Gilbert Dennison Harris
(1864 - 1952)

Founder of the *Bulletins of American Paleontology* (1895)

ISBN 0-87710-421

PALEONTOLOGICAL RESEARCH INSTITUTION
FOUNDED 1932

Bulletins of American Paleontology

Begun in 1895

VOLUME 105, NUMBER 343 OCTOBER 20, 1993

Jurassic and Cretaceous Trigoniid Bivalves from West-Central Argentina

by

Hector A. Leanza

Paleontological Research Institution
1259 Trumansburg Road
Ithaca, New York, 14850 U.S.A.

BULLETINS OF AMERICAN PALEONTOLOGY
and
PALAEONTOGRAPHICA AMERICANA

A list of titles in both series, and available numbers and volumes may be had on request. Volumes 1–23 of *Bulletins of American Paleontology* have been reprinted by Kraus Reprint Corporation, Route 100, Millwood, New York 10546 USA. Volume 1 of *Palaeontographica Americana* has been reprinted by Johnson Reprint Corporation, 111 Fifth Ave., New York, NY 10003 USA.

Subscriptions to *Bulletins of American Paleontology* may be started at any time, by volume or year. Current price is US $45.00 per volume. Numbers of *Palaeontographica Americana* are priced individually, and are invoiced separately on request.

for additional information, write or call:

Paleontological Research Institution
1259 Trumansburg Road
Ithaca, NY 14850 USA
(607) 273-6623
FAX (607) 273-6620

PALEONTOLOGICAL RESEARCH INSTITUTION
FOUNDED 1932

Bulletins of American Paleontology

Begun in 1895

VOLUME 105, NUMBER 343 OCTOBER 20, 1993

Jurassic and Cretaceous Trigoniid Bivalves from West-Central Argentina

by

Hector A. Leanza

Paleontological Research Institution
1259 Trumansburg Road
Ithaca, New York, 14850 U.S.A.

ISSN 0007-5779
ISBN 0-87710-430-1
Library of Congress Card Number: 93-085393

Printed in the United States of America
Allen Press, Inc.
Lawrence, KS 66044 U.S.A.

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

JURASSIC AND CRETACEOUS TRIGONIID BIVALVES FROM WEST-CENTRAL ARGENTINA

By

HÉCTOR A. LEANZA[1]

With the contribution of JOSÉ I. GARATE ZUBILLAGA[2]

ABSTRACT

This monograph describes 73 species and 1 subspecies of precisely dated Trigoniidae from the Lower Jurassic (Liassic) to the Upper Cretaceous (Maastrichtian) of western central Argentina. These are classified into 14 subfamilies as follows: Minetrigoniinae, Trigoniinae, Neuquenitrigoniinae, n. subfam., Frenguelliellinae (emend.), Myophorellinae, Vaugoniinae, Steinmanellinae, Anditrigoniinae, n. subfam., Megatrigoniinae, Buchotrigoniinae, n. subfam., Pterotrigoniinae, Laevitrigoniinae, Austrotrigoniinae and Nototrigoniinae. The Frenguelliellinae are reinterpreted to range in age from the Triassic to the Middle Jurassic (Bajocian), and include only the genera *Frenguelliella* and *Kumatrigonia*. Neuquenitrigoniinae, n.subfam., include the very specialized Middle Jurassic genus *Neuquenitrigonia*, which shows a transversely costate flank and escutcheon, characteristics that are absent in Trigoniinae s.s. Anditrigoniinae, n. subfam., is erected to group the Middle Jurassic to Lower Cretaceous genera and subgenera *Eoanditrigonia*, n. subgen., *Anditrigonia*, *Paranditrigonia*, *Antutrigonia*, *Virgotrigonia*, and *Lambertrigonia*, n. gen., which are characterized by an smooth area in early representatives, or by transverse or radial ornamentation, or a combination of both, and a poor to well developed marginal carina. The Buchotrigoniinae, n. subfam. include the very specialized Lower Cretaceous genera *Buchotrigonia* and *Syrotrigonia*, which are characterized by a tripartite development of oblique, subconcentric and subvertical costae on the flank. The treated genera are twenty one, including: *Groeberella*, n. gen. (type species: *Myophoria neuquensis* Groeber, 1924), *Trigonia*, *Frenguelliella*, *Jaworskiella*, *Myophorella*, *Scaphotrigonia*, *Scaphorella*, *Neuquenitrigonia*, *Vaugonia*, *Andivaugonia*, n. gen. (type species: *Trigonia radixscripta* Lambert, 1944), *Steinmanella*, *Virgotrigonia*, *Lambertrigonia*, n. gen. (type species *Trigonia pichimoncolensis* Lambert, 1944), *Anditrigonia*, *Antutrigonia*, *Rutitrigonia*, *Syrotrigonia*, *Pterotrigonia*, *Quoiecchia*, *Austrotrigonia*, and *Pacitrigonia*. The genus *Myophorella* is divided into the subgenera *Myophorella* sensu stricto, *Promyophorella*, and *Haidaia*. The genus *Steinmanella* is represented by the subgenera *Transitrigonia*, *Macrotrigonia*, and *Splenditrigonia*, n. subgen. (type species: *Trigonia splendida* A. F. Leanza, 1941). *Anditrigonia* is represented by *Anditrigonia* sensu stricto, and by an early representative, *Eoanditrigonia*, n. subgen. (type species: *Trigonia keideli* Weaver, 1931). The Upper Jurassic and Cretaceous genus *Pterotrigonia* is divided into the subgenera *Pterotrigonia* sensu stricto, *Scabrotrigonia*, *Rinetrigonia*, and *Notoscabrotrigonia*.

Ten new species and one new subspecies are established, as follows: *Frenguelliella poultoni* (Liassic); *Trigonia losadai*, *Trigonia levyi*, *Frenguelliella perezreyesi*, and *Scaphorella camachoi* (Middle Jurassic); *Myophorella* (*Myophorella*) *schulzi*, *Myophorella* (*Haidaia*) *elguetai*, *Pterotrigonia* (*Notoscabrotrigonia*) *coheni*, and *Anditrigonia* (*A.*) *eximia tesselicaudata* (Upper Jurassic); *Rutitrigonia kauffmani* and *Syrotrigonia brocardoi* (Lower Cretaceous).

Comments on the Family Trigoniidae, as well as taxonomic considerations, stratigraphic occurrence, and facies relationships of the described species are presented. With the new taxonomy proposed here, the trigoniids have a much greater temporal resolution than previously thought, especially at the species level.

RESUMEN

En la presente monografía se describen 73 especies y una subespecie de Trigoniidae precisamente datadas del Jurásico inferior (Liásico) al Cretácico superior (Maastrichtiano) del oeste central de la Argentina. Estas se clasifican en 14 subfamilias a saber: Minetrigoniinae, Trigoniinae, Neuquenitrigoniinae, n. subfam., Frenguelliellinae (emend.), Myophorellinae, Vaugoniinae, Steinmanellinae, Anditrigoniinae, n. subfam., Megatrigoniinae, Buchotrigoniinae, n. subfam., Pterotrigoniinae, Laevitrigoniinae, Austrotrigoniinae y Nototrigoniinae. La subfamilia Frenguelliellinae se reinterpreta extiendiéndose en edad desde el Triásico hasta el Jurásico Medio (Bajociano), e incluye solamente los géneros *Frenguelliella* y *Kumatrigonia*. Neuquenitrigoniinae, n. subfam. incluye al muy especializado género del Jurásico Medio *Neuquenitrigonia*, que muestra costulación transversal en área y flanco, característica que está ausente en Trigoniinae s.s. Anditrigoniinae, n.subfam., se erije para agrupar géneros y subgéneros que se extienden desde el Jurásico Medio al Cretácico Inferior, tales como *Eoanditrigonia*, n. subgen., *Anditrigonia*, *Paranditrigonia*, *Antutrigonia*, *Virgotrigonia*, and *Lambertrigonia*, n. gen., que se caracterizan por areas lisas en representantes tempranos, o por una ornamentación transversal o radial, o una combinación de ambas, y una débil a bien desarrollada carena marginal. Buchotrigoniinae, n. subfam., incluye los muy especializados géneros del Cretácico Inferior *Buchotrigonia* y *Syrotrigonia* que se caracterizan por un desarrollo tripartito de costillas oblíquas, subconcéntricas y subverticales sobre los flancos. Los géneros tratados son veintiuno, incluyendo: *Groeberella*, n. gen. (especie tipo: *Myophoria neuquensis* Groeber, 1924), *Trigonia*, *Fren-*

[1] Secretaría de Minería. Member of the National Research Council (CONICET). Av. Julio A. Rosa 651. 1067 Buenos Aires. Argentina.

[2] Museo Juan Olsacher. Dirección General de Minería. Olascoaga 421. 8340 Zapala. Neuquén. Argentina.

guelliella, *Jaworskiella*, *Myophorella*, *Scaphotrigonia*, *Scaphorella*, *Neuquenitrigonia*, *Vaugonia*, *Andivaugonia*, n. gen. (especie tipo: *Trigonia radixscripta* Lambert, 1944), *Steinmanella*, *Virgotrigonia*, *Lambertrigonia*, n. gen. (especie tipo: *Trigonia pichimoncolensis* Lambert, 1944), *Anditrigonia*, *Antutrigonia*, *Rutitrigonia*, *Syrotrigonia*, *Pterotrigonia*, *Quoiecchia*, *Austrotrigonia*, and *Pacitrigonia*. El género *Myophorella* se divide en los subgéneros *Myophorella* sensu stricto, *Promyophorella*, y *Haidaia*. El género *Steinmanella* esta representado por los subgéneros *Transitrigonia*, *Macrotrigonia*, y *Splenditrigonia*, n. subgen. (especie tipo: *Trigonia splendida* A. F. Leanza, 1941). *Anditrigonia* está representado por los subgéneros *Anditrigonia* sensu stricto, y por un representante temprano, *Eoanditrigonia*, n. subgen. (especie tipo: *Trigonia keideli* Weaver, 1931). El género *Pterotrigonia* característico del Jurásico Superior y Cretácico se divide en los subgéneros *Pterotrigonia* sensu stricto, *Scabrotrigonia*, *Rinetrigonia*, and *Notoscabrotrigonia*.

Se establecen diez nuevas especies y una nueva subespecie a saber: *Frenguelliella poultoni* (Liássico); *Trigonia losadai*, *Trigonia levyi*, *Frenguelliella perezreyesi*, y *Scaphorella camachoi* (Jurasico Medio); *Myophorella* (*Myophorella*) *schulzi*, *Myophorella* (*Haidaia*) *elguetai*, *Pterotrigonia* (*Notoscabrotrigonia*)*coheni* y *Anditrigonia* (*A.*) *eximia tesselicaudata*, n. ssp. (Jurásico Superior); *Rutitrigonia kauffmani* y *Syrotrigonia brocardoi* (Cretácico Inferior).

Se efectúan comentarios sobre la Familia Trigoniidae, así como consideraciones taxonómicas, distribución estratigráfica, y relaciones de facies de las especies descriptas. Según la nueva taxonomía propuesta, los trigónidos muestran una mucho mayor resolución temporal de la que se creía previamente, especialmente al nivel de especie.

INTRODUCTION

This revision of the Trigoniidae from west-central Argentina was necessary in order to update the taxonomic knowledge of this interesting group of bivalves, and to improve the Jurassic and Cretaceous biostratigraphy and paleontology of the southern Andes.

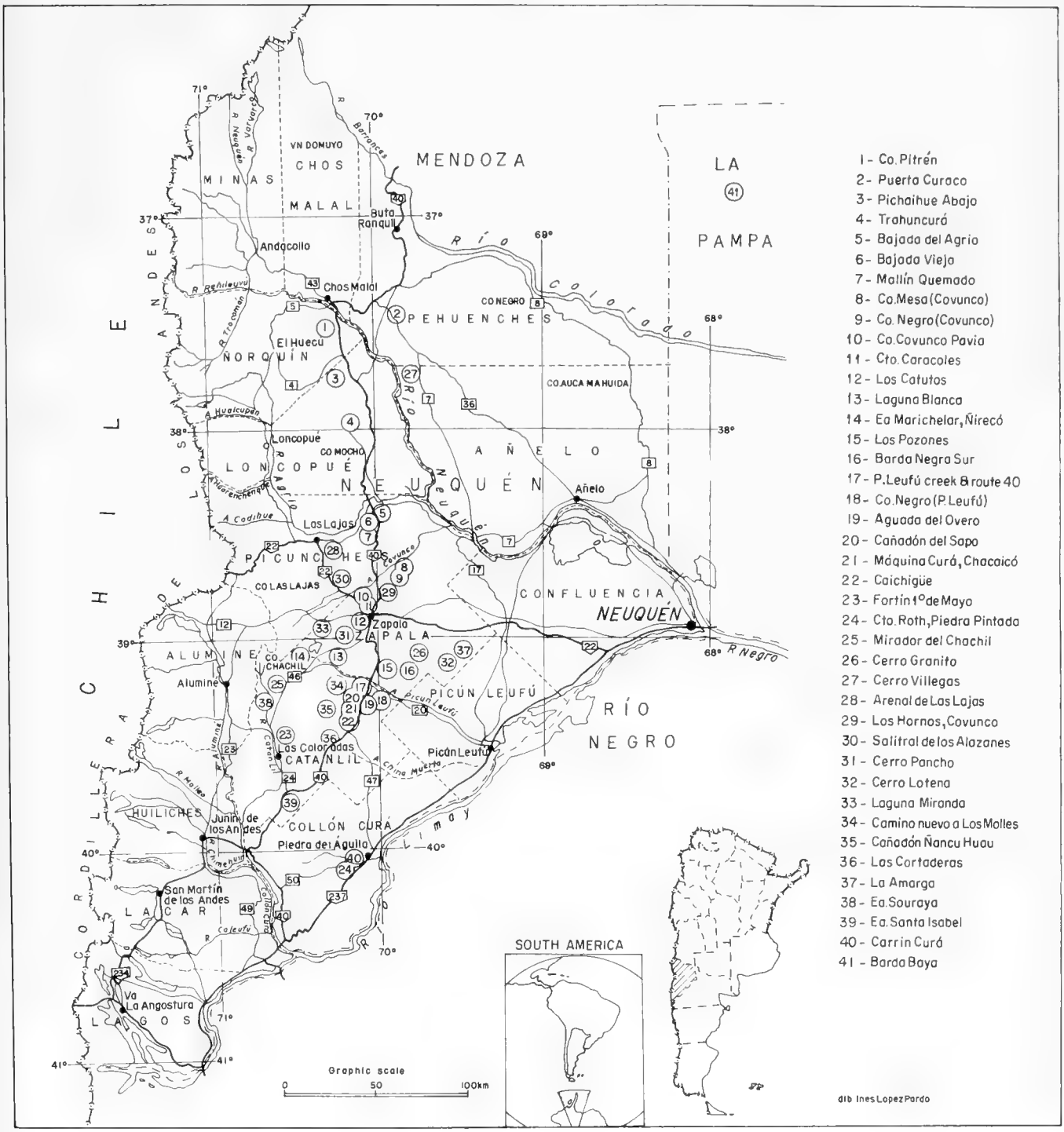
The first description of trigoniids in west-central Argentina was made by Gottsche (1878), based on fossils from Espinacito Pass in the High Cordillera of San Juan Province. The knowledge of the family in this region was later improved by Behrendsen (1891–1892), Tornquist (1898), Burckhardt (1900a, 1900b, 1901, 1903), Haupt (1907), Douvillé (1910), Jaworski (1916, 1925, 1926), Groeber (1924), Weaver (1931) and A. F. Leanza (1941, 1942). It was Lambert (1944) who published the first paper exclusively dedicated to trigoniids from Neuquén Province, describing a total of 24 species. Levy (1966, 1967a, 1967b, 1967c, 1969, 1985) published a number of papers devoted to the taxonomic revision of the Argentine trigoniids, and Mariñelarena (1959) described an Upper Jurassic species from Neuquén. Camacho (1967, 1968) described Upper Cretaceous trigoniids, and Camacho and Riccardi (1978) published a list of fossil invertebrates from Neuquén including an updated list of trigoniid bivalves. In recent years, Camacho and Olivero (1985), Leanza (1981, 1985), Leanza and Garate (1983a, 1983b, 1985, 1986, 1987), Leanza, Pérez and Reyes (1987), Manceñido and Damborenea (1984), Farinatti, Quattrocchio and Labudía (1987), and Leanza and Casadío (1991) described several species mainly from the Jurassic and Cretaceous of the Neuquén Basin.

The present monograph includes the description and taxonomic revision of 73 species and one subspecies of trigoniid bivalves. Of these, 71 species have been collected in Neuquén Province, one species is common both in Neuquén and La Pampa Provinces, and the remaining two taxa were found in La Pampa Province. The studied material has been collected over the past 20 years from 41 different fossil localities (Text-figure 1). In the systematic descriptions, a concise diagnosis is provided for each genus and/or subgenus, and a discussion is added in the case where new morphologic information or new taxa are described. New concepts of trigoniid morphology and descriptive features, which are valuable in differentiating taxa, are included in the systematic descriptions, such as the dorsoposterior and ventroposterior angles or junctions (Kauffman et al. in preparation); these parameters better define the shell shape of each species than those previously used. Characters of the ornamentation of the area (see Terminology, p. 16) were especially taken into account when distinguishing species or even genera and subgenera (Pérez and Reyes, 1987). Many previous trigoniid workers (*e.g.*, Cox, 1952, 1969; Nakano, 1960) have been conservative in their approach to higher taxonomic division of the Trigoniaceae, but more detailed morphologic analysis in this study has allowed new revisions at the subfamily level. Taking as a point of departure the interpretations of the family by van Hoepen (1929), Kobayashi (1954), and Saveliev (1958), 13 subfamilies, two of them new, are herein distinguished. Species duration may be as little as one million years for 27% of the described trigoniid species; the average species duration is 3.8 million years.

COMMENTS ON THE FAMILY TRIGONIIDAE

The bivalve family Trigoniidae, generally the group of "les trigonées" of Lamarck (1819), had a cosmopolitan distribution throughout the Mesozoic. During this time they developed immense diversity of form and external sculpture, which is reflected in a large number of genera and species described from every continent. The family is characterized by a peculiar paleoheterodont dentition and by varied, highly ornate, thick shells of trigonal shape.

The superfamily Trigoniaceae, which includes both



Text-figure 1.—Location of fossil localities.

the Trigoniidae and the Myophoriidae, has been phyletically isolated since the Late Silurian. A modest radiation occurred in the late Early Permian, leading to increased diversity. The radiation of the Trigoniaceae was interrupted briefly by the major extinctions of the Late Permian. But the radiation continued and increased through the Mesozoic, during which time the family Trigoniidae reached its acme. The majority of trigoniid lineages terminated abruptly at the end of the latest Cretaceous (Maastrichtian) in coincidence with the world wide mass extinction episode at or near the Cretaceous/Tertiary boundary. During the Cenozoic a

few trigoniaceans survived in temperate waters of the continental shelf of the Austral Province, where they were represented by *Eotrigonia*, now extinct, and the only living genus *Neotrigonia*.

Paleozoic and Mesozoic trigoniaceans inhabited diverse environments within epeiric seas. They were physiologically adapted to or tolerant of a wide range of salinities (poikilohaline) as indicated by the common occurrence of their shells with stenohaline forms, such as ammonoids, and in dolomites, in association with evaporites and red beds. In the southern Neuquén Basin, Argentina, the Piedra Pintada Formation yields Liassic trigoniids in association with muddy tuffaceous sandstones that also contain abundant remains of land plants. The trigoniids commonly are found in a variety of sedimentary rocks such as bituminous shales and many kinds of calcarenites, but they are by far most common in fine- to medium grained arenitic sandstones.

The combination of sedimentological evidence and paleoecological analysis indicates that a large majority of Mesozoic trigoniids inhabited areas of the seafloor no deeper than perhaps 10 or 15 meters (Stanley, 1977). Living populations of *Neotrigonia* live primarily in deeper waters (150 m) in terrigenous muddy sands, so that the occurrence of the genus in this environment is quite atypical for the family, and may represent a refugium.

The trigoniids are considered suspension feeders, possibly supplementing their diet of living plankton and bacteria with organic detritus (Purchon, 1957).

Hinge teeth of the Trigoniidae are large and distinctive, radiating from the beaks far into the interior of the shell. The dentition consists typically in the left valve of a strong median tooth and a weaker one on each side, and in the right valve of two main teeth dividing deep sockets which receive the teeth of the left valve; additional, smaller teeth may be present. The articulating surface of the teeth typically bear very well developed transverse ridges which are interpreted to have a crucial role in the alignment of the valves (Stanley, 1977). Fossil evidence documents the origin of this kind of dentition early in the Mesozoic. Newell and Boyd (1975) suggested that dentition evolved in parallel in several lineages that are recognized by their external morphology. In coincidence with Poulton's (1979) opinion, however, this view is not tenable, as once established, this specialized dentition remained a conservative and stable feature, changing little from the early Mesozoic trigoniids to the living *Neotrigonia*.

The ligament is external, paravincular and opisthodetic, showing remarkable conservatism during evolution (Newell and Boyd, 1975). The insertion areas of the anterior and posterior adductor muscles are generally small, and are placed very close to the hinge teeth. The pallial line is complete, and the ostracum nacreous. As far as known, the original constitution of the shell was wholly aragonitic, and commonly prismato-nacreous. The shell microstructure of *Neotrigonia* was studied in detail by Taylor, Kennedy and Hall (1969).

One of the most important features of living *Neotrigonia* is its large and muscular foot, which gives species within this genus the ability to jump when threatened (Ansell, 1969; Stanley, 1977, p. 870, his pl. 116, fig. 6–9), showing a strong resemblance to the typical muscular foot of the Cardiidae. The foot and visceral mass are closely appressed to the anterior adductor muscle. Posteriorly, the foot attaches to the shell above the adductor by an elongate and discrete pedal muscle (Tevesz, 1975, p. 333). Though not itself fossilized, the unusual muscular foot can be traced back through trigoniid phylogeny by indirect means because of its coadaptative relationship to certain skeletal features (Stanley, 1970, 1977).

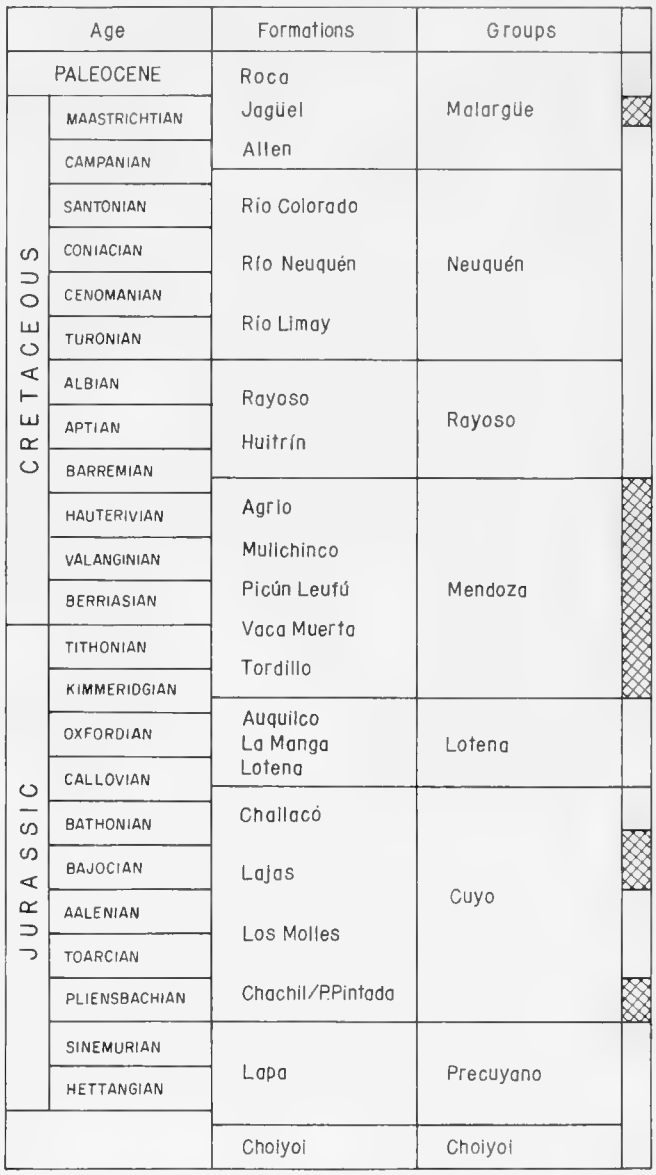
Although Cox (1969) stated that the Trigoniidae were non-byssate, contrary to the view of Lycett (1870), a study by Gould (1969) on the non-functional byssal apparatus of *Neotrigonia margaritacea* (Lamarck) concluded that this system functions in juveniles only. Gould therefore dismissed previous arguments that this is a vestigial organ reduced from an hypothetical byssate adult ancestor. Supporting Gould's assertion, in the collection of Trigoniidae from Argentina there are some examples of trigoniids with possible byssal slits, e.g., *T. carinata* (see Weaver, 1931), *T. aliexpandita* Leanza and Garate (1983) and some species of *Steinmanella* (see Leanza and Garate, 1987). Judging by their functional morphologies (Kauffman et al., in press), these species are presumed to have possessed an active bysal apparatus, at least as juveniles.

GEOLOGICAL SETTING OF THE TRIGONIID-BEARING STRATA IN WEST-CENTRAL ARGENTINA

The Neuquén Basin of west central Argentina is famous for its well exposed Mesozoic sediments; in this area up to 6000 m of marine and continental deposits accumulated in a typical back-arc setting. The basin expands toward the eastern foreland forming a large embayment in which different sedimentary cycles of lowermost Jurassic to uppermost Cretaceous age can be recognized. Text-figure 2 shows, in simplified form, the stratigraphic terms used in this paper from the Hettangian to the Maastrichtian in the Neuquén Basin, including the trigoniid-bearing formational units. The oldest marine deposits belong to the Cuyo Group, which is represented by a system of marine, transitional and continental sediments deposited between the Intraliassic and Intracallovian tectonic episodes. During the

Pliensbachian, deposition of near-shore marine tuffaceous sediments (Piedra Pintada Formation) occurred in southern Neuquén and silicified limestones and tuffs (Chachil Formation) in central Neuquén. During the Toarcian to Aalenian, thick, mostly anoxic shales (Los Molles Formation) were deposited, from which no trigoniids have been recovered. Therefore the Toarcian extinction event could not be analyzed from the point of view of trigoniid evolution in this region.

A subsequent gradual fall of sea level is indicated by the presence of shore-face arenaceous sediments with several well developed hardgound tops containing abundant trigoniids (Lajas Formation). This unit extends from the Lower Bajocian to the early Bathonian, depending on the area considered. The regression reaches its maximum expression with the accumulation, during the early Callovian, of a redbed facies (Challacó Formation), but again no trigoniid-bearing strata have been recorded in this sequence. After the Intermalmic tectonic episode took place, the widespread marine transgression of the Mendoza Group, ranging in age from Kimmeridgian s.s. to early Barremian occurred. The Mendoza Group extends widely from southern Neuquén to southern Mendoza Provinces, and contains several formational units with abundant trigoniids (Tordillo, Vaca Muerta, Picún Leufú, Mulichinco, and Agrio Formations). The Rayoso Group follows conformably, ranging in age from Hauterivian-Barremian to Aptian-Albian. The Patagonidic tectonic episode broke for the first time the connection of this region of Neuquén with the Pacific, and extensive continental dinosaur-bearing strata of the Neuquén Group were deposited. The last Mesozoic marine transgression connects the Atlantic with the Pacific through the Malargüe Group. In the shallow marine Maastrichtian sediments (Jagüel Formation) some important trigoniid species are present. The Cenomanian/Turonian extinction event could not be analyzed in this study, because in west-central Argentina thick continental dinosaur-bearing deposits of the Neuquén Group were deposited during that time.



Text-figure 2.—Schematic stratigraphic section for the Jurassic and Cretaceous of west-central Argentina.

TEMPORAL DISTRIBUTION OF TRIGONIID BIVALVES IN WEST-CENTRAL ARGENTINA

Lower Jurassic species

Lower Jurassic trigoniid species in west-central Argentina have been described by Burckhardt (1901), Jaworski (1916, 1925, 1926), Groeber (1924), A. F. Leanza (1942), Lambert (1944), Levy (1967a) and Leanza and Garate (1987). In the present paper eight Lower Jurassic (Liassic) species from western central Argentina are described. These are distributed among the genera *Groeberella*, n. gen., *Myophorella*, *Jaworskiella*, and *Frenguelliella*. These taxa have been found in the Piedra Pintada Formation (Stipanicic et al., 1978) which is approximately equivalent to the Lower and Upper Pliensbachian *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones recently established by Damborenea (*in* Riccardi, Damborenea and Manceñido, 1990); and in the Chachil Formation (Weaver, 1942) which is equivalent to the Pliensbachian "*Fanninoceras* Zone" as recently established by Riccardi (*in* Riccardi, Manceñido and Damborenea, 1990).

Groeberella, n. gen. has been erected, with *Myophoria neuquensis* Groeber (1924) as the type species, to differentiate species with only radial ornament from the Triassic *Myophorigonia* Cox (1952), which is characterized by both radial and transverse ornament. The

genus is represented by its type species from the Pliensbachian Piedra Pintada Formation at La Amarga, near Rincón del Aguila, and by *Groeberella*, sp. indet. from the Middle (now Early) Bajocian Lajas Formation at Barda Negra Sur. The genus *Myophorella* is represented by its subgenus *Myophorella* sensu stricto [e.g., *Myophorella* (*M.*) *araucana* (A. F. Leanza), *Myophorella* (*M.*) *catenifera* (Hupé) and *M.* (*M.*) cf. *M. tuberculata* (Agassiz)]; the last two taxa are cited for the first time in Argentina. The genus *Jaworskiella* is represented by very well preserved adult and juvenile specimens of the type species *Jaworskiella burckhardti* (Jaworski). The genus *Frenguelliella* is represented by the type species *Frenguelliella inexspectata* (Jaworski) and by a new species named *Frenguelliella poultoni*, n. sp. which appears to be identical to *Frenguelliella*, sp. B of Poulton (1979, p. 18, pl. 1, fig. 10) from the early Sinemurian Laberge Group, Yukon Territory, Canada. *Myophorella* (*M.*) *araucana*, *M.* (*M.*) *catenifera*, *M.* (*M.*) cf. *M. tuberculata*, *Jaworskiella burckhardti*, *Frenguelliella inexspectata*, and *Groeberella neuquensis* have been found in the near-shore Piedra Pintada Formation. *Frenguelliella tapiai*, *Frenguelliella poultoni*, n. sp. and also *Myophorella (M.) catenifera* are found in the Chachil Formation (Weaver, 1942).

Middle Jurassic species

The first description of a trigoniid species in west-central Argentina was made by Gottsche (1878) from Middle Jurassic strata at the Espinacito Pass region in the High Cordillera de Los Andes, followed by work of Tornquist (1898) and Behrendsen (1891–1892). In this century Middle Jurassic trigoniid species have been described by Weaver (1931), Lambert (1944), Leanza and Garate (1983, 1985, 1986, 1987) and Leanza, Pérez and Reyes (1987). The present study provides the description of 21 Middle Jurassic trigoniid species distributed among eleven genera and subgenera, all of which have been found in the Lajas Formation (Weaver, 1931). This unit outcrops in the southern part of the Neuquén Basin and is represented by a well developed shoreface unit characterized by fine- to coarse-grained sandstones. This facies was very favorable to habitation by trigoniid bivalves, and reflects a number of marine oscillations belonging to eustatic fourth order cycles. In a previous paper (Leanza and Garate, 1987) the author considered the specimens from Los Pozones and Covunco Pavia to range between Middle to early Callovian. According to its ammonite content (Westermann and Riccardi, 1985, p. 12, fig. 3), however, the age of the Lajas Formation in these localities ranges from the Early Bajocian to the Early Bathonian, and is approximately equivalent to the *Emiliea giebeli* to the *Cadomites*–Tulitidae Assemblage Zones (Riccardi, Westermann and Damborenea, 1990).

The following trigoniid genera are present in the Middle Jurassic Lajas Formation: *Groeberella*, n. gen., *Frenguelliella*, *Trigonia*, *Neuquenitrigonia*, *Vaugonia*, *Andivaugonia*, n. gen., *Myophorella* (*Myophorella*), *Myophorella* (*Promyophorella*), *Scaphorella*, *Scaphotrigonia* and *Anditrigonia* (*Eoanditrigonia*). *Groeberella* is represented by a single undetermined Early Bajocian species at Barda Negra Sur. Although the poor preservation of the specimen precludes any further taxonomic determination, it has a relatively small size and thin shell in comparison with the Pliensbachian *G. neuquensis* (Groeber). *Frenguelliella* is represented by a new Early Bajocian species, *F. perezreyesi*, which is characterized by small size and relatively flat and transversely costate area. The genus *Trigonia* is well represented at several localities from the Early Bajocian to the Middle Bathonian by *Trigonia corderoi* Lambert, *Trigonia mollesensis* Lambert, *Trigonia densestriata* Behrendsen, and the new species *Trigonia losadai* from Los Pozones which shows close affinities with the group of *Trigonia costata* Agassiz. *Neuquenitrigonia* is represented in Barda Negra Sur by some fragmentary specimens belonging to its type species *N. huenickeni*. The genus *Vaugonia* is represented by two typical elongated Vaugoniinae species: *V. rectangularis* (Gottsche, 1878) and *V. chunumayensis* (Jaworski), both occurring in association at Barda Negra Sur. The genus *Andivaugonia*, n. gen. has been erected with "*Trigonia*" *radixscripta* Lambert as the type species in order to group somewhat large and inflated species characterized by a non- to poorly developed marginal carina, and an area that is usually smooth or ornamented only by growth lines. This new genus constitutes a homogeneous stock including *Andivaugonia radixscripta* (Lambert), *Andivaugonia covuncoensis* (Lambert), *Andivaugonia fuenzalidai* (Reyes and Pérez) and *Andivaugonia lissocostata* (Reyes and Pérez); the last two species were originally described from the Middle Jurassic of Chile, and are recorded herein for the first time in Argentina at the localities of Chacaicó and Fortín 1º de Mayo. The genus *Myophorella* is represented by the subgenus *Myophorella* (*Myophorella*), with the single species *M.* (*M.*) *argentinica* (Jaworski), and by the subgenus *Myophorella* (*Promyophorella*) containing *M.* (*P.*) *praescabroidea* (Jaworski). Both occur in association at the Early Bajocian locality of Barda Negra Sur. This last species is considered as the Jurassic ancestor of the Upper Jurassic and Cretaceous Pterotrigoniinae. The genus *Scaphorella* is well documented by *Scaphorella leanzai* (Lambert), *Scaphorella kruusei* Leanza and Garate, and by the new species *Scaphorella camachoi*; the last species is very similar in size and shape to *Trigonellina* Parnes (1981), but the shell area exhibits transverse instead of radial costellae. The subgenus *Eoanditrigonia*, n. subgen., based

on *Anditrigonia keideli* (Weaver), is present at the locality of Los Pozones.

UPPER JURASSIC SPECIES

Upper Jurassic trigoniids in west-central Argentina have been described by Behrendsen (1892), Burckhardt (1900a, 1900b, 1903), Haupt (1907), Douvillé (1910), Weaver (1931), A. F. Leanza (1941), Lambert (1944), Mariñelarena (1959), Levy (1967c) and Leanza and Garate (1987). The present study treats 21 species and one subspecies of Upper Jurassic (Kimmeridgian to Upper Tithonian) Trigoniidae which occur in the Mendoza Group. The Kimmeridgian Tordillo Formation (Groeber, 1946), yields trigoniids near Laguna Miranda and Los Catutos, *Lambertrigonia pichimoncolensis* (Lambert) and *Trigonia mirandaensis* Lambert. Both species occur in association in coarse-grained to conglomeratic, brown sandstones. The remaining 19 species and one subspecies have been found in Middle and Upper Tithonian strata, namely in shoreface facies of the Carrín Curá (Leanza, Marchese and Riggi, 1977) and Picún Leufú (Leanza, 1973) formations. These units interfinger with shales and marls of the Vaca Muerta Formation (Weaver, 1931). In this study the genera and subgenera *Trigonia, Anditrigonia, Antutrigonia, Rutitrigonia, Steinmanella* (*Splenditrigonia*), *Myophorella* (*Myophorella*), *Myophorella* (*Promyophorella*), *Myophorella* (*Haidaia*), *Pterotrigonia* (*Rinetrigonia*), *Pterotrigonia* (*Scabrotrigonia*), and *Pterotrigonia* (*Notoscabrotrigonia*) have been recognized. The genus *Trigonia* is represented by *T. carinata* Agassiz, *T. levyi*, n. sp., *T. fortinensis* Lambert and *T.*, sp. juv. indet. *Anditrigonia* is represented by the subgenus *Anditrigonia* s.s., with *A.* (*A.*) *eximia* (Philippi), *A.* (*A.*) *carrincurensis* (A. F. Leanza), *A.* (*A.*) *lamberti* Levy, *A.* (*A.*), sp. juv. indet., and *A.* (*A.*) *eximia tesselicaudata*, n. ssp. *Antutrigonia* is represented by *A. frenguellii* (Mariñelarena) and *A. groeberi* (Weaver). The genus *Steinmanella* is represented by the subgenus *Splenditrigonia*, n. subgen. which groups an homogeneous stock composed by *S.* (*Spl.*) *splendida* (A. F. Leanza), *S.* (*Spl.*) *erycina* (Philippi) and *S.* (*Spl.*) *haupti* (Lambert). The genus *Myophorella* is represented by *Myophorella* (*M.*) *schulzi*, n. sp., the subgenus *Promyophorella* by *M.* (*P.*) *hillebrandti* Reyes and Pérez, and by the subgenus *Haidaia* containing the new species *M.* (*H.*) *elguetai*. *Rutitrigonia* appears in west-central Argentina for the first time in the Upper Tithonian and is represented by an undetermined juvenile species from the Picún Leufú Formation at Cerro Caracoles. The genus *Pterotrigonia* appears for the first time in the Upper Tithonian, represented by the subgenera *Scabrotrigonia, Rinetrigonia*, and *Notoscabrotrigonia*. *Scabrotrigonia* is represented by *P.* (*Scabrotrigonia*) *transatlantica* (Behrendsen), redescribed here for the first time since the original description in 1892, and by *P.* (*Rinetrigonia*), sp. juv. indet. The subgenus *Notoscabrotrigonia* is represented by *P.* (*Notoscabrotrigonia*) *coheni*, n. sp. The age of these taxa has been precisely determined by co-occurring ammonites in the *Aulacosphinctes proximus, Windhauseniceras internispinosum* (Middle Tithonian), *Corongoceras alternans*, and *Substeueroceras koeneni* (Upper Tithonian) Zones (Leanza, in Riccardi, Leanza and Volkheimer, 1990).

LOWER CRETACEOUS SPECIES

Lower Cretaceous trigoniid species have been described in west-central Argentina by Behrendsen (1892), Burckhardt (1900a, 1900b, 1903), Weaver (1931), Lambert (1944), Leanza (1985), Camacho and Olivero (1985) and Leanza and Garate (1987). In the present paper, 21 species of Lower Cretaceous age (Berriasian to Hauterivian, and probably also Early Barremian) are described. The species are confined to the Mendoza Group (Groeber, 1946), and are present in shoreface facies and/or on the top of hardgrounds of the Vaca Muerta, Mulichinco and Agrio formations (Weaver, 1931). The recorded Lower Cretaceous genera and subgenera are mainly *Steinmanella* (*Transitrigonia*), *Steinmanella* (*Macrotrigonia*), *Steinmanella* (*Splenditrigonia*), *Virgotrigonia, Antutrigonia, Trigonia, Quoiecchia, Syrotrigonia, Rutitrigonia, Anditrigonia, Pterotrigonia* (*Pterotrigonia*), *Myophorella* (*Myophorella*), *Myophorella* (*Promyophorella*) and *Myophorella* (*Haidaia*). The genus *Steinmanella* is present in the Berriasian, Valanginian and Hauterivian, and probably the Early Barremian. The genera *Virgotrigonia* and *Pterotrigonia* have been found in the Berriasian, whereas *Antutrigonia* has been found in the latest Berriasian/earliest Valanginian. *Trigonia, Myophorella, Quoiecchia, Rutitrigonia, Anditrigonia* and *Syrotrigonia* are clearly dominant in the Hauterivian.

Berriasian species are represented by *Virgotrigonia hugoi* (Leanza) formerly the type species of the genus *Maputrigonia*, and by *Pterotrigonia* (*Pterotrigonia*) *aliformis* (Parkinson). Both species occur in association at Mallín Quemado in the *Argentiniceras noduliferum* Zone. In addition, a description of *Steinmanella* (*Transitrigonia*) *neuquensis* (Burckhardt) from Trahuncurá is presented. Late Berriasian/Early Valanginian species include *Antutrigonia opistolophophora* (Lambert) from the Mulichinco Formation at Mallín Quemado in the *Spiticeras damesi/Neocomites wichmanni* Zones, and *Steinmanella* (*Transitrigonia*) *quintucoensis* (Weaver) and *Steinmanella* (*Splenditrigonia*) *splendida* (A. F. Leanza). Both species occur in association at Trahuncurá in the same ammonite assemblage. The Valanginian *Steinmanella* (*Transitrigonia*) *steinmanni* (Philippi) from the Mulichinco Formation at Puerta Curaco in the *Olcostephanus curacoensis* Zone is also de-

scribed. *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann) is present in the Agrio Formation in the Late Valanginian/Early Hauterivian locality of Cerro Pitrén, whereas Lower Hauterivian species are described from Pichaihue Abajo, including *Syrotrigonia brocardoi*, n. sp. and *Quoiecchia sigeli* Leanza and Garate. Lower to Middle Hauterivian species are abundant and diverse. They are mostly found in the Agrio Formation of the Cerro Mesa and Cerro Negro (Covunco) areas. The list includes *Steinmanella* (*Transitrigonia*) *raimondii* (Lisson), *Myophorella* (*Promyophorella*) *garatei* Leanza, *Myophorella* (*Haidaia*) *volkheimeri* Leanza and Garate, *Trigonia wiedmanni* Leanza and Garate, *T. angustecostata* Behrendsen, *T. aliexpandita* Leanza and Garate, *Rutitrigonia agrioensis* (Weaver), *Rutitrigonia kauffmani*, n. sp., and undetermined species of *Anditrigonia* from the Arenal of Las Lajas. These species occur in the *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones. In light of the revision of Pterotrigoniinae by Cooper (1989), the Hauterivian species *coihuicoensis* of Weaver, formerly thought to be a representative of *Myophorella* (*Myophorella*), is herein placed in the subgenus *Pterotrigonia* (*Rinetrigonia*). *Pterotrigonia* (*Rinetrigonia*) *coihuicoensis* (Weaver) ranges throughout the Hauterivian, and probably the Early Barremian, whilst *Steinmanella* (*Macrotrigonia*) *vacaensis* (Weaver) is found in the Upper Hauterivian *Crioceratites* (*Paracrioceras*) *andinus* Zone.

Upper Cretaceous species

Upper Cretaceous trigoniid species have been described in west-central Argentina, including Río Negro and La Pampa Provinces, by Levy (1967b), Camacho (1967, 1968), Farinati, Quattrocchio and Labudía (1987) and Leanza and Casadío (1991). The species are usually found in the Maastrichtian Jagüel Formation (Windhausen, 1914) and equivalents, mostly in association with *Eubaculites argentinicus* (Weaver). The present study describes three Upper Cretaceous trigoniid species. *Pacitrigonia sobrali* Leanza and Casadío and *Austrotrigonia pampeana* Leanza and Casadío are from the Jagüel Formation at the locality of Barda Baya, La Pampa Province. The remaining species *Pterotrigonia* (*Rinetrigonia*) *windhauseniana* (Wilckens), was found by the authors in the Jagüel Formation at the locality of Cerro Villegas in the northeastern part of the Neuquén Province.

SPECIES DURATIONS OF THE FAMILY TRIGONIIDAE IN WEST-CENTRAL ARGENTINA

Each of the 74 described Jurassic and Cretaceous trigoniid species and subspecies have been referred to known ammonite zones, and in the localities in which cephalopods are not present, bivalve zonations have been used for reference. For the Lower Jurassic the bivalve zonation by Damborenea (in Riccardi, Damborenea and Manceñido, 1990), and the ammonite zonation by Riccardi (in Riccardi, Damborenea and Manceñido, 1990) have been used. For the Middle Jurassic the ammonite zonation proposed by Riccardi (in Riccardi, Westermann and Damborenea, 1990) was utilized. The Upper Jurassic trigoniid occurrences in west-central Argentina were matched with the ammonite zones proposed by Leanza (in Riccardi, Leanza and Volkheimer, 1990), whereas the Lower Cretaceous were correlated with the ammonite zonation published by Leanza (1981a). The Upper Cretaceous trigoniid occurrences occur within the Maastrichtian *Eubaculites* Assemblage Zone (see Riccardi, 1984).

In Table 1 the vertical range of each species from its first to its last occurrence has been plotted against the linear time scale in millions of years before present of Haq et al. (1988), and the duration of species ranges calculated. At the specific level, 27% of the trigoniid species had durations of approximately one million years. The average species duration for all described trigoniids was approximately 3.8 million years. It is worth noting that 69% of the described species have durations of one to three million years, and the remaining 31% have longevities from three to 17.5 million years.

For practical purposes, the trigoniids discussed in this paper have been divided into four groups, as follows:

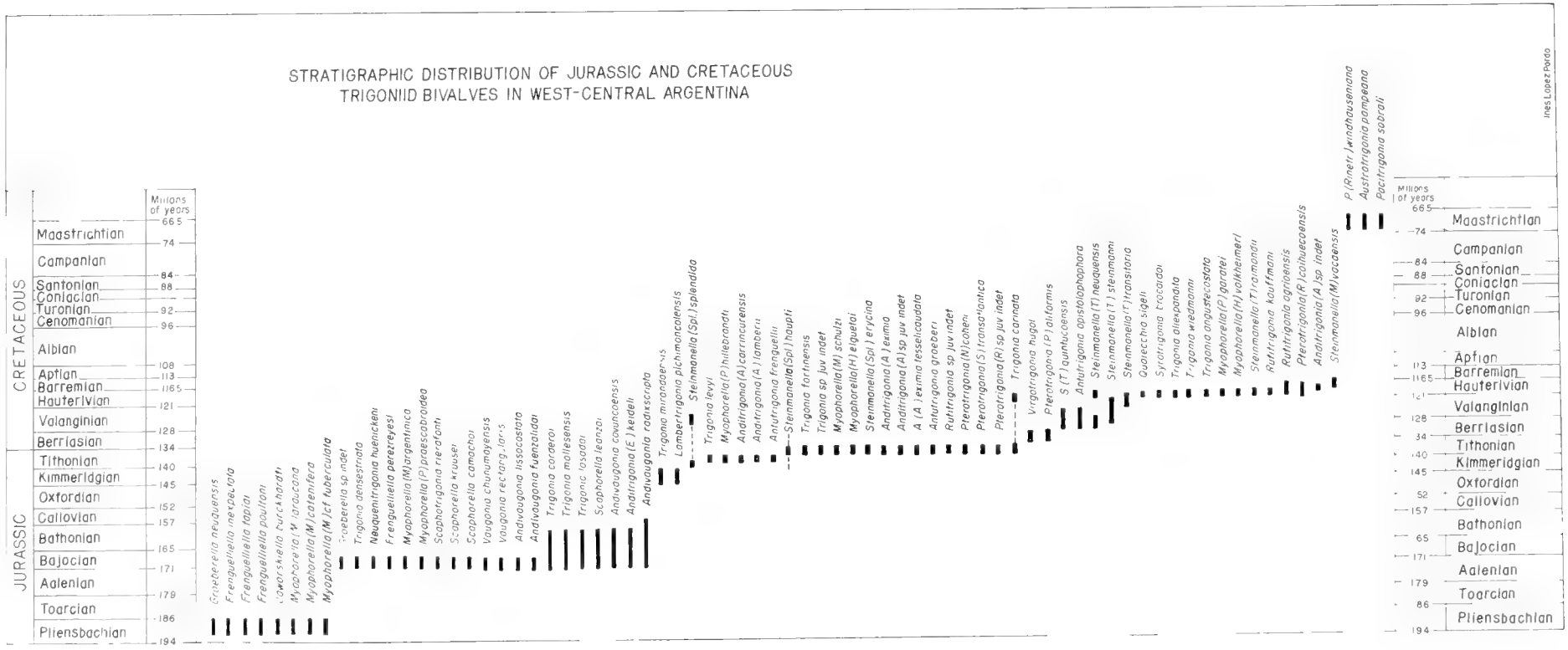
1) Longevities up to one million year: 20 species (27%).

Groeberella, sp. indet., *Trigonia densestriata, Trigonia*, sp. juv. indet., *Trigonia fortinensis, Neuquenitrigonia huenickeni, Frenguelliella perezreyesi, Myophorella* (*Myophorella*) *argentinica, M.* (*M.*) *schulzi, M.* (*Promyophorella*) *praescabroidea, M.* (*Haidaia*) *elguetai, Scaphotrigonia rierafonti, Scaphorella camachoi, S. kruusei, Steinmanella* (*Splenditrigonia*) *erycina, Vaugonia chunumayensis, V. rectangularis, Andivaugonia lissocostata, Syrotrigonia brocardoi, Pterotrigonia (Rinetrigonia)*, sp. juv. indet., and *Quoiecchia sigeli.*

2) Longevities from one to three million years: 30 species and 1 subspecies (42%).

Trigonia levyi, T. aliexpandita, T. wiedmanni, T. angustecostata, T. mirandaensis, Frenguelliella tapiai, F. poultoni, Myophorella (*Promyophorella*) *hillebrandti, M.* (*P.*) *garatei, M.* (*Haidaia*) *volkheimeri, Steinmanella* (*Macrotrigonia*) *vacaensis, S.* (*Transitrigonia*) *raimondii, Anditrigonia* (*Anditrigonia*) *carrincurensis, A.* (*A.*) *lamberti, A.* (*A.*), sp. indet., *A.* (*A.*), sp. juv. indet., *A.* (*A.*) *eximia tesselicaudata, Antutrigonia op-*

Table 1.—Stratigraphic distribution of Jurassic and Cretaceous trigoniid bivalves in west-central Argentina, in stratigraphic order.



istolophophora, A. frenguellii, A. groeberi, Lambertrigonia pichimoncolensis, Virgotrigonia hugoi, Rutitrigonia agrioensis, R. kauffmani, R. sp. juv. indet., *Pterotrigonia* (*Notoscabrotrigonia*) *coheni, P.* (*Scabrotrigonia*) *transatlantica, P.* (*Rinetrigonia*) *windhausenіana, P.* (*Pterotrigonia*) *aliformis, Austrotrigonia pampeana*, and *Pacitrigonia sobrali*.

3) Longevities from three to 11.5 million years: 21 species (29%).

Steinmanella (*Transitrigonia*) *transitoria, S.* (*T.*) *quintucoensis, S.* (*T.*) *steinmanni, S.* (*T.*) *neuquensis, S.* (*Splenditrigonia*) *haupti, Pterotrigonia* (*Rinetrigonia*) *coihuicoensis, Anditrigonia* (*Anditrigonia*) *eximia, A.* (*Eoanditrigonia*) *keideli, Trigonia corderoi, T. mollesensis, T. losadai, Andivaugonia radixscripta, A. covuncoensis, A. fuenzalidai, Groeberella neuquensis, Frenguelliella inexspectata, Jaworskiella burckhardti, Myophorella* (*Myophorella*) *araucana, M.* (*M.*) *catenifera, M.* (*M.*) cf. *tuberculata*, and *Scaphorella leanzai*.

4) Longevities from 11.5 to 17.5 million years: two species (2%).

Steinmanella (*Splenditrigonia*) *splendida* and *Trigonia carinata*.

The maximum species longevity (17.5 million years) recorded is for *Trigonia carinata* Agassiz, a taxon which ranges from the Upper Tithonian to the Middle Hauterivian, although a diminution in size has been noted for the Hauterivian representatives of the species. The second most long-lived species (15.5 million years) is *Steinmanella* (*Splenditrigonia*) *splendida* which ranges from the Lower Tithonian to the Early Valanginian of Argentina and Chile.

ACKNOWLEDGEMENTS

The John Simon Guggenheim Memorial Foundation supported this study through a Research Fellowship to the senior author which was held in Department of Geological Sciences of the University of Colorado at Boulder, U. S. A. The Guggenhiem Foundation also contributed to the printing costs of this paper. The Secretaría de Minería and the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) of Argentina authorized the tenure of the Fellowship in the United States of America. The author is particularly grateful to Dr. Erle G. Kauffman (University of Colorado, Boulder) for his critical comments on the manuscript and improvement of the English text, and for his kind assistance and stimulating discussions with the author during his stay in Boulder. Terry P. Poulton (Calgary), Cathryn R. Newton (Syracuse) and Peter R. Hoover (Ithaca) acted as kind reviewers. Thanks to their precise observations, the presentation of this monograph has been significantly improved.

Special thanks are due, in different stages of the preparation of this monograph, to A. C. Riccardi and S. E. Damborenea (La Plata), C. A. Hugo, M. A. Uliana, L. Legarreta, C. Gulisano, W. Volkheimer (Buenos Aires), U. Rosenfeld (Münster), J. Wiedmann (Tübingen), T. P. Poulton (Canada), M. R. A. Thompson (England), E. Pérez d'Angelo (Santiago), and T. Villamil (Bogotá).

Acknowledgements are due also to persons who in one way or another supported the activities of the Museum Juan Olsacher in Zapala, as follows: Eliseo Sepúlveda, Klauss Eppinger, Marzio Smareglia, Jorge Diz, Eduardo Jawerbaum, Carlos Zabala, Jorge Preloran, Daniel Ghedin, Kurt Hirt von Sigel, Segundo Vásquez, Domingo and Ramona Elgueta, Luis Ardanaz, Juan Domingo Soto, Pablo di Laudo, Juan Carlos Vega, Roberto López, Chiyomi Masuda de Nishimoto, Guillermo and Gabriel Nicolossi, Gustavo Azúa, Daniel Sanchez, Daniel Fernández Ramphastos, Enrique Schulz, Francisco Romero, Juan Mario Raone, Héctor and Hugo Marichelar, Laura Ibañez, Heraclio Osvaldo Ortiz, Gustavo Atienza, Luis and Jorge Demetrio, Santiago Jara, María Soledad Azar, Enrique Riera Font, Marcelo Martínez, Roberto Suarez, Oscar Encina, Eduardo Mundano, Rodolfo Zimmt, Roberto P. and Teresa H. Garate, Richard Cohen and Eduardo J. Rebord. Thanks also to Sergio Eduardo and Juan Rafael Cocca for the permanent improvement of the Museum's collections.

