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Bivalves from the Carboniferous glacial deposits of central Patagonia, Argentina

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with 11 text-figures and 3 tables

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Carboniferous deposits of central Patagonia afford important evidence on the range and origin of various components of the endemic bivalve fauna of Gondwana, but the available material of some interesting forms is unfortunately scarce and incomplete remains that allow a very limited description. A new genus, *Waterhouseus,* and four new species are described: *Waterhouseus keideli* n. sp., *Streblopteria?* n. sp., *Megadesmus?* n. sp. and *Myonia? prinsi* n. sp. The morphology of *Merismopteria salinensis* González is amplified after revision. New occurrences are reported for two previously known species: *Waterhouseus tepuelensis* (González, 1969) and *Pyramus primigenius* González, 1972. Five further species: *Nuculopsis* sp., *Leptodesma (Leiopteria)* sp., *Myonia?* sp. *Pyramus?* sp. and *Amosius* sp. are left innominate because insufficiently known.

Karbonische Ablagerungen von Zentral-Patagonien (Argentinien) liefern wichtige Hinweise zu Reichweite und Herkunft verschiedener Angehöriger der endemischen Bivalven-Fauna von Gondwana. Allerdings ist nur sehr wenig Material zu interessanten Taxa verfügbar, das darüber hinaus nur unvollständig erhalten ist, sodass Beschreibungen unvollständig bleiben. Die neue Gattung *Waterhouseus* und vier neue Arten werden beschrieben: *Waterhouseus keideli* n. sp., *Streblopteria?* n. sp., *Megadesmus?* n. sp. und *Myonia? prinsi* n. sp. Die Beschreibung der Morphologie von *Merismopteria salinensis* González kann durch Revision präzisiert werden. Neue Vorkommen werden für zwei bereits bekannte Arten, *Waterhouseus tepuelensis* (González, 1969) und *Pyramus primigenius* González, 1972, vorgestellt. Fünf weitere Arten, *Nuculopsis* sp., *Leptodesma (Leiopteria)* sp., *Myonia?* sp. *Pyramus?* sp. und *Amosius* sp. werden wegen ihrer unzureichenden Erhaltung unter offener Nomenklatur beschrieben.

Key words: bivalve fauna, new taxa, *Waterhouseus* n. gen., Gondwana, Patagonia, glacial deposits, Carboniferous, Serpukhovian – Bashkirian
Schlüsselwörter: Bivalven-Fauna, neue Taxa, *Waterhouseus* n. gen., Gondwana, Patagonien, glaziale Ablagerungen, Karbon, Serpukhovium – Bashkirium

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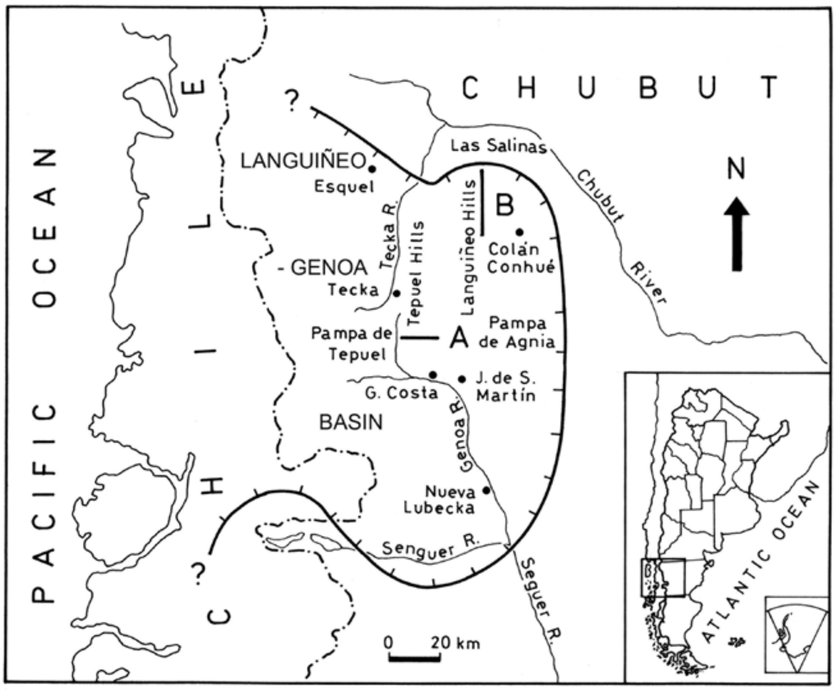
Introduction

Upper Palaeozoic deposits of central Patagonia have long since been of interest because they display one of the most complete stratigraphic successions of Gondwana that includes sediments from Early Carboniferous to earliest Permian age. They are also of biostratigraphic and palaeoclimatic significance for the reason that, unlike other sequences, it probably yields a nearly continuous fossil record associated with the climatic changes that happened during this period. Another circumstance of interest is that during this time central Patagonia was situated at an intermediate position between the western and eastern fringes of the Gondwana periphery, circumstance that makes this region crucial in the dispersion of marine faunas of that realm.

Bivalves described in this paper come from different stratigraphic levels of the Pampa de Tepuel and Las Salinas formations in central Patagonia, where they occur within the "mid"-Carboniferous (Serpukhovian – Bashkirian) *Levipustula levis* Zone. Many of them consist of few remains that were collected in the course of several expeditions to central Patagonia carried out since 1970 until 1990. During later years these deposits were scrutinized for new collections, but unfortunately, no more specimens were found. Although the material available is regarded in many cases insufficient for a proper systematic assignation, it is herein described and figured because there are new elements of the



Text-fig. 1: The Languiñeo-Genoa embayment in central Patagonia and location of type sections of A: the Pampa de Tepuel Formation, B: the Las Salinas Formation (see Text-fig. 2)(after González 1984).

Carboniferous Gondwana fauna, some of them potentially important to understand the origin and evolution of endemic taxa. In this regard, some specimens show characteristics that cannot be definitely allocated into a definite genus, but that suggest some phylogenetic links with Early Permian genera. Others are assigned with question marks because poorly preserved. Also new occurrences of previously known species are included.

Stratigraphy

Suero (1948) was the first to identify the upper Palaeozoic deposits of central Patagonia that he named "Tepuel System", where he recognized two sections that informally called "lower" and "upper". Later, Lesta & Ferello (1972) named Pampa de Tepuel and Mojón de Hierro formations for the lower and upper sections respectively, and the whole sequence became Tepuel Group. Finally, Page et al. (1984) separated the lower, mostly sandy part without glacial sediments that contain few plant remains and probably brackish water mollusks, as the Jaramillo Formation. The Tepuel Group is fully developed only at the type locality of the Tepuel Hills (Text-fig. 1), being dated from the Tournaisian until probably the Sakmarian without perceptible stratigraphic discontinuities. Other stratigraphic considerations on this sequence were made elsewhere (González 2002b, 2006). However, some additional considerations are opportune. The Pampa de Tepuel Formation (Text-fig. 2A) is the most conspicuous unit of the Tepuel Group; it is made up of 2,700 m of sediments mainly of glacial origin, consisting of nearly 60% pelites and 40% diamictites, conglomerates and sandstones. Glacial sediments show frequent facial changes in the direction of strike, and were deposited at different depths; a tillite at the upper part of the formation shows several surfaces with glacially striated pavements, suggesting their formation at the littoral zone (Text-fig. 3). The Pampa de Tepuel Formation is overlain by the Mojón de Hierro Formation and conformably covers the underlying non-marine Jaramillo Formation, although a hiatus probably exists between them because its lower glacial member encloses large blocks of the upper sandstone beds of the Jaramillo Formation (Text-fig. 4). Equivalent outcrops at the northern border of the basin are known as the Las Salinas Formation (Text-fig. 2B). Isolated fossils occur sparcely throughout most of these formations, but are especially abundant in some levels (Text-fig. 2).

The Carboniferous faunas of Gondwana

The origin of Upper Palaeozoic endemic (Gondwana) bivalves can be traced back to the beginning of the Carboniferous glaciations. They evolved in the course of the ice age, and gradually disappeared with the global warming at the middle–late Early Permian, except for few genera that persisted until the Upper Permian.

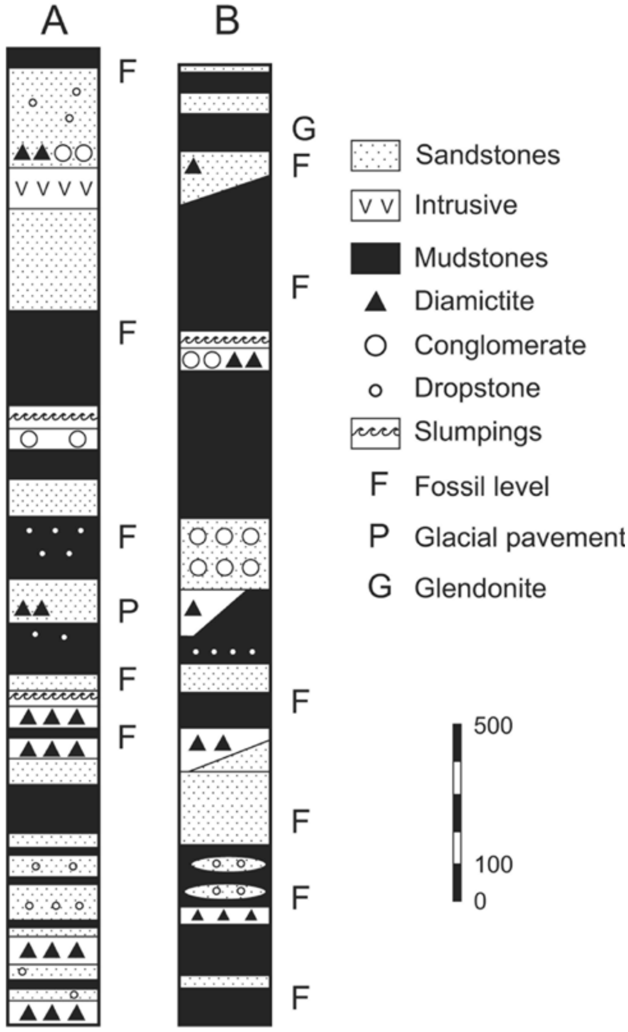
Carboniferous marine deposits of Gondwana crop out discontinuously along the peripheral belt that extends from western Argentina to eastern Australia, including central Patagonia and western Antarctica. These outcrops extend north in South America until the Subandean Bolivian region (Taiguati Formation), where a "*Levipustula* fauna" has been reported by Rocha-Campos et al. (1977). These sediments were deposited during a major flooding contemporaneous with the Carboniferous glacial period (Bashkirian–Serpukhovian). Marine faunas were affected by the lowering of temperature, and cold sea-water favoured the appearance of endemic (Gondwana) taxa.

In central Patagonia, the Pampa de Tepuel and Las Salinas formations show probably the greatest development of the Carboniferous faunas of Gondwana. These deposits yield the precursors of some endemic bivalves that flourished during the Early Permian. This is the case of the pholadomyiids *Pyramus* (Gonzalez 1972b), *Megadesmus* and *Myofossa* (González 1974, 1975) and probably *Myonia* and *Vacunella* (González 1997); the pectinoid *Orbiculopecten* (González 1978) and probably *Deltopecten* (González 2002a), and the pterioids *Merismopteria* (González 1975) and some atomodesmids? (González 1983, in prep.). Also some forms appeared that seem to have been short-lived "experiments", as *Orbiculopecten* (González 1978), *Amosius* (González & Waterhouse 2004), and other forms of uncertain taxonomic allocation that are described herein, which are exceptionally preserved in these deposits of central Patagonia. Although a species of *Pyramus* was reported in Australia (Runnegar 1972) and the occurrence of *Merismopteria,* probably the same species than in central Patagonia (see below), many of these genera are not represented in the Carboniferous deposits of eastern Australia. The diversity that this "primeval fauna" shows in these deposits may be explained by environmental stability in the Languiñeo-Genoa Embayment. However, this could be also assigned to preservation, because it cannot be ruled out that they also lived in other zones of the peri-Gondwánic belt, but without record.

