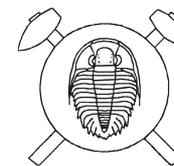


Position of the Malvinokaffric Realm's northern boundary (Early Devonian) based on newly discovered brachiopods from the Parecis Basin (Brazil)

Pozice severní hranice malvinokaferské provincie ve spodním devonu podle nových nálezů brachiopodů v pareciské pánvi (Brazílie)



(7 figs)

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The northern biogeographic boundary between the earlier Devonian Malvinokaffric Realm and the adjacent Eastern Americas Realm has customarily been placed midway between the northern margin of the Paraná Basin and the southern margin of the Amazon Basin, which also permits it to pass through the Parnaíba Basin. The recent discovery of typical Early Devonian Malvinokaffric Realm brachiopods within the Parecis Basin, to the north of the Paraná Basin now permits one to move this boundary significantly to the north, placing it between the Parecis and Amazon basins, and still permitting it to pass through the Parnaíba Basin. Previously described trilobites from the Parecis basin are in agreement with the biogeographic conclusions based on the brachiopods.

The inarticulate brachiopods, identified by Rowell are *Orbiculoidea falklandensis*, *Orbiculoidea* sp. cf. *Orbiculoidea collis*, and *Lingula* sp. cf. *Lingula lepta*; the articulate brachiopods, chonetoids identified by Racheboeuf, include *Australostrophia mesembria*, *Australostrophia clarkei*, *Pleurochonetes sorucoi*, non-chonetoids, identified by Boucot, include *Australospirifer* sp., *Australocoelia palmata*, *Pleurothyrella* cf. *knodi*, *Derbyina* sp., and an unidentified orthotetacid.

Among these brachiopods *Orbiculoidea falklandensis*, *Australostrophia mesembria*, *Australocoelia palmata*, and *Pleurothyrella* are typical Malvinokaffric Realm taxa. No typically Eastern Americas Realm brachiopods are present in this fauna. Paleogeographically this fauna is best placed near the boundary between Benthic Assemblages 2 and 3, i.e., shallow subtidal, photic zone. In terms of age it corresponds to the earlier Devonian of the Paraná Basin, of which it represents an outlier.

Key words: Devonian, Malvinokaffric Realm, Parecis Basin, Brazil

Introduction

J. H. G. M. and L. P. S. collected the fossils at the Morro Vermelho (13°39'457"S, 53°52'455"W, measured by GPS) and Morro do Indio (13°58'522"S, 54°00'008"W) localities, north of Paranatinga Town, Mato Grosso State (Fig. 1.B). The main fossil site, Morro Vermelho, is situated on the Serra Azul Farm, and is a low relief, flat topped hill which represents an isolated outlier west of the main outcrop belt of Devonian rocks on the south-east border of the Parecis Basin. This outcrop consists of deeply weathered micaceous shales and ferruginous sandstones which rest directly on low-grade metasediments of Late Precambrian age (Fig. 1.C). These metamorphics also make up the Morro do Indio outcrop in a Xavantes Indian reservation, where remnants of the former Devonian sedimentary cover consist of blocks of oxidized sandstones lying loose around the Precambrian hillsides, and containing spiriferids and large orbiculoids.

The weathered shales are unsuitable for palynology, but resemble the basal Devonian shales of Chapada dos Guimarães, Mato Grosso (northwest border of the Paraná Basin), where miospores indicate a latest Lochkovian-early Pragian age (Loboziak et al. 1998). The fossils and lithology suggest that the two regions were formerly con-

tinuous, parts of the same shallow marine basin during the Early Devonian.

The Morro Vermelho shales contain an abundant, low diversity assemblage of marine invertebrates (molluscs, trilobites and brachiopods of Malvinokaffric Realm character). Most of the fossils at this site are preserved three dimensionally inside argillaceous concretions within the shales, but flattened forms are also found in the shales proper.

Systematic paleontology

Phosphatic-shelled brachiopods

A. J. Rowell

In rocks deposited in appropriate environments, phosphatic-shelled brachiopods, now referred to the class Lingulata (Popov et al. 1993), are common elements of Early Devonian faunas in the Malvinokaffric Realm. Two species of *Orbiculoidea* and a lingulid occur in the Parecis Basin. One of the orbiculoids, *O. falklandensis*, is interpreted as showing considerable morphologic variability over its extensive geographic range. The taxon has been recorded previously from the Falkland Islands and the