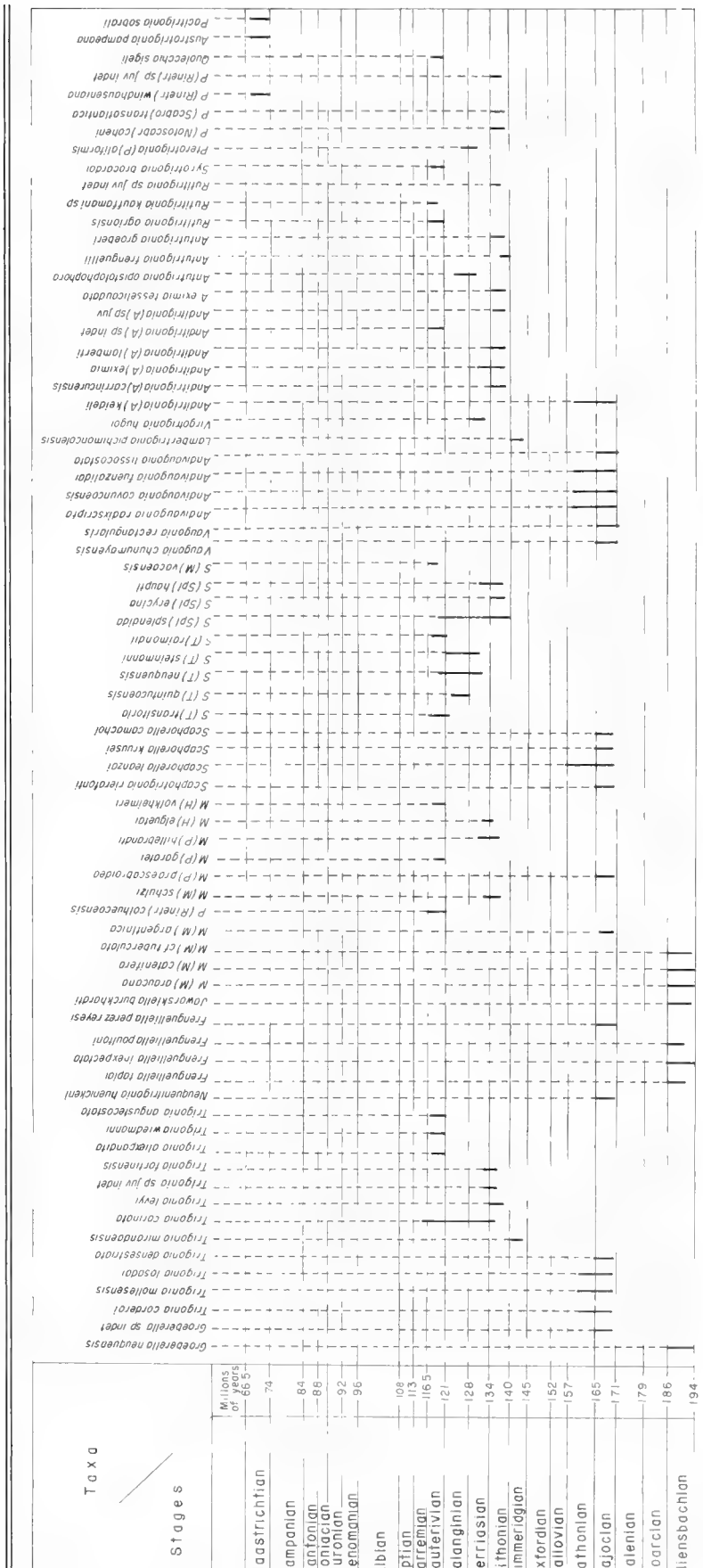
INTRODUCTION TO SYSTEMATIC PALEONTOLOGY

Philosophical considerations

Evolution of trigoniids in each geographic realm occurred mostly in isolation for long periods of time, punctuated by episodic regional interchange at maximum flooding episodes at times of sea level rise. Although there are general signatures between trigoniids of different regions that can be traced at the generic level, species are almost invariably endemic. In order to clarify the great radiation of the Trigoniacea during the Mesozoic, and contrary to the view of Cox (1969), a non-conservative taxonomy is used in the classification of the trigoniid faunas of west-central Argentina. Although the views presented here are in agreement with those of Cooper (1991), who has recently revised the classification of the order Trigonioidea, his paper appeared almost simultaneously with the completion of this manuscript. Therefore his taxonomy higher than subfamily level has not been adopted, as this needs still further analysis.

The philosophy used by the author in taxonomic determinations in this paper was to consider the most important characteristics of the trigoniid shell, namely:

Table 2.—Stratigraphic distribution of Jurassic and Cretaceous trigoniid bivalves in west-central Argentina, in systematic order.



(1) size, (2) shape, (3) convexity, (4) direction of coiling of the umbo, and (5) nature of ornamentation on the outer surface. This last feature includes mainly strength, orientation and ontogenetic changes in the nature of the costae and carinae (cf., Poulton, 1979).

The dentition and other internal features of the trigoniids are conservative characters showing little change from the origin of the group to the present. Taxonomic determinations in this paper thus have been based largely upon external shell shape and ornamentation, of which the surface features of the area are the most relevant to the distinction of different genera and subgenera within the family (Perez and Reyes, 1987).

A good example of what the author interprets as useful generic level characteristics is provided by members of the subfamily Anditrigoniinae. Although the flank ornamentation displays more or less similar patterns in different genera, the area of *Anditrigonia* has transverse costellae near the umbo and a smooth distal area, whereas *Paranditrigonia* bears faint radial costellae over the entire area. *Antutrigonia* bears transverse costellae in the whole area, whilst *Virgotrigonia* shows transverse costellae near the umbo and radial costellae in the distal part of the area. Similarly, marginal carinae may be absent (*Antutrigonia*), only defined in the umbonal region (*Anditrigonia, Paranditrigonia*), or continuous along the whole length of the shell (*Virgotrigonia, Lambertrigonia*).

Subgeneric interpretation may be exemplified by members of the genus *Myophorella*, in which the subgenus *Myophorella* sensu stricto bears tuberculated costae, whilst the subgenus *Promyophorella* displays beaded or almost smooth costae, and *Haidaia* shows flank costae with crenulations in their ventral parts. In general, escutcheon, area and marginal carinae conserve similar patterns. The subgenus *Eoanditrigonia*, in a similar way, shows on the flanks subconcentric costae forming with the posterior set of costae a ventrally directed V- or L-shaped inflection. But these posterior costae are fewer, thicker and in inverse relation to those of *Anditrigonia* sensu stricto.

Concerning the author's concept of subspecies, *Anditrigonia* (*A.*) *eximia tesselicaudata* n. subsp. serves as an example. It displays a not very elongate shell shape and a comparatively less convex anterior margin in comparison with *Anditrigonia eximia*, but these differences fall in the intraspecific variability of this species, already demonstrated by Lambert (1944) and Pérez and Reyes (1983). Nevertheless, the reticulate ornamentation on the posterior flank resulting from the intersection of subvertical costae with subhorizontal grooves is interpreted as a secondary character of subspecific value.

The key points followed in this paper for taxonomic purposes may be summarized as follows:

Subfamily level: general trends of the outer shell, ornamentation of escutcheon, area and flank;

Generic level: ornamentation of escutcheon, area and marginal carina;

Subgeneric level: ornamentation of flank, mainly costae;

Species level: size, shape, convexity of shell, nature of ornamentation;

Subspecies level: minor differences in flank ornamentation not falling beyond the intraspecific variability of a species.

Each genus treated here has a diagnosis based on the author's own observations. References are also given to previous authors who may have made different diagnoses of a given genus. Temporal and geographic distribution are given for each genus, and age assignments for units that have yielded trigoniids are documented briefly.

The phylogeny of trigoniids is complex and, in the view of the author, still poorly understood. Kobayashi (1954), Kobayashi and Mori (1955), Saveliev (1958) and Nakano (1960), among others, made attempts to establish some phylogenetic trends among the Trigoniacea, but most of them resulted in misinterpretations and confusion, due in large part to lack of taxonomic certainty. It is not the purpose of this paper to promote particular phylogenetic interpretations, but the refined taxonomy developed here may provide a basis for future discussions.

TERMINOLOGY

The terminology used in the systematic descriptions is in general agreement with the Trigoniid Glossary of Terms by Kauffman, Leanza and Villamil (in preparation). The following original trigoniid morphological terms have been commonly used (see Text-figure 3), and are here described with the permission of the above cited authors:

Antecarinal sulcus/groove: A narrow radial depression located at the posterior edge of the flank, just anterior to the marginal carina, extending from the umbo to the ventral-posterior junction.

Anterior margin: The margin of the shell extending anteriorly from the beaks to the beginning of the ventral margin.

Area: Commonly triangular-shaped dorsal-posterior portion of the shell surface bounded by the marginal carina, the posterior margin and the escutcheon carina. The area commonly bears distinct ornamentation important to the differentiation of different genera within the family.

Beak: The sharply to bluntly pointed dorsal tip of the umbo, projecting above the hinge margin.

Costa: A moderately prominent elevated ornamental feature of the outer shell surface that may be oriented radially, obliquely or concentrically. Same as "rib" in previous literature.

Costella: A small and narrow, elevated ornamental feature of the shell, usually present in the area and/or escutcheon, which is normally radial, as in *Trigonia*, but may be oblique, as in *Apiotrigonia*, or concentric, as in *Frenguelliella*. Same as "riblet" in previous literature.

Dorsal margin: The margin of the shell extending from the beaks to the dorsoposterior junction.

Dorsoposterior junction: The normally angular, predominantly obtuse, intersection between the dorsal and posterior margins, forming the dorsoposterior angle.

Escutcheon: A dorsal surface on either side of the ligamental groove extending posteriorly from the beaks. The escutcheon is commonly bounded by the escutcheon carina in each valve. The shape may be highly excavated to strongly convex, as in *Trigonia aliexpandita*. The escutcheon surface may be smooth, or usually ornamented by radial, oblique, or concentric growth lines or costellae, but exceptionally it can bear transverse costae, as in *Neuquenitrigonia*.

Escutcheon carina: A narrow elevated ridge or keel extending posteriorly from the beak along the dorsolateral margins of the escutcheon and forming a discrete border.

Flank: The entire valve surface between the anterior and ventral margins and the marginal carina. The term flank is equivalent to "disk" of the bivalve literature, but is more used by trigoniid workers. The ornamentation of this surface is important in the distinction of different taxa within the family.

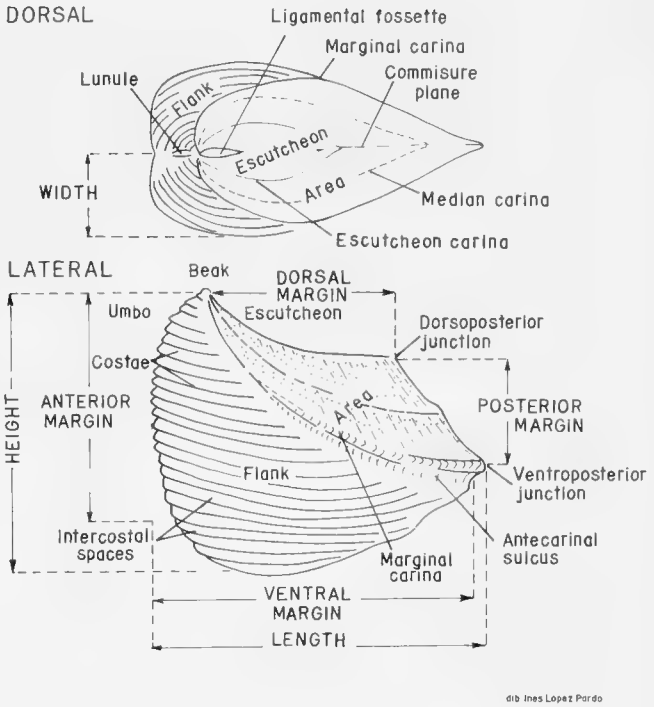
Intercostal space: Concave depression between adjacent costae.

Ligamental fossette: A narrow depressed lunate platform extending posteriorly from the beak along the dorsal margin, within the escutcheon, and serving for attachment of ligament.

Lunule: A concave depression along the dorsoanterior margin below the beaks.

Marginal carina: A prominent fold or subangular ridge that extends from the beak and umbo to the ventroposterior junction. This ornamental feature is important to the differentiation of taxa within the family. It may be smooth, beaded or tuberculate, and strongly defined on the whole shell or sharply defined only in the umbonal region, becoming distally indistinct or completely absent. Same as "umbonal ridge" in bivalve literature.

Median carina/groove/sulcus: A narrow radial ridge, fold or depression that divides the area into inner and outer parts and extends from the beak or umbo to the mid-posterior margin. In cases in which the area is divided into two asymmetrical parts, the term submedian carina/groove/sulcus is used.



Text-figure 3.—Morphological terminology used to describe trigoniid bivalves in this paper.

Postcarinal sulcus/groove: A radial depression located on the inner area, just posterior to the marginal carina.

Posterior margin: Margin of the shell between the dorsoposterior junction and the ventroposterior junction, and defining the distal edge of the area.

Umbo: The dorsal portion of the valve just below the beaks, marking the inflation and curvature at the growth axis in many trigoniids. This region may be demarcated ventrally by a change from juvenile/early adult to normal adult ornamentation.

Ventral margin: The margin of the valve between the ventroposterior and anterior-costal junctions.

Ventroposterior junction: The normally angular intersection between the posterior and ventral margins, forming the ventroposterior angle.

MEASUREMENTS AND ABBREVIATIONS

The trigoniid sizes are in accordance with the conventional scale of Saveliev (1958), as follows: $\leq$ 10 mm, very small; 10–20 mm, moderately small; 20–30 mm, small; 30–50 mm, medium size; 50–100 mm, large; and $\geq$ 100 mm, very large. The following measures have been taken into account, whose definitions have been taken after Kaufmann, Leanza and Villamil (in preparation):

Length (L): The horizontal distance between two vertical planes perpendicular to the cardinal axis or hinge line. These planes pass through the most anterior and most posterior projections of the shell margin when the cardinal axis is oriented horontally.

Height (H): The perpendicular distance between two planes parallel to the cardinal axis. The planes pass through the most dorsally and ventrally projecting portions of the shell when oriented with the cardinal axis horizontal. These points are normally the beak and the mid-ventral margin.

Width (W): The distance taken perpendicular to the commissural plane and extending to the point of maximum inflation of one valve.

Ratio H/L: Ratio between the height and the length of a single valve.

Ratio W/L: Ratio Between the width and length of a single valve.

ABBREVIATIONS OF REPOSITORY INSTITUTIONS

MOZ – Museo Juan Olsacher. Dirección General de Minería de la Provincia del Neuquén. Olascoaga 421. 8340 Zapala, Neuquén, Argentina.

GHUNLPam – Cátedra de Geología Histórica de la Universidad Nacional de La Pampa. Uruguay 151. 6300 Santa Rosa. La Pampa, Argentina.

SGN – Servico Geológico Nacional. Av. Santa Fe 1548. 1060 Buenos Aires. Argentina.

SYSTEMATICS

Order **TRIGONIOIDA** Dall, 1889

Suborder **TRIGONIINA** Dall, 1889

Superfamily **TRIGONIACEA** Lamarck, 1819

Family **TRIGONIIDAE** Lamarck, 1819

Subfamily **MINETRIGONIINAE** Kobayashi, 1954

Genus **GROEBERELLA**, new genus

Type species.—*Myophoria neuquensis* Groeber, 1924, Liassic (Pliensbachian), Neuquén, Argentina.

Diagnosis.—Shell of large size, inequivalve. Umbones opisthogyrous. Flank ornamented with radial plicae extending from the umbonal region to the ventral margin. Marginal carina of the same strength as the flank plicae. Area smooth. Escutcheon narrow and smooth. Concentric or transverse costae absent, growth lines weak.

Distribution.—Lower Jurassic (Pliensbachian) to Middle Jurassic (Bajocian). Argentina and Chile.

Etymology.—This genus is dedicated to the memory of the outstanding geologist Dr. Pablo Groeber, author of the type species.

Discussion.—Groeber (1924) described *Myophoria neuquensis* from the Chachil Formation (Weaver, 1942), which he assigned to the Triassic based on the occurrence of this bivalve. Today the associated fauna found in this unit is thought to indicate a Liassic (Pliensbachian) age. Levy (1967a) assigned "*M.*" *neuquensis* to *Myophorigonia* Cox, 1952 (type species: *Myophoria paucicostata* Jaworski, 1922) but strong differences with the type species of this genus exist. Damborenea (in Riccardi, Damborenea and Manceñido, 1990, p. 89) considered the generic assignment of the *neuquensis* species of Groeber to *Myophorigonia* with quotation marks while discussing the age range of this species. The genus *Groeberella*, n. gen. differs from *Myophorigonia* Cox in: (1) being of larger size; (2) having a subquadratic instead of subrectangular shell shape; (3) having thicker valves; (4) in the total total absence of transverse or concentric costae; and (5) in the absence of nodes, tubercles, beads or knobs in any part of the shell. This new genus includes, apart from the type species, an Early Bajocian undetermined species which is also described in this paper. C. Newton (written communication, 1991) believes that there may be some specimens of *Groeberella* from the North American Triassic.

Groeberella, n. gen. is here tentatively included in Minetrigoniinae Kobayashi (1954). This subfamily fluorished in the Permo-Triassic, but some representatives are present in the Lower Jurassic (Hettangian) from Chile (Pérez and Reyes, 1977, p. 19). It might be possible to group this taxon into a new subfamily. The lack of preservation of the internal structures in the Argentine material, however, precludes assessing this possibilty for the time being.

Groeberella neuquensis (Groeber, 1924)
Plate 1, figures 2–3

Myophoria neuquensis Groeber, 1924, p. 92, pl. 1, figs. a, b; Wahnish, 1942, p. 59, pl. 6, figs. 3a–c; Levy, 1967a, p. 13.

Description.—Shell large. Strongly inequivalve, with the left valve largest than the right valve. Thick valved (4 mm). Umbones opisthogyrous, situated anteriorly. Dorsal margin short and straight. Dorsoposterior angle slightly obtuse. Posterior margin short. Ventroposterior junction rounded. Ventral margin convex, passing abruptly to the almost straight anterior margin. Flank occupying two-thirds of the shell surface, ornamented by two strong radial plicae extending from the umbonal region to the ventral margin. Marginal carina or umbonal ridge of the same strength as the flank plicae, extending from the beaks to the ventroposterior junction. Area smooth and slightly concave. Escutcheon narrow and smooth, bounded by smooth escutcheon carinae. Concentric weakly defined growth lines best

developed at the shell margins. No concentric rugae or costae.

Material.—One hypotype specimen, MOZ P4060, a left valve with the ventroposterior part broken, but still preserving its internal mold.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P4060	51	50	30	0.98	0.58

Remarks.—The differences between *Groeberella neuquensis* (Groeber) and the type species of the Triassic *Myophorigonia paucicostata* Jaworski (1922) from Perú are the same as for the genus. *Groeberella neuquensis* differs from the Middle Bajocian *Groeberella* sp. indet. (this paper) in (1) having larger size; (2) having a different shell shape; and (3) having thicker valves.

Age and occurrence.—Pliensbachian, *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones, Piedra Pintada Formation; Cerrito Roth, Cañadón de la Piedra Pintada (Locality 24), Dept. Collón Curá, Neuquén, Argentina.

Groeberella, species indeterminate
Plate 3, figure 16

Myophorigonia, sp. indet. Leanza and Garate, 1987, p. 225, pl. 1, fig. 3.

Description.—This specimen is a fragment of a left valve on which it is possible to distinguish an elevated opisthogyrous umbo situated centrally on the valve. The flank ornament consists of two strong radial costae or plicae which radiate from the beaks and extend in a straight line toward the ventral margin. These are crossed by weak concentric growth lines. Area and escutcheon not well impressed.

Material.—One (adult ?) fragment , MOZ P1375, of a poorly preserved left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1375	21	18	8	0.85	0.38

Remarks.—This fragment can be assigned to *Groeberella*, n. gen. on the basis of shell shape and the strong radial flank plicae crossed only by weak concentric growth lines, but its poor preservation precludes any finer taxonomic assignment. It differs from *Groeberella neuquensis* (Groeber) (herein described) by its smaller size and much thinner shell.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Subfamily **TRIGONIINAE**
Kobayashi, 1954

Genus **TRIGONIA** Bruguière, 1789

Type species.—*Venus sulcata* Hermann, 1781 (see Crickmay, 1932), Upper Liassic, Alsacia.

Diagnosis.—Trigonal to trigonally ovate. Inequivalve. Area, flank and escutcheon distinctly separated. Area wide, generally bipartite, with radial or reticulated ornament in areas where the radial and transverse costae intersect. Marginal carina prominent, usually tuberculated. Distinct antecarinal groove in left valve and postcarinal groove in right valve. Flank with continuous subconcentric costae on its main part. Costae generally meet the anterior margin at a high angle. Escutcheon smooth, or with transverse to oblique ridges (Crickmay, 1932; Cox, 1952).

Distribution.—Middle Triassic to Upper Cretaceous. Cosmopolitan.

Trigonia corderoi Lambert, 1944
Plate 3, figure 11; Plate 4, figures 5, 9;
Plate 5, figures 1, 2

Trigonia corderoi Lambert, 1944, p. 366, pl. 4, figs. 1–3; Pérez and Reyes, 1977, p. 11, pl. 1, figs. 1, 11; Leanza and Garate, 1987, p. 206, pl. 2, figs. 1, 2.

Description.—Shell large, inequivalve. Umbones prominent, opisthogyrous, strongly raised above the hinge line. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle acute. Ventral margin nearly straight, forming a sharp obtuse angle with the nearly vertical anterior margin. Flank occupying only two-thirds of the shell surface, ornamented with more than 30 equally spaced, prominent, subconcentric costae. Marginal carina well developed; antecarinal sulcus present on the flank of the left valve; postcarinal sulcus occurs in the area of the right valve. Area wide, bipartite, with narrow, radial, beaded costellae and transverse growth lines, divided into two equal parts by a beaded median area carina. Escutcheon lanceolate, excavated, ornamented only by oblique growth lines, bounded by a well developed, clavate escutcheon carina. Ligamental fossette wide, short and deep.

Material.—Three hypotype specimens: MOZ P0910, complete adult specimen; MOZ P5235, complete adult specimen; MOZ P3022, juvenile complete specimen.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0910	82	68	21	0.82	0.25
MOZ P5235	75	54	21	0.72	0.28
MOZ P3022	53	45	16	0.84	0.30

Remarks.—*Trigonia corderoi* Lambert (1944) differs from the associated *Trigonia mollesensis* Lambert

(1944, p. 364, pl. 3, figs. 1–4, pl. 10, fig. 6; described herein) from the Bajocian of Neuquén, Argentina in the following details: (1) its shape is different, characterized by a more erect anterior margin which passes evenly to the ventral margin; (2) the flank occupies a proportionally smaller surface of the shell; and (3) it is ornamented by much more sinuous concentric costae. Affinities of *T. corderoi* Lambert can also be traced to the Jurassic *Trigonia bajuranasi* Saveliev (1960, pl. 6, figs. 1a–b) from Mangyschlak, Turkmenistan; but the latter species differs in having more numerous and more arched costae on the flank. Damborenea (in Riccardi, Westermann and Damborenea, 1990, p. 118) tentatively considered *T. corderoi* Lambert as a junior synonym of *T. stelzneri* Gottsche (1878, p. 24, pl. 6, figs. 1a–d)), a species which has also been found in the Middle Jurassic of Perú (see Cox, 1956, p. 1184, pl. 128, figs. 5–6). Although *T. stelzneri* and *T. corderoi* are species which appear to be rather similar, a reexamination of the Gottsche's type would be necessary to confirm this. Moreover, Pérez and Reyes (1977, p. 9 and p. 11) have described separately *T. stelzneri* and *T. corderoi* as valid species from different fossil localities in Chile, and Lambert (1944, p. 364, pl. 2, figs. 6–7) reported *T. stelzneri* in the same paper in which he founded *T. corderoi*.

It is highly probable, however, that "*Trigonia stelzneri*" Weaver non Gottsche (Weaver, 1931, p. 240, pl. 20, figs. 103–104) from the Lajas Formation in Central Neuquén, which was not included in the synonomy of the true *Trigonia stelzneri* by Lambert (1944), constitutes a juvenile specimen of *T. corderoi*, very similar to the one figured in Plate 4, figures 5 and 9 of this monograph.

Age and occurrence.—Early Bajocian to Early Bathonian, *Emileia giebeli* to *Cadomites*–Tulitidae Zones, Lajas Formation; Los Pozones (Locality 15), Dept. Zapala, and Chacaicó (Locality 21), Dept. Catán Lil, Neuquén, Argentina. Also present in Chile in similar aged rocks.

Trigonia mollesensis Lambert, 1944
Plate 2, figures 12, 19

Trigonia mollesensis Lambert, 1944, p. 364, pl. 3, figs. 1–4; pl. 10, fig. 6; Leanza and Garate, 1987, p. 207, pl. 2, figs. 3, 4.

Description.—Shell large, inequivalve, trigonally ovate. Umbones opisthogyrous, not as prominent as in *T. corderoi*. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin convex, very slightly sinuous at its posterior end; ventral margin curves evenly into the convex anterior margin. Flank wide, occupying four-fifths of the shell surface, ornamented by 25 to 32 subconcentric costae that show a marked undulation on the anterior flank. Area not very wide, divided into two asymmetrical parts by a median carina, ornamented by 10–12 beaded, radial costae. Marginal carina well developed, with crenulations duplicating in number the flank costae. Antecarinal sulcus present in the left valve; postcarinal sulcus found in the right valve. Escutcheon lanceolate, depressed, bounded by a well developed, clavate escutcheon carina.

Material.—One hypotype, adult specimen, MOZ P0911, complete, with both valves very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0911	72	58	23	0.80	0.32

Remarks.—*Trigonia mollesensis* Lambert clearly differs from the associated *Trigonia corderoi* Lambert in that: (1) the umbones are less prominent; (2) the ventral margin shows a sinuosity near its posterior end; (3) the anterior and ventral margins merge very gradually; (4) the flank occupies a relatively major proportion of the shell surface; and (5) the costae describe a clear sinuosity at the anterior flank.

Age and occurrence.—Early Bajocian to Early Bathonian, *Emileia giebeli* to *Cadomites*–Tulitidae Zones, Lajas Formation; Los Pozones (Locality 15), Dept. Zapala, Neuquén, Argentina.

Trigonia losadai, new species
Plate 5, figures 3, 4

Holotype.—MOZ P3017, a complete and well preserved specimen.

Type locality.—Los Pozones (Locality 15), Dept. Zapala (39°10'S, 70°04'W). Lajas Formation (Weaver, 1931), Cuyo Group (Groeber, 1946).

Etymology.—In memoriam of Dr. Carlos A. Losada, former Director of the Mining Bureau of Neuquén Province, who improved the activities of the Museum Juan Olsacher.

Diagnosis.—Classic Trigoniidae of the *costata* group characterized by unusually wide flanks which are ornamented by sparse subconcentric costae. Marginal carina poorly defined. Area asymmetrically divided by a median carina, and ornamented by radial, beaded costellae. Escutcheon apparently with weak growth lines. Both area and escutcheon with rather flattened surfaces.

Description.—Shell large, inequivalve, trigonal. Umbones prominent, opisthogyrous. Dorsal margin slightly concave, very short. Dorsoposterior angle very obtuse. Posterior margin short. Ventroposterior angle acute. Ventral margin slightly convex, markedly sinuous at its posterior end, and curving evenly to the convex anterior margin. Flank very wide, occupying

five-sixths of the shell surface, ornamented by 18–20 subconcentric costae which are separated by intercostal spaces equal to three times the width of the costae. Area divided into two asymmetrical parts by a shallow median carina, ornamented by fine, beaded radial costae. Marginal carina not well developed. Antecarinal sulcus present in the left valve, and postcarinal sulcus occurs in the right valve. Escutcheon short and narrow, excavated, apparently with growth lines, bounded by a beaded escutcheon carina.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3017	70	58	23	0.82	0.32

Remarks.—*Trigonia losadai*, n. sp. differs from the associated *Trigonia mollesensis* Lambert in the following details: (1) its more trigonal shell shape; (2) its relatively shorter dorsal margin; (3) both the area and escutcheon form a more flattened surface; (4) the flanks occupy a relatively greater surface of the shell; and (5) the costae on the flank are regularly concentric and less abundant, resulting in wider intercostal spaces.

Trigonia losadai, n. sp. differs from the associated *T. corderoi* Lambert, in having: (1) a different shell shape; (2) the flank occupying a relatively larger proportion of the shell surface; (3) fewer flank costae; (4) a more indistinct marginal carina; and (5) a much more flattened area.

Trigonia costata Lamarck (in Agassiz, 1840, pl. 3, figs. 12–14) from the Liassic of Switzerland is a closely related species, but differs from *T. losadai*, n. sp. in that: (1) the flanks occupy a relatively greater surface of the shell; (2) the costae on the flank are more numerous; and (3) the marginal carina is much more prominent on *T. costata*. *Trigonia similis* Agassiz (1840, pl. 2, figs. 18–21, pl. 3, figs. 7, 7') from the Liassic of Gundershofen, Haut-Rhin, Germany, also shows strong affinities, but differs from *T. losadai*, n. sp. in having: (1) a more prominent marginal carina; and (2) more regular concentric costae.

Age and occurrence.—Early Bajocian to Early Bathonian, *Emileia giebeli* to *Cadomites*–Tulitidae Zones, Lajas Formation; Los Pozones (Locality 15), Dept. Zapala, Neuquén, Argentina.

Trigonia densestriata Behrendsen, 1892
Plate 3, figures 7–9

Trigonia densestriata Behrendsen, 1892, pl. 1, fig. 8; Leanza and Garate 1987, p. 207, pl. 1, fig. 4.

Description.—Shell small, shape trigonal, inequivalve. Umbones opisthogyrous. Dorsal margin flattened. Dorsoposterior angle very obtuse. Posterior margin short. Ventroposterior angle acute. Ventral margin well rounded, curving continuously into the convex anterior margin. Flank ornamented by more than 25 very fine, concentric costae, with the intercostal spaces equal to the width of the costae. Marginal carina poorly defined. Area ornamented by radial costellae. Escutcheon ornamented by oblique growth lines, bounded by a shallow, poorly defined escutcheon carina.

Material.—One hypotype adult specimen, MOZ P3042, complete, with both valves not very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3042	28	18	8	0.64	0.28

Remarks.—This hypotype allows new morphological observations to be made on the previously poorly known *T. densestriata* Behrendsen. The shell is longer than high, and the escutcheon is ornamented by oblique growth lines. Although in lateral view the flank ornamentation resembles that of *Frenguelliella perezreyesi*, n. sp. (this paper) from the same beds, the transversely costulate area of the latter species easily differentiates these taxa. Leanza and Garate (1987, p. 207, pl. 1, fig. 4) previously described this species from Los Pozones (Locality 15).

Age and occurrence.— Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Trigonia mirandaensis Lambert, 1944
Plate 5, figure 7

Trigonia mirandaensis Lambert, 1944, p. 371, pl. 1, fig. 9.

Description.—Shell small, trigonal, somewhat longer than high, slightly inflated. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin slightly concave. Dorsoposterior angle very obtuse. Posterior margin short. Ventroposterior angle acute. Ventral margin slightly convex, curving strongly into the almost straight anterior margin. Flank occupying four-fifths of the shell surface, ornamented by nearly 18 smooth, subconcentric, relatively wide costae. The intercostal spaces are equivalent to twice the width of the costae. Area subplanate, forming almost a right angle with the plane of the flanks, divided into two parts by a median carina, ornamented by 3 or 4 radial costellae on each portion. Marginal carina protruding, with antecarinal sulcus in the left valve and postcarinal sulcus in the right valve. Escutcheon, short and wide, apparently smooth.

Material.—One topotype adult specimen, MOZ P4252/3, a poorly preserved right valve, in a coarse-grained, light-brown sandstone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
SGN 41-201	26	20	–	0.75	–

Remarks.—*Trigonia mirandaensis* Lambert shows affinities with *T. angustecostata* Behrendsen (1892, p. 28, pl. 3, fig. 7) from the Hauterivian Agrio Formation of Neuquén (see Leanza and Garate, 1987, p. 208), but in this species the flank costae are narrower and more numerous, and the intercostal spaces narrower. This species occurs in association with *Lambertrigonia pichimoncolensis* (Lambert) in coarse-grained, light-brown sandstones from the Tordillo Formation.

Age and occurrence.—Kimmeridgian (unknown ammonite Zone), Tordillo Formation; northwest of Laguna Miranda (Locality 33), Dept. Zapala, Neuquén, Argentina.

Trigonia carinata Agassiz, 1840
Plate 7, figures 7–9

Trigonia carinata Agassiz, 1840, p. 43, pl. 7, figs. 7–10; d'Orbigny, 1843, vol. 3., p. 132, pl. 286, fig. 7; Lycett, 1877, p. 179, pl. 35, figs. 3–6; Burckhardt, 1900a, p. 22, pl. 25, figs. 6–8; 1903, p. 75, pl. 13, fig. 6, pl. 14, fig. 3; Weaver, 1931, p. 263, pl. 26, figs. 137–141, pl. 27, figs. 147–149; A. F. Leanza, 1945, p. 94, fig. 17; Corvalán and Pérez, 1958, p. 40, pl. 3, figs. 1a, b; Corvalán, p. 31, fig. 5; Leanza and Garate, 1987, p. 207, pl.5, figs. 6, 7.

Trigonia stelzneri Agassiz. Philippi, 1899, p. 68, pl. 31, figs. 1–3, pl. 35, fig. 2.

Trigonia (*Trigonia*) *carinata* Agassiz. Reyes and Pérez, 1978, pl.1, figs. 1, 2.

Description.—Shell large. Trigonally ovate. Inequivalve, with very wide and thick valves. Umbones opisthogyrous, not elevated above the hinge line. Dorsal margin flat, slightly elevated in its middle part. Dorsoposterior angle very obtuse. Posterior margin short. Ventroposterior angle also obtuse. Ventral margin short and strongly convex, passing abruptly to the slightly convex anterior margin. Flank occupying more than two-thirds of the shell surface, ornamented by nearly 28 strong, subconcentric costae that meet the anterior margin at very high angles. Marginal carina prominent, ornamented by short, raised costae that duplicate the number of costae on the flank. Antecarinal sulcus present in the flank of the left valve; postcarinal sulcus occurs in the area of the right valve. Area well defined, divided almost symmetrically by a tuberculated median carina, and ornamented with beaded radial costae which are intercepted by concentric growth lines; concentric lines more dominant in the distal portion of the area. Escutcheon very wide and subplanate, with a shallow elevation in its middle part, ornamented by radial and prominent growth lines. Escutcheon carina well developed, tuberculated. A short, deep ligamental fossette is present. Both valves show a shallow anterior byssal gape at the plane of commissure, just below the beaks.

Material.—Two hypotype adult specimens, MOZ P0915, complete, with both valves very well preserved (see Leanza and Garate, 1987, pl. 5, figs. 6–7) and MOZ P4395, from Cerrito Caracoles (Locality 11), and one hypotype adult specimen, MOZ P5607, complete, with both valves very well preserved, from Cerro Mesa, Covunco (Locality 8).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0915	92	57	38	0.61	0.41
MOZ P5607	58	40	22.5	0.68	0.38

Remarks.—There is a possibility that the Andean specimens of *Trigonia carinata* Agassiz figured since Philippi (1899) and Burckhardt (1900a,b) belong to other new taxa, but a reexamination of the specimens of *T. carinata* figured by d'Orbigny (1843) and Lycett (1877) is needed to determine this.

T. carinata Agassiz (1840, pl. 7, figs. 7–10) from the Neocomian of Neuchâtel, Switzerland, was originally founded on the basis of an internal mold which exhibits significant differences when compared with the southwestern Gondwanan forms. The assignment of the South American specimens to *T. carinata* Agassiz thus follows the interpretation of this taxon by previous workers (Burckhardt, 1903; Weaver, 1931; Corvalán and Pérez, 1958; Corvalán, 1959; Reyes and Pérez, 1978; Leanza and Garate, 1987).

Age and occurrence.—Upper Tithonian, *Substeueroceras koeneni* Zone, Picún Leufú Formation; Cerrito Caracoles (Locality 11), Dept. Zapala. Lower/Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Trigonia levyi, new species
Plate 6, figures 3, 4

Holotype.—MOZ P5314, a well preserved adult right valve with the posterior part broken, fossilized as a quartz geode with calcite in the center.

Type locality.—Las Cortaderas (Locality 36), Dept. Catán Lil (39°23'S, 70°11'W), Picún Leufú Formation (Leanza, 1973), Mendoza Group (Groeber, 1946).

Etymology.—This species is dedicated to the Argentine paleontologist Regina Levy of Buenos Aires, Argentina, former specialist in trigoniid bivalves.

Diagnosis.—Shell large, with flank ornamentation similar to *Trigonia carinata* Agassiz, but area and escutcheon distinctly ornamented by protruding transverse rugae crossed by deep radial grooves.

Description.—Shell large, trigonally ovate. Umbones opisthogyrous, situated in the extreme anterior part of the shell. Escutcheon, area and flank distinctly separated. Dorsal margin slightly convex in its middle part. Dorsoposterior angle obtuse. Posterior margin and ventroposterior angle not preserved. Ventral margin not preserved, but presumably short and convex. Anterior margin widely convex. Flank occupying only one-half of the shell surface, ornamented by more that 20 sharp, elevated, subconcentric costae that meet the anterior margin at high angles, similar to the style of costulation of *Trigonia carinata* Agassiz. Marginal carina prominent, ornamented by short, transverse rugae. Area well defined, ornamented by protruding transverse rugae, symmetrically divided by a deep median groove, and the remaining lower and upper portions of the area by further deep radial grooves, giving the area a corn-like aspect. Escutcheon relatively wide and long, separated form the area by a deep groove, ornamented by oblique rugae which are smaller than those of the area, but equally crossed by deep radial grooves.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5314	≈85	–	28	–	0.32

Remarks.—*Trigonia levyi*, n. sp. differs from any other known species of the genus *Trigonia* Bruguière by the characteristic ornamentation of area and escutcheon, consisting in protruding transverse rugae crossed by deep radial grooves producing a corn-like aspect. *Trigonia levyi*, n. sp. has a flank ornamentation similar to the South American Tithonian and Neocomian representatives of *Trigonia carinata* Agassiz (1840, p. 43, pl. 7, figs. 7–1; Weaver, 1931, p. 263, pl. 26, figs. 137–141; pl. 27 figs. 147–149; herein described), or the Hauterivian *Trigonia aliexpandita* Leanza and Garate (1983, p. 106, pl. 1, figs. 1–3; herein described), but the different pattern of the ornamentation of area and escutcheon easily allows differentiation of these taxa.

Age and occurrence.—Middle Tithonian, *Windhauseniceras internispinosum* Zone, Picún Leufú Formation; Las Cortaderas (Locality 36), Dept. Catán Lil, Neuquén, Argentina.

Trigonia, species juvenile indeterminate
Plate 8, figure 5

Description.—Shell very small (L = 8.5 mm), trigonally ovate. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin straight. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle almost 90°. Ventral margin straight, curving strongly into the widely convex anterior margin. Flank occupying four-fifths of the shell surface, ornamented by twelve, equally spaced, weakly beaded, subconcentric costae. Surfaces of flank and area meet at a high angle where a poorly defined marginal carina is present. Area ornamented by faint radial costellae. Escutcheon not observable.

Material.—One juvenile specimen, MOZ P5466, consisting of a rather well preserved right valve, fossilized in a yellowish-white calcarenite.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5466	8.5	5.5	2	0.64	0.23

Remarks.—Although this very small right valve is relatively well preserved, the juvenile nature of the specimen precludes further taxonomic determination.

Age and occurrence.—Upper Tithonian, *Substeueroceras koeneni* Zone, Picún Leufú Formation; Laguna Blanca (Locality 13), Dept. Zapala, Neuquén, Argentina.

Trigonia fortinensis Lambert, 1944
Plate 6, figures 6, 7

Trigonia fortinensis Lambert, 1944, p. 386, pl. 4, figs. 5–8.

Description.—Shell small, elongated. Umbones prominent, opisthogyrous. Dorsal margin short, nearly straight. Dorsoposterior angle very obtuse. Posterior margin relatively long. Ventroposterior angle acute. Ventral margin slightly convex, passing evenly to the convex anterior margin. Flank ornamented by nearly 30 very narrow, subconcentric costae. Marginal carina poorly defined, except that the surfaces of flank and area meet at a high angle. Area relatively narrow, ornamented by numerous radial costellae. Escutcheon narrow, ornamented by radial growth lines, bounded by a poorly defined escutcheon carina.

Material.—One hypotype adult specimen, MOZ P3006, complete, with both valves relatively well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3006	30	19	5.5	0.63	0.18

Remarks.—*Trigonia fortinensis* Lambert closely resembles the Bajocian *T. densestriata* Behrendsen from the Lajas Formation of the Neuquén Basin (herein described), but it differs in having more elevated umbones, a rostrate shell, and denser costae on the flank. The Hauterivian *T. angustecostata* Behrendsen (1892) from the Agrio Formation (herein described) is also a closely related species, but differs from *T. fortinensis* in being much wider and shorter, in not exhibiting the

elongate pattern of the shell, and in having the area and escutcheon approximate a flattened surface.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* Zone, Picún Leufú Formation; Cerro Lotena (Locality 32), Dept. Zapala, Neuquén, Argentina.

Trigonia aliexpandita Leanza and Garate, 1983b
Plate 10, figures 3, 4

Trigonia carinata Lambert, 1944 (non Agassiz), p. 383, pl. 8, fig. 5.
Trigonia carinata aliexpandita Leanza and Garate, 1983b, p. 106, pl. 1, figs. 1–3; Leanza and Garate, 1987, pl. 5, figs. 1–3; pl. 6, fig. 1.

Description.—Shell large, inequivalve, trigonally ovate. Umbones opisthogyrous, very anteriorly situated. Dorsal margin notably expanded in correspondence with the large escutcheon. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle almost 90°. Ventral margin short and strongly convex, passing abruptly to the gently convex anterior margin. Flank occupying more than two-thirds of the shell surface, ornamented by strong, subconcentric costae. Marginal carina prominent, ornamented by transversely elongated short costae, duplicating distally the number of flank's costae. Antecarinal sulcus present in the left valve; postcarinal sulcus present on the right valve. Area well-defined, strongly ornamented by beaded radial costae which are intercepted by concentric growth lines, producing a reticulate ornament. Escutcheon well defined, diagnostic of the species, notably expanded in the form of a wing in its mid-posterior region. Escutcheon carina clavate, prominent.

Material.—The holotype specimen, MOZ P0951/1 (see Leanza and Garate, 1983b, pl. 1, figs. 1–3), an adult specimen, complete, with both valves very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0951/1	78	63	23	0.80	0.29

Remarks.—Although this species was originally described by Leanza and Garate (1983b) as a variety of *T. carinata*, it is now considered that the strongly protruding escutcheon is a unique feature in the shell morphology of specific significance. This feature may also have importance in the mode of life of this trigoniid bivalve; the escutcheon seems likely to have had respiratory functions, and may have been elevated above the water-sediment interface, resembling the living position of *Trigonia* as drawn by Stanley (1977, p. 881, text-fig. 5). For this reason the subspecies *aliexpandita* is here elevated to species rank.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Trigonia wiedmanni Leanza and Garate, 1987
Plate 17, figures 7–10

Trigonia wiedmanni Leanza and Garate, 1987, p. 209, pl. 6, figs. 3–5.

Description.—Shell small, inequivalve. Trigonally ovate. Umbones opisthogyrous, very anteriorly situated. Dorsal margin short and nearly flat. Dorsoposterior angle obtuse. Posterior margin long. Ventroposterior angle almost 90°. Ventral margin slightly convex, curving continuously to the convex anterior margin. Flank ornamented by eight to nine smooth, raised, subconcentric costae, separated by intercostal spaces equivalent to three times their width. Marginal carina strongly developed. Antecarinal sulcus present in the left valve; postcarinal sulcus occurs in the right valve. Area occupying one-third of the shell surface, divided in two equal parts by a median carina, and ornamented by a narrow, widely spaced costellae, protruding above the otherwise smooth surface. Escutcheon smooth, somewhat excavated, bounded by a well-defined, raised, escutcheon carina. Byssal gape occurs just below the beaks.

Material.—Holotype, a well preserved adult shell MOZ P0942/1 (see Leanza and Garate, 1987, pl. 6, figs. 3–5). Paratype, an adult specimen, MOZ P0942/2, with both valves well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0942/1	29	24	9	0.83	0.31
MOZ P0942/2	28	22	8.5	0.78	0.30

Remarks.—*Trigonia wiedmanni* Leanza and Garate (1987) resembles in its general shape some juvenile forms of *T. cassiope* d'Orbigny, as figured by Lycett (1863, 1872). But these forms differ in having a greater number of costae on the flanks. Affinities of *T. wiedmanni* can also be traced to the original Neocomian *T. carinata* Agassiz (1840, pl. 7, figs. 7–10), but this species has a proportionally greater shell length, a different general shape, and has a distinct dorsal margin and anteroventral margin.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Negro, Covunco (Locality 9), Dept. Zapala, Neuquén, Argentina.

Trigonia angustecostata Behrendsen, 1892
Plate 13, figures 3–5

Trigonia angustecostata Behrendsen, 1892, p. 28, pl. 3, fig. 7 (= 1922, pl. 4, fig. 7); Steinmann, 1929, p. 220, fig. 29; Leanza and Garate, p. 208, pl. 5, figs. 4, 5.

Description.—Shell small, inequivalve, trigonally ovate. Umbones depressed. Escutcheon and area collectively form a flattened surface. Dorsal and posterior margins forming both a straight line. Ventral margin slightly convex, curving gradually into the convex anterior margin. Flank ornamented by fine subconcentric costae parallel to the ventral region of shell, and meeting the anterior margin at high angles. Marginal carina forming a sharp edge between flank and dorsal face of shell. Area wide, with radial costellae asymmetrically divided by a very shallow submedian carina. Escutcheon lanceolate, ornamented by faint radial costellae.

Material.—One hypotype, an adult specimen, MOZ P0950, complete, with both valves relatively well preserved. (See Leanza and Garate, 1987, pl. 5, fig. 5).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0950	26	18	9	0.69	0.35

Remarks.—*Trigonia angustecostata* Behrendsen shows some affinities with *T. fortinensis* Lambert (1944, pl. 4, figs. 5, 8) from the Tithonian of Arroyo del Fortín (middle course of Catán Lil river), but the latter species is essentially rostrate, the umbones are more prominent, the flank is more densely costate, and the area and escutcheon do not conform to a flattened surface.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Subfamily NEUQUENITRIGONIINAE, new subfamily

Diagnosis.—Same as for genus.

Distribution.—Middle Jurassic (Bajocian), Argentina and Chile.

Discussion.—As restricted here, the new subfamily comprises only the nominate genus, *Neuquenitrigonia*, which bears transverse costellae on the escutcheon, and thick, widely spaced, transverse flank costae. Although Neuquenitrigoniinae clearly belongs to the family Trigoniidae s.s., as it displays a broad area with truncated posterior margin, prominent marginal carina, and an antecarinal groove restricted to the left valve, the presence in *Neuquenitrigonia* of a wide, flat, transversely costate escutcheon, as well as thick transverse flank costae precludes assignment of this taxon to the Trigoniinae Lamarck (1819), as this subfamily is characterized by an escutcheon with radial ornament, and subconcentric flank costae (see Cooper, 1991, p.7). Accordingly, *Neuquenitrigonia* is regarded as an independent lineage, justifying a new subfamily.

Genus NEUQUENITRIGONIA Leanza and Garate, 1987

Type species.—*Trigonia huenickeni* Leanza and Garate, 1985, Bajocian, Neuquén, Argentina.

Diagnosis.—Shell large, inequivalve, trigonally ovate. Flank ornamented by thick, widely spaced, transverse costae. Area relatively wide, ornamented by beaded radial costae crossed by transverse growth lines, divided into two asymmetrical parts by a submedian carina. Marginal carina very well developed. Escutcheon large, elevated, subplanate, and ornamented by transverse costae (Leanza and Garate, 1985, 1987).

Distribution.—Middle Jurassic (Bajocian). Argentina.

Neuquenitrigonia huenickeni (Leanza and Garate, 1985) Plate 3, figures 10, 17

Trigonia huenickeni Leanza and Garate, 1985, p. 290, pl. 1, figs. 1–3.

Neuquenitrigonia huenickeni (Leanza and Garate). Leanza and Garate, 1987, p. 209, pl. 3 , figs. 1–3.

Description.—Shell large, inequivalve, trigonally ovate, longer than high, and very wide. Umbones opisthogyrous, very anteriorly situated. Dorsal margin short and straight, coincident with the escutcheon. Dorsoposterior angle obtuse. Posterior margin relatively long. Ventroposterior junction rounded. Ventral margin short and slightly convex, abruptly curving into the gently convex anterior margin. Flank occupying one-half of the shell surface, ornamented by thick, widely spaced, transverse costae that meet the anterior margin at nearly 90°. Marginal carina prominent, rounded, ornamented by short, transverse costae that duplicate in number those costae arising from the flanks. Area relatively wide, divided into two asymmetrical parts by a submedian carina; ornamented by beaded radial costae, terminated by transverse growth lines, giving this region a reticulated aspect. Escutcheon large, elevated, subplanate, ornamented by thick transverse costae. Ligamental fossette wide, short, extending posteriorly from the beaks.

Material.—One topotype specimen (Barda Negra Sur), MOZ P2319, consisting of a well preserved adult right valve, with the umbonal region of the left valve. Two hypotype specimens (Máquina Curá, Chacaicó), MOZ P4919/1, a beak of an adult left valve with the internal structure preserved; and MOZ P4919/2, a fragment of the umbonal region of a left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2319	86	59	35	0.68	0.40

Remarks.—The clear demarcation between the flank, area and escutcheon, and the general shape of the shell favors the inclusion of the genus *Neuquenitrigonia* into the subfamily Trigoniinae. *Neuquenitrigonia huenickeni* is easily distinguished by the thick, widely spaced, transverse costae on the flanks, and by its wide, flat, transversely costated, escutcheon. *Neuquenitrigonia* has recently been found in the Middle Jurassic of Chile (E. Pérez, written communication, 1991).

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, and Máquina Curá, Chacaicó (Locality 21), Dept. Catán Lil, Neuquén, Argentina.

Subfamily **FRENGUELLIELLINAE** Nakano, 1960 emend.

Genus **FRENGUELLIELLA** A. F. Leanza, 1942

Type species.—*Trigonia inexspectata* Jaworski, 1916 (=1925), Liassic, Piedra Pintada, Neuquén, Argentina.

Diagnosis.—Trigonally ovate. Umbones less prominent than in *Trigonia*. Area with transverse costae or growth lines. Marginal carina ornamented by costae arising from the flank or area, or both. Flank with concentric costae that meet the anterior margin at high angles, and that may be somewhat irregular (A.F. Leanza, 1942; Cox, 1969; Poulton, 1979).

Distribution.—Upper Triassic to Upper Cretaceous. Cosmopolitan.

Frenguelliella tapiai (Lambert, 1944)
Plate 1, figure 8

Trigonia tapiai Lambert, 1944, p. 358, pl. 13, fig. 1
Trigonia (*Frenguelliella*) *tapiai* Lambert. Pérez and Reyes, 1977, p. 12, pl. 1, fig. 1.
Frenguelliella tapiai (Lambert). Leanza and Garate, 1987, p. 210, pl. 1, fig. 5.

Description.—Shell of small to medium size. Ovate to subquadrangular in shape. Umbones prominent, very anteriorly situated. The flank, which occupies less than two-thirds of the shell surface, is ornamented by more than 30 very thin, equally spaced, concentric costae. Marginal carina well developed and antecarinal sulcus present, both ornamented by the costae arising from the flanks. Area triangular, widening strongly posteriorly, asymmetrically divided by a submedian groove, and ornamented by numerous very thin, transverse costellae.

Material.—Hypotype, an adult specimen, MOZ P2679, consisting in an incomplete left valve that precludes measurements.

Remarks.—The described specimen undoubtedly belongs to *Frenguelliella tapiai* (Lambert, 1944, pl. 13, fig. 1) from the southeast of Cerro Chachil, Neuquén, especially because it possesses a similar shell shape and the same number of concentric costae on the flanks. H. Leanza and Garate (1987, p. 210, pl. 1, fig. 5) described the escutcheon of this species as narrow and elongated from a specimen preserved in butterfly position, ornamented by 8–10 very fine oblique costellae which are finally parallel to the dorsal margin. C. Newton (written communication, 1991) has pointed out that this taxon is also present in North America and Perú.

Age and occurrence.—Pliensbachian. *Fanninoceras* Zone, Chachil Formation; Estancia Marichelar, Arroyo Ñireco (Locality 14), Dept. Catán Lil, Neuquén, Argentina.

Frenguelliella inexspectata Jaworski, 1916
Plate 2, figure 9

Trigonia inexspectata Jaworski, 1916, p. 377, pl. 5, figs. 2a, b (=1925, p. 79, pl. 1, figs. 2a, b).
Trigonia (*Frenguelliella*) *inexspectata* (Jaworski). A. F. Leanza, 1942, p. 265, pl. 7, fig. 1.

Description.—Internal mold of a large shell. Inequivalve. Umbones opisthogyrous, not very prominent. Flank occupying two-thirds of the shell surface, ornamented by nearly 30 simple, regularly spaced subconcentric costae. Marginal carina poorly defined. Area ornamented by transverse, equally spaced, narrow costae which duplicate in number those costae present on the flank. Escutcheon not recognizable.

The internal mold preserves evidence of a broad, bifid tooth 2 (Douvillé notation, 1913) in the left valve, and a transversely ridged 3a tooth in the right valve.

Material.—Hypotype, MOZ P2766, consisting in an internal mold, poorly preserved juvenile specimen, showing part of the left and right valves.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2766	≈55	40	15	0.72	0.27

Remarks.—Although the described specimen is an internal mold, its morphological features allow assignment to *Frenguelliella inexspectata* (Jaworski).

Age and occurrence.—Pliensbachian, *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones; Estancia Santa Isabel (Locality 39), Dept. Catán Lil, Neuquén, Argentina.

Frenguelliella poultoni, new species
Plate 2, figures 3–6

Frenguelliella sp. B. Poulton, 1979, p. 18, pl. 1, fig. 10.

Holotype.—MOZ P5315, a complete, well preserved right valve.

Paratypes.—MOZ P5316, a well preserved adult right valve; MOZ P5317/1, a relatively well preserved juvenile right valve; MOZ P5317/2, an external cast of an adult right valve.

Type locality.—Arroyo Ñireco. Estancia Marichelar (Locality 14), Dept. Catán Lil (39°02'S, 70°32'W), Chachil Formation (Weaver, 1942), Cuyo Group (Groeber, 1946).

Etymology.—The species is dedicated to the Canadian paleontologist Terry P. Poulton (Calgary, Canada).

Diagnosis.—Finely sculptured and more nearly rectangular in outline than any other known species of *Frenguelliella*. Area broad, with fine regular transverse costellae. Marginal carina distinct. Flank with no more than 18 very regular, equally spaced, concentric costae.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5315	18	15	–	0.83	–
MOZ P5317/1	18	15	3.5	0.83	0.19
MOZ P5316	33	25	–	0.75	–
MOZ P5317/2	23	17	4	0.74	0.17

Description.—Shell small, rectangular in shape, much longer than high. Umbones very anteriorly situated. Dorsal margin slightly concave. Dorsoposterior angle slightly obtuse. Posterior margin long. Ventroposterior angle almost 90°. Ventral and anterior margins forming a broad, continuous convex margin up to the beaks. Area wide, asymmetrically divided by a median groove, strongly flaring toward the posterior margin, ornamented by transverse costellae in the proximal portion, and by growth lines in the distal part. Marginal carina distinct. Escutcheon carina poorly defined except near umbo. Flank ornamented by no more than 18 very regular, equally spaced, concentric costae that meet the anterior margin at high angles. Escutcheon probably with very faint oblique growth lines.