Other components of this fauna show more widespread distribution, revealing affinities especially with North America and the western Tethys, a relationship that was previously observed in the gastropods by Sabattini (1984). At the other fringe of the peri-Gondwanic belt, the corresponding *Levipustula* fauna of eastern Australia includes elements showing eastern Tethyan affinities.

The Late Pennsylvanian climatic amelioration (González 1990) caused a significant shrinking of the Gondwana province, and the "mid" Carboniferous "cold" faunas were perhaps displaced to still higher latitudes, so that the environments they previously occupied were invaded by "warmer" faunas with palaeoequatorial affinities (González 1997). The fact that some taxa of this endemic fauna reappeared and flourished during the Early Permian glacial period means that during the Late Pennsylvanian interglacial they survived, probably confined to residual cold seas closer to the palaeopoles, but no record of such a sanctuary is known.

The *Levipustula* Zone and the Carboniferous glacial period: Some authors (Simanauskas 1996; Taboada et al. 2005) claim that in central Patagonia the brachiopod *Levipustula* should be re-assigned to the Russian genus *Lanipustula* Klets. However, this is in contradiction with the occurrence of *Levipustula* in western Argentina and eastern Australia, which were situated at the fringes of the peri-Gondwana belt and not in central Patagonia that was at an intervening position between these regions. Also, this re-assignation of *Levipustula* is disapproved of by Roberts et al. (1993, 1995) and Waterhouse (pers. comm.). As this is still a matter of contention, and for the entails of this paper the bivalves here described will be referred to the *Levipustula* Zone.



Text-fig. 2: **A**: The Pampa de Tepuel Formation, slightly modified from Suero (1948). – **B**: The Las Salinas Formation, after González (1972). Middle Carboniferous (Serpukhovian–Bashkirian). See location in map of Text-fig. 1.

Roberts (1981) pointed out that the *Levipustula levis* fauna has lower diversity and an increased proportion of endemic (Gondwana) genera over the underlaying *Marginirugus barringtonensis* fauna. Conversely, Dickins (1996) claimed that the *Levipustula* fauna may not represent as cold sea water as the *Eurydesma* fauna, because its higher diversity level and its association with a quite diverse bryozoan fauna and some molluscs that re-appeared with the Permian amelioration in warm temperature. However, it is obvious that these two faunas occur in quite different environments, which must have caused different degree of diversity. *Eurydesma* is associated with near-shore sediments and was probably semi-infaunal in sandy bottoms at a zone perhaps little above the wave base with moderate energy level. In the Bonete Formation of eastern Argentina, moulds of *Eurydesma* occur with the plane of commissure parallel to oblique lamination in sandstone beds, where they were probably transported after death from a more proximal zone (Harrington pers. comm. 1971; González 2003a. in Archangelsky et al. 1987: 193-194). It is almost improbable that *Eurydesma* was free-living as pointed out by Runnegar (1979), who argued that younger species abandoned the habit of byssal attachment at the last ontogenetic stages, to rest unattached with the heavy umbonal region down-side over the bottom and with the commissural plane of the shell in vertical position. In opposition, *Levipustula* is always found within finer sediments suggesting some distance from the coast, probably below the base of waves, which is favourable for the life of epifaunal bivalves, ostracodes, bryozoans and other suspension feeders with which this brachiopod generally occurs.

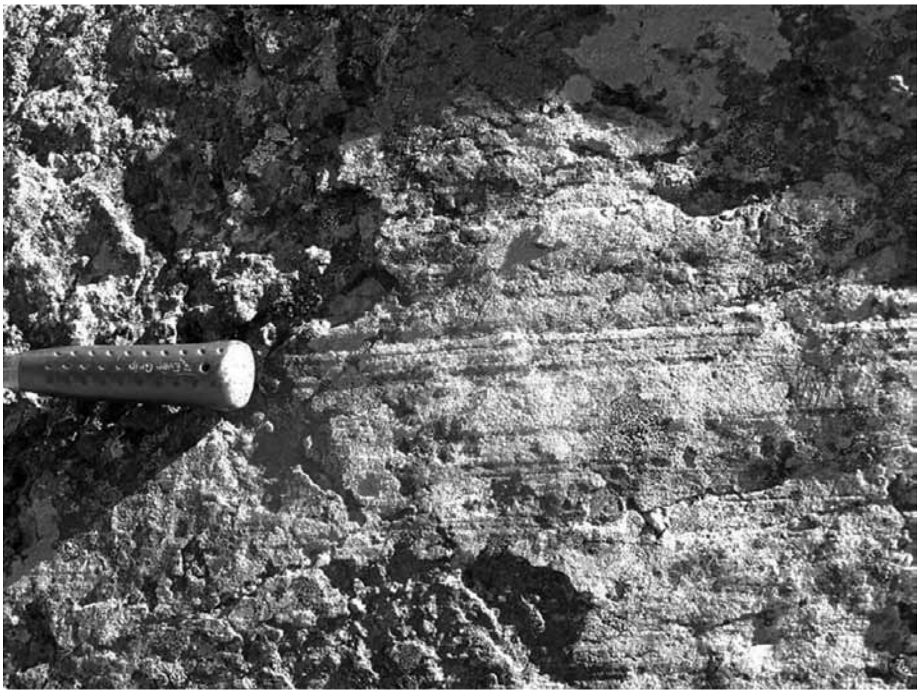
The *Levipustula* fauna is closely associated with glacial deposits, its range being linked to the duration of the Carboniferous glacial period. In eastern Australia, the occurrence of the ammonoid *Cravenoceras* indicates a Namurian age for the *Levipustula* fauna (Roberts et al. 1976). Radiometric ages of 328 ± 1.4 Ma, obtained by Claoué-Long et al (1995) from zircons in volcanics below continental glacial deposits of the Seaham Formation, showed the onset of the Carboniferous glaciation at close to the Viséan-Namurian boundary. Roberts et al (1995) place within this age the *Marginirugus barringtonensis* Zone, which is below the *Levipustula* Zone. The top of the *Levipustula levis* Zone is more difficult to assess. In eastern Australia, the *Auriculispina levis* Zone is part of the sparcely fossiliferous interval between the *Levipustula levis* Zone and the faunas of undoubted Permian age. Waterhouse (1987, 1989) has argued that these intervening faunas are mostly Late Carboniferous, although they have "Permian" aspect. This is not surprising; "Permian affinities" were also observed in the *Levipustula levis* Zone and younger Carboniferous faunas of Argentina, a circumstance that is considered consequence of the development of a dynamic fauna (González 1993), as can be considered the endemic Gondwana fauna since the "mid"-Carboniferous (Serpukhovian–Bashkirian) until the Early Permian. Roberts et al. (1995) also place *Auriculispina levis* in the Upper Pennsylvanian. Although Runnegar (1968) reported Early Permian fossils in the Seaham Formation, the assignation is doubtful because of Runnegar's failure to properly describe the material (Waterhouse, comm. 2007). Moreover, Roberts et al. (1993) and Claoué-Long et al. (1995), dated zircons from tuffs of the upper part of this formation at 310.6 ± 4.0 Ma (Westfalian), and Roberts et al. (1995) indicate that a major hiatus of at least 15 Ma duration exist between the marine and continental Late Carboniferous facies of the South New England Orogen and Permian sediments of the Sydney Basin. *Auriculispina* does not occur in Argentina although *Cancrinella* aff. *farleyensis* (now *Costatumulus amosi*) was compared by authors with *Aurisculispina levis*. Waterhouse (1987) analyzed the fauna accompanying *Levipustula levis*, which he assigned to the Bashkirian.

In central Patagonia, *Levipustula* (*Lanipustula?*) occurs in horizons stratigraphically separated by more than 2000 metres of sediments mostly glacigenic. The youngest occurrence of *Levipustula* is accompanied by the ammonoids *Wiedeioceras argentinense* (Miller & Garner) and *Glaphyrites* sp. that Riccardi & Sabattini (1975) regard of Westfalian age, and is associated with probably the last Carboniferous glacial phase (Las Salinas Glaciation; González 2001). This is consistent with the age of the Seaham Formation of eastern Australia, suggesting that the upper limit of the *Levipustula* Zone, and the end of the Carboniferous glacial period, may be at the upper Pampa de Tepuel Formation, probably at the lowermost Westfalian (upper Bashkirian).

Some authors extend the range of the *Levipustula* fauna in Argentina up to the Early Permian (Simanauskas & Sabattini 1997; Pagani & Sabattini 2002; Taboada 2001), but these assumptions are feeble because they ignore the stratigraphic position of the fossils. Kelly et al. (2001) pointed out that the *Levipustula* fauna of west Antarctica has unquestionable Carboniferous characteristics.

Palaeogeography and ice-sheets

The Languiñeo-Genoa Basin (González 1984, also known as Tepuel-Genoa Basin) originated during the Early Carboniferous by subsidence of a large portion of the central Patagonian platform, which formed an embayment open to the Palaeo-Pacific Ocean (Text-fig. 1). During the Carboniferous glacial period, a large area of central Patagonia surrounding the basin was probably a region of low relief. At the northern (Arroyo Pescado area) and southeastern (El Molle area) borders of the basin glacial sediments of the Pampa de Tepuel and Las Salinas formations that were deposited at the littoral zone show glacially striated pavements in soft sediments (González et al. 1995, 2003). This shows that grounded glaciers were active at the sea level and that ice tongues may have penetrated deeply into the central Patagonian embayment. To the west, in the Andean Orogen, one or perhaps two glacial stages are preserved in the Esquel Formation (López Gamundí 1980; González Bonorino & González Bonorino 1988). Moreover, in deposits of this age



Text-fig. 3: Striated intratill pavement at the middle section of the Pampa de Tepuel Formation, P in Text-fig. 2A (hammer for scale); middle Carboniferous (Serpukhovian–Bashkirian). Tepuel Hills, Chubut.

of central western Argentina striated pavements in hard rock and or in soft sediments within littoral glacimarine deposits are especially abundant (González 1990, in prep.). These evidences reveal that the ice cover probably extended over a vast continental area farther beyond the outer limits of the subsiding basins. In the southeastern margin of Gondwana, the Carboniferous glacial deposits of eastern Australia are long ago known. There is enough support to assume that during this glacial period the area covered with ice was large and that the central region of Gondwana, which was closer to the south palaeopole, was probably the main source area of ice. Evidence is lacking over a wide extent of the central part of Gondwana, probably for tectonic reasons: subsidence began in these regions at earliest Permian time.

Based on the lithofacial and biofacial succession in Argentina González (1981, 1983a) first claimed the existence of two events of cold maxima or glacial periods, the oldest in the Namurian–early Westfalian (Serpukhovian–Bashkirian), associated with *Levipustula levis*, and the youngest in the Asselian–Sakmarian, associated with *"Cancrinella* aff. *farleyensis"* (= *Costatmulus amosi*) and *Eurydesma*, and that these were separated by a long-lasting interglacial during the Stefanian (Moscovian–Gzhelian). Waterhouse (1987) arrived to the same conclusion; this author assessed the invertebrate faunas on a world wide basis and considered the existence of two major glacial intervals, the first during the Bashkirian and Moscovian and the second during the Asselian–Sakmarian, separated by a warm interval during the Kasimovian and Gzhelian. Later, the significance of the interglacial period was indirectly emphasized in Australia by radiometric ages obtained by Roberts et al. (1995), and accepted by reappraisal of palaeontological data by Dickins (1996), who pointed out that a long interval is present without evidence of glaciation before the Early Permian. This rules out the concept of a long glacial period stretching through the Carboniferous, as alleged by Veevers & Powell (1987) and many sedimentological and other interpretations by workers who were inspired by that paper but have not made themselves familiar with the original evidence. In Antarctica, Isbell et al. (2005) pointed out that it is unlikely that a single ice sheet covered this continent throughout the Carboniferous and Permian.

