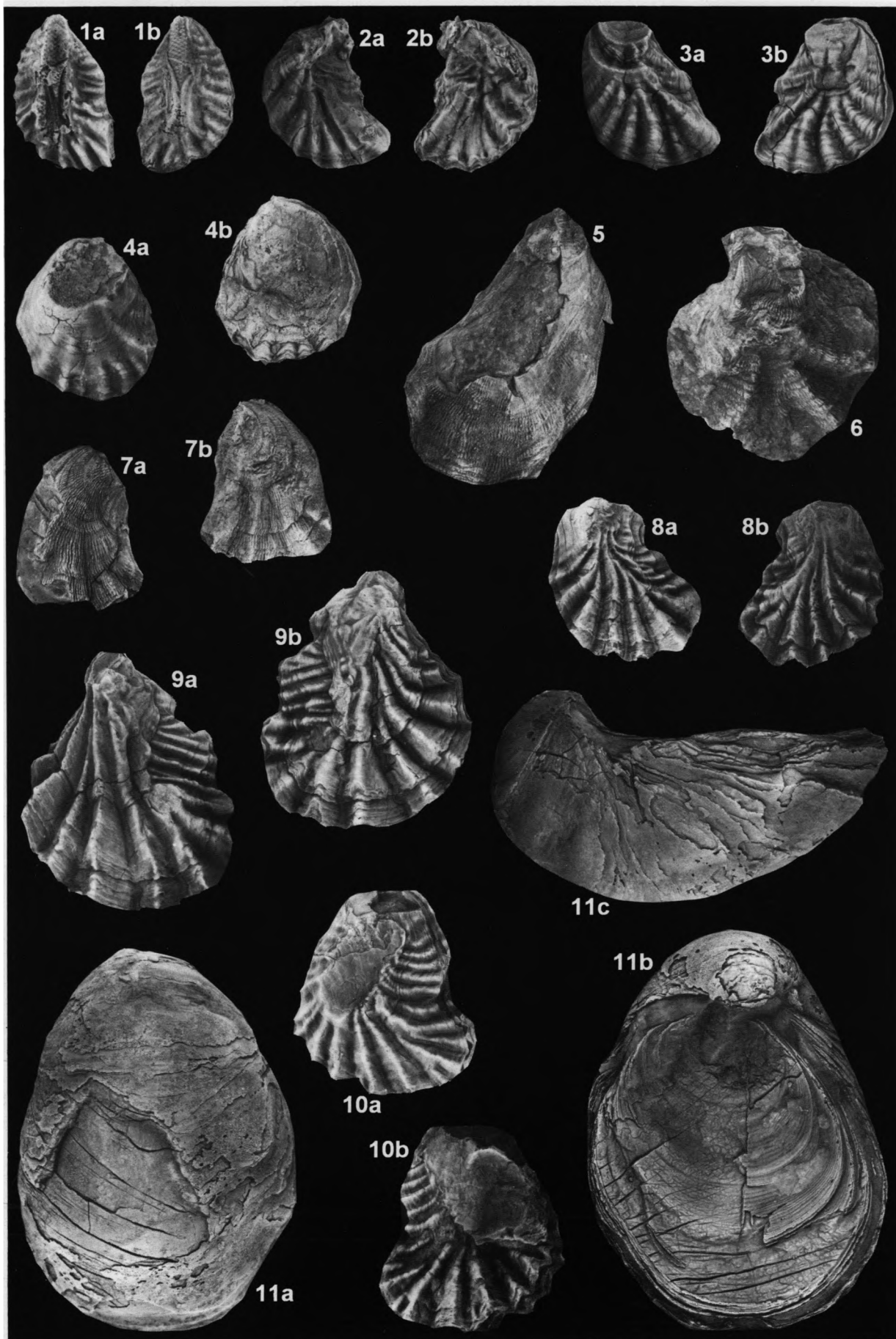


Plate 13

Figs. 1-2. *Gryphaea (Gryphaea) darwini* FORBES 1846

1. Left valve; Late Sinemurian between Río Copiapó and Quebrada Amolanas; x 1. - SNGM 8108 (HILLEBRANDT 670117/5).
2. Left valve of articulated specimen; Late Sinemurian of Quebrada Los Eucaliptos; x 1. - SNGM 8109 (HILLEBRANDT 720103/2).

Figs. 3-8. *Gryphaea (Bilobissa) tricarinata* PHILIPPI 1899

3. Left valve; a: exterior view, b: posterior view; Late Sinemurian of Quebrada Larga (HILLEBRANDT & SCHMIDT-EFFING 1981: 18); x 1. - SNGM 8110 (HILLEBRANDT 670219/3).
4. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Chancoquin; x 1. - SNGM 8111 (HILLEBRANDT 671011/1).
5. Articulated specimen; a: left valve view; b: posterior view; Sinemurian of Río Manflas (section between the river and Port. El Padre in HILLEBRANDT & Schmidt-Effing 1981: 24); x 1. - SNGM 8112 (HILLEBRANDT 670106/2).
6. Left valve; a: exterior view; b: interior view; Late Sinemurian of Quebrada Yervas Buenas; x 1. - SNGM 8113 (HILLEBRANDT 711210/4).
7. Left valve, exterior view; Late Sinemurian of Quebrada Larga (HILLEBRANDT & SCHMIDT-EFFING 1981: 18); x 1. - SNGM 8114 (HILLEBRANDT 670219/3).
8. Left valve, interior view; Late Sinemurian of Quebrada Noria (HILLEBRANDT & SCHMIDT-EFFING 1981: 20); x 1. - SNGM 8115 (HILLEBRANDT 670220/7).

Figs. 9-10. *Gryphaea (Gryphaea) cf. dumortieri* JOLY 1907

9. Articulated specimen; a: left valve view; b: right valve view; Early Pliensbachian of Quebrada Vaca Muerta; x 1.5. - SNGM 8116 (HILLEBRANDT 661126/3).
10. Articulated specimen; a: left valve view; b: right valve view; Early Pliensbachian of Quebrada Vaca Muerta; x 1.5. - SNGM 8117 (HILLEBRANDT 661126/3).