Remarks.—This species appears to be identical with *Frenguelliella* sp. B of Poulton (1979, p. 18, pl. 1, fig. 10) from the Early Sinemurian of Laberge Group, Yukon Territory, Canada, in the rectangular shape of the shell, and the great similarity of ornamentation on the area and flank, including a distinct marginal carina. It differs from the English "*Trigonia*" *costatula* Lycett (1872–1879, pl. 12, figs. 6, 6a) in being more elongated and in having a more flared area. *Frenguelliella tapiai* (Lambert, 1944, pl. 13, fig. 1), which occurs in the same formation in the southwestern part of the Neuquén Basin, differs from *Frenguelliella poultoni*, n. sp. in having a subquadrangular shape, an area with marked transverse costae occupying a relatively larger portion of the shell surface, as well as by a greater number of costae on the flanks.

Age and occurrence.—Sinemurian, Laberge Group, Yukon, Canada. Pliensbachian, *Fanninoceras* Zone, Chachil Formation; Estancia Marichelar, Arroyo Ñireco (Locality 14), Dept. Catán Lil, Neuquén, Argentina.

Frenguelliella perezreyesi, new species
Plate 2, figures 1–2, 7–8

Holotype.—MOZ P3030/1, consisting in a well-preserved, adult right valve.

Paratype.—MOZ P3030/2, consisting in a small adult, right valve.

Type locality.—Barda Negra Sur (Locality 16), Dept. Zapala (39°10'S, 69°57'W). Neuquén. Argentina, Lajas Formation (Weaver, 1931), Cuyo Group (Groeber, 1946).

Etymology.—This species is dedicated to the Chilean paleontologists and trigoniid specialists Ernesto Pérez d'Angelo and Renato Reyes.

Diagnosis.—Shell of small size, trigonal. Umbones opisthogyrous. Flank densely ornamented by narrow subconcentric costae. Marginal carina forming a strong junction between the flank and dorsal face of the shell. Area wide, with narrow transverse costellae that duplicate in number those of the flank. Escutcheon very narrow, apparently smooth.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3030/1	19	14	6	0.73	0.31
MOZ P3030/2	15	10	4	0.66	0.26

Description.—Shell moderately small, inequivalve. Umbones opisthogyrous, relatively prominent. Escutcheon and area forming a flattened surface. Dorsal and posterior margins extending through a same line up to the ventroposterior junction. Ventral and anterior margins forming a wide convexly curved margin. Flank ornamented by more than 30, very narrow, equally spaced, subconcentric costae. Marginal carina distinct, but not well developed, coinciding with a strong junction between the flank and dorsal face of the shell. Area relatively wide, ornamented by transverse costellae that duplicate in number those arising from the flank. Escutcheon very narrow, apparently smooth.

Remarks.—This new species of *Frenguelliella* is easily distinguished from other known species by its moderately small size and the shell shape, in which the dorsal face of the valve forms a flattened surface that meets the flank surface almost perpendicularly. This feature also distinguishes this new species from the densely costate Pliensbachian *Frenguelliella tapiai* (herein described), in which the area is also comparatively wider. *Frenguelliella poultoni*, n. sp. exhibits a much more sparsely costate flank, and the shell shape is also different. Resemblance of the new species with *Trigonia densestriata* Behrendsen and *Trigonia angustecostata* Behrendsen (both herein described) are only superficial, as these species display radial ornament in the area and escutcheon, a feature which is absent in *Frenguelliella*.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Subfamily **MYOPHORELLINAE** Kobayashi, 1954

Genus **JAWORSKIELLA** A. F. Leanza, 1942

Type species.—*Trigonia burckhardti* Jaworski, 1916 (=1925), Liassic (Pliensbachian), Piedra Pintada, Neuquén, Argentina.

Diagnosis.—Oblong, strongly inequivalve. Area with strong, transverse ridges. Marginal carina well developed. Costae on the anterior flank gently oblique, anteroventrally sloping; costae on the posterior flank upwardly curved. These can be either continuous or with lines of pustules. Antecarinal groove present, across which faint extensions of the costae may extend. Each costa of the area may correspond with a flank costa, or there may be a larger number of spaced costae (A.F. Leanza, 1942; Cox, 1969; Poulton, 1979).

Distribution.—Lower Jurassic. North and South America.

Jaworskiella burckhardti (Jaworski, 1916)
Plate 1, figures 1, 6–7, 10

Trigonia gryphitica Burckhardt non Steinmann. Burckhardt, 1901, p. 21, pl. 4, fig. 4.
Trigonia burckhardti Jaworski, 1916, p. 380, pl. 5, fig. 3 (= 1925, p. 81, pl. 1, fig. 3).
Trigonia (*Jaworskiella*) *burckhardti* (Jaworski). A. F. Leanza, 1942, p. 166, pl. 6, figs. 2, 3.
Jaworskiella burckhardti (Jaworski). Pérez and Reyes, 1977, p. 14, pl. 2, figs. 1, 3, 6; Leanza and Garate, p. 210, pl. 1, figs. 1, 2.

Description.—Shell of medium to very large size. Oblong, inequivalve, somewhat inflated, with thick valves. Umbones prominent, opisthogyrous, slightly raised above the hinge line. Dorsal margin concave. Dorsoposterior angle obtuse. Ventroposterior angle almost right to slightly obtuse. Posterior margin short. Ventral margin well rounded, curving into the convex anterior margin. Flank occupying more than four-fifths of the shell surface, ornamented in the adult stage by more than 22 subconcentric, more or less sinuous costae. On the anterior flank these are bifurcated in some cases, and on the posterior flank they are pustulate and upwardly curved. In the juvenile specimen, the costae follow the same pattern, but they do not show complications on the anterior flank, and they are fewer in number. Area well-defined, bounded by tuberculated marginal and escutcheon carina, ornamented in the adult by strong oblique ridges and growth lines, and asymmetrically divided by a submedian groove. The juvenile shells have narrow, transverse costellae. Escutcheon elongated, slightly concave, apparently smooth.

Material.—Hypotype, MOZ P3044, complete adult shell, very well preserved, with the right valve somewhat broken posteriorly; hypotype, MOZ P3043, complete juvenile shell, very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3044	105	78	28	0.74	0.26
MOZ P3043	41	33	13	0.80	0.31

Remarks.—Although the type species of *Jaworskiella* bears simple costae (see Jaworski, 1916, pl. 5, fig. 3), the presence of pustulose costae in the posterior flank of *J. burckhardti* is interpreted to represent intraspecific variation. The presence of somewhat tuberculated costae in this part of the flank was already referred to in this species by Leanza and Garate (1987, p. 210); the other essential features of the species remain constant, in agreement with the interpretation of this genus made by Poulton (1979, p. 19). The small specimen is interpreted to be a juvenile representative of *J. burckhardti*. It displays similar morphometric parameters, with the only exception being that the flank costae are simple, as in the type species of *Jaworskiella*.

Quadratojaworskiella pustulata Reyes and Pérez (1980, p. 89, pl. 1, figs. 1–4; pl. 2, figs. 1–4) from the Early Pliensbachian of Quebrada Los Asientos, northern Chile, differs from *J. burckhardti* by its quadrate shape, nearly straight anterior margin, greater number of costae, and presence of true tubercles on the flank ornamentation.

Age and occurrence.—Pliensbachian, *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones, Piedra Pintada Formation; Cerrito Roth, Cañadón de la Piedra Pintada (Locality 24), Dept. Collón Curá, and Estancia Santa Isabel (Locality 27), Dept. Collón Curá, Neuquén, Argentina.

Genus **MYOPHORELLA** Bayle, 1878

Type species.—*Myophorella nodulosa* Bayle, 1878, Upper Jurassic (Oxfordian), France.

Diagnosis.—Trigonally ovate, strongly inequivalve. Area bipartite, with transverse costae or growth lines, and in some species with oblique costae superimposed on the transverse ornament. Marginal and escutcheon carinae generally distinct. Flank variously ornamented, usually with oblique and curved costae which may bear rows of different type and size of tubercles. Escutcheon very distinct, shallow, with transverse to oblique costellae or growth lines (Crickmay, 1932; Cox, 1969; Poulton, 1979).

Distribution.—Lower Jurassic (Middle Liassic) to Upper Cretaceous. Cosmopolitan.

Subgenus **MYOPHORELLA** sensu stricto

Myophorella (Myophorella) araucana
(A. F. Leanza, 1942)
Plate 1, figures 4, 5

Trigonia aff. *angulata* Sowerby. Burckhardt, 1901, p. 22, pl. 4, figs. 5, 6.
Trigonia (*Clavitrigonia*) *araucana* A. F. Leanza, 1942, p. 162, pl. 6, figs. 4–6.
Myophorella (*Promyophorella*) *araucana* (A. F. Leanza). Levy, 1966, p. 240.
Myophorella (*Myophorella*) *araucana* (A. F. Leanza). Pérez and Reyes, 1977, p. 13, figs. 1–3. (= *T.* (*C.*) *araucana* A. F. Leanza, 1942, pl. 6, figs. 4–6); Pérez, 1982, pl. 14, fig. 9; Leanza and Garate, 1987, p. 211, pl. 1, figs. 6–8.

Description.—Shell medium to large in size. Ovate, somewhat longer than high, inequivalve. Umbones opisthogyrous, very anteriorly situated, slightly raised above the hinge line. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin relatively long. Ventroposterior angle obtuse. Ventral margin rounded, curving continuously into the convex anterior margin. Area wide, ornamented by fine transverse costae, bounded by a tuberculated marginal carina, more marked in its distal portion, and a clavate escutcheon carina. Flank ornamented with concentric tuberculated costae, with intercostal spaces widening toward the ventral margin. Antecarinal sulcus present. Escutcheon smooth, highly excavated.

Material.—One adult topotype specimen, MOZ P0875, a complete shell, with both valves well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0875	65	48	20	0.73	0.30

Remarks.—Levy (1966, p. 240) suggested that this species should be included in the subgenus *Promyophorella* Kobayashi and Tamura (1955), but the presence of sharp tubercles precludes such assignment. Although this species was recorded in the Pliensbachian of Piedra Pintada, it may range in Argentina well into the Early Toarcian *Dactylioceras simplex* and *D. tenuicostatum chilense* Zones.

Age and occurrence.—Pliensbachian, *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones, Piedra Pintada Formation; La Amarga, near Rincón del Aguila (Locality 37), Dept. Zapala, Neuquén, Argentina.

Myophorella (*Myophorella*) catenifera
(Hupé, 1854)
Plate 2, figures 10, 11

Trigonia catenifera Hupé in Gay, 1854, p. 388, pl. 5, fig. 8; Philippi, 1899, p. 85, pl. 36, fig. 5.
Myophorella (*Myophorella*) *catenifera* (Hupé). Pérez and Reyes, 1977, p. 12, pl. 3, fig. 6.

Description.—Shell small. Umbones opisthogyrous, very anteriorly situated. Dorsal margin strongly concave. Dorsoposterior junction situated slightly above the plane of the beaks, almost forming a right angle. Posterior margin relatively long. Ventroposterior angle obtuse. Ventral and anterior margins forming a continuous, convex curve. Area ornamented with narrow transverse costellae, bounded by a prominent marginal carina and a poorly defined escutcheon carina. Flank ornamented with subconcentric costae that bear small and equally prominent tubercles. Escutcheon not preserved.

Material.—Two adult hypotype specimens, MOZ P2682 (Estancia Souraya, Espinazo del Zorro), consisting in a well preserved left valve, and MOZ P4525 (Cerrito Roth, Cañadón de la Piedra Pintada) consisting of a mold of a right valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2682	28	23	4.6	0.82	0.16

Remarks.—The general shell shape and ornamentation of the specimens closely resembles *Myophorella* (*Myophorella*) *catenifera* (Hupé, in Gay, 1854, pl. 5, fig. 8) from the Pliensbachian of Chile (see Pérez and Reyes, 1977, p. 12), especially in having the dorsoposterior junction in a plane situated slightly above a horizontal line passing through the beaks. *Myophorella* (*Myophorella*) *catenifera* (Hupé) is here cited for the first time in the Argentine Liassic.

Age and occurrence.—Pliensbachian, *Fanninoceras* Zone, Chachil Formation; Estancia Souraya, Espinazo del Zorro (Locality 38), Dept. Catán Lil; *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones, Piedra Pintada Formation; Cerrito Roth, Cañadón de la Piedra Pintada (Locality 24), Dept. Collón Curá, Neuquén, Argentina.

Myophorella (Myophorella) cf. **M. tuberculata**
(Agassiz, 1840)
Plate 1, figure 9

Description.—Shell small. Umbones opisthogyrous. Dorsal margin flat. Anterior and ventral margins forming a continuous convex curve. Posterior part of the shell not preserved. Area well defined, bounded centrally by a distinct, beaded, marginal carina, and ornamented by narrow, sharp, transverse costae. Flank ornamented with widely spaced, prominent, concentric costae which bear very small, equal-sized tubercles.

Material.—One adult hypotype specimen, MOZ P2675, consisting of an incomplete external mold of a poorly preserved left valve which precludes measurements.

Remarks.—The described specimen closely resembles *Myophorella tuberculata* (Agassiz, 1840, p. 20, pl. 2, fig. 17; pl. 9, figs. 7–8) from the Liassic of Gundershofen, Germany, but the poor preservation of the Argentine specimen precludes comparison of the shell shape and other morphological features.

Age and occurrence.—Pliensbachian, *Otapiria neuquensis* and *Radulonectites sosneadensis* Zones, Piedra Pintada Formation; Estancia Santa Isabel (Locality 39), Dept. Collón Curá, Neuquén, Argentina.

Myophorella (Myophorella) argentinica
(Jaworski, 1926)
Plate 2, figures 14, 17

Trigonia argentinica Jaworski, 1926, p. 180, pl. 1, fig. 6.
Myophorella argentinica Jaworski. Leanza and Garate, 1987, p. 211, pl. 3, fig. 10.

Description.—Shell of medium size, elongated. Umbones opisthogyrous, prominent, situated in the anterior one-quarter of the shell. Dorsal margin slightly concave. Posterior margin not preserved. Ventral margin slightly convex, curving evenly into the convex anterior margin. Flank occupying two-thirds of the shell's surface, ornamented by distant, subconcentric costae which bear small, rounded tubercles which closely touch each other. The intercostal spaces become wider toward the anteroventral region of the shell. Marginal carina sharp, equally beaded over its whole length. Area contains faint transverse costellae. Escutcheon not recognizable.

Material.—Two adult hypotype specimens, MOZ P1879 (Barda Negra Sur), consisting in a right valve without its posterior part, and MOZ P4914 (Máquina Curá, Chacaicó), consisting of a right valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P4914	43	24	9	0.55	0.20

Remarks.—The characteristic tubercles on the flank costae support assignment of this specimen to *Myophorella* (*M.*) *argentinica* Jaworski (1926, pl. 1, fig. 6). It can be differentiated from *Myophorella* (*Promyophorella*) *praescabroidea* Jaworski (1926, p. 86, pl. 1, figs. 5a–b; herein described) by: (1) its different shape; (2) its sharper tubercles which merge into each other; and (3) its less dense flank costae.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, and Máquina Curá, Chacaicó (Locality 21), Dept. Catán Lil, Neuquén, Argentina.

Myophorella (Myophorella) schulzi, new species
Plate 8, figures 8, 9

Holotype.—MOZ P3075/1, consisting of a poorly preserved right valve.

Paratypes.—MOZ P3075/2, 3, and 4, three poorly preserved adult right valves in yellowish-white calcarenites.

Type locality.—Camino nuevo a Los Molles (Locality 34), Dept. Zapala (39°13'S, 70°05'W), Picún Leufú Formation (Leanza, 1973), Mendoza Group (Groeber, 1946).

Etymology.—This species is dedicated to Enrique Schulz (Zapala, Neuquén) a friend of the Museum Juan Olsacher.

Diagnosis.—*Myophorella* of medium size, characterized by very few, widely spaced and uncurved flank costae, which bear isolated and rounded, relatively large tubercles. Area narrow, transversely ornamented by low ridges arising from the tubercles of the marginal carina.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3075/1	52	42	10	0.80	0.19

Description.—Right valves of medium size. Umbones not prominent, opisthogyrous, very anteriorly situated. Dorsal margin long, almost straight. Dorsoposterior angle rounded. Ventral margin very convex, curving evenly into the slightly convex èanterior margin. Flank occupying three-fourths of the shell surface, ornamented by no more than 10 very widely spaced straight costae. These bear isolated, rounded, relatively large tubercles. Marginal carina not well developed, demarcated by transversely elongated tubercles corresponding to each flank costae. Area narrow, transversely ornamented by shallow ridges arising from the tubercles of the marginal carina, apparently asymmetrically divided by a submedian groove. Escutcheon not recognizable, probably very narrow.

Remarks.—This new species can be easily distinguished from any other known species of *Myophorella* Bayle by its extremely low number of flank costae which are almost straight instead of concavely curved as in most myophorellids, and by the presence of a somewhat transversely rugate area. These features make this species very similar to *Steinmanella* Crickmay, a genus which arose in the Tithonian and flourished in the Neocomian with increasing diversity. *Myophorella* (*M.*) *schulzi*, n. sp. shows some affinities with *Myophorella mearnsi* (Stoyanow, 1949, p. 78, pl. 12, fig. 5) from the Upper Aptian of Arizona, but the North American species differs in having: (1) a more subquadrangular

shape; (2) a relatively larger size; and (3) very well developed tubercles along its whole marginal carina.

Age and occurrence.—Upper Tithonian, *Substeueroceras koeneni* Zone, Picún Leufú Formation; Camino nuevo a Los Molles (Locality 34), Dept. Catán Lil, Neuquén, Argentina.

Subgenus **PROMYOPHORELLA** Kobayashi and Tamura, 1955

Type species.—*Myophorella* (*Promyophorella*) *sigmoidalis* Kobayashi and Tamura, 1955, Bajocian, Japan.

Diagnosis.—*Myophorella* with narrow and uninterrupted subconcentric costae on the flanks bearing very small tubercles or beads regularly aligned on their crests. These may be obsolete in some species (Kobayashi and Tamura, 1955; Leanza, 1981).

Distribution.—Middle Jurassic to Neocomian. Cosmopolitan.

Discussion.—Although Cox (1969, p. N485) and Poulton (1979, p. 27) considered the subgenus *Promyophorella* Kobayashi and Tamura (1955) as a junior synonym of *Myophorella* Bayle, the presence of flank costae with or without very small tubercles is considered to be an important morphological feature that allows a division between these two taxa. Fleming (1987, p. 36) considered *Promyophorella* as a junior synonym of *Scaphogonia* Crickmay, 1930b (type species: *Scaphogonia argo* Crickmay, 1930b, pl. 5, figs. a, b) on the basis that Kobayashi and Tamura (1955) included Crickmay's species in the list of species assigned to *Promyophorella*. This view is not supported, inasmuch as *Scaphogonia argo*, placed in *Myophorella* by Cox (1969, p. N485) and Poulton (1979, p. 31), displays flank costae with well-developed tubercles, and a minor break occurring in the anterior part of the flank, a feature which is unknown in any other species of *Promyophorella*. For this reason, the author considers *Scaphogonia* as a junior synonym of *Myophorella* Bayle, in agreement with Cox (1969) and Poulton (1979), and maintaining *Promyophorella* Kobayashi and Tamura as a valid subgenus of *Myophorella*.

Myophorella (Promyophorella) praescabroidea (Jaworski, 1916)
Plate 3, figures 5, 6

Trigonia praescabroidea Jaworski, 1916, p. 385, pl. 5, figs. 5a, b (=Jaworski, 1925, p. 386, pl.1, figs. 5a,b).
Myophorella (*Promyophorella*) *praescabroidea* (Jaworski). Levy, 1966, p. 240; Leanza and Garate, 1987, p. 212, pl. 3, figs. 8, 9.

Description.—Shell of medium size, elongated. Slightly inflated anteriorly, posteriorly attenuated. Umbones prominent, opisthogyrous, very anteriorly situated. Dorsal margin concave. Dorsoposterior angle slightly obtuse. Posterior margin very short. Ventroposterior angle not known. Ventral margin broadly convex, curving evenly into the convex anterior margin. Flank ornamented by nearly 20 subconcentric beaded costae, with intercostal spaces becoming wider toward the ventral margin of the shell. Marginal carina well defined, formed by a beaded keel. Area ornamented by narrow transverse costellae which are more numerous than those of the flank. Escutcheon short, narrow and excavated, completely smooth.

Material.—One adult hypotype specimen, MOZ P0953/2, a complete shell, relatively well preserved shell.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0953/2	34	24	9	0.70	0.26

Remarks.—This species is very important because it represents in South America the Middle Jurassic ancestor of *Pterotrigonia* van Hoepen (1929), a characteristic Upper Jurassic and Cretaceous genus. *Myophorella* (*P.*) *praescabroidea* (Jaworski) has some affinities with *Myophorella* (*M.*) *agniaensis* Levy (1966, p. 283, figs. 1a–b) from the Liassic of Pampa de Agnia, Chubut, Argentina. Both of these species, however, have a comparatively less club-shaped form, larger area, and better defined tubercles.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Myophorella (Promyophorella) garatei Leanza, 1981
Plate 12, figures 1–4

Myophorella (*Promyophorella*) *garatei* Leanza, 1981, p. 4, figs. 1–7; Leanza and Garate, 1987, p. 212, pl. 13, figs. 8–11.

Description.—Shell small, subtrigonal, somewhat anteriorly inflated. Umbones opisthogyrous, situated in the anterior one-fourth of the shell. Dorsal margin concave. Dorsoposterior angle slightly obtuse. Posterior margin short. Ventroposterior angle almost 90°. Ventral margin broadly convex, curving evenly into the convex anterior margin. Flank occupying four-fifths of the shell surface, ornamented anteriorly by subconcentric costae which bear, near the umbonal region, weak transverse crenulations; toward the anterior and ventral margins the costae tend to be smooth, thicker, and more widely separated. On the posterior flank the costae become narrower and more crowded, intersecting the ventral margin almost perpendicularly. Both marginal and escutcheon carina well developed. Area

with submedian sulcus, ornamented with transverse costellae. Escutcheon elongated, transversely ridged. Commissural plane crenulate.

Material.—Four topotype adult specimens, MOZ P0930/4–7, complete shells, very well preserved. The specimen MOZ P0930/4 shows a ventrally directed V-shaped inflection on the anterior flank costae (see Leanza and Garate, 1987, pl. 13, figs. 8a–b).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0930/4	24	19	6	0.79	0.25
MOZ P0930/6	19	16	5.5	0.84	0.28

Remarks.—*Myophorella* (*P.*) *garatei* Leanza (1981) is closely related to *Myophorella* (*P.*) *hillebrandti* Reyes and Pérez (1985, p. 95, pl. 1, figs. 1–20) from the Neocomian Pedernales Formation, Chile, but the Argentine species differs by: 1) its smaller size; 2) different shell shape; and 3) more densely costulate flank. *Myophorella* (*Promyophorella*) *eufalensis* (Gabb in Myers, 1968, p. 61, pl. 10, fig. 6), a species widely distributed in the Upper Cretaceous of Mexico and southern United States, is a very closely related species, but differs from *M.* (*P.*) *garatei* Leanza in having: 1) a more elongate shell; 2) the area occupying a smaller surface of the shell; and 3) the marginal carina not well developed.

The specimen MOZ P0930/4 shows a ventrally directed V-shaped inflection on the anterior flank. The author has observed this anomaly in a few specimens (see Leanza and Garate, 1987, p. 213, pl. 13, figs. 8a–b), and these might well constitute a new variety or subspecies.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Myophorella (Promyophorella) hillebrandti
Reyes and Pérez, 1985
Plate 8, figure 6

Myophorella (*Myophorella*) *hillebrandti* Reyes and Pérez, 1985, p. 95, pl. 1, figs. 1–20.

Description.—Shell small, longer than high. Umbones very anteriorly situated. Dorsal margin straight. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle very acute. Ventral margin widely convex, curving evenly into the convex anterior margin. Flank occupying four-fifths of the shell surface, ornamented by scarce, subconcentric costae in its anterior part, and ventroposteriorly sloping costae in its posterior portion. The costae are smooth or contain some obsolete, small beads. Area narrow, ornamented by very weak, transverse striae. Escutcheon not known.

Material.—One hypotype, probably an adult specimen, MOZ P3075, consisting of a well preserved fragment of a left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3075	19	15	4	0.78	0.21

Remarks.—The specimen strongly agrees with *Myophorella hillebrandti* Reyes and Pérez (1985, p. 95, pl. 1, figs. 1–20) from the Neocomian of northern Chile. Although Reyes and Pérez (1985) originally included this species in the subgenus *Myophorella* s.s., the lack or obsolescence of tubercles in the flank costae favors its assignment to the subgenus *Promyophorella* Kobayashi and Tamura.

Age and occurrence.—Middle Tithonian, *Aulacosphinctes proximus* Zone, Carrín Curá Formation; Fortín 1º de Mayo (Locality 23), Dept. Catán Lil, Neuquén, Argentina.

Subgenus **HAIDAIA** Crickmay, 1930a
(emend. Kobayashi and Tamura, 1955)

Type species.—*Trigonia dawsoni* Whiteaves, 1876, Jurassic, British Columbia, Canada.

Diagnosis.—*Myophorella* with subconcentric and uninterrupted costae on the flanks, which are characterized by narrow ridges and grooves respectively extending from tubercles and depressions. These give rise to crenulations in their ventral parts (Kobayashi and Tamura, 1955, p. 99).

Distribution.—Middle Jurassic to Cretaceous. Cosmopolitan.

Myophorella (Haidaia) volkheimeri
Leanza and Garate, 1987
Plate 12, figures 8–12

Myophorella (*Haidaia*) *volkheimeri* Leanza and Garate, 1987, p. 213, pl. 6, figs. 6–9.

Description.—Shell moderately small, inequivalve. Umbones opisthogyrous, very anteriorly situated. Dorsal margin slightly concave, with a slight expansion in its middle part. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle almost 90°. Ventral and anterior margins broadly convex. Flank occupying four-fifths of the shell surface, ornamented by 15–16 fine and prominent subconcentric costae. The first 10–11 costae in the anterior flank bear narrow ridges and grooves on their ventral part, producing the characteristic crenulations of the subgenus. These costae are concave-curved, and progressively more separated from each other toward the ventral and anterior margins. The last five to six costae situated in the pos-

terior flank are more crowded, intersecting the ventral margin almost perpendicularly. The marginal and escutcheon carinae contain sharp beads on their distal portion. Area ornamented by fine transverse costellae, asymmetrically divided by a submedian sulcus. Escutcheon elongated, ornamented by very fine and distant, transverse costellae, with a little protruding expansion in its middle part. Commissure plane slightly crenulated.

Material.—Three adult specimens, MOZ P1752/1, the holotype (see H. A. Leanza and Garate, 1987, pl. 6, figs. 7–9) a complete shell; MOZ P1752/2 and 3, the original paratypes, consisting of complete shells with both valves well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1752/1	17	14	3	0.82	0.18
MOZ P1752/2	21	19	4	0.90	0.19
MOZ P1752/3	20	15	4	0.75	0.20

Remarks.—The subgenus *Haidaia*, according to the emended diagnosis of Kobayashi and Tamura (1955), is characterized by shells very similar to *Promyophorella* Kobayashi and Tamura, but which display characteristic crenulations on the ventral part of the costae. This feature is well represented in *M.* (*H.*) *volkheimeri* Leanza and Garate, and it might have played an important role in the mode of burrowing of this species. *Myophorella* (*H.*) *crenulata* Kobayashi and Tamura (1955, p. 100, pl. 5, figs. 8–10) from the Jurassic of Soma Mountains, Fukushima Prefecture, Japan, is a closely related species, but differs from *M.* (*H.*) *volkheimeri* in: 1) having a more elongate shell shape; and 2) the flanks occupying a smaller proportion of the shell surface. *Myophorella* (*H.*) *elegans* Baily (in Woods, 1906, p. 293, pl. 35, figs. 3–4) from the Cretaceous of South Africa, is a comparable species, but differs from *M.* (*H.*) *volkheimeri* in having: 1) a more densely costulate flank, and 2) a different shell shape.

Myophorella (*Haidaia*) *elguetai*, n. sp. (this paper) from the Upper Tithonian of Cerrito Caracoles area, Neuquén, is also a closely related species, but differs in having: (1) a different shell shape, (2) an poorly-defined marginal carina, (3) a very weakly ornamented area, and (4) proportionally fewer costae on the flanks.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Myophorella (Haidaia) elguetai, new species
Plate 9, figures 9–11

Holotype.—MOZ P3067, consisting in a very well preserved right valve, in a hard, pink-yellowish, coarse-grained limestone.

Paratypes.—Seven specimens, all adults unless otherwise indicated: MOZ P2486/2, a well preserved left valve; MOZ P5767, a well preserved complete shell; MOZ P5768, a poorly preserved right valve; MOZ P5769, a very well preserved right valve; MOZ P5770, a broken right valve; MOZ P3898, a complete juvenile shell, well preserved; MOZ P5766, a complete shell with both valves poorly preserved.

Type locality.—Cerrito Caracoles (Locality 11), Dept. Zapala (38°49′S, 70°09″W), Picún Leufú Formation (Leanza, 1973), Mendoza Group (Groeber, 1946).

Etymology.—After Ramona and Domingo Elgueta, inhabitants of Aguada del Overo, and friends of the Museum Juan Olsacher.

Diagnosis.—Shell of small to medium size, slightly longer than high. Umbones very anteriorly situated. Flank very wide, ornamented by equally spaced subconcentric costae, bearing characteristic crenulations on their ventral part. Marginal carina poorly defined, except near umbo. Area very narrow, transversely ornamented by weak costellae. Escutcheon apparently smooth.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3067	19	14	5	0.73	0.26
MOZ P5767	18	15	4	0.83	0.22
MOZ P2486/2	34	30	7	0.88	0.20

Description.—Shell of small to medium size, trigonally ovate, slightly longer than high. Umbones opisthogyrous, very anteriorly situated. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle slightly obtuse. Ventral margin broadly convex, curving evenly into the slightly convex anterior margin. Flank very wide, occupying five-sixths of the shell surface, ornamented by 12–14 subconcentric costae with intercostal spaces widening toward the ventral and anterior margins. The costae exhibits characteristic crenulations on their ventral side. Area very narrow, transversely ridged by faint costellae. Marginal carina weakly developed. Escutcheon poorly preserved, apparently smooth.

Remarks.—*Myophorella* (*Haidaia*) *elguetai*, n. sp. can readily be assigned to the subgenus *Haidaia* Crickmay (1930a) emend. Kobayashi and Tamura (1955) on the basis of the myophorellid shell shape, and the characteristic crenulations on the ventral side of the flank costae. The species is recognized by its slightly longer than high shell shape, very wide flanks, and poorly defined marginal carina. *Myophorella* (*Haidaia*) *elguetai*, n. sp. differs from the Hauterivian *M.* (*H.*) *volkheimeri* Leanza and Garate (1987, p. 213, pl. 6, figs. 6–9) (herein described) in having: (1) a lesser number of flank costae; (2) a less well defined marginal

carina and (3) a slightly concave dorsal margin, instead of one with a slight expansion on its middle part, as in *M.* (*H.*) *volkheimeri*. *Myophorella* (*Haidaia*) *elguetai*, n. sp. also differs from the Jurassic *M.* (*H.*) *crenulata* Kobayashi and Tamura (1955, p. 100, pl. 5, figs. 8–10) from the Soma Mountains, Fukushima Prefecture, Japan, in having: (1) shorter valves, (2) flanks occupying a larger portion of the shell surface, and (3) more poorly defined marginal carina.

Age and occurrence.—Upper Tithonian, *Substeueroceras koeneni* Zone, Picún Leufú Formation; Cerrito Caracoles (Locality 11), Dept. Zapala, Neuquén, Argentina.

Genus **SCAPHOTRIGONIA** Dietrich, 1933

Type species.—*Trigonia navis* Lamarck, 1819, Aalenian, Alsacia.

Diagnosis.—Trigonally ovate, with prominent umbones. Marginal carina and escutcheon carina poorly defined except in early growth stages. Area initially transversely ridged, and subsequently smooth, or persistently smooth. Escutcheon smooth. Anterior end of shell broadly flattened. Flank ornamented by two sets of costae: the anterior with subconcentric costae, usually terminating in tubercles, and the posterior set with ventroposteriorly sloping, usually tuberculated, costae. Both sets of costae are separated on the anterior flank by a smooth band (Cox, 1969; Leanza and Garate, 1986).

Distribution.—Lower Jurassic (Upper Liassic) to Middle Jurassic (Bajocian). North and South America (Argentina), Europe.

Scaphotrigonia rierafonti
Leanza and Garate, 1986
Plate 3, figures 3, 4

Scaphotrigonia rierafonti Leanza and Garate, 1986, p. 156, fig. 2 : 1–8; Leanza and Garate, 1987, p. 214, pl. 3, figs. 4, 5, pl. 4, figs. 4–6.

Description.—Shell small, longer than high. Umbones somewhat prominent, opisthogyrous, very anteriorly situated. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle almost 90°. Ventral and anterior margins forming a broad and continuous convex curve up to the beaks. Flank ornamented by two series of costae interrupted by a smooth band. Marginal carina defined by a continuous line. Area smooth. Escutcheon smooth, narrow and elongated almost up to the posterior margin.

Material.—One adult topotype, MOZ P0931, a complete shell with both valves very well preserved (see Leanza and Garate, 1987, pl. 4, figs. 4–6).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0931	24	19	5	0.79	0.20

Remarks.—The differences between *Scaphotrigonia rierafonti* and *Scaphotrigonia navis* are clear, and have been described by Leanza and Garate (1986). "*Scaphotrigonia*" *somensis* Kobayashi and Tamura (1957, p. 40, pl. 1, figs. 1–3) from the Middle Jurassic of Japan belongs to the genus *Scaphorella* Leanza, Pérez and Reyes (1987).

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Genus **SCAPHORELLA**
Leanza, Pérez, and Reyes, 1987

Type species.—*Trigonia leanzai* Lambert, 1944, Middle Jurassic (Bajocian-Bathonian), Neuquén, Argentina.

Diagnosis.—Shell of medium to large size, trigonally rounded or somewhat elongated. Shell moderately convex. Umbones prominent, opisthogyrous, very anteriorly situated. Flank ornamented by two series of tuberculated costae, the anterior one radial and the posterior one radial-retroverse; these meet the ventral margin at nearly 90°. Area transversely ridged, asymmetrically divided by a submedian groove. Escutcheon wide, lanceolate and excavated, ornamented posteriorly by the continuation of the costae of the area (Leanza, Pérez and Reyes, 1987).

Distribution.—Middle Jurassic. North and South America, Japan.

Scaphorella leanzai (Lambert, 1944)
Plate 3, figures 1, 2

Trigonia leanzai Lambert, 1944, p. 362, pl. 1, figs. 5, 6.
Myophorella (*Promyophorella*) *leanzai* (Lambert). Levy, 1966, p. 240.
Myophorella leanzai (Lambert). Camacho and Riccardi, 1978, table 2.
? *Myophorella* cf. *argo* (Crickmay). Poulton, 1979, p. 32, pl. 4, figs. 18–22
"*Myophorella*" *leanzai* (Lambert). Leanza and Garate, 1987, p. 213, pl. 4, figs. 7–10.
Scaphorella leanzai (Lambert). Leanza, Pérez and Reyes, 1987. p. 84, pl. 1., figs. 1–4.

Description.—Shell large, subrounded in shape, almost as long as high. Umbones prominent, opisthogyrous. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior junction obtuse. Ventral margin broadly convex. Anterior margin slightly rounded. Flank ornamented by two series of tuberculated costae,

the anterior set radial, and the posterior one radial-retroverse in direction, meeting the ventral margin at nearly 90°. Area well defined, occupying one-fourth of the surface of the shell, ornamented by transverse and somewhat rugate costae, asymmetrically divided by a submedian groove. Marginal carina well defined, bearing progressively more well defined tubercles toward the ventroposterior junction. Escutcheon carina bearing at first oblique, and subsequently transversely enlarged tubercles. Escutcheon lanceolate, wide, ornamented in its proximal part by growth lines, and in its distal part by diagnostic transverse costae arising from the area.

Material.—Two specimens. One adult hypotype, a left valve, MOZ P0919/1 (Los Pozones), very well preserved (see Leanza and Garate, 1987, pl. 4, figs. 7–9; Leanza, Pérez and Reyes, 1987, pl. 1, figs. 2a, b, c), and one topotype, a fragmentary left valve MOZ P4557 (Cañadón Ñancu Huau, Chacaicó).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0919/1	55	54	17	0.90	0.38

Remarks.—*Scaphorella leanzai* (Lambert) is very closely related to *Myophorella* sp. cf. *M. argo* (Crickmay, 1930b) as figured by Poulton (1979, p. 32, pl. 4, figs. 18–22) from the Middle (now Early) Bajocian Kialagvik (Alaska) and Weberg (Oregon) Formations, western United States. Although the poor preservation of the North American species precludes confirmation that they are conspecific, this taxon has been placed in the genus *Scaphorella* by Leanza, Pérez and Reyes (1987, p. 85).

"*Scaphotrigonia*" *somensis* Kobayashi and Tamura (1957, p. 40, pl. 1. figs. 1–3) from the Middle Jurassic of Soma County, Fukushima Prefecture, Japan, may also be included in *Scaphorella* on the basis of its shell shape, similar flank ornamentation pattern, and in having area pervasively ornamented by transverse costae.

Age and occurrence.—Early Bajocian to Early Bathonian, *Emileia giebeli* to *Cadomites*–Tulitidae Zones, Lajas Formation; Los Pozones (Locality 15), Dept. Zapala, and Cañadón Ñancu Huau, Chacaicó (Locality 35), Neuquén, Argentina.

Scaphorella kruusei Leanza and Garate, 1987
Plate 3, figures 14, 15

"*Myophorella*" *kruusei* Leanza and Garate, 1987, p. 214, pl. 4, fig. 1.

Scaphorella kruusei Leanza and Garate. Leanza, Pérez and Reyes, 1987, p. 85.

Description.—Shell large, subrectangular, much longer than high. Umbones situated in the anterior one-fifth of the shell. Dorsal margin almost straight. Dorsoposterior angle widely obtuse. Posterior margin short. Ventroposterior angle obtuse. Ventral margin very slightly convex. Anteroventral junction well defined. Anterior margin almost straight. Flank ornamented by two sets of beaded costae, the anterior radially oriented, and the posterior ventroposteriorly inclined. Area and escutcheon forming a flattened surface. Area occupying one-third of the shell surface, ornamented by transverse costae. Escutcheon wide, excavated and smooth.

Material.—One adult topotype specimen, MOZ P1813, consisting of a rather well preserved left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1813	59	42	12	0.71	0.20

Remarks.—Based on the original description, Damborenea (in Riccardi, Westermann and Damborenea, 1990, p. 118) considered *Scaphorella kruusei* Leanza and Garate as a junior synomym of *Scaphorella leanzai* (Lambert). The specimen described herein, however, provides more details of this taxon, and it can be demonstrated that it differs from *Scaphorella leanzai* by its shell shape that results in: (1) a subrectangular outline, much longer than high; (2) umbones more anteriorly situated; (3) anterior margin which is almost straight; and (4) a better defined anteroventral junction. In addition, *S. kruusei* has a narrower area, and lacks a submedian groove. For these reasons this species is considered to be valid.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Fortín 1º de Mayo (Locality 23), Dept. Catán Lil, Neuquén, Argentina.

Scaphorella camachoi, new species
Plate 3, figures 12, 13

Holotype.—MOZ P4920/1, a complete small adult, well preserved right valve, fossilized in a fine-grained, reddish-brown sandstone.

Paratype.—MOZ P4920/2, an small adult, well preserved left valve.

Type locality.—Máquina Curá, Chacaicó (Locality 21), Dept. Catán Lil (39°20'S, 70°22'W), Lajas Formation (Weaver, 1931), Cuyo Group (Groeber, 1946).

Etymology.—The species is dedicated to the Argentine paleontologist Dr. Horacio H. Camacho, of Buenos Aires.

Diagnosis.—Shell moderately small, trigonally ovate. Flank occupying two-thirds of the shell surface, ornamented by two sets of costae: the anterior one subconcentric, and the posterior one following a ventroposterior direction. Protruding marginal carina. Area

ornamented by narrow, transverse costellae. Escutcheon unknown.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P4920/1	13	11	4	0.84	0.30
MOZ P4920/2	14	11	5	0.78	0.35

Description.—Shell moderately small, trigonally ovate, with the anterior part broadly flattened. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle slightly obtuse. Posterior margin relatively long. Ventroposterior angle obtuse. Ventral margin slightly convex, curving abruptly into the slightly straight anterior margin. Flank occupying two-thirds of the shell surface, ornamented by two sets of costae: the anterior consisting in seven subconcentric costae; the posterior with only five ventroposteriorly inclined serrated costae with intercostal spaces equal to two times the thickness of each costa. A protruding marginal carina is present. Area wide, ornamented throughout by very narrow transverse costellae. Escutcheon unknown.

Remarks.—*Scaphorella camachoi*, n. sp. differs from *Scaphorella leanzai* (Lambert, 1944; herein described), also from Bajocian beds of the Lajas Formation, in the following details: (1) smaller size; (2) the flank occupies a smaller proportion of the shell surface; (3) the area is proportionally wider; (4) the flank is less densely costate, and (5) the marginal carina is very well developed. *Scaphorella kruusei* Leanza and Garate (1987, p. 214, pl. 4, fig. 1) from the Middle Bajocian Lajas Formation at Fortín 1º de Mayo (Neuquén), has a different shell shape, with subrectangular outline which gives a different morphological pattern to the shell, and it lacks a protruding marginal carina. *Trigonellina* Parnes, 1981 (type species: *Myophorella* (*Trigonellina*) *delicata* Parnes, 1981) from the Bajocian Makhtesh Ramon Formation, Israel, is very similar in size and shape, but the area is ornamented by radial and transverse costellae.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Máquina Curá, Chacaicó (Locality 21), Dept. Catán Lil, Neuquén, Argentina.

Subfamily **VAUGONIINAE** Kobayashi, 1954

Genus **VAUGONIA** Crickmay, 1930b

Type species.—*Vaugonia veronica* Crickmay, 1930b, Middle Jurassic, British Columbia, Canada.

Diagnosis.—Trigonally ovate to elongate. Umbones opisthogyrous, anteriorly situated. Escutcheon, area and flank distinctly demarcated by protruding carinae. Flank ornamented by distinctive costation, characterized by simple and/or tuberculate costae up to an advanced stage of growth, with the V-shaped inflection situated in a relatively posterior position. Area bipartite, transversely costate (Crickmay, 1930b; Cox, 1969; Poulton, 1979; Reyes and Pérez, 1984).

Distribution.—Lower to Upper Jurassic. Cosmopolitan.

Discussion.—The distinctive flank costation characteristic of *Vaugonia* Crickmay is formed by the intersection of the anterior and posterior sets of costae, forming a down-pointing (i.e., ventrally-directed) V-shaped inflection, which is hereafter referred to as "vaugonic costation". This kind of costation may be present in other genera, including *Iotrigonia, Anditrigonia, Paranditrigonia, Lambertrigonia, Apiotrigonia, Andivaugonia*, and in some growth stages of *Buchotrigonia* and *Syrotrigonia*. The position of the V-shaped inflection on the flank, the angle of divergence between both sets of costae, and the numbers of costae on the anterior portion of the flank, are of diagnostic value. "Vaugonic costation" is here regarded, however, as a secondary character. The nature of the ornamentation of the area and the escutcheon, as well as the characteristics of the marginal carina are considered of greater importance in making taxonomic determinations at the generic level (see "Philosophical Considerations", p. 14).

Vaugonia chunumayensis (Jaworski, 1916)
Plate 2, figure 15

Trigonia chunumayensis Jaworski, 1916, p 384, pl. 5, fig. 4; (=Jaworski, 1925, p. 83, pl. 1, fig. 4); Weaver, 1931, p. 236.
Vaugonia (*Vaugonia*) *chunumayensis* (Jaworski). Reyes and Pérez, 1978, p. 9, pl. 2, fig. 3
Vaugonia chunumayensis (Jaworski). Leanza and Garate, 1987, p. 219, pl. 4, fig. 3.

Description.—Shell small, strongly elongated. Umbones opisthogyrous, prominent, situated in the anterior one-fourth of the shell. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle acute. Ventral margin straight, curving evenly to the strongly convex anterior margin. Flank occupying two-thirds of the shell surface, ornamented by narrow and elevated costae forming ventrally directed V-shaped inflection in a relatively posterior position; some beads may be present in this zone. Area bipartite, with median groove, and transverse growth lines. Marginal carina well defined from the beaks to the ventroposterior junction. Escutcheon with some transverse, very faint, growth lines.

Material.—Three adult hypotype specimens, MOZ P1903, a well preserved right valve, MOZ P3193/1 and 2, two relatively well preserved right valves.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1903	45	27	6	0.60	0.13

Remarks.—Pérez, Biró and Reyes (1987, p. 36) have recently assigned specimens formerly classified as *Vaugonia* (*Vaugonia*) *chunumayensis* (Jaworski; see Reyes and Pérez, 1978, 1979) from the Berriasian of Lo Valdés Formation, Central Cordillera of Chile, to *Virgotrigonia hugoi* (Leanza). Therefore, *Vaugonia chunumayensis* (Jaworski) can be now regarded as an exclusively Middle Jurassic species.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Vaugonia rectangularis (Gottsche, 1878)
Plate 2, figure 13

Trigonia rectangularis Gottsche, 1878, p. 26, pl. 6, figs. 5a, b.
Vaugonia (*Vaugonia*) *rectangularis* (Gottsche). Pérez and Reyes, p. 18, pl. 3, figs. 8, 9
Vaugonia rectangularis (Gottsche). Leanza and Garate, 1987, p. 219, pl. 4, fig. 2.

Description.—Shell small, strongly elongated. Umbones opisthogyrous, prominent, situated in the anterior one-fifth of the shell. Dorsal margin strongly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin slightly convex, curving evenly into the convex anterior margin. Flank ornamented by widely separated, narrow, elevated, tuberculate costae, forming a ventrally pointing V-shaped inflection in a relatively posterior position. Area narrow, bipartite, ornamented by faint transverse growth lines; median groove present. Marginal carina protruding throughout its entire length. Escutcheon lanceolate and narrow, probably smooth.

Material.—One adult hypotype specimen, MOZ P1753, consisting of a right valve with the anteroventral part of the shell broken (see Leanza and Garate, 1987, pl. 4, fig. 2).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1753	35	21	5	0.60	0.14

Remarks.—*Vaugonia rectangularis* (Gottsche) is very similar to the associated *Vaugonia chunumayensis* (Jaworski, 1915, p. 384, pl. 5, fig. 4; herein described), but differs in having a somewhat different style of costation, with persistent small tubercles in the flank costae.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Barda Negra Sur (Locality 16), Dept. Zapala, Neuquén, Argentina.

Genus **ANDIVAUGONIA**, new name
(= *Lambertiella* Cooper, 1991)

Type species.—*Trigonia radixscripta* Lambert, 1944, Middle Jurassic (Early Bajocian/Early Bathonian), Neuquén, Argentina.

Diagnosis.—Trigonally ovate to elongate, somewhat inflated. Demarcation between escutcheon, area and flank poorly defined. Area wide, generally bipartite, smooth or transversely ridged by growth lines or rugae. Marginal carina poorly defined in the proximal portion of the shell, becoming obsolete in the distal part. Flank ornamented by vaugonic costae. Escutcheon smooth.

Distribution.—Middle Jurassic (Lower Bajocian to Lower Callovian). Argentina and Chile.

Etymology.—*Andi*= Andes, meaning *Vaugonia* from the Andes.

Discussion.—Cooper (1991) proposed the new genus *Lambertiella,* with *Trigonia radixscripta* Lambert as type species. I agree that this species probably represents a distinct genus. The name *Lambertiella,* however, is preoccupied by *Lambertiella* Chechi-Rispoli, 1917 (Echinoidea) and so is unavailable. The new name *Anditrigonia* is proposed in replacement.

Trigonia radixscripta Lambert (1944) is a very common species in Middle Jurassic strata from western central Argentina, and it has been the subject of some uncertainty regarding its taxonomic position. Kobayashi and Mori (1955, p. 75) were the first to assign the species of Lambert to the genus *Iotrigonia* van Hoepen. This view was only partially accepted by later workers who included *T. radixscripta* as well in *Iotrigonia* (see Reyes and Pérez, 1978, p. 21, Reyes and Pérez, 1979, p. 20; Leanza and Garate, 1987, p. 225), in *Trigonia* (see Reyes and Pérez, 1984, p. 40) or in *Vaugonia* (see Leanza, Pérez and Reyes, 1987, p. 86) without comments. It is worth noting, however, that *Iotrigonia* van Hoepen (type species: *I. crassitesta* van Hoepen, 1929, p. 6, pl. 2, fig. 4; pl. 3, figs. 1–2) has the umbones in a much more central position of the shell, producing a very different morphological pattern to the shell with the ventrally pointing V-shaped inflection in a central position on the flank (see Fleming, 1987, p. 58). The genus *Vaugonia* Crickmay (type species: *V. veronica* Crickmay, 1930b, p. 53, pl. 7, figs. 5a–b) has the umbones situated in a more anterior position of the shell. The affinities of *Iotrigonia* to *Vaugonia,* however, are only superficial. This genus is clearly characterized by mostly elongated representatives, with areas ornamented by transverse costae, and the presence of a well developed marginal carina throughout its development. These features are clearly recognizable in elongated South American Vaugoniinae such as *V. sub-*

striata (Burmeister and Giebel, 1861), *V. lycetti* (Gottsche, 1878), *V. rectangularis* (Gottsche, 1878), *V. praelonga* (Gottsche, 1878), *V. gottschei* Möricke (1894), *V. exotica* (Möricke, 1894) and *V. chunumayensis* (Jaworski, 1915). Based on the lack of transverse costae in the area and the poor development of the marginal carina, restricted only to the proximal portion of the shell, it is proposed to institute the genus *Andivaugonia,* n. gen. with *Trigonia radixscripta* Lambert as type species. The new genus comprises a homogeneous stock including the Middle Jurassic "*T.*" *covuncoensis* Lambert (1944) from Argentina and "*Vaugonia* (*V.*)" *fuenzalidai* Reyes and Pérez (1984) and "*Vaugonia* (*V.*)" *lissocostata* Reyes and Pérez (1984) from Chile. All of these taxa are not very elongated, somewhat inflated forms characterized by smooth or poorly ornamented areas, and lacking well developed marginal carinae. On the basis of the general characteristics of the shell and the vaugonic style of costation on the flanks, the new taxon is placed in the subfamily Vaugoniinae Kobayashi.

The Jurassic *Trigonia manflarum* (Philippi, 1899, p. 77, pl. 34, fig. 4) from the Liassic–Bajocian (?) Lautaro Formation, Chile, transferred doubtfully to *Iotrigonia* by Nakano (1965, p. 19), is considered here to be a *Vaugonia* (?) (see Pérez and Reyes, 1989). Therefore, according to the new taxonomy proposed here, *Iotrigonia* van Hoepen remains as an exclusively Cretaceous genus characteristic of the southern circum-Pacific region. Apart from the differences between the genera *Andivaugonia*, n. gen., *Vaugonia* Crickmay (1930b) and *Iotrigonia* van Hoepen (1929) already referred to, the new genus shows superficial affinities with *Anditrigonia* Levy (1967c) and with *Anditrigonia* (*Paranditrigonia*) Reyes and Pérez (1983) especially in the shell shape, and in exhibiting a very poorly defined marginal carina. The areas, however, are totally different among these taxa; the genus *Anditrigonia* shows transverse costellae on the proximal area, and the subgenus *Paranditrigonia* exhibits radial costellae on the whole area.

Andivaugonia radixscripta (Lambert, 1944)
Plate 4, figures 1–2, 4, 10

Trigonia radixscripta Lambert, 1944, p. 369, pl. 1, figs. 7, 8, pl. 6, fig. 1.

Iotrigonia radixscripta (Lambert). Kobayashi and Mori, 1955, p. 75; Reyes and Pérez, 1978, p. 21, pl. 3, fig. 1; Leanza and Garate, 1987, pl. fig. 7.

Description.—Shell medium to large in size, very elongated. Umbones prominent, opisthogyrous, situated in the anterior one-fifth of the shell. Dorsal margin almost straight, slightly concave. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle acute. Ventral margin slightly convex, curving evenly into the convex anterior margin. Flanks occupying nearly three-quarters of the shell surface, ornamented by two sets of costae on the anterior and posterior flank respectively. The line of junction between the two sets of costae begins in the umbonal region and terminates in the posterior portion of the ventral margin, forming a V-shaped inflection of 45° to 80°. The anterior set of costae, which is narrower than the posterior one, is characterized by some irregularities forming a radix-like inflection on the right valve, and a similar but inverted inflection in the left valve. The intercostal spaces are wider than the costae in the anterior set, and the relations are inverse in the posterior one. Area relatively wide, asymmetrically divided by a median carina containing in its posterior two-thirds transversely elongate swellings. The area is ornamented by transverse growth lines in the proximal region, and by transverse rugae in its distal portion. Marginal carina developed only in the umbonal region, subsequently undefined, forming a blunt crest. Escutcheon carina somewhat similar to the submedian carina. Escutcheon somewhat excavated, rather long, ornamented only by growth lines.

Material.—Ten adult hypotype specimens: MOZ P0936/2, a left valve with the umbonal region broken; MOZ P0936/3, a right valve (Cañadón del Sapo); MOZ P4926, a poorly preserved right valve; MOZ P4571, complete, with both valves well preserved; MOZ P4572, a poorly preserved left valve; MOZ P4573, a well preserved right valve; MOZ P4574, a right valve with the area very well preserved; MOZ P4575, a right valve with the posterior part broken; MOZ P4576, a very well preserved right valve; MOZ P4577, a well preserved right valve (Máquina Curá). All the specimens are fossilized in a coarse-grained, brown, calcareous sandstone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P4571	58	42	14	0.72	0.24
MOZ P4572	83	48	17	0.57	0.20
MOZ P4573	72	47	18	0.65	0.25
MOZ P4576	80	47	19	0.58	0.23

Remarks.—*Andivaugonia radixscripta* (Lambert) is very closely related to *Andivaugonia fuenzalidai* (Reyes and Pérez, 1984, p. 37, pl. 1, figs. 1–13; pl. 2, figs. 8–14) from the Upper Bathonian (?)–Lower Callovian Asientos Formation, northern Chile, especially in its large size and poorly developed carinae. But in the Chilean species the vaugonic pattern of the flank ornamentation does not reach the ventral margin of the shell, and it is replaced by isolated subhorizontal costae which are not present in the Argentine species (Reyes and Pérez, 1984, p. 40).

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Máquina Curá, Chacaicó (Locality 21), Dept. Catán Lil, Neuquén, Argentina. *Andivaugonia* may also reach in Argentina the early Callovian *Eurycephalites vergarensis* Zone.

Andivaugonia covuncoensis (Lambert, 1944)
Plate 4, figure 3

Trigonia covuncoensis Lambert, 1944, p. 360, pl. 1, fig. 1.
Vaugonia (*Vaugonia*) *covuncoensis* (Lambert). Reyes and Pérez, 1979, pl. 6, fig. 1.
Vaugonia covuncoensis (Lambert). Leanza and Garate, p. 219, pl. 3, fig. 11.