Deposits and faunas clearly indicating the Late Pennsylvanian climatic amelioration, like those of western Argentina (Gonzalez 1990, 1997), do not occur in the Tepuel Group. However, the thick upper pelitic members of the upper Pampa de Tepuel Formation and the Las Salinas Formation show slow depositional rate and deepening of the basin. These fine-grained sediments may have been deposited during the Upper Pennsylvanian deglaciation, being perhaps equivalent, at least in part, to the "warm" (interglacial) deposits of western Argentina. Similar facies were illustrated by Wopfner (1999) for the Early Permian deglaciation in the Tethyan margin of Gondwana. This evidence emphasizes the meaning of the long-lasting interglacial period, previous to the Early Permian glaciation, and the rapidity and complexity of the climatic changes in the Late Palaeozoic.

In the northern hemisphere, clear evidence of the Late Palaeozoic Ice Age are poor or lacking because at this time arctic regions were mostly below sea-level (see Golonka & Ford 2001; Scotese et al. 1979). However, Waterhouse (1987) mentioned the report by authors of Carboniferous tillites in Kolyma and possibly in China. Moreover, the

Text-fig. 4: Large block (hammer for scale) scrapped from the upper sandstone bed of the Jaramillo Formation and dropped by ice rafting in the lower glacial member of the overlying Pampa de Tepuel Formation; "middle" Carboniferous (Serpukhovian–Bashkirian). Tepuel Hills, Chubut.

bimodal pattern of the Upper Palaeozoic glaciations and the existence of a Late Pennsylvanian (Kasimovian–Gzhelian) interglacial alleged by González (1981, 1983, 1990) may also be recognized in the region of Angara: the Carboniferous glacial period of Gondwana corresponds to the disappearance of warm-climate endemic licophytes due to the Ostrogsky cooling episode (Durante 2000; Mosseichik & Ignatiev 2003); the Late Pennsylvanian interglacial and the Early Permian glacial periods can be matched perfectly with and the Alykaevo climatic optimum and the Early Permian global cooling, respectively (Ganelin & Durante 2002). More recently, Cleal & Thomas (2005) showed also the coincidence of the climatic changes in Gondwana with the variations of plant diversity in the pan-tropical forests.

Stages between the Viséan to the Sakmarian in the Global Stratigraphic Chart are not useful for the Gondwana stratigraphy, where glaciations left a strong imprint. During this time, major faunal assemblages developed during periods of stability between climatic changes, which suggest a more natural subdivision (González 2003b).

The finiglacial stage

Different ages of glacial deposits inspired DuToit (1927) to the existence of "excentric ice-capping". Other very alike postulations perhaps inspired by DuToit were exposed later by King (1958), Frakes et al. (1971) and Caputo & Crowell (1985), who emphasize about migration of glacial centers throughout Gondwana during the Palaeozoic. Although this theory is still accepted, the available evidence suggests a different interpretation.

Palaeogeographic reconstructions by Scotese et al. (1979), Golonka et al. (1994) and Golonka & Ford (2000) as well as palaeomagnetic results obtained by Creer (1972), Valencio & Mitchell (1972), Valencio (1973), Rapalini & Vilas (1996) and Rapalini & Mena (2001), show that the south polar shifting during the Late Paleozoic was not so significant as to support great climatic differences within the Gondwana supercontinent, as suggests the theory of migration of glacial centers. Conversely to previously thought, the existence of earliest Permian glacial deposits in western Argentina and central Patagonia (González 2003b; González & Díaz Saravia in press) reveal that the oldest phases of the Early Permian glacial period affected the western margin of Gondwana. On the contrary, in the upper part of these deposits no-glacial sediments are associated with progressive cosmopolitan faunas suggesting gradual warming. Younger Early Permian glacial phases, as those associated with the *Eurydesma* fauna in eastern Argentina and other regions of Gondwana are lacking in western Argentina and central Patagonia. The decreasing Early Permian age of the glacial deposits from west to east in the Argentinean territory shows that the final deglaciation was progressive and that melting of the ice-cap was a gradual process that started at the western margin of southern South America perhaps at the middle Asselian and continued to the east probably until the Tastubian (early Sakmarian).

Systematic palaeontology

Abbreviations: Abbreviations used in this article are as follows: H, holotype; L, left valve; P, paratype; R, right valve; s, steinkern; c, composite mould; d, damaged or deformed by post-depositional pressure; e, estimated; f, fragmentary; I, internal mould; p, partially decorticated; x, external mould.

Repository: The material is lodged in the Instituto de Paleontología of the Fundación Miguel Lillo (abbreviated IPI). Other repository mentioned in the text are: Museo de La Plata (MLP) and Instituto Miguel Lillo (PIL).

Family NUCULIDAE d'Orbigny, 1844

Nuculopsis Girty, 1911

Type species: *Nucula ventricosa* Hall, 1858 (OD); Pennsylvanian of U.S.A.

Observations: Schenck (1934) proposed the name *Nuculopsis*, and *Nuculopsis girtyi* as the type species because of homonymy of Hall's *Nucula ventricosa* with *Nucula ventricosa* Hinds (1843). Tasch (1953) distinguished *Nuculanella* with *Nuculanella piedmontia* as the type species, to distinguish from *Nuculopsis* species having a prominent umbo and a distinct triangular outline. Dickins (1963) placed *Nuculanella* as a subgenus of *Nuculopsis* having shells with relatively upright umbo, while in *Nuculopsis* s.s. it is inrolled and opisthogyrate. This author pointed out the difficulty to distinguish between *Nuculopsis* and *Nuculanella*, especially because of variations in the umbonal attitude in these forms. This is the case of a single specimen described below from the Carboniferous of Patagonia, which shows characteristics intermediate between these subgenera, and which is assigned to *Nuculopsis*. Arguments supporting relationships with *Nuculanella* are feeble and the term should be used as subgenus of *Nuculopsis* as proposed by Dickins (1963), or abandoned.

Nuculopsis sp.

Text-fig. 5C

Material: IPI.3986, a steinkern with right valve lacking fragment of the posterior and left valve mostly destroyed (Text-fig. 5C).
Locality: El Molle, 100 m north of Route 265, Chubut.
Stratigraphy: Upper Pampa de Tepuel Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.

Morphology: Shell suboval. Umbo upright to slightly opisthogyrate, slightly incurved, situated at nearly 0.7 shell length from anterior margin. Anterior margin rounded, passing to ventral smoothly. Posterior margin apparently circular, projected behind umbo. Dorsal anterior margin straight, meeting anterior margin at rounded obtuse angle. A lanceolate lunule may be present. Anterior adductor scar weakly impressed 1/7 shell length, sited at the anterior-dorsal inflection of margin. Posterior adductor close to posterior dorsal margin. 3-4 weakly impressed dorso-median elongate muscle scars. A fifth scar is situated below and backwards on the postumbonal slope. Anterior teeth very small towards umbo. Posterior teeth fewer an larger than anterior.

External ornament unknown.

Measurements: Dimensions of IPI.3986 (Text-fig. 5C): length 27 mm (estimated), height 20 mm.

Remarks: *Nuculopsis* sp. can be distinguished from *Nuculopsis(Nuculanella) camachoi* González (1972b) (Carboniferous, central Patagonia), because its shell is somewhat higher and the posterior margin is nearly circular and more projected backwards, giving a more oval shape in profile. Some specimens included by Pagani (2004) in *Nuculopsis (Nuculanella) camachoi* show variation in shape and attitude of the umbo.

Family POLIDEVCIIDAE Kumpera, Prantl & Ruzicka, 1960

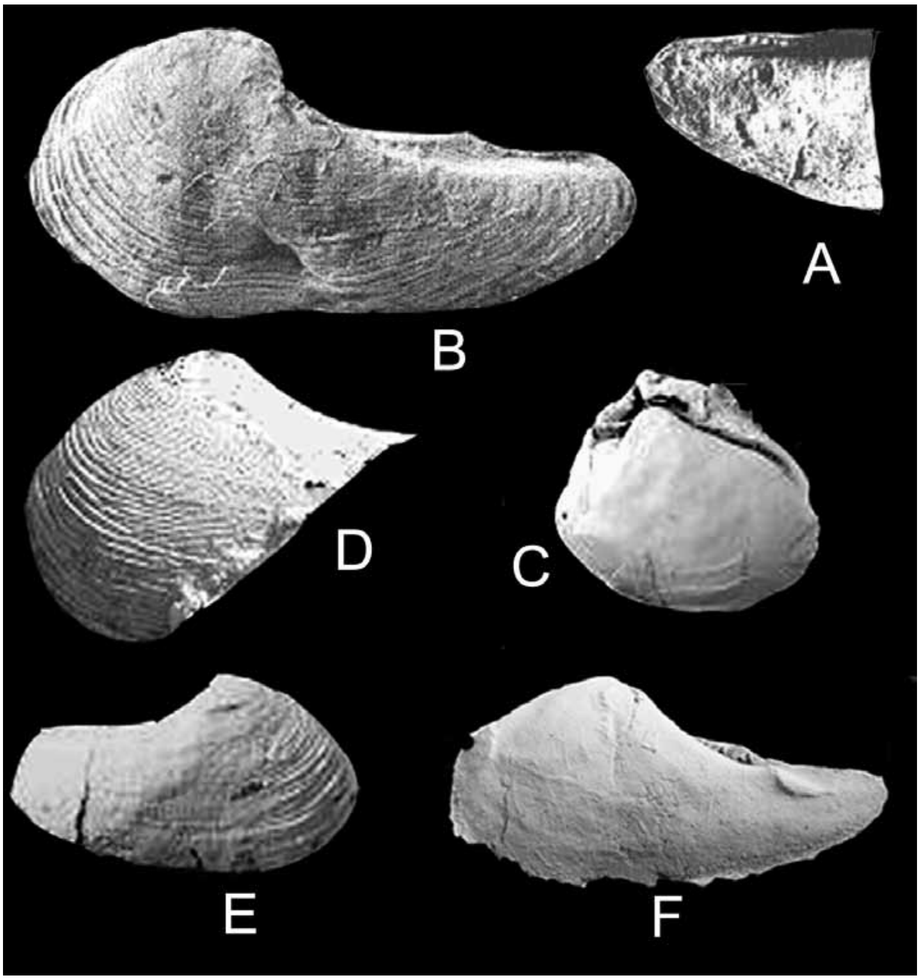
The terminology used herein to describe polidevciids follows the morphological nomenclature proposed by Kumpera et al. (1960) and Waterhouse (1964).

Remarks: *Polidevcia* (type species: *Leda karagandensis* Chernyshev, 1941 by original designation, Lower Carboniferous of Kazakhstan, Russia) was erected by Chernyshev (1951) to reunite Lower Carboniferous nuculanids that have elongate shells, posteriorly attenuate into a rostrum, with opisthogyrate beaks and an escutcheon delimited by a lateral carina. For a translation and discussion of Chernyshev's (1951) diagnosis of *Polidevcia* see Kumpera et al. (1960) and Elias (1957). The generic status of *Polidevcia* was discussed elsewere (González 2006). According to Waterhouse (1964), *Polidevcia* is more elongated than *Phestia*. However, the most important characteristic that distinguishes *Polidevcia* from *Phestia* Chernyshev is the nature of the escutcheon. In *Polidevcia* the escutcheon has a raised inner part that is limited by a rib from the outer part; whereas in *Phestia* the escutcheon is simple, without a raised inner part. The presence of a chondrophore in *Polidevcia* has been suspected by authors (Elias 1957; Wilson 1960; Dickins 1963; Waterhouse 1964). Specimens below described from Patagonia have a chondrophore; they are assigned to a new genus, *Waterhouseus*.

Phestiinae are usually differentiated at the genus level by the ornamentation, as *Gliptoleda* Fletcher (1945) and *Nucundata* Waterhouse (1964). Another characteristics of the new genus *Waterhouseus* proposed herein is the delicate cancellate ornamentation, which has not been previously reported in other Phestiinae.

Waterhouseus n. gen.