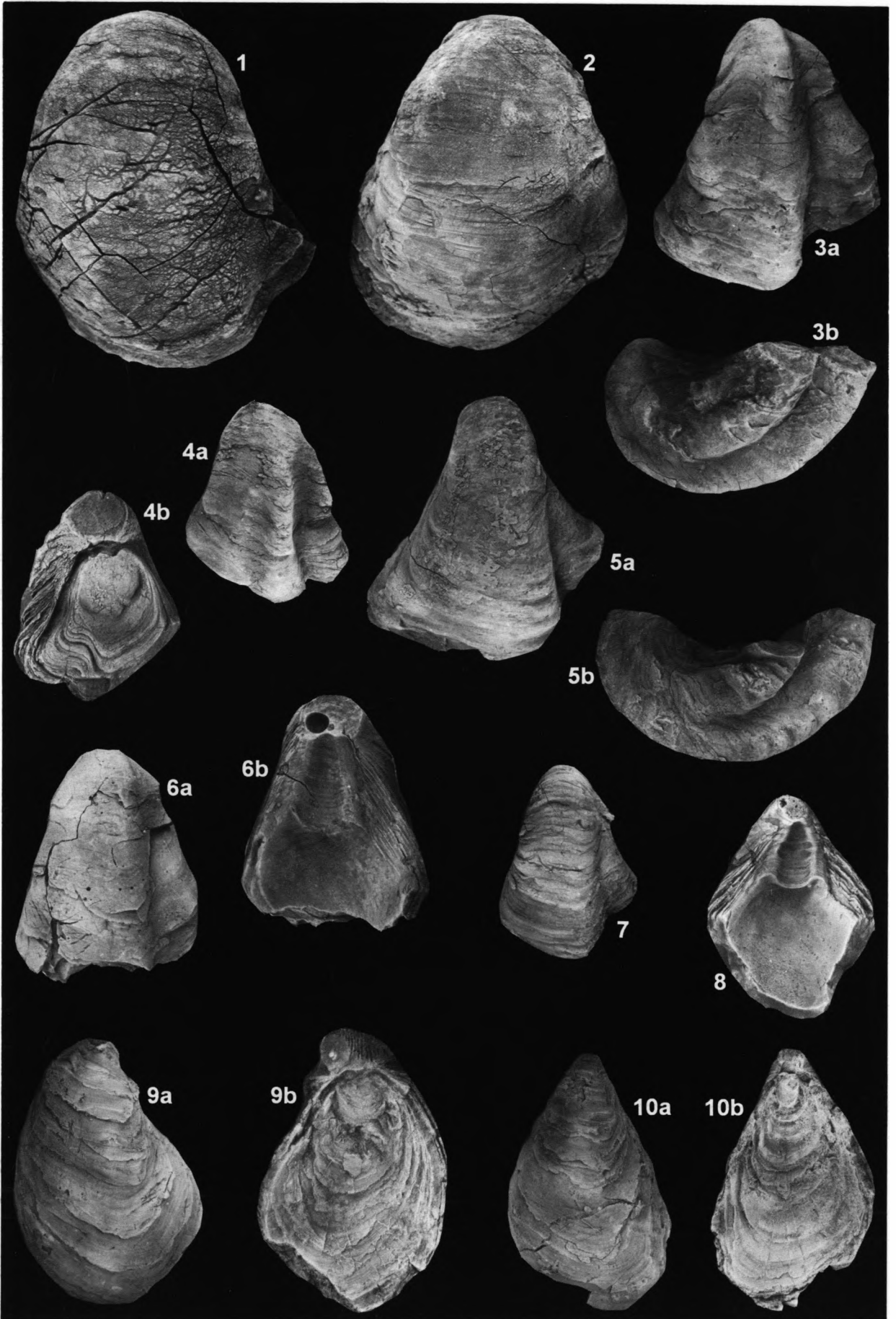


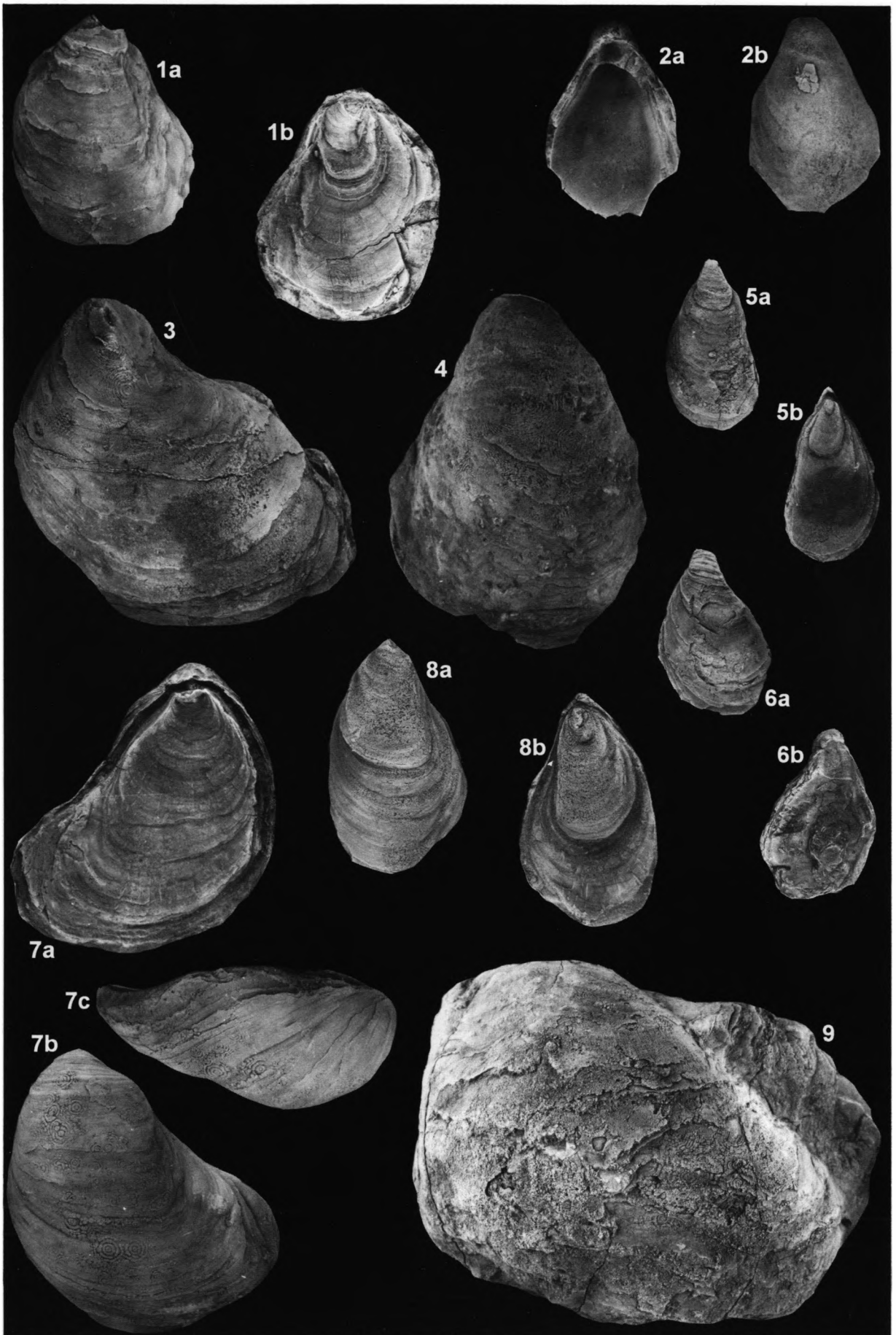
Plate 14

Figs. 1-8. *Gryphaea (Gryphaea) cf. dumortieri* JOLY 1907

1. Articulated specimen; a: left valve view; b: right valve view; Early Pliensbachian of Quebrada Vaca Muerta; x 1.5. - SNGM 8118 (HILLEBRANDT 661126/3).
2. Left valve; a: interior view; b: exterior view; Early Pliensbachian of Quebrada Vaca Muerta; x 1.5. - SNGM 8119 (HILLEBRANDT 661126/3).
3. Left valve; Early Pliensbachian of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 7; fig. 3, below hor. 1); x 1.5. - SNGM 8120 (HILLEBRANDT 660708/7).
4. Left valve; Early Pliensbachian of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 7; fig. 3, below hor. 1); x 1.5. - SNGM 8121 (HILLEBRANDT 660708/7).
5. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Cerro Salto del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 1); x 1.5. - SNGM 8122 (HILLEBRANDT 670107/1).
6. Left valve; a: exterior view; b: interior view; Late Sinemurian of Cerro Salto del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 1); x 1.5. - SNGM 8123 (HILLEBRANDT 670107/1).
7. Articulated specimen; a: right valve view; b: left valve view; c: anterior view; Late Sinemurian of Cerro Salto del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 1); x 1.5. - SNGM 8124 (HILLEBRANDT 670107/1).
8. Articulated specimen; a: left valve view; b: right valve view; Pliensbachian west of Quebrada de la Iglesia; x 1.5. - SNGM 8125 (HILLEBRANDT 670115/2).

Fig. 9. *Gryphaea (Bilobissa) latior* STEINMANN 1929

9. Left valve; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-81); x 1. - SNGM 8126.



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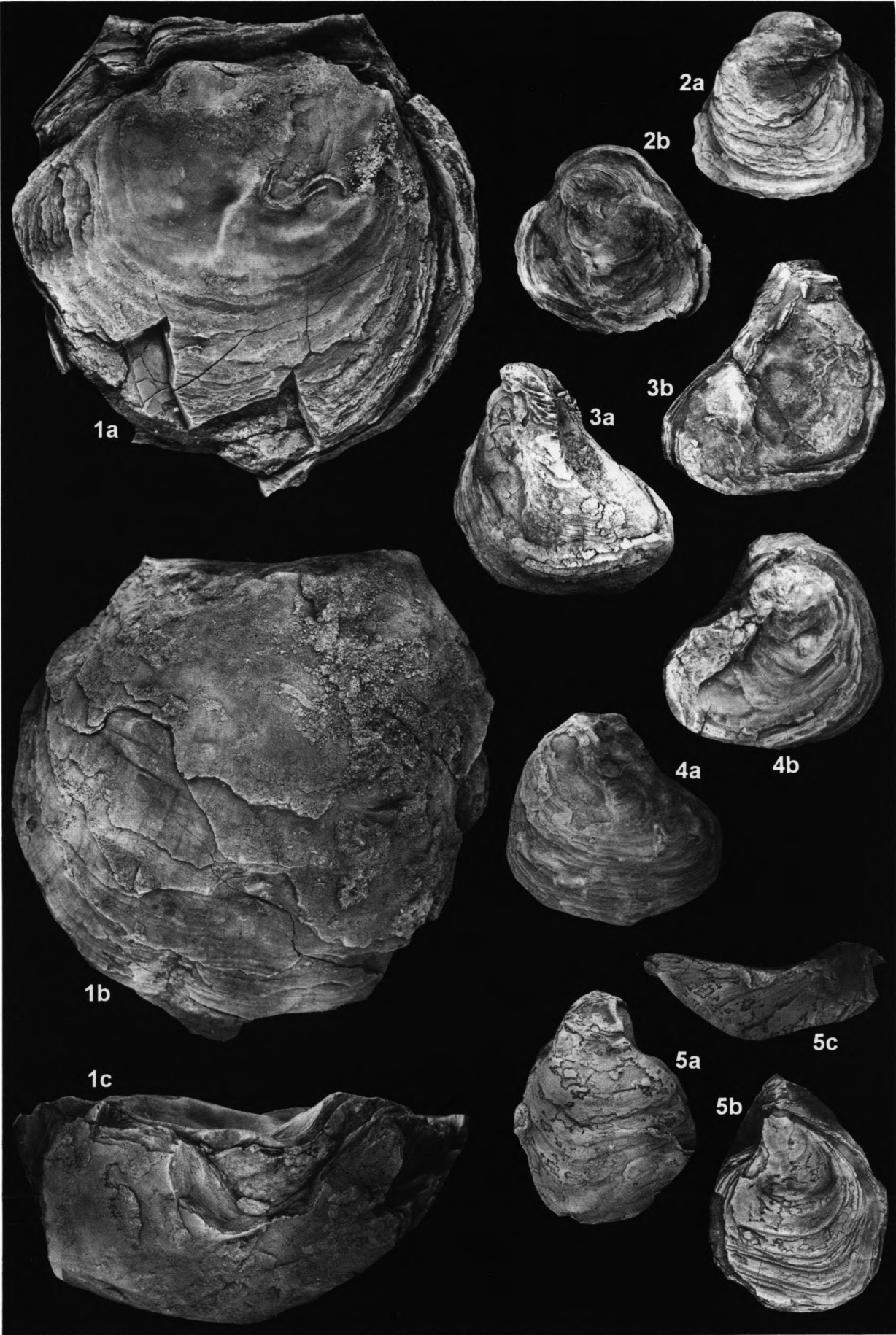
Plate 15

Fig. 1. *Gryphaea (Bilobissa) latior* STEINMANN 1929

1. Articulated specimen; a: right valve view; b: left valve view; c: posterior view; Late Pliensbachian of Quebrada Pinte; x 1. - SNGM 8127.