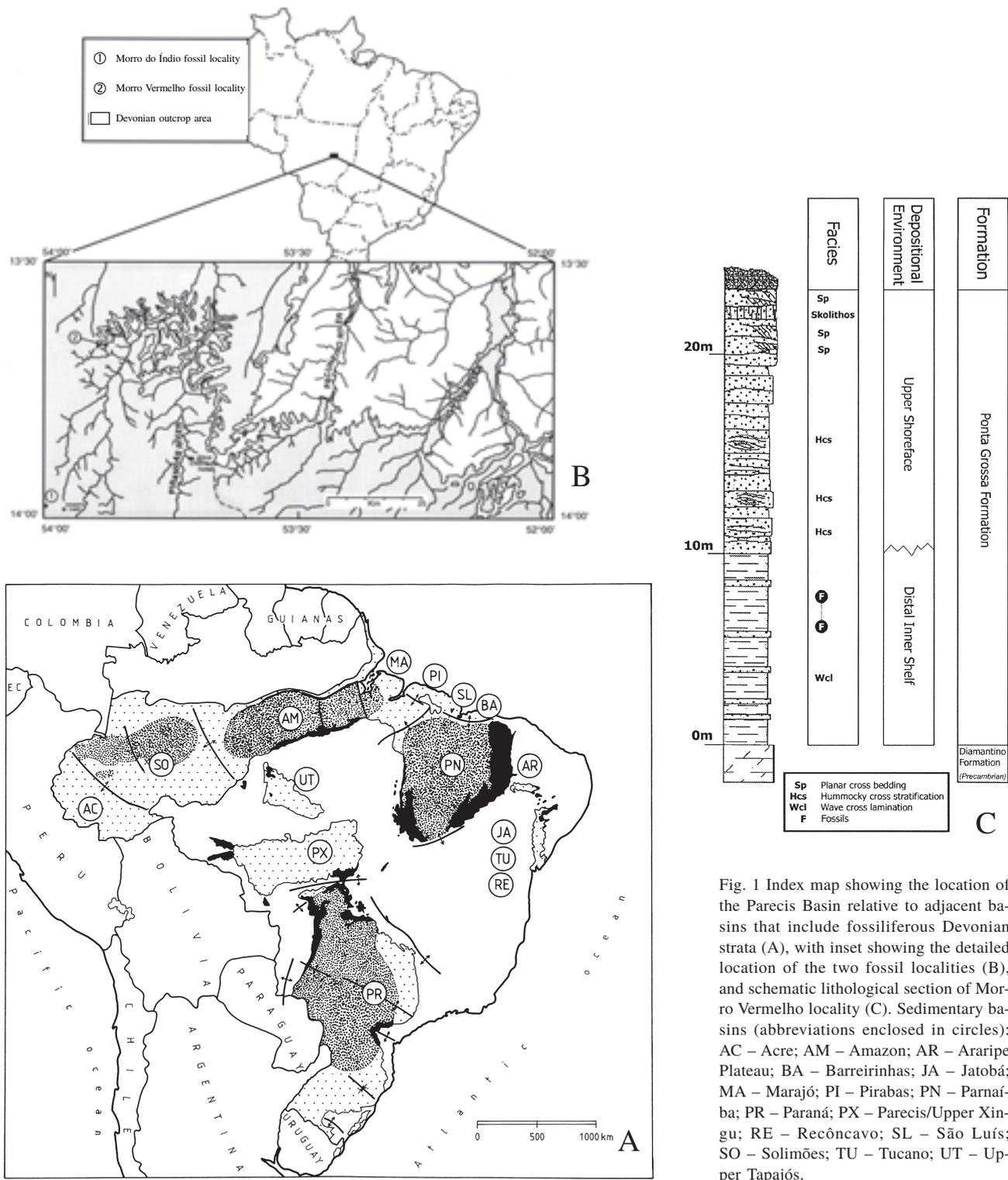


Fig. 1 Index map showing the location of the Parecis Basin relative to adjacent basins that include fossiliferous Devonian strata (A), with inset showing the detailed location of the two fossil localities (B), and schematic lithological section of Morro Vermelho locality (C). Sedimentary basins (abbreviations enclosed in circles): AC – Acre; AM – Amazon; AR – Arapize Plateau; BA – Barreirinhas; JA – Jatobá; MA – Marajó; PI – Pirabas; PN – Parnaíba; PR – Paraná; PX – Parecis/Upper Xingu; RE – Recôncavo; SL – São Luís; SO – Solimões; TU – Tucano; UT – Upper Tapajós.

Ellsworth Mountains of Antarctica, and probably occurs in the Paraná Basin, where it has been identified as *O. baini*. The second species is huge for the genus and in its maximum dimensions is comparable to those of *O. collis*, a species known only from South America.

The collection is of modest size, some 59 specimens. The majority of the specimens, however, are imperfect in one or more ways. Commonly, the outer shell layers

are exfoliated or were abraded prior to fossilization; many specimens are chipped peripherally or have been crushed. Rather surprisingly, five of the 31 specimens of *O. falklandensis* retain both valves in contact. Fortunately, collection size in that species allows most features to be evaluated, but preservation imposes limitations on the value of measurements. These were rounded to the nearest millimeter and some, of necessity, had to be made

on subperipheral growth lines rather than the margin of the valve.

Genus *Orbiculoidea* D'Orbigny, 1847

Orbiculoidea falklandensis Rowell, 1965

Figs 2.1–2.17, 3, 4

The Parecis Basin material shows the greatest similarity to topotypic specimens of *Orbiculoidea falklandensis* but, as is discussed below, most dorsal valves differ from topotypic examples in at least two characters. Limited understanding of distribution of variation in these characters, however, suggests that the differences may be an expression of geographic variation that does not merit creation of yet another new species of the genus.

Description of material from Parecis Basin: Specimen size typical of species, largest valve some 26 mm long. Shells circular to subcircular at commissural margin varying from 10 percent longer than wide to 10 percent wider than long (Figs 2.1, 2.9). Dorsal valve a low cone, apex eccentric, typically 30 percent of valve length behind posterior margin, maximum height of valve immediately in front of apex, height 30 to 40 percent of valve length (Fig. 3). In lateral profile (Figs 2.2, 2.13) posterior slope concave immediately behind apex, gently concave to nearly straight posteriorly, anterior slope of valve gently convex; in posterior profile, lateral slopes of valve gently convex (Fig. 2.13) subtending angle of 110° to 139°. Dorsal valve interior typically featureless, muscle scars unknown; very lightly impressed, radially disposed grooves on inner shell layers probably traces of distal mantle canal branches; rare valves display low median ridge extending back from apex to about midlength of valve (Fig. 2.4). Ventral valve low cone with subcentral apex, about 15 percent as high as long, gently and uniformly convex for initial 10 mm, larger valves concave anteriorly (Fig. 2.18), convexity in all valves interrupted by elongate subelliptical depression around pedicle opening (Fig. 2.9). Adult pedicle opening length about one-third that of valve (Fig. 4).

Ornament of both valves consisting of narrowly rounded subconcentric fila separated by flat interspaces typically four to five times width of fila, interspaces bearing low growth lines (Figs 2.1, 2.9, 2.12). In ventral valves, most of which have more conspicuous and continuous fila than dorsal ones, approximately 4 fila per mm in initial 2 mm of shell growth, becoming more widely spaced with growth of shell, approximately 1 mm apart at margin of valve 25 mm long. In detail, however, ornament of both valves is irregular and complex (Figs 2.15, 2.16, 2.17). Not all fila are continuously tracable around 360° of arc (Fig. 2.17) and, particularly in dorsal valves, they may form outwardly convex drapes with chord length typically 500 to 1000 µm (Fig. 2.16).

Discussion: The Parecis material differs clearly in at least two aspects from modal topotypic material of

O. falklandensis: the dorsal valves are relatively higher, and the majority lack the low median ridge characteristic of specimens from the Falkland Islands. An obvious taxonomic response to such morphological distinction would be to create yet another new species of *Orbiculoidea*. Indeed, one might argue that the consequences of large scale geographic variation, combined with localized, ecologically controlled phenotypic expression, plagues fossil lingulate systematics.