Derivation of name: Honour to Prof. Dr. J. Bruce Waterhouse.
Type species: *Waterhouseus tepuelensis* (González, 1969: pl. 1 figs. 6-9). Upper Pampa de Tepuel Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Species assigned to the genus: *Waterhouseus keideli* n. sp., described



Text-fig. 5: *Waterhouseus tepuelensis* (González, 1969), *Nuculopsis* sp. and *Waterhouseus keideli* n. sp.; middle Carboniferous (Serpukhovian–Bashkirian). Specimen A from 600 m SW of Puesto Tres Lagunas, Pampa de Tepuel Formation, Tepuel Hills, Chubut; specimen B from "horizonte con *Fenestella*", Pampa de Tepuel Formation, Tepuel Hills, Chubut; specimens C-F from type locality at El Molle (Pampa de Tepuel Formation), north of Route 265, Chubut.
A-B: *Waterhouseus tepuelensis* (González).
A: Poyvinylsiloxane cast of posterior segment of left valve showing row of circular pits or hollows along the margin of internal escutcheon, IPI.2405, natural size.
B: Poyvinylsiloxane cast of external mould of left valve of paratype, MLP.11015 (González 1969, pl. I fig. 9), included for comparison, x2.
C: *Nuculopsis* sp. Internal mould of right valve, natural size.
D-F: *Waterhouseus keideli* n. sp.
D: Poyvinylsiloxane cast of anterior fragment of left valve showing ornamentation, IPI.3983, x3.
E: Steinkern viewed from right valve, **holotype** IPI.3982, natural size.
F: Poyvinylsiloxane cast of left valve, paratype IPI.3984, natural size.

here (Text-figs. 5D-F) and *Waterhouseus tepuelensis* (González, 1969) (Text-figs 5A-B); both species from central Patagonia.
Geological range: Carboniferous (Serpukhovian–Bashkirian), *Levipustula levis* Zone.

Diagnosis: Shell elongate polidevciid of moderate size, tapering posteriorly, moderately convex. Anterior regularly rounded. Umbo opisthogyrous, situated at 0.37 shell length from anterior margin. Chondrophore present between anterior and posterior teeth rows. Anterior adductor oval, close to anterior margin, 1/6 shell length. Posterior adductor oval, deeply impressed, nearly same size than anterior adductor. External escutcheon concave, separated from flank by rounded ridge. Inner escutcheon raised above external escutcheon, limited by inner escutcheon ridge. Seven small circular holes forming row parallel to outer border of inner escutcheon.

Exterior densely covered with comarginal ribs that change in size below umbo, being thinner behind umbo, some bifurcated. Very thin radial riblets, more dense at umbonal region. Small nodules projected at intersection of comarginal ribs and radial riblets. Comarginal ribs and radial riblets give the outer surface a cancellate ornament.

Waterhouseus tepuelensis (González, 1969)

Text-figs. 5A-B

v * 1969 *Phestia tepuelensis* González, Nuevas especies de Bivalvia: 239, pl. 1 figs. 6-9.
1979 *Phestia tepuelensis*. – Amos, Faunas Carbónicas: 106.
1985 *Phestia tepuelensis*. – González, El Paleozoico Superior marino: 131.
1987 *Phestia tepuelensis*. – Archangelsky et al., El Sistema Carbonífero: 182, 191.
2004 *Phestia tepuelensis*. – Pagani, Los bivalvos carboníferos y pérmicos: 277, text-fig. 7 A-L.

Type material: All type material figured in González (1969). Holotype MLP.11021 (R, i, d) (González 1969: pl. 1 fig. 6), paratypes MLP.11015 (L, x) (González 1969: pl. 1 fig. 9) (Text-fig. 5B), MLP.11019 (L, i) (González 1969: pl. 1 fig. 7), MLP.11018 (R, i) (González 1969: pl. 1 fig. 8) in the Invertebrate Palaeontology collection of the Museo de La Plata.
Material:Two specimens. IPI.2405A (L, x, f, lacking anterior) (Text-fig. 5A), IPI.2405B (R, i, d, f, lacking ventral posterior).
Type locality: SE of puesto Marillán (Jones Farm), Languiñeo Hills, Chubut.
Type stratum: Upper Las Salinas Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Occurrence: 500 m SW of Puesto Tres Lagunas, Tepuel Hills, Chubut, and at the type locality.

Diagnosis: As for the genus.

Morphology: Shell of moderate size, posteriorly elongate. Anterior regularly rounded. Posterior umbonal slope concave, separated from flank by rounded postumbonal ridge or carina. Umbo moderately projected, sited at 0.4 shell length from anterior margin. Inner escutcheon raised above postumbonal slope, limited by inner escutcheon ridge. A row of small holes or perforations parallel and outer to the border of the inner escutcheon.

Exterior with thin comarginal ribs and finer radial riblets giving to the outer surface a cancellate ornament. Small nodules at intersection of comarginal and radial ribs.

Measurements: Dimensions of specimen IPI. 2405 (Text-fig. 5A) length 16 mm, height 8 mm.

Discussion: A characteristic that distinguishes *Waterhouseus tepuelensis* is the occurrence of a row of small circular holes or puncta, located at the outer margin of the inner escutcheon ridge and parallel to it. This singular characteristic of unknown function seems homologous with the row of perforated nodules of *Polidevcia nodulosa* Waterhouse, 1964 (Early Permian, New South Wales).

Waterhouseus keideli n. sp.

Text-figs. 5D-F, Tab. 1

Derivation of name: Honour to the late Dr. Juan Keidel, pioneer researcher of the Carboniferous in Argentina.
Holotype: IPI.3982, a steinkern lacking little fragment of posterior and the external mould of its right valve (Text-fig. 5E).
Paratypes: IPI.3983 (B, x, f, lacking posterior) (Text-fig. 5D); IPI.3984 (L, i) (Text-fig. 5F)
Other material: IPI.3761: various fragments, mainly internal moulds, IPI.4067 (L, i, d), IPI.4066 (R, i).
Type locality: Paraje El Molle, close north of Route 265, Chubut.
Type stratum: Upper Pampa de Tepuel Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Occurrence: 1000 m SW of Route 25, Las Salinas (Almacén Nazer), Languiñeo Hills, Chubut, and at the type locality.

Diagnosis: Shell elongate rostrate. Beaks opisthogyrous. Inner escutcheon moderately raised. Exterior surface with comarginal ribs thicker and more spaced anterior to umbo, thinner posterior to umbo, and thin vertical threads.

Morphology: Shell elongate, tapering posteriorly. Umbones at 0.35 shell length from anterior margin, opisthogyrous. Anterior margin rounded. Posterior dorsal margin gently concave. Ventral margin convex. Lunule thin, lanceolate. Inner part of escutcheon moderately raised and limited by gentle ridge. Umbonal ridge moderate, with two irregular elongate scars. Anterior adductor scar rounded, 1/9 shell length, bounded behind by low buttress or bulge extended to dorsal anterior margin. Posterior adductor scar oval elongate, deeply impressed, 1/6 shell length. Anterior teeth-row with 16-17 teeth, posterior row with more than 19 teeth smaller than anterior teeth. Anterior and posterior teeth-rows separated below umbo by small triangular, prosocline resilifer below umbo.

Exterior with comarginal ribs that change in size below umbo. Behind umbo, ribs are thin and grow by intercalation and bifurcation. In front of umbo ribs are thicker and more spaced. Very thin vertical (not radial) riblets or threads intersect comarginal ribs, giving delicate cancellate pattern to shell surface.

Measurements: See Tab. 1.

Tab. 1: *Waterhouseus keideli* n. sp. – Dimensions (in mm).

Specimen	Material	Length	Height	Illustration
IPI.3982 H	S, f.	33.2	17	Text-fig. 5E
IPI.3984 P	L, i, f.	44 e	22.5	Text-fig. 5F

Discussion: The available specimens do not show the pallial line. *Waterhouseus keideli* n. sp. is distinguished by the abrupt change of thickness of the concentric ribs below the umbo; ribs are thicker in front of the umbo and thinner and more numerous behind it. *Waterhouseus keideli* n. sp. differs from *Waterhouseus tepuelensis* in being shorter, and the beak is more distant from the anterior margin, furthermore because the inner escutcheon is lower and does not have the row of small holes parallel to the border. The specimen MLP.29735 from near La Carlota, assigned to *Polidevcia tepuelensis* by Pagani (2004: fig. 7L) probably belongs to *Waterhouseus keideli* n. sp. *Phestia?* n. sp. González (2006) has a cancellate external ornament, and probably belongs to *Waterhouseus*, but this species is incompletely known.

Family PTERINEIDAE Miller, 1877

Leptodesma Hall, 1883

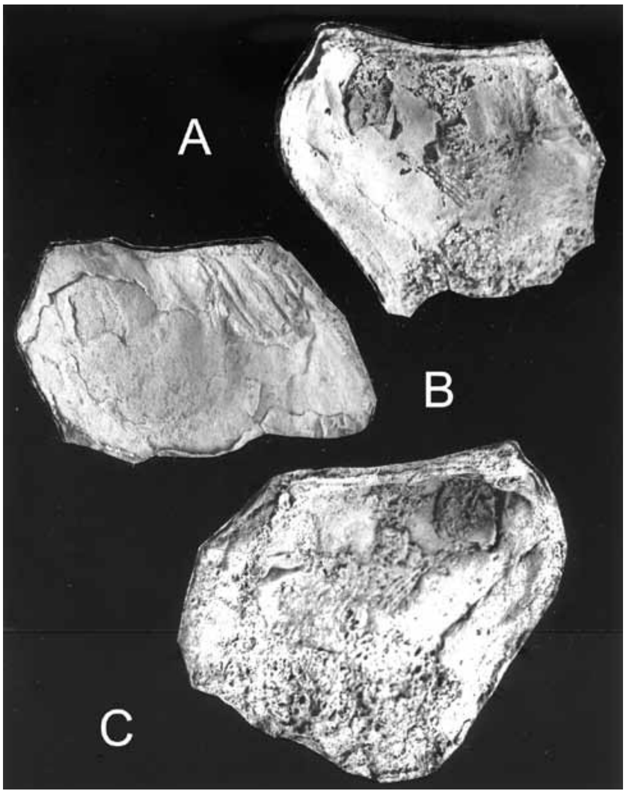
Type species: *Leptodesma dekayi* Hall, 1883 (SD Miller 1889). Upper Devonian of U.S.A.

Leptodesma (Leiopteria) n. sp.

Text-figs. 6A–C, 7

Material: Partly destroyed internal mould of left valve lacking fragments of ventral and posterior, and fragment of external mould of the same, PIL.12313 (Text-figs. 6A-C, 7).
Locality: 5000 m south of Route N° 25, Languiñeo Hills, Chubut.
Stratigraphy: Member LS-5, Las Salinas Formation, lower *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Occurrence: Known only from the locality mentioned above.

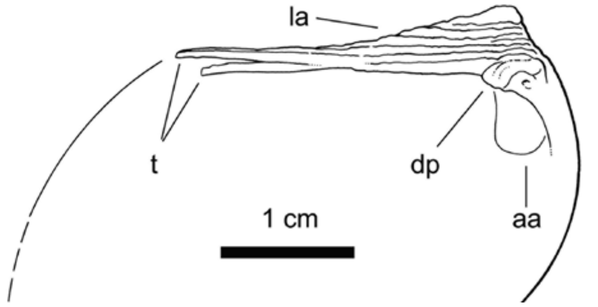
Morphology: Shell pteriform, strongly projected posteroventrally, without posterior auricle. Anterior umbonal slope



Text-fig. 6: *Leptodesma (Leiopteria)* n. sp.; middle Carboniferous (Serpukhovian–Bashkirian). All specimens from 5000 m south of route 25 (member LS-5, Las Salinas Formation), Languiñeo Hills, Chubut. – **A**: Internal mould of left valve, PIL.12313, natural size.– **B**: Poyvinylsiloxane cast of PIL.12313, natural size. – **C**: Poyvinylsiloxane cast of fragment of external mould of left valve, PIL.12313, natural size.

continued in broad, rounded lobe little extended anteriorly. The lobe is separated from rest of anterior margin by broad sinus. Umbo prosogyrous, incurved, slightly projected above dorsal margin, situated 0.2 shell length from anterior margin. Ventral and posterior margins rounded. Dorsal posterior margin slightly concave at union with posterior umbonal slope, shorter than shell length. Greater convexity from umbo to posteroventral. Ligament external, duplivincular. Ligament area amphidetic, tapering backwards, extended posteriorly from the anterior margin all along the cardinal margin. Ligament area with deep parallel longitudinal furrows longer ventrally, obliquely truncated above by dorsal margin. Plane of ligament area and plane of commissure slightly divergent upwards. Kidney shape protuberance (cardinal tooth ?) below anterior end of ligament area and close to upper margin of anterior lobe. Two short lateral teeth below posterior third of cardinal area, the upper parallel to dorsal margin, the lower slightly diverging. Anterior adductor tear shape, 1/6 shell length, situated high at anterior umbonal cavity. External ornament of comarginal rugae and thin growth lines Other characteristics unknown.