Figs. 2-5. *Exogyra (Exogyra)* sp. indet.

2. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8128.
3. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8129.
4. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8130.
5. Articulated specimen; a: left valve view; b: right valve view; c: anterior view; Late Sinemurian east of Quebrada El Carbon; x 1. - SNGM 8131 (HILLEBRANDT 661012/2).



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Plate 16

Figs. 1-6. *Gryphaea (Gryphaea)* sp. indet.

1. Articulated specimen; a: left valve view; b: right valve view; c: posterior view; Late Toarcian of Quebrada La Titora; x 1. - SNGM 8132.
2. Articulated specimen; a: left valve view; b: right valve view; Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-b); x 1. - SNGM 8133.
3. Left valve; Toarcian of Quebrada Pinte; x 1. - SNGM 8134 (HILLEBRANDT 670912/3).
4. Articulated specimen; a: left valve view; b: right valve view; Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-a); x 1. - SNGM 8135.
5. Articulated specimen; a: left valve view; b: anterior view; Toarcian of Quebrada La Titora (ABERHAN 1992: app. I + III, hor. 5-2); x 1. - SNGM 8136.
6. Articulated specimen; a: left valve view; b: right valve view and view of ligamental area of left valve; Toarcian of Quebrada La Titora (ABERHAN 1992: app. I + III, hor. 5-2); x 1. - SNGM 8137.

Figs. 7-9. *Otapiria neuquensis* DAMBORENEA 1987

7. Internal mould of left valve; Late Sinemurian of Quebrada Incaguasi; x 1. - SNGM 8138 (HILLEBRANDT 660725/6).
8. Slab with several specimens; Late Sinemurian of Quebrada Incaguasi; x 1. - SNGM 8139 (HILLEBRANDT 660725/6).
9. Slab with three left valves; Late Sinemurian of Quebrada Incaguasi; x 1. - SNGM 8140 (HILLEBRANDT 660725/6).

Fig. 10. *Oxytoma (Palmoxytoma)* sp. indet.

10. Left valve; Middle or Late Hettangian of Quebrada Cachina; x 1. - SNGM 8141 (HILLEBRANDT 841112/2).

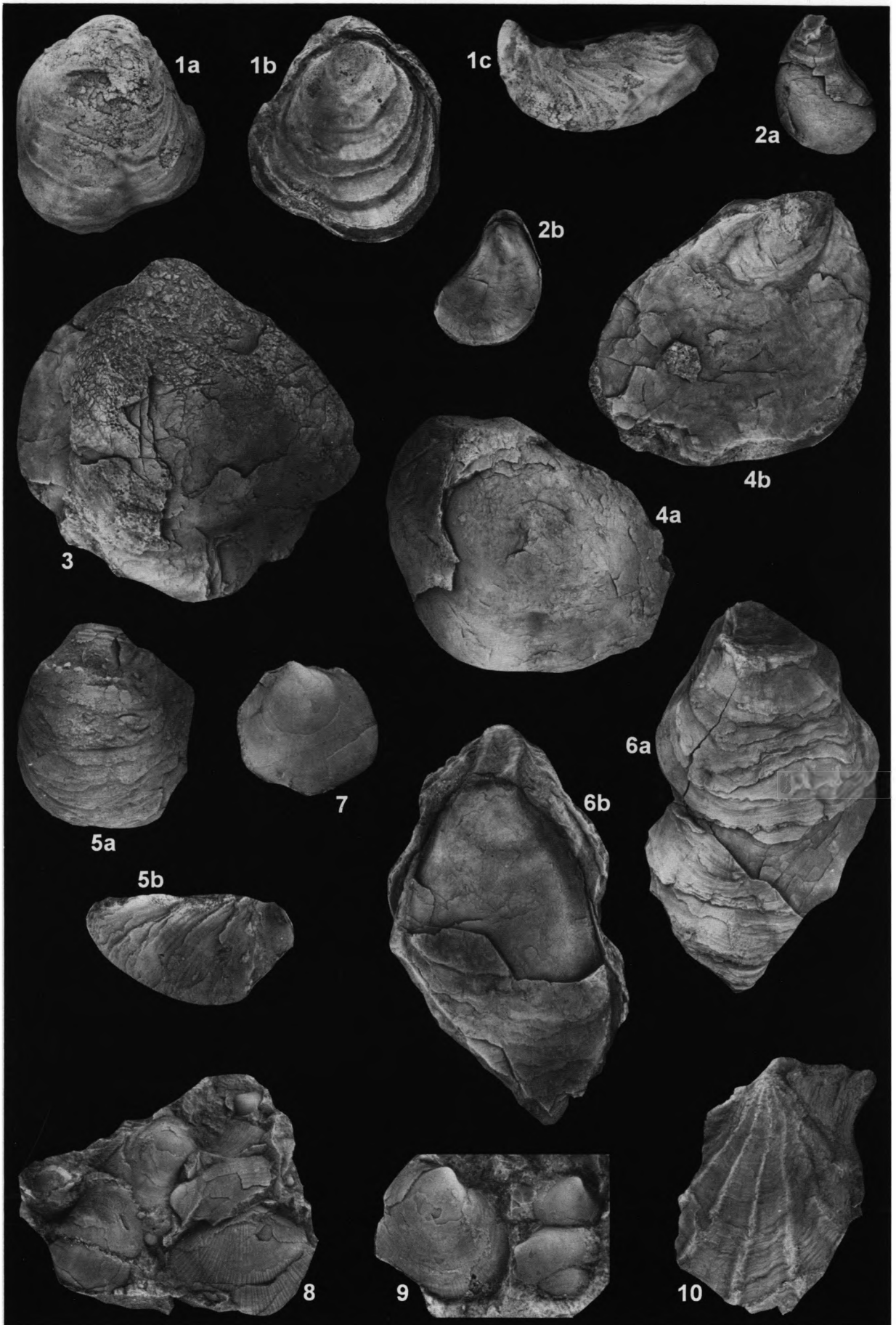


Plate 17

Figs. 1-5. *Oxytoma (Oxytoma) inequivalvis* (J. SOWERBY 1819)

1. Internal mould of left valve; Middle Hettangian of Quebrada Bonita; x 1.5. - SNGM 8142 (HILLEBRANDT 830311/6).
2. Left valve; Early Sinemurian of Posado de los Hidalgos (QUINZIO 1987: figs. 8-9, hor. Cf-45); x 1.5. - SNGM 8143.
3. Left valve; Early Sinemurian of Posado de los Hidalgos (QUINZIO 1987: figs. 8-9, hor. Cf-45); x 1.5. - SNGM 8144.
4. Internal mould of left valve; Early Hettangian of Quebrada San Juan; x 1.5. - SNGM 8145 (HILLEBRANDT 841115/7).
5. Left valve; Early Sinemurian of Posado de los Hidalgos (QUINZIO 1987: figs. 8-9, hor. Cf-45); x 1.5. - SNGM 8146.

Figs. 6-8. *Placunopsis radiata* (PHILLIPS 1829)

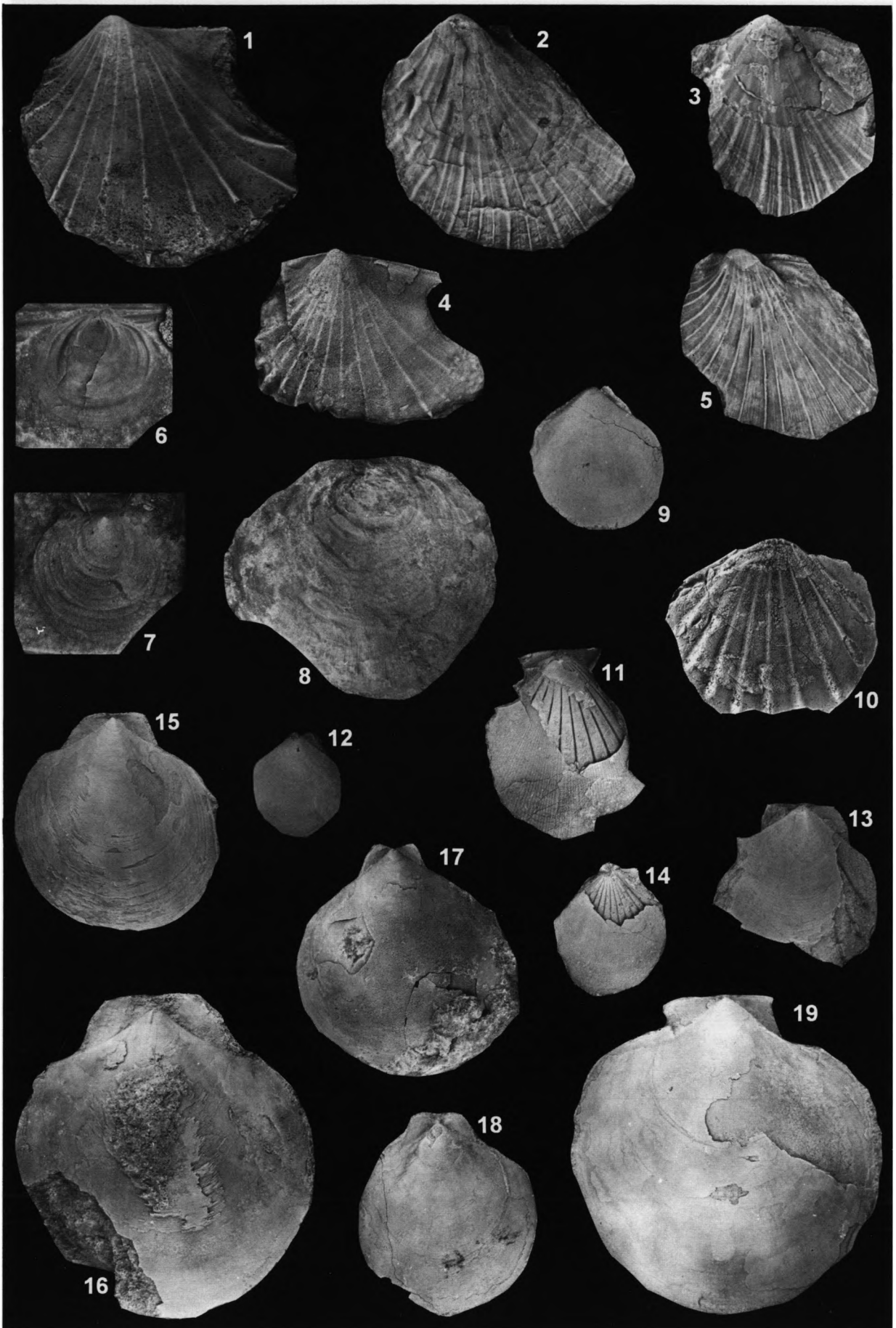
6. External mould of right valve; Early Pliensbachian of Salar de Pedernales; x 1. - SNGM 8147.
7. Composite mould of left valve; Early Pliensbachian of Salar de Pedernales; x 1. - SNGM 8148.
8. Left valve; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 2-81 B2); x 1. - SNGM 8149.