Description.—Shell small, trigonally ovate, posteriorly enlarged and attenuated. Dorsal margin straight. Dorsoposterior angle almost 90°. Posterior margin very short. Ventroposterior angle obtuse. Ventral margin slightly convex, curving evenly into the convex anterior margin. Flank occupying almost the whole surface of the shell, ornamented by 10–15 fine, subconcentric costae which are parallel to the ventral margin. Acute V-shaped inflection of costae in the posterior flank, resulting in a lesser number of wider costae. Area narrow and smooth. Marginal carina poorly defined in the proximal region, subsequently indistinct. Escutcheon smooth, bounded by a very poorly defined marginal carina.

Material.—One adult topotype specimen, MOZ P0932/1, complete shell, but with both valves poorly preserved (see Leanza and Garate, 1987, pl. 3, fig. 11).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0932/1	40	33	12	0.83	0.30

Remarks.—The described specimen shows a smooth area and very weakly defined marginal and escutcheon carinae which are characteristic of the new genus *Andivaugonia*.

Age and occurrence.—Early Bajocian to Early Bathonian, *Emileia giebeli* and *Cadomites*–Tulitidae Zones, Lajas Formation; Covunco Pavia (Locality 10), Dept. Zapala, Neuquén, Argentina.

Andivaugonia fuenzalidai
(Reyes and Pérez, 1984)
Plate 4, figure 11

Vaugonia (*Vaugonia*) *fuenzalidai* Reyes and Pérez, 1984, p. 37, pl. 1, figs. 1–13, pl. 2, figs. 8–14.

Description.—Shell large, oblong. Umbones prominent, opisthogyrous, situated in the anterior one-eighth of the shell. Dorsal margin straight. Dorsoposterior angle very obtuse. Posterior margin straight and relatively short. Ventroposterior junction almost 90°. Ventral margin convex, curving evenly into the slightly convex anterior margin. Flank occupying two-thirds of the shell surface, ornamented on its anterior part successively from the umbo to the ventral margin by smooth or weakly beaded, vaugonic, subhorizontal and subconcentric costae. The posterior flank is characterized by the ascending vaugonic branch of costae which are wide and smooth, and oriented in a subvertical direction. Area wide and subplanate, ornamented by faint, transverse growth lines, asymmetrically divided by a submedian groove. Marginal carina poorly defined in the umbonal region, subsequently undefined. Escutcheon carina poorly defined by a row of transversely elongate beads arising from the growth lines of the area. Escutcheon relatively wide and excavated, apparently smooth.

Material.—One adult hypotype specimen, MOZ P2314, a complete right valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2314	82	52	28	0.63	0.34

Remarks.—This species can be readily assigned to the genus *Andivaugonia*, n. gen. on the basis of its large size, weakly defined marginal carina, and the special costation of the anterior part of the flank, which show successively vaugonic, subhorizontal and subconcentric stages. At specific level the described specimen coincides with *Andivaugonia fuenzalidai* (Reyes and Pérez, 1984, p. 37, pl. 1, figs. 1–13; pl. 2, figs. 8–14) from the Upper Bathonian (?)–Lower Callovian Asientos Formation, northern Chile, and the specimen figured by the Chilean authors in their pl. 2, fig. 13 is practically identical with the Argentine specimen. *Andivaugonia fuenzalidai* (Reyes and Pérez) shows strong resemblances with *A. radixscripta* (Lambert), the type species of *Andivaugonia*, n. gen., but in the first species the vaugonic pattern on the flank does not reach the ventral margin of the shell. *A. fuenzalidai* (Reyes and Pérez) is cited here for the first time in the Middle Jurassic of west-central Argentina.

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humpriesianum* Zones, Lajas Formation; Chacaicó (Locality 21), Dept. Catán Lil, Neuquén, Argentina.

Andivaugonia lissocostata
(Reyes and Pérez, 1984)
Plate 4, figures 6–8

Vaugonia (*Vaugonia*) *lissocostata* Reyes and Pérez, 1984, p. 40, pl. 2, figs. 1–7.

Description.—Shell small, trigonally elongate. Umbones opisthogyrous, situated in the anterior one-sixths

of the shell. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle almost 90°. Ventral margin slightly convex, curving evenly into the convex anterior margin. Flank occupying three-fourths of the shell surface, ornamented by concentric costae in the umbonal region, then by smooth vaugonic costae with the junction between them anteroventrally inclined from the umbo toward the posterior part of the ventral margin. Area ornamented by faint transverse growth lines; asymmetrically divided by a narrow and shallow submedian groove. Marginal and escutcheon carinae poorly defined near the umbo, then undefined, forming a blunt crest in the distal portion. Escutcheon lanceolate, excavate and smooth.

Material.—Three hypotype juvenile specimens, MOZ P1821/1, somewhat broken, left valve; MOZ P1821/2, a poorly preserved left valve, and MOZ P4322, a poorly preserved left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1821/1	20	15	5	0.75	0.25
MOZ P1821/2	32	27	8	0.84	0.25
MOZ P4322	20	13	7	0.65	0.35

Remarks.— Although juveniles, the described specimens are identical to *Andivaugonia lissocostata* (Reyes and Pérez, 1984, p. 40, pl. 2, figs. 7) from the Upper Bathonian (?)–Lower Callovian Asientos Formation of northern Chile. The assignment of this species to *Andivaugonia*, n. gen. is based on the less elongated shell shape and the presence of a very poorly defined marginal carina which distinguishes it from other known species of *Vaugonia*. The most closely allied species is *Andivaugonia covuncoensis* (Lambert, 1944, pl. 1, fig. 1; herein described) but this species has anterior flank costae parallel to the ventral margin, whereas in *Andivaugonia lissocostata* the costae are posteroventrally inclined (see Reyes and Pérez, 1984, p. 41).

Age and occurrence.—Early Bajocian, *Emileia giebeli* and *Stephanoceras humphriesianum* Zones, Lajas Formation; Fortín 1º de Mayo (Locality 23), Dept. Catán Lil, Neuquén, Argentina.

Subfamily **STEINMANELLINAE** Cooper, 1991

Genus **STEINMANELLA** Crickmay, 1930a

Type species.—*Trigonia holubi* Kitchin, 1908, Upper Valanginian, southeastern Africa.

Diagnosis.—Oblong to subquadrangular. Flank ornamented by strong, concave, tuberculated costae. Area smooth except for tuberculate carinae, or transversely ridged by rugate costae that may or may not arise from the flank, and which may be asymmetrically divided by a submedian groove. Escutcheon variable in size, containing oblique, strongly tuberculate ridges or rugae in most representatives (Crickmay, 1930a, Cox, 1969, Pérez, Reyes and Pérez, 1981).

Distribution.—Upper Jurassic (Tithonian) to Upper Cretaceous. Cosmopolitan, except for boreal regions.

Discussion.—The genus *Steinmanella* was proposed without an adequate diagnosis by Crickmay (1930a, p. 50), with the Neocomian *Trigonia holubi* Kitchin (1908) as type species. In a later reference to this genus, Crickmay (1932, p. 459) described its area as ". . . broad, costellate in juvenile, smooth but for carinal tubercles in middle growth, irregular costellae in mature". After examining a plastotype of the South African *Trigonia holubi* Kitchin, I confirm that it has a smooth proximal area except for tuberculate carinae (see also Camacho and Olivero, 1985, pl. 1, figs. 1–2).

Dietrich (1933) described the genus *Transitrigonia*, with the Neocomian South American *Trigonia transitoria* Steinmann (1881, pl. 13, fig. 3) as type species. This species is characterized in juvenile specimens by an area with transverse costae or rugae that may reach the upper part of the posterior flank. Although some authors (Cox, 1952, 1969; Kobayashi and Amano, 1955; Levy, 1969; Poulton, 1979) considered *Transitrigonia* Dietrich as a synonym of *Steinmanella* Crickmay, the present author, in coincidence with Saveliev (1958) and Camacho and Olivero (1985), believes that both taxa are valid based mostly on the different ornamentation of the area. In my opinion *Trigonia transitoria* Steinmann, the type species of *Transitrigonia* Dietrich, possesses the morphological patterns of the South American Steinmanellas. The genus *Steinmanella* will be divided in this study into four different groups as follows: subgenus *Steinmanella* sensu stricto [*S.* (*S.*) *holubi*], subgenus *Transitrigonia* Dietrich [*S.* (*T.*) *transitoria, S.* (*T.*) *quintucoensis, S.* (*T.*) *neuquensis, S.* (*T.*) *steinmanni, S.* (*T.*) *raimondii*], subgenus *Macrotrigonia* Camacho and Olivero [*S.* (*M.*) *vacaensis*], and subgenus *Splenditrigonia*, n. subgen. [*S.* (*Spl.*) *splendida, S.* (*Spl.*) *erycina, S.* (*Spl.*) *haupti*].

Subgenus **TRANSITRIGONIA** Dietrich, 1933

Type species.—*Trigonia transitoria* Steinmann, 1881, Neocomian, Caracoles, Chile.

Diagnosis.—Shell large, ovate to subquadrate. Flank ornamented by evenly spaced, tuberculate, concave costae. Area ornamented by transversely elongated tubercles in the proximal portion, and by transverse costae or rugae in its mid- and distal part. These may well cross onto the upper part of the posterior flank. Marginal and escutcheon carinae mostly defined in the umbonal region by rows of tubercles, then indistinct. Escutcheon mostly ornamented with the same pattern as found on the area (Dietrich, 1933; Saveliev, 1958; Camacho and Olivero, 1985).

Distribution.—Upper Jurassic (Middle Tithonian) to Lower Cretaceous (Barremian and ? Aptian), South America, southern North America.

Steinmanella (Transitrigonia) transitoria (Steinmann, 1881)
Plate 10, figures 1, 2

Trigonia transitoria Steinmann, 1881, p. 260, pl. 13, figs. 3, 3a; 1882, p. 221, pl. 7, figs. 3, 4, pl. 8, figs. 1–3; Philippi, 1899, p. 63, pl. 29, figs. 5–7; Burckhardt, 1900a, p. 21, pl. 25, figs. 1–3; 1900b, p. 73, pl. 14, figs. 1, 2; Douvillé, 1910, p. 20, fig. 5; Lambert, p. 374, pl. 7, figs. 1, 2 (non pl. 6, fig. 1 = *S. quintucoensis* Weaver; non pl. 6, fig. 2 = *S. vacaensis* Weaver)

Steinmanella (*Steinmanella*) *transitoria* (Steinmann). Reyes and Pérez, 1978, p. 23, pl. 5, fig. 2

Steinmanella transitoria (Steinmann). Reyes, Serey and Pérez, 1981, pl. 2, fig. 16; Leanza and Garate, 1987, p. 214, pl. 9, fig. 2.

Steinmanella transitoria transitoria (Steinmann). Pérez, Reyes and Pérez, 1981, p. 105.

Description.—Shell large, oval, longer than wide. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle obtuse. Posterior margin relatively short, curving evenly into the well rounded ventral margin, and then continuously to the convex anterior margin. Flank ornamented by concave costae, bearing medium sized, rounded and closely spaced tubercles. Antecarinal groove very poorly defined. Marginal carina poorly defined near umbo, and disappearing in the posterior part of the shell. Area ornamented by tubercles in the umbonal region, and then by transverse rugae which reach the upper part of the flank. Escutcheon with isolated and irregularly distributed tubercles.

Material.—One hypotype adult specimen, MOZ P0916, a complete shell, very well preserved (see also Leanza and Garate, 1987, pl. 9, fig. 2).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0916	114	89	20	0.78	0.17

Remarks.—Although this species is very common in Hauterivian strata of the Agrio Formation at several localities of the Neuquén Basin, its first appearance was recorded in outcrops of the Upper Tithonian Vaca Muerta and Picún Leufú Formations. For further comparisons between this species and other species of *Steinmanella* from the Andean region see Reyes, Serey and Pérez (1981) and Pérez, Reyes and Pérez (1981).

Age and occurrence.—Late Valanginian/Early Hauterivian, *Olcostephanus curacoensis* and *Lyticoceras pseudoregale* Zones, Agrio Formation; Cerro Pitrén (Locality 1), Dept. Ñorquín, Neuquén, Argentina. This species may range also in western central Argentina well into the Middle and Upper Hauterivian.

Steinmanella (Transitrigonia) quintucoensis (Weaver, 1931)
Plate 14, figures 1–2, 4, 10

Trigonia transitoria var. *quintucoensis* Weaver, 1931, p. 248, pl. 21, fig. 111, pl. 23, figs. 119–125; Corvalán and Pérez, 1958, p. 40, pl. 3, figs. 2a, b

Trigonia transitoria Steinmann. Lambert, 1944, p. 374, pl. 6, fig. 1 (non pl. 6, fig. 2 = *S. vacaensis* (Weaver), non pl. 7, figs. 1–1 = *S. transitoria* (Steinmann)).

Steinmanella transitoria quintucoensis (Weaver). Saul, 1978, pl. 11, figs. 7, 8; Reyes, Serey and Pérez, 1981, pl. 1, fig. 4.

Steinmanella quintucoensis (Weaver). Leanza and Garate, 1987, p. 215, pl. 12, figs. 5, 6.

Description.—Shell large, ovate to subquadrate. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle obtuse. Posterior margin relatively long. Ventroposterior angle rounded, curving into a broadly convex ventral margin, and then continuously to the somewhat convex anterior margin. Flank ornamented by slightly concave and rather distant costae, which contain sparse, medium-sized, tubercles. Presence of a broad antecarinal sulcus which becomes wider toward the posterior part of the shell. Area asymmetrically divided by a median groove, ornamented by oblique rugae. Escutcheon with oblique growth lines and some scattered tubercles. Ligamental fossette narrow, short, and deep.

Material.—Two topotype adult specimens. MOZ P0925, a complete shell, with both valves very well preserved, and MOZ P2552, a complete shell with *Lycettia* epizoans.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0925	83	63	18	0.75	0.21
MOZ P2552	87	67	19	0.77	0.21

Remarks.—Leanza and Garate (1987, p. 215) elevated the original variety of Weaver (1931) to the rank of species on the basis of its easily recognizable shape in which the wide antecarinal sulcus is its outstanding feature. Stoyanow (1949, p. 69) has compared *S. quintucoensis* (Weaver) with "*Trigonia*" *vyschetzkii* Cragin (1905, pl. 8, fig. 2) from the Upper Jurassic (Kimmeridgian) Malone Formation of Texas, which was placed in *Steinmanella* by Saul (1978, p. 11), but the North American species differs in having: (1) a different shell shape; (2) a tuberculated marginal carina; and (3) less well developed antecarinal sulcus.

In the specimen MOZ P2552, which shows attachment of *Lycettia* epizoans, it is possible to recognize clearly an exhalant aperture in the upper part of the posterior margin, and also an inhalant aperture counterpart of greater size in the lower part of the posterior margin. These epizoans also allow reconstruction of

living position and the depth of burrowing for this species. The living position of *S. quintucoensis* using the occurrence of epizoans coincides with the interpretation already made by Saul (1978, p. 19, fig. 8) for the North Pacific Cretaceous genus *Yaadia* Crickmay (1930a), and it is the subject of a further paper (Kauffman, Leanza and Villamil, in press).

Age and occurrence.—Upper Berriasian/Lower Valanginian, *Spiticeras damesi* and *Neocomites wichmanni* Zones, Vaca Muerta Formation; Cerrito de la Ventana, Trahuncurá (Locality 4), Dept. Loncopué, Neuquén, Argentina.

Steinmanella (Transitrigonia) neuquensis (Burckhardt, 1903)
Plate 12, figures 6, 7

Trigonia aff. *nodosa* Sowerby. Burckhardt, 1900a, p. 22, pl. 25, figs. 4, 5.

Trigonia neuquensis Burckhardt, 1903, p. 74, pl. 14, figs. 4–6; Weaver, 1931, p. 254, pl. 22, figs. 112–114; Lambert, 1944, p. 383, pl. 9, fig. 5.

Steinmanella (*Steinmanella*) *neuquensis* (Burckhardt). Reyes and Pérez, 1978, p. 22, pl. 4, fig. 2.

Steinmanella neuquensis (Burckhardt). Cooper, 1979, p. 62, fig. 11; Pérez, Reyes and Pérez, 1981, p. 105; Reyes, Serey and Pérez, 1981, pl. 2, fig. 21; Leanza and Garate, 1987, p. 216, pl. 11, figs. 1, 2.

Steinmanella (*Transitrigonia*) *neuquensis* (Burckhardt). Camacho and Olivero, 1985, pl. 2, fig. 1, pl. 4, fig. 2.

Description.—Shell large, rather inflated, subquadrate. Umbones opisthogyrous, situated very anteriorly. Dorsal margin straight, with a slight expansion in its middle part. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle also obtuse. Ventral margin gently convex, curving evenly into the convex anterior margin. Flank ornamented by regularly concave, somewhat distant, tuberculated costae. Area exhibits transversely elongate tubercles in its proximal portion, and rugae arising the flank in its distal portion. Escutcheon as in other species of *Steinmanella*.

Material.—One hypotype adult specimen, MOZ P2767, a complete shell, with both valves very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2767	81	66	21	0.81	0.25

Remarks.—*Steinmanella neuquensis* (Burckhardt) shows close affinities with *S. transitoria* (Steinmann) and *S. steinmanni* (Philippi), differing from these species by its subquadrate shape, straighter anterior margin, with the umbones more anteriorly situated and shell more inflated.

Age and occurrence.—Upper Berriasian, *Spiticeras damesi* Zone, Vaca Muerta Formation; Cerrito de la Ventana, Trahuncurá (Locality 4), Dept. Loncopué, Neuquén, Argentina. In the Neuquén Basin this species range in age from the Upper Berriasian to the Hauterivian.

Steinmanella (Transitrigonia) steinmanni (Philippi, 1899)
Plate 13, figures 1, 10

Trigonia steinmanni Philippi, 1899, p. 64, pl. 30, figs. 1, 2; Lambert, 1944, p. 378, pl. 9, figs. 1–4.

Trigonia transitoria var. *curacoensis* Weaver, 1931, p. 245, pl. 22, figs. 115–118.

Steinmanella (*Steinmanella*) *transitoria* (Steinmann) var. *curacoensis* Weaver. Reyes and Pérez, 1978, p. 25, pl. 3, fig. 4.

Steinmanella (*Steinmanella*) *steinmanni* (Philippi). Reyes and Pérez, 1978, p. 23, pl. 5, fig. 5.

Steinmanella steinmanni (Philippi). Pérez, Reyes and Pérez, 1981, p. 105; Reyes, Serey and Pérez, 1981, pl. 2, figs. 12–15; Leanza and Garate, 1987, p. 216, pl. 13, figs. 1, 2.

Steinmanella (*Transitrigonia*) *steinmanni* (Philippi). Camacho and Olivero, 1985, p. 49, pl. 1, figs. 3, 4.

Description.—Shell of medium size, oval, somewhat inflated. Umbones opisthogyrous, very anteriorly situated, somewhat prominent. Dorsal margin straight. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle obtuse. Ventral margin widely convex, curving evenly into the convex anterior margin. Flank ornamented by strongly concave costae exhibiting small tubercles which are partially united, this is a diagnostic character. Marginal carina partially developed in the proximal part of the shell and absent in the distal portion. Area contains in its distal portion, strong, crowded transverse rugae that cross the carinal line, reaching the upper part of the posterior flank. Escutcheon as in other species of *Steinmanella*.

Material.—One hypotype adult specimen. MOZ P0917, a complete shell, with both valves very well preserved (see Leanza and Garate, 1987, pl. 13, figs. 1–2).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0917	91	63	22	0.69	0.24

Remarks.—This species is easily distinguishable from the other known species of *Steinmanella* by its oval shape, with anterior margin strongly convex, and especially by its strongly concave costae of the flank which bear small and partially united tubercles. Lambert (1944, p. 379) demonstrated that the variety *curacoensis* of Weaver (1931, p. 245, pl. 22, figs. 115–118) belongs to this species; this criterion was already adopted by Leanza and Garate (1987, p. 216).

Age and occurrence.—Valanginian, *Olcostephanus curacoensis* Zone, Mulichinco Formation; Puerta Curaco (Locality 2), Dept. Pehuenches, Neuquén, Argentina.

Steinmanella (Transitrigonia) raimondii
(Lisson, 1930)
Plate 11, figures 1–4

Trigonia Bronii Gabb (non Agassiz), 1877, p. 288.
Trigonia transitoria var. *raimondii* Lisson, 1930, p. 15, pl. 8, figs. 1, 2.
Steinmanella transitoria raimondii (Lisson). Pérez, Reyes and Pérez, 1981, p. 105; Reyes, Serey and Pérez, 1981, pl. 1, figs. 19, 20.
Steinmanella raimondii (Lisson). Leanza and Garate, 1987, p. 218, pl. 11, figs. 8–13.

Description.—Shell small, subquadrate. Umbones opisthogyrous, very anteriorly located. Dorsal margin straight. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle widely obtuse. Ventral margin gently convex. Anteroventral angle present, widely obtuse. Anterior margin rather straight. Flank occupying two-thirds of the shell surface, ornamented by widely spaced, slightly concave, tuberculate costae. Antecarinal sulcus present widening toward the posterior part of the shell. Marginal and escutcheon carinae very sharp, provided with tubercles. Area ornamented by transverse costae that do not reach the flank. Escutcheon elongate and narrow, crossed obliquely by rugose growth lines, with some irregular, unordered nodes.

Material.—Fourteen hypotypes, adult specimens unless otherwise indicated: MOZ P1756/1, whole shell, very well preserved; MOZ P1756/2, whole shell, but with the posterior part broken; MOZ P1756/3, whole shell, well preserved; MOZ P1756/4, whole shell, but with the left valve broken; MOZ P1756/5, whole shell, well preserved; MOZ P1756/6, whole shell, poorly preserved; P 1756/7, with both valves, but somewhat broken; MOZ P1756/8, whole shell, well preserved; MOZ P1756/9–11, whole shell, but poorly preserved; P 1756/12, a right valve poorly preserved; P 1756/13, a right valve of a juvenile specimen; MOZ P1756/14, a well preserved left valve. All specimens are preserved in a light green siltstone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1756/3	29	24	8.5	0.82	0.29
MOZ P1756/9	36	28	9	0.77	0.25

Remarks.—*Steinmanella raimondii* (Lisson) was cited for the first time in Argentina by Leanza and Garate (1987, p. 218). It clearly differs from the other known species of *Steinmanella* by its small size, shell shape, and characteristic marginal and escutcheon carinae.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Subgenus **SPLENDITRIGONIA**, new subgenus

Type species.—*Trigonia splendida* A. F. Leanza, 1941, Upper Jurassic (Tithonian), Neuquén, Argentina.

Diagnosis.—Shell large, subquadrate to subrectangular. Flank ornamented by nearly straight, tuberculate costae, arranged in narrow or wide bundles. Area wide, strongly tuberculated or with lines of beads. Marginal carina tuberculated in the umbonal region, or distinctly demarcated by different ornamentation of flank and area. Escutcheon wide, irregularly tuberculated.

Distribution.—Upper Jurassic (Tithonian) to Lower Cretaceous (Lower Valanginian). Argentina and Chile.

Discussion.—Kobayashi and Amano (1955) were the first to include *Trigonia erycina* Philippi and *Trigonia haupti* Lambert in the genus *Steinmanella* Crickmay (1930a). This view was later accepted by Levy (1969), who also added *Trigonia splendida* A. F. Leanza to this group. Reyes et al. (1981) noted the strong affinities of *Steinmanella haupti* with *Steinmanella erycina*, grouping these two species in their subgroup B1. Pérez, Reyes and Pérez (1981) considered *S. splendida* and *S. haupti* as *Steinmanella* characterized by tuberculate areas. Camacho and Olivero (1985, p. 51), in their revision of the genus *Steinmanella*, stated that the group of trigoniids composed of *S. splendida, S. erycina* and *S. haupti* might constitute a different lineage or even a separate genus related to *Steinmanella*. In agreement with this view, and based on newly collected material from western central Argentina, the subgenus *Splenditrigonia*, n. subgen. is proposed herein, with *T. splendida* A. F. Leanza as type species. The new subgenus constitutes an homogeneous stock composed by *S.* (*Spl.*) *splendida, S.* (*Spl.*) *haupti* and *S.* (*Spl.*) *erycina*, the first two species characterized by strong tuberculation on the area, and the third species being closely linked with *S.* (*Spl.*) *haupti* in shell shape and flank ornamentation, and with the area ornamented by lines of beads.

Steinmanella (Splenditrigonia) splendida
(A. F. Leanza, 1941)
Plate 11, figures 5–8

Trigonia splendida A. F. Leanza, 1941, p. 225, pl. 1, figs. 1, 2.
? *Trigonia* cf. *splendida* A. F. Leanza. Corvalán, 1959, p. 33, pl. 2, fig. 6.
Steinmanella (*Steinmanella*) *splendida* (A. F. Leanza). Reyes and Pérez, 1978, p. 22, pl. 5, fig. 3.
Steinmanella splendida (A. F. Leanza). Pérez, Reyes and Pérez, 1981, p. 105; Reyes, Serey and Pérez, 1981, pl. 1, fig. 23; Leanza and Garate, 1987, p. 217, pl. 13, fig. 7.

Description.—Shell large, subquadrate. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle obtuse, rounded. Posterior margin short. Ventroposterior angle very rounded. Ventral margin gently convex, curving evenly into the straight anterior margin. Flank ornamented initially by straight costae and subsequently by slightly concave costae, bearing irregularly sized tubercles. Area completely ornamented by oblique lines of irregularly sized tubercles. Marginal carina tuberculate. Antecarinal groove absent. Escutcheon ornamented, as the area, also by irregular tubercles. Exhalant aperture well developed.

Material.—One hypotype adult specimen, MOZ P2553, a whole shell, with both valves very well preserved, bearing *Lycettia* sp. epizoans.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2553	91	77	20	0.84	0.22

Remarks.—*Steinmanella* (*Splenditrigonia*) *splendida* differs from other species of the subgenus *Transitrigonia* by its characteristic tuberculate area and escutcheon, and also by its subquadrate shape. This species closely resembles the Neocomian *Mediterraneotrigonia* Nakano (1974) (type species: *Trigonia hondeana* Lea, 1841) from the Barremian/Aptian of Perú, Colombia and Venezuela, and it might be considered its direct ancestor in the Andean region. Originally *S.* (*Spl.*) *splendida* was found in Lower Tithonian beds of Carrín Curá (see A. F. Leanza, 1941), but subsequently the authors found the same species in the Upper Tithonian (*Substeuroceras koeneni* Zone) of Mallín Quemado, and in the Lower Valanginian (*Neocomites wichmanni* Zone) from Cerrito de la Ventana, Trahuncurá area (Leanza and Garate, 1987). One of the specimens illustrated here (Pl. 11, fig.7) shows the well-developed exhalent aperture particularly well.

Age and Occurrence.—Early Valanginian, *Neocomites wichmanni* Zone, Vaca Muerta Formation; Cerrito de la Ventana, Trahuncurá (Locality 4), Dept. Loncopué, Neuquén, Argentina. In the Neuquén Basin this species is known from strata of Lower Tithonian to Early Valanginian age.

Steinmanella (Splenditrigonia) erycina (Philippi, 1899)
Plate 7, figure 1

Trigonia erycina Philippi, 1899, p. 66, pl. 30, figs. 3–5; Lambert, 1944, p. 379, pl. 8, fig. 4.

Steinmanella erycina erycina (Philippi)). Pérez, Reyes and Pérez, 1981, p. 105.

Steinmanella erycina (Philippi). Reyes, Serey and Pérez, 1981, pl. 2, figs. 3–8 [non figs. 4, 8 = *S. haupti* (Lambert)]; Leanza and Garate, 1987, p. 217, pl. 13, fig. 6.

Steinmanella (*S.*) *erycina* (Philippi). Pérez and Reyes, 1989, p. 10, pl. 1, figs. 5, 10.

Description.—Shell large, subrectangular. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight and long. Dorsoposterior angle obtuse. Posterior margin relatively long. Ventroposterior angle obtuse, very rounded. Ventral margin straight, curving abruptly into the straight anterior margin. Flank occupying four-fifths of the shell surface, ornamented with straight costae in its ventral portion, curving abruptly near the marginal carina; the costae bear closely spaced medium size tubercles. Marginal carina absent, only demarcated by the distinct ornamentation of flank and area. Area narrow, showing rows of finely beaded transverse costae. Escutcheon with elongated tubercles forming oblique lines toward the escutcheon carina. Ligamental fossette elongate. Shell rather thick.

Material.—One adult hypotype specimen, MOZ P0921, an incomplete left valve with its posterior part broken.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0921	80	69	24	0.86	0.30

Remarks.—Although *Steinmanella* (*Splenditrigonia*) *erycina* (Philippi) has weakly defined costae on the area, they bear small tubercles which clearly relate this species with *Steinmanella* (*S.*) *splendida* (A. F. Leanza) and *Steinmanella* (*Spl.*) *haupti* (Lambert); these species form an homogeneous stock. *S.* (*Spl.*) *erycina* differs from *S.* (*Spl.*) *splendida* in its subrectangular instead of subquadrangular shape, and in having smaller tubercles in the area. *S.* (*Spl.*) *haupti* (Lambert), as it was stated by Lambert (1944) differs from *S.* (*Spl.*) *erycina* in having lines of small tubercles over the whole area.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* Zone, Picún Leufú Formation; Caichigüe, Charahuilla (Locality 22), Dept. Catán Lil, Neuquén, Argentina.

Steinmanella (Splenditrigonia) haupti (Lambert, 1944)
Plate 6, figures 1–2

Trigonia erycina Haupt (non Philippi), 1907, p. 215, pl. 8, figs. 5a, b.

Trigonia erycina Weaver (non Philippi), 1931, p. 259, pl. 21, figs. 109, 110.

Trigonia haupti Lambert, 1944, p. 381, pl. 5, figs. 7, 8; A. F. Leanza and Castellaro, 1955, p. 188, pl. 1, fig. 18.

Steinmanella (*Steinmanella*) *haupti* (Lambert). Reyes and Pérez, 1978, p. 21, pl. 5, fig. 4.

Steinmanella erycina haupti (Lambert). Pérez, Reyes and Pérez, 1981, p. 105.

Steinmanella haupti (Lambert). Reyes, Serey and Pérez, 1981, pl. 2, figs. 1, 2; Leanza and Garate, 1987, p. 218, pl. 12, figs. 1, 2.

Description.—Shell large, subrectangular. Umbones opisthogyrous, very anteriorly situated. Shape of the shell and ornamentation of the flanks very similar to *Steinmanella* (*Spl.*) *erycina* (Philippi), but the area is characterized throughout its whole development by lines of very small tubercles.

Material.—One adult hypotype specimen, MOZ P0913, a complete shell, with both valves very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0913	90	64	20	0.71	0.22

Remarks.—The differences between *Steinmanella* (*Spl.*) *haupti* (Lambert) with *S.* (*Spl.*) *splendida* (A. F. Leanza) and *S.* (*Spl.*) *erycina* (Philippi) have been treated in the descriptions of those species.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* Zone, Picún Leufú Formation; Aguada del Overo (Locality 19), Dept. Catán Lil, Neuquén, Argentina. Although Lambert (1944) ascribed *Steinmanella* (*Splenditrigonia*) *haupti* to the Valanginian, later studies by H. Leanza (1973, 1981) have revealed that this species only extends from the Middle Tithonian to the Lower Berriasian (see Leanza and Garate, 1987).

Subgenus **MACROTRIGONIA**
Camacho and Olivero, 1985

Type species.—*Steinmanella* (*Macrotrigonia*) *katterfeldensis* Camacho and Olivero, Hauterivian/Barremian, Chubut, Argentina.

Diagnosis.—Shell very large, elongated, with acuminate ventroposterior angle. Anterior margin of the shell subplanate. Flank ornamented by almost straight or only gently tuberculated costae. Area tuberculated, transversely ridged by prominent rugae on its distal portion. Escutcheon wide, ornamented as on the area (Camacho and Olivero, 1985).

Distribution.—Lower Cretaceous (Valanginian to Barremian). Argentina, Chile and South Africa.

Steinmanella (Macrotrigonia) vacaensis
(Weaver, 1931)
Plate 15, figures 6–7; Plate 16, figure 13

Trigonia transitoria var. *vacaensis* Weaver, 1931, p. 251, pl. 24, figs. 126–130; Lambert, 1944, p. 377, pl. 7, fig. 3, pl. 8, figs. 1–3.

Trigonia transitoria Steinmann. Lambert, 1944, p. 374, pl. 6, fig. 2 (non pl. 6, fig. 1 = *S. quintucoensis* (Weaver), non pl. 7, figs. 1, 2 = *S. transitoria* (Steinmann).

Steinmanella (*Steinmanella*) *transitoria* (Steinmann) var. *vacaensis* Weaver. Reyes and Pérez, 1978, p. 26, pl. 4, fig. 4.

Steinmanella transitoria vacaensis Weaver. Reyes, Serey and Pérez, 1981, pl. 1, figs. 14–18; Pérez, Reyes and Pérez, 1981, p. 105.

Steinmanella (*Macrotrigonia*) *vacaensis* (Weaver). Camacho and Olivero, 1985, p. 59, pl. 3, figs. 3, 4.

Steinmanella vacaensis (Weaver). Leanza and Garate, 1987, p. 215, pl. 10, figs. 1–3.

Description.—Shell very large, strongly elongated and posteriorly acuminate. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle very obtuse. Posterior margin very long. Ventroposterior angle slightly acute, resulting in an acuminate end of the shell. Ventral margin slightly convex. Anteroventral angle nearly 90°. Anterior margin straight, giving the anterior part of the shell a subplanate aspect. Flank ornamented by strongly tuberculated, almost straight or only gently curved costae. Area and escutcheon ornamented as in other species of *Steinmanella*.

Material.—One hypotype adult specimen, MOZ P2329, a whole shell, with both valves very well preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2329	164	86	26	0.52	0.15

Remarks.—*Steinmanella* (*M.*) *vacaensis* (Weaver) can readily be distinguished from the other known species of *Steinmanella* by its very large size, with almost straight anterior margin and an acuminate end of the shell. In this species the exhalant and inhalant apertures are well developed (see Pl. 15, fig. 6). Differences with other representatives of the subgenus *Macrotrigonia* [*S.* (*M.*) *posadensis* Camacho and Olivero (1985, p. 55, pl. 4, figs. 1,3); *S.* (*M.*) *maxima* Camacho and Olivero (1985, p. 58, pl. 1, fig. 5; pl. 3, fig. 1); *S.* (*M.*) *katterfeldensis* Camacho and Olivero (1985, pl. 2, figs. 3–4)] from the Hauterivian/Barremian of Chubut, Argentina, and with *S.* (*M.*) *herzogi* (Goldfuss) from the Valanginian of South Africa, are principally based on shell shape and the curvature of the flank costae.

Age and occurrence.— Middle Hauterivian, *Holcoptychites neuquensis* Zone, Agrio Formation; Los Hornos, Covunco Creek (Locality 29), Dept. Zapala, Neuquén, Argentina. In the Neuquén Basin this species is also very common in the Upper Hauterivian.

Subfamily **ANDITRIGONIINAE**, new subfamily

Diagnosis.—Shell small to large in size, mostly pyriform, but also subquadrate to elongate. Flank ornamented by two sets of costae meeting on different parts of the flank forming L-, V- or W-shaped patterns or a combination of these in which tuberculate costae or isolated tubercles may be present. Area practically smooth in early representatives (*Eoanditrigonia*), later ornamented by transverse costellae near umbo and a smooth distal area (*Anditrigonia*), faint radial costellae

on the area (*Paranditrigonia*), transverse costellae on the whole surface (*Antutrigonia*), or transverse costellae near umbo and then radial costellae on the distal area (*Virgotrigonia*). Marginal carina may be absent (*Antutrigonia*), only defined in the umbonal region (*Eoanditrigonia*, *Anditrigonia*, *Paranditrigonia*) or continuous along the whole length of the shell (*Lambertrigonia, Virgotrigonia*). Escutcheon usually wide and smooth, and not very well impressed.

Distribution.—Early Jurassic (Early Bajocian) to Lower Cretaceous (Hauterivian). North America (Canada, United States, México) and South America (Argentina, Chile, Perú).

Discussion.—Nakano (1965) revised Megatrigoniinae van Hoepen (1929), and defined the subfamily as follows:

> Shell large to small in size, triangularly ovate to pyriform, inequilateral, moderately inflated; umbo large, opisthogyrous and located anteriorly; marginal and escutcheon carinae evanescent except near umbo; area narrow, curved, with an upward-facing concavity; median carina or groove indistinct; escutcheon narrow and depressed; on flank several early costae concentric or subconcentric; but most others are diagonal, V- or L-shaped and sometimes effaced later; costellae on area and escutcheon first transverse but die out later. Internally, a lengthy radial ridge conicides approximately with the middle of the area; test rather thick (Nakano, 1965, p. 14).

When Nakano (op. cit.) revised the Megatrigoniinae, however, the genus *Anditrigonia* Levy (1967c) (type species: *Trigonia carrincurensis* A. F. Leanza, 1941) had not yet been erected. In recent years the knowledge of this taxon has significatively improved thanks to the studies of Reyes and Pérez (1982) and Pérez and Reyes (1983, 1989). These authors (Reyes and Pérez, 1983) erected the subgenus *Paranditrigonia* to differentiate forms of *Anditrigonia* with radial costellae on the area. Leanza and Garate (1987) created the genus *Antutrigonia* to identify species closely related and formerly included in *Anditrigonia*, but in which the area is characterized by transverse costellae throughout its entire development. Alleman (Nov. 1985) erected the genus *Virgotrigonia* (=*Maputrigonia* Leanza, Dec. 1985) with flank ornamentation similar to *Anditrigonia*, but with the area characterized by transverse costellae near the umbo, and by radial costellae on the remaining surface. In the present study the subgenus *Eoanditrigonia*, n. subgen. and the genus *Lambertrigonia*, n. gen. are proposed. The first taxon includes Middle Jurassic forms with a smooth area and flank pattern opposite to that of *Anditrigonia*; the second taxon includes forms very closely related to *Paranditrigonia*, on the basis of radial costation on the area, but with a well developed marginal carina and a protruding submedian groove on the area.

These new and numerous very closely related taxa confirm that the subfamily comprises a phyletically homogeneous stock. Several taxa have superimposed ornamentational patterns on the area which were not adopted in the differential diagnosis of the Megatrigoniinae by Nakano (1965), especially the nature of the marginal and escutcheon carinae, and the ornamentation of the area. Therefore the relationships of this North and South American group of Trigoniidae with Megatrigoniinae appear to be only superficial, and the subfamily Anditrigoniinae, n. subfam. is proposed herein. Anditrigoniinae, n. subfam., includes the following taxa: *Eoanditrigonia, Lambertrigonia, Paranditrigonia, Anditrigonia, Virgotrigonia* and *Antutrigonia*. The Megatrigoniinae are considered to include, in agreement with Nakano (1965, p. 20), the genera *Megatrigonia* van Hoepen and *Iotrigonia* van Hoepen.

Genus **ANDITRIGONIA** Levy, 1967c

Type species.—*Trigonia* (*Megatrigonia*) *carrincurensis* A. F. Leanza, 1941, Upper Jurassic (Middle Tithonian), Neuquén, Argentina.

Diagnosis.—Shell usually large, ovate, subtrigonal or pyriform. Flank ornamented by subconcentric costae, followed by a two sets of costae, the anterior one subhorizontal or sinuous, and the posterior subvertical or oblique. The junction of these two sets of costae can be simple, sinuous, in L-shape, or in more complex V- or W- shape. In the mid-anterior flank tubercles may be present. Area narrow, with faint transverse or concentric costellae near umbo, then smooth, with or without submedian groove. Marginal and escutcheon carinae poorly defined. Escutcheon elongated, narrow, excavated and smooth, or ornamented by oblique growth lines (Levy, 1967c; Reyes and Pérez, 1982; Leanza and Garate, 1987).

Distribution.—Early Jurassic (Early Bajocian) to Lower Cretaceous (Hauterivian). North America (Canada, United States, México) and South America (Argentina, Chile, Perú).

Subgenus **EOANDITRIGIONIA**, new subgenus

Type species.—*Trigonia keideli* Weaver, 1931, Middle Jurassic (Middle Bajocian/Early Callovian), Neuquén, Argentina.

Diagnosis.—Shell medium to large in size, pyriform. Umbones prominent, very anteriorly located. Anterior flank ornamented by up to 40, very narrow, subconcentric costae that form on the posterior flank a ventrally directed V- or L-shaped inflection with a posterior set of costae. But these are fewer, thicker, and in inverse relation to those of *Anditrigonia* sensu stricto. Area narrow and smooth, with submedian groove.

Marginal carina only defined in the umbonal region. Escutcheon narrow and smooth.

Distribution.—Middle Jurassic (Middle Bajocian to Early Callovian). Argentina and Chile.

Discussion.—The type species of *Eoanditrigonia*, n. subgen., *Trigonia keideli* Weaver, has been discussed in detail by Leanza and Garate (1983, p. 98; 1987, p. 220), who demonstrated the affinities to *Anditrigonia* Levy, as well as the synonymy of *T. keideli* and *Trigonia chacaicoensis* Lambert. In accordance with the grade of refinement of the taxonomy proposed in this monograph, there is a strong argument for the separation of this form as an independent subgenus of *Anditrigonia*. It is based principally on the presence of a totally smooth area which is not present in Levy's genus, and an exactly inverse costation on the flank with regard to *Anditrigonia*: the anterior part is crowded with narrow subconcentric costae, whilst the posterior set includes thick and fewer costae.

Eoanditrigonia, n. subgen. shows affinities with *Andivaugonia*, n. gen. (this paper), but this genus is a member of Vaugoniinae, showing the two set of costae meeting in a narrow V-shaped inflection of vaugonic style; the area is wider, and usually ornamented by transverse rugae or growth lines, whereas the marginal carina is somewhat better defined than in *Eoanditrigonia*, n. subgen.

Anditrigonia (Eoanditrigonia) keideli
(Weaver, 1931)
Plate 2, figures 16, 18

Trigonia literata Young and Bird var. *keideli* Weaver, 1931, p. 367, pl. 20, fig. 102.
Trigonia chacaicoensis Lambert, 1944, p. 367, pl. 2, figs. 1–5.
Iotrigonia chacaicoensis (Lambert). Kobayashi and Mori, 1955, p. 75.
Megatrigonia chacaicoensis (Lambert). Nakano, 1965, p. 17.
Anditrigonia chacaicoensis (Lambert). Levy, 1967c, p. 137; Reyes and Pérez, 1982, p. A291.
Anditrigonia keideli (Weaver). Leanza and Garate, 1983a, p. 98, pl. 1, figs. 1, 2, pl. 2, figs. 1–3; Leanza and Garate, 1987, p. 220, pl. 2, figs. 5–5, pl. 3, figs. 6, 7.

Description.—Shell medium to large in size, pyriform. Umbones highly opisthogyrous, very anteriorly situated. Dorsal margin strongly convex. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle almost 90°. Ventral margin sinuous in coincidence with the antecarinal region, subsequently slightly convex, curving evenly into the convex anterior margin. Flank occupying fourth-fifths of the shell surface, with a highly variable ornamentation characterized by 25 to 40 faint, subconcentric costae that form in the posterior part of the flank a ventrally directed V- or L-shaped inflection with another set of costae, but these being fewer and thicker. Area nearly smooth, ornamented only by very faint, transverse growth lines. A shallow submedian groove divides the area into two asymmetrical parts. Marginal carina only poorly defined in the proximal part of the shell, and absent in the distal portion. Escutcheon narrow and smooth.

Material.—Four topotype specimens: MOZ P0902/3, an adult left valve; MOZ P2748, an adult left valve: MOZ P2749/1, a juvenile left valve; MOZ P1749/2, a juvenile right valve. All specimens are well preserved in a fine-grained, reddish-brown sandstone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2748	≈28	20	5	0.71	0.17
MOZ P2749/2	24	19	8	0.55	0.33
MOZ P2749/1	19	12	7	0.63	0.36
MOZ P0902/3	53	38	9	0.71	0.16

Remarks.—*Anditrigonia* (*Eoanditrigonia*) *keideli* (Weaver) has been extensively discussed by Leanza and Garate (1983a), and it constitutes the oldest representative of the genus *Anditrigonia* Levy as it has been recorded in Middle Jurassic (Middle Bajocian, Early Callovian) Lajas Formation from Neuquén, and equivalent strata in Chile. *Anditrigonia plumasensis* (Hyatt) (in Poulton, 1979, p. 43, pl. 11, figs. 6–7) from the Callovian Hinchman Formation of Mount Jura, California, U.S.A., and the Lower Oxfordian Hazelton and Bowser Lake Groups, British Columbia, Canada, is another Middle and Upper Jurassic representative of the genus in the Northern Hemisphere. It is worth noting that some specimens (Leanza and Garate, 1987, pl. 3, figs. 6–7) show on the flank costae similarities to *A.* (*A.*) *eximia*, although this Upper Jurassic and Lower Cretaceous species show an inverse relation in the costation of the flank: the posterior set of costae are more numerous and narrower than in *A.* (*E.*) *keideli* (Weaver).

Age and occurrence.—Early Bajocian to Early Bathonian, *Emileia giebeli* to *Cadomites*–Tulitidae Zones, Lajas Formation; Los Pozones (Locality 15), Dept. Zapala, Neuquén, Argentina.

Subgenus **ANDITRIGONIA** Levy, 1967c

Anditrigonia (Anditrigonia) carrincurensis
(A. F. Leanza, 1941)
Plate 5, figures 8, 9

Trigonia (*Megatrigonia*) *carrincurensis* A. F. Leanza, 1941, p. 229, pl. 2, figs. 1, 2.
? *Trigonia* cf. *carrincurensis* A. F. Leanza. Lambert, 1944, p. 390, pl. 5, fig. 6.
Anditrigonia carrincurensis (A. F. Leanza). Levy, 1967c, p. 137; Reyes and Pérez, 1978, p. 16, pl. 2, fig. 1; Reyes and Pérez, 1982, p. A298; Leanza and Garate, 1987, p. 221, pl. 7, figs. 1, 2.

Description.—Shell of medium to large size, subovate, longer than high. Umbones opisthogyrous, sit-

uated in the anterior one-third of the shell. Dorsal margin strongly convex. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle a right to obtuse angle. Ventral margin slightly convex, curving abruptly into the slightly convex anterior margin. Flank somewhat proximally inflated, and distally flattened, ornamented by two sets of well defined costae; anterior set subconcentric; posterior set radial retroverse, both meeting in undulations forming irregular V- or W-shaped inflection on which some scattered tubercles may be present. Area narrow, asymmetrically divided by a shallow submedian groove, ornamented near the umbones by faint transverse costellae, subsequently smooth. Marginal carina poorly defined, only present in juvenile stages of growth. Escutcheon smooth, elongate and excavated.

Material.—One adult hypotype specimen, MOZ P0923/1, a complete shell, with both valves relatively well preserved (Leanza and Garate, 1987, pl. 7, fig. 1).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0923/1	68	54	15	0.79	0.22

Remarks.—The holotype of *Anditrigonia* (*A.*) *carrincurensis* was found at Carrín Curá in the southernmost Tithonian outcrops of the Neuquén Basin (A. F. Leanza, 1941). According to the ammonite biochronology proposed by Leanza and Hugo (1977), the holotype of *A.* (*A.*) *carrincurensis* can be regarded as mid-Middle Tithonian (*Aulacosphinctes proximus* Zone) in age, and stratigraphically belongs to the Carrín Curá Formation (Leanza, Marchese and Riggi, 1977). This species is also very common in fine-grained green sandstones of the distal tongues of the Carrín Curá Formation in the Cerro Caichigüe and Fortín 1° de Mayo areas.

Age and occurrence.—Middle Tithonian, *Windhauseniceras internispinosum* Zone, Picún Leufú Formation; Cañadón del Sapo (Locality 20), Dept. Catán Lil, Neuquén, Argentina.

Anditrigonia (Anditrigonia) eximia
(Philippi, 1899)
Plate 9, figures 3, 4

Trigonia eximia Philippi, 1899, p. 76, pl. 34, figs. 3, 3a, 3b; Gillet, 1924, p 92; Lambert, 1944, p. 391, pl. 10, figs. 1, 2, pl. 11, figs. 1, 2, pl. 12, figs. 1, 2, pl. 13, fig. 1 (non pl. 10, figs. 3–5 = *Anditrigonia lamberti* Levy).
Trigonia eximia var. B. Philippi, 1899, p. 76.
Trigonia crassidens Philippi, 1899, p. 73, pl. 33, fig. 1.
Trigonia arnisoe Philippi, 1899, p. 76, pl. 34, fig. 2.
Trigonia macrorrhyncha Philippi, 1899, p. 77, pl. 34, fig. 5.
Trigonia pusilla Philippi, 1899, p. 78, pl. 34, fig. 7.
Trigonia consanguinea Philippi, 1899, p. 79, pl. 34, fig. 9.
Trigonia gampsorrhyncha Philippi, 1899, p. 79, pl. 34, fig. 10.
Trigonia angusta Philippi, 1899, p. 79, pl. 35, figs. 1, 2.
Trigonia foveata Philippi, 1899, p. 80, pl. 35, fig. 3.
Trigonia semicostata Philippi, 1899, p. 82, pl. 35, fig. 7.
Trigonia aff. *conocardiiformis* Krauss. Burckhardt, 1903, p. 72, pl. 13, figs. 1, 2.
Trigonia cf. *eximia* (Philippi). Haupt, 1907, p. 216.
Trigonia picunensis Weaver, 1931, p. 261, pl. 25, figs. 131–136, pl. 27, fig. 150.
Megatrigonia eximia (Philippi). Nakano, 1965, p. 17.
Anditrigonia eximia (Philippi). Levy, 1967c, p. 137; Reyes and Pérez, 1978, p. 17, pl. 1, fig. 8; Pérez and Reyes, 1982, p. A294; Leanza and Garate, 1987, p. 221, pl. 9, fig. 1; Pérez and Reyes, 1989, p. 14, pl. 2, figs. 7, 11, 14, 15.
Anditrigonia picunensis Weaver, Levy, 1967c, p. 138.

Description.—Shell large, pyriform, anteriorly inflated. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin convex. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle almost 90°. Ventral margin slightly convex, curving evenly into the strongly convex anterior margin. Flank occupying five-sixths of the shell surface, ornamented by a highly variable costation, consisting in two sets of costae, the anterior and the posterior. These meet in patterns of diverse complexity from V, W, or zig-zag shape. The more distal costae are isolated and vertical. Area very narrow, ornamented with faint transverse costellae barely developed near the umbonal region, subsequently disappearing. Submedian groove divides area into two asymmetrical parts. Marginal and escutcheon carinae only distinguishable near the umbones, disappearing in the distal portion. Escutcheon narrow, lanceolate, smooth, except near the umbo where diagonal growth lines or faint costellae occur on very well preserved specimens.

Material.—Two adult hypotype specimens, MOZ P1902/1, a left valve with a *Ptychomya* sp. epizoan and MOZ P1902/2, a complete shell, with the two valves relatively well-preserved.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1902/1	98	63	24	0.64	0.24
MOZ P1902/2	64	41	13	0.64	0.20

Remarks.—*Anditrigonia* (*A.*) *eximia* (Philippi) is one of the more common and highly variable species from the Andean region, and was considered to be an aberrant form of the taxon Scabrae Agassiz (1840) by Gillet (1924, p. 92). As evidenced by the large synonymy, this species has received much attention from paleontologists. Lambert (1944, p. 391, pl. 10, figs. 1–5; pl. 11, figs. 1–2; pl. 12, figs. 1–2; pl. 13, fig. 1) demonstrated the great variability of this species in which it is hard to find one specimen similar to another even

in a same bed or community. In recent years Reyes and Pérez (1982) and Pérez and Reyes (1983, 1989) have made substantial progress in the knowledge of this species. They distinguished the subgenus *Paranditrigonia* Reyes and Pérez 1983 (type species: *Anditrigonia* (*Paranditrigonia*) *potrerillensis* Reyes and Pérez, 1983, p. 62, pl. 1, figs. 4, 7 and 9) to identify forms with only radial ornamentation on the area; these are barely distinguishable when this portion of the shell is not well preserved inasmuch all other features remain the same.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* and *Substeueroceras koeneni* Zones, Picún Leufú Formation; Aguada del Overo (Locality 19), Dept. Catán Lil, Neuquén, Argentina.

Anditrigonia (Anditrigonia) lamberti
Levy, 1967c
Plate 9, figure 7

Trigonia eximia Philippi. Lambert, 1944, p. 391, pl. 10, figs. 3–5 (non *T. eximia* Philippi, 1899).
Anditrigonia lamberti Levy, 1967c, p. 139, pl. 1, figs. 2a–c, text-fig. on p. 139; Leanza and Garate, 1987, p. 222, pl. 7, fig. 3.

Description.—Shell small, pyriform, anteriorly inflated. Dorsal margin slightly convex. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle nearly 90°. Ventral margin slightly convex, curving evenly into the strongly convex anterior margin. Flank ornamented by two sets of costae: the anterior one with subconcentric, widely spaced costae meeting the posterior set in a L-shaped junction. Area narrow and smooth, except in the portion near the umbo where some faint transverse costellae are present. Marginal and escutcheon carinae undefined. Escutcheon smooth.

Material.—One complete hypotype adult specimen, MOZ P0914, complete, very well-preserved with the valves in butterfly position (Leanza and Garate, 1987, pl. 7, fig. 3).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0914	46	22	–	0.48	–

Remarks.—It is possible that the specimen figured as *Trigonia eximia* var. *multicostata* by Corvalán (1959, pl. 1, fig. 1) from the Chilean Tithonian, also illustrated and considered by Pérez and Reyes (1983, pl. 4, fig. 13) as *Anditrigonia discors* (Philippi), belongs to *Anditrigonia* (*A.*) *lamberti* Levy.

Age and occurrence.—Middle Tithonian, *Windhauseniceras internispinosum* Zone, Picún Leufú Formation; Los Catutos (Locality 12), Dept. Zapala, Neuquén, Argentina.

Anditrigonia (Anditrigonia), species indeterminate
Plate 16, figures 5, 8

Description.—Shell of medium size, pyriform, longer than high. Umbones orthogyrous, situated in the anterior one-third of the shell. Posterior dorsal margin slightly concave; anterior dorsal margin slightly convex. Posterior portion of the shell not preserved. Ventral margin slightly convex, curving evenly into the strongly convex anterior margin. Flank very wide, occupying five-sixths of the shell surface, ornamented by two sets of costae. The anterior set is widely spaced, raised and subconcentric, meeting the anterior margin at right angles. The posterior flank set of costae meet the posterior set in L- or V- shaped junctions. These costae trend subvertically; their intercostal spaces are narrower than the costae. Both area and escutcheon comprise a narrow and somewhat concave surface, but the preservation of the specimen precludes any observation on the nature of the ornamentation in these regions.

Material.—One adult specimen, MOZ P5236, a complete shell with both flanks well preserved, but with area and escutcheon not observable, and the posterior part of the shell broken.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5236	≈58	34	14	0.58	0.24

Remarks.—The extremely convex anterior margin differentiates this species from *Anditrigonia* (*A.*) *eximia* (Philippi), and *Anditrigonia* (*A.*) *discors* (Philippi). As these taxa are highly variable (see Lambert, 1944, Pérez and Reyes, 1983), however, and considering the shortage of material (only one specimen) in which the area and escutcheon are not observable, any further taxonomic comparison cannot be made.

Age and occurrence.—Middle Hauterivian, *Holcoptychites neuquensis* Zone, Agrio Formation; El Arenal, Las Lajas (Locality 28), Dept. Picunches, Neuquén, Argentina.