Studies of living lingulates gives some clue to the magnitude of the problem (Emig 1982) and the extent of within species morphologic variation. Chuang (1961), by transplanting young lingulids, was the first to demonstrate conclusively the importance of local environmental effects on growth rate and maximum attained size. Shape variation, however, is also known to be large. No less than thirteen species of living *Lingula* have been described that resemble the type species *L. anatina*; many of them are thought to be synonyms (Emig – Hammond 1981). Along the coast of Queensland, for example, Hammond – Kenchington (1978) have demonstrated that a large sample from a single locality has variability that encompasses the diagnostic features of *L. bancrofti*, *L. exusta*, *L. hians*, and *L. murphiana*, all of which have their type localities along the Queensland coast. They concluded that *Lingula anatina* is the widely distributed lingulid around the entire Indo-West Pacific region and that all the Queensland specimens should be referred to this species. Subsequent enzyme studies of *Lingula* populations show that the gene pool is “virtually homogeneous” for 1200 km along the Queensland coast (Hammond – Poiner 1984) and that genetic distance between populations is almost zero over this distance.

The distribution of variation in Devonian orbiculoid species in the Malvinokaffric Realm is compatible with similar gene pool homogeneity. Samples of *Orbiculoidea falklandensis* from the Parecis Basin are distinguishable from those from the Falkland Islands or the Ellsworth Mountains, but the variation fields overlap. Thus, although topotypic dorsal valves have average height that is only half that of the Parecis material, topotypes include forms that are comparable in height (e.g., Fig. 2.6). Likewise, although most Parecis specimens lack a low dorsal median ridge, it is developed in some individuals (Fig. 2.4). The species has also been recovered from Lower Devonian rocks in the Ellsworth Mountains of Antarctica (Webers 1988) and reexamination of collections from the Horlick Formation of Antarctica shows comparable variation in the height of the dorsal valve (Figs 2.5 and 2.10). The dorsal median ridge appears to be more commonly developed in the Antarctic populations than in our Brazilian samples. What is probably *O. falklandensis* has been recorded previously as *Orbiculoidea bainii* (Sharpe) (Clarke 1913) from the Paraná Basin (see Rowell 1965, for discussion and lectotype designation of *O. bainii*). Clarke's description of the unusual ornament of the specimens is closely comparable with the ornament of the Parecis material for he observed