Figs. 9-14. *Propeamusium (Propeamusium) pumilum* (LAMARCK 1819)

9. Right valve; Early Toarcian of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 3; fig. 3, hor. 4); x 2. - SNGM 8150 (HILLEBRANDT 660707/15).
10. Interior view of shell; Pliensbachian or Early Toarcian south of Vega Redonda; x 2. - SNGM 8151 (HILLEBRANDT 720130/1).
11. Internal mould and shell exterior of left valve; Middle Toarcian of Río Jorquera; x 2. - SNGM 8152 (HILLEBRANDT 720108/3).
12. Left valve; Early Toarcian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: 22 (sec. at Vegas de Chañar), fig. 9, ± hor. 7); x 2. - SNGM 8153 (HILLEBRANDT 670118/3).
13. Left valve; Early Toarcian of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 3, hor. 4); x 2. - SNGM 8154 (HILLEBRANDT 660707/15).
14. Internal mould and shell exterior of left valve; Early or Middle Toarcian of Río Pulido; x 2. - SNGM 8155 (HILLEBRANDT 680108/4a).

Figs. 15-19. *Entolium (Entolium) corneolum* (YOUNG & BIRD 1828)

15. ?Right valve; Early/Late Pliensbachian of Portezuelo de Pedernales (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 16); x 1. - SNGM 8156 (HILLEBRANDT 660710/2).
16. Right valve; Early Toarcian of Quebrada Pinte; x 1. - SNGM 8157.
17. Right valve; Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 7-14); x 1. - SNGM 8158.
18. Right valve; Early Pliensbachian of Quebrada Pinte; x 1. - SNGM 8159.
19. Left valve; Middle or Late Hettangian of Quebrada Cachina; x 1. - SNGM 8160 (HILLEBRANDT 860318/7a).



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Plate 18

Figs. 1-6. *Agerchlamys wunschae* (MARWICK 1953)

1. Composite mould of right valve; Middle Hettangian of Quebrada Cachina; x 1. - SNGM 8161 (HILLEBRANDT 841112/1).
2. Composite mould of right valve; Middle Hettangian of Quebrada Cachina; x 1. - SNGM 8162 (HILLEBRANDT 841112/1).
3. Composite mould of ?right valve; Middle Hettangian of Quebrada Cachina; x 1. - SNGM 8163 (HILLEBRANDT 841112/10).
4. Left valve; Late Hettangian of Quebrada Bonita (QUINZIO 1987: figs. 24-25, hor. QB-8); x 2. - SNGM 8164.
5. Left valve; Late Hettangian of Aguada Alto de Varas (QUINZIO 1987: fig. 21, hor. AV-14); x 2. - SNGM 8165.
6. Composite mould of right valve; Middle Hettangian of Quebrada Cachina; x 1. - SNGM 8166 (HILLEBRANDT 841112/10).

Figs. 7-9. *Camptonectes (Camptonectes) auritus* (SCHLOTHEIM 1813)

7. Articulated specimen; a: right valve view; b: left valve view; Toarcian of Quebrada Pinte; x 1.5. - SNGM 8167.
8. Left valve; Toarcian of Quebrada La Totorá (ABERHAN 1992: app. I + III, hor. 5-2); x 1.5. - SNGM 8168.
9. Left valve; Aalenian of Quebrada Pinte; x 1.5. - SNGM 8169 (HILLEBRANDT 670912/7).

Fig. 10. *Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820)

10. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8170 (HILLEBRANDT 670910/8).

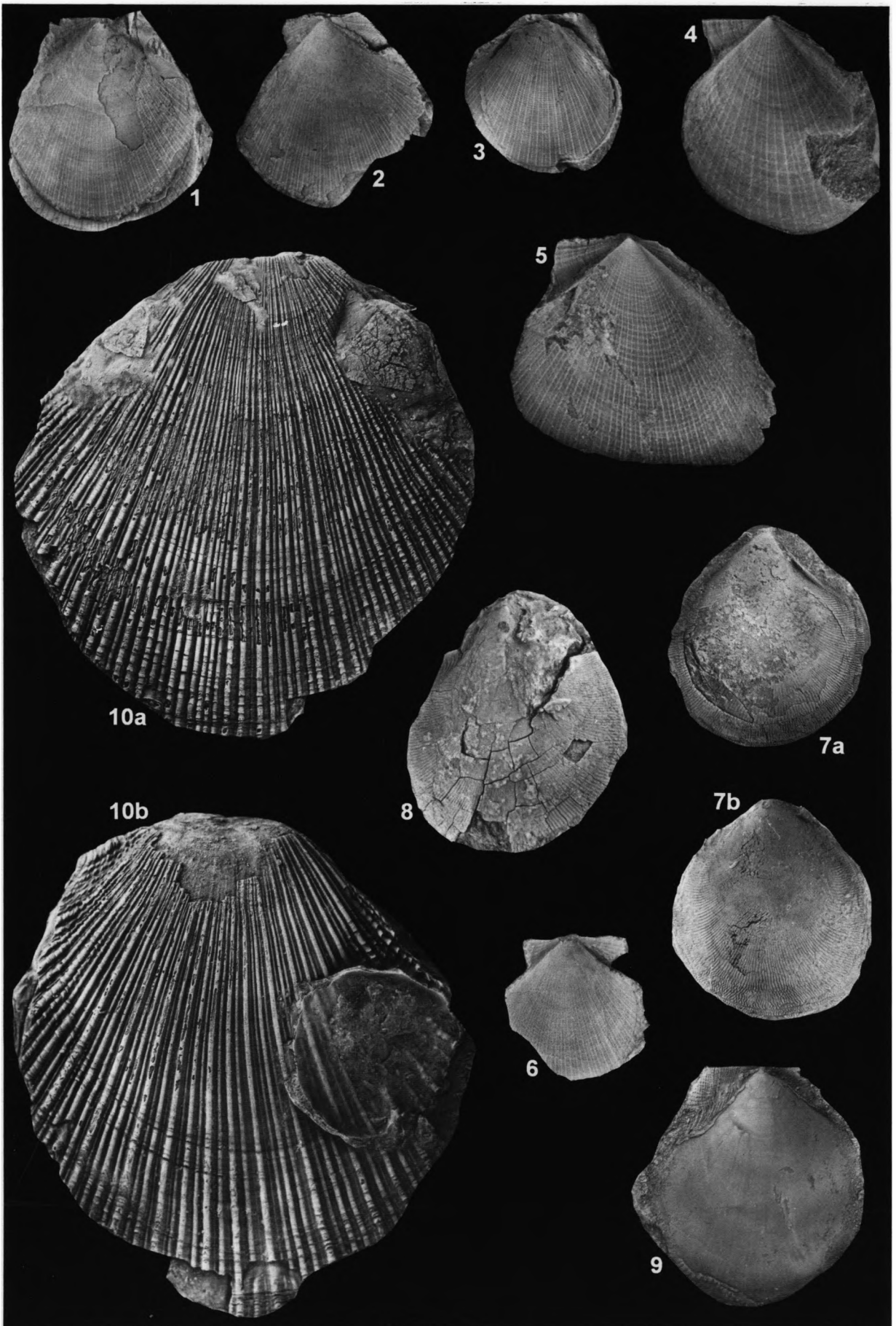


Plate 19

Figs. 1-6. *Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820)

1. Articulated specimen; a: left valve view; b: right valve view; Toarcian/Aalenian north of Portezuelo de Pedernales; x 1. - SNGM 8171 (HILLEBRANDT 660709/3).
2. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8172.
3. Articulated specimen; a: right valve view; b: left valve view; Early Pliensbachian of Quebrada Larga (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 7, hor. 2); x 1. - SNGM 8173 (HILLEBRANDT 670219/4).
4. Right valve; Late Pliensbachian of Quebrada Asientos; x 1. - SNGM 8174.
5. Left valve; Middle or Late Hettangian of Quebrada Cachina; x 3. - SNGM 8175 (HILLEBRANDT 860319/2).
6. Articulated specimen; a: left valve view; b: right valve view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8176 (HILLEBRANDT 670913/1).