Anditrigonia (Anditrigonia), species juvenile indeterminate
Plate 9, figure 5

Description.—Shell of moderately small size, anteriorly inflated, and posteriorly compressed. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin convex. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin convex, curving evenly into the convex anterior margin. Flank occupying four-fifths of the shell surface, ornamented by two sets of costae, the anterior subconcentric, and the posterior subvertical, meeting in an L-shaped inflection at the posterior

flank. Marginal carina poorly defined. Area presumably ornamented in the umbonal region. Escutcheon not observable.

Material.—One juvenile specimen, MOZ P3014, consisting in a well preserved left valve, fossilized in a coarse-grained, brownish limestone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3014	13.5	10	–	0.74	–

Remarks.—The described specimen differs from the Tithonian *Anditrigonia* (*A.*) *lamberti* Levy (1967c, p. 139, pl. 1, figs. 2a–c; herein described) by its different shell shape, and in that the junction of the two set of flank costae is situated more posteriorly on the flanks. This form could also be considered questionably as a juvenile representative of the highly variable Tithonian and Neocomian *Anditrigonia* (*A.*) *eximia* (Philippi), but the immature nature of the specimen precludes a firm determination.

Age and occurrence.—Upper Tithonian, *Substeueroceras koeneni* Zone, Picún Leufú Formation; Cerro Pancho, Bajada de La Americana (Locality 31), Dept. Zapala, Neuquén, Argentina.

Anditrigonia (Anditrigonia) eximia tesselicaudata, new subspecies
Plate 9, figures 1, 2

Holotype.—MOZ P1901, consisting in an adult specimen, with both valves very well preserved.

Type locality.—Camino nuevo a Los Molles (Locality 34), Dept. Catáan Lil (39°13′S, 70°05′W), Picún Leufú Formation (Leanza, 1973), Mendoza Group (Groeber, 1946).

Etymology.—from the Latin, *tesseli*= forming squares; *caudata*=tail. Refers to the superimposed vertical costae and horizontal grooves resulting in a reticulate pattern of the posterior flank.

Diagnosis.—Shell large, pyriform. Not as elongate, and anterior margin not as convex, as in other species of *Anditrigonia*. Flank ornamented by two set of costae, the anterior one characterized by strong, widely spaced, subhorizontal and ondulate costae that meet the posterior set at the mid- flank in a form of a V. Posterior flank crowded by subvertical, narrowly spaced costae superimposed by subhorizontal grooves, giving as a result a subquadrate pattern. Area very narrow, nearly smooth. Escutcheon wide, excavated, ornamented by faint oblique growth lines.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1901	90	65	23	0.72	0.25

Description.—Shell large, pyriform, anteriorly inflated and posteriorly compressed, but not as elongate as other species of *Anditrigonia*. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle almost 90°. Ventral margin slightly convex, curving evenly into the slightly convex anterior margin. Flank occupying almost the whole surface of the shell, ornamented by two set of costae, the anterior one being situated in the anterior flank and characterized by strong, widely spaced, subhorizontal and undulate costae that meet the posterior set on the mid-flank in a form of a V. Posterior flank crowded by subvertical, narrowly spaced costae which are superimposed by subhorizontal grooves, giving as a result a reticulate pattern diagnostic for the species. Area very narrow, nearly smooth, ornamented by faint radial growth lines. Submedian groove present. Marginal and escutcheon carinae only impressed in the umbonal region, disappearing distally. Escutcheon wide, excavate, ornamented by faint oblique growth lines.

Remarks.—Lambert (1944) demonstrated the high variability of *Anditrigonia eximia* (Philippi) and Pérez and Reyes (1983) included a number of "species" of Philippi under this heading. The described specimen clearly belongs in *Anditrigonia eximia*. Its not very elongate shell shape and moderately convex anterior margin fall within the range of variability of this species. The reticulate ornamentation on the posterior flank resulting from the intersection of subvertical costae with subhorizontal grooves, however, constitutes a secondary character of subspecific value, and hence the previously described taxon is here regarded as a new subspecies of *Anditrigonia (A.) eximia*.

Age and occurrence.—Upper Tithonian, *Substeueroceras koeneni* Zone, Picún Leufú Formation; Camino nuevo a Los Molles (locality 34), Dept. Catán Lil, Neuquén, Argentina.

Genus **ANTUTRIGONIA** Leanza and Garate, 1987

Type species.—*Trigonia opistolophophora* Lambert, 1944, Berriasian/Valanginian boundary, Neuquén, Argentina.

Diagnosis.—Shell of variable size, including oval, subquadrate or subrectangular forms. The flank is ornamented with concentric costae in the umbonal region, which can be subsequently (1) interrupted by tubercles in the mid-anterior flank, (2) united by a tuberculate region forming an irregular V- or W- shaped inflection, or (3) showing alternations along a zone on the flank of ventral convexity in which bifurcation or trifurcation of costae may be present. Marginal carina only developed in the umbonal region, in later growth stages only demarcated by the different ornamentation

of flank and area. Area ornamented by transverse costae on its entire development. Escutcheon very narrow, with occasional transverse costellae (Leanza and Garate, 1987).

Distribution.—Middle Tithonian to Valanginian. Argentina and Chile.

Antutrigonia opistolophophora (Lambert, 1944)
Plate 13, figures 2, 6–9

Trigonia opistolophophora Lambert, 1944, p. 388, pl. 3. figs. 5, 6.
Anditrigonia opistolophophora (Lambert). Levy, 1967c, p. 137; Reyes and Pérez, 1982, p. A291; Reyes and Pérez, 1983, p. 59.
Antutrigonia opistolophophora (Lambert). Leanza and Garate, 1987, p. 223, pl. 8, figs. 1–3.

Description.—Shell medium to large in size, anteriorly slightly inflated and posteriorly compressed. Umbones opisthogyrous, prominent, situated in the anterior one-third of the shell. Dorsal margin slightly concave. Dorsoposterior angle very obtuse. Posterior margin relatively short. Ventroposterior angle almost 90°. Ventral margin slightly convex, curving very strongly into the almost straight anterior margin. Flank occupying fourth-fifths of the shell surface, ornamented by strong costae of rounded section, arising divergently from the marginal carina, suffering subsequently a series of alterations along a zone which begin near the umbo and finish in the posterior third of the ventral margin. This zone forms an arc of ventral convexity in which bifurcation or trifurcation of costae can be observed, as well as some small tubercles in the first millimeters of each costa. Marginal carina only defined in the proximal part of the shell by the different ornamentation of flank and area. Area ornamented by strong transverse costae which are parallel to the posterior margin of the shell. In the proximal part of the area, these costae regularly alternate with other ones arising from the flanks, adding in its middle part some secondary costae that are born at the same level of the flank costae, forming with them a right angle. Escutcheon very narrow, apparently smooth.

Material.—One topotype adult specimen, MOZ P0903/2, consisting of a relatively well preserved left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0903/2	≈73	64	26	0.87	0.36
SGN 41-93	≈55	51	20	0.92	0.36

Remarks.—As the topotype specimens of *Antutrigonia opistolophophora* (Lambert) figured by Leanza and Garate (1987, pl. 8, figs. 1–3) and in this paper (see Pl. 13, figs. 2, 6–7) do not show clearly the transverse costation on the area which is characteristic for the genus *Antutrigonia*, the original illustation by Lambert (1944, pl. 3, figs, 5–6) of the type species is here reproduced (see Pl. 13, figs. 8–9). In the dorsal view it is possible to observe a transversely costate area and a marginal carina only developed in the umbonal region, disappearing to the distal portion of the shell.

Age and occurrence.—Late Berriasian/Early Valanginian, *Spiticeras damesi* and *Neocomites wichmanni* Zones, Lower part of Mulichinco Formation; Mallín Quemado, Sierra de la Vaca Muerta (Locality 7), Dept. Picunches, Neuquén, Argentina.

Antutrigonia frenguellii (Mariñelarena, 1959)
Plate 8, figures 1, 2

Trigonia frenguellii Mariñelarena, 1959, p. 183, pl. 1, figs. 2, 3.
Anditrigonia frenguellii (Mariñelarena). Levy, 1967c, p. 141; Reyes and Pérez, 1978, p. 20, pl. 5, fig. 1.
Anditrigonia (?) *frenguellii* (Mariñelarena). Reyes and Pérez, 1982, p. A298; Reyes and Pérez, 1983, p. 59.
Antutrigonia frenguellii (Mariñelarena). Leanza and Garate, 1987, p. 223, pl. 7, figs. 5, 6.

Description.—Shell large, subrectangular. Umbones opisthogyrous, very anteriorly situated. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin relatively short. Ventroposterior angle convex. Ventral margin slightly convex, curving abruptly into the almost straight anterior margin. Flank occupying three-fourths of the shell surface, ornamented with two sets of mostly tuberculate costae meeting unordered along a band extending from the umbones toward the posterior one-third of the ventral margin. Area relatively narrow, ornamented by transverse costellae in its whole development, extending from the escutcheon carina to the marginal carina. Submedian groove present. Marginal carina with transversely elongate swellings in its distal part. Escutcheon carina poorly defined. Escutcheon narrow and smooth.

Material.—One adult topotype specimen, MOZ P0918, a well preserved right valve (see Leanza and Garate, 1987, pl. 7, figs. 5, 6).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0918	76	58	18	0.76	0.24

Remarks.—*Antutrigonia frenguellii* (Mariñelarena) shows transverse ornamentation on the whole area as it was stated by Mariñelarena (1959, pp. 183–188) and confirmed by Leanza and Garate (1987, p. 224). For this reason, its assignment to *Antutrigonia* Leanza and Garate (1987) instead to *Anditrigonia* Levy (1967c) is doubtless. *Antutrigonia frenguellii* is a species closely related to *Antutrigonia groeberi* (Weaver, 1931, p. 257, pl. 20, fig. 105; herein described), but the latter species has subquadrate shape, and a more defined tuberculate stage in the mid-anterior flank which sharply separates the anterior and posterior set of costae.

Age and occurrence.—Middle Tithonian, *Windhauseniceras internispinosum* Zone, Picún Leufú Formation; Cañadón del Sapo (Locality 20), Dept. Catán Lil, Neuquén, Argentina.

Antutrigonia groeberi (Weaver, 1931)
Plate 8, figures 3, 4, 7, 10

Trigonia groeberi Weaver, 1931, p. 257, pl. 20, fig. 105.
Anditrigonia groeberi (Weaver). Levy, 1967c, p. 137.
Anditrigonia (?) *groeberi* (Weaver). Reyes and Pérez, 1982, p. A291; Reyes and Pérez, 1983, p. 59.
Antutrigonia groeberi (Weaver). Leanza and Garate, 1987, p. 224, pl. 7, figs. 5, 6.

Description.—Shell medium to large in size, subquadrate, with rounded margins. Umbones opisthogyrous, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle very obtuse. Posterior margin long, almost of the same size as the anterior margin. Ventroposterior angle 90°. Ventral margin slightly convex, curving in an almost 90° angle into the straight anterior margin. Flank ornamented by two sets of costae which are separated in the mid-anterior flank by a region only ornamented by irregularly distributed tubercles. Area relatively narrow, ornamented by transverse costae in its whole development. Submedian groove absent. Marginal carina indistinct, only defined by the different ornamentation of area and flank. Escutcheon carina poorly defined. Escutcheon very narrow, containing very faint transverse costellae.

Material.—Four topotype adult specimens: MOZ P2069, complete, with both valves very well preserved; MOZ P0922/3, complete, but with the left valve broken; MOZ P0367/1, a small right valve, relatively well preserved; MOZ P0367/2, a poorly preserved left valve. All specimens are fossilized in a fine-grained, yellowish-white limestone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2069	78	68	30	0.87	0.38
MOZ P0922/3	40	37	13.5	0.92	0.33
MOZ P0367/1	30	29	10	0.96	0.33
MOZ P0367/2	33	31	11	0.93	0.33

Remarks.—*Antutrigonia groeberi* (Weaver) differs from *Antutrigonia frenguellii* (Mariñelarena; herein described) in its subquadrate shape, in having a sharp tuberculate region in the mid-anterior flank which separates the anterior and posterior set of costae, and absence of a submedian groove in the area.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* and *Substeueroceras koeneni* Zones, Picún Leufú Formation; Picún Leufú Creek and Route 40 (Locality 17), Dept. Zapala, Neuquén, Argentina.

Genus **VIRGOTRIGONIA** Alleman, 1985
(= Genus *Maputrigonia* Leanza, 1985)

Type species.—*Virgotrigonia peterseni* (non *petersenensis*) Alleman, 1985. Lower Cretaceous (Valanginian), Perú.

Diagnosis.—Shell small to medium in size, pyriform, posteriorly elongated, inequivalve. Umbones anteriorly situated. Flank ornamented in the umbonal region by concentric costae, then by two sets of tuberculate costae that meet forming a V-shaped inflection in the anterior part of the flank. Area very narrow, ornamented with transverse costellae near the umbo, and radial costellae on its remaining surface. Shallow median groove present. Marginal carina beaded, well developed from the umbo to the ventroposterior junction. Escutcheon carinae present. Escutcheon smooth (Leanza, 1985; Alleman, 1985; Pérez, Biró and Reyes, 1987).

Distribution.—Upper Jurassic (Upper Tithonian) to Lower Cretaceous (Valanginian). Argentina, Chile and Perú.

Discussion.—The genus *Virgotrigonia* Alleman (Nov. 1985) (=*Maputrigonia* Leanza, Dec. 1985) differs from *Iotrigonia* van Hoepen (1929), *Vaugonia* Crickmay (1930b) and *Anditrigonia* Levy, 1967c, although having a similar flank ornamentation pattern, by the peculiar ornamentation of the area characterized by transverse costellae in the umbonal region, and by radial costellae in the remaining surface. *Anditrigonia* (*Paranditrigonia*) Pérez and Reyes (1983) has a similar flank ornamentation with regard to *Virgotrigonia*, but differs in having only radial ornamentation on the area, and a marginal carina only developed in the umbonal region. *Heterotrigonia* Cox (1952) differs from *Virgotrigonia* (=*Maputrigonia*) in having only radial costation on the area, and untuberculated flank costae. The genus *Lambertrigonia*, n. gen. (type species: *Trigonia pichimoncolensis* Lambert, 1944) is very similar to *Virgotrigonia* in shell shape, flank ornamentation, and presence of a well developed marginal carina; but in the area only exhibits radial costellae. At subfamily level, the taxonomic position of *Virgotrigonia* and *Lambertrigonia*, n. gen. offers some difficulties. Leanza (1985) stated that *Maputrigonia* (now *Virgotrigonia*) has affinities with the Vaugoniinae Kobayashi (1954), giving also the possibility that this genus could belong into the Iotrigoniinae Saveliev, if this subfamily is interpreted as a Cretaceous derivative of Vaugoniinae. In view of the importance that the author ascribes to the ornamentation of the area, however, it seems clear that affinities with Vaugoniinae or Iotrigoniinae are entirely superficial, as these subfamilies are integrated by representatives with totally different ornamentational patterns on the area. As already mentioned in

the discussion of Anditrigoniinae, n. subfam., these genera can be better assigned to this subfamily as it includes forms with radial and transverse ornament on the area.

Virgotrigonia hugoi (Leanza, 1985)
Plate 14, figures 5–9

Maputrigonia hugoi Leanza, 1985, p. 280, figs. 2 : 1–5; Leanza and Garate, 1987, p. 220, pl. 8, figs. 8, 9.
Virgotrigonia hugoi (Leanza). Pérez and Reyes, 1987, p. 39, pl. 1, figs. 1–6, 10–15.

Description.—Shell of small to medium size, pyriform, strongly inequilateral. Umbones prominent, situated at anterior one-fourth of the shell. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin slightly convex, curving evenly into the widely convex anterior margin. Flank occupying five-sixths of the shell surface, ornamented by two sets of tuberculate costae meeting in the anterior flank forming an irregular V-shaped inflection with angles between 50° and 90°. The posterior flank costae are subvertically inclined, intercepting the ventral margin at high angles. These costae are triangular in section, and their vertices bear faint crenulations giving them a serrated aspect. Area ornamented near the umbo with transverse costellae, by radial costellae in the mid- and distal portion, those being crossed by faint transverse growth lines, giving to the area a reticulate aspect. Marginal carina well defined, with faint beads along its entire length. Escutcheon very narrow and elongate, smooth, exhibiting a small elevation in its proximal portion.

Material.—Seven topotype adult specimens from Mallín Quemado: MOZ P2733/1, complete; MOZ P2733/2, anterior part of the shell; MOZ P2733/3, complete, but the posterior part broken; MOZ P2733/4, with only the umbonal part of both valves preserved; MOZ P2733/5, fragment of a right valve; MOZ P2733/6, external mold of a right valve; MOZ P0949/1, a complete right valve (see Leanza and Garate, pl. 8, fig. 8). These specimens were found in dark brown siltstones in association with collophane nodules (see Leanza, 1985). Three hypotype adult specimens from Salitral de Los Alazanes: MOZ P2332/1, anterior flank with both valves; MOZ P2332/2, anterior flank with both valves; MOZ P2332/3, anterior flank of a right valve. These specimens are replaced by a white silicified material.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2733/1	62	39	10	0.62	0.16

Remarks.—*Virgotrigonia hugoi* (Leanza) differs from *V. peterseni* Alleman (1985) from the Valanginian of Morro Solar, Distrito de Chorrillos, Lima, Perú, in having tuberculate costae on the flanks, and narrower radial costellae on the area. Pérez, Biró and Reyes (1987) have recently assigned to *Virgotrigonia hugoi* (Leanza) specimens previously assigned to *Vaugonia chunumayensis* (see Reyes and Pérez, 1978, 1979) from the uppermost Tithonian/lowermost Berriasian (Jurassic–Cretaceous boundary) of Lo Valdés Formation, southwest from Santiago, Central Chile. The northwestern European late Jurassic–early Cretaceous genus *Turbitrigonia* Kelly, 1984 (type species: *Turbitrigonia boudiccae* Kelly, 1984) exhibits flank ornamentation and shell shape comparable in some extent to *Virgotrigonia*, but the area is completely smooth, lacking marginal and escutcheon carina.

Age and occurrence.—Lower Berriasian, *Argentiniceras noduliferum* Zone, Vaca Muerta Formation; Mallín Quemado (Locality 7), Dept. Picunches, and Salitral de los Alazanes (Locality 30), Dept. Picunches, Neuquén, Argentina.

Genus **LAMBERTRIGONIA**, new genus

Type species.—*Trigonia pichimoncolensis* Lambert, 1944, Upper Jurassic (Kimmeridgian), Neuquén, Argentina.

Diagnosis.—Shell small, pyriform. Flank ornamented by two sets of costae forming an L- or V-shaped inflection on its mid-posterior portion. Marginal carina beaded, well developed along its entire length. Area radially ornamented by faint costellae, asymmetrically divided by a submedian groove. Escutcheon carina poorly defined. Escutcheon excavate, apparently smooth.

Distribution.—Upper Jurassic (Kimmeridgian). Argentina.

Etymology.—This genus is dedicated to Luis R. Lambert, who in 1944 produced the first trigoniid monograph in Argentina.

Discussion.—*Trigonia pichimoncolensis* Lambert (1944) remained as a taxonomically uncertain species for a long time. In 1988 the present author had the opportunity to rediscover the fossil locality near Laguna Miranda, and to collect some new specimens. The completely radial costation of the area and the protruding marginal carina of this species have been confirmed, thus allowing erection of *Lambertrigonia*, n. gen. The new genus has superficial affinities with *Heterotrigonia* Cox (1952), *Anditrigonia* (*Paranditrigonia*) Reyes and Pérez (1983), and *Virgotrigonia* Alleman (1985) (=*Maputrigonia* Leanza, 1985). The Upper Cretaceous *Heterotrigonia* Cox, 1952 (type species: *Trigonia diversicostata* Whiteaves, 1876) exhibits round-

ed and strong radial costae on the area, lacks a marginal carina, and the flank is ornamented by two sets of strong and rounded costae forming an L-shaped inflection in the anterior flank. The Early Cretaceous *Virgotrigonia* Alleman (type species: *Virgotrigonia peterseni* Alleman, 1985) has a very similar flank costation pattern, but the area is ornamented by transverse costellae in the umbonal portion which are totally absent in *Lambertrigonia*, n. gen. Leanza (1985) and Leanza and Garate (1987) tentatively included *pichimoncolensis* of Lambert in the genus *Maputrigonia*, but as Pérez, Biró and Reyes (1987, p. 39) observed, *T. pichimoncolensis* lacks transverse costellae in the umbonal region of the area, and Pérez and coauthors stated that this species might constitute the type of a new genus. The Neocomian subgenus *Anditrigonia* (*Paranditrigonia*) Reyes and Pérez (1983) (type species: *A.* (*P.*) *potrerillensis* Reyes and Pérez, 1983) exhibits an area with faint, radial costellae, but the size of its representatives is much larger, the marginal carina is only poorly developed in the umbonal region, and the flank ornamentation is much more complex, as it displays V- and W-shaped junctions of the two sets of costae in which some tubercles can occur. Therefore, the affinities to *Paranditrigonia* can be regarded as only superficial. For discussion of inclusion of *Lambertrigonia* in Anditrigoniinae, n. subfam., see remarks above.

Lambertrigonia pichimoncolensis (Lambert, 1944)
Plate 5, figures 5, 6

Trigonia pichimoncolensis Lambert, 1944, p. 372, pl. 4, fig. 4.
cf. *Maputrigonia pichimoncolensis* (Lambert). Leanza and Garate, 1987, p. 20, pl. 7, fig. 4.

Description.—Shell small, pyriform, somewhat inflated. Umbones opisthogyrous, situated in the anterior one-fourth of the shell. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin slightly convex, curving evenly in the strongly convex anterior margin. Flank occupying three-fourths of the shell surface, ornamented by two sets of costae, the anterior composed by 12–14, faint, widely spaced, subconcentric costae, that meet the posterior set in a V-shaped junction. The posterior costae are subvertically oriented, thicker and their interspaces narrower. To one anterior costa usually correspond two posterior costae. The line of junctions of these two sets of costae begins in the umbonal region and finishes in the mid-posterior part of the ventral margin. Marginal carina beaded, well developed along its entire length, smooth, and slightly arched. Area completely ornamented by two faint, radial costellae at both sides of a very protruding submedian groove. Escutcheon carina poorly defined. Escutcheon excavate, apparently smooth.

Material.—Four topotype adult specimens, MOZ P4252/1, a very well preserved a right valve; MOZ P4251/2, a very well preserved left valve; MOZ P4252/3&4, poorly preserved right valves. The specimens were found in coarse-grained, light-brown sandstones.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P4252/1	15	8	–	0.53	–
MOZ P4252/2	23	13	–	0.56	–

Remarks.—*Lambertrigonia pichimoncolensis* (Lambert) shows superficial affinities with *Heterotrigonia* Cox (1952), *Anditrigonia* (*Paranditrigonia*) Reyes and Pérez (1983) and with *Virgotrigonia* Alleman (1985). This taxon remains as an isolated and monospecific genus of Kimmeridgian age, from which probably were phyletically derived the very abundant Tithonian and Neocomian South American Anditrigoniinae.

Age and occurrence.—Kimmeridgian, unknown ammonite Zone, Tordillo Formation; northwest of Laguna Miranda (Locality 33), Dept. Zapala, Neuquén, Argentina.

Subfamily **RUTITRIGONIINAE**
van Hoepen, 1929

Genus **RUTITRIGONIA** van Hoepen, 1929

Type species.—*Rutitrigonia peregrina* van Hoepen, 1929, Lower Cretaceous, Zululand, South Africa.

Diagnosis.—Pyriform to ovate. Flank ornamented on its anterior part with narrow, rather flexuous, subconcentric costae. Area narrow, ornamented by oblique costae on the umbonal region, subsequently smooth except for growth lines. Marginal and escutcheon carinae poorly defined, except near umbo. Escutcheon narrow, smooth or with oblique costellae (see van Hoepen, 1929; Cox, 1969).

Distribution.—Upper Jurassic (Tithonian) to Upper Cretaceous. Cosmopolitan.

Rutitrigonia agrioensis (Weaver, 1931)
Plate 16, figures 1–3

Trigonia agrioensis Weaver, 1931, p. 266, pl. 27, figs. 142–146; Lambert, 1944, p. 373, pl. 5, figs. 1–4.
Rutitrigonia agrioensis (Weaver). Nakano, 1963, p. 526; Reyes and Pérez, 14, pl. 2; Leanza and Garate, 1987, p. 224, pl. 12, figs. 3, 4.

Description.—Shell of medium size, pyriform, anteriorly inflated and posteriorly compressed. Umbones opisthogyrous, situated on the anterior one-third of the shell. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle almost 90°. Ventral margin slightly convex, curving evenly into the strongly convex anterior margin. Flank

occupying almost the whole surface of the shell, ornamented only on its anterior part by nearly 30 subhorizontal costae exhibiting abrupt dorsal slope, and softly inclined ventral slope. These costae tend to disappear in the posterior flank where only faint growth lines remain. Area extremely narrow, ornamented by faint, oblique costellae in the proximal region, subsequently smooth except for growth lines. Marginal carina only defined in the umbonal region, distally becoming wide and blunt. Escutcheon carina forming a shallow edge in the proximal region, then undefined. Escutcheon very elongated and strongly depressed, with some proximal faint oblique costellae, subsequently smooth.

Material.—Four adult hypotype specimens, MOZ P0920/1,2 and MOZ P0920/3, all of them complete, with both valves well preserved; MOZ P3112, a well preserved right valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P0920/1	56	39	16	0.69	0.28
MOZ P0920/2	46	30	13	0.65	0.28
MOZ P0920/3	59	38	15	0.64	0.25

Remarks.—In contrast with the generic diagnosis of *Rutitrigonia* by Cox (1969, p. N487), the area and escutcheon of the present material are not smooth, but are ornamented by faint transverse and oblique costellae, especially in the umbonal region. *Rutitrigonia agrioensis* (Weaver) has affinities with the type species *R. peregrina* van Hoepen (1929, p. 31, pl. 7, figs. 13–16) from the Lower Cretaceous from Zululand, South Africa, but the Argentine species has less dense costae that disappear more anteriorly on the flanks. *Rutitrigonia weaveri* (Stoyanow, 1949, p. 87, pl. 15, figs. 4–8) from the Lower Cretaceous of southeastern Arizona, U.S.A., is also a very closely related species, but the South American species is relatively longer, and the wavy character of the costae in the anterior region of the flank is much less pronounced.

Age and occurrence.—Lower Hauterivian, *Lyticoceras pseudoregale Zone*, Agrio Formation; Cerro Negro Chico de Picún Leufú (Locality 18), Dept. Catán Lil, Neuquén, Argentina. The specimens were found in this locality at the lowermost levels of the Agrio Formation overlying the Mulichinco Formation. The same species is also present in Middle and Upper Hauterivian outcrops of the Agrio Formation in other localities of the Neuquén Basin.

Rutitrigonia kauffmani, new species
Plate 15, figures 1–5

Holotype.—MOZ P3527/2, a well preserved left valve.

Paratypes.—MOZ P3527/1, a well preserved right valve; MOZ P3527/3, a complete specimen with both valves well preserved; MOZ P3527/3, a complete specimen, with the posterior part of the shell broken; MOZ P3527/5, a poorly preserved left valve; MOZ P3527/6, a well preserved right valve; MOZ P4295/1, a well preserved right valve; MOZ P4295/2, a well preserved left valve; MOZ P4295/3, a juvenile specimen with a well preserved right valve; MOZ P4281, a poorly preserved left valve. All are adult specimens, with the exception of MOZ P4295/3.

Type locality.—Cerro Mesa, Covunco (Locality 8), Dept. Zapala (38°44'S, 69°55'W), Agrio Formation (Weaver, 1931), Mendoza Group (Groeber, 1946).

Etymology.—This species is dedicated to American paleontologist Dr. Erle G. Kauffman (Boulder, Colorado, U.S.A.).

Diagnosis.—*Rutitrigonia* moderately small to small in size, somewhat pyriform. Flank ornamented by faint subhorizontal costae that tend to disappear toward the posterior flank. Area ornamented by weak, oblique costae that are the continuation of those on the flank. Marginal carina defined by a sharp edge between the costae from the flank and area. Escutcheon only ornamented by faint growth lines.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P3527/1	19	15	4.5	0.78	0.23
MOZ P3527/2	20	15	6	0.75	0.30
MOZ P3527/3	24	17	5	0.70	0.20
MOZ P3527/4	19	14.5	7	0.76	0.36
MOZ P3527/5	–	13.5	6	–	–
MOZ P3527/6	24	17	6.5	0.70	0.27
MOZ P4295/1	27	19	7	0.70	0.25
MOZ P4295/2	17.5	13	5	0.74	0.28
MOZ P4295/3	7.8	5.5	2.5	0.70	0.32
MOZ P4281	27.5	20	9	0.72	0.32

Description.—Shell moderately small to small in size, pyriform. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin slightly convex. Dorsoposterior angle obtuse. Posterior margin short. Ventroposterior angle acute. Ventral margin slightly convex, curving evenly into the gently convex anterior margin. Flank occupying three-fourths of the shell surface, ornamented by nearly 22, at first subconcentric, then subhorizontal, somewhat wavy, faint costae that tend to disappear on the ventroposterior region of the flank. These costae show an asymmetrical profile, very abrupt dorsally and weakly inclined ventrally. Area very narrow, ornamented on almost its whole development by oblique costae which are the continuation of those arising from the flanks. Marginal carina defined by a sharp edge just formed when the flank costae penetrates the area. Escutcheon carina de-

fined by a sharp change in direction of the costellae arising from the area. Escutcheon narrow and very elongated, ornamented by very fine oblique costellae arising from the area.

Remarks.—*Rutitrigonia kauffmani*, n. sp. is easily distinguishable from the other known species of *Rutitrigonia* van Hoepen (1929): apart from its small size, it is not very elongated and it has on the umbonal region a sharp demarcation of escutcheon, area and flank. The juvenile specimen MOZ P4295/3 (L=7.8 mm) exhibits the same characteristics of the adult forms, which only reach maximum sizes of 28 mm. *R. kauffmani*, n. sp. differs from *R. agrioensis* (Weaver, 1931, p. 266, pl. 27, figs. 142–146; herein described) by: (1) its smaller size; (2) its less pyriform and elongated shape; (3) sharper demarcation of escutcheon, area and flank where, and (4) the ornamentation reaches much more distal portion of the shell. The H/L ratio of both species are: *Rutitrigonia agrioensis* = 0.64 to 0.69, and *Rutitrigonia kauffmani*, n. sp. = 0.70 to 0.78.

Rutitrigonia sanchuensis (Nakano) (in Kobayashi and Nakano, 1958, p. 145, pl. 12, figs. 1–8) from the Albian of western Japan, is close to *R. kauffmani*, n. sp. but differs from the Argentine species in having a more prominent umbo, more elongated shell shape, and flank more densely costulate.

Age and occurrence.—Lower and Middle Hauterivian, *Lyticoceras pseudoregale* and *Holcoptychites neuquensis* Zones, Agrio Formation; Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Rutitrigonia, species juvenile indeterminate
Plate 9, figure 8

Description.—Shell small, rostrate, pyriform, anteriorly inflated and posteriorly acuminated. Umbones opisthogyrous, situated in the anterior one-third of the shell. Dorsal margin concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin first straight, then slightly convex, curving evenly into the widely convex anterior margin. Flank occupying four-fifths of the shell surface, ornamented by approximately 10, widely separated, subconcentric costae which disappear in the smooth posterior flank. Marginal carina poorly defined except near umbo. Area and escutcheon too poorly preserved for an accurate description.

Material.—One juvenile specimen, MOZ P5002, consisting in a poorly preserved left valve, fossilized in a yellowish-white fine-grained, limestone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5002	20	14	5	0.70	0.25

Remarks.—The described specimen is characterized by a pyriform shell with widely spaced subconcentric costae on the anterior flank. It can readily be assigned to *Rutitrigonia* van Hoepen (1929), but its immature status and poor preservation of the area and escutcheon preclude any more definite identification. This specimen is very important, however, as it marks the earliest appearance of the genus *Rutitrigonia* in west-central Argentina in the Uppermost Jurassic.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* Zone, Picún Leufú Formation; Cerrito Caracoles (Locality 11), Dept. Zapala, Neuquén, Argentina.

Subfamily **BUCHOTRIGONIINAE**, new subfamily

Diagnosis.—Shell trigonal. Flank ornamented in the umbonal region by oblique costae. On a later growth stage two sets of costae appear, a subconcentric set in the anterior and central flank, and a subvertical set in the posterior flank, these forming a ventrally directed V-shaped inflection at their junction. This costation can be replaced in some species by concentric rugae near the ventral margin. Wide antecarinal depression usually present. Area diagonally costate in early growth stages, then smooth. Marginal carina well developed. Escutcheon carina absent. Escutcheon smooth, or weakly ornamented by growth lines or faint costellae.

Distribution.—Upper Jurassic (Upper Tithonian) to Upper Cretaceous (Campanian).

Discussion.—Kobayashi and Mori (1955, p. 76) placed *Buchotrigonia* Dietrich, 1938 (type species: *Trigonia abrupta* von Buch, 1839) into the subfamily Vaugoniinae. Saveliev (1958) assigned *Buchotrigonia* and *Syrotrigonia* Cox, 1952 [type species: *Buchotrigonia* (*Syrotrigonia*) *fraasi* Cox, 1952 = *B.* (*S.*) *libanotica* (Vokes, 1942, p. 168, pl. 4, figs. 8–12)] into his Quadratotrigoniinae together with the genera *Asiatotrigonia* Cox (1952) and *Korobkovitrigonia* Saveliev (1958). Nakano (1960) included *Buchotrigonia* in Vaugoniinae. Some years later the same author, after revising the subfamily Quadratotrigoniinae, stated that *Syrotrigonia* ". . . possibly belonged to the Vaugoniinae and an issue derived from *Vaugonia* by the development of the antecarinal depression on the disk" (Nakano, 1968, p. 33). At the same time, Nakano (1968) commented that *Buchotrigonia* had been derived from *Linotrigonia* ". . . by the effacement of the carinae and the development of the L shaped costation as can be judged from the surface sculpture", and he transferred *Buchotrigonia* to the Myophorellinae. Pérez and Reyes (1980, 1986) presented an excellent taxonomic and historical revision of *Buchotrigonia* and *Syrotrigonia* from South America and the rest of the world. These Chilean authors did not comment, however, on the subfamily status of either taxon, pointing out their

differences from the genera *Iotrigonia, Anditrigonia* and *Megatrigonia*, including them plainly in the Family Trigoniidae.

In my opinion, *Buchotrigonia* and *Syrotrigonia* are extremely closely related taxa that cannot be separated into different subfamilies as Nakano did (1968, p. 33). Although probably derived from *Vaugonia*, their relationships with Vaugoniinae, Myophorellinae, Quadratotrigoniinae, or even Megatrigoniinae are entirely superficial, as strong differences in the evolution of flank costae and other morphological parameters in comparison with these subfamilies can be detected. The flank of *Buchotrigonia* and *Syrotrigonia* exhibits a very distinct ornamentation pattern characterized in the umbonal region by oblique costae, and in later growth stages by a subconcentric set of costae on the anterior and central flank, and a subvertical set of costae in the posterior flank, both meeting in a form of V-, W- or zig-zag-shaped junction. Together with the presence of an antecarinal depression (*Syrotrigonia*) and transverse ornamentation in the proximal area (*Buchotrigonia*), these closely related taxa, elevated here to the genus rank, are very distinctive members of the Family Trigoniidae. As a matter of fact, this had already been implicit in the work of Stoyanow (1949, p. 83), who created the Group of *Trigonia abrupta* while describing *Trigonia reesidei*, now considered a *Buchotrigonia*. Therefore the subfamily Buchotrigoniinae, n. subfam. is proposed, including *Buchotrigonia* and *Syrotrigonia*, ranging in age from the Upper Tithonian to the Campanian. It is possible that the new subfamily was derived from the Jurassic Vaugoniinae, and developed during the Lower Cretaceous in parallel evolution with the subfamily Apiotrigoniinae Tashiro (1979).

According to the revision of *Buchotrigonia* by Pérez and Reyes (1980), the following original species can be assigned to this genus: *Trigonia abrupta* von Buch (1839), *Trigonia reesidei* Stoyanow (1949), and *Buchotrigonia* (*B.*) *topocalmensis* Pérez and Reyes (1980). Recently, Villamil (1991, in press) described three new species of *Buchotrigonia* from the Lower Cretaceous of Colombia ranging in age from the Berriasian to the Upper Valanginian. He demonstrated that the point where the costae meet has a more ventral position on the flank as the species become younger in age.

After the revision of *Syrotrigonia* by Pérez and Reyes (1986) the following species belong to this genus: *Syrotrigonia fraasi* Cox (1952), *Trigonia distans* (Noetling, 1886), *Trigonia gerthi* (Lisson, 1930), *Trigonia steinmanni* (Lisson, 1930), *Trigonia paradisensis* (Lisson, 1930), *Buchotrigonia* (?) aff. *paradisensis* (Lisson, 1930 in Etayo Serna, 1985), *Buchotrigonia* (*B.*) sp. (Manceñido and Damborenea, 1984), *Buchotrigonia* (*Syrotrigonia*) *chilensis* Pérez and Reyes (1986) and *B.* (*S.*) *biroi* Pérez and Reyes (1986). These species range in age from the Late Jurassic (Upper Tithonian) to the Early Cretaceous (Neocomian). To this list the Lower Hauterivian *Syrotrigonia brocardoi*, n. sp. from the Agrio Formation from west-central Argentina, must now be added.

Genus **SYROTRIGONIA** Cox, 1952

Type species.—*Buchotrigonia* (*Syrotrigonia*) *fraasi* Cox, 1952 (=*Trigonia libanotica* Vokes, 1942; =*T. syriaca* Fraas, 1878 non Conrad), Lower Cretaceous, Middle East (Syria).

Diagnosis.—Shell trigonal, short. Flank with antecarinal depression ornamented by oblique, subconcentric and subvertical costae. The oblique costae are present in the umbonal region and cut the growth lines. The subconcentric costae are present in the anterior and central flank. The subvertical costae are situated in the posterior flank. These two sets of costae meet in the posterior flank forming a V-, W- or zig-zag-shaped pattern. Antecarinal depression present. Area wide, subplanate, with transverse costellae in the proximal region, then smooth. Marginal carina well developed on its entire length. Escutcheon not well impressed (Cox, 1952, 1969, Pérez and Reyes, 1986).

Distribution.—Upper Jurassic (Upper Tithonian) to Lower Cretaceous (Aptian). Middle East (Syria), Europe (Spain), and South America (Colombia, Perú, Chile and Argentina).

Syrotrigonia brocardoi, new species
Plate 16, figures 4, 7, 10, 12

Holotype.—MOZ P5319, an adult, complete shell, with both valves relatively well preserved, fossilized in a yellowish-gray limestone.

Paratype.—MOZ P5318, and adult, complete shell, with both valves relatively well preserved. Same size and matrix as the holotype.

Type locality.—Pichaihue Abajo (Locality 3), Dept. Loncopué (37°45'S, 70°14'W), Agrio Formation (Weaver, 1931), Mendoza Group (Groeber, 1946).

Etymology.—This species is dedicated to Prof. Giusepe Brocardo, Director of the Museum San Juan Bosco (Torino, Italy), for his contributions to the Museum Juan Olsacher.

Diagnosis.—Shell of medium size, trigonal. Anterior margin straight. Flank weakly ornamented by oblique umbonal costae, and then by subconcentric and subvertical costae meeting in a down-pointing V-shaped inflection in the posterior flank, those being replaced in a mid-late growth stage by conspicuous concentric rugae. Antecarinal depression extremely shallow. Area ornamented by transverse costae in the umbonal region, then smooth. Marginal carina well developed,

forming an edge between area and flank. Escutcheon carina absent. Escutcheon smooth.

Description.—Shell of medium size, trigonal and short in shape. Umbones opisthogyrous, slightly elevated, very anteriorly situated. Dorsal margin straight. Dorsoposterior angle widely obtuse. Posterior margin short. Ventroposterior angle 90°. Ventral margin widely convex, curving evenly into the straight, anterior margin. Flank occupying four-fifths of the shell surface, weakly ornamented in the umbonal region by approximately 10 oblique, faint costae that cut the growth lines. As the growth of the shell continues, a subconcentric and subvertical set of costae appears, situated in the anterior and central flank, and in the posterior flank respectively, both meeting in a ventrally directed V-shaped junction. In the mid-late growth stage this ornamentation is replaced by concentric folds and rugae which are characteristic for the species. Antecarinal depression very shallow in the distal portion of the shell. Area narrow and flat, forming a sharp edge with the flank surface, ornamented in the umbonal region by transverse costae which are the continuation of those costae arising from the flank. Distal area smooth. Marginal carina defined by the change in direction of the flank costae toward the area. Escutcheon carina absent. Escutcheon smooth.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5318	30	28	10	0.93	0.33
MOZ P5319	35	31	11	0.88	0.31

Remarks.—*Syrotrigonia brocardoi*, n. sp. is an extreme representative of *Syrotrigonia* Cox (1952), easily distinguishable by its weak flank ornamentation, its almost straight anterior margin, extremely shallow antecarinal depression, and by its sharp concentric rugae, which are present at a mid-late growth stage and replace the more typical flank ornamentation of this genus. In this sense, the closest species to *Syrotrigonia brocardoi*, n. sp. is *Syrotrigonia biroi* Pérez and Reyes (1986, p. 85, pl. 2, figs. 1–20) from the Neocomian Pedernales Formation, Chile, in which these characters are well developed. The Argentine species, however, has a different shell shape with an straight anterior margin, and the concentric rugae in the ventral part of the flank are more conspicuous and begin at an earlier growth stage. These specific characters also separate *Syrotrigonia brocardoi*, n. sp. from *Syrotrigonia gerthi* (Lisson, 1930, p. 8, pl. 3, figs. 1–5), *Syrotrigonia steinmanni* (Lisson, 1930, p. 6, pl. 2, figs. 1–3) and *Syrotrigonia paradisensis* (Lisson, 1930, p. 18, pl. 9, figs. 1–5) of the Valanginian of Perú.

Age and occurrence.—Lower Hauterivian, *Lyticoceras pseudoregale* Zone, Agrio Formation; Pichaihue Abajo (Locality 3), Dept. Loncopué, Neuquén, Argentina.

Subfamily **PTEROTRIGONIINAE** van Hoepen, 1929

Genus **PTEROTRIGONIA** van Hoepen, 1929

Type species.—*Pterotrigonia cristata* van Hoepen, 1929, Middle Cretaceous, Zululand, South Africa.

Diagnosis.—Shell small to medium size, crescent-shaped, gibbous, Umbones very elevated, strongly opisthogyrous. Dorsal margin strongly concave. Flank anteriorly ornamented by narrow, high, widely-spaced, steep or oblique, usually tuberculated costae. Posterior flank costae subvertical, narrow, crowded, and finely crenulated. Area very narrow, smooth or transversely ridged, strongly curved, with an upward-facing concavity. Marginal and escutcheon carinae poorly defined, except near umbo. Escutcheon wide, well impressed near umbo (van Hoepen, 1929; Cox, 1969; Kobayashi and Nakano, 1957; Cooper, 1989).

Distribution.—Lower Cretaceous (Berriasian) to Upper Cretaceous (Maastrichtian). Cosmopolitan.

Subgenus **PTEROTRIGONIA** van Hoepen, 1929

Pterotrigonia (Pterotrigonia) aliformis (Parkinson, 1811)

Plate 14, figure 3

Trigonia aliformis Parkinson, 1811, p. 176, pl. 12, fig. 9; Agassiz, 1840, p. 31, pl. 7, figs. 14–16, pl. 8, fig. 12; d'Orbigny, 1843, p. 143, pl. 291, figs. 1–3; Coquand, 1865, p. 134; Lycett, 1875, p. 116, pl. 25, figs. 3–6.

Trigonia cf. *aliformis* Parkinson. Weaver, 1931, p. 258.

Pterotrigonia (*Pterotrigonia*) *aliformis* Parkinson. Reyes and Pérez, 1978, p. 12, pl. 3, fig. 2.

Pterotrigonia aliformis Parkinson. Leanza and Garate, 1987, p. 225, pl. 11, figs. 3–7.

Description.—Shell of medium size, strongly inequilateral, longer than high. Umbones strongly opisthogyrous, elevated, situated in the anterior one-third of the shell. Anterior part of the shell inflated and posterior part compressed. Dorsal margin strongly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle 90°. Ventral margin slightly convex, curving evenly into the strongly convex anterior margin. Flank very wide, occupying five-sixths of the shell surface, ornamented by simple, rounded, oblique, beaded costae, with their interspaces widening toward the anterior and ventral margins, becoming at the same time thicker and more prominent. Posterior set of costae subvertical, showing subtriangular section and serrated surface. Area very narrow, with an upward-facing concavity, ornamented by transverse costellae in the proximal region, subsequently smooth. Submedian groove present. Marginal carina well developed, smooth. Escutcheon carina

poorly defined. Escutcheon narrow, elongated and excavated, ornamented by faint oblique costellae.

Material.—Two adult hypotype specimens: MOZ P2687, a very well preserved external mold of a left valve, and MOZ P2686/1, a complete shell with the posterior part somewhat damaged. The specimens are phosphatized, and preserved in a violet-brownish phosphatic siltstone, occurring in association with *Virgotrigonia hugoi* (Leanza).

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2687	36	18	6	0.50	0.16

Remarks.—*Pterotrigonia* (*P.*) *aliformis* (Parkinson, 1811) is a cosmopolitan species known in the Lower Cretaceous of Europe, North and South America, former Soviet Union and Japan. The Argentine specimens show affinities with the Neocomian *P.* (*P*). *aliformis attenuata* (Lycett, 1878, p. 118, pl. 25, fig. 6) and *P.* (*P.*) *vectiana* (Lycett, 1875, p. 123, pl. 24, figs. 10–11, pl. 25, fig. 7) from the Isle of Wight, England, and with *P.* (*P.*) *cubanica* (Sinzow, in Saveliev, 1958, p. 291, pl. 34, figs. 1–6) from the Lower Cretaceous of Turkmenistan. It is possible that all these very closely related species of *Pterotrigonia* are representatives of *P.* (*P.*) *aliformis* (Parkinson, 1811), but analysis of this possibility falls beyond the scope of this paper.

Age and occurrence.—Lower Berriasian, *Argentiniceras noduliferum* Zone, Vaca Muerta Formation; Mallín Quemado (Locality 7), Dept. Picunches, Neuquén, Argentina.

Subgenus **NOTOSCABROTRIGONIA** Dietrich, 1933

Type species.—*Trigonia tocaimaana* Lea, 1841, Lower Cretaceous (Neocomian), Venezuela and Colombia.

Diagnosis.—Like *Pterotrigonia*, but generally larger and with flank ornament, with coarse, widely spaced costae that are generally weakly tuberculated. Posterior flank costae rather distant (Dietrich, 1938; Cooper, 1989).

Distribution.—Upper Jurassic (Tithonian) to Cretaceous (Neocomian–Campanian). South America, North America, Japan, England, South Africa.

Pterotrigonia (Notoscabrotrigonia) coheni, new species
Plate 6, figures 5, 8–10

Holotype.—MOZ P4723, a well preserved adult left valve, fossilized in a yellow-grayish fine-grained limestone.

Paratypes.—Three adult specimens: MOZ P3073, a well preserved right valve; MOZ P5764, a poorly preserved left valve; MOZ P5765, a well preserved right valve.

Type locality.—Cerrito Caracoles (Locality 11), Dept. Zapala (38°49'S, 70°09'W), Picún Leufú Formation (Leanza, 1973), Mendoza Group (Groeber, 1946).

Etymology.—This species is dedicated to my friend Richard Cohen (Boulder, Colorado) who actively supports the Museum Juan Olsacher.

Diagnosis.—Shell of medium to large size, inflated anteriorly and attenuated posteriorly, with the umbones prominent, elevate and highly opisthogyrous. Flank ornamented anteriorly by coarse, widely spaced weakly tuberculated, costae, and posteriorly by rather distant subvertical costae. Area very narrow, with faint transverse costellae. Marginal and escutcheon carinae poorly defined. Escutcheon relatively wide, somewhat excavated, ornamented by faint oblique costellae.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P4723	52	39	16	0.75	0.30
MOZ P5764	≈40	28	10	0.70	0.25
MOZ P5765	≈41	28	10	0.68	0.24
MOZ P3073	54	37	16	0.68	0.29

Description.—Shell of medium to large size, anteriorly inflated and posteriorly compressed, longer than high. Umbones very inflated, elevated, highly opisthogyrous, and very anteriorly situated. Dorsal margin strongly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle almost 90°. Ventral margin broadly convex, curving evenly into the slightly convex anterior margin. Flank very wide, occupying five-sixths of the shell surface, ornamented on its anterior and central region by subconcentric, then oblique, coarse, widely spaced, weakly tuberculate costae, and in its posterior region by rather spaced, subvertical untuberculated costae. Area extremely narrow, ornamented by faint transverse costellae. Submedian groove present. Marginal and escutcheon carinae poorly defined. Escutcheon relatively wide, excavated, ornamented by faint oblique costellae.

Remarks.—Although Kobayashi and Nakano (1957) and Cox (1969) considered *Notoscabrotrigonia* Dietrich a synonym of *Pterotrigonia* van Hoepen, the present author follows the recent interpretation of this taxon by Cooper (1989, p. 242), who placed it as a subgenus of *Pterotrigonia* characterized by sparsely or weakly tuberculated anterior costae, and rather widely-spaced posterior costae. The described specimens can therefore be assigned to the subgenus *Pterotrigonia* (*Notoscabrotrigonia*) Dietrich (1933) on the basis of their shell shape, characterized by a highly inflated anterior part, and the peculiar flank ornamentation, which exhibits

on its anterior and central portions coarse, widely spaced, weakly tuberculated costae, and in its posterior region rather spaced, subvertical, untuberculated costae. *P.* (*N.*) *coheni*, n. sp. differs from the Neocomian *P.* (*N.*) *tocaimaana* (Lea, 1841, p. 6, pl. 9, fig. 8, see also Dietrich, 1938, p. 94, pl. 19, figs. 1–2), the type species of *Notoscabrotrigonia*, by: (1) its relative smaller size; (2) its more widely spaced and therefore fewer costae on the flanks, and (3) the escutcheon only weakly ornamented by faint oblique costellae. *P.* (*N.*) *stolleyi* (Hill in Stoyanow, 1949, p. 88, pl. 15, figs. 9–11) from the Lower Cretaceous of Texas and Arizona, USA, is also a closely related species but differs from *P.* (*N.*) *coheni*, n. sp. in being: (1) comparatively shorter and wider, and (2) in having fewer flank costae. *P.* (*N.*) *thoracica* (Morton in Dane, 1929, p. 110, pl. 21, fig. 4) from the Cretaceous Saratoga Formation of southwestern Arkansas, U.S.A., is a very closely related species, differing from *P.* (*N.*) *coheni*, n. sp. in having: 1) a less elongate shell shape and 2) a more densely costate flank.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* and *Substeueroceras koeneni* Zones, Picún Leufú Formation; Cerrito Caracoles (Locality 11), Dept. Zapala, Neuquén, Argentina.

Subgenus **SCABROTRIGONIA** Dietrich, 1933

Type species.—*Trigonia scabra* Lamarck, 1819, Upper Cretaceous (Cenomanian), France.

Diagnosis.—Shell of medium size, crescent-shaped. Umbones prominent, with dorsal margin shallowly concave. Flank ornamented usually by tuberculated or rarely smooth costae. Area narrow, ornamented by oblique costae that form chevrons with the flank costae, this being the most diagnostic feature of the subgenus. Escutcheon depressed, wide, with transverse costellae (Dietrich, 1933, Kobayashi and Nakano, 1957, Cox, 1969, Cooper, 1989).

Distribution.—Tithonian to Maastrichtian. USA (Texas, North Carolina), México, Argentina, Europe.

Pterotrigonia (Scabrotrigonia) transatlantica
(Behrendsen, 1892)
Plate 7, figures 2–6

Trigonia transatlantica Behrendsen, 1892, p. 220, pl. 3, figs. 5a, b.
Scabrotrigonia transatlantica (Behrendsen). Kobayashi and Nakano, 1957, p. 231.
Scabrotrigonia transatlantica (Behrendsen). Levy, 1967b, p. 104.

Description.—Shell of medium size, crescent-shaped, height almost equals length. Umbones inflated and elevated, very anteriorly situated, and highly opisthogyrous. Dorsal margin strongly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle almost 90°. Ventral margin widely convex, curving evenly into the straight anterior margin. Flank very wide, occupying five-sixths of the shell surface, ornamented by prominent costae which in the ventral portion they bear characteristic ridges and grooves giving as a result a crenulated *Haidaia*-like costation pattern. The costae exhibit in the umbonal region a concentric direction, becoming oblique in the central flank, and subvertical in the posterior flank, with their interspaces widening toward the anterior and ventral margins. Area extremely narrow, ornamented by faint transverse costellae, forming a chevron-like feature when they meet the flank costae. Marginal and escutcheon carinae well defined especially near the umbo. Escutcheon wide, excavated and elongated, ornamented on its whole development by sharp oblique costellae.

Material.—Twenty-seven hypotype specimens, all adult unless otherwise indicated: MOZ P2486, MOZ P2953, and MOZ P3190, well preserved right valves; MOZ P4002, anterior flank of a right valve; MOZ P3189, a complete shell, well preserved; MOZ P4400, a complete shell moderately well preserved; MOZ P4399 and MOZ P2638/4, left valves, well preserved; MOZ P4397, MOZ P2638/1, 3, 5, and 6, and MOZ P2554/5, poorly preserved left valves; MOZ P2638/7,8 and MOZ P3072, poorly preserved right valves; MOZ P2638/9, a fragment of a left valve; MOZ P2638/1, a juvenile left valve well preserved; MOZ P2638/10, 12,14, juvenile left valves regularly preserved; MOZ P2638/1, 13,15, juvenile right valves, regularly preserved; MOZ P2554/6, a juvenile complete shell, poorly preserved; MOZ P2638/15, a juvenile left valve mold. All specimens are fossilized in a yellowish-white, coarse-grained limestone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2486	≈31	28	10	0.90	0.32
MOZ P2953	≈28	21	12	0.75	0.42
MOZ P4399	≈34	33	12	0.97	0.35
MOZ P3189	≈40	35	12	0.87	0.30

Remarks.—Kobayashi and Nakano (1957, p. 231) were the first to suggest that *Trigonia transatlantica* Behrendsen might be a member of *Scabrotrigonia* Dietrich, and this view was accepted by Levy (1967b, p. 104). In Plate 7, figure 5 of the present paper it can be clearly observed that the costae of the area form a chevron-like angulosity with the flank costae. Therefore the *transatlantica* species of Behrendsen is assigned to *Scabrotrigonia*, which is placed, according to Cox (1969), as a subgenus of *Pterotrigonia* van Hoepen. Although the flank bears *Haidaia*-like costae, their directions and pterotrigoniid shell shape preclude assignment to this subgenus of *Myophorella*. *Pterotrigonia gerthi* (Olsson, 1944, p. 42, pl. 3, figs. 4, 5, 10) from the Paita region, northern Perú, is a closely re-

lated species, but differs from *P.* (*S.*) *transatlantica* in having: 1) the area proportionally wider; 2) the flank less densely costate, and 3) the umbo less elevated. Moreover, the chevron-like feature is barely present. This report constitutes the first record of this species after the original description by Behrendsen in 1892.