Measurements: Estimated dimensions of specimen PIL.12313 (fragmentary internal mould of left valve) (Text-fig. 6A): length 46 mm (estimated), length of anterior 9 mm, height more than 36 mm.



Text-fig. 7: *Leptodesma (Leiopteria)* n. sp. camera lucida drawing of cast of PIL.12313 (Text-fig. 6A), aa: anterior adductor, t: lateral posterior teeth, la: ligament area, dp: protuberance or dental process.

Discussion: The hinge of *Leptodesma (Leiopteria)* n. sp. is well preserved: the ligament area shows deep parallel furrows that extend to the anterior margin. The kidney-shaped protuberance below the anterior end of the ligament area is probably part of the structure of articulation of the valves and may have been fit within a concavity in the opposite valve. *Leptodesma (Leiopteria) variabilis* González (1977) from the Pampa de Tepuel Formation is smaller and more elongate, not projected posteroventrally as *Leptodesma (Leiopteria)* n. sp. *Leptodesma (Leiopteria) nalikini* (Jakovlev) (fide Astafieva-Urbaitis 1983) from the Lower Carboniferous of Mongolia resembles in shape *Leptodesma (Leiopteria)* n. sp., but has a larger anterior lobe and more straight contour of the dorsal margin.

Merismopteria Etheridge, 1892

Type species: *Pterinea macroptera* Morris, 1845 (OD). Early Permian, Tasmania.

Observations: The present author was not able to examine the type specimen in the British Museum. As pointed out by Dickins (1960), it may be lost. Some considerations about this genus were made by González (1997).

Merismopteria has the classical pterioid shell shape of *Leptodesma*, but differs from this genus in having a buttress (notch in the mould) descending vertically from the anterior umbonal region. Newell (1940) showed that the heavy buttress is immediately in front of the anterior adductor impression, but Dickins (1960) assumed that an anterior adductor was sited at the anterior lobe, and that the anterior notch was a buttress ridge. González (1977) regards the two muscle scars at the upper part of the anterior end of the pallial line as belonging to the anterior adductor the lower and to the pedal retractor the upper. This was posteriorly admitted by Dickins (1981).

Pre-Permian species of *Merismopteria* known in Argentina are *Merismopoteria* sp. Manceñido et al. (1976) from the Del Salto Formation (Upper Pennsylvanian, western Argentina) and *Merismopteria salinensis* González, 1975 (revised below) from uppermost strata of the Las Salinas Formation. *Liopteria dutoiti* Harrington, 1955 and *Liopteria bonaerensis* Harrington, 1955 from the Bonete Formation (Early Permian, eastern Argentina) were erroneously assigned to *Merismopteria* by Dickins (1960) and Andreis & Japas (1996), as discussed by González (1977, also in Pagani 2000).

Merismopteria salinensis González, 1975

Text-figs. 8A-E

v *1975 *Merismopteria? salinensis* González, Nuevos Bivalvia de la Formación Las Salinas: 344, pl. 1 figs. 1-2.

v *1995 Merismopteria* sp. – Roberts et al., Devonian-Carboniferous Stratigraphy of the southern Hastings Block: 625-626.

Type material: Holotype PIL11208a (S) (González 1975: pl. I fig. 1) (Text-figs. 8A, B), paratypes PIL.11200 (L, i) (Text-fig. 8C), PIL11203 (L, f, lacking fragments of anterior and posterior), PIL11206 (B, f, lacking ventral), PIL11208b (S, f, lacking posterior) (Text-fig. 8D), PIL11215 (L, i) (pl. 1 fig. 2), PIL11219 (L, f, lacking fragment of posterior), PIL11222 (L, j) (Text-fig. 8E), PIL11215 (L, i) (González 1975: pl. I fig. 2); other specimens PIL11204, PIL11209 and PIL11212.

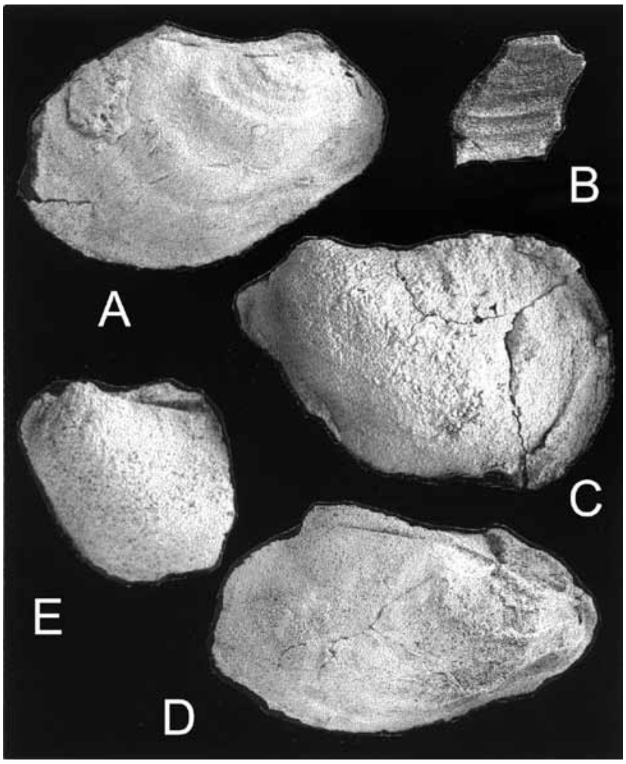
Type locality: 700 m S of Route 25, Las Salinas, Languiñeo Hills, Chubut.

Type stratum: Member LS-9, Las Salinas Formation, upper *Levipustula* Zone, Serpukhovian–Bashkirian.

Occurrence: Probably in the Mingaletta Formation, *Levipustula* Zone, New South Wales (Roberts et al. 1995a) and at the type locality.

Diagnosis (revised): Pterioid, moderately prosocline. Valves expanded posteriorly. Dorsal posterior obliquely truncate at obtuse angle. Greater convexity from umbo to posterior ventral. Anterior ear or lobe circular. Umbo anterior, prosogyrous slightly projected over dorsal margin. Anterior of ventral margin gently sinuated, posteriorly convex. Posterior margin convex regularly continuous with ventral margin. Ligament area mainly posterior, slightly extended in front of umbones. Buttress ridge shortly extended ventrally from anterior umbonal slope, behind anterior lobe. A posterior lateral tooth in each valve. Shell thin, prismatic. Extrerior surface with thin growth lamellae.

Morphology: Pteioid elongate prosocline shell. Anterior lobe rounded. Umbones prosogyrous situated 0.2 shell length from anterior margin. Posterior margin forming obtuse angle with dorsal margin. Ventral margin anteriorly sinuate, posteriorly convex. Postumbonal ridge or greater convexity of shell from umbo to postero-ventral. Angle between postumbonal ridge and dorsal margin = 44°. A single lateral posterior tooth at left and right valves, slightly divergent posteriorly from dorsal margin. Lateral posterior tooth of right valve at a lower position than left. Ligament duplivincular, area slightly extended in front of umbo, with longitudinal grooves. Muscle scars weakly impressed A buttress ridge, groove in the mould, extends vertically at anterior umbonal slope. Shell thin, prismatic. External ornament of thin concentric growth lamellae.

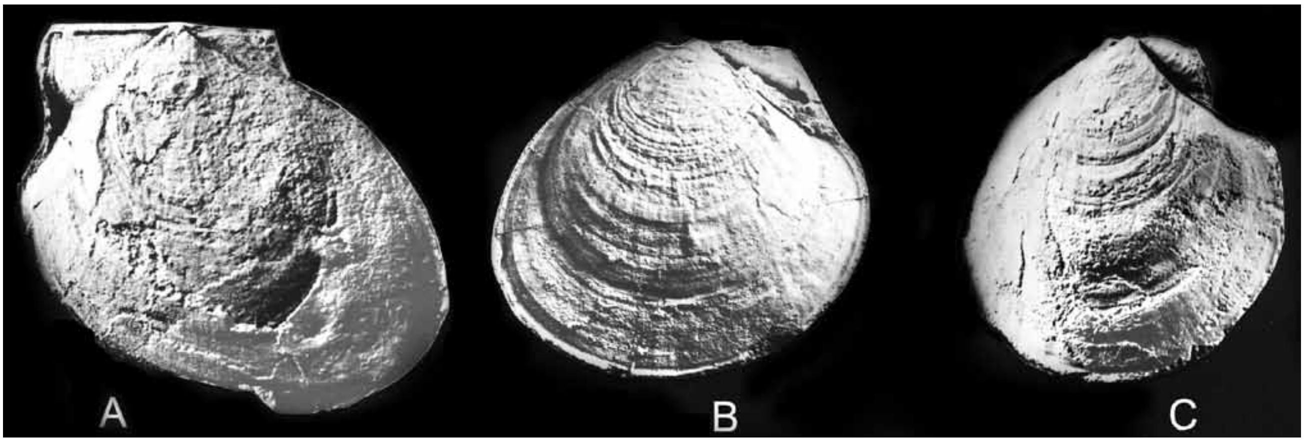


Text-fig. 8: *Merismopteria salinensis* González, 1975; middle Carboniferous (Serpukhovian–Bashkirian). All specimens from type locality at 700 m south of route 25 (member LS-9, Las Salinas Formation), Languiñeo Hills, Chubut. – **A**: Steinkern, view of right valve, **holotype** IPI.11208a (González 1975, pl. I fig. 1), natural size. – **B**: Fragment of external mould to show ornamentation, IPI.11208, natural size. – **C**: Internal mould of left valve, IPI.11200, natural size. – **D**: Steinkern, view of right valve, paratype IPI.11208b, natural size. – **E**: Internal mould of a juvenile left valve, IPI.11222, x2.

Measurements: Dimensions of holotype PIL.11208 (steinkern lacking fragment of posterior margin) (Text-fig. 8A) length = 47.5 (estimated), height = 33.5.

Observations: *Merismopteria salinensis* does not have a posterior auricle the posterior dorsal margin is obliquely truncated forming an obtuse angle with dorsal margin. The buttress or “clavicle” which separates the umbonal region from the anterior ear is not as strongly developed as in the Permian species; suggesting this feature is probably at an early stage of evolution. Also different specimens examined show this feature differently developed.

The existence of a posterior lateral tooth in the right valve of *Merismopteria* was suspected by Dickins (1960) and confirmed in *Merismopteria salinensis*. Cardinal teeth were not observed in *Merismopteria salinensis*; in this regard, Dickins (1960), observed that teeth are variable in Australian specimens and assigned no significance to this feature to



Text-fig. 9: *Streblochondria* n. sp.; middle Carboniferous (Serpukhovian–Bashkirian). All figured specimens from 550 m SW of puesto Tres Lagunas (Pampa de Tepuel Formation), Tepuel Hills, Chubut. – **A**: Composite mould of left valve, IPI.3775, x2.5. – **B**: Composite mould of right valve, IPI.3776, x2. - **C**: internal mould of right valve, IPI.3777, x2.

separate genera. *Merismopteria salinensis* is probably the oldest representative of the genus, which differentiated from *Leptodesma* at the end of the Carboniferous glacial period. Roberts et al. (1995a) reported *Merismopteria* sp. from the Mingaletta Formation, and the present author examined a large collection at the University of New England, Armidale, which are indistinguishable from *Merismopteria salinensis*. In eastern Australia this species occurs with *Oriocrassatella compressa* Maxwell (Roberts et al. (1995a); in Patagonia it is associated with *Myonia?* sp., described herein, at the upper member of the Las Salinas Formation.