Figs. 7-9. *Chlamys (Chlamys) valoniensis* (DEFrance 1825)

7. Left valve and interior mould; Early Hettangian south of Sierra Minillas (QUINZIO 1987: fig. 16, hor. CCPA-4); x 1. - SNGM 8177.
8. Right valve; Early Hettangian south of Sierra Minillas (HILLEBRANDT 1990: fig. 3, sec. a, hor. with *Psiloceras rectocostatum*); x 1. - SNGM 8178 (HILLEBRANDT 860320/1).
9. Right valve and internal mould; Early Hettangian south of Sierra Minillas (QUINZIO 1987: fig. 16, ± hor. CCPA-4; HILLEBRANDT 1990: fig. 3. ± hor. with *Psiloceras rectocostatum*); x 1. - SNGM 8179 (HILLEBRANDT 871122/8).

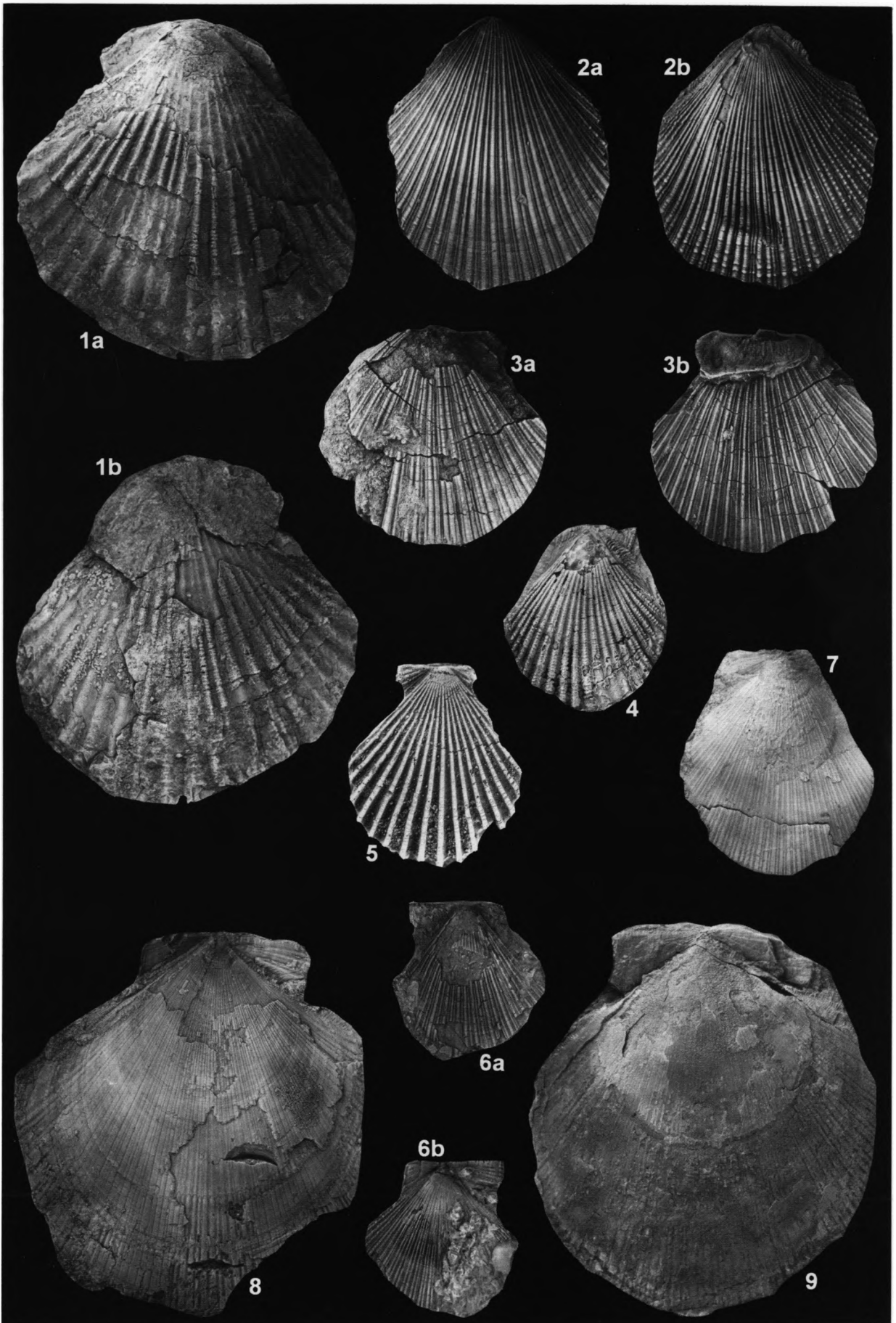


Plate 20

Figs. 1-2, 4, 7. *Eopecten abjectus* (PHILLIPS 1829)

1. Articulated specimen; a: left valve view; b: right valve view; Aalenian of Río Pulido; x 0.8. - SNGM 8180 (HILLEBRANDT 680227/1).
2. Left valve of articulated specimen; Late Toarcian of Quebrada La Totorá; x 1. - SNGM 8181 (HILLEBRANDT 671010/8).
4. Left valve of articulated specimen; Aalenian of Quebrada Larga (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 7, hor. 12); x 1. - SNGM 8182 (HILLEBRANDT 680222/4).
7. Articulated specimen; a: left valve view; b: right valve view; Aalenian of Cerro Salto del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 12); x 1. - SNGM 8183 (HILLEBRANDT 670108/1).

Fig. 3. pectinid gen. et sp. indet.

3. Articulated specimen; a: left valve view; b: right valve view; Early Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I, hor. 1-118); x 1.5. - SNGM 8184.

Figs. 5-6. *Radulonectites sosneadoensis* (WEAVER 1931)

5. Right valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-27); x 1.5. - SNGM 8185.
6. Right valve; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-26); x 1.5. - SNGM 8186.



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Figs. 1, 5. *Eopecten abjectus* (PHILLIPS 1829)

1. Articulated specimen; a: left valve view; b: right valve view; Late Toarcian of Quebrada southeast of Hacienda Manflas (HILLEBRANDT & WESTERMANN 1985: 10, fig. 4, loc. 2, Cerro de la Cuesta); x 1. - SNGM 8187 (HILLEBRANDT 661202/6).
5. Left valve; Toarcian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-45); x 1. - SNGM 8188.

Figs. 2, 6-7. *Eopecten velatus* (GOLDFUSS 1833)

2. Left valve; ?Pliensbachian west of Quebrada de las Pircas; x 1. - SNGM 8189 (HILLEBRANDT 711219/3).
6. Composite mould and shell of left valve; Middle or Late Hettangian of Quebrada Cachina; x 1. - SNGM 8190 (HILLEBRANDT 860318/6a).
7. Left valve; Aalenian of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 1; fig. 3, hor. 12); x 1. - SNGM 8191 (HILLEBRANDT 670306/11).

Figs. 3-4. *Eopecten?* sp. indet.

3. ?Left valve; Early Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-147); x 0.8. - SNGM 8192.
4. ?Left valve; Early Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-147); x 0.8. - SNGM 8193.



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Plate 22**Figs. 1-3. *Weyla (Weyla) alata* (VON BUCH 1838)**

1. Articulated specimen; a: right valve view; b: left valve view; c: posterior view; d: dorsal view; Late Sinemurian or Early Pliensbachian of Río del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 1); x 1. - SNGM 8194 (HILLEBRANDT 670109/7).
2. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada east of Hacienda Manflas; x 1. - SNGM 8195 (HILLEBRANDT 680130/1).
3. Articulated specimen; a: right valve view; b: left valve view; c: posterior view; d: dorsal view; Early Pliensbachian north of Juntas del Tolar (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 4); x 1. Figured by HILLEBRANDT (1980: pl. 1, fig. 1a-c). - SNGM 8196 (HILLEBRANDT 670109/3).

