



Observations on Zealandian Triassic and Jurassic Brachiopoda

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Abstract

This paper includes a series of new records, nomenclatural changes and changes in stratigraphic and geographic ranges of Brachiopoda from the Triassic and Jurassic of New Zealand and New Caledonia. Following a suggestion in the Treatise on Invertebrate Paleontology, the Early Jurassic species *Vincentirhynchia uitoeensis* and *Vincentirhynchia pomeyrol* are assigned to the genus *Prionorhynchia*. Specimens of *Aparimarhynchia dunrobinensis* from the Kaka Point Fold Belt, South Otago are recorded and figured, and the time range of the genus *Aparimarhynchia* is reviewed. Two species of Norellidae are now recognised, and are tentatively placed in the subfamily Diholkorhynchiinae. *Clavigera drotae* is reviewed on New Caledonian material in University of Auckland collections. A single related specimen is recorded from Kawhia. The New Zealand material identified by Trechmann (1918) as *Spiriferina fragilis* is assigned to *Punctospirella* Dagsys, 1974, of which *S. fragilis* is the type species. The use of *Punctospirella* cf. *fragilis* is recommended for the Zealandian material. A newly found spiriferinide from the Late Triassic (Otapirian / Rhaetian) of Marokopa, Kawhia Syncline is identified as *Dispiriferina* cf. *davidsoni*. A spiriferinide previously noted as *Psioidiella* from the Hettangian of New Caledonia is doubtfully identified as *Spiriferina arakiwa*. New records of *Linguithyr* *ageri*, *Murihikurhynchia malingi* and *Herangirhynchia awakinoensis* extend the stratigraphic and geographic ranges of these species.

Key words: Zealandia, New Zealand, New Caledonia, Triassic, Jurassic, Brachiopoda

Introduction

The author has been working on Zealandian Mesozoic brachiopod faunas since the 1970s, beginning with a M.Sc. thesis on the Mesozoic stratigraphy of the Marokopa area at the University of Auckland under the supervision of Prof. J.A. Grant-Mackie. This was completed in 1975 and published as MacFarlan (1998). This led to a PhD on Triassic and Jurassic rhynchonellides at the University of Otago under the supervision of Prof. J.D. Campbell in 1985, published in 1992 and subsequent publications on Triassic and Jurassic terebratulides (MacFarlan & Campbell, 2003, MacFarlan 2016, 2019, 2023b) and spiriferinides (MacFarlan 2023a). Some identifications were published in the biodiversity inventories of Gordon (2009) and Kelly *et al.* (2023).

This paper is intended to put on record some of the taxonomic items that have been noted in the course of this previous work, but which have not been given a detailed systematic account. While the items are unrelated, all require publication.

Locality and collection data

The specimens described here were found in the Murihiku Terrane and Kaka Point Fold Belt of New Zealand and the Teremba Terrane of New Caledonia (Figure 1), and are held by Earth Sciences New Zealand, Lower Hutt, the Geology Museum, University of Otago, Dunedin, and the University of Auckland.

The localities discussed here are registered in the New Zealand Fossil Record File maintained by the Geoscience Society of New Zealand and GNS Science (Clowes *et al.* 2021). Localities are registered by NZMS260 map sheet number and registration number (FR number), with a letter to indicate a recollection (for example R13/f6613A). New Caledonian collections (Fig. 2) held in New Zealand are also registered in the Fossil Record File (prefixed NC).