Family STREBLOCHONDRIIDAE Newell, 1938

Streblopteria M'Coy, 1851

Type species: *Meleagrina laevigata* M'Coy, 1844 (SD by Meek & Worthen 1866). Early Carboniferous of Ireland.

Remarks: *Streblochondria* Newell, 1938 reunites biconvex, almost equivalve ovate, procrescent shells with simple central resilifer. It is also characterized by having the anterior auricle longer than posterior and by its delicate ornamentation of fine radial costellae and comarginal fila on both valves that give the shell its cancellate external ornament. *Streblopteria* McCoy, 1851 is exteriorly smooth, but the nature of hinge is not known, and Newell & Boyd (1995) assumed that the genus had a transitional type of ligament area. As observed by Gonzalez (2006), the circumstance that the hinge of the type species is unknown makes the systematic position of the genus imprecise. Waterhouse (1982) pointed out that there appears to be many species with characters intermediate between *Streblopteria* and *Streblochondria,* and assumed that the Pennsylvanian *Streblochondria* diversified in different lineages distinguished by ornament, which persisted into the Permian period with little or very fine radial ornament. Gonzalez (2006) described *Streblopteria montgomeryi* González, a species showing platyvincular ligament area. A detailed discussion on the family Streblochondriidae was made by Waterhouse (2008), who separated shells with platyvincular hinge and disk with comarginal rugae and no radial ornament in the genus *Montorbicula* Waterhouse, 2008, with *Streblopteria montgomeryi* González (2006) as the type species. Material described below is known only from internal and composite moulds, some showing external ornament of probable comarginal ribs and thin rugae and fine radial ornament. According the above criteria for generic separation, this species should be regarded as a new genus, but it is provisionally assigned to *Streblopteria* McCoy until more material with preserved external ornament is obtained.

Streblopteria? n. sp.

Text-figs. 9A-C, Tab. 2

Material: Eight specimens IPI.3775 (L, i, d) (Text-fig. 9A), IPI.3776 (S, c, f, lacking upper part, partly embedded in matrix) (Text-fig. 9B), IPI.3777 (S, c), IPI.3778 (R, i, f, lacking auricles and ventral) (Text-fig. 9C), IPI.3779 (L, c, f, lacking posterior auricle and ventral), IPI2425 (three fragmentary specimens).

Locality: 500 m SW of puesto Tres Lagunas, Tepuel Hills, Chubut.

Stratigraphy: Upper Pampa de Tepuel Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.

Occurrence: Found only at the locality mentioned above.

Morphology: Suborbicular obliquely oval, moderately retrocrescent. Umbo orthocline. Beak slightly projected above hinge margin. Right anterior auricle large, anteriorly rounded. Deep and narrow byssal notch and auricular sulcus. Left anterior auricle subquadrate, separated from disc by marked auricular sulcus. Right and left posterior auricles small, less than half the length of the anterior auricles, meeting hinge margin at obtuse angle (140°). Ligament area platyvincular thin, with thin ridge (groove in mould) at the base. Two thin buttress or crura diverge from subumbonal region of ligament area, corresponding to internal projections of anterior and posterior auricular sulcus.

Composite moulds reflect external ornament consisting of radial striae and thin comarginal rugae or ribs.

Measurements: See Tab. 2.

Tab. 2: *Streblochondria* n. sp. – Dimensions (in mm).

Specimen	Material	Length	Height	Illustration
IPI.3775	L, d	21	22 e	Text-fig. 9A
IPI.3776	S, c, f.	22	19.5	Text-fig. 9B
IPI.3777	S, f.	19 e	22	Text-fig. 9C

Observations: No well preserved exterior surface of *Streblopteria?* n. sp. is available, the existence of radial and comarginal ornamentation is weakly reflected in composite moulds. A characteristic of this form is the thin ligament area with a thin ridge at the base. *Streblochondria sueroi* González, 1969 (Carboniferous, central Patagonia), differs from *Streblopteria?* n. sp. in being acline and having costellae and fila with tiny spines at their intersection. *Montorbicula montgomeryi* (González, 2006) (Early Permian, central Patagonia) has only anterior crura, well defined rugae and apparently lacks radial ornamentation. *Streblochondria* sp. (Sterren 2003) (Carboniferous, western Argentina) probably belongs to this group. *Streblochondria stappenbecki* (Reed, 1927) (Carboniferous, western Argentina) strongly differs from *Streblopteria?* n. sp. by its procrescent shape.

Family EDMONDIIDAE King, 1850

Observations: Some observations on the Edmondiidae were quoted elsewere (González 2006). A characteristic of this group is the internal lamellar plates of the hinge plate, which Waterhouse (1966, 1969, 2001) showed to be also present in *Myonia*.

Myonia Dana, 1847

Type species: *Myonia elongata* Dana (SD by Fletcher 1932). Early Permian of Australia.

Observations: *Myonia* is edentulous, lacks pallial sinus and pedal and siphonal gaps, has a posterior carina and variably developed lateral sulcus. Two forms from the Las Salinas Formation are tentatively placed into this genus because of insufficient material. One of them is a large form having a portion of the hinge plate preserved that shows internal lamellar plates; it is provisionally placed in *Myonia*, but new collections will probably demonstrate to be a new genus.

Myonia? prinsi n. sp.

Text-figs. 10A-B

Derivation of name: Honour to Dr. Cornelius Winkler Prins.
Holotype: IPI.3710. A steinkern with left valve partly included in matrix and somewhat deformed. Small fragment of shell material (Text-fig. 10A).
Other material: Also included in the description is a cast of the external mould of a complete left valve that was found in situ and could not be extracted from the outcrop (Text-fig. 10B).
Type locality: Near casa Pinchulef, 5 km south of Route 25, Languiñeo Hills, Chubut.
Type stratum: Member LS-5 of the Las Salinas Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Occurrence: Known only from the locality mentioned above.

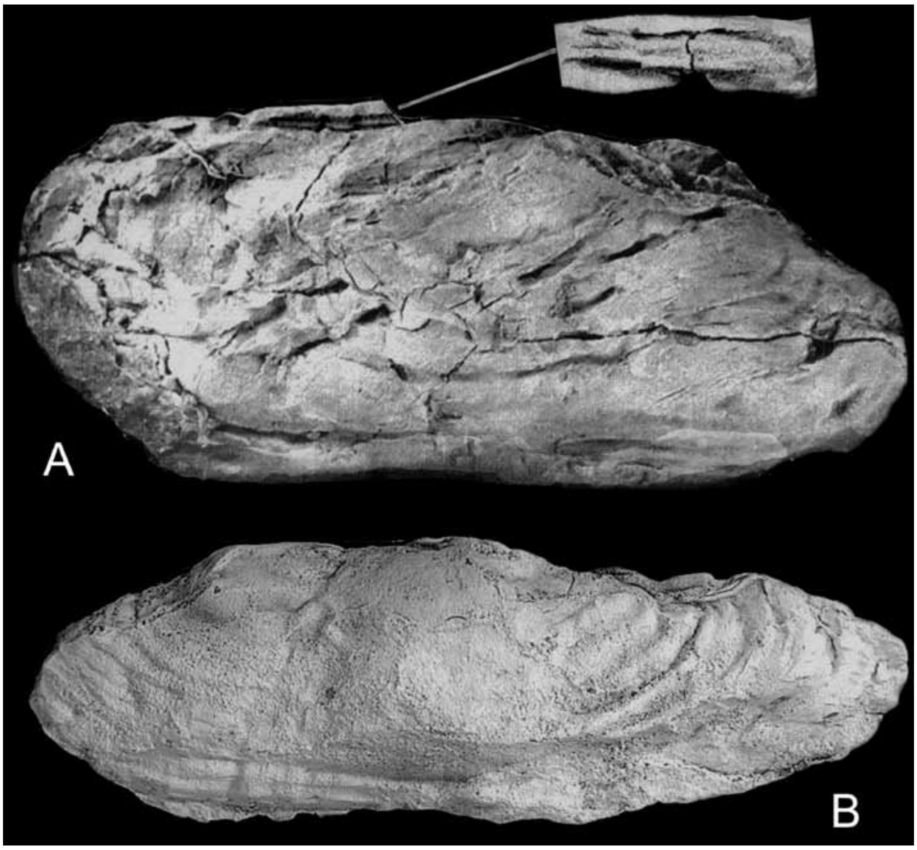
Diagnosis: Suboval elongate shell with shallow lateral sulcus. Exterior with concentric rugae.

Morphology: Large, elongate suboval, Moderately convex. Umbones prosogyrous and incurved, little projected above dorsal part of shell, sited 0.3 shell length behind anterior margin. Dorsal posterior margin and ventral margin almost parallel. Dorsal anterior margin slightly concave. Posterior rounded. Shallow lateral sulcus from umbonal region to ventral margin. Rounded, low postumbonal carina. Posterior segment of hinge plate with one or two ridges. Shell thin (inner layer?) prismatic. Elongate escutcheon may be present.

Exterior surface with irregular comarginal rugae. Other characteristics unknown.

Measurements: Dimensions of IPI.3710 (Text-fig. 10A): length 155 mm, height 60 mm, length of anterior 55 mm. A cast of the external mould of a left valve that could not be extracted from the outcrop, is stil larger (Text-fig. 10B): length 235 mm, height 75 mm.

Remarks: These bivalves occur within wackes with dropstones that contain palaeochannels filled with conglomerate and big slabs of sandstone. They probably lived below wave base, at a distance not too far from the glacier terminus. This was a relatively quiet environment, although frequently disturbed by sliding and slumping of glacially produced debris flow (González 1972a). Because of these conditions most fossils within this bed are fragmentary, especially of very large and thin shells, but sometimes complete specimens as described above are found. Large Anomalodesmata are frequent in the Permian of Australia and New Zealand, but *Myonia? prinsi* n. sp. is an unusually large form in the Carboniferous rocks of Patagonia. *Myonia? prinsi* n. sp. shows some resemblance in size and shape with two species: *Myonia elongata* Dana, the type species, especially if compared with material described by Waterhouse (1969: pl. 14 fig. 5) (Early Permian, New Zealand), which differs in having more prominent umbones, and with *Notomya gigantissima* Waterhouse (1969) (Early Permian, New Zealand), but in this species the umbones are orthogyrous.



Text-fig. 10: *Myonia? prinsi* n. sp.; middle Carboniferous (Serpukhovian–Bashkirian). All specimens from 4500 m S of Route 25 (member LS-5, Las Salinas Formation), Languiñeo Hills, Chubut. – **A**: Internal mould of fragmentary right valve, IPI.3710, natural size. – **B**: Cast made in situ of external mould of left valve that could not be extracted from the outcrop, x0.7.

Myonia? sp.

Text-figs. 11G-H, Tab. 3

Material: Two specimens, isolated valves. IPI.4071 (L, p, f, lacking fragment of posteroventral margin) (Text-fig. 11H), IPI.4072 (R, p, f, lacking fragment of posterodorsal margin) (Text-fig. 11G).
Locality: 700 m S of Route 25, Las Salinas, Languiñeo Hills, Chubut.
Stratigraphy: Member LS-9 of the Las Salinas Formation, *Levipustula* Zone, Serpukhovian–Bashkirian.
Occurrence: Known only from the locality mentioned above.