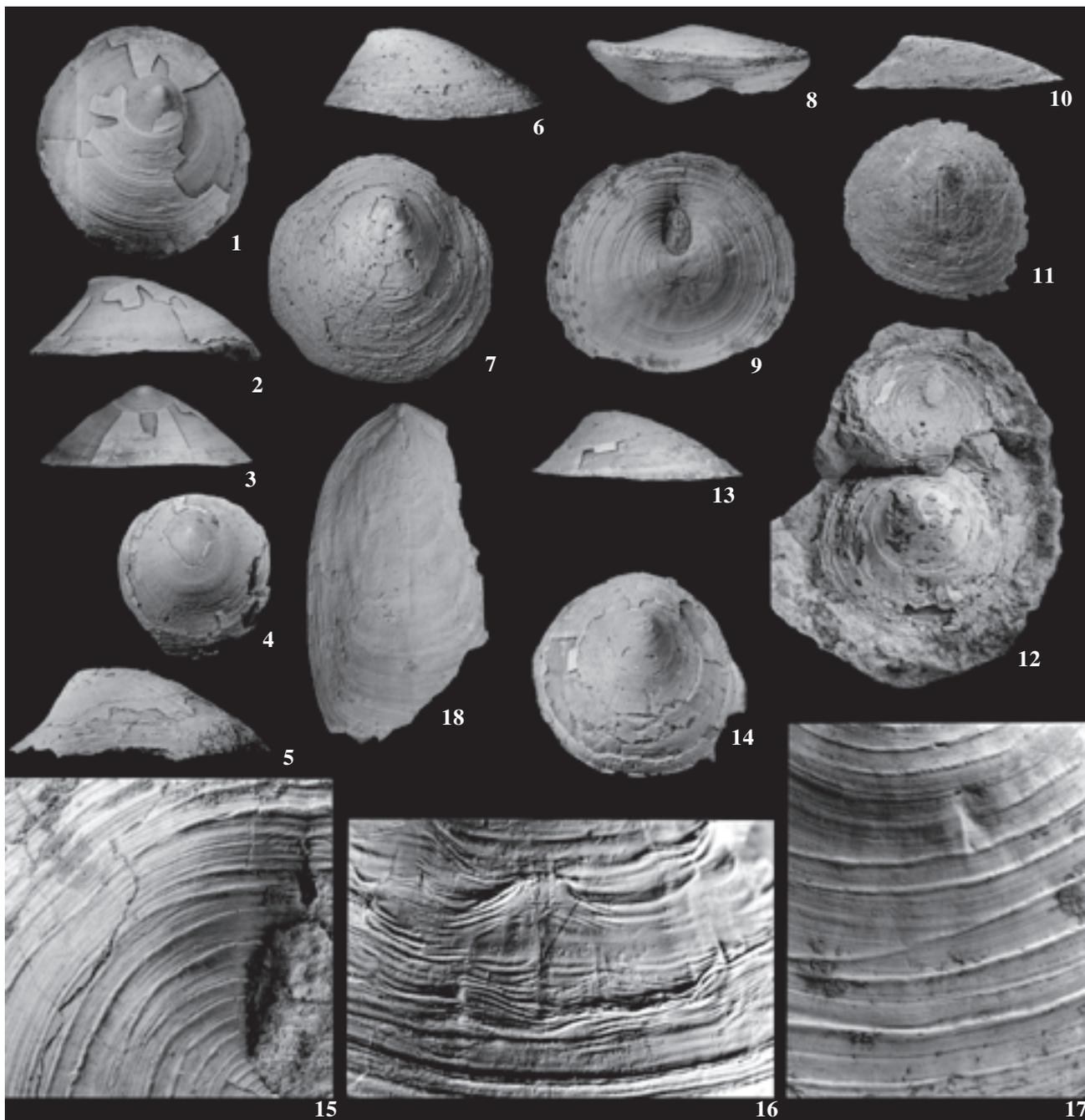


Fig. 2 1–17 – *Orbiculoidea falklandensis* Rowell. Specimens of Figs 1–3, 4, 8–9, 12, 13–17 from the Morra Vermelho Paranatinga region, of Figs 5, 10–11 from Mount Wyatt Earp Formation, unnamed nunatak, 3 km northwest of Plank Point, Heritage Range, Ellsworth Mountains (Lat. 79°21'S, Long. 85°17'W), of Figs 6–7 from Devonian, Chatres, West Falkland Islands, British Museum collections. 1–3, 16 – Specimen B dorsal, lateral and posterior views of dorsal valve, all x1.5, and detail of anterior ornament x10; 4 – Specimen I, dorsal view of largely exfoliated dorsal valve with small medial ridge x2; 5 – USNM 481282, lateral view of relatively high dorsal valve x2 from Antarctica; 6–7 – plaster cast of British Museum specimen BB 17491, lateral and dorsal views of high dorsal valve from the Falkland Islands, both x2; 10–11 – USNM 481283, lateral and dorsal view of low dorsal valve with median ridge from Antarctica, both x2; 12 – Specimen D, Slab with dorsal valve and mold of ventral valve x1.5; 13–14 – Specimen C, lateral and dorsal view of relatively low dorsal valve, both x2; 15, 17 – Specimen A, lateral (with ventral valve uppermost) and ventral views of complete shell with damaged dorsal valve apex both x1.5, detail of ventral valve ornament lateral of pedicle opening x6, detail of pedicle valve ornament anterolateral slope x7; 18 – *Lingula lepta* Clarke, Specimen J, from Morro Vermelho incomplete slightly exfoliated dorsal valve interior, x1.5.

that fila are “...at times quite noticeably irregular, broken or discontinuous.” Such descriptions would fit the “drapes” (Fig. 2.16) that are common features of the Parecis collection. These features are similar to those recorded from

acrotretids (Williams – Holmer 1992), but are an order of magnitude larger. They were presumably formed by secretion from a retractile outer mantle lobe, but whether retraction was associated with mantle setal muscular activi-

ty, as has been suggested for acrotretids (Williams – Holmer 1992) is unclear. Retraction could have been induced by localised trauma at the mantle margin.

I would interpret *Orbiculoidea falklandensis* as a geographically variable species that was the dominant brachiopod at many Early Devonian Malvinokaffric Realm localities. Indeed, in some environments, it was the dominant shelly organism in its community.

***Orbiculoidea* sp. cf. *Orbiculoidea collis* Clarke, 1913**
Figs 5.1–5.3

Four large dorsal valves and two smaller ones probably belong to this species, which was initially described from a collection of two dorsal and a single ventral valve collected from the Paraná Basin (Clarke 1913). Our material is kept in open nomenclature, rather than confidently referred to the species, because the associated ventral valve is currently unknown from the Parecis Basin. Furthermore, from the available illustrations (Clarke 1913, Pl. 25, Figs 25 and 26), we suspect that Clarke (1913) misidentified anterior and posterior directions in his description of the dorsal valves, but we have not had the opportunity to examine the type collection.

The Parecis material is not well preserved. Of the four large dorsal valves, only the figured one is uncrushed and even this specimen (Figs 5.1–5.3) has lost the majority of its outer shell material. The apical region of the valve is retained, however, and the apex of the juvenile valve is clearly present (Fig. 5.1). In all lingulates, this apex points towards, or overhangs, the posterior sector of the dorsal valve. We assume this to be the case in the present material but lack muscle or mantle canal patterns to confirm it.

The biggest shells are relative giants for the genus, the figured one is 52 mm long. Like the type material, it has a subcircular commissural outline but the valve is slightly narrower behind than anteriorly (the reverse of Clarke's description for the species). The subcentral beak is slightly behind the highest point of the valve (Fig. 5.2), and maximum height is almost half of valve length. In posterior profile, the lateral slopes are gently convex and the apex obtuse and rounded. The posterior slope is gently concave in lateral profile, but the unusual feature of the new material is apparent in this view because the anterior slope is initially strongly convex becoming more gently so towards the valve margin. In its strong anterior convexity, the valve differs rather markedly from Clarke's (1913) figured brachial valve.

Genus *Lingula* Bruguière, 1797

***Lingula* sp. cf. *Lingula lept* Clarke, 1913**
Fig. 2.18

Of the nine linguloid specimens in the collection the best, a dorsal valve, is figured. Linguloids are notoriously difficult to identify for reasons discussed above. Bosetti

Dorsal valves

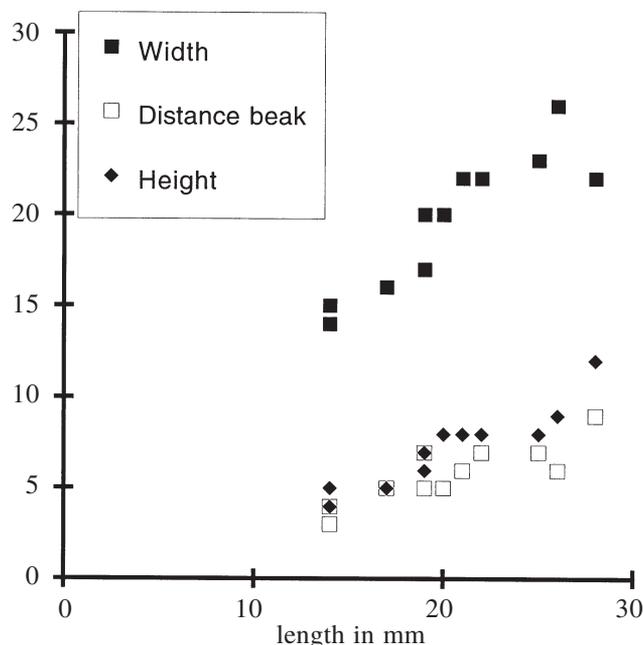


Fig. 3 *Orbiculoidea falklandensis* Rowell from Morro Vermelho locality, Parecis Basin. Bivariate scatter plots of dorsal valve width, height, and distance of beak in front of posterior margin plotted against length.