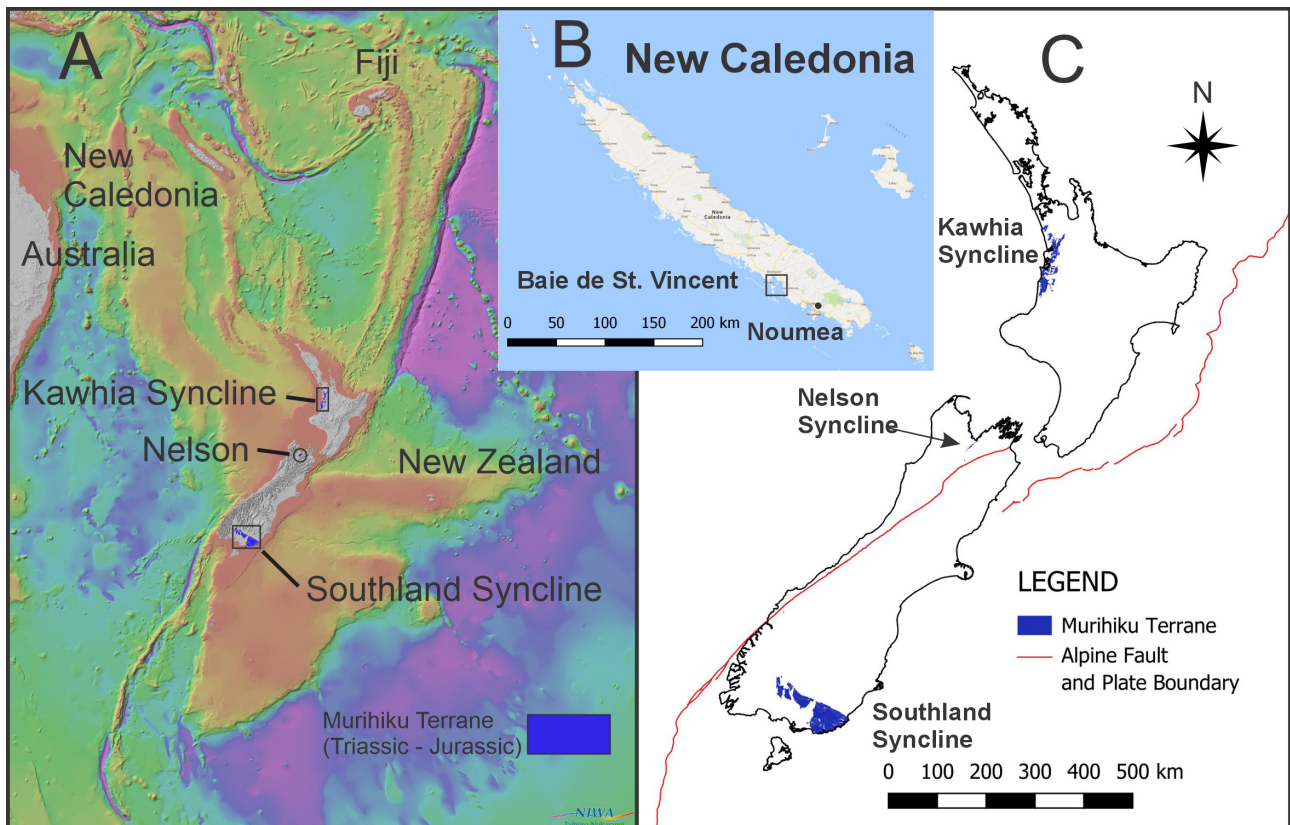


FIGURE 1. A Zealandia in the southwest Pacific (NIWA map) B New Caledonia, showing Baie de St Vincent C New Zealand, showing key areas.

The Paleobiology Database has been used in establishing international time and geographical ranges of genera and species. In a small number of cases, the primary literature cited in the PBDB has not been obtainable locally. These are marked as *fide* PBDB.

Classification follows the *Treatise on Invertebrate Paleontology part H (revised)* (Kaesler, (Ed.) 1997–2006, Selden (ed.) 2007). Authorship for higher taxa, genera and type species also follows Treatise usage. The timescale used follows Cooper (2004) and Raine *et al.* (2015).

Collections and specimens are catalogued as follows:

Auckland University School of Environment: Collections prefixed AU, brachiopod specimens prefixed B.

Otago University Geology Museum: collections under collector's field number, catalogued specimens prefixed OU, J.D. Campbell collection specimens prefixed C, Maling collection specimens with locality and specimen numbers.