Morphology: Suboval elongate, very convex shell. Strong rounded carina from umbo to posteroventral margin. Umbo prosogyrous, incurved, not raised from dorsal margin, situated 0.35 shell length from anterior margin. Greater convexity at length of carina. Lesser convexity in front of carina, but not true sulcus. Dorsal margin gently convex. Ventral margin gently convex, not sinuated. Escutcheon may be present. Probably not gaping posteriorly. Exterior densely covered with very thin, rounded ribs.

Other characteristics unknown.

Measurements: See Tab. 3.

Tab. 3: *Myonia?* sp. – Dimensions (in mm).

Specimen	Material	Length	Height	Illustration
IPI.4071	L, p, f.	63 e	47	Text-fig. 11H
IPI.4072	R, p, f.	68	49	Text-fig. 11G

Observations: *Myonia?* sp. occurs with *Pyramus?* sp. González, 1975, *Merismopteria salinensis* González, 1975 and *Vacunella?* sp. described herein. These fossils occur into a bed of fine sandstone some tenths of metres stratigraphically below sandstones with hollow moulds of glendonite, near the top of the Las Salinas Formation.

Family MEGADESMIDAE Vokes, 1967

Observations: Members of this family have thick shells, a large tooth in right valve and other characteristics in common.

Newell (1956) recognized that at equal size the shells of *Megadesdmus* may be difficult to distinguish from *Astartila* in general form. Dickins (1963) also noted that some species are difficult to assign to one or the other genus based only in external characters and suggested desirable to consider *Astartila* as a subgenus of *Megadesmus*. After Waterhouse (comm. 2007) the Dickins' west Australian *Astartila* are in fact *Megadesmus (Cleobis)*.

Newell (1969b) includes *Megadesmus*, *Astartila, Myonia* and *Pyramus* in the Megadesmidae Vokes. A further separation is proposed by Waterhouse (1969), who reunited *Megadesmus* and *Pyramus* in the family Edmondiidae, subfamily Pachydominae, and recently (Waterhouse 2001) in the subfamily Megadesminae Vokes, because they share the large size and variably defined escutcheon and posterior gape.

Megadesmus is characterized by large, oval inflated shells with slightly prosogyrous umbones and escutcheon-like depression. The lateral sulcus is absent to faint. Hinge with a large tooth in the right valve and a corresponding socket in left valve poorly formed in the commisure. Pallial sinus shallow or absent and posterior gape little or absent. The bysus is also weak or absent. *Megadesmus* is equivalve with inflated shells and was probably semiinfaunal.

Pyramus has lenticular form and shells are medium sized with rounded posterior ridge or carina. Wedge-shaped lateral sulcus from beaks to ventral margin. The hinge has a single blunt tooth in the right valve and a socket in left below beaks. The ligament is lodged in a slender nymph, which is a somewhat ventrally extended cavity. A characteristic of this genus is the retractor scar at apex of umbonal cavity. Shows moderate pallial sinus and small siphonal gape, and was probably infaunal to semiinfaunal shallow-digger. *Pyramus* was successful in the middle Carboniferous periglacial seas of Patagonia, their remains are abundant in some horizons of the lower Pampa de Tepuel Formation, sometimes forming coquinoid beds.

The valves overlapping was indicated in *Pyramus* (Runnegar 1967: 33) and in *Megadesmus* (Runnegar 1965: 230; Waterhouse 2001: 144). The siphonal gape may be variably developed to absent in different specimens of *Pyramus laevis*, as shown by Runnegar (1967: 36, pl. 1 figs. 11-12). *Megadesmus* and *Pyramus* are restricted to the cold sea-water of Gondwana. An exception could be *Pyramus anceps* (Reed) of the Estrada Nova Formation (Runnegar & Newell 1971). *Pyramus* occurs at the first stages of the Carboniferous glaciation in central Patagonia (González 1972b) and in the *Marginirugus* Zone of eastern Australia (Runnegar 1972), which corresponds to the Lower Serpukhovian or slightly earlier. It is probable that *Megadesmus* also originated at the beginning of the glaciations. Differences between *Megadesmus* and *Pyramus* are subtle, and for some specimens of the Carboniferous of Patagonia that are known from insufficient material it is difficult to decide, whether they belong to one or the other genus.

Megadesmus Sowerby, 1838

Type species: *Megadesmus globosus* Sowerby, 1838 (SD by Woodward 1854, fide Newell 1969b).

Observations: A single specimen insufficiently known from central Patagonia is provisionally placed in this genus because it shows some morphological features characteristic of Early Permian *Megadesmus*.

Megadesmus? n. sp.

Text-fig. 11C

Material: A steinkern lacking a small fragment of posterodorsal margin, with right valve partly deformed by pressure, IPI.4073 (Text-fig. 11C).

Locality: 700 m SSE of puesto Marillán (Jones Farm), north slope of Cerro Punta Pedregosa, Languiñeo Hills, Chubut.

Stratigraphy: Member LS-3, Las Salinas Formation, lower *Levipustula levis* Zone, Serpukhovian–Bashkirian.

Morphology: Oval posteriorly elongate, anterior short. Unbones prosogyrous, incurved, placed at 0.2 shell length from anterior margin. Anterior dorsal margin straight to gently concave, almost vertical. Posterior dorsal margin gently concave. Ventral margin well rounded, not sinuate. Posterior not gaping. Lateral flat area, not sulcus, from umbones to ventral margin. Posterior carina rounded at umbonal region, almost disappearing before reaching the posterior ventral angle. Posterior umbonal slope slightly concave. Right valve with a blunt tooth (mould) below umbo, corresponding to socket in formed by inflection of left valve margin. Right valve margin in front of tooth probably overlaps left valve margin. Ligament opisthodetic. Nymphs short. Anterior adductor muscle scar triangular, nearly 1/7 shell length. Anterior protractor and retractor scars probably attached to upper margin of adductor. A small rounded muscle scar at anterior part of umbonal cavity. Escutcheon probable.

Other characteristics unknown.

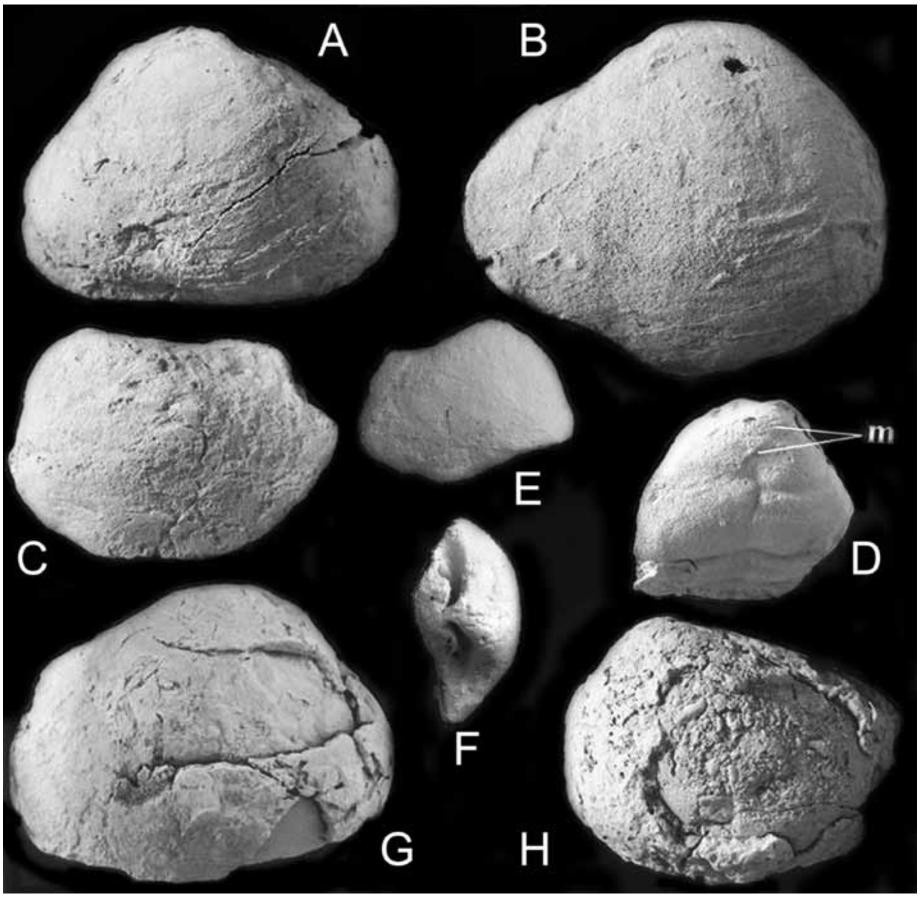
Measurements: Dimensions of IPI.4073 (Text-fig. 11C): length 64 mm, height 45 mm. width of left valve 14 mm.

Remarks: The right valve of the steinkern is deformed by pressure, but the left valve shows a moderate convexity. Although the specimen lacks a small fragment of the posterior margin, it is possible to deduce from the convexity of the valve and the projection of the commissure that the valves were probably closed, without a siphonal gape. The depression at the dorsal margin behind the umbones, suggest the presence of a escutcheon. The attitude of the anterior dorsal margin of the right valve in front of the tooth shows that it probably overlapped the left valve margin.

Pyramus Dana, 1847

Type species: *Pyramus myiformis* Dana (1847) (SD by Newell 1956). Lower Permian of New South Wales, Australia.

Observations: *Pyramus tehuelchis* González, 1972 and *Pyramus primigenius* González, 1972 from central Patagonia, and *Pyramus barringtonensis* Runnegar, 1972 from eastern Australia, were the first known Carboniferous species. Two new specimens of *Pyramus primigenius* afford new data of the species. Another single incomplete specimen is tentatively assigned to *Pyramus*.



Text-fig. 11: *Pyramus primigenius* GONZÁLEZ, 1972, *Megadesmus?* n. sp., *Amosius* sp., *Vacunella?* sp. and *Myonia?* sp.; middle Carboniferous (Serpukhovian–Bashkirian). Specimens A-B from type locality at Las Salinas, 7000 m S of Route 25 (member LS-3, Las Salinas Formation), southern slope of Cerro Antinao, Languiñeo Hills, Chubut; specimens C and G-H from 700 m SSE of puesto Marillán (member LS-3, Las Salinas Formation), Languiñeo Hills, Chubut; specimen D from El Molle, 100 m S of route 265 (Pampa de Tepuel Formation), Chubut; specimens E-F from 700 m S of Route 25 (member LS-9, Las Salinas Formation), Languiñeo Hills, Chubut;.
A-B: *Pyramus primigenius* GONZÁLEZ, 1972. **A**: external mould of left valve, IPI.4069, natural size; **B**: external mould of right valve, IPI.4068, natural size.
C: *Megadesmus?* n. sp. Steinkern, view of left valve, IPI.4073, natural size.
D: *Amosius* sp. fragmentary Steinkern view from right valve, IPI.3985, natural size.
E-F: *Vacunella?* sp. **E**: internal mould of fragmentary right valve, IPI.4070, natural size; **F**: idem anterior, dorsal view, IPI.4070, natural size.
G-H: *Myonia?* sp. **G**: decorticated right valve, IPI.4072, natural size; **H**: decorticated left valve, IPI.4071, natural size.

Pyramus primigenius GONZÁLEZ, 1972

Text-figs. 11A-B

v *1972 *Pyramus primigenius* GONZÁLEZ, La Formación Las Salinas: 201, pl. 3 figs.1-3.

Type material: All type material figured in González (1972b). Holotype MLP 11502 (R, c, f, lacking fragments of umbo and ventral) (pl. 3 fig. 1), paratypes MLP 11503 (L, c, f, lacking fragment of anterior) (pl. 3 fig. 2), MLP 11504 (R, c) (pl. 3 fig. 3).
Material: Two specimens. IPI.4068 (R, i, f, lacking fragments of anterior and ventral margins) (Text-fig. 11B), IPI.4069 (L. c, p) (Text-fig. 11A).
Type locality: 7 km south of Route 25, southern slope of Cerro Antinao, Languiñeo Hills, Chubut.
Type stratum: Member LS-3, Las Salinas Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Occurrence: Same as the type locality.