Ventral valves

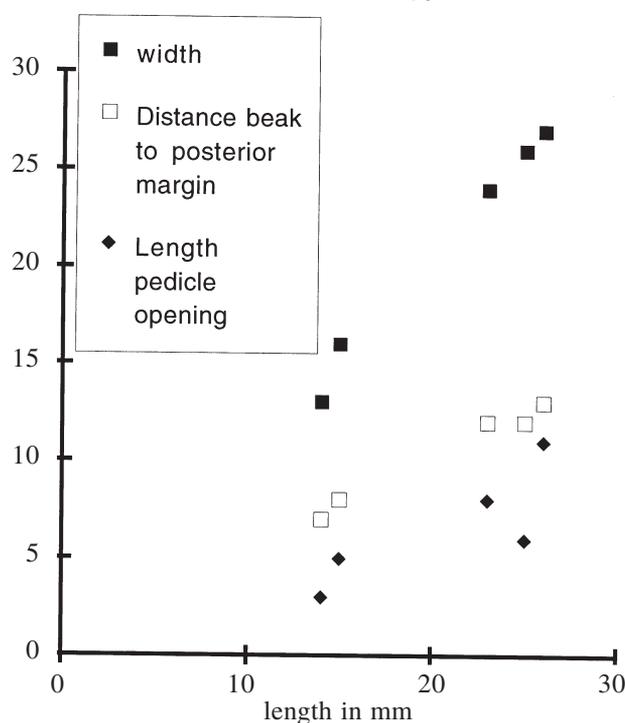


Fig. 4 *Orbiculoidea falklandensis* Rowell from Morro Vermelho locality, Parecis Basin. Bivariate scatter plots of ventral valve width and distance of beak in front of posterior margin plotted against length.

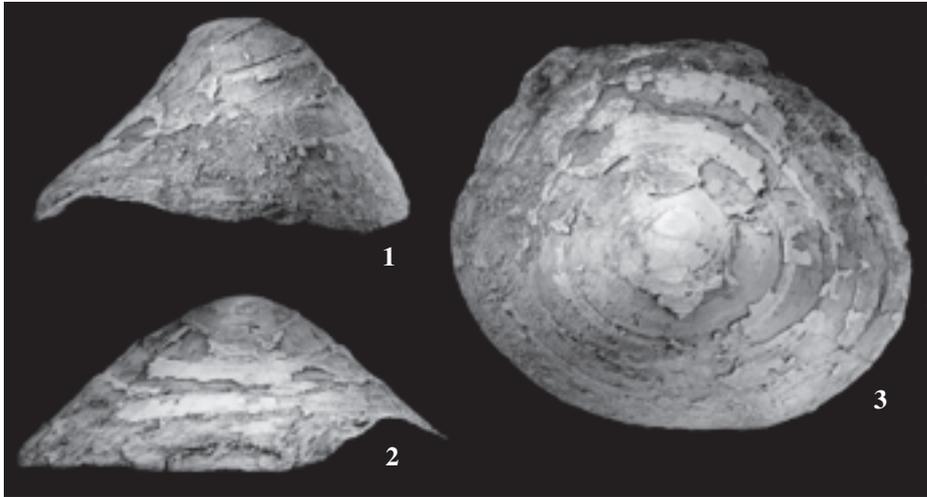


Fig. 5 1–3 – *Orbiculoidea* sp. cf. *Orbiculoidea collis* Clarke, Specimen H, from Paranatinga (Morro do Indio locality) posterior, lateral (anterior slope of valve to the righthand side of figure), and dorsal views of dorsal valve, all x1.

(1989) has struggled with the problems of Brazilian Devonian linguloid systematics but the limited sample size available does not lend itself to statistical treatment of our species. Among described lingulids from the Paraná Basin (Clarke 1913), the material shows close resemblance to *Lingula lepta*, but no well preserved ventral valve material is available for confirmation.

Chonetoid Brachiopods

P. R. Racheboeuf

Superfamily *Chonetoidea* Bronn, 1862

Among the articulate brachiopods, the chonetoideans are represented by two species from the Morro Vermelho locality, namely *Australostrophia mesembria* and *Pleurochonetes sorucoi*. The material is decalcified and well preserved, although not abundant, and the exteriors and interiors of both valves of each species have been found, allowing complete description. The Bolivian species *Australostrophia clarkei* Racheboeuf et Herrera, 1994, is reillustrated here for comparison.

Family *Strophochonetidae* Muir-Wood, 1962

Genus *Australostrophia* Caster, 1939

Type species: *Leptostrophia? mesembria* Clarke, 1913

Australostrophia mesembria (Clarke, 1913)

Fig. 6.1–6.4

Material: One ventral valve external mould; two incomplete ventral interiors; one incomplete dorsal interior and a fragment of a dorsal external mould.

Description: The unique available ventral valve is 12 mm long and 18 mm wide; it bears two well developed growth lines which are respectively 2 mm long and

3.5 mm wide; 10 mm long and 15.5 mm wide; the corresponding length/width ratio increasing during growth respectively from 0.57 to 0.60 then 0.66. The radial ornamentation is composed of low and narrow, subangular costae, progressively widening and tapering anteriorly, while the intervals get narrower; this induces a variation in the ornamentation which is typically parvicostellate posteriorly and becomes costellate along the antero-lateral margins; a total number of 118 costae occur on the 10 mm long stage of the shell; due to the widening of the radial ribs they number 21 per 5 mm on the anterior margin of the 10 mm long stage, and 16 per 5 mm on the 12 mm long shell. The whole surface of both valves is covered by numerous and very fine fila. Two spines are preserved on the left side of the posterior margin; they are rectomorph oblique with an angle of 50°. Ventral interarea aplanate, flat, with a prominent, wide, triangular pseudodeltidium. Dorsal interarea unknown.

Ventral interior with a long, narrow, rounded pad developed along hinge line. Hinge teeth relatively short, rounded anteriorly. Muscle field postero-laterally bounded by low ridges anteriorly divergent at 90°; diductors regularly rounded antero-laterally, divided by a long, narrow, subtriangular myophragm extending anteriorly almost to the anterior margin of the muscle field; adductors very long and narrow, posteriorly situated. Periphery of the valve covered by numerous small endospines, irregularly arranged in the postero-lateral parts of the valve, and becoming progressively radially arranged towards the anterior of the valve.

Dorsal interior with well developed antheridia, anteriorly divergent at about 30°. Median septum relatively wide and longitudinally grooved. Dental sockets not observed; inner socket ridges short, slightly bent posteriorly, anteriorly divergent at 120°. Adductor scars well impressed in the valve floor. Cardinal process wide and deeply bilobed posteriorly; myophore not observed. Inner surface covered with very small endospines and impressed by the external fila.

Discussion: Although not abundant, the available material is sufficient for its assignment to the genus *Australostrophia* Caster, 1939, within the Strophochonetidae (see Racheboeuf – Herrera, 1994; Racheboeuf, 1998, 2000), as well as for establishing the conspecificity of the specimens from the Parecis Basin with Clarke's species *mesembria*. The ornamentation and the internal features of this new material is in good agreement with Caster's (1939) and Boucot's (1975) descriptions. The Parecis material differs from the Bolivian representatives of the genus (assigned to *A. clarkei* Racheboeuf et Herrera, 1994) in the more transverse outline of the shell, the radial ornamentation with more numerous and anteriorly widened ribs, the higher angle of spines, smaller hinge teeth, less anteriorly divergent posterior ventral ridges and dorsal anderidia, and the longitudinally grooved or depressed dorsal septum (see Racheboeuf – Branisa 1985; Racheboeuf 1992; Racheboeuf – Herrera 1994).