National Paleontological Collection at Earth Sciences New Zealand, Avalon: collections prefixed GS, catalogued specimens prefixed BR.

Measurements: The measurement scheme is as used in previous papers and detailed in MacFarlan (2022).

Abbreviations: **Lv** length of ventral valve, **Ld** length of dorsal valve, **W** width, **H** height (double-valved specimens), **Ha** height of area (spiriferinides), **Wp** width of fold/sulcus (spiriferinides), **b<** beak angle (degrees) on ventral valve, **ms/dv** length of median septum as proportion of Ld (rhynchonellides). **Material:** **vv** ventral valve, **dv** dorsal valve, **b** both valves, **int** internal mould, **ext** external, **pt** part, **juv** juvenile. **ant** anterior, **post** posterior.

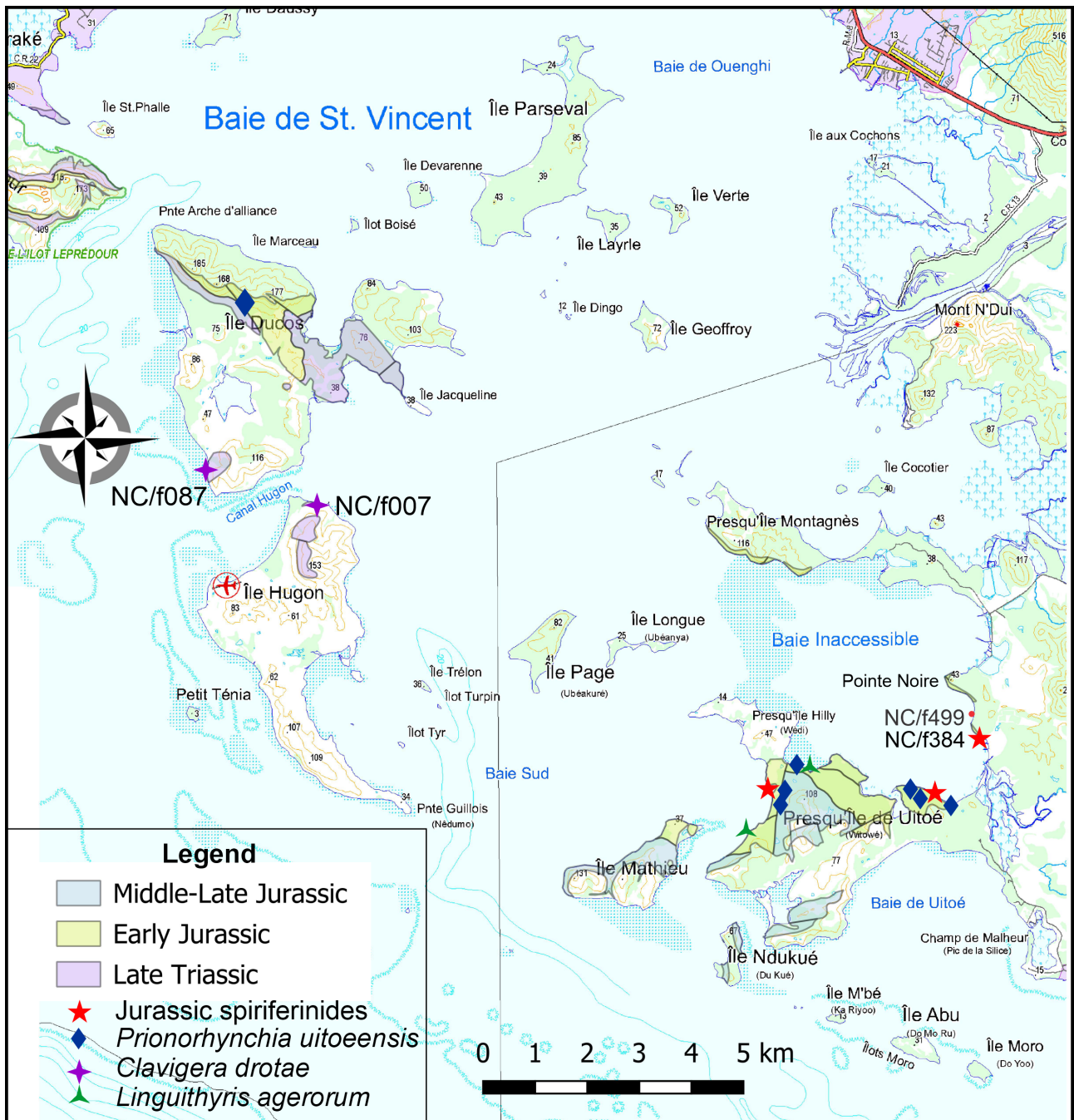


FIGURE 2. Uitoé Peninsula and Baie de St. Vincent.. Base and geology from Gouvernement de Nouvelle-Calédonie data. Fossil Record File numbers referred to in the text are shown.

Systematics

Status of species originally placed in *Vincentirhynchia*

Vincentirhynchia uitoeensis and *V. toki* were erected by MacFarlan (1992) within the new genus *Vincentirhynchia* MacFarlan (type species *Rhynchonella pomeyrol* Drot, 1953).

In the Treatise on Invertebrate Paleontology, Part H (revised) Brachiopoda, Savage *et al.* (2002, p. 1266) suggested that *Vincentirhynchia* is “best restricted to the type species, as other assigned species may be referable to *Cirpa* and *Prionorhynchia*”. This note is intended to give effect to this suggestion and places both species in *Prionorhynchia*, leaving only *V. pomeyrol* in *Vincentirhynchia*.

The small beak, prominent planareas and generally triangular outline of the two Zealandian species fit well into the European and Mediterranean genus *Prionorhynchia* Buckman, 1918. The hingeplate differs, with a shallow trough-like septalium in *V. toki* and *V. uitoeensis*, whereas *Prionorhynchia* generally does not have a septalium and