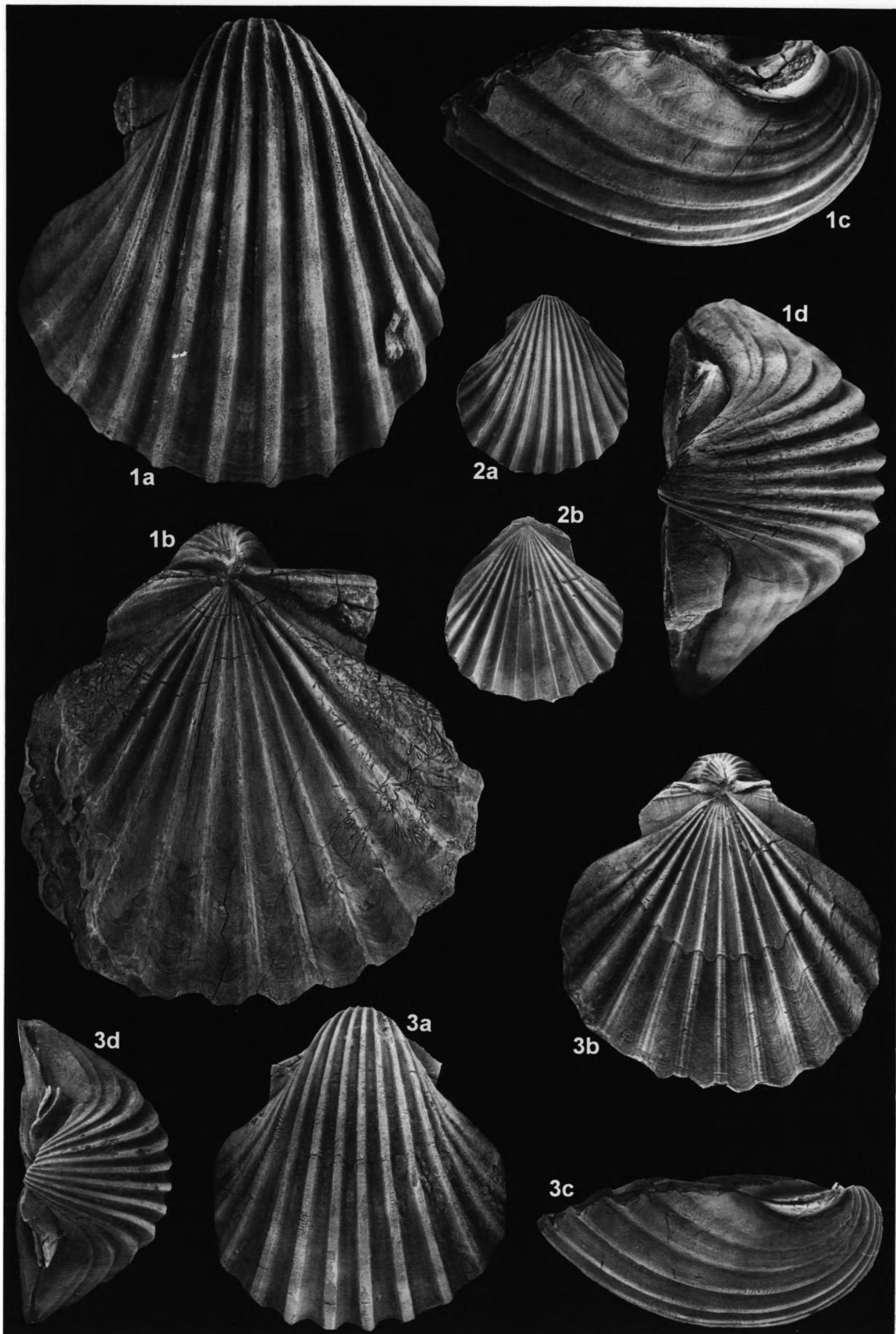


Plate 23**Figs. 1-2. *Weyla (Weyla) alata* (VON BUCH 1838)**

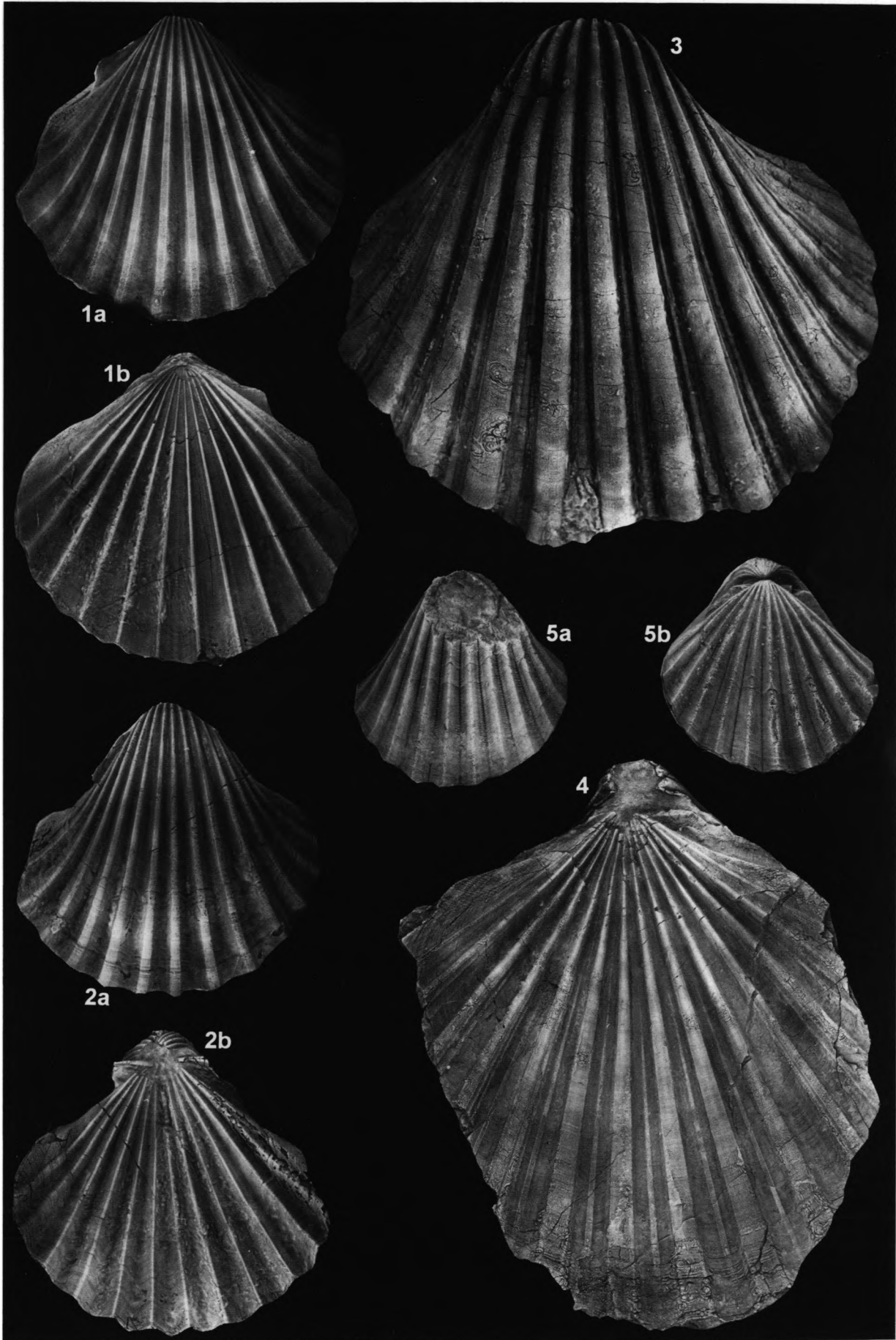
1. Articulated specimen; a: right valve view; b: left valve view; Early Toarcian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: 23, sec. 2.5 km west of La Guardia, above Las Banderitas); x 1. - SNGM 8197 (HILLEBRANDT 720108/2).
2. Articulated specimen; a: right valve view; b: left valve view; Pliensbachian between Quebrada El Carbon and Quebrada de Paipote; x 1. - SNGM 8198 (HILLEBRANDT 661012/9).

Figs. 3-4. *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891)

3. Articulated specimen, right valve view; Late Pliensbachian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 3-26); x 0.8. - SNGM 8199.
4. Articulated specimen, left valve view; Late Pliensbachian of Quebrada Pinte; x 0.8. - SNGM 8200.

Fig. 5. *Weyla (Lywea) unca* (R. PHILIPPI 1899)

5. Articulated specimen; a: right valve view; b: left valve view; Early Pliensbachian of Quebrada Vaca Muerta; x 1. - SNGM 8201 (HILLEBRANDT 661126/5).



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Plate 24**Fig. 1.** *Weyla (Lywea) aff. unca* (R. PHILIPPI 1899)

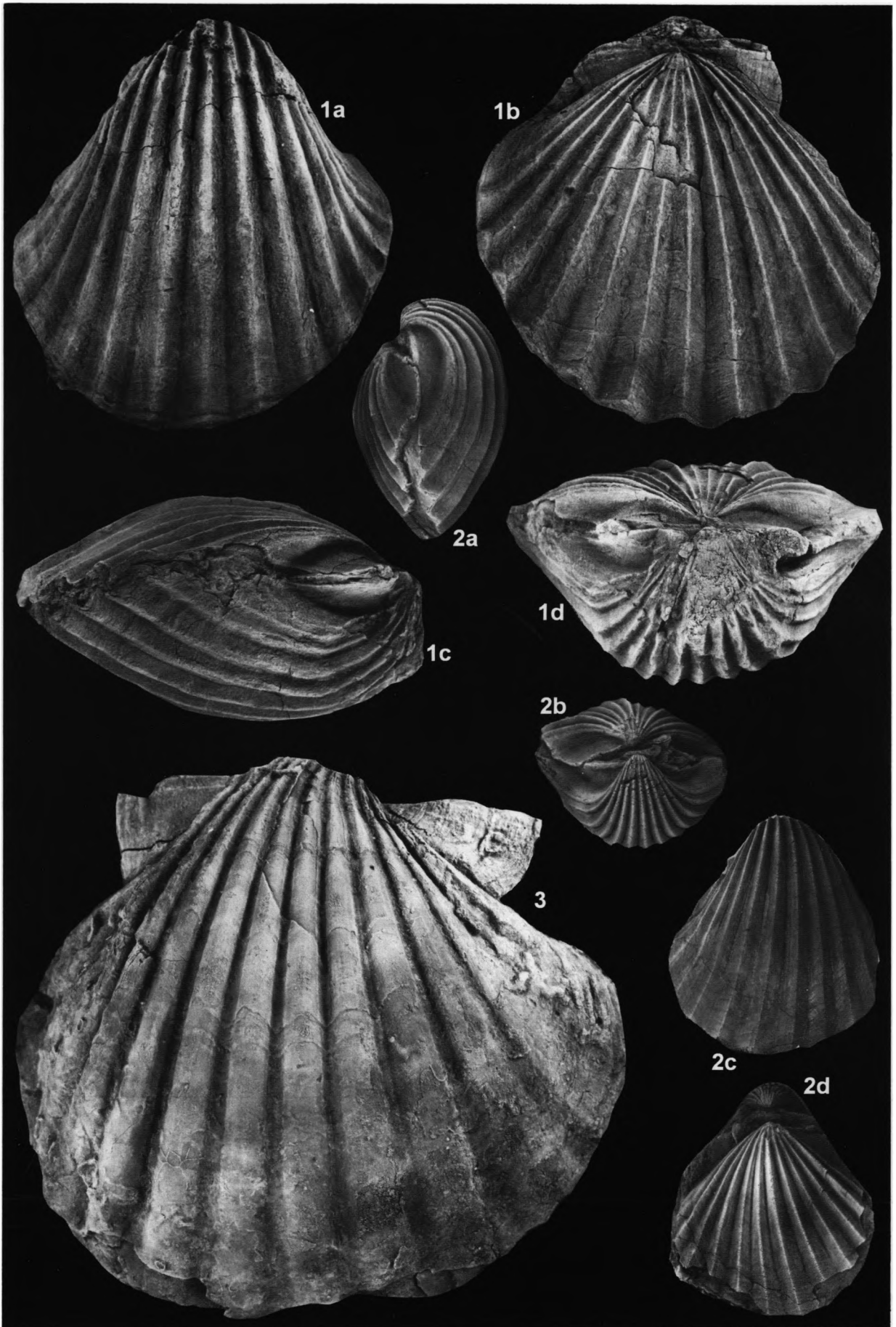
1. Articulated specimen; a: right valve view; b: left valve view; c: posterior view; d: dorsal view; Late Sinemurian or Early Pliensbachian of Río del Toro (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 10, hor. 1); x 1. - SNGM 8202 (HILLEBRANDT 670109/7).