Age and occurrence.—Upper Tithonian, *Corongoceras alternans* and *Substeueroceras koeneni* Zones, Picún Leufú Formation; Cerrito Caracoles (Locality 11), Dept. Zapala, Neuquén, Argentina.

Subgenus **RINETRIGONIA** van Hoepen, 1929

Type species.—*Trigonia ventricosa* Krauss, 1843, Lower Cretaceous, East Africa.

Diagnosis.—Shell small to large, not as elongate as *Pterotrigonia*; the height almost equals length. Anterior flank costae broader as in *Pterotrigonia*, more commonly coarsely nodated than tuberculated, but in some species smooth. The nodes of the anterior costae become increasingly restricted ventrally, and connect with the area via a long thin stem. Posterior costae narrow, crowded, finely crenulated (van Hoepen, 1929, Cooper, 1989).

Distribution.—Upper Jurassic (Tithonian) to Cretaceous (Maastrichtian). South Africa, East Africa, South America, India, Australia, New Zealand.

Pterotrigonia (Rinetrigonia),
species juvenile indeterminate
Plate 9, figure 6

Description.—Shell moderately small, crescent-shaped, longer than high. Umbones inflated, highly opisthogyrous, and very anteriorly situated. Dorsal margin strongly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin slightly convex, curving evenly into the straight anterior margin. Flank very wide, ornamented anteriorly by six to eight first subconcentric, then oblique, prominent, smooth costae. Posterior flank not observable. Area very narrow, apparently smooth. Marginal and escutcheon carinae very poorly defined. Escutcheon ornament not impressed.

Material.—One juvenile specimen, MOZ P2489, a left valve with its posterior part broken, fossilized in a white-yellowish, coarse-grained, limestone.

Measurements.—

Specimen No.	L	H	W	H/L	W/L
MOZ P2489	11	9	5	0.70	0.25

Remarks.—Recently Cooper (1989, p. 242) claimed that if *Pisotrigonia* van Hoepen and *Rinetrigonia* van Hoepen are considered synonyms, *Pisotrigonia* has page priority. Kobayashi and Nakano (1957) revised for the first time the subfamily Pterotrigoniinae, and (on pages 223 and 230) placed *Pisotrigonia* as a synonym of *Rinetrigonia*. According to the International Code of Zoological Nomenclature (p. 53, Article 24, Principle of the First Reviser) it can be interpreted that Kobayashi and Nakano (1957) acted as the first revisers, and therefore *Rinetrigonia* has to be retained as the valid name.

Although the described specimen can readily be assigned to the subgenus *Pterotrigonia* (*Rinetrigonia*) on the basis of its shell shape, its juvenile nature, together with its relatively poor preservation and the shortage of material (only one specimen), precludes further taxonomic resolution. Nevertheless, this find is important because it records the occurrence of *Pterotrigonia* (*Rinetrigonia*) as early as the Middle Tithonian.

Age and occurrence.—Middle Tithonian, *Windhauseniceras internispinosum* Zone, Picún Leufú Formation; Cerro Lotena (Locality 32), Dept. Zapala, Neuquén, Argentina.

Pterotrigonia (Rinetrigonia) coihuicoensis
(Weaver, 1931)
Plate 16, figures 6, 9, 11

Trigonia coihuicoensis Weaver, 1931, p. 268, pl. 27, fig. 151, pl. 28, figs. 155–160; Lambert, 1944, p. 384, pl. 7, figs. 4–7; Corvalán and Pérez, 1958, p. 40, pl. 4, figs. 3a, c.

Pterotrigonia coihuicoensis (Weaver). Freneix, 1958, p. 190.

Trigonia sp. aff. *T. coihuicoensis* Weaver. Corvalán, 1959, p. 32, pl. 2, fig. 9.

Myophorella (*Myophorella*) *coihuicoensis* (Weaver). Reyes and Pérez, 1978. p. 10, pl. 1, fig. 3; Leanza and Garate, 1987, p. 211, pl. 13, figs. 3–5.

Description.—Shell of medium size. Strongly inflated anteriorly, attenuated posteriorly. Umbones prominent, opisthogyrous. Anterior face of the shell broad and flattened. Dorsal margin concave. Dorsoposterior angle slightly obtuse. Posterior margin very short. Ventral margin strongly convex, curving evenly into the almost straight anterior margin. Flank occupying five-sixths of the shell surface. Anterior and central flank ornamented by approximately 15 strong, subconcentric costae, which bear small but sharp tubercles. Posterior flank ornamented by approximately, beaded, retroverse costae. Marginal carina beaded over its whole length. Area narrow, ornamented by transverse costellae, asymmetrically divided by a submedian sulcus. Escutcheon well defined, ovate, narrow, ornamented by concentric growth lines.

Material.—Two hypotype adult specimens, MOZ P3018 (Bajada del Agrio), complete, very well preserved shell, and MOZ P5313 (Cerro Mesa, Covunco), consisting of a fragment of a left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P5313	39	31	16	0.79	0.41

Remarks.—It is difficult to determine whether the species *coihuicoensis* of Weaver (1931) belongs to *Myophorella* or *Pterotrigonia*. Following Japanese authors (see Levy, 1966), this species was assigned for several years to *Myophorella* (*Myophorella*). Only Freneix (1958) (and a mention by Reyes and Pérez (1983, p. 63)) assigned the species to *Pterotrigonia*. Thanks to the recent revision of the Pterotrigoniinae by Cooper (1989), however, and his redefinition of several genera and subgenera of the family, the present author believes that Weaver's species, characterized by a very inflated, anteriorly flattened, being almost as high as long, and a posteriorly attenuate shell, can be better assigned to *Pterotrigonia* (*Rinetrigonia*) van Hoepen than to *Myophorella* Bayle. The suggestion of Kobayashi and Tamura (1955, p. 100) that the species *coihuicoensis* might be considered as a member of *Haidaia* Crickmay (1930b, emend. Kobayashi and Tamura, 1955) cannot be accepted, because the characteristic vertical crenulations that are present in the ventral part of the costae in *Haidaia* have not been observed in this species, and the shell shape is more related to Pterotrigoniinae.

Age and occurrence.—Lower to Upper Hauterivian, *Lyticoceras pseudoregale, Holcoptychites neuquensis* and *Crioceratites* (*Paracrioceras*) *andinus* Zones, Agrio Formation; Bajada del Agrio (Locality 5), Dept. Pehuenches, and Cerro Mesa, Covunco (Locality 8), Dept. Zapala, Neuquén, Argentina.

Pterotrigonia (Rinetrigonia) windhauseniana
(Wilckens, 1921)
Plate 17, figures 6, 11–13

Trigonia windhauseniana Wilckens, 1921, p. 12; Petersen, 1946, p. 124, pl. 6, fig. 1.

Trigonia sp. Wichmann, 1927, p. 338.

Trigonia wilckensi Feruglio, 1936, p. 109, pl. 12, figs. 11, 12, pl. 21, figs. 1, 2.

Pterotrigonia (*Rinetrigonia*) *windhauseniana* (Wilckens). Levy, 1967b, p. 103; Camacho, 1967, p. 132, pl. 1, fig. 2; Manceñido and Damborenea, 1984, p. 447, pl. 66, fig. 7; Farinati, Quattrocchio and Labudia, 1987, p. 157, pl. 1, fig. 1; Leanza and Casadío, 1991, pl. 1, figs. 9–12.

Description.—Shell small to medium size, crescent-shaped, almost as high as long. Umbones elevated, strongly opisthogyrous, and very anteriorly situated. Anterior part of the shell inflated and posteriorly compressed. Dorsal margin strongly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle obtuse. Ventral margin slightly convex, curving evenly into the straight anterior margin. Flank occupying four-fifths of the shell surface, ornamented on its anterior part by 12–14 prominent and widely spaced, at first oblique and then subradial costae, which bear rounded tubercles. In some specimens the tubercles near the shell margin become closer to each other and concentrically elongated, showing a typical gerontic growth stage. The posterior set is constituted by six to eight beaded, narrowly spaced, subvertical costae. In the ventral part of the flank the costae are crossed by sharp concentric growth lines. Area extremely narrow, ornamented on the umbonal region by faint transverse costellae, subsequently smooth. Marginal and escutcheon carinae poorly defined, except near umbo. Escutcheon wide, highly excavated, ornamented in its proximal region by faint oblique costellae.

Material.—Three hypotype specimens: MOZ P2317/1, an adult relatively well preserved left valve with its posterior part broken; MOZ P2317/2, a well preserved right valve with its posterior part broken; MOZ P2317/3, a juvenile, well preserved left valve.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P2317/1	48	38.5	13	0.80	0.27
MOZ P2317/2	≈55	54	24	0.98	0.43
MOZ P2317/3	32	25	–	0.78	–

Remarks.—*Pterotrigonia* (*Rinetrigonia*) *windhauseniana* (Wilckens, 1921) is a very common species in the Maastrichtian of Argentina, and has also been found in the provinces of Chubut, Río Negro, Neuquén and La Pampa. *P.* (*R.*) *windhauseniana* (Wilckens) shows close affinities to *P.* (*P.*) *feruglioi* (Pianitzky, 1938, p. 75, pl. 1, figs. 5–6) from the Albian of Santa Cruz Province, with *P.* (*P.*) *bustamantina* (Feruglio, 1936, p. 196, pl. 21, figs. 3–4) from the Mastrichtian Bahía Bustamante Member of the Salamanca Formation in the Tetas de Pineda area, eastern Chubut Province, and with *P.* (*P.*) *capricornia* (Skwarko, 1963, p. 21, pl. 2, figs. 2–8) from the Neocomian of the Northern Territory, Australia. The described specimens differ from these species, however, in having a slightly different shell shape and flank ornamentation pattern.

Age and occurrence.—Maastrichtian, *Eubaculites argentinicus* Zone, Jagüel Formation; Cerro Villegas (Locality 27), Dept. Añelo, Neuquén, Argentina.

Subfamily **LAEVITRIGONIINAE** Saveliev, 1958

Genus **QUOIECCHIA** Crickmay, 1930a

Type species.—*Quoiecchia aliciae* Crickmay, 1930a, Hauterivian/Barremian, British Columbia, Canada.

Diagnosis.—Rather small, oval, higher than long, without differentiated area or escutcheon. Flank ornamented by broad, rounded, radial folds, crossed by concentric grooves, present until mid-growth, where they are replaced by concentric folds (Crickmay, 1930a, Cox, 1969, Poulton, 1979).

Distribution.—Lower Cretaceous (Hauterivian/Bar-

remian). North America (Canada) and South America (Argentina).

Quoiecchia sigeli Leanza and Garate, 1987
Plate 17, figure 3

Quoiecchia sigeli Leanza and Garate, 1987, p. 226, pl. 8, figs. 4–7.

Description.—Shell of medium size, subtrigonal, almost as wide as high, inflated. Dorsal and posterior margin almost conforming a continuous line. Ventroposterior angle slightly acute. Ventral margin short and convex, curving abruptly into the straight anterior margin. Flank ornamented by subconcentric rugae bounded by parallel narrow grooves, and crossed in its posterior part by some radial folds. Area ornamented near the umbo by seven to eight transverse faint costellae, and on the remaining surface by oblique striae arising from the flank. Marginal carina poorly defined in the umbonal region, becoming more indistinct toward the margin, where it is difficult to demarcate the boundary between area and flank. Escutcheon not impressed. Ligamental fossette well defined, ovate and short.

Material.—Seven adult specimens: MOZ P1610/2, a complete shell with both valves well preserved; MOZ P1610/5, a poorly preserved right valve; MOZ P1610/6, a complete shell with both valves well preserved; MOZ P1610/7, a complete shell with both valves well preserved; MOZ P1610/8, a complete shell with the right valve broken; MOZ P1610/9, a well preserved right valve; MOZ P1610/10, a large complete shell, with the umbonal region broken.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
MOZ P1610/10	50	51	15	1.02	0.30

Remarks.—This genus has been considered valid by Poulton (1977, p. 11), as a derivative of Myophorellinae through a simplification of the ornamentation and changes in the shape and size of the shell. Saveliev (1958, p. 113) included *Quoiecchia* in his Laevitrigoniinae based on the presence of subconcentric costation, although this family includes forms very distantly related. Tashiro (1979, p. 211) considered *Quoiecchia* questionably as a member of his subfamily Apiotrigoniinae, and stated that the posterior series of costae are more closely related to those of *Apiotrigonia* s.s. or *Heterotrigonia* s.s. than to the costation of *Myophorella* and *Laevitrigonia*. In the absence of newer evidence, however, I assign *Quoiecchia* to the Laevitrigoniinae Saveliev, as I did in 1987.

Quoiecchia sigeli Leanza and Garate differs from the type species *Q. aliciae* Crickmay (1930a, p. 51, pl. 13, figs. 3–8) from the Hauterivian–Barremian of British Columbia, Canada, in having the area ornamented with faint transverse costellae in the umbonal region, flanks ornamented by weaker subconcentric plicae, and a less dorsoventral elongation. The genus *Quoiecchia* as figured by Tashiro (1979, p. 216, text-fig. 18) is very close in morphology to the Argentine species.

Age and occurrence.—Lower Hauterivian, *Lyticoceras pseudoregale* Zone, Agrio Formation; Pichaihue Abajo, (Locality 3), Dept. Loncopué, Neuquén, Argentina.

Subfamily **AUSTROTRIGONIINAE** Skwarko, 1963

Genus **AUSTROTRIGONIA** Skwarko, 1963

Type species.—*Austrotrigonia prima* Skwarko, 1963, Neocomian, Australia.

Diagnosis.—Shell very inequilateral, broad and generally rounded anteriorly, produced and attenuated posteriorly. Umbones slightly opisthogyrous. Flank concentrically costate. Antecarinal sulcus very wide, flat, striated with irregular continuations of the flank costae. Area very narrow, with no obvious radial lineations. Sulcus, area and escutcheon ornamented with growth lines only (Skwarko, 1963, p. 33).

Distribution.—Cretaceous (Neocomian, Maastrichtian). Australia, Antarctica ?, and South America (Argentina).

Austrotrigonia pampeana
Leanza and Casadío, 1991
Plate 17, figures 4, 5

Austrotrigonia pampeana Leanza and Casadío, 1991, pl. 1, figs. 4–8

Description.—Shell of medium size, trigonal, strongly inequilateral, posteriorly elongate. Umbones not elevated, opisthogyrous, very anteriorly situated. The maximum inflation is situated in the central flank, decreasing gradually toward the ventral and posterior region of the shell. Dorsal margin slightly concave. Dorsoposterior angle obtuse. Posterior margin very short. Ventroposterior angle acute. Ventral margin widely convex, curving evenly into the slightly convex anterior margin. Flank occupying four-fifths of the shell surface, ornamented by subconcentric costae and a wide sulcus characteristic for the genus. The costae, present in number of 10–12, are wide and convex in transverse section, and the intercostal spaces are equivalent to one-fourth of their thickness. The sulcus is triangular in shape, wide and shallow, widening gradually from the umbo toward the posteroventral region of the shell, and is ornamented by striae which are the continuation of the flank costae. Marginal carina undefined, especially on the central and distal portion of the shell. Area excavated, narrow and smooth, ornamented by growth lines only. A barely identifiable submedian sulcus is present in the umbonal region. Escutcheon very narrow, smooth and slightly concave.

Material.—Two adult specimens: GHUNLPam 400 (the holotype, see Leanza and Casadío, 1991), complete, with both valves well preserved (Barda Baya); GHUNLPam 625, complete but poorly preserved (Salitral de La Amarga). The specimens are fossilized in a yellowish-white, fine grained limestone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
GHUNLPam 400	48	37	10	0.77	0.20
GHUNLPam 625	51	37	10	0.72	0.19

Remarks.—*Austrotrigonia pampeana* Leanza and Casadío differs from *A. prima* Skwarko (1963, p. 33, pl. 6, figs. 1–3 and ? 4) from the Neocomian of Queensland, Australia, by its comparatively smaller size, less elongate shell shape, and less convex anterior margin of the shell. *A. secunda* Skwarko (1968, p. 177. pl. 13, figs. 1–6) has a different shell shape, being comparatively more inflated anteriorly, and more elongated posteriorly. *Nototrigonia oliveroi* (Medina, 1980, p. 109, pl. 4, fig. 1; pl. 6, figs. 2, 4) from the Campanian of James Ross Island, Antarctica, originally placed by its author in the genus *Austrotrigonia*, exhibits in the area some radial costae which invalidate any comparison with *A. pampeana*.

Age and occurrence.—Maastrichtian, *Eubaculites argentinicus* Zone, Jagüel Formation; Barda Baya (Locality 41) and Salitral de La Amarga (Locality 42), Dept. Puelén, La Pampa, Argentina.

Subfamily **NOTOTRIGONIINAE** Skwarko, 1963

Genus **PACITRIGONIA** Marwick, 1932

Type species.—*Pacitrigonia sylvesteri* Marwick, 1932, Maastrichtian, New Zealand.

Diagnosis.—Oblong, rather elongated, strongly inequilateral shell shape. Umbo broadly rounded, protruding slightly. Flank with broad, smooth, sometimes depressed antecarinal space (or sulcus), but otherwise ornamented with broad, irregular undulations which may be broken up into elongated pustules, and are oblique in early growth stages but almost concentric near the ventral margin. Area smooth or with radial costellae that fade away in late growth stages, and are absent in younger species of the genus. Marginal and escutcheon carinae poorly defined, except in early growth stages. Escutcheon barely impressed (Marwick, 1932; Cox, 1952, 1969; Nakano, 1961; Fleming, 1987).

Distribution.—Upper Cretaceous (Campanian and Maastrichtian). South America (Argentina, Chile), New Zealand.

Pacitrigonia sobrali Leanza and Casadío, 1991
Plate 17, figures 1, 2

Pacitrigonia sobrali Leanza and Casadío, 1991, pl. 1, figs. 1–3.

Description.—Shell medium to large in size, inequilateral, longer than high. Umbones opisthogyrous, very anteriorly situated. Dorsal margin slightly concave near the umbo, then straight. Dorsoposterior angle obtuse. Posterior margin relatively long. Ventroposterior angle acute. Ventral margin slightly convex, curving strongly into the slightly convex anterior margin. Flank occupying three-fourths of the shell surface, ornamented by 18–20 subconcentric, somewhat sinuous costae that show a wavy character in the posterior flank. Appearing at the same time are elongate pustules typical of the genus. Shallow and narrow antecarinal sulcus present, ornamented only by faint growth lines. Marginal carina present in the umbonal region, then undefined. Area relatively narrow, ornamented by barely observable faint radial costellae, which become obsolete in the distal portion. Escutcheon not well impressed, ornamented with growth lines only.

Material.—Two adult specimens: GHUNLPam 399 (the holotype, see Leanza and Casadío, 1991), a complete shell, with both valves well preserved; and GHUNLPam 624, complete shell, but with both valves poorly preserved. The specimens are fossilized in a yellowish-brown, fine-grained, calcareous sandstone.

Measurements (in mm).—

Specimen No.	L	H	W	H/L	W/L
GHUNLPam 399	62	42	11	0.67	0.26

Remarks.—*Pacitrigonia sobrali* Leanza and Casadío (1991) shows close affinities with *P. hanetiana* (d'Orbigny, 1842) from the Maastrichtian of Isla Quiriquina, Chile (see Skwarko, 1963, text-fig. 5; Pérez and Reyes, 1978, pl. 2, figs. 4 and 6; Fleming, 1987, text-fig. 12), but the Argentine species differs in having: (1) a lesser shell inflation; (2) a different shell shape; (3) antecarinal sulcus shallower and narrower, and (4) presence of elongate pustules in a more distal position on the posterior flank. *Pacitrigonia patagonica* (Feruglio, 1936, p. 271, fig. 2; pl. 21, fig. 5) from the Maastrichtian Lefipán Formation in the middle course of the Chubut river, Argentina, differs from *P. sobrali* in having: (1) a longer shell; (2), presence of pustules in the anterior flank; (3) the flank costae are more developed and elevated; and (4) the ventral part of the flank is ornamented by costae parallel to the ventral margin. *Pacitrigonia alamensis* Levy (1985, p. 59, pl. 1, figs. 4–6) from the Lower Campanian Puesto El Alamo Formation in southern Santa Cruz Province, Argentina, clearly differs from *P. sobrali* in having: (1) the intersection of the anterior and ventral margins forming a very sharp angulation; (2) a deeper antecarinal sulcus, and (3) a lesser density of flank costae. With regard to the different species assigned to *Pacitrigonia* by Fleming (1987, p. 46) the differences are still greater.

Age and occurrence.—Maastrichtian, *Eubaculites argentinicus* Zone, Jagüel Formation; Barda Baya (Locality 41), Dept. Puelén, La Pampa, Argentina.

APPENDIX.

FOSSIL LOCALITIES OF THE DESCRIBED TAXA AND ASSOCIATED FAUNAS.

Locality 1.—Cerro Pitrén, Dept. Ñorquín (37°30'S, 70°16'W). *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann) in association with *Olcostephanus atherstoni* (Sharpe), *Karaskachiceras attenuatum* (Behrendsen), *Pseudofavrella angulatiformis* (Behrendsen), *Sarasinella*, sp., *Eriphyla argentina* Burckhardt, *Ptychomya koeneni* Behrendsen, and *Myoconcha transatlantica* Burckhardt. Agrio Formation. Late Valanginian/Early Hauterivian.

Locality 2.—Puerta Curaco, Dept. Pehuenches (37°30'S, 70°02'W). *Steinmanella* (*Transitrigonia*) *steinmanni* (Philippi) in association with *Olcostephanus atherstoni* (Sharpe), *Lissonia riveroi* (Gerth), *Meretrix quintucoensis* Weaver, and *Exogyra couloni* (Defrance). Mulichinco Formation. Valanginian.

Locality 3.—Pichaihue Abajo, Dept. Loncopué (37°45'S, 70°14'W). *Quoiecchia sigeli* Leanza and Garate and *Syrotrigonia brocardoi*, n. sp. in association with *Pseudofavrella garatei* Leanza and Leanza, *Pseudofavrella angulatiformis* (Behrendsen), *Lyticoceras pseudoregale* (Burckhardt), and *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann). Lowermost part of the Agrio Formation. Lower Hauterivian.

Locality 4.—Cerrito de la Ventana, Trahuncurá, Dept. Loncopué (38°00'S, 70°10'W). *Steinmanella* (*Transitrigonia*) *quintucoensis* (Weaver) and *Steinmanella* (*Splenditrigonia*) *splendida* (A. F. Leanza) in association with *Lissonia riveroi* (Lisson), *Acantholissonia gerthi* (Weaver), *Valanginites argentinicus* Leanza and Wiedmann, *Meretrix quintucoensis* Weaver, and *Exogyra couloni* (Defrance). Uppermost part of the Vaca Muerta Formation. Upper Berriasian/Early Valanginian.

Locality 5.—Bajada del Agrio, Dept. Picunches (38°28'S, 70°00'W). *Pterotrigonia* (*Rinetrigonia*) *coihuicoensis* (Weaver) in association with *Holcoptychites neuquensis* (Douvillé), *Crioceratites* (*Paracrioceras*) *andinus* (Gerth), *Ptychomya koeneni* Behrendsen, *Eriphyla argentina* Burckhardt, *Myoconcha transatlantica* Burckhardt. Upper Member of the Agrio Formation. Middle and Upper Hauterivian.

Locality 6.—Bajada Vieja, Dept. Picunches (38°29'S, 70°05'W). *Steinmanella*, sp. indet. (in Leanza and Garate, 1987, Pl. 6, fig. 2) in association with *Argentiniceras noduliferum* (Steuer), *Trigonia carinata* Agassiz, and *Steinmanella* (*T.*) *transitoria*. Upper part of the Vaca Muerta Formation. Berriasian.

Locality 7.—Mallín Quemado, Dept. Picunches (38°33'S, 70°05'W). *Virgotrigonia hugoi* (Leanza), *Steinmanella* (*Transitrigonia*) *neuquensis* (Burckhardt), *Antutrigonia opistolophophora* (Lambert), and *Pterotrigonia* (*Pterotrigonia*) *aliformis* (Parkinson) in association with *Spiticeras* (*Kilianiceras*) *fraternum* A. F. Leanza, *Argentiniceras noduliferum* (Steuer), *Cuyaniceras*, sp., *Anditrigonia* (*A.*) *eximia* (Philippi), *Trigonia carinata* Agassiz, *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann), *Steinmanella* (*Splenditrigonia*) *splendida* (A. F. Leanza), *Cucullaea mendozana* Weaver, and *Arca keideli* Weaver. Vaca Muerta Formation. Lower Berriasian to Early Valanginian.

Locality 8.—Cerro Mesa, Covunco, Dept. Zapala (38°44'S, 69°55'W). *Trigonia aliexpandita* Leanza and Garate, *T. carinata* Agassiz, *Myophorella* (*Promyophorella*) *garatei* Leanza, *Pterotrigonia* (*Rinetrigonia*) *coihuicoensis* (Weaver), *M.* (*Haidaia*) *volkheimeri* Leanza and Garate, *Steinmanella* (*Transitrigonia*) *raimondii* (Lisson), *S.* (*T.*) *neuquensis* (Burckhardt), *S.* (*Macrotrigonia*) *vacaensis* (Weaver), and *Rutitrigonia kauffmani*, n. sp. in association with *Pseudofavrella angulatiformis* (Behrendsen), *Acanthodiscus vaceki* (Neumayr and Uhlig), *Lyticoceras pseudoregale* (Burckhardt), *Holcoptychites neuquensis* (Douvillé), *Cucullaea gabrielis* Leymerie, *Pholadomya gigantea* Sowerby, *Pholadomya agrioensis* Weaver, *Ptychomya koeneni* Behrendsen, *Panopea neocomiensis* (Leymerie), *Astarte elongata* d'Orbigny, *Pecten vacaensis* Weaver, *Gervillia anceps* Deshayes, *Pinna robinaldina* d'Orbigny, *Gervillaria alaeformis* (Sowerby), *Nodomytilus trigonimimus* Kauffman and Leanza, *Tylostoma jaworskii* Weaver, *Natica* cf. *N. bulimoides* (Deshayes), *Cerithium* cf. *C. heeri* Pictet and Renevier, *Turritella* aff. *T. lineolata* Roemer, and *Actaeon andinus* Haupt. Agrio Formation. Lower and Middle Hauterivian.

Locality 9.—Cerro Negro, Covunco, Dept. Zapala (38°46'S. 69°59'W). *Trigonia angustecostata* Behrendsen, and *T. wiedmanni* Leanza and Garate in association with *Acanthodiscus*, sp., *Pseudofavrella angulatiformis* (Behrendsen), *Lyticoceras pseudoregale* (Burckhardt), *Holcoptychites neuquensis* (Douvillé), *Trigonia carinata* Agassiz, *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann), *Steinmanella* (*Macrotrigonia*) *vacaensis* (Weaver), *Pterotrigonia* (*Rinetrigonia*) *coihuicoensis* (Weaver), *M.* (*Promyophorella*) *garatei* Leanza, *Cucullaea gabrielis* Leymerie, *Pholadomya gigantea* Sowerby, *Eriphyla argentina* Burckhardt, *Myoconcha transatlantica* Burckhardt, *Gervillia anceps* Deshayes, *Ptychomya koeneni* Behrendsen, *Panopea* sp, *Astarte* sp., *Pecten* sp., *Tylostoma jaworskii* Weaver, *Natica* cf. *N. bulimoides* (Deshayes), *Pygaster gerthi* Weaver, and *Serpula antiquata* Sowerby. Agrio Formation. Lower and Middle Hauterivian.

Locality 10.—Covunco Pavia, Dept. Zapala (38°49'S,

70°09′W). *Andivaugonia covuncoensis* (Lambert). No associated fauna has been recorded. Lajas Formation. Early Bajocian to Middle Bathonian.

Locality 11.—Cerrito Caracoles, Dept. Zapala (38°49′S, 70°09′W). *Trigonia carinata* Agassiz, *Pterotrigonia* (*Scabrotrigonia*) *transatlantica* (Behrendsen), *Myophorella* (*Haidaia*) *elguetai*, n. sp., and *Rutitrigonia*, sp. juv. indet. in association with *Corongoceras lotenoense* Spath, *Subdichotomoceras araucanense* Leanza, *Volanoceras*, n. sp., *Aspidoceras haupti* Krantz, *Anditrigonia* (*A.*) *eximia* (Philippi), *A.* (*A.*) *lamberti* Levy, *Steinmanella* (*Splenditrigonia*) *erycina* (Philippi), *Ostrea lotenoensis* Weaver, *Ostrea minos* Coquand, *Exogyra couloni* (Defrance). Picún Leufú Formation. Middle/Upper Tithonian.

Locality 12.—Los Catutos, Dept. Zapala (38°51′S, 70°12′W). *Anditrigonia* (*A.*) *lamberti* Levy in association with *Aulacosphinctes proximus* (Steuer), *Windhauseniceras internispinosum* (Krantz), *Djurjuriceras catutosense* Leanza and Zeiss, *Zapalia fascipartita* Leanza and Zeiss, and *Lucina*, sp. indet. Vaca Muerta Formation. Los Catutos Member. Middle Tithonian.

Locality 13.—Laguna Blanca, Dept. Zapala (39°04′S, 70°20′W). *Trigonia*, sp. juv. indet. in association with *Anditrigonia* (*A.*) *eximia* (Philippi), *Trigonia carinata* Agassiz, and *Corongoceras* sp. Picún Leufú Formation. Upper Tithonian.

Locality 14.—Estancia Marichelar, Arroyo Ñirecó, Dept. Catán Lil (39°02′S, 70°33′W). *Frenguelliella tapiai* (Lambert) and *Frenguelliella poultoni*, n. sp. in association with *Ctenostreon paucicostatum* Leanza, *Camptochlamys* sp., *Chlamys* (*Chlamys*) *textoria* (Schlotheim), *Weyla alata* (von Buch), *Entolium* aff. *E. disciformis* (Schuebler), *Entolium* sp., *Gryphaea* sp., *Neocrassina aureliae* (Feruglio), *Pholadomya* sp., *Lithotrochus humboldti* von Buch, Rhynchonellidae sp. indet, and a number of ammonites of Pliensbachian age. Chachil Formation. Pliensbachian.

Locality 15.—Los Pozones, Dept. Zapala (39°10′S, 70°04′W). *Trigonia corderoi* Lambert, *T. mollesensis* Lambert, *T. losadai*, n. sp., *Scaphorella leanzai* (Lambert), *Anditrigonia* (*Eoanditrigonia*) *keideli* (Weaver), and *Andivaugonia radixscripta* (Lambert) in association with *Trigonia densestriata* Behrendsen, *Vaugonia chunumayensis* (Jaworski), *Modiolus contortus* Gottsche, *Lucina* sp., *Protocardia striatula* (Philippi), *Lima laeviscula* Sowerby, *Myoconcha* sp., *Eriphyla* sp., *Nerinea* cf. *N. decorata* Piette, *Natica* sp., *Trochus* sp., *Pleurotomaria leufuensis* Weaver, *Bulla* sp., *Sonninia* (*Papilliceras*) *espinazitensis* (Tornquist), *Emileia multiformis* (Gottsche), *Montlivaltia delabechei andina* Gerth, *Montlivaltia victoriae* (Duncan), and *Convexastrea weaveri* Gerth. Lajas Formation. Early Bajocian to Middle Bathonian.

Locality 16.—Barda Negra Sur, Dept. Zapala (39°10′S, 69°57′W). *Trigonia corderoi* Lambert, *T. densestriata* Behrendsen, *Neuquenitrigonia huenickeni* (Leanza and Garate), *Scaphotrigonia rierafonti* Leanza and Garate, *Myophorella* (*Promyophorella*) *praescabroidea* (Jaworski), *Myophorella* (*Myophorella*) *argentinica* (Jaworski), *Vaugonia chunumayensis* (Jaworski), *Vaugonia rectangularis* (Gottsche), *Vaugonia*, sp. indet., *Frenguelliella perezreyesi*, n. sp., and *Groeberella*, sp. indet. in association with *Sonninia* (*Papilliceras*) *espinazitensis* (Tornquist), *Emileia multiformis* (Gottsche), *Pseudotoites sphaeroceroides* (Tornquist), *Gervillia leufuensis* Weaver, *Pholadomya* sp., *Pleuromya* sp., *Goniomya* sp. and *Lucina* sp. Lajas Formation. Early Bajocian.

Locality 17.—Picún Leufú creek and Route 40, Dept. Zapala (39°14′S, 70°11′W). *Antutrigonia groeberi* (Weaver) in association with *Substeueroceras* sp., *Corongoceras* sp., *Trigonia carinata* Agassiz, *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert), *Pholadomya agrioensis* Weaver, *Pholadomya sanctaecrucis* Pictet and Campiche, *Lucina neuquensis* Haupt, and *Solemya neocomiensis* (Haupt). Picún Leufú Formation. Upper Tithonian.

Locality 18.—Cerro Negro Chico de Picún Leufú, Dept. Catán Lil (39°16′S, 70°01′W). *Rutitrigonia agrioensis* (Weaver) in association with *Steinmanella* (*Transitrigonia*) *transitoria, Myoconcha transatlantica* Burckhardt, *Pinna robinaldina* d'Orbigny, *Eriphyla argentina* Burckhardt, *Ptychomya koeneni* Behrendsen, *Panopea dupiniana* d'Orbigny, and *Pholadomya gigantea* Sowerby. Agrio Formation. Lower Hauterivian.

Locality 19.—Aguada del Overo, Dept. Catán Lil (39°19′S, 70°11′W). *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert) and *Anditrigonia* (*Anditrigonia*) *eximia* (Philippi) in association with *Substeueroceras* sp., *Trigonia carinata* Agassiz, *Steinmanella* (*Splenditrigonia*) *erycina* (Philippi), *Panopea dupiniana* d'Orbigny, *Lucina neuquensis* Haupt, *Lucina leufuensis* Weaver, *Exogyra couloni* (Defrance), *Astarte elongata* d'Orbigny, *Pholadomya sanctaecrucis* Pictet and Campiche, *Pholadomya agrioensis* Weaver, *Grammatodon securis* Leymerie, *Cyprina*? *argentina* Behrendsen, *Solemya neocomiensis* (Haupt), *Isocardia koeneni* Behrendsen, *Isognomon ricordeanus* d'Orbigny, *Anomya* sp., and *Pleuromya* sp. Picún Leufú Formation. Upper Tithonian.

Locality 20.—Cañadón del Sapo, Dept. Catán Lil (39°18′S, 70°15′W). *Antutrigonia frenguellii* (Mariñelarena) and *Anditrigonia* (*A.*) *carrincurensis* (A. F.Leanza) in association with *Subdichotomoceras* sp., *Parapallasiceras* sp. *Anditrigonia* (*A.*) *eximia* (Philippi), *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert), *Steinmanella* (*Splenditrigonia*) *erycina* (Philippi), *Trigonia carinata* Agassiz, *Lucina neuquensis* Haupt, *Lu-*

cina leufuensis Weaver, *Panopea dupiniana* d'Orbigny, and *Pholadomya gigantea* Sowerby. Picún Leufú Formation. Middle Tithonian.

Locality 21.—Máquina Curá, Chacaicó, Dept. Catán Lil (39°20'S, 70°22'W). *Andivaugonia radixscripta* (Lambert), *Scaphorella camachoi*, n. sp., *Andivaugonia fuenzalidai* (Reyes and Pérez), and *Myophorella* (*Myophorella*) *argentinica* (Jaworski) in association with *Trigonia corderoi* Lambert, *Trigonia mollesensis* Lambert, (Lambert), *Scaphorella leanzai* (Lambert), *Scaphorella kruusei* Leanza and Garate, *Vaugonia chunumayensis* (Jaworski), *Modiolus contortus* Gottsche, *Arcomya elongata* d'Orbigny, *Isognomon americanus* (Forbes), *Gervillaria leufuensis* (Weaver), *Chlamys* sp., *Amussium* sp., *Natica* aff.*N. catanlilensis* Weaver, *Nerinea* sp., *Montlivaltia delabechei andina* Gerth. Lajas Formation. Early Bajocian.

Locality 22.—Caichigüe, Charahuilla, Dept. Catán Lil (39°26'S, 70°21'W). *Steinmanella* (*Splenditrigonia*) *erycina* (Philippi) in association with *Substeueroceras* sp., *Anditrigonia* (*A.*) *carrincurensis* (A. F. Leanza), *Anditrigonia* (*A.*) *lamberti* Levy, *Anditrigonia* (*A.*) *eximia* (Philippi), *Antutrigonia frenguellii* (Mariñelarena), *Antutrigonia groeberi* (Weaver), *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert), *Lucina neuquensis* Haupt, *Pholadomya gigantea* Sowerby, *Lucina leufuensis* Weaver, *Panopea dupiniana* d'Orbigny, *Myoconcha transatlantica* Burckhardt, *Ostrea minos* Coquand, *Ostrea lotenoensis* Weaver, and *Exogyra couloni* (Defrance). Picún Leufú Formation. Upper Tithonian.

Locality 23.—Fortín 1° de Mayo, Dept. Catán Lil (39°25'S, 70°38'W). *Scaphorella kruusei* Leanza and Garate and *Andivaugonia lissocostata* (Reyes and Pérez) in association with *Trigonia corderoi* Lambert, *T. mollesensis* Lambert, and *Sonninia* (*Papilliceras*) *espinazitensis* (Tornquist). Lajas Formation. Early Bajocian.

Locality 24.—Cerrito Roth, Cañadón de la Piedra Pintada, Dept. Collón Curá (40°07'S, 70°16'W). *Jaworskiella burckhardti* (Jaworski), *Myophorella* (*Myophorella*) *catenifera* (Hupé), and *Groeberella neuquensis* (Groeber) in association with *Myophorella* (*M.*) *araucana* (A. F. Leanza), *Frenguelliella inexspectata* (Jaworski), *Weyla bodenbenderi* (Behrendsen), *Myochoncha neuquena* A. F. Leanza, *M. neuquena torulosa* A. F. Leanza, *Cardinia andium* (Giebel), *C.* cf. *C. andium* (Giebel), *C. densestriata* Jaworski, *Entolium disciformis* (Schuebler), *Cucullaea jaworskii* A. F. Leanza, *C. rothi* A. F. Leanza. *Isognomom jupiter* (A. F. Leanza), *Gervillaria pallas* (A. F. Leanza), *Gervillia? turgida* A. F. Leanza, *Lopha longistriata* (Jaworski), and *Gryphaea darwini* Forbes. Piedra Pintada Formation. Pliensbachian.

Locality 25.—Mirador del Chachil, Dept. Catán Lil (39°13'S, 70°32'W). *Frenguelliella tapiai* (Lambert) (in Leanza and Garate, 1987, p. 210) in association with *Chlamys* (*Chlamys*) *textoria* (Schlotheim),*Entolium* aff. *E. disciformis* (Schuebler) and *Neocrassina aureliae* (Feruglio). Chachil Formation. Upper Pliensbachian.

Locality 26.—Cerro Granito, Dept. Zapala (39°09'S, 69°34'W). *Myophorella* (*Myophorella*) *araucana* (in Leanza and Garate, 1987, Pl. 1, figs. 6-7) in association with *Weyla bodenbederi* (Behrendsen), *Cardinia* cf. *andium* (Giebel), *Entolium disciformis* (Schuebler), and *Gervilliaria pallas* (A. F. Leanza). Piedra Pintada Formation. Pliensbachian.

Locality 27.—Cerro Villegas, Dept. Pehuenches (37°35'S, 69°55'W). *Pterotrigonia* (*Rinetrigonia*) *windhauseniana* (Wilckens) in association with *Eubaculites argentinicus* (Weaver), *Baculites* sp., *Pterotrigonia* sp., *Pacitrigonia* sp., *Nototrigonia* sp., *Ostrea clarae* Ihering, and *Pecten mahuidaensis* Weaver. Jagüel Formation. Maastrichtian.

Locality 28.—Arenal de Las Lajas, Dept. Picunches. (38°31'S, 70°22'W). *Anditrigonia* (*A.*), sp. indet in association with *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann) and *Pterotrigonia* (*Rinetrigonia*) *coihuicoensis* (Weaver). Agrio Formation. Middle Hauterivian.

Locality 29.—Los Hornos, Covunco Abajo, Dept. Zapala (38°43'S, 69°59'W). *Steinmanella* (*Macrotrigonia*) *vacaensis* (Weaver) in association with *Steinmanella* (*Transitrigonia*) *raimondii* (Lisson), *Ptychomya koeneni* Behrendsen, *Panopea dupiniana* d'Orbigny, *Eriphyla argentina* Burckhardt, and *Myoconcha transatlantica* Burckhardt. Agrio Formation. Middle Hauterivian.

Locality 30.—Salitral de los Alazanes, Dept. Picunches (38°46'S, 70°13'W). *Virgotrigonia hugoi* (Leanza) in association with *Argentiniceras* sp., *Cuyaniceras* sp., *Arca keideli* Weaver, and *Cucullaea mendozana* Weaver. Vaca Muerta Formation. Berriasian.

Locality 31.—Cerro Pancho, Bajada de La Americana, Dept. Zapala (38°48'S, 70°02'W). *Anditrigonia* (*A.*), sp. juv. indet. in association with *Corongoceras mendozanum* (Gerth), *Lytohoplites burckhardti* (Mayr-Eymar), *Volanoceras*, n. sp., *Substeueroceras* sp., *Ostrea minos* Coquand, *Ostrea lotenoensis* Weaver, *Anditrigonia* (*Anditrigonia*) *eximia* (Philippi), and *Trigonia carinata* Agassiz. Picún Leufú Formation. Upper Tithonian.

Locality 32.—Cerro Lotena, Dept. Zapala (39°10'S, 69°38'W). *Trigonia fortinensis* Lambert and *Pterotrigonia* (*Rinetrigonia*), sp. juv. indet. in association with *Subdichotomoceras araucanense* Leanza, *Subdichotomoceras windhauseni* (Weaver), *Windhauseniceras internispinosum* (Krantz), *Substeueroceras* sp., *Corongoceras* sp., *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert), *Anditrigonia* (*Anditrigonia*) *eximia* (Philippi), *Ostrea lotenoensis* Weaver, *Ostrea minos* Co-

quand, *Pholadomya* sp., *Lucina neuquensis* Haupt, and *Lucina leufuensis* Weaver. Picún Leufú Formation. Middle [*P.* (*P.*), sp. juv. indet.] and Upper (*T. fortinensis*) Tithonian.

Locality 33.—Laguna Miranda, Dept. Zapala (38°54′S, 70°15′W). *Trigonia mirandaensis* Lambert and *Lambertrigonia pichimoncolensis* (Lambert) in association with unindentified ammonite fragments, Nuculidae ? molds, *Nerinea* ? sp., a small *Exogyra*, sp. indet., Pectinidae (*Amussium* ? sp.), and fragments of *Pentacrinus* sp. Tordillo Formation. Kimmeridgian.

Locality 34.—Camino nuevo a Los Molles, Dept. Catán Lil. (39°13′S, 70°05′W). *Anditrigonia* (*A.*) *eximia tesselicaudata*, n. ssp. and *Myophorella* (*Myophorella*) *schulzi*, n. sp. in association with *Himalayites andinus* Leanza, *Corongoceras* sp., *Substeueroceras* sp, *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert), *S.* (*Spl.*) *erycina* (Philippi), and *Lucina leufuensis* Weaver. Picún Leufú Formation. Upper Tithonian.

Locality 35.—Cañadón Ñancu Huau, Chacaicó, Dept. Catán Lil (39°17′S, 70°17′W). *Scaphorella leanzai* (Lambert) in association with *Sonninia* (*Papilliceras*) *espinazitensis* (Tornquist), *Sonninia variabilis* (Schlotheim), *Sonninia altecostata* (Tornquist), *Emileia* spp., *Otoites sauzei* (d'Orbigny), *Trigonia mollesensis* Lambert, *Natica* sp., *Chlamys* sp., *Amussium* sp., *Protocardia* sp., *Lucina* sp., *Pentacrinites* sp., *Rhynconella* cf. *R. tetraedra* Möericke, *Rhynconella* cf. *R. variabilis* Schlotheim, *Ctenostreon neuquensis* (Philippi), *Montlivaltia delabechei andina* Gerth, Cycadaceae fragments, silicified wood, and Ichthyosauridae. Lajas Formation. Early Bajocian.

Locality 36.—Las Cortaderas, Dept. Catán Lil (39°23′S, 70°11′W). *Trigonia levyi*, n. sp. in association with *Subdichotomoceras* sp., *Parapallasiceras* sp., *Anditrigonia* (*A.*) *eximia* (Philippi), and *Exogyra couloni* (Defrance). Picún Leufú Formation. Middle Tithonian.

Locality 37.—La Amarga, near Rincón del Aguila, Dept. Zapala (39°05′S, 69°32′W). *Myophorella* (*Myophorella*) *araucana* (A. F. Leanza) in association with *Cardinia andium* (Giebel), *Cardinia densestriata* Jaworski, *Weyla alata* (von Buch), and *Lopha* sp. Piedra Pintada Formation. Pliensbachian.

Locality 38.—Estancia Souraya, Espinazo del Zorro, Dept. Catán Lil. (39°16′S, 70°37′W). *Myophorella* (*Myophorella*) *catenifera* (Hupé) in association with "*Fanninoceras*" *behrendseni* (Jaworski), *Chlamys* (*Chlamys*) *textoria* (Schlotheim), *Entolium* aff. *E. disciformis* (Schuebler), *Entolium* sp., and *Camptochlamys* sp. Chachil Formation. Pliensbachian.

Locality 39.—Estancia Santa Isabel, Dept. Catán Lil (39°52′S, 70°29′W). *Myophorella* (*Myophorella*) cf. *M. tuberculata* (Agassiz) and *Frenguelliella inexspectata* (Jaworski) in association with *Myophorella* (*Myophorella*) *araucana* (A. F. Leanza), *Cardinia andium* (Giebel), *Lithotrochus* sp., and Rhynchonellidae indet. Piedra Pintada Formation. Pliensbachian.

Locality 40.—Carrín Curá, Dept. Collón Curá (40°01′S, 70°20′W). *Jaworskiella burckhardti* (Jaworski) (sp. juv.) in association with *Frenguelliella inexspectata* (Jaworski), *Cucullaea rothi* A. F. Leanza, *Lopha longistriata* (Jaworski), and *Gervillia* ? *turgida* A. F. Leanza. Piedra Pintada Formation. Pliensbachian.

Locality 41.—Barda Baya, Dept. Puelén. Prov. La Pampa (36°54′S, 67°55′W). *Pacitrigonia sobrali* Leanza and Casadío and *Austrotrigonia pampeana* Leanza and Casadío in association with *Eubaculites argentinicus* (Weaver), *Pterotrigonia* (*Rinetrigonia*) *windhauseniana* (Wilckens), *Panopea inferior* Wilckens, *Acesta latens* Feruglio, *Veniella pampaensis* (A. F. Leanza and Hünicken), *Lahillia luisa* (Wilckens), *Cucullaea antarctica* (Wilckens), *Nucula* sp., *Ostrea clarae* Ihering, *Pecten mahuidaensis* Weaver and several species of *Turritella*. Jagüel Formation. Maastrichtian.

REFERENCES CITED

Agassiz, L.

1840. *Études critiques sur les mollusques fossiles.* Mémoire sur les Trigonies. Petitpierre, Neuchâtel, 58 pp.

Alleman, V.

1985. Virgotrigonia, *género nuevo de Trigoniidae Lamarck, 1819 (Mollusca–Bivalvia).* Boletín de la Sociedad Geológica de Perú, vol. 75, pp. 1–11.

Ansell, A. D.

1969. *Leaping movements in the Bivalvia.* Proceedings of the Malacological Society of London, vol. 38, pp. 387–399.

Bayle, E.

1878. *Fossiles principaux des terrains,* in *Explanation del la Carte Géologique France,* Paris, vol. 4 (1), atlas (without text).

Behrendsen, O.

1891–1892. *Zur Geologie des Ostabhanges der Argentinischen Kordillere.* Zeitschrift der Deutsche Geologischen Gesellschaft, vol. 43, 1891, pp. 369–420, pls. 22–25; vol. 44, 1892, pp. 1–42, 4 pls. [Translation (1922): *Contribución a la geología a la pendiente oriental de la Cordillera Argentina.* Actas de la Academia Nacional de Ciencias, Córdoba, vol. 7, pp. 157–227].

Bruguière, J. G.

1789. *Encyclopédie méthodique.* Paris. Volume 1, pls. 237–238.

Buch, L. von

1839. *Pétrifications recuilles en Amérique par Alexander von Humboldt et par Charles Dagenhardt, décrites par Léopold von Buch.* Academie Royal des Sciences, Berlin, 22 pp.

Burmeister, H., and Giebel, C.

1861. *Die Versteinerungen von Juntas im Thal des Río Copiapó* Abhandlungen der Naturforschung Gesellschaft. Halle, vol. 6, pp. 111–113.

Burckhardt, C.
1900a. *Profils géologiques transversaux de la Cordillere Argentino-chilienne.* Anales de Museo de La Plata, Sección Mineralogía y Geologia, vol. 2, pp. 1–136.
1900b. *Coupe géologique de la Cordillere entre Las Lajas et Curacautin.* Anales de Museo de La Plata, Sección Mineralogía y Geologia, vol. 3, pp. 1–102.
1901. *Sur les fossiles marines du Lias de la Piedra Pintada.* Revista del Museo de La Plata, vol. 10, pp. 19–25.
1903. *Beiträge zur Kenntniss der Jura und Kreideformation der Cordillere.* Palaeontographica, vol. 50, pp. 1–145.

Camacho, H. H.
1967. *Consideraciones sobre una fauna del Cretácico superior (Maestrichtiano) del Paso del Sapo, curso medio del río Chubut.* Ameghiniana, vol. 5, pp. 131–134.
1968. *Acerca de la megafauna del Cretácico superior de Huantraico, provincia del Neuquén (Argentina).* Ameghiniana, vol. 5, pp. 321–329.

Camacho, H. H., and Riccardi, A. C.
1978. *Invertebrados. Megafauna.* Relatorio Geol. y Rec. Nat. del Neuquén. 7 Congreso Geológico Argentino, vol. 1, pp. 137–146.

Camacho, H. H., and Olivero, E. B.
1985. *El género* Steinmanella *Crickmay, 1930 Bivalvia—Trigoniidae) en el Cretácico inferior del sudoeste gondwánico.* Anales de la Academia Nacional de Ciencias Exactas, Físicas y Naturales, vol. 37, pp. 41–62.

Castillo, A. del, and Aguilera, J.
1895. *Fauna fósil de la Sierra de Catorce, San Luis de Potosí.* Com. Geol. (México), Bull. 1, 55 pp.

Cooper, M. R.
1979. *Cretaceous Trigoniidae (Mollusca–Bivalvia) from the Brenton Formation, Knysna.* Annals of the South African Museum, vol. 78, pp. 49–67.
1989. *The Gondwanic bivalve* Pisotrigonia *(family Trigoniidae), with description of a new species.* Paläontologisches Zeitschrift, vol. 63, pp. 241–250.
1991. *Lower Cretaceous Trigonioidea (Mollusca, Bivalvia) from the Algoa Basin, with a revised classification of the order.* Annals of the South African Museum, vol. 100, pp. 1–52.

Coquand, M.
1865. *Monographie paléontologique de l'Etage Aptiene de l'Espagne.* Mémoire de la Societé d'Emulation de la Provence, vol. 3, pp. 191–411.

Corvalán, J.
1959. *El Titoniano de Río Leñas, provincia de O'Higgins, con una revisión del Titoniano y Neocomiano de la parte chilena del Geosinclinal Andino.* Instituto de Investigaciones Geológicas de Chile, Bulletin. 3, pp. 1–65.

Corvalán, J., and Pérez, E.
1958. *Fósiles guías chilenos. Titoniano–Neocomiano.* Instituto de Investigaciones Geológicas de Chile, Manual No. 1, pp. 1–48.

Cox, L. R.
1952. *Notes on the Trigoniidae, with outlines of a classification of the family.* Proceedings of the Malacological Society of London, vol. 29, pp. 45–70.
1956. *Jurassic Mollusca from Perú.* Journal of Paleontology, vol. 30, pp. 1179–1186.
1969. *Trigoniaceae Lamarck, 1819,* in R.C. Moore (ed.): *Treatise on Invertebrate Paleontology.* Geological Society of America, Part N (1), pp. 471–489.

Cragin, F. W.
1905. *Paleontology of the Malone Jurassic Formation of Texas.* U. S. Geological Survey Bulletin 266, pp. 7–169.

Crickmay, C. H.
1930a. *Fossils from Harrison Lake area, British Columbia.* National Museum of Canada, Bulletin 63, pp. 33–66.
1930b. *The Jurassic rocks of Ashcroft, British Columbia.* University of California Publications, Department of Geological Sciences, Bulletin 19, pp. 23–74.
1932. *Contributions toward a monograph of the Trigoniidae.* American Journal of Sciences, vol. 24, pp. 443–464.

Dane, C. H.
1929. *Cretaceous formation of southwestern Arkansas.* Arkansas Geological Survey, Bulletin 1, pp. 98–119.

Dietrich, W. O.
1933. *Zur Stratigraphie und Paläontologie der Tendaguruschichten.* Palaeontographica, vol. 7, pp. 1–86.
1938. *Lamelibranquios cretácicos de la Cordillera Oriental.* Estudios Geológicos y Paleontológicos Cordillera Oriental, Colombia, pp. 81–108.

Douvillé, H.
1910. *Cephalopodes argentins.* Memoires de la Societé Géologique de la France, 43, pp. 1–22.

Etayo Serna, F.
1985. *Paleontología estratigráfica del Sistema Cretácico en la Sierra Nevada del Cocuy.* Ingeominas Colombia, Publicación Especial No. 16, Proyecto Cretácico, Capítulo 24, pp. 1–47.

Etheridge, R.
1902. *The Cretaceous Mollusca of South Australia and the Northern Territory.* Memoirs of the Royal Society of Australia, vol. 2, pp. 1–54.

Farinati, E., Quattrocchio, M., and Labudía, C.
1987. *Hallazgo del Maestrichtiano–Terciario fosilífero en el Bajo de Lenza Niyeu y Colan Conhué, comarca Nordpatagónica, provincia de Río Negro, Argentina.* X Congresso Geológico Argentino, Actas 3, pp. 153–157.

Feruglio, E.
1936. *Paleontographia Patagonica.* Memoria de Instituto Geologico de la Universita di Padova, No. 2, pp. 1–384.

Fleming, C. A.
1987. *New Zealand Mesozoic Bivalves of the Superfamily Trigoniacea.* New Zealand Geological Survey, Paleontological Bulletin No. 53, pp. 1–73.

Frass, O.
1878. *Aus dem Orient. 2. Geologische beobachtungen am Lebanon.* Wurtemberg Naturwwissenschaft, Jahresheft, vol. 34, pp. 1–134.

Freneix, S.
1958. *Contribution à l'étude des Lamellibranches du Crétacé de Nouvelle-Calédonie.* Science de la Terre, vol. 4, pp. 153–207.

Gabb, W. M.
1877. *Description of a collection of fossils made by Doctor Antonio Raimondi in Perú.* Journal of the Academy of Natural Sciences of Philadelphia, 2nd. ser., vol. 8., pp. 1–25.

Gay, L.
1854. *Historia Física y política de Chile. Zoología.* Paris, vol. 8, pp. 1–499.

Gould, S. J.
1969. *The byssus of trigonian clams: phylogenetic vestige or functional organ?.* Journal of Paleontology, 43, pp. 1125–1129.