Distribution: According to Clarke (1913) the species *mesembria* is known from the Paraná Basin and from the Falkland Islands. Melo (1988) listed the species from the Emsian of Uruguay and the Paraná Basin; from the Upper Emsian-Eifelian of the Paraná and Mato Grosso; with doubt from the Late Eifelian of the Paraná. It is to be noticed here that, according to Melo (1988, part 2) *Australostrophia mesembria* and *Scaphiocoelia* are never associated except in one Bolivian locality, the Chiquitos area, where the chonetoidan would probably be better assigned to *A. clarkei*.

***Australostrophia clarkei* Racheboeuf et Herrera, 1994**
Fig. 6.5–6.8

- v. 1985 *Australostrophia mesembria* (Clarke, 1913); Racheboeuf and Branisa, p. 1448, Figs 9.1–9.5.
- v. 1992 *Australostrophia mesembria* (Clarke, 1913); Racheboeuf, p. 51, Pl. 4, Figs 16–20.
- v. 1994 *Australostrophia clarkei* sp. nov.; Racheboeuf – Herrera, p. 556, Fig. 5.

Holotype: Internal mould of an almost complete shell with articulated valves, illustrated in Racheboeuf and Herrera, 1994, Fig. 5e and herein (Pl. 6, Fig. 5). MHNC 2821.

Type locality: El Peral section, 3.5 km SE of Presto, 300 m east of the hairpin bend of the track from Presto to the YPFB pumping station of Tapirani (Departamento de Chuquisaca, Provincia de Zudañez).

Material: 143 decalcified, complete and incomplete articulated shells and isolated valves.

Diagnosis: A species of *Australostrophia* characterized by radial ornamentation of very narrow, rounded costae, weakly widening anteriorly and with intervals of the same width at the anterior margin; costae number 23 to 28 per 5 mm, 10 mm from beak, and 21 to 24 at the anterior margin; low-angled rectomorph oblique spines (25° to 35°); anteriorly divergent ventral muscle bound-

ing ridges (90° to 112°); high and rounded dorsal median septum; anderidia anteriorly divergent at 32° to 40°.

Description: Racheboeuf – Branisa, 1985, Racheboeuf, 1992, and Racheboeuf – Herrera, 1994.

Comparison: *Australostrophia clarkei* differs from *A. mesembria* in its less transverse outline; its weaker ornamentation with more numerous costae (23 to 28 per 5 mm, 10 mm from the beak instead of about 20); less erect spines (25° to 35° instead of 50°); more divergent muscle bounding ridges (90° to 112° instead of 70° to 90°); a rounded and not longitudinally grooved or depressed dorsal median septum and more divergent anderidia (32° to 40° instead of 30°).

Distribution: Bolivia in the *Scaphiocoelia* Fauna: Altiplano, in the lower part of the Lower Member of the Belén Formation, central Subandine zone, in the transitional beds between the top of the Santa Rosa Formation and the lower part of the Lower Member of the Icla Formation, Upper Lochkovian-Lower Pragian (Le Hérisse et al. 1992).

Family Chonetidae Bronn, 1862

Subfamily Notiochonetinae Racheboeuf, 1992

Genus *Pleurochonetes* Isaacson, 1977

Type species: *Chonetes (Pleurochonetes) lauriata* Isaacson, 1977

***Pleurochonetes sorucoi* Racheboeuf, 1992**

Fig. 6.1–6.4

Material: Three ventral exteriors; eight exteriors; one ventral interior and two dorsal interiors.

Discussion: The specimens from the Parecis Basin cannot be distinguished from the Bolivian ones. The shells have identical morphologies, ornamentation and spines. The outline of the Brazilian specimens is the same (ratio of length versus width between 0.66 and 0.68, instead of 0.62 to 0.68); the ventral costae number 9 to 10 instead of about 10; they bear 5 spines on each side of the beak, but the shells are smaller. Internally the only difference would lie in the ventral interior which has a longer myophragm (compare with Racheboeuf, 1992, Pl. II, Fig. 15), but the unique available, poorly preserved ventral interior has no significance. Dorsally the brevisseptum is not developed in the Brazilian material, but this is related to the relatively small size of the shells (compare with Racheboeuf 1992, Pl. III, Figs 4 and 5).

Distribution: In Bolivia *Pleurochonetes sorucoi* is known from the central Subandine zone in the middle part of the Upper Member of the Icla Formation, while on the Altiplano the species occurs in the higher part of the Lower Member of the Belén Formation. A late Eifelian age has been assigned to these levels in Bolivia (Le Hérisse et al. 1992).



Non-chonetid articulate brachiopods

A. J. Boucot

Order Orthotetida Waagen, 1884

Unidentified orthotetid

Fig. 7.9

A single impression of a dorsal exterior has form and ornamentation consistent with assignment to the orthotetids. In the Malvinokaffric Realm this type of shell has commonly been assigned to “*Schuchertella*”, although pending revision of the Silurian and Devonian orthotetids this assignment is questionable (see Isaacson 1977a, for a typical treatment of such materials within the Realm).

Order Spiriferida Waagen, 1883
Superfamily Atrypacea Gill, 1871
Family Leptocoeliidae Boucot et Gill, 1956

Comment: For over a century it has been customary to assign the leptocoelids to the spire bearers, despite the absence of spiralia in any known leptocoelid, because of their overall external similarity to the spire-bearing anplotheccids. However, Dr. Norman Savage in the forthcoming Treatise revision has decided to reassign the leptocoelids to the rhynchonellids. We maintain the “traditional” superfamilial assignment pending the appearance of Savage’s revision.

Genus *Australocoelia* Boucot et Gill, 1956***Australocoelia palmata* (Morris et Sharpe, 1846)**

Fig. 7.10–7.14

Boucot – Gill (1956) and Isaacson (1977b) provide adequate descriptions of *Australocoelia palmata*, and Isaacson justifies the specific terminology, which is well supported now by specimens from the Falkland Islands that clearly indicate that Morris and Sharpe’s species differs in no significant manner from Boucot and Gill’s (1956) Bolivian material which they assigned to a new species. The Parecis Basin material is typical of the species.