Fig. 2. *Weyla (Lywea) unca* (R. PHILIPPI 1899)

2. Articulated specimen; a: posterior view; b: dorsal view; c: right valve view; d: left valve view; Early Pliensbachian of Quebrada Vaca Muerta; x 1. - SNGM 8203 (HILLEBRANDT 661126/5).

Fig. 3. *Weyla (Weyla) titan* (MÓRICKE 1894)

3. Right valve; Early Pliensbachian of Quebrada El Peñon (see faunal list in HILLEBRANDT & SCHMIDT-EFFING 1981: 12); x 0.8. - SNGM 8204 (HILLEBRANDT 790118/1).



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Plate 25**Fig. 1. *Weyla (Weyla) titan* (MÖRICKE 1894)**

1. Articulated specimen; a: right valve view; b: left valve view; Late Pliensbachian of Quebrada Asientos; x 0.8. - SNGM 8205.

Fig. 2. *Weyla (Lywea) unca* (R. PHILIPPI 1899)

2. Articulated specimen; a: right valve view; b: left valve view; c: anterior view; d: dorsal view; Early Pliensbachian of Quebrada Vaca Muerta; x 1. - SNGM 8206 (HILLEBRANDT 661126/5).

Figs. 3-4. *Weyla (Lywea?)* sp. indet.

3. Single valve; Middle Hettangian of Cerros de Cuevitas (HILLEBRANDT 1990: fig. 2, most likely hor. with ?*Euphyllites* and ?*Caloceras*); x 1. - SNGM 8207 (HILLEBRANDT 871114/7).

4. Single valve; Middle Hettangian of Cerros de Cuevitas (± same hor. as in Pl. 25, Fig. 3); x 1. - SNGM 8208 (HILLEBRANDT 871215/3).

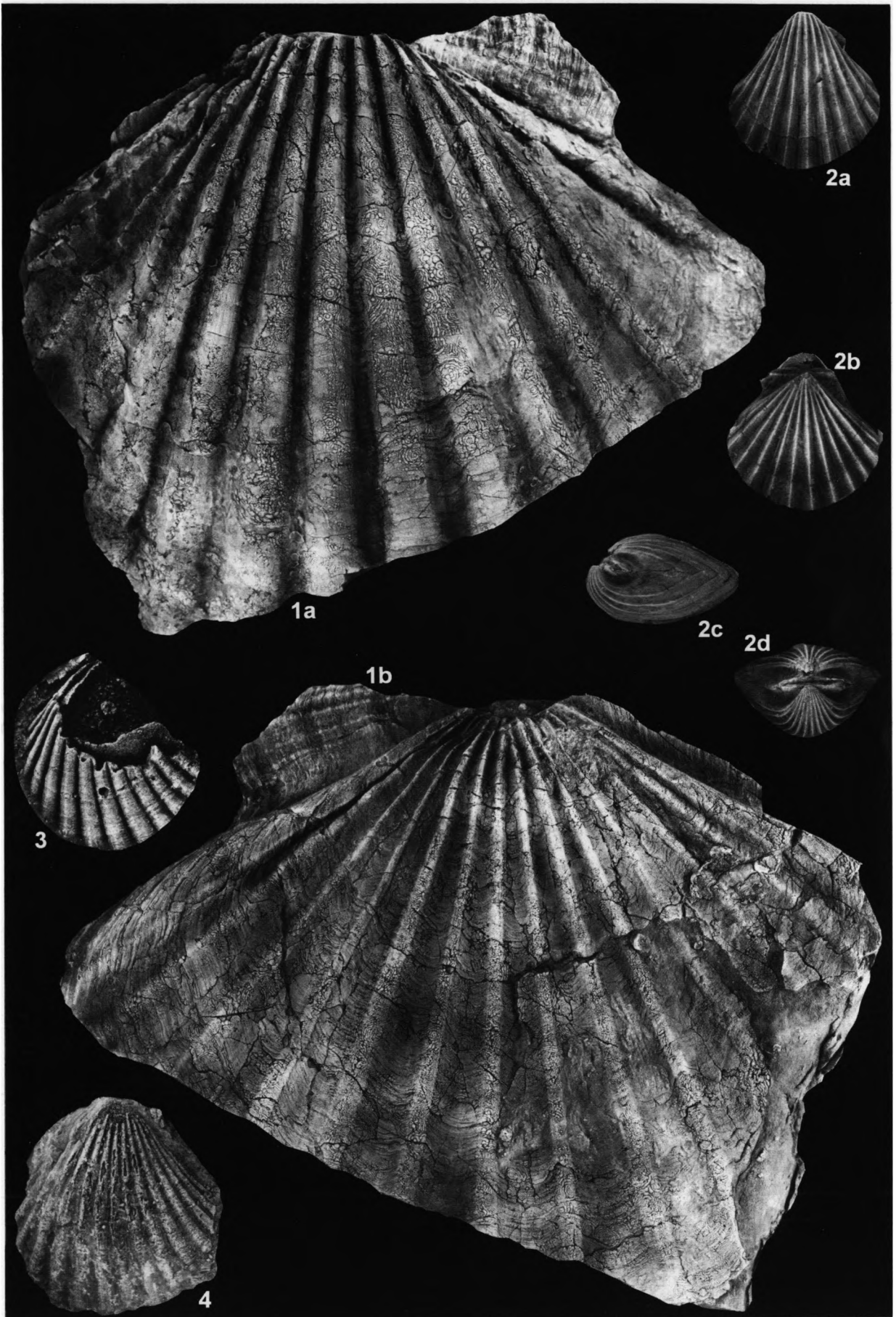


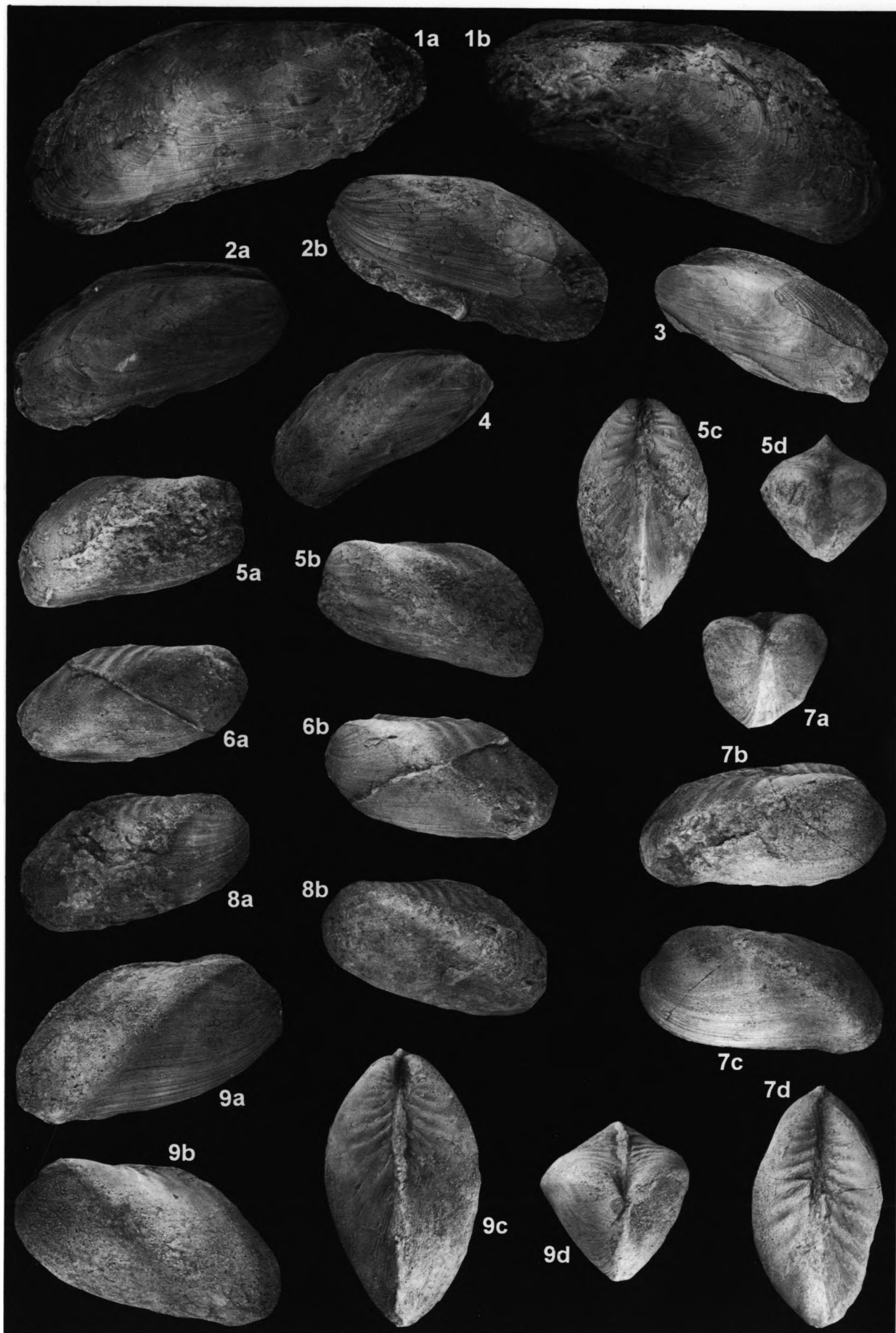
Plate 26

Figs. 1-4. *Modiolus (Modiolus) baylei* (R. PHILIPPI 1899)

1. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-54); x 1. - SNGM 8209.
2. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-26); x 1. - SNGM 8210.
3. Articulated specimen, left valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-18); x 1. - SNGM 8211.
4. Internal mould of right valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-26); x 1. - SNGM 8212.