Gottsche, C.
1878. *Über jurassische Verstainerungen aus der argentinischen Kordillere.* In: Stelzner, A.: *Beiträge zur Geologie und Paläontologie der argentinischen Republik.* Palaeontographica, Suppl., vol. 3, pp. 1–50. [Translation (1925): *Contribuciones a la Paleontología de la República Argentina.*

Sobre fósiles jurásicos de la Cordillera Argentina (Paso del Espinacito, provincia de San Juan). Actas de la Academia Nacional de Ciencias, Córdoba, vol. 8, pp. 229–283.]

Groeber, P.

1924. *Descubrimiento del Triásico marino en la República Argentina.* Comunicaciones del Museo de Historia Natural de Buenos Aires, vol. 2, pp. 87–94.

1946. *Observaciones geológicas a lo largo del meridiano 70°. 1. Hoja Chos Malal.* Revista de la Asociatión Geológica Argentina, vol. 1, pp. 177–208.

Haq, B., Hardenbol, J., and Vail, P.

1988. *Mesozoic chronostratigraphy and cycles of sea level change.* Society of Economic Paleontologists and Mineralogists Special Publication 42, pp. 71–108.

Haupt, O.

1907. *Beiträge zur Fauna des oberen Malm und der unteren Kreide in den argentinischen Kordillere.* Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, vol. 23, pp. 187–236.

Hermann, J.

1781. *Brief über einige Petrifakten.* Der Naturforscher, vol. 15 (fide Crickmay, 1932)

Hoepen, E. C. N. van

1929. *Die Kryptfauna van Soeloeland. I. Trigoniidae.* Paleontologiese Navorsing van die Nasionale Museum van Bloemfontein, vol. 1, pp. 1–38.

Jaworski, E.

1916. *Beiträge zur Kenntniss der Jura in Süd Amerika.* Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, vol. 40, pp. 364–456. [Translation (1925): *Contribución a la Paleontología del Jurásico Sudamericano.* Dirección General de Minería, Geología e Hidrogeología, Sección Geología, Publicacíon No. 4, pp. 1–160.]

1926. *La fauna del Lias y Dogger de la Cordillera Argentina en la parte meridional de la provincia de Mendoza.* Actas de la Academia Nacional de Ciencias, Córdoba, vol. 9, pp. 137–316. [Translation (1926): *Beiträge zur Paläontologie und Stratigraphie des Lias, Dogger, Tithons und der Unterkreide in den Kordilleren im Süden der provinz Mendoza (Argentinien). Teil I. Lias and Dogger.* Geologisches Rundschau, vol. 17A, pp. 373–427.]

Kauffman, E. G., Leanza, H. A., and Villamil, T.

in press. *Epibiont-endobiont habitation patterns and their implications for life habits and orientation among Trigoniancean bivalves.* Journal of Paleontology

in preparation. *The evolution of morphospace in Trigoniacean bivalves.* Lethaia

Kelly, S. R. A.

1984. *Bivalvia of the Spilsby sandstone and Sandringham sands (Late Jurassic–Early Cretaceous) of eastern England. Part 1.* Monographs of the Palaeontographical Society, 566, 1094 pp.

Kitchin, F. L.

1908. *The invertebrate fauna and paleontological relations of the Uitenhage Series.* Annals of the South African Museum, vol. 7, pp. 21–250.

Kobayashi, T.

1954. *Studies on the Jurassic Trigonians in Japan. Part 1. Preliminary Notes.* Japanese Journal of Geology and Geography, vol. 25, pp. 61–80.

Kobayashi, T., and Mori, K.

1955. *Studies on the Jurassic Trigonians in Japan. Part 3. The Vaugoniinae from the Kitami Mountains in North Japan.* Japanese Journal of Geology and Geography, vol. 26, pp. 73–88.

Kobayashi, T., and Tamura, M.

1955. *Studies on the Jurassic Trigonians in Japan. Part 4. The Myophorellinae from North Japan.* Japanese Journal of Geology and Geography, vol. 26, pp. 89–106.

1957. *Studies on the Jurassic Trigonians in Japan. Part 6. Additional new genera and species of Trigonians from the Jurassic of Soma, North Japan.* Japanese Journal of Geology and Geography, vol. 28, pp. 35–41.

Kobayashi, T., and Amano, M.

1955. *On the Pseudoquadratae Trigonians,* Steinmanella, *in the Indo-Pacific Province.* Japanese Journal of Geology and Geography, vol. 26, pp. 193–208.

Kobayashi, T., and Nakano, M.

1957. *On the Pterotrigoniinae.* Japanese Journal of Geology and Geography, vol. 28, pp. 220–238.

1958. *The Lower and Middle Cretaceous Trigonians in Wakayama, Oita and Kumamoto Prefectures, west Japan.* Japanese Journal of Geology and Geography,vol. 29, pp. 139–152.

Lamarck, J. R.

1819. *Historie des animaux sans vertèbres.* Paris, vol. 6, part 1.

Lambert, L. R.

1944. *Algunas Trigonias del Neuquén.* Revista del Museo de La Plata, nueva serie, Paleontología, vol. 2, pp. 357–397.

Lea, I.

1841. *Notice of the Oolithic Formation in America, with descriptions of some of its organic remains.* Transactions of the American Philosophical Society, N. S., vol. 7, pp. 225–233.

Leanza, A.F.

1941. *Dos nuevas Trigonias en el Titonense de Carrín Curá en el Territorio del Neuquén.* Notas del Museo de La Plata, Paleontología, vol. 6, pp. 225–233.

1942. *Los Pelecípodos del Lias de Piedra Pintada en el Neuquén.* Revista del Museo de La Plata, nueva serie, Paleontología, vol. 2, pp. 145–206.

1945. *Introducción al estudio de la Paleontología. I. Pelecípodos.* Holmbergia, vol. 4, pp. 77–100.

Leanza, A. F., and Castellaro, H.

1955. *Algunos fósiles Cretácicos de Chile.* Revista de la Asociatión Geológica Argentina, vol. 10, pp. 179–213.

Leanza, H A.

1973. *Estudio sobre los cambios faciales de los estratos limítrofes Jurásico–Cretácicos entre Loncopué y Picún Leufú, provincia del Neuquén, República Argentina.* Revista de la Asociatión Geológica Argentina, vol. 28, pp. 97–132.

1981. *Una nueva especie de* Myophorella *(Trigoniidae–Bivalvia) del Cretácico inferior del Neuquén.* Ameghiniana, vol. 18, pp. 1–9.

1981a. *The Jurassic Cretaceous boundary beds in West Central Argentina and their ammonite zones.* Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, vol. 161, pp. 62–92.

1985. Maputrigonia, *un nuevo género de Trigoniidae (Bivalvia) del Berriasiano del Neuquén.* Boletín de la Academia Nacional de Ciencias, Córdoba 56, pp. 275–285.

Leanza, H. A., and Garate Zubillaga, J. I.

1983a. Anditrigonia keideli *(Weaver) n. comb. (Trigoniidae–Bivalvia) del Jurásico Medio del Neuquén, Argentina.* Ameghiniana, vol. 20, pp. 95–104.

1983b. *Una nueva subespecie de* Trigonia carinata *Ag. (Bivalvia) del Cretácico inferior del Neuquén, Argentina.* Ameghinana, vol. 20, pp. 105–110.

1985. *Una nueva especie de* Trigonia *Bruguière (Bivalvia) del Jurásico Medio del Neuquén, Argentina.* Boletín de la Academia Nacional de Ciencias, Córdoba 56, pp. 287–292.

1986. *Presencia de* Scaphotrigonia *Dietrich (Trigoniidae–Bivalvia) en el Jurásico andino*. Ameghiniana, vol. 23, pp. 155–159.

1987. *Faunas de Trigonias (Bivalvia) del Jurásico y Cretácico inferior del Neuquén, Argentina, conservadas en el Museo Juan Olsacher de Zapala*, in W. Volkheimer (ed.): *Bioestratigrafía de los Sistemas Regionales del Jurásico y Cretácico de América del Sur*, Mendoza, vol. 1, pp. 201–255.

Leanza, H. A., Marchese, H. G., and Riggi, J. C.

1977. *Estratigrafía del Grupo Mendoza con especial referencia a la Formación Vaca Muerta y sincrónicas entre los paralelos 35° y 40° l. s. Cuenca Neuquina–Mendocina*. Revista de la Asociación Geológica Argentina, vol. 32, pp. 190–208.

Leanza, H. A., and Hugo, C. A.

1977. *Sucesión de ammonites y edad de la Formación Vaca Muerta y sincrónicas entre los paralelos 35°y 40°l.s. Cuenca Neuquina–Mendocina*. Revista de la Asociación Geológica Argentina, vol. 32, pp. 248–264.

Leanza, H. A., Pérez, E., and Reyes, R.

1987. Scaphorella, *un nuevo género de Trigoniidae (Bivalvia) del Jurásico medio de Argentina, Chile y Estados Unidos de América*. Ameghiniana, vol. 24, pp. 81–88.

Leanza, H. A., and Casadío, S.

1991. *Descripción de dos nuevas especies de* Pacitrigonia *Marwick y* Austrotrigonia *Skwarko (Trigoniidae; Bivalvia) en el Cretácio superior del occidente de la provincia de La Pampa, Argentina*. Revista Geológica de Chile, vol. 18, pp. 25–35.

Levy, R.

1966. *Revisión de las Trigonias de Argentina. Parte 1. Una nueva especie de* Myophorella *del Lías de Pampa de Agnia (Chubut) con consideraciones acerca de la presencia de Myophorellinae en Argentina*. Ameghiniana, vol. 4, pp. 237–241.

1967a. *Revisión de las Trigonias de Argentina. Parte 2. La presencia de* Myophorigonia *en el Lias medio de Neuquén y Chubut*. Ameghiniana, vol. 5, pp. 11–16.

1967b. *Revisión de las Trigonias de Argentina. Parte 3. Los Pterotrigoniinae de Argentina*. Ameghiniana, vol. 5, pp. 101–106.

1967c. *Revisión de las Trigonias de Argentina. Parte 4. Los Megatrigoniinae de Argentina y su relación con* Anditrigonia *gen. nov*. Ameghiniana, vol. 4, pp. 135–144.

1969. *Revisión de las Trigonias de Argentina. Parte 5. El grupo de las Pseudoquadratae*. Ameghiniana, vol. 6, pp. 65–68.

1985. *Dos nuevas especies de Trigoniidae (Mollusca–Bivalvia) en la Formación Puesto El Alamo, Cretácico Superior (Santa Cruz, Argentina)*. Ameghiniana, vol. 22, pp. 57–61.

Lisson, C. I.

1930. *Contribución al conocimiento de algunas trigonias Neocómicas del Perú*. Boletín del Ministerio de Industria y Construcciones, Serie 2, vol. 20, pp. 3–26.

Lycett, J.

1863. *Supplementary monograph on the Mollusca from the Stonefield State, Great Oolite, Forest Marble and Cornbrash*. Palaeontographical Society, London, pp. 1–129.

1870. *On a byssiferous fossil* Trigonia. Annals and Magazine of Natural History, vol. 5, pp. 17–18.

1872–1979. *A monograph of the British fossil Trigoniae*. Monographs of the Palaeontographical Society, London, pp. 1–245.

Manceñido, M. O., and Damborenea, S. E.

1984. *Megafauna de invertebrados Paleozoicos y Mesozoicos*. IX Congreso Geológico Argentino, Relatorio, vol. 2, pp. 413–465.

Mariñelarena, M. M.

1959. *Sobre una nueva* Trigonia *del Titoniense de Aguada del Sapo en la provincia de Neuquén*. Notas de la Museo de La Plata, Paleontología, vol. 104, pp. 181–189.

Marwick, J.

1932. *A new trigoniid from Canterbury*. Records of the Canterbury Museum, vol. 3, pp. 505–509.

Medina, F. A.

1980. *Revisión y origen de las Trigonias del Grupo de Islas James Ross*. Instituto Antarctico Argentino, Contribucion No. 247, pp. 107–127.

Mitchum, R. M., and Uliana, M. A.

1985. *Seismic stratigraphy of carbonate depositional sequences. Upper Jurassic–Lower Cretaceous, Neuquén Basin, Argentina*. American Association of Petroleum Geologists Memoir, Mem. 39, pp. 255–274.

Möricke, W.

1894. *Versteinerungen des Lias und Unteroolith von Chile*. Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, vol. 9, pp. 1–100.

Myers, R. L.

1968. *Bioestratigrafía de la Formación Cárdenas, San Luis Potosí, México*. Paleontologia Mexicana, vol. 24, pp. 1–78.

Nakano, M.

1960. *Stratigraphic occurrence of the Cretaceous trigoniids in the Japanese Islands and their faunal significance*. Journal of Science, Hiroshima University, Ser. C, vol. 2, pp. 215–280.

1961. *On the Trigoniinae*. Journal of Science, Hiroshima University, Ser. C., vol. 1, pp. 71–94.

1963. *On the Rutitrigoniinae*. Journal of Science, Hiroshima University, Geological Reports 12, pp. 513–530.

1965. *On the Megatrigoniinae*. Journal of Science, Hiroshima University, Ser. C, vol. 5, pp. 13–20.

1968. *On the Quadratotrigoniinae*. Japanese Journal of Geology and Geography, vol. 39, pp. 27–41.

1974. *A new genus* Mediterraneotrigonia *nov*. Research Bulletin of the Hiroshima Institute of Technology, vol. 9, pp. 77–80.

1975. *A note on* Trigonia calderoni *(Castillo & Aguilera)*. Bulletin, Hiroshima Institute of Technology, vol. 1, pp. 11–13.

Newell, N. D., and Boyd, D. W.

1975. *Parallel evolution in early Trigoniacean bivalves*. Bulletin of the American Museum of Natural History, vol. 154, pp. 53–162.

Noetling, F.

1886. *Entwurf einer Gliederung der Kreideformation in Syrien und Palestina*. Zeitschrift der Deutsche Geologischen Gesellschaft, vol. 38, pp. 824–875.

Olsson, A. A.

1944. *Contributions to the paleontology of northern Perú. Part 7. Cretaceous of the Paití region*. Bulletins of American Paleontology, vol. 28, no.111, pp. 23–60.

d'Orbigny, A.

1843. *Paleontologie Française. Terrains Crétacés. Part 3, Lamellibranches*. Paris, pls. 285–299.

Parkinson, J.

1811. *Organic remains of a former world*. London, pp. 1–479.

Parnes, A.

1981. *Biostratigraphy of the Mahmal Formation (Middle Bajocian) in Makhtesh Ramon (Negev, southern Israel)*. Geolgical Survey of Israel, Bulletin 74, pp. 1–55.

Pérez, E.

1982. *Bioestratigrafía del Jurásico de Quebrada Asientos, norte*

de Potrerillos, región de Atacama, Chile. Servicio Nacional Geológico Minero de Chile, Boletín 137, pp. 1–149.

Pérez, E., and Reyes, R.

1977. *Las Trigonias Jurásicas de Chile y su valor cronoestratigráfico*. Instituto de Investigaciones Geológicas de Chile, Boletín 30, pp. 1–58.

1978. *Las Trigonias del Cretácico superior de Chile y su valor cronoestratigráfico*. Instituto de Investigaciones Geológicas de Chile, Boletín 34, pp. 1–67.

1980. Buchotrigonia (Buchotrigonia) topocalmensis *(Trigoniidae–Bivalvia) del Cretácico superior de Chile*. Revista Geológica de Chile, vol. 9, pp. 37–55.

1983. *Las especies del género* Anditrigonia *Levy, 1967, en la colección Philippi*. Revista Geológica de Chile, vol. 18, pp. 15–41.

1986. *Presencia de* Buchotrigonia (Syrotrigonia) *Cox, 1952 (Bivalvia–Trigoniidae) en Sudamérica y descripción de dos nuevas especies*. Revista Geológica de Chile, vol. 28–29, pp. 77–93.

1989. *Católogo analítico de los tipos de Trigoniidae (Mollusca–Bivalvia) descritos por R. A. Philippi*. Servicio Nacional Geológico Minero de Chile, Boletín 41, pp. 1–52.

Pérez, E., Reyes, R., and Pérez, V.

1981. *Clave de las especies sudamericanas del género* Steinmanella *Crickmay, 1930 (Trigoniidae–Bivalvia)*. Revista Geológica de Chile, vol. 13–14, pp. 103–106.

Pérez, E., Biró, L., and Reyes, R.

1987. *Nuevos antecedentes sobre* Virgotrigonia *Alleman, 1985 (Bivalvia–Trigoniidae) y presencia de V. hugoi (Leanza) en Chile*. Revista Geológica de Chile, vol.30, pp. 35–45.

Petersen, C. S.

1946. *Estudios geológicos en la región del río Chubut medio*. Dirección Nacional de Geología y Minería, Boletín 50, pp. 1–63.

Philippi, R.

1899. *Los fósiles secundarios de Chile*. Santiago de Chile, pp. 1–104.

Pianitzky, A.

1938. *Observaciones geológicas en el oeste de Santa Cruz (Patagonia)*. Boletín de Infomaciones Petroleras, vol. 165, pp. 45–85.

Poulton, T. P.

1977. *Early Cretaceous trigoniid bivalves of Manning Provincial Park, southwestern British Columbia*. Geological Survey of Canada, Paper 75, pp. 1–18.

1979. *Jurassic trigoniid bivalves from Canada and western United States of America*. Geological Survey of Canada Bulletin 282, pp. 1–60.

Purchon, R. D.

1957. *The stomach in the Filibranchia and Pseudolamellibranchia*. Proceedings of the Zoological Society of London, vol. 129, pp. 27–60.

Reyes, R., and Pérez, E.

1978. *Las Trigonias del Titoniano y Cretácico inferior de la Cuenca Andina de Chile y su valor cronoestratigráfico*. Instituto de Investigaciones Geológicas de Chile, Boletín 32, pp. 1–105.

1979. *Estado actual del conocimiento de la Familia Trigoniidae (Mollusca–Bivalvia) en Chile*. Revista Geológica de Chile, vol. 8, pp. 13–57.

1980. Quadratojaworskiella *nov., a Liassic subgenus of Trigoniidae from Chile*. Pacific Geology, vol. 14, pp. 87–93.

1982. *El género* Anditrigonia *Levy, 1967 (Mollusca–Bivalvia) en Chile*. III Congreso Geológico Chileno, Actas 1, pp. A289–A301.

1983. Paranditrigonia, *subgénero nuevo de* Anditrigonia *Levy (Mollusca–Bivalvia)*. Revista Geológica de Chile, vol. 19–20, pp. 57–79.

1984. *Dos nuevas especies del género* Vaugonia *Crickmay, 1930 (Bivalvia–Trigoniidae) del Bathoniano(?)–Caloviano inferior, Norte de Chile*. Revista Geológica de Chile, vol. 22, pp. 35–47.

1985. Myophorella (Myophorella) hillebrandti *sp. nov. (Trigoniidae–Bivalvia) del Neocomiano, Norte de Chile*. Revista Geológica de Chile, vol. 24, pp. 93–101

Reyes, R., Serey, I., and Pérez, E.

1981. *Estudio sistemático y filogenético de las especies sudamericanas del género* Steinmanella *(Trigoniidae–Bivalvia)*. Revista Geológica de Chile, vol. 12, pp. 25–47.

Riccardi, A. C.

1984. *Las asociaciones de amonitas del Jurásico y Cretácico de la Argentina*. IX Congreso Geológico Argentino, Actas 4, pp. 559–595.

Riccardi, A. C., Damborenea, S. E., and Manceñido, M. O.

1990. *Lower Jurassic of South America and Antarctic Peninsula*, in Westermann, G. E. G., and Riccardi, A. C. (eds.): *Jurassic taxa ranges and correlation charts for the Circum Pacific*. Newsletter on Stratigraphy, vol. 21, pp. 75–103.

Riccardi, A. C., Westermann, G. E. G., and Damborenea, S. E.

1990. *Middle Jurassic of South America and Antarctic Peninsula*, in Westermann, G. E. G, and Riccardi, A. C. (eds.): *Jurassic taxa ranges and correlation charts for the Circum Pacific*. Newsletter on Stratigraphy, vol. 21., pp. 105–128.

Ricccardi, A. C., Leanza, H. A., and Volkheimer, W.

1990. *Upper Jurassic of South America and Antarctic Peninsula*, in Westermann, G. E. G., and Riccardi, A. C. (eds.): *Jurassic Taxa ranges and correlation charts for the Circumpacific*. Newsletter on Stratigraphy, vol. 21, pp. 129–147.

Saul, L. R.

1978. *The north Pacific Cretaceous Trigoniid genus* Yaadia. University of California Publications in Geological Sciences, Bulletin 119, pp. 1–65.

Saveliev, A. A.

1958. *Lower Cretaceous trigoniids from Mangyschlak and western Turkmenia*. Trudy VNIGRI, vol. 125, pp. 1–386. (In Russian)

1960. *Jurassic trigoniids from Mangyschlak and western Turkmenia*. Trudy VNIGRI, Leningrad, vol. 148. 1–45.

Skwarko, S. K.

1963. *Australian Mesozoic Trigoniids*. Australian Bureau of Mineral Resources, Bulletin 67, pp. 1–42.

1968. *Lower Cretaceous Trigoniidae from Stanwell, Eastern Queensland*. Australian Bureau of Mineral Resources, Bulletin 80, pp. 169–182.

1970. *An Upper Jurassic* Apiotrigonia *from Mexico*. Sociedad Geológica Mexicana, vol. 31, pp. 75–78.

1981. *On the Trigoniinae, Nototrigoniinae, and Austrotrigoniinae*. Australian Bureau of Mineral Resources, Bulletin 209, pp. 65–67.

Stanley, S.M.

1970. *Relation of shell form to life habits in the Bivalvia*. Geological Society of America Memoir 125, pp. 1–296.

1977. *Coadaptation in the Trigoniidae, a remarkable family of burrowing bivalves*. Palaeontology, vol. 20, pp. 869–899.

Steinmann, G.

1881. *Zur Kenntniss der Jura -und Kreideformation von Cara-*

coles (Bolivia). Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, vol. 1, pp. 239–301.

1882. *Die Gruppe der Trigoniae Pseudoquadratae*. Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, vol. 1, 219–228.

1929. *Geologie von Perú*. Springer Verlag. Heidelberg, 448 pp.

Stipanicic, P. N, Rodrigo, F., Baulies, O., and Martinez, C. G.

1958. *Las formaciones presenonianas en el denominado Macizo Nordpatagónico y regiones adyacentes*. Revista Asociacion Geológica Argentina, vol. 23, pp. 367–388.

Stoyanow, A.

1949. *Lower Cretaceous stratigraphy in southeastern Arizona*. Geological Society of America Memoir 38, pp. 1–136.

Tashiro, M.

1979. *A study of the "Pennatae Trigoniids" from Japan*. Transactions and Proceedings of the Paleontological Society of Japan, N. S., vol. 116, pp. 179–22.

Tashiro, M., and Matsuda, T.

1988. *Mode of life in Cretaceous trigonians*. Fossils, vol. 45, pp. 9–21. (In Japanese).

Taylor, J. D., Kennedy, W. J., and Hall, A.

1969. *The shell structure and mineralogy of the Bivalvia: Introduction–Nuculacea–Trigoniacea*. Bulletin of the British Museum (Natural History), Zoology, suppl. 3, pp. 1–125.

Tornquist, A.

1898. *Der Dogger am Espinacito-Pass, nebst einer Zusammenstellung der jetzigen Kenntnisse von der argentinischen Juraformation*. Paläontologisches Abhandlungen, vol. 4, pp. 135–204.

Vail, P. R., Mitchum, R.M., and Thompson, S.

1977. *Seismic stratigraphy and global changes of sea level. Part 3: Relative changes of sea level from coastal onlap*. In Payton, C. W. (ed.): *Seismic stratigraphy—Application to Hydrocarbon exploration*. American Association of Petroleum Geologists Memoir 26, pp. 83–97.

Villamil, T.

1991. *Evolutionary and bioestratigraphic relationships among three new Lower Cretaceous species of* Buchotrigonia *Dietrich, 1938 (Trigoniidae–Bivalvia) from Colombia*. Revista Geológica de Chile, (in press).

Vokes, H. E.

1946. *Contribution to the paleontology of Lebanon mountains*. American Museum of Natural History Bulletin, vol. 87, pp. 145–185.

Wagoner, J. C. Van, Posamentier, H. W., Mitchum, R. M., Vail, P. R., Sarg, J. F., Luotit, T. S., and Handerbol, J.

1988. *An overview of the fundamentals of sequence stratigraphy and key definitions*. Society of Economic Paleontologists and Mineralogists Special Publication No. 42, pp. 39–45.

Wahnish de Carral Tolosa, E.

1942. *Observaciones geológicas en el oeste de Chubut. Estratigrafía y fauna del Liásico en los alrededores del rio Genua*. Boletín de la Dirección Nacional de Minería y Geología, vol. 51, pp. 1-73, pls. 1-6.

Weaver, C.,

1931. *Paleontology of the Jurassic and Cretaceous from west central Argentina*. University of Washington Memoir Memoir 1, pp. 1–496.

1942. *A general summary of the Mesozoic of South America and Central America*. Proceedings of the VIII American Science Congress (1940), part 4, Geology, pp. 149–193.

Westermann, G. E. G, and Riccardi, A. C.

1972. *Middle Jurassic ammonoid fauna and biochronology of the Argentine–Chilean Andes. Part 1, Hildoceratáceae*. Palaeontographica, vol. 140, pp. 1–116.

1979. *Middle Jurassic ammonoid fauna and biochronology of the Argentine–Chilean Andes. Part 2, Bajocian Stephanoceratáceae*. Palaeontographica, vol. 164 A, pp. 85–188.

1985. *Middle Jurassic ammonite evolution in the Andean province and emigration to Tethys*, in Bayer, E. and Seilacher, A. (eds.): *Sedimentary and evolutionary cycles*. Lecture Notes in Earth Sciences, vol. 7, pp. 7–34

Wichmann, R.

1927. *Sobre las facies lacustres Senoniana de los Estratos con Dinosaurios y su fauna (en los Territorios del Río Negro y Chubut)*. Boletín de la Academia Nacional de Ciencias, Córdoba, 30, pp. 385–405.

Windhausen, A.

1914. *Contribución al conocimiento geológico de los Territorios del Río Negro y Neuquén*. Anales del Ministerio de Agricultura, Sección Geología, vol. 10, pp. 1–60.

Whiteaves, J. F.

1876. *On some invertebrates from the coal-bearing rocks of Queen Charlotte Islands. Mesozoic Fossils*. Geological Survey of Canada, vol. 1, pp. 1–92.

Wilckens, O.

1921. *Beiträge zur Paläontologie von Patagonien*. Neues Jahrbuch für Mineralogie, Geologie und Paläontologie, vol. 1, pp. 1–14.

Woods. H.

1906. *Cretaceous Fauna from Pondoland*. Annals of the South African Museum, vol. 7, No. 12, pp. 252–315.

EXPLANATION OF PLATE 1

(All figures natural size, unless otherwise indicated)

Figures — Page

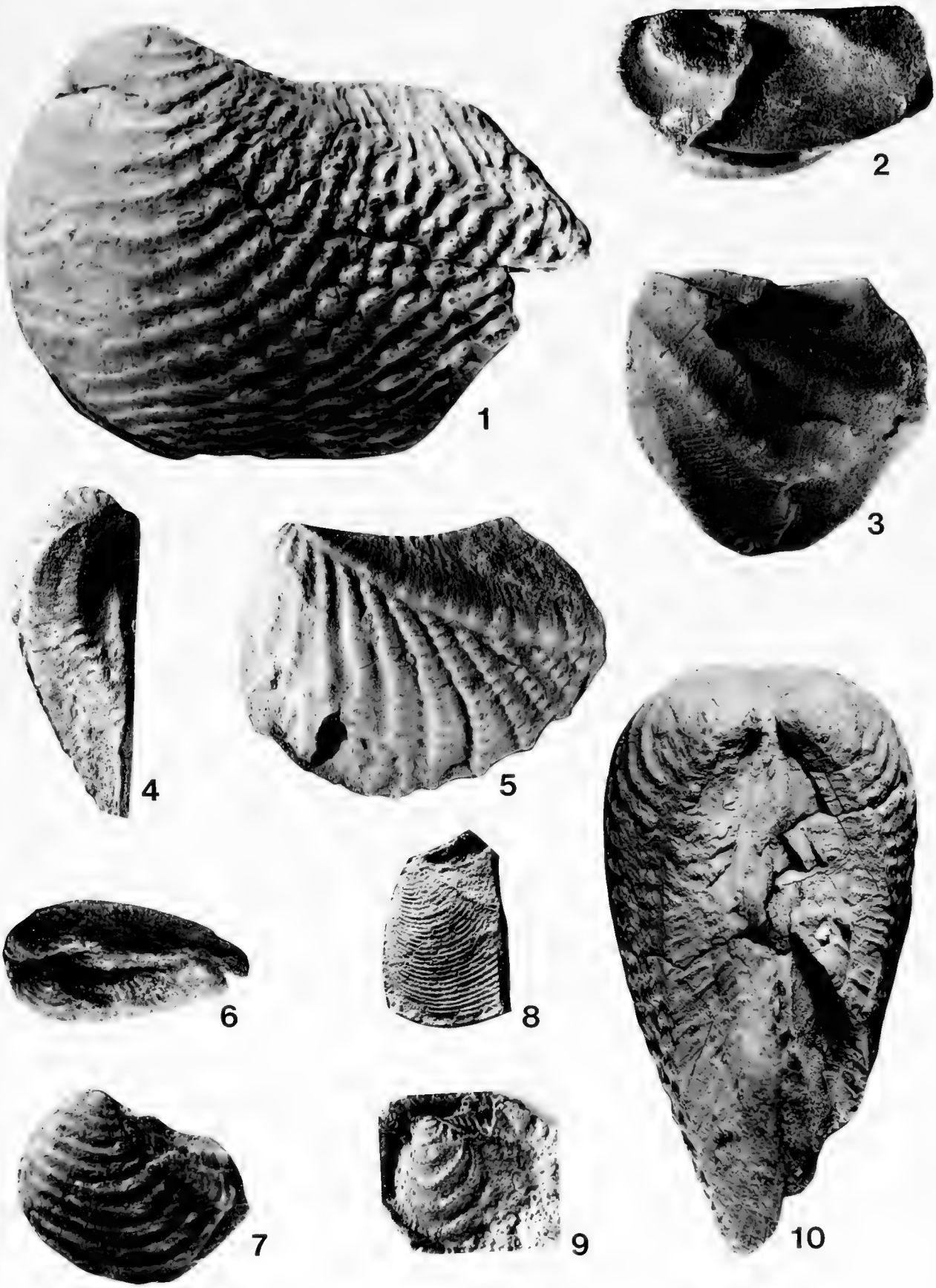
1, 6, 7, 10. *Jaworskiella burckhardti* (Jaworski) 28
1, Hypotype, MOZ P3044, lateral view of left valve; 6, Hypotype, MOZ P3043, juvenile specimen, dorsal view; 7, lateral view of left valve of same specimen. Pliensbachian, Piedra Pintada Formation, Carrín Curá (Locality 40). 10, dorsal view of same specimen. Pliensbachian, Piedra Pintada Formation, Cerrito Roth, Cañadón de la Piedra Pintada (Locality 24).

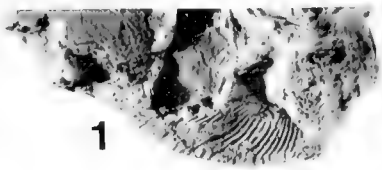
2, 3. *Groeberella neuquensis* (Groeber) 18
2, Hypotype, MOZ P4060, dorsal view; 3, lateral view of left valve of same specimen. Pliensbachian, Piedra Pintada Formation, Cerrito Roth. Cañadón de la Piedra Pintada (Locality 24).

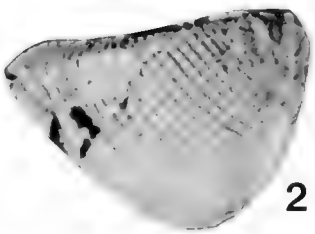
4, 5. *Myophorella* (*Myophorella*) *araucana* (A. F. Leanza) 29
4, Hypotype, MOZ P0875, dorsal view; 5, lateral view of left valve of same specimen. Pliensbachian, Piedra Pintada Formation, La Amarga, near Rincón del Aguila (Locality 37).

8. *Frenguelliella tapiai* (Lambert) 26
8, Hypotype, MOZ P2679, a mold of left valve. Upper Pliensbachian. Chachil Formation, Estancia Marichelar, Arroyo Ñirecó (Locality 14).

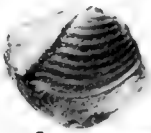
9. *Myophorella* (*Myophorella*) cf. *M. tuberculata* (Agassiz) 29
9, Hypotype, MOZ P2675, a mold of left valve. Pliensbachian, Piedra Pintada Formation, Estancia Santa Isabel (Locality 39).


1
2
3
4
5
6
7
8
9
10


1

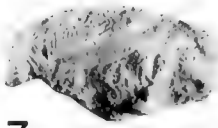

2

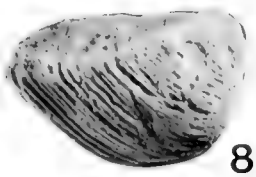

3


4

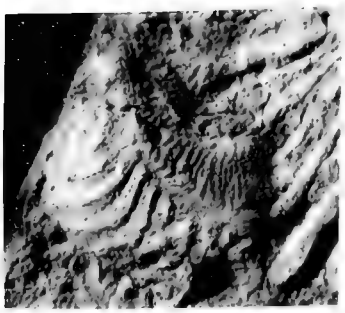

5

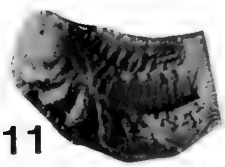

6

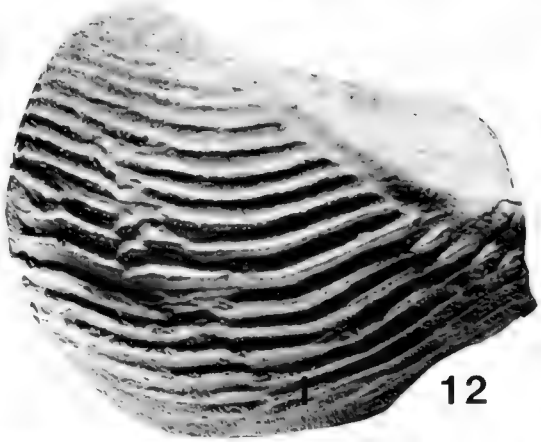

7

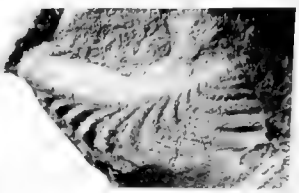

8

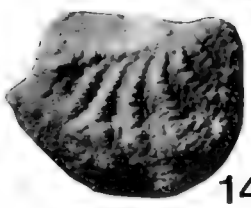

9

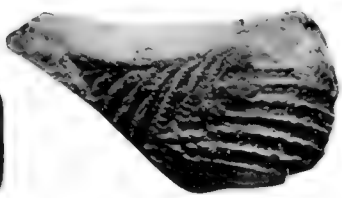

10

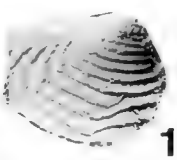

11

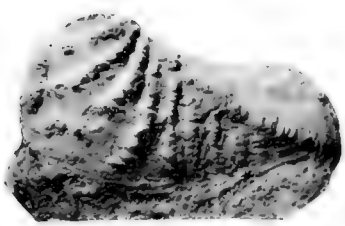

12

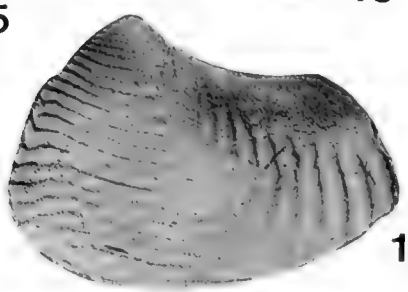

13

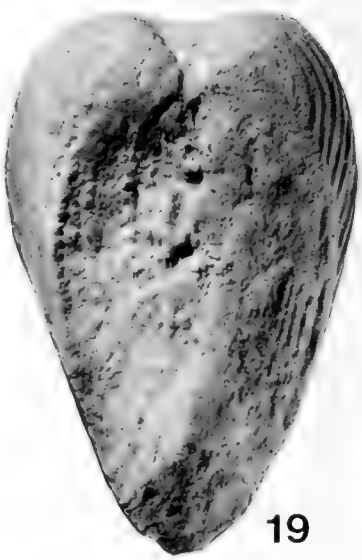

14


15


16


17


18


19

EXPLANATION OF PLATE 2

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2, 7, 8. *Frenguelliella perezreyesi*, new species 27
1, Holotype, MOZ P3030/1, dorsal view; 2, lateral view of of right valve of same specimen (×2). 7, Paratype, MOZ P3030/2, dorsal view; 8, lateral view of right valve of same specimen (×2). Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

3–6. *Frenguelliella poultoni*, new species 26
3, Holotype, MOZ P5315, lateral view of right valve (in association with a broken left valve). 4, Paratype, MOZ P5317/1, lateral view of a young right valve. 5, Paratype, MOZ P5316, lateral view of right valve. 6, Paratype, MOZ P5317/2, lateral view of a mold of right valve. Upper Pliensbachian, Chachil Formation, Arroyo Ñirecó (Locality 14).

9. *Frenguelliella inexspectata* (Jaworski) 26
9, Hypotype, MOZ P2766, lateral view of an internal mold of right valve. Pliensbachian, Piedra Pintada Formation, Estancia Santa Isabel (Locality 39).

10, 11. *Myophorella* (*Myophorella*) *catenifera* (Hupé) 29
10, Hypotype, MOZ P2682, lateral view of left valve. Upper Pliensbachian, Chachil Formation, Estancia Souraya, Espinazo del Zorro (Locality 38). 11, Hypotype, MOZ P4525, mold of upper portion of left valve. Pliensbachian, Piedra Pintada Formation, Cerrito Roth, Cañadón de la Piedra Pintada (Locality 24).

12, 19. *Trigonia mollesensis* Lambert 20
12, Hypotype, MOZ P0911, lateral view of left valve; 19, dorsal view of same specimen. Early Bajocian to Early Bathonian, Lajas Formation, Los Pozones (Locality 15).

13. *Vaugonia rectangularis* (Gottsche) 37
13, Hypotype, MOZ P1753, lateral view of right valve. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

14, 17. *Myophorella* (*Myophorella*) *argentinica* (Jaworski) 30
14, Hypotype, MOZ P1897, lateral view of right valve. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16). 17, Hypotype, MOZ P4914, lateral view of left valve. Middle Bajocian, Lajas Formation, Máquina Curá, Chacaico (Locality 21).

15. *Vaugonia chunumayensis* (Jaworski) 36
15, Hypotype, MOZ P1903, lateral view of right valve. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

16, 18. *Anditrigonia* (*Eoanditrigonia*) *keideli* (Weaver) 47
16, Topotype, MOZ P2749/2, lateral view of a young right valve. 18, Topotype, MOZ P0902/3, lateral view of left valve. Early Bajocian to Early Bathonian, Lajas Formation, Los Pozones (Locality 15).

EXPLANATION OF PLATE 3

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2. *Scaphorella leanzai* (Lambert) 34
1, Hypotype, MOZ P0919/1, dorsal view; 2, lateral view of left valve of same specimen. Early Bajocian to Early Bathonian, Lajas Formation, Los Pozones (Locality 15).

3, 4. *Scaphotrigonia rierafonti* Leanza and Garate 34
3, Topotype, MOZ P0931, dorsal view (×1.5); 4, lateral view of left valve of same specimen (×1.5). Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

5, 6. *Myophorella* (*Promyophorella*) *praescabroidea* (Jaworski) 31
5, Hypotype, MOZ P0953/2, lateral view of left valve; 6, dorsal view of same specimen. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

7–9. *Trigonia densestriata* Beherendsen 21
7, Hypotype, MOZ P3042, lateral view of right valve; 8, dorsal view of same specimen; 9, lateral view of left valve of same specimen. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

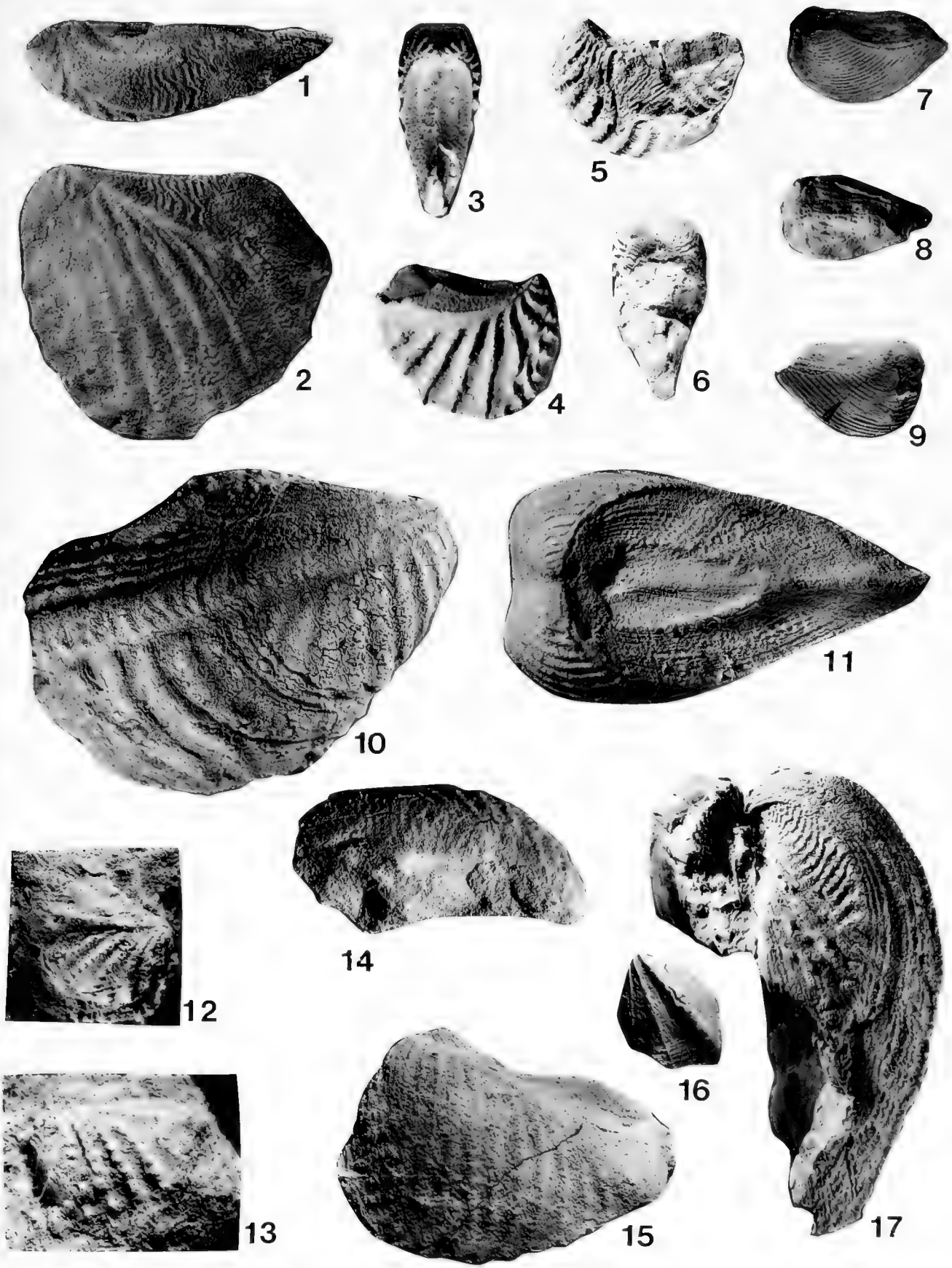
10, 17. *Neuquenitrigonia huenickeni* (Leanza and Garate) 25
10, Topotype, MOZ P2319, lateral view of right valve; 17, dorsal view of same specimen. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

11. *Trigonia corderoi* Lambert 19
11, Hypotype, MOZ P5235, dorsal view. Early Bajocian to Early Bathonian, Lajas Formation, Los Pozones (Locality 15).

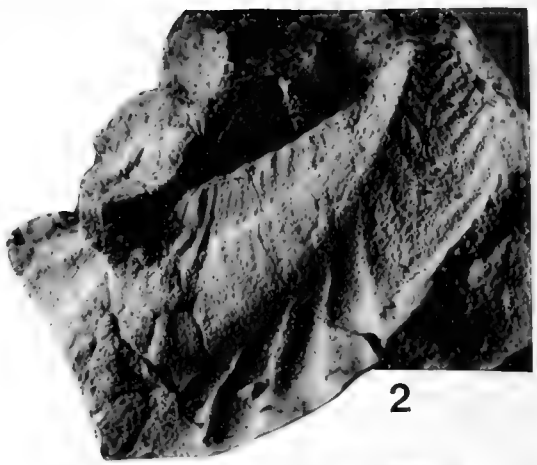
12, 13. *Scaphorella camachoi*, new species 35
12, Holotype, MOZ P4920/1, lateral view of right valve (×2). 13, Paratype, MOZ P4920/2, lateral view of left valve (×2). Early Bajocian, Lajas Formation, Máquina Curá, Chacaico (Locality 21).

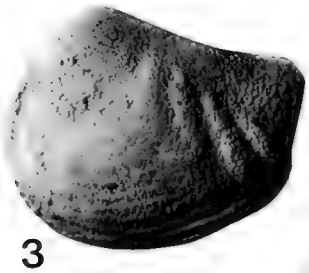
14, 15. *Scaphorella kruusei* Leanza and Garate 35
14, Topotype, MOZ P1813, dorsal view; 15, lateral view of left valve of same specimen. Early Bajocian, Lajas Formation, Fortín la'a de Mayo (Locality 23).

16. *Groeberella*, species indeterminate 19
16, Hypotype, MOZ P1375, lateral view of left valve. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17


1

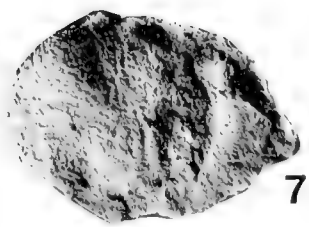

2

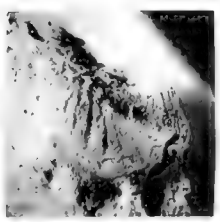

3


4

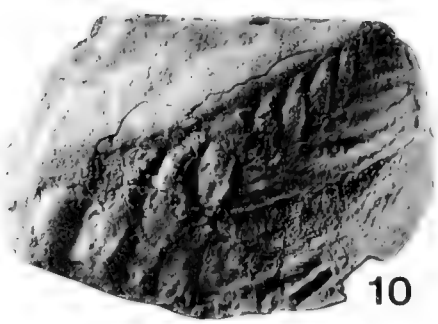

5

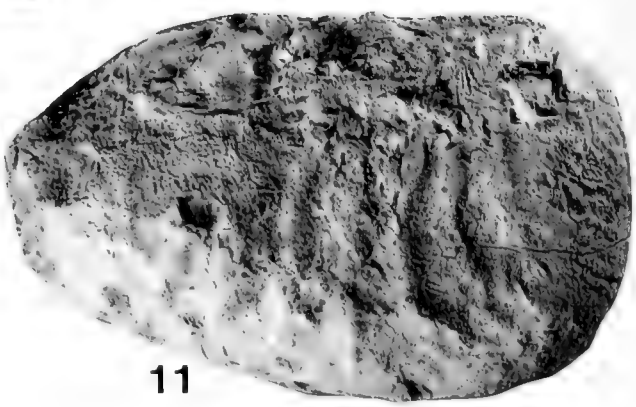

6


7


8


9


10


11

EXPLANATION OF PLATE 4

(All figures natural size, unless otherwise indicated)

Figure — Page

1, 2, 4, 10. *Andivaugonia radixscripta* (Lambert) 38
1, Hypotype, MOZ P4576, lateral view of left valve. 2, Hypotype, MOZ P4574, lateral view of a fragmentary right valve. 4, Hypotype, MOZ P4572, lateral view of right valve. 10, Hypotype, MOZ P4571, lateral view of right valve. Early Bajocian, Lajas Formation, Máquina Curá, Chacaicó (Locality 21).

3. *Andivaugonia covuncoensis* (Lambert) 39
3, Topotype, MOZ P0932/1, lateral view of left valve. Early Bajocian to Early Bathonian, Lajas Formation, Covunco Pavia (Locality 10).

5, 9. *Trigonia corderoi* Lambert 19
5, Hypotype, MOZ P3022, dorsal view of a young specimen; 9, lateral view of left valve of same specimen. Early Bajocian, Lajas Formation, Barda Negra Sur (Locality 16).

6–8. *Andivaugonia lissocostata* (Reyes and Pérez) 39
6, Hypotype, MOZ P1821/1, lateral view of left valve. 7, Hypotype, MOZ P1821/2, lateral view of left valve. 8, Hypotype, MOZ P4322, lateral view of left valve. Early Bajocian, Lajas Formation, Fortín 1° de Mayo (Locality 23).

11. *Andivaugonia fuenzalidai* (Reyes and Pérez) 39
11, Hypotype, MOZ P2314, lateral view of right valve. Early Bajocian, Lajas Formation, Chacaicó (Locality 21).

EXPLANATION OF PLATE 5

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2. *Trigonia corderoi* Lambert 19
1, Hypotype, MOZ P0910, dorsal view; 2, lateral view of left valve of same specimen. Early Bajocian to Early Bathonian, Lajas Formation, Los Pozones (Locality 15).

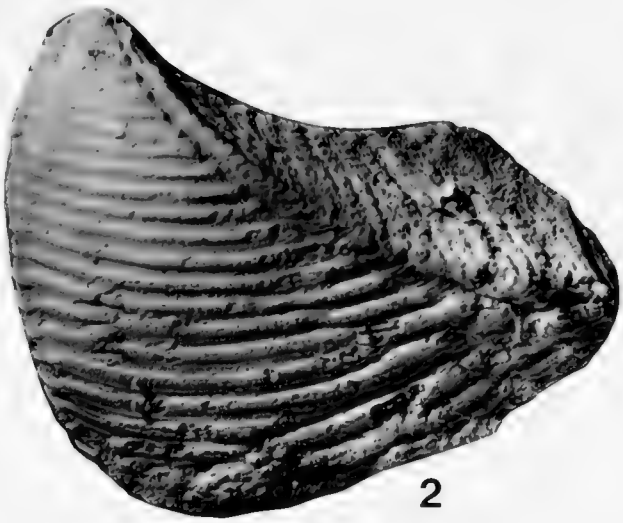
3, 4. *Trigonia losadai*, new species 20
3, Holotype, MOZ P3017, dorsal view; 4, lateral view of left valve of same specimen. Early Bajocian to Early Bathonian, Lajas Formation, Los Pozones (Locality 15).

5, 6. *Lambertrigonia pichimoncolensis* (Lambert) 54
5, Topotype, MOZ P4252/1, lateral view of right valve (×1.5). 6, Topotype, MOZ P4252/2, lateral view of left valve (×1.5). Kimmeridgian, Tordillo Formation, Laguna Miranda (Locality 33).

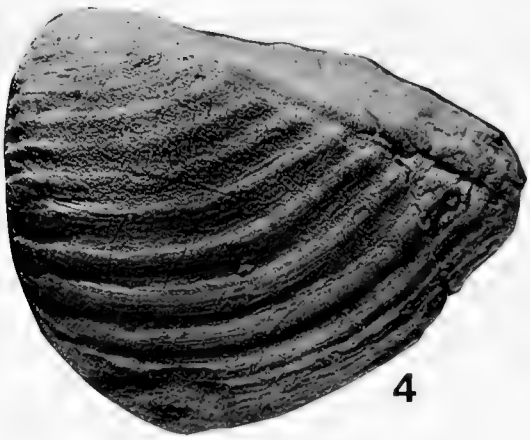
7. *Trigonia mirandaensis* Lambert 21
7, Reproduction of the Holotype, SGN 41-201, figured by Lambert (1944, pl. 1, fig. 9). Kimmeridgian, Tordillo Formation, Laguna Miranda (Locality 33).

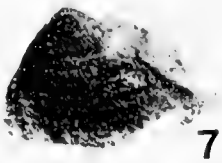
8, 9. *Anditrigonia* (*Anditrigonia*) *carrincurensis* (A. F. Leanza) 47
8, Hypotype, MOZ P0923.1, lateral view of left valve; 9 dorsal view of same specimen. Middle Tithonian, Picún Leufú Formation, Cañadón del Sapo (Locality 20).

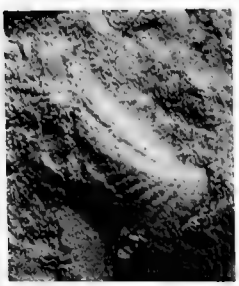

1


2

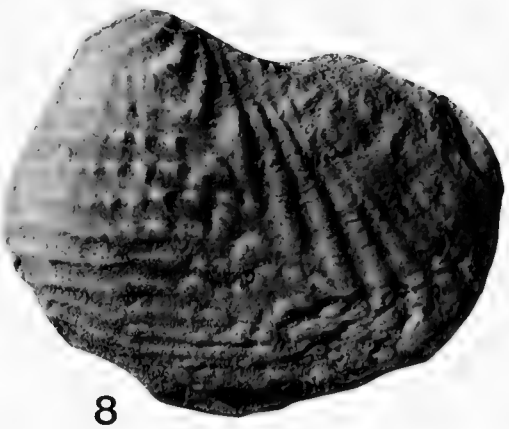

3


4

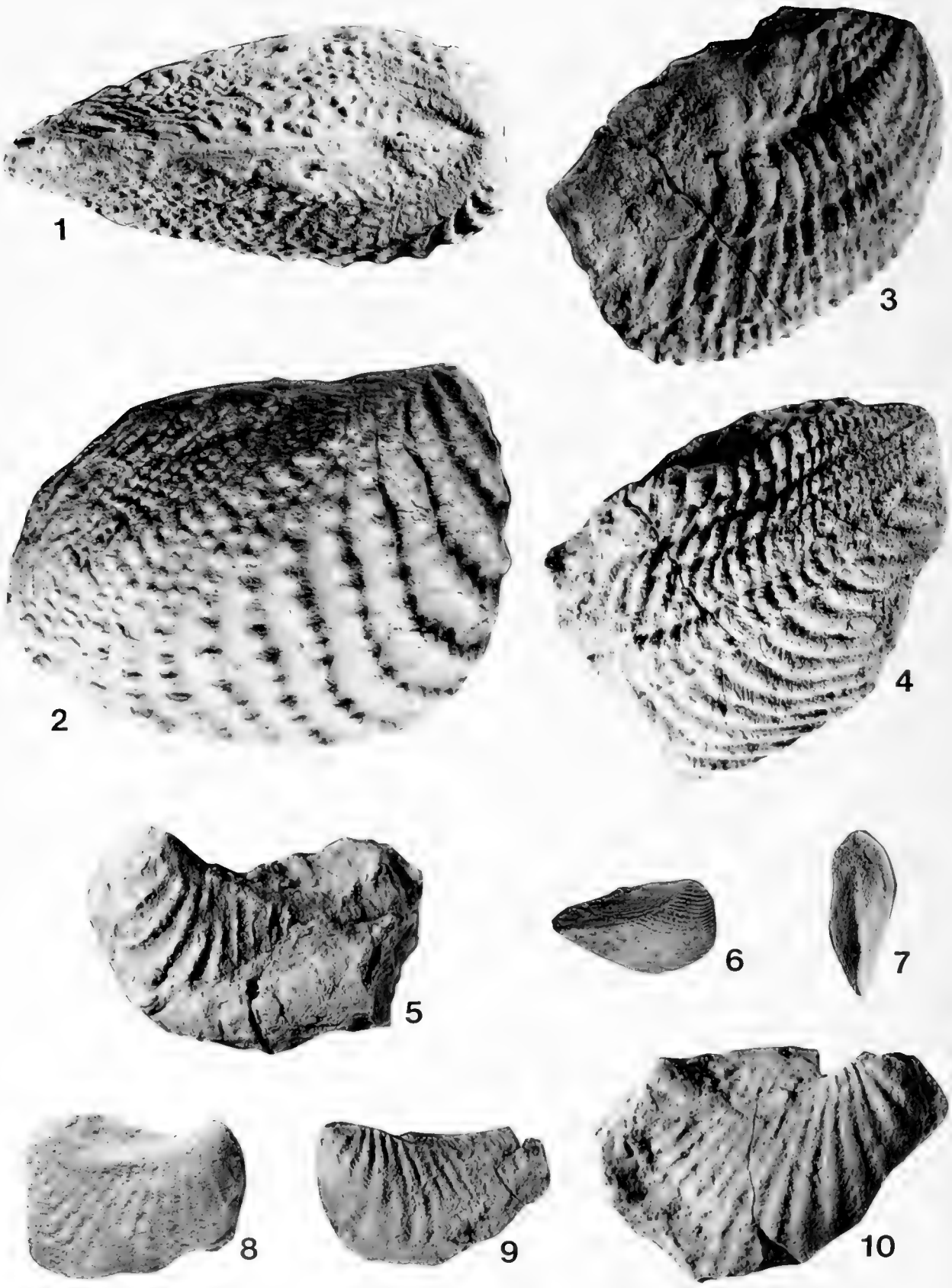

7


5


6


8


9


1
2
3
4
5
6
7
8
9
10

EXPLANATION OF PLATE 6

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2. *Steinmanella* (*Splenditrigonia*) *haupti* (Lambert) 44
1, Hypotype, MOZ P0913, dorsal view; 2, lateral view of left valve of same specimen. Upper Tithonian, Picún Leufú Formation, Aguada del Overo (Locality 19).