Superfamily Spiriferacea King, 1846
Family Delthyridae Waagen, 1883
Subfamily Acrospiriferinae Termier et Termier, 1949

Genus *Australospirifer* Caster, 1939***Australospirifer* sp.**

Fig. 7.1–7.3

Several specimens of typical *Australospirifer* are present in the Parecis Basin collections from Morro do Indio, but are too poorly preserved to be specifically identifiable.

Suborder Centronellidina Stehli, 1965
Family Meganteridae Schuchert et Levene, 1929
Subfamily Mutationellinae Cloud, 1942

Genus *Pleurothyrella* Boucot, Caster, Ives et Talent, 1963***Pleurothyrella* cf. *knodi* (Clarke, 1913)**

Fig. 7.4–7.8

A single sample, including two individuals, of *Pleurothyrella* records one conjoined individual and one dorsal valve. Both specimens are external impressions, with no information about the interiors, which is unfortunate. However, the external form, size and nature of the costellae conform in all regards to known Bolivian specimens of *P. knodi*. The confer status is employed because of the absence of information about the interiors. Boucot et al. (1963) provide an adequate description of the genus and its species, with no additional information having been uncovered since that time.

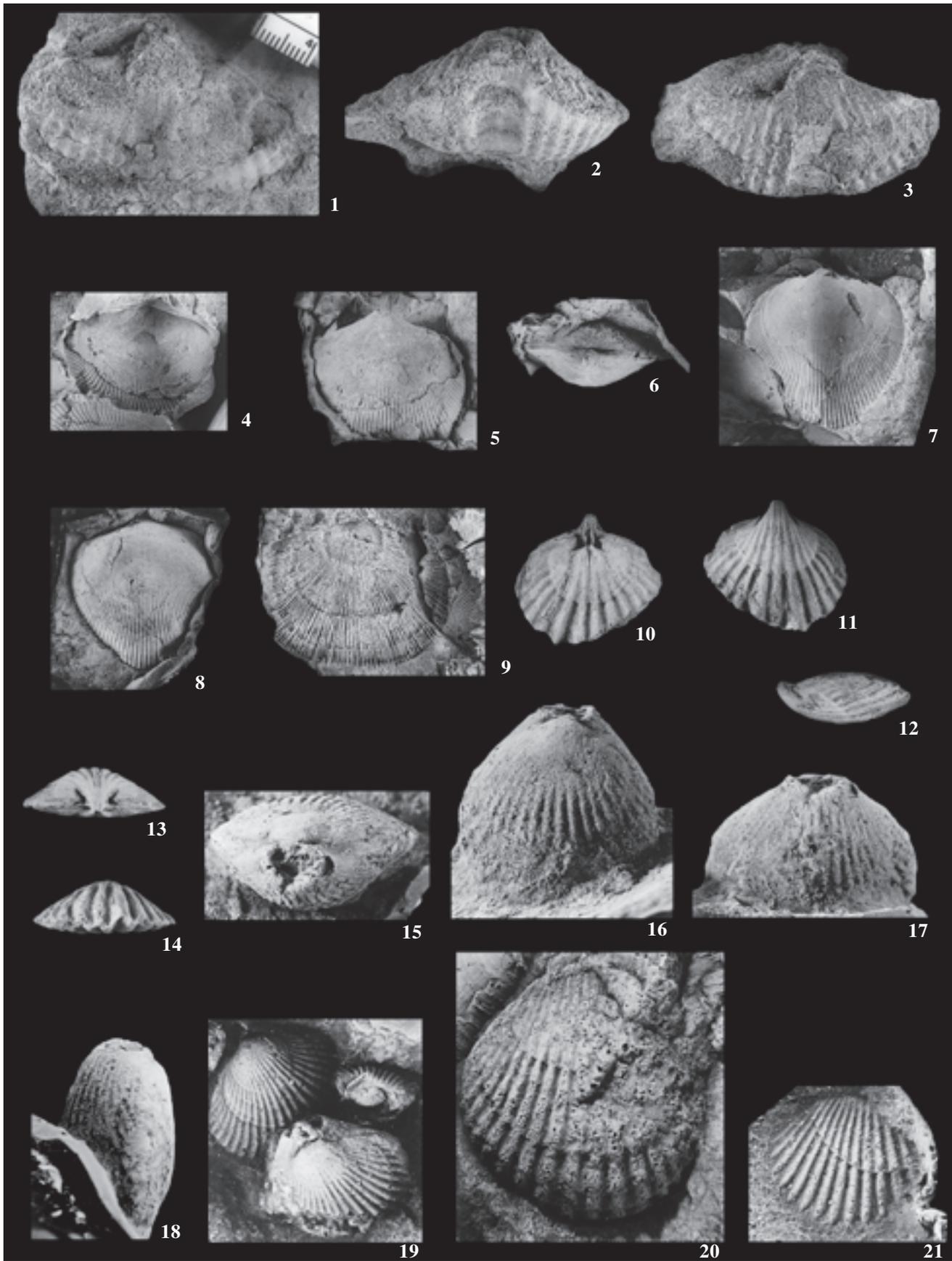
Genus *Derbyina* Clarke, 1913***Derbyina* sp.**

Fig. 7.15–7.21

Cloud (1942) has discussed the many problems associated with *Derbyina* and closely related or possibly synonymous genera. The Parecis Basin material is too limited, with no data about internal features, to provide any insight into these problems. However, the external morphology of the Parecis Basin specimens leaves no doubt



Fig. 6 Chonetoidean brachiopods. 1–4 – *Australostrophia mesembria* (Clarke). 1 – Ventral valve exterior, rubber cast, x2 (MN 7530-I); 2, 3 – Incomplete ventral valve interior, internal mold, x2, and rubber cast of the same, x4, respectively (MN 7531-I); 4 – Incomplete juvenile dorsal valve interior, rubber cast, x2 (MN 7532-I). Morro Vermelho; 5–8 – *Australostrophia clarkei* Racheboeuf et Herrera. Presto-EI Peral section, Bolivia; 5 – Dorsal side of an articulated shell, rubber cast, x2, MHNC 2792; 6 – Ventral valve internal mould, x2, MHNC 2794; 7 – Dorsal valve interior, rubber cast, x2, MHNC 2823; 8 – Incomplete interior of an articulated shell, rubber cast, x4, rubber cast, MHNC 2821; 9–12 – *Pleurochonetes sorucoi* Racheboeuf. 9, 10 – Two articulated shells, rubber casts, ventral and dorsal views, x2 (MN 7533-I); 11 – Dorsal valve interior of the complete articulated shell, rubber cast illustrated in Fig. 9, x2 (MN 7533-I); 12 – Ventral valve internal mold, x2 (MN 7534-I). Morro Vermelho.



about their nature. Until the varied species assigned to *Derbyina* and the possibly synonymous genera are analysed with better material than has hitherto been available it would be unwise to attempt a specific determination.