Figs. 5-9. *Modiolus (Modiolus) chilensis* sp. nov.

5. Paratype, internal mould and shell of articulated specimen; a: right valve view; b: left valve view; c: dorsal view; d: anterior view; Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 3, hor. 1); x 1. - SNGM 8213 (HILLEBRANDT 660708/1).
6. Paratype, internal mould and shell of articulated specimen; a: right valve view; b: left valve view; Early/Late Pliensbachian of Quebrada Asientos (ABERHAN 1992: app. I + III, hor. 7-14); x 1. - SNGM 8214.
7. Paratype, internal mould and shell of articulated specimen; a: anterior view; b: right valve view; c: left valve view; d: dorsal view; Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 3, hor. 1); x 1. - SNGM 8215 (HILLEBRANDT 660708/1).
8. Paratype, internal mould and shell of articulated specimen; a: right valve view; b: left valve view; Pliensbachian of Quebrada Pinte; x 1. - SNGM 8216.
9. Holotype, internal mould and shell of articulated specimen; a: right valve view; b: left valve view; c: dorsal view; d: anterior view; Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 7; fig. 3, hor. 1); x 1. - SNGM 8217 (HILLEBRANDT 660708/8).



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Plate 27

Figs. 1-5. *Modiolus (Modiolus) gerthi* DAMBORENEA 1987

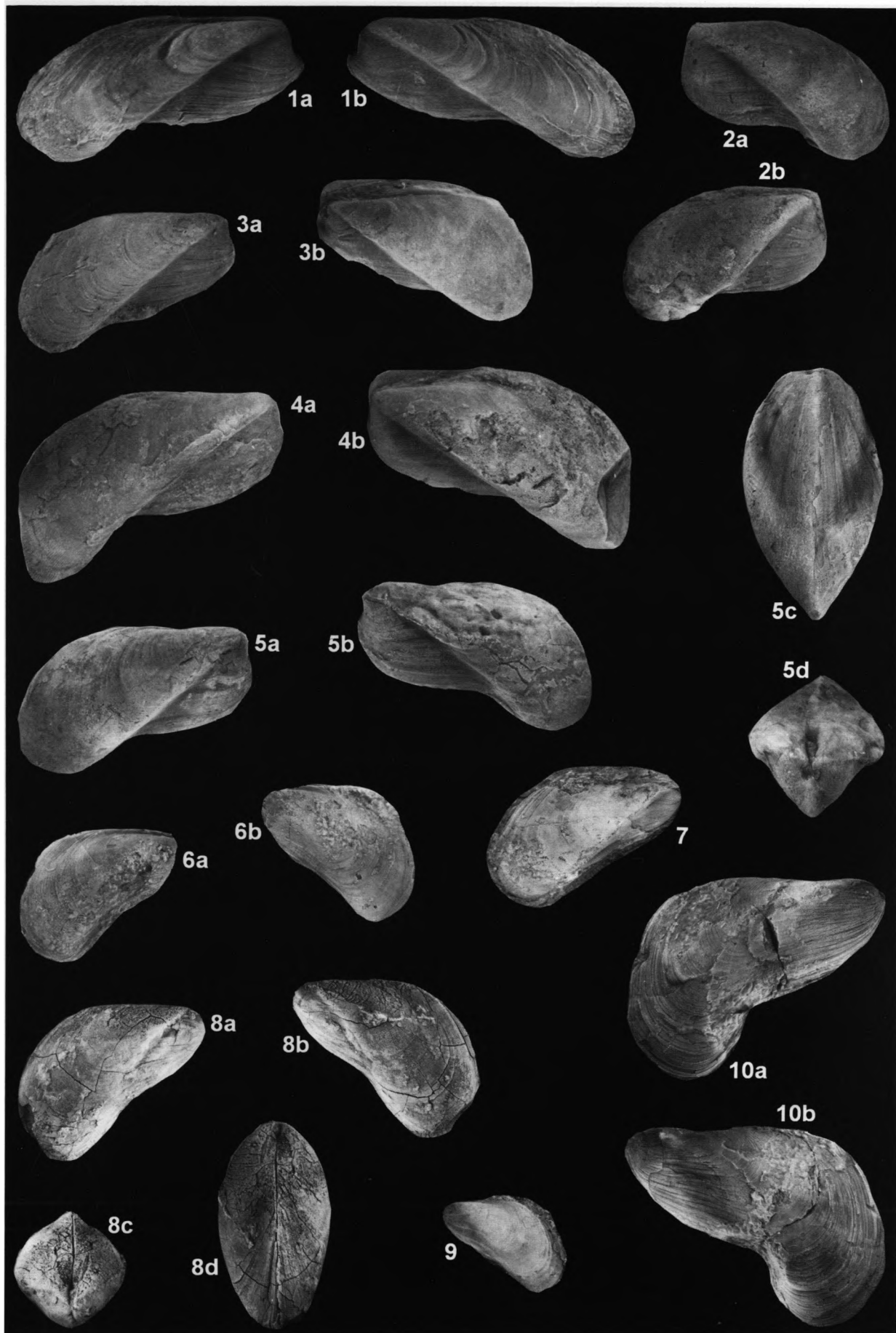
1. Articulated specimen; a: right valve view; b: left valve view; Middle Toarcian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: 23, sec. 2.5 km west of La Guardia, above Las Banderitas); x 1.5. - SNGM 8218 (HILLEBRANDT 720108/4).
2. Articulated specimen; a: left valve view; b: right valve view; Middle Toarcian of Río Jorquera (HILLEBRANDT & SCHMIDT-EFFING 1981: 23, sec. 2.5 km west of La Guardia, above Las Banderitas); x 1.5. - SNGM 8219 (HILLEBRANDT 720108/4).
3. Articulated specimen; a: right valve view; b: left valve view; Middle Toarcian of Quebrada El Bolito (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 5, hor. 7); x 1.5. - SNGM 8220 (HILLEBRANDT 670222/7).
4. Articulated specimen; a: right valve view; b: left valve view; Middle Toarcian of Quebrada El Bolito (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 5, hor. 7); x 1.5. - SNGM 8221 (HILLEBRANDT 670222/7).
5. Internal mould and shell of articulated specimen; a: right valve view; b: left valve view; c: ventral view; d: anterior view; Middle Toarcian of Quebrada El Bolito (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 5, hor. 7); x 1.5. - SNGM 8222 (HILLEBRANDT 670222/7).

Figs. 6-9. *Modiolus (Modiolus) giganteus* QUENSTEDT 1857

6. Articulated specimen; a: right valve view; b: left valve view; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-67); x 1. - SNGM 8223.
7. Right valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 1-44); x 1. - SNGM 8224.
8. Articulated specimen; a: right valve view; b: left valve view; c: anterior view; d: dorsal view; Late Sinemurian of Quebrada Pinte; x 1. - SNGM 8225 (HILLEBRANDT 670913/2).
9. Internal mould of left valve; Late Sinemurian of Quebrada Pinte (ABERHAN 1992: app. I + III, hor. 4-31 B2); x 1. - SNGM 8226.

Fig. 10. *Modiolus (Modiolus) imbricatus* J. SOWERBY 1818

10. Articulated specimen; a: right valve view; b: left valve view; Toarcian of Quebrada La Titora (ABERHAN 1992: app. I + III, hor. 5-2); x 1. - SNGM 8227.



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Plate 28

Fig. 1. *Modiolus (Modiolus) imbricatus* J. SOWERBY 1818

1. Articulated specimen; a: right valve view; b: left valve view; c: anterior view; d: dorsal view; Middle/Late Toarcian of Quebrada La Totorá; x 1. - SNGM 8228 (HILLEBRANDT 671010/7).

Figs. 2-5. *Modiolus (Modiolus) cf. scalprum* J. SOWERBY 1821

2. Internal mould of articulated specimen; a: right valve view; b: left valve view; Late Pliensbachian of Quebrada Pinté; x 1. - SNGM 8229.
3. Articulated specimen; a: right valve view; b: left valve view; c: dorsal view; Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 7; fig. 3, hor. 1); x 1. - SNGM 8230 (HILLEBRANDT 660708/8).
4. Internal mould of articulated specimen; a: right valve view; b: left valve view; Late Pliensbachian of Quebrada Pinté (ABERHAN 1992: app. I + III, hor. 3-25); x 1. - SNGM 8231.
5. Internal mould and shell of articulated specimen; a: right valve view; b: left valve view; c: anterior view; d: dorsal view; Early/Late Pliensbachian (*F. fannini*-zone) of Quebrada Asientos (HILLEBRANDT & SCHMIDT-EFFING 1981: fig. 2, sec. 7; fig. 3, hor. 1); x 1. - SNGM 8232 (HILLEBRANDT 660708/8).



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