Diagnosis (revised): Moderately convex, oval to subtriangular shell. Umbones raised, prosogyrous, subcentral, slightly incurved. Dorsal anterior and posterior margins form a slightly obtuse angle. Shallow lateral sulcus slightly concave to anterior. Aductor anterior slightly larger than posterior. Sinupalliate. Exterior with imbricate growth lamellae and growth lines.

Morphology: Oval subtriangular, moderately convex. Umbo at 0.5 shell length behind anterior margin, projected above dorsal margin. Anterior and posterior margins rounded. Dorsal anterior margin straight, forming slight inflection at union with umbonal slope. Dorsal posterior margin oblique, following the postumbonal slope and reaching the posterior margin without angularity. Anterior and posterior dorsal margins form an angle of nearly 100°. Ventral margin sinuated at terminus of lateral sulcus. Very shallow lateral sulcus slightly concave forwardly near the middle of the valve. Greater convexity of valve behind sulcus. Small posterior gape. Exterior surface with growth lines.

Measurements: Dimensions of IPI.4069 (Text-fig. 11A), length 65 mm, height 47 mm, beak from anterior 33 mm.

Observations: The posterior margin of the shell in the specimens described above show a slight convexity in back view, suggesting a small posterior gape. A distinctive characteristic of *Pyramus*. *primigenius* is the triangular outline of the shell, which recalls *Pyramus concentricus?* (ETHERIDGE Sen.) RUNNEGAR (1967, especially CPC7497, pl. 4 fig. 1) (Early Permian, Australia), but this species has a slightly concave posterior margin and regularly rounded ventral margin without inflection. *Pyramus laevis* (SOWERBY) (Sakmarian, Australia) figured by RUNNEGAR (1967), is a carinate species somewhat more elongate carinate species with lower umbones.

Pyramus? sp.

Text-figs. 11E-F

Material: Internal mould of fragmentary right valve lacking ventral and posterior, IPI.4070 (Text-figs. 11E-F).
Locality: 700 m S of Route 25, Languiñeo Hills, Chubut.
Occurrence: Found only at the locality mentioned above.
Stratigraphy: Member LS-9 of the Las Salinas Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.

Morphology: Inflated shell. Umbo anterior, orthogyrous, very prominent and incurved. Posterior dorsal margin concave in outline. Adductor posterior large. Posterior retractor elongate, attached to upper margin of adductor and close to dorsal margin. Retractor scar at apex of umbonal cavity. Small siphonal gape probable. Shallow groove at anterior margin of right valve. Hinge with rounded projection below umbo (Text-fig. 9F). Short, nymphs behind umbo.

Other characteristics unknown.

Measurements: Dimensions of IPI.4070 (Text-fig. 11E) are only estimative because the material is fragmentary: length 40 mm, height 28 mm.

Observations: The specimen lacks a fragment of the posterior margin, but the convexity of the mould suggests that a posterior gape may be present. The umbonal retractor at the apex of the umbonal cavity is a characteristic of *Pyramus*; it was probably deeply inserted in the specimen, as shown by its projection in the mould. A distinct tooth is not present, but there is a rounded projection of the hinge below the umbo. The longitudinal groove along the anterior margin of the right valve probably received the anterior edge of the left valve. A lateral sulcus running from the anterior side of the beaks to ventral margin that is common in species of the genus, was very shallow or absent because not observed in the mould.

Family indet.

Amosius González & Waterhouse, 2004

Type species: *Amosius harringtoni* (González, 1972c) by monotypy. Upper Mississippian (Serpukhovian) of Patagonia, Argentina.

Diagnosis: Oval-elongate shell, channel-form ligament area with anterior denticle. Subumbonal row of circular muscle insertion scars.

Discussion: A single incomplete specimen is ascribed to the genus *Amosius*.

Amosius sp.

Text-fig. 11D

1972b *Eurydesma harringtoni*. – González, Un nuevo Eurydesmidae: 215, text-figs. 2-4.
v 2004 *Amosius harringtoni*. – González & Waterhouse, A new Carboniferous bivalve: 341, text-figs. 2A-D, 3, 4.

Type material: All the type material figured in González & Waterhouse (2004). Holotype MLP.11501 (R, i, f. lacking anterior, ventral and posterior), hypotypes IPI.2216 (L, i, f, lacking a small fragment of the anterior), IPI.3712a, b (two pieces: R, i, f, lacking fragment of anterior and R, x, f, lacking anterior), IPI.3713 (S, d, f, lacks anterior and posterior), IPI.3714 (L, f, lacking posterior), IPI.3615 (B, i, f, only umbonal region and part of cardinal area preserved), IPI.3716 (L, i, f, only umbonal region and fragment of ligament area preserved).
Material: A steinkern lacking fragment of posterior, with shell preserved in the anterior margin and umbonal region, IPI.3985 (Text-fig. 11D).
Locality: Paraje El Molle, north of Route 265, Chubut.
Stratigraphy: Pampa de Tepuel Formation, *Levipustula levis* Zone, Serpukhovian–Bashkirian.
Occurrence: Found only at the locality mentioned above.

Morphology: Shell convex, inequilateral. Anterior rounded. Umbo prosogyrous, incurved, sited anteriorly, slightly projected above cardinal margin. Hinge margin straight. Channel-like ligament area. A row of rounded to oval muscle insertion scars directs from umbo downwards and backwards. Exterior with comarginal rugae. Shell prismatic.

Other characteristics unknown.

Measurements: Dimensions of IPI.3985 (a fragmentary steinkern) (Text-fig. 11D): estimated length more than 50 mm, estimated height 39 mm.

Discussion: The row of vertically aligned muscle scars at the subumbonal region of *Amosius harringtoni*, the type species, was not assigned to a known function by González & Waterhouse (2004), but Etheridge & Dun (1910) ascribed such pits in *Eurydesma* to mantle and visceral retractors muscles, by analogy with *Pteria* and *Pinctada*. The anterior of the specimen described above is lobular and more rounded than in *Amosius harringtoni*, and these muscle insertions are clearly seen to continue downward and backwards. Although the material lacks a fragment of its posterior, it is evident that these scars are the anterior segment of a discontinuous pallial line. A shallow anterior sulcus below anterior umbonal slope, clearly separates the rounded anterior part of shell. These forms do not have a muscular impression that can be assigned to the anterior adductor in this anterior part of the shell, which may be regarded as an anterior lobe. Below the umbo, the anterior portion of the hinge is covered with shell material, which shows the transversal section of the channel-like ligament area, but conceals the anterior "denticles". *Amosius* probably lived very near the coast in waters of low to moderate energy (González & Waterhouse 2004). The anterior lobe may have been related with the stability, perhaps working like an "anchor" of the shell when attached by byssus.

Resumen

Las secuencias y faunas del Paleozoico Superior de Argentina demuestran que el origen de las faunas de bivalvos endémicos de Gondwana se remonta al comienzo de las glaciaciones del Carbonífero medio. Ellas continuaron evolucionando en el transcurso de la Edad de Hielo y en su mayor aparte desaparecieron gradualmente con el calentamiento global que se inicio a fines del Pérmico Inferior.

Depósitos glaciales del Carbonífero medio afloran en forma discontinua a lo largo de una faja que se extiende por el margen austral de Gondwana desde el oeste de Argentina hasta el este de Australia. Estos sedimentos han proporcionado una fauna que se caracteriza por su marcado endemismo. En este trabajo se describen algunos bivalvos provenientes de diferentes niveles estratigráficos de las formaciones Pampa de Tepuel y Las Salinas que se encuentran dentro de la Zona de *Levipustula levis*. Si bien gran parte del material ha sido recolectado en el curso de varias expediciones a la Patagonia central entre los años 1970 y 1990, para la descripción de algunas especies se contó con material insuficiente para una asignación sistemática precisa. A pesar de que las búsquedas realizadas con posterioridad a esa fecha no proporcionaron nuevos ejemplares, el material disponible es aquí descripto y figurado por tratarse de nuevas formas para el Carbonífero de Gondwana. Por otro lado, ellas son potencialmente importantes para comprender la composición de la cadena evolutiva de algunos taxones endémicos. En este sentido, algunos especímenes muestran ciertas características que sugieren vinculaciones filogenéticas con los del Pérmico Inferior. Otros han sido clasificados con dudas debido a su deficiente preservación. También se incluyen nuevas ocurrencias de especies previamente conocidas .

Las formaciones Pampa de Tepuel y Las Salinas muestran una gran riqueza fosilífera; en cuanto a su contenido en bivalvos presenta probablemente el mayor desarrollo (o quizá el mejor preservado) de este grupo entre las faunas conocidas del Carbonífero medio de Gondwana. Entre ellos se encuentran los antecesores de algunos géneros endémicos que llegaron a su apogeo durante el Permico Inferior. Tal es el caso de los pholadomiidos *Pyramus* (Gonzalez 1972b), *Megadesmus* y *Myofossa* (González 1974, 1975) y probablemente *Myonia* y *Vacunella* (González 1997); los pectínidos *Orbiculopecten* González (1978) y probablemente *Deltopecten* (González 2002a), y los pteriideos *Merismopteria* (González 1975) y *Atomodesma?* (González 1983). Durante esta época también aparecieron algunas formas a las que consideramos como “experimentos” de corta existencia, como *Orbiculopecten* (González 1978), *Amosius* (González & Waterhouse 2004) y otras de ubicación sistemática incierta que aquí se describen. Aunque en el este de Australia se conoce una especie de *Pyramus* (Runnegar 1972) y una especie de *Merismopteria,* probablemente la misma que se encuentra en la Patagonia central (ver más abajo), es sorprendente que esos elementos estén tan pobremente representados en los depósitos carboníferos de ese continente. Es posible que tanto la variedad que esta “fauna primigenia” muestra en la Patagonia central, se deba a la estabilidad ambiental que existió en el engolfamiento de Languiñeo-Genoa durante el Carbonífero medio; o quizá solo sea el producto de mejores condiciones de preservación, ya que no es posible descartar su existencia en los mares y cuencas de otras regiones de la faja peri-gondwánica, aunque no existan registros.

Basado en las secuencias y faunas en el oeste de Argentina (González (1981, 1983a) propone la existencia de dos períodos glaciales, el más antiguo en el Serpukhoviano-Bashkiriano, y el más joven en el Asseliano-Sakmariano, separados por un largo período interglacial durante el Moscoviano a Gzheliano. Al mismo resultado llega Waterhouse (1987) mediante una evaluación mundial de las faunas de invertebrados. En Australia, edades radimétricas obtenidas por Roberts et al. (1995) refuerzan indirectamente la significación del período interglacial, el que es aceptado por Dickins (1996) luego de una reevaluación de datos paleontológicos. Esto invalida existencia de un largo período glacial sin interrupciones a través del Carbonífero propuesta por Veevers & Powell (1987) y muchas interpretaciones sedimentologicas y otras, de autores que se inspiraron en ese trabajo pero que no estaban familiarizados con las evidencias originales. Asimismo, la teoría de migración de los centros glaciales propuesta por Caputo & Crowell (1985), queda superada ante la existencia de depósitos glaciales del Pérmico Inferior en el oeste de Argentina y en la Patagonia central señalada por González (2003b), quien propuso una progresiva contracción del área englazada al finalizar la Edad de Hielo.

Se describe un nuevo género: *Waterhouseus,* y cuatro nuevas especies: *Waterhouseus keideli* n. sp., *Streblopteria?* n. sp., *Megadesmus?* n. sp., and *Myonia? prinsi* n. sp. La morfología de *Merismopteria salinensis* González es revisada y ampliada. Dos especies previamente conocidas: *Waterhouseus tepuelensis* (González, 1969) y *Pyramus primigenius* González, 1972 fueron obtenidas en nuevas localidades de la Cuenca. Otras cinco especies: *Nuculopsis* sp., *Leptodesma (Leiopteria)* sp., *Myonia?* sp. *Pyramus?* sp. y *Amosius* sp., se mantienen con nomenclatura abierta debido al insuficiente material disponible.

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