3, 4. *Trigonia levyi*, new species 22
3, Holotype, MOZ P5314, dorsal view; 4, lateral view of right valve of same specimen. Middle Tithonian, Picún Leufú Formation, Las Cortaderas (Locality 36).

5, 8–10. *Pterotrigonia* (*Notoscabrotrigonia*) *coheni*, new species 59
5, Holotype, MOZ P4723, lateral view of left valve. 8, Paratype, MOZ P5764, lateral view of right valve. 9, Paratype, MOZ P5765, lateral view of left valve. 10, Paratype, MOZ P3073, lateral view of left valve. Upper Tithonian, Picún Leufú Formation, Cerrito Caracoles (Locality 11).

6, 7. *Trigonia fortinensis* Lambert 23
6, Hypotype, MOZ P3006, lateral view of left valve; 7, dorsal view of same specimen. Upper Tithonian, Picún Leufú Formation, Cerro Lotena (Locality 32).

EXPLANATION OF PLATE 7

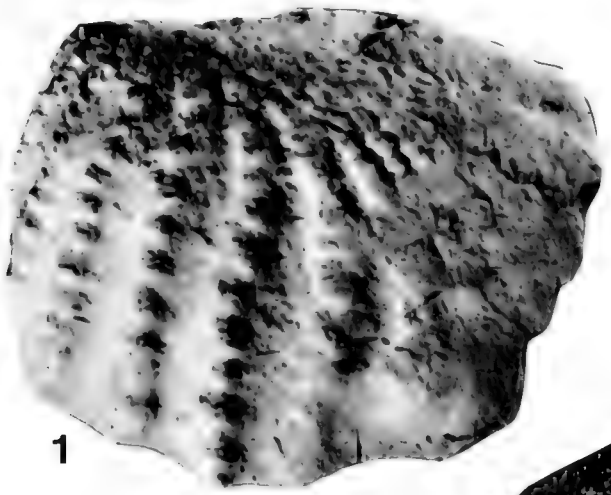
(All figures natural size, unless otherwise indicated)

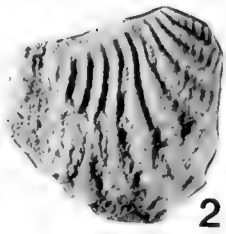
Figures — Page

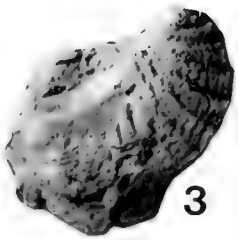
1. *Steinmanella* (*Splenditrigonia*) *erycina* (Philippi) 44
1, Hypotype, MOZ P0921, lateral view of left valve. Upper Tithonian, Picún Leufú Formation, Caichigüe, Charahuilla (Locality 22).

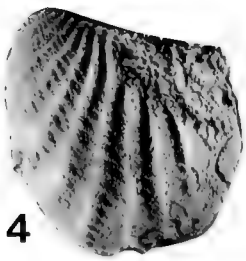
2–6. *Pterotrigonia* (*Scabrotrigonia*) *transatlantica* (Behrendsen) 60
2, Hypotype, MOZ P2486, lateral view of right valve. 3, Hypotype, MOZ P2953, lateral view of right valve. 4, Hypotype, MOZ P4399, lateral view of right valve. 5, Hypotype, MOZ P3189, dorsal view; 6, lateral view of left valve of same specimen. Upper Tithonian, Picún Leufú Formation, Cerrito Caracoles (Locality 11).

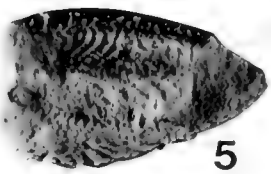
7–9. *Trigonia carinata* Agassiz 22
7, Hypotype, MOZ P0915, lateral view of right valve, showing the attachment of an epizoan oyster on the posterior area; 8, dorsal view of same specimen; 9, ventral view of same specimen, showing a probable byssal slit. Upper Tithonian, Picún Leufú Formation, Cerrito Caracoles (Locality 11).

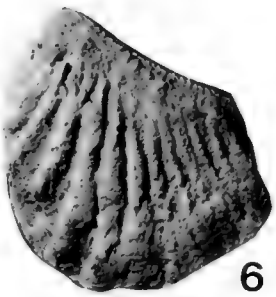

1

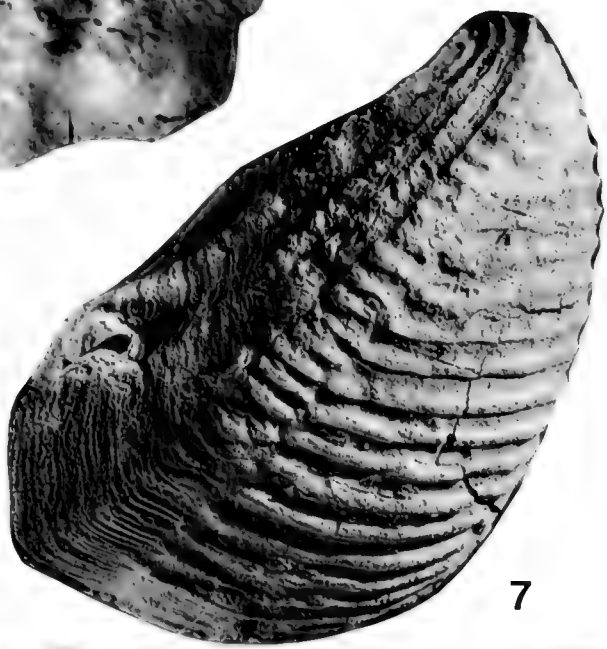

2


3


4

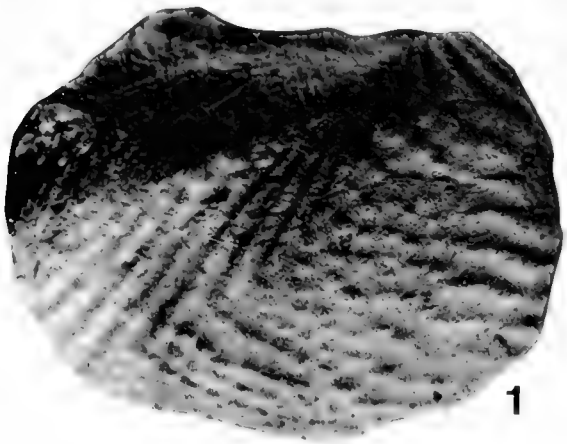

5

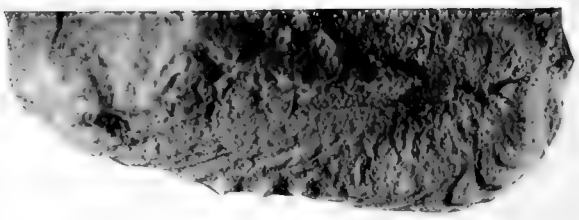

6


7


8


9

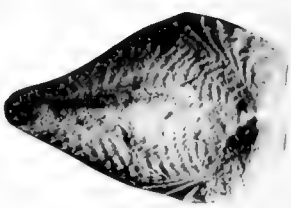

1

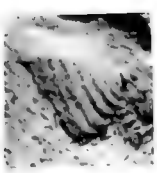

2

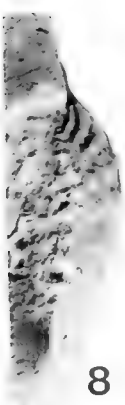

3

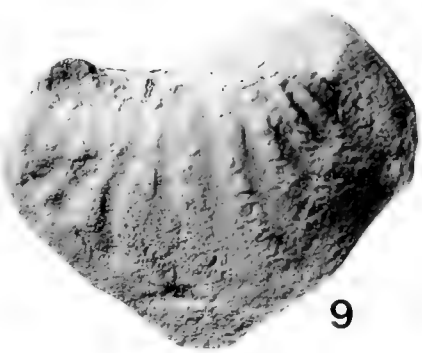

4

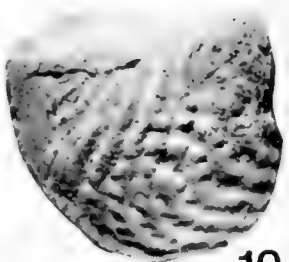

6


7


5


8


9


10

EXPLANATION OF PLATE 8

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2. *Antutrigonia frenguelli* (Mariñelarena) 51
1, Topotype, MOZ P0918, lateral view the right valve; 2, dorsal view of same specimen. Late Middle Tithonian, Picún Leufú Formation, Cañadón del Sapo (Locality 20).

3, 4, 7, 10. *Antutrigonia groeberi* (Weaver) 52
3, Topotype, MOZ P2069, dorsal view; 4, lateral view of right valve of same specimen. 7, Topotype, MOZ P0922/3, dorsal view; 10, lateral view of left valve of same specimen. Upper Tithonian, Picún Leufú Formation, Picún Leufú creek and route 40 (Locality 17).

5. *Trigonia*, sp. juv. indet. 23
5, Type, MOZ P5466, lateral view of right valve (×2). Upper Tithonian, Picún Leufú Formation, Laguna Blanca (Locality 13).

6. *Myophorella* (*Promyophorella*) *hillebrandti* (Reyes and Pérez) 32
6, Hypotype, MOZ P3075, lateral view of left valve (×1.5). Middle Tithonian, Carrín Curá Formation, Fortín 1° de Mayo (Locality 23).

8, 9. *Myophorella* (*Myophorella*) *schulzi*, new species 30
8, Holotype, MOZ P3075/1, dorsal view; 9, lateral view of right valve of same specimen. Upper Tithonian, Picún Leufú Formation, Camino nuevo a Los Molles (Locality 34).

EXPLANATION OF PLATE 9

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2. *Anditrigonia* (*Anditrigonia*) *eximia tesselicaudata*, new subspecies 50
1, Holotype, MOZ P1901, dorsal view; 2, lateral view of right valve of same specimen. Upper Tithonian, Picún Leufú Formation, Camino nuevo a Los Molles (Locality 34).

3, 4. *Anditrigonia* (*Anditrigonia*) *eximia* (Philippi) 48
3, Hypotype, MOZ P1902/1, lateral view of left valve. 4, Hypotype, MOZ P1902/2, lateral view of left valve. Upper Tithonian, Picún Leufú Formation, Aguada del Overo (Locality 19).

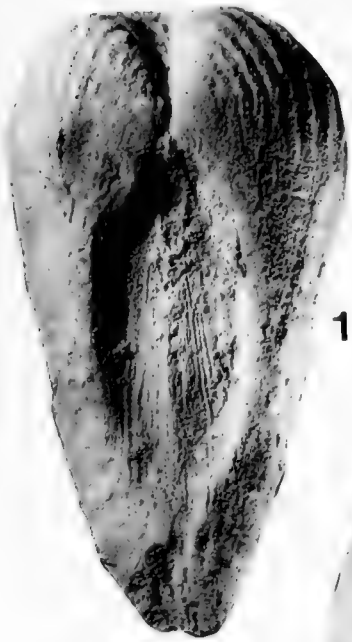
5. *Anditrigonia* (*Anditrigonia*), sp. juv. indet. 49
5, Type, MOZ P3014, lateral view of left valve (×1.5). Upper Tithonian, Picún Leufú Formation, Cerro Pancho, Bajada de La Americana (Locality 31).

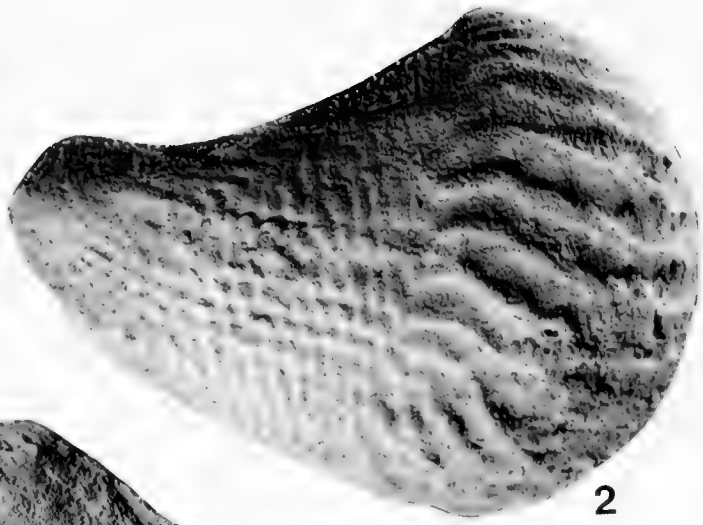
6. *Pterotrigonia* (*Rinetrigonia*), sp. juv. indet. 61
6, Type, MOZ P2489, umbonal view of left valve of a broken specimen (×1.5). Middle Tithonian, Picún Leufú Formation, Cerro Lotena (Locality 32).

7. *Anditrigonia* (*Anditrigonia*) *lamberti* Levy 49
7, Hypotype, MOZ P0914, dorsal view of both valves in butterfly position. Upper Tithonian, Picún Leufú Formation, Los Catutos (Locality 12).

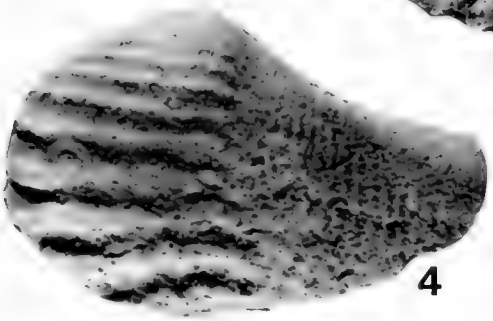
8. *Rutitrigonia*, sp. juv. indet. 56
8, Type, MOZ P5002, lateral view of left valve (×1.5). Upper Tithonian, Picún Leufú Formation, Cerrito Caracoles (Locality 11).

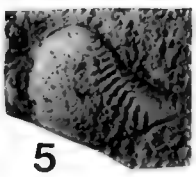
9–11. *Myophorella* (*Haidaia*) *elguetai*, new species 33
9, Paratype, MOZ P5767, lateral view of left valve. 10, Holotype, MOZ P3067, lateral view of right valve. 11, Paratype, MOZ P2486/2, lateral view of left valve. Upper Tithonian, Picún Leufú Formation, Cerrito Caracoles (Locality 11).

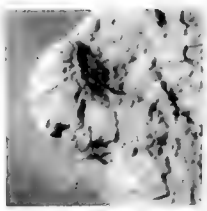

1

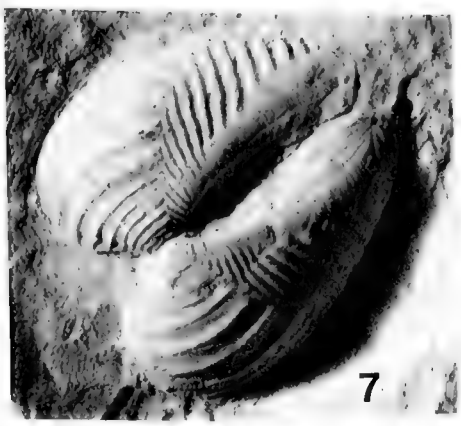

2

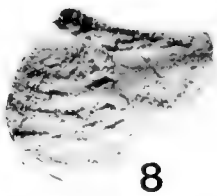

3


4

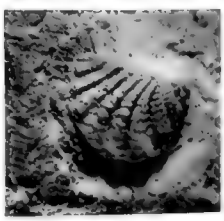

5

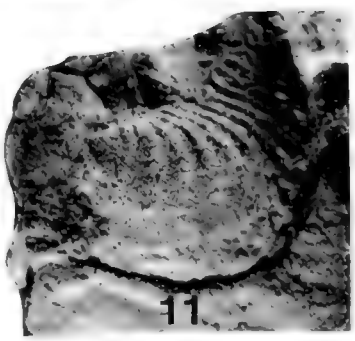

6


7


8


9

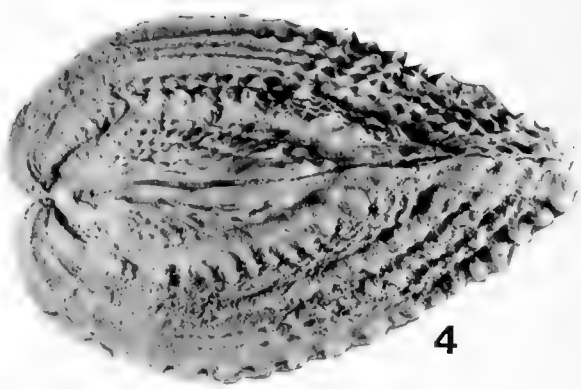

10


11


1


2


3


4

EXPLANATION OF PLATE 10

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2. *Steinmanella* (*Transitrigonia*) *transitoria* (Steinmann) 41
1, Hypotype, MOZ P0916, lateral view of left valve; 2, dorsal view of same specimen. Late Valanginian/Early Hauterivian, Agrio Formation, Cerro Pitrén (Locality 1).

3, 4. *Trigonia aliexpandita* Leanza and Garate 24
3, Holotype, MOZ P0951/1, lateral view of left valve; 4, dorsal view of same specimen. Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

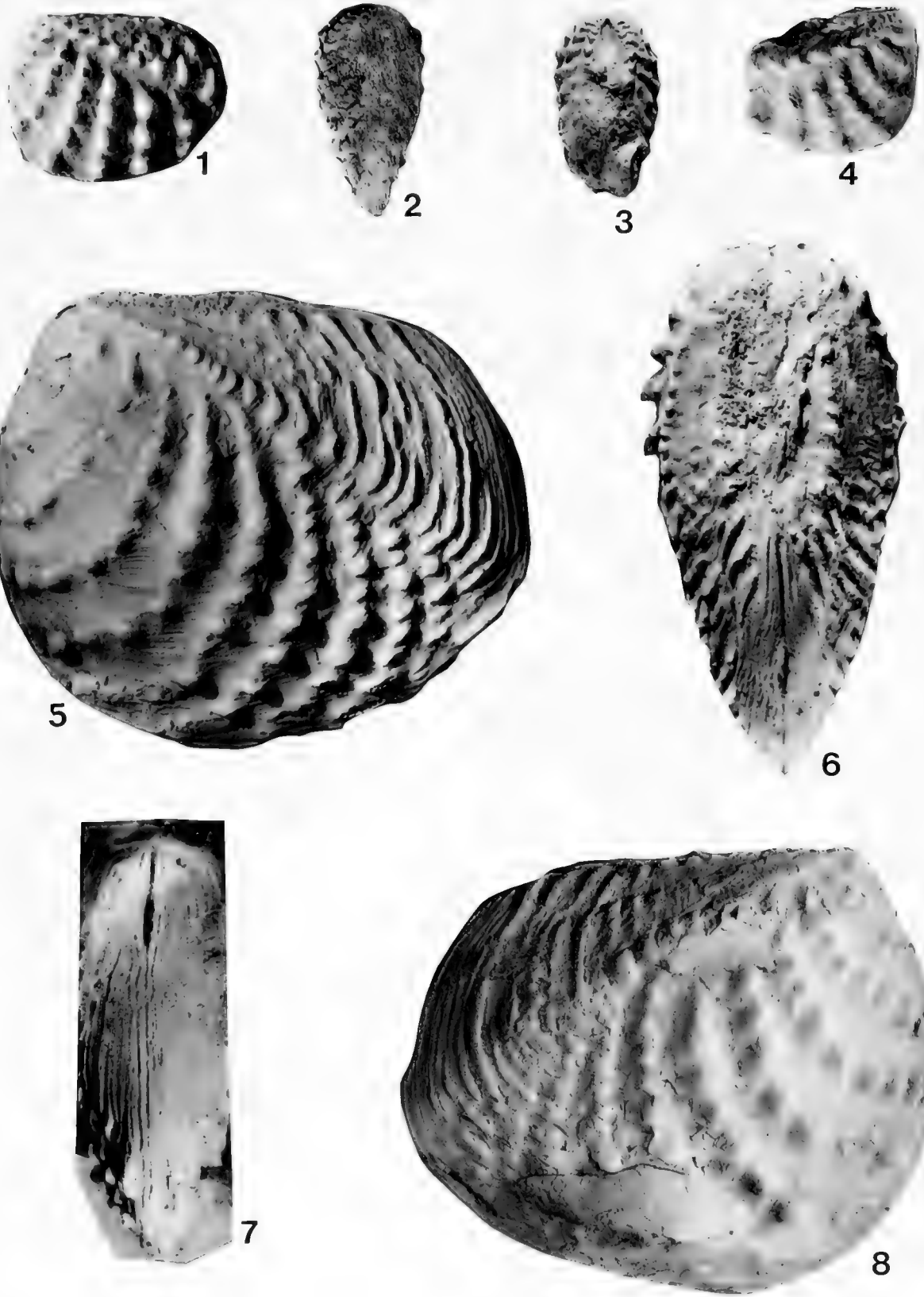
EXPLANATION OF PLATE 11

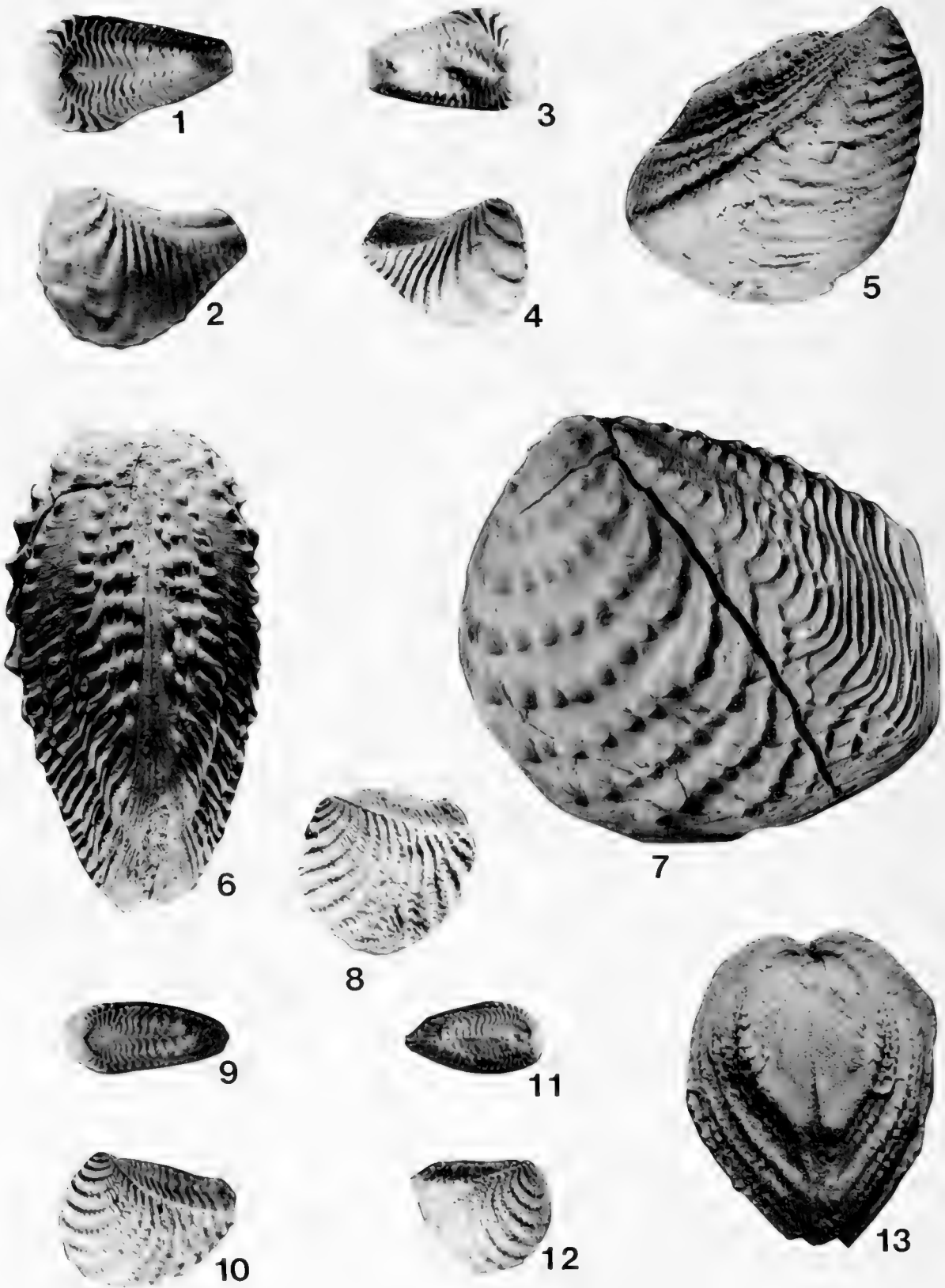
(All figures natural size, unless otherwise indicated)

Figures — Page

1–4. *Steinmanella* (*Transitrigonia*) *raimondii* (Lisson) 43
1, Hypotype, MOZ P1756/9, lateral view of left valve; 2, dorsal view of same specimen. 3, Hypotype, MOZ P1756/3, dorsal view. 4, lateral view of right valve of same specimen. Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

5–8. *Steinmanella* (*Splenditrigonia*) *splendida* (A. F. Leanza) 43
5, Hypotype, MOZ P2553, lateral view of left valve; 6, dorsal view of same specimen; 7, posterior view of both valves of same specimen showing the exhalant aperture matching with the outer area; 8, lateral view of right valve of same specimen showing attachment of some *Lycettia* sp. epizoans. Early Valanginian, Cerrito de La Ventana, Trahuncurá (Locality 4).


1
2
3
4
5
6
7
8


1
2
3
4
5
6
7
8
9
10
11
12
13

EXPLANATION OF PLATE 12

(All figures natural size, unless otherwise indicated)

Figures — Page

1–4. *Myophorella* (*Promyophorella*) *garatei* Leanza 31
1, Topotype, MOZ P0930/4, dorsal view; 2, lateral view of left valve of same specimen (×1.5). 3, Topotype, MOZ P0930/6, dorsal view; 4, lateral view of right valve of same specimen (×1.5). Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

5, 13. *Trigonia carinata* Agassiz 22
5, Hypotype, MOZ P5607, lateral view of right valve; 13, dorsal view of same specimen. Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

6, 7. *Steinmanella* (*Transitrigonia*) *neuquensis* (Burckhardt) 42
6, Hypotype, MOZ P2767, dorsal view; 7, lateral view of left valve of same specimen. Upper Berriasian, Vaca Muerta Formation, Cerrito de La Ventana, Trahuncurá (Locality 4).

8–12. *Myophorella* (*Haidaia*) *volkheimeri* Leanza and Garate 32
8, original Paratype, MOZ P1752/2, lateral view of left valve (×1.5). 9, original Paratype, MOZ P1752/3, dorsal view; 10, lateral view of left valve of same specimen (×1.5). 11, original Holotype, MOZ P1752/1, dorsal view; 12, lateral view of left valve of same specimen (×1.5). Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

EXPLANATION OF PLATE 13

(All figures natural size, unless otherwise indicated)

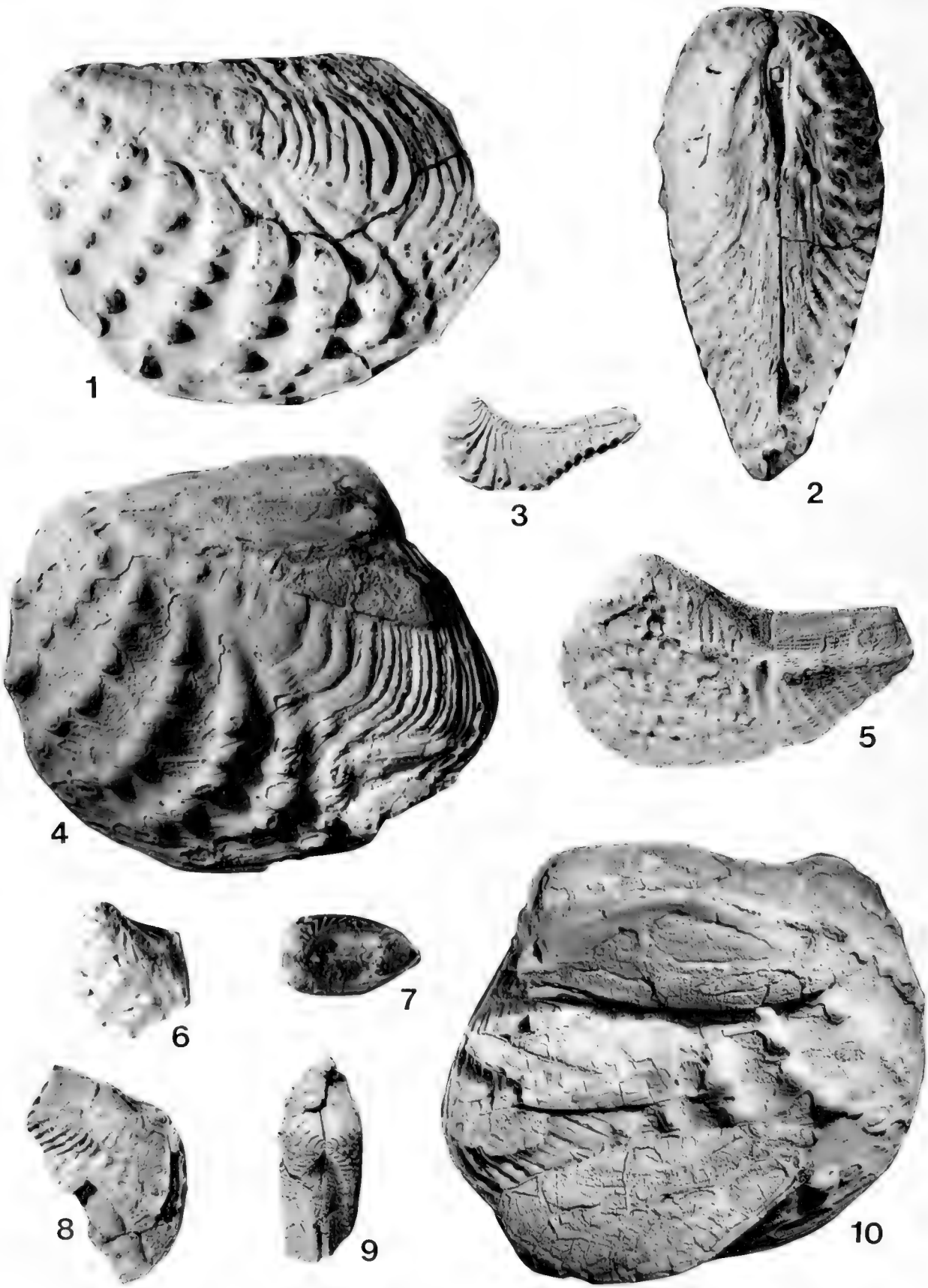
Figures — Page

1, 10. *Steinmanella* (*Transitrigonia*) *steinmanni* (Philippi) 42
1, Hypotype, MOZ P0917, lateral view of left valve, showing attachment of serpulid epizoans; 10, dorsal view of same specimen. Valanginian, Mulichinco Formation, Puerta Curaco (Locality 2).

2, 6–9. *Antutrigonia opistolophophora* (Lambert) 51
2, Topotype, MOZ P0903/2, dorsal view; 6, anterior view of same specimen; 7, lateral view of left valve of same specimen. Late Berriasian/Early Valanginian, Mulichinco Formation, Mallín Quemado, Sierra de la Vaca Muerta (Locality 7). 8, reproduction of the Holotype figured by Lambert (1944, pl. 3, figs. 5–6), dorsal view, showing transverse costulation on the area characteristic of *Antutrigonia* Leanza and Garate; 9, lateral view of same specimen. Same age, horizon and locality than specimen MOZ P0903/2.

3–5. *Trigonia angustecostata* Behrendsen 24
3, Hypotype, MOZ P0950, lateral view of left valve; 4, dorsal view of same specimen; 5, lateral view of right valve of same specimen. Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).


1
2
3
4
5
6
7
8
9
10


1
2
3
4
5
6
7
8
9
10

EXPLANATION OF PLATE 14

(All figures natural size, unless otherwise indicated)

Figures — Page

1, 2, 4, 10. *Steinmanella* (*Transitrigonia*) *quintucoensis* (Weaver) 41
1, Topotype, MOZ P0925, lateral view of left valve; 2 dorsal view of same specimen. 4, Topotype MOZ P2552, lateral view of left valve; 10, lateral view of right valve of same specimen showing the attachment of three generation of Lycettia sp. epizoans. Late Berriasian/Early Valanginian, Vaca Muerta Formation, Cerrito de La Ventana, Trahuncurá (Locality 4).

3. *Pterotrigonia* (*Pterotrigonia*) *aliformis* (Parkinson) 58
3, Hypotype, MOZ P2687, lateral view of a mold of left valve. Berriasian, Vaca Muerta Fomation, Mallín Quemado, Sierra de la Vaca Muerta (Locality 7).

5–9. *Virgotrigonia hugoi* (Leanza) 53
5, Topotype, MOZ P2733/1, lateral view of left valve. 8, Topotype, MOZ P2733/4, lateral view of a broken right valve; 9, dorsal view of same specimen. Berriasian. Vaca Muerta Formation. Mallín Quemado, Sierra de la Vaca Muerta (Locality 7). 6, Hypotype, MOZ P2332/2, lateral view of left valve; 7, dorsal view of same specimen. Berriasian, Vaca Muerta Formation, Salitral de los Alazanes (Locality 30).

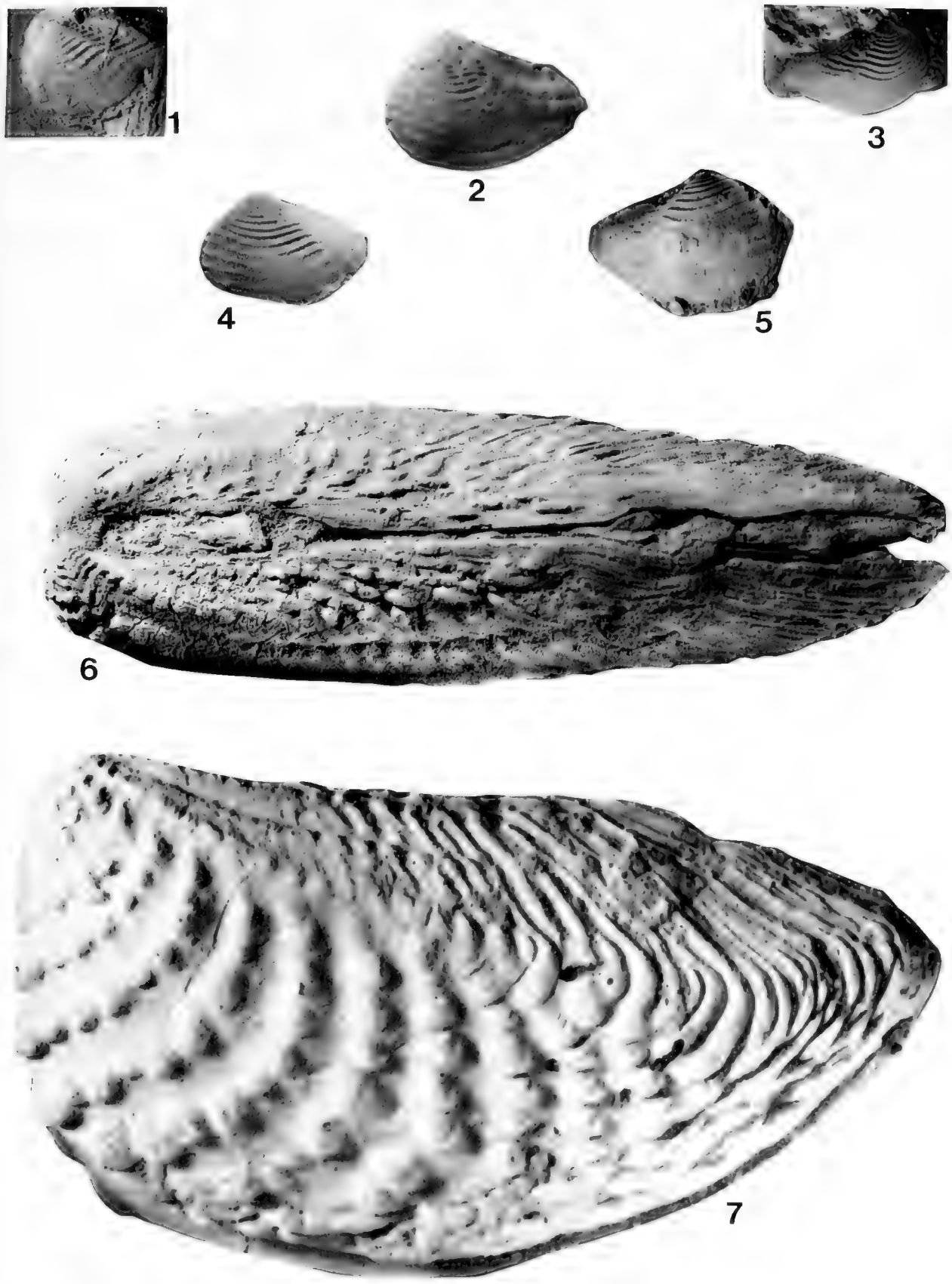
EXPLANATION OF PLATE 15

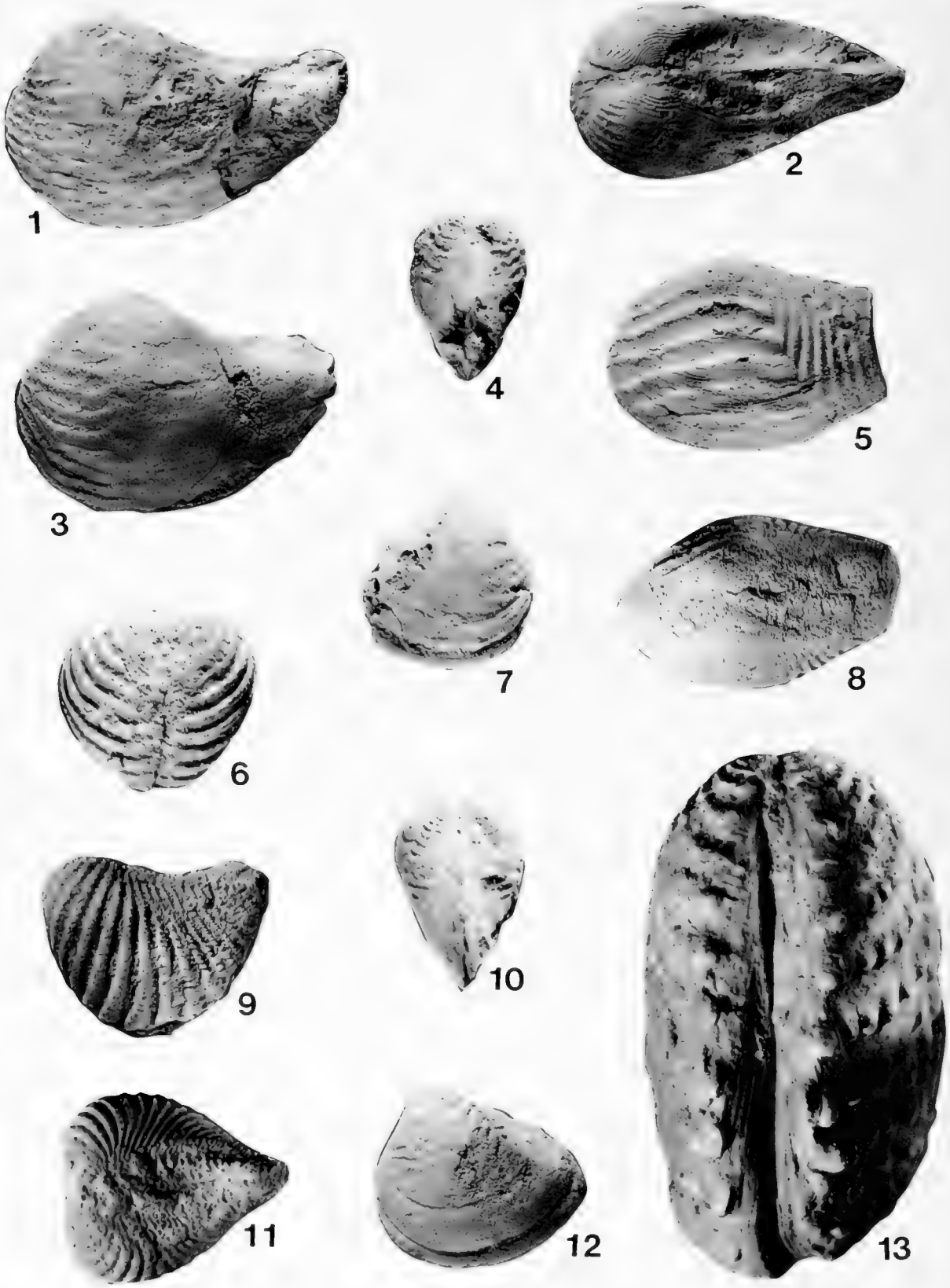
(All figures natural size, unless otherwise indicated)

Figures — Page

1–5. *Rutitrigonia kauffmani,* new species 55
1, Paratype, MOZ P4295/2, lateral view of left valve (×1.5). 2, Paratype MOZ P3527/3, lateral view of left valve (×1.5). 3, Paratype, MOZ P4295/1, lateral view of right valve (×1.5). 4, Holotype, MOZ P3527/2, lateral view of left valve (×1.5). 5, Paratype. MOZ P3527/6, lateral view of right valve (×1.5). Lower and Middle Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

6, 7. *Steinmanella* (*Macrotrigonia*) *vacaensis* (Weaver) 45
6, Hypotype, MOZ P2329, dorsal view showing in the posterior area the inhalant and exhalant apertures; 7, lateral view of left valve of same specimen. Middle Hauterivian, Agrio Formation, Los Hornos, Covunco (Locality 29).


1
2
3
4
5
6
7


1
2
3
4
5
6
7
8
9
10
11
12
13

EXPLANATION OF PLATE 16

(All figures natural size, unless otherwise indicated)

Figures — Page

1–3. *Rutitrigonia agrioensis* (Weaver) 54
1, Hypotype, MOZ P0920/3, lateral view of left valve; 2 dorsal view of same specimen. 3, Hypotype, MOZ P0920/1, lateral view of left valve. Lower Hauterivian, Agrio Formation, Cerro Negro Chico de Picún Leufú (Locality 18).

4, 7, 10, 12. *Syrotrigonia brocardoi*, new species 57
4, Paratype, MOZ P5318, dorsal view. 7, lateral view of right valve of same specimen. 10, Holotype, MOZ P5319, dorsal view; 12, lateral view of left valve of same specimen. Lower Hauterivian, Agrio Formation, Pichaihue Abajo (Locality 3).

5, 8. *Anditrigonia* (*Anditrigonia*), species indeterminate 49
5, Type, MOZ P5236, lateral view of left valve; 8 dorsal view of same specimen. Middle Hauterivian, Agrio Formation, Arenal de Las Lajas (Locality 28).

6, 9, 11. *Pterotrigonia* (*Rinetrigonia*) *coihuicoensis* (Weaver) 61
6, Hypotype, MOZ P5313, anterior view of both valves; 9, lateral view of left valve of same specimen; 11, dorsal view of same specimen. Middle and Upper Hauterivian, Agrio Formation, Cerro Mesa, Covunco (Locality 8).

13. *Steinmanella* (*Macrotrigonia*) *vacaensis* (Weaver) 45
13, Hypotype, MOZ P2329, anterior view of both valves, with a probable byssal slit below the beaks. Middle Hauterivian, Agrio Formation, Los Hornos, Covunco (Locality 29).

EXPLANATION OF PLATE 17

(All figures natural size, unless otherwise indicated)

Figures — Page

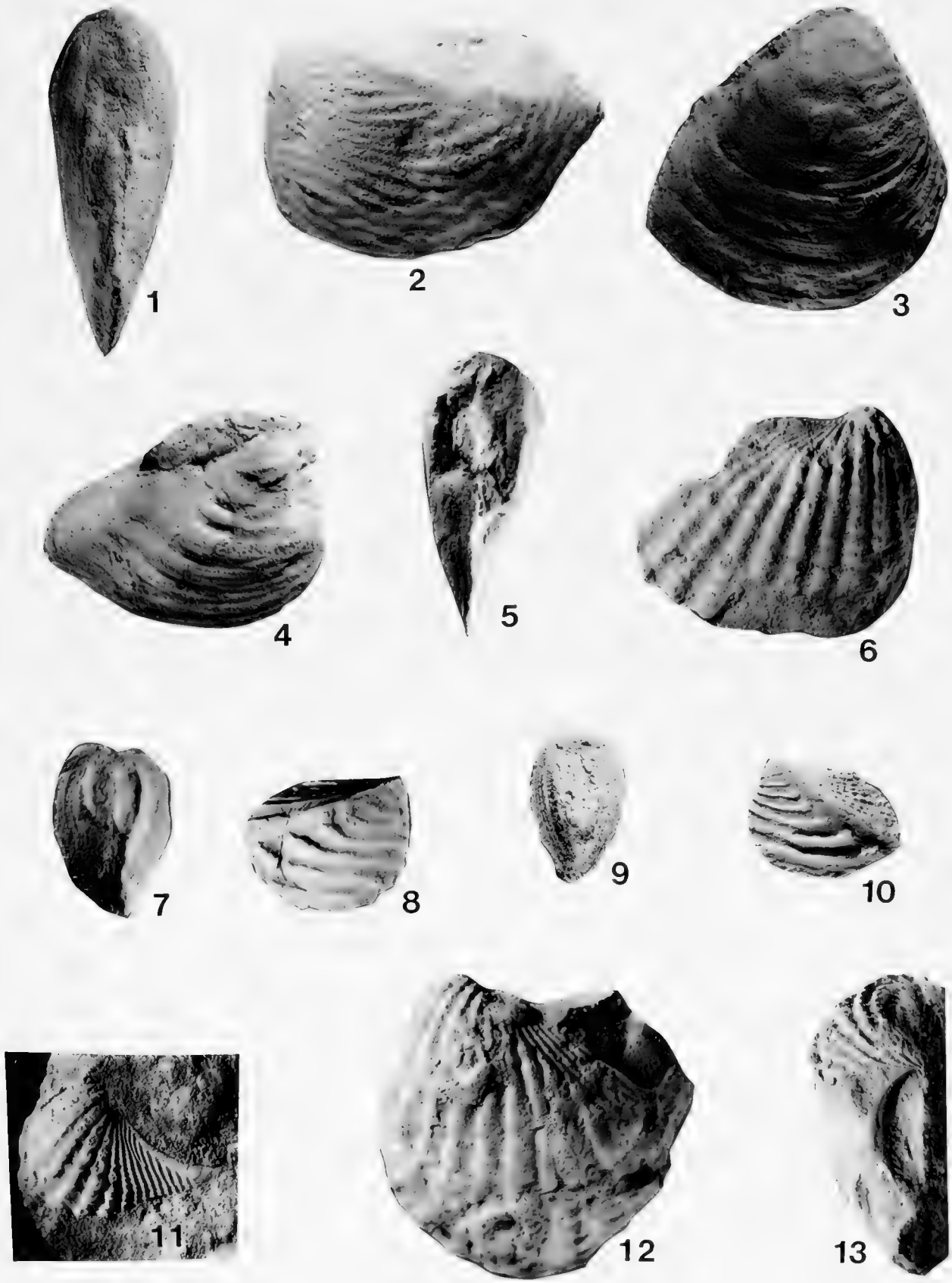
1, 2. *Pacitrigonia sobrali* Leanza and Casadío 64
1, Holotype, GHUNLPam 399, dorsal view showing radial costellae on the area; 2, lateral view of left valve of same specimen. Maastrichtian, Jagüel Formation, Barda Baya, La Pampa (Locality 41).

3. *Quoiecchia sigeli* Leanza and Garate 63
3, original Paratype, MOZ P1610/10, lateral view of right valve. Lower Hauterivian, Agrio Fomation, Pichaihue Abajo (Locality 3).

4, 5. *Austrotrigonia pampeana* Leanza and Casadío 63
4, Holotype, GHUNLPam 400, lateral view of right valve; 5, dorsal view of same specimen. Maastrichtinan, Jagüel Formation, Barda Baya, La Pampa (Locality 41).

7–10. *Trigonia wiedmanni* Leanza and Garate 24
7, Holotype, MOZ P0942/1, dorsal view; 8, lateral view of right valve of same specimen. 9, Paratype MOZ P0942/2, dorsal view; 10, lateral view of left valve of same specimen. Lower and Middle Hauterivian, Agrio Formation, Cerro Negro, Covunco (Locality 9).

6, 11–13. *Pterotrigonia* (*Rinetrigonia*) *windhauseniana* (Wilckens) 62
6, Hypotype, MOZ P2317/1, lateral view of right valve. 11, Hypotype, MOZ P2317/3, lateral view of left valve. 12, Hypotype MOZ P2317/2, lateral view of left valve; 13, dorsal view of same specimen. Maastrichtian, Jagüel Formation, Cerro Villegas (Locality 27).


1
2
3
4
5
6
7
8
9
10
11
12
13

INDEX

(**Bold** numbers refer to plates in which a taxon is illustrated; *italic* numbers refer to pages in which a taxon is described; plain numbers refer to pages in which a taxon is cited)

M

N

O

P

PREPARATION OF MANUSCRIPTS

Bulletins of American Paleontology usually comprises two or more separate papers in two volumes each year. The series is a publication outlet for significant, longer paleontological monographs (*i.e.*, more than approximately 50 printed pages), for which high quality photographic illustrations and the large quarto format are required.

Submissions are welcome from any author, regardless of institutional or organizational affiliation. Authors must, however, be members of the Paleontological Research Institution at time of publication; annual membership is currently US$20.00. Publication costs of the *Bulletins* are heavily subsidized by the Institution, but authors are currently required to pay illustration charges at a rate of $120.00 per plate and $35.00 per text-figure.

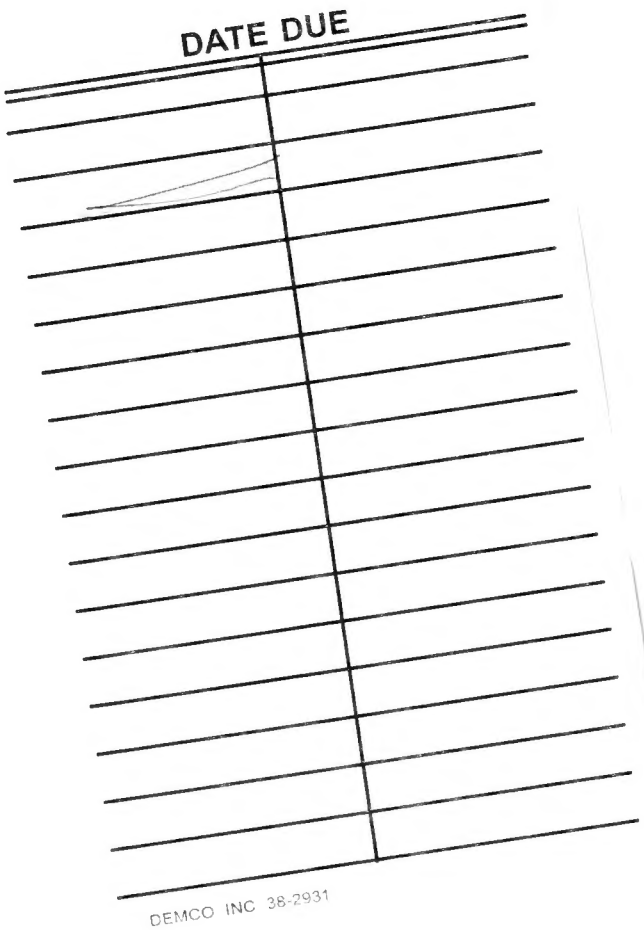
Manuscripts must be typewritten, and double-spaced *throughout* (including direct quotations, tables and references). All manuscripts should contain a table of contents, lists of text-figures and/or tables, and a short, informative abstract that includes names of all new taxa. Format should follow that of recent numbers in the series. All measurements must be given in the metric system, alone or in addition to their English system equivalents. The maximum dimensions for photographic plates are 178 mm × 229 mm (7 inches × 9 inches; outlined on this page). Single-page text-figures should be drafted for reproduction as single column (82 mm; 3¼ inches) or full page (178 mm; 7 inches) width, but arrangements can be made to publish text-figures that must be larger.

Authors must provide three (3) printed copies of the text and accompanying illustrative material. Authors are *strongly* encouraged to prepare their manuscripts on word processors, as this considerably expedites publication. On initial submission, however, only printed copies of the manuscript should be sent; the disk copy should be retained so that revisions can be made after the review process. The text and line-drawings may be reproduced xerographically, but glossy prints at publication size must be supplied for all half-tone illustrations and photographic plates. These prints should be identified clearly on the back.

Referenced publication titles *must be spelled out in their entirety.* Refer to a recent number of the *Bulletins* for details of reference format. Citations of illustrations within the text bear initial capitals (*e.g.*, Plate, Text-figure), but citations of illustrations in other works appear in lower-case letters (*e.g.*, plate, text-figure).

Format of systematic descriptions should follow that in any recent number of the *Bulletins.*

Original plate photomounts should have oversize cardboard backing and strong tracing paper overlays. These photomounts should be retained by the author until the manuscript has been formally accepted for publication. The approximate position of each text-figure in the text should be indicated. Explanations of plates and text-figures should follow the References Cited.


DATE DUE
DEMCO INC 38-2931