Biogeography and paleoecology

The marine invertebrate fauna from Morro Vermelho includes a homalonotid trilobite, *Burmeisteria*, which also occurs at many other Malvinokaffric Realm localities (Carvalho 1997). Carvalho and Edgecombe (1991) have previously described two Malvinokaffric Realm trilobites from Morro Vermelho (*Calmonia triacantha* and *Metacryphaeus australis*). The specimens of *Pleurothyrella* cf. *knodi* (Clarke, 1913) are strongly indicative of Malvinokaffric Realm affinities, since the genus is known only from the Malvinokaffric Realm, except for the morphologically divergent *P. venusta* of the New Zealand Region with its anteriorly bifurcating costellae. It is notable that *P. knodi* is known elsewhere only from Bolivia (Boucot et al. 1963), with other, distinct species known from both South Africa and Antarctica, i.e. the species of this genus appear to be highly endemic. The presence of *Australostrophia*, a genus restricted to the Malvinokaffric Realm (*A. mesembria*, Brazil; *A. clarkei*, Bolivia; *A. senegalensis*, Senegal; see Racheboeuf – Villeneuve 1989) is important, as is the presence of large orbiculoids, like *Orbiculoidea falklandensis*. Also significant is the presence of the strictly Malvinokaffric Realm *Australocoelia palmata*, widespread in the South American Malvinokaffric Realm fauna, as well as from the Falkland Islands and South Africa. The non-Malvinokaffric Realm Tasmanian *Australocoelia polyspera* is morphologically distinctive (Boucot – Gill 1956). The presence of *Derbyina* sp. is also indicative of Malvinokaffric Realm affinities since this genus (see Cloud, 1942, for discussion) is thus far known only from the Malvinokaffric Realm. The presence of *Australospirifer*, a strictly Malvinokaffric Realm taxon is also important, although the poor state of preservation of the Parecis Basin material is unfortunate. Notable by their absence are such Eastern Americas Realm taxa as atrypaceans and pentamerids. The Parecis Basin fauna, despite the limited number of specimens and taxa, is overall a typical Malvinokaffric Realm fauna.

Ecologically it is difficult to deal with the Parecis Basin fauna because it was collected chiefly from loose, weathered blocks, rather than from outcrop, with no hint of stratigraphic order for the individual blocks. However, the abundant orbiculoids might represent a benthic assemblage 1 community type, while the bunched association of *Australocoelia*, as well as chonetoids might represent benthic assemblage 2 or slightly deeper conditions, as is also the case for the *Pleurothyrella* aggregation (one small piece only), while the spiriferids and the orthotetacid might suggest benthic assemblage 3.

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Fig. 7 Non-chonetoid articulate brachiopods. *Australospirifer* sp. 1 – impression of interior of ventral valve (x1) (MN 7535-I). Morro do Indio locality; 2, 3 – impression of interior of conjoined valves, anterior, dorsal (x1) (MN 7536-I). Morro do Indio locality; *Pleurothyrella* cf. *knodi* (Clarke) 4–8 – impression of ventral exterior, rubber replica of ventral exterior, rubber replica of conjoined exterior, impression of dorsal exterior, rubber replica of dorsal exterior (x1.5) (MN 3537-I). Morro Vermelho; Orthotetacid. 9 – impression of dorsal exterior (x1) (MN 7538-I); *Australocoelia palmata* (Morris et Sharpe). 10–14 – impression of interior, (x1.5), dorsal, ventral, side, posterior, anterior views (MN 3539-I). Morro Vermelho; *Derbyina* sp. 15–21 – rubber replicas of exteriors, posterior view of conjoined valves, dorsal view of conjoined valves, ventral view of conjoined valves, side view of conjoined valves (x4) (MN 7542-I). Morro Vermelho.

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Pozice severní hranice malvinokaferské provincie ve spodním devonu podle nových nálezů brachiopodů v pareciské pánvi (Brazílie)

Severní biogeografická hranice mezi spodnodedevonskou malvinokaferskou a východoamerickou provincií je obvykle kladena mezi severním okrajem pánve Paraná a jižním okrajem amazonské pánve. Toto umístění tak prochází i pánví Parnaíba. Současný objev typické spodnodedevonské malvinokaferské brachiopodové fauny v pareciské pánvi, tj. severně od pánve Paraná, umožňuje výrazné posunutí této hranice k severu, k umístění mezi pareciskou a amazonskou pánví a současně umožňuje její průchod pánví Parnaíba. Dřívější údaje o trilobitech z pareciské pánve jsou v souladu s biogeografickými závěry založenými na brachiopodových faunách.

Inartikulární brachiopodi, které identifikoval A. J. Rowell, jsou *Orbiculoidea falklandensis*, *Orbiculoidea* sp. cf. *Orbiculoidea collis* a *Lingula* sp. cf. *Lingula lepta*. Z artikulárních brachiopodů byli chonetidní brachiopodi determinováni P. R. Racheboeufem jako *Australostrophia mesembria*, *Australostrophia clarkei* a *Pleurochonetes sorucoi*. Zbývající artikulární brachiopody determinoval A. J. Boucot, který zjistil *Australospirifer* sp., *Australocoelia palmata*, *Pleurothyrella* cf. *knodi*, *Derbyina* sp. a blíže neurčitelný druh orthotetacida.

Z těchto brachiopodových taxonů jsou druhy *Orbiculoidea falklandensis*, *Australostrophia mesembria*, *Australocoelia palmata* a rod *Pleurothyrella* typickými taxony malvinokaferské provincie. Zcela zde chybí taxony význačné pro východoamerickou provincii. Z paleoekologického hlediska je tato fauna nejlépe umístitelná do bentického souboru 2 až 3, tj. do mělce subtidálního prostředí v rámci fotické zóny. Ze stratigrafického hlediska je fauna srovnatelná s faunami spodního devonu pánve Paraná.