has a very short median septum (Ager 1956, Siblík 2008). However, Ager (1967) noted a small septalium in one BM(NH) specimen of *P. serrata*, and Siblík (1964) described a narrow but deep septalium in *P. aff. serrata*. Later, Siblík (2008) described “*Rhynchonella*” aff. *belemnitica* from the Mittenwald of Austria. This has a large v-shaped septalium and well-developed median septum. The outline is triangular, but with a broadly convex anterior margin. Planareas are not as well developed as in the two species discussed here.

Rhynchonella rubrisaxensis Rothpletz, 1886 is placed in *Sphenorhynchia* by some authors (Manceñido 1991, Kamyshan & Babanova 1973, Alméras & Cougnon 2013), but others, including more recent workers, include it in *Prionorhynchia* (Rousselle 1973, Garcia Joral *et al.* 1990, 2022, 2023, Garcia Joral & Goy 2022) and this usage is followed here. This species is common in some localities in the Northern Calcareous Alps (Garcia Joral *et al.* 2023) and is present in northern Spain (Garcia Joral & Goy 1994) and the Balearic Islands (Garcia Joral *et al.* 2022). Kamyshan & Babanova (1973) record *Sphenorhynchia rubrisaxensis* from Georgia and the Caucasus and Manceñido (1991) records *S.?* cf. *rubrisaxensis* from the Toarcian of Argentina.

Most other species of *Prionorhynchia* have a more convex anterior margin than the two species listed here, but some species such *P. fraasi* (Oppel, 1861) and *P. palmata* (Oppel, 1861) have a more triangular outline. *P. belemnitica* (Quenstedt, 1852) has a pentagonal outline, a straight anterior margin and a similar sulcus to the two species discussed here.

Prionorhynchia is present in the Early Jurassic of much of Europe and North Africa, and is characteristically Tethyan (Ager 1967, Ager & Sun 1988 among many others). It is found in Turkey (Ager 1959b) and Thailand (Alméras 1988).

Cirpa De Gregorio, 1930, the other genus mentioned by Savage *et al.* (2002), has a thickened anterior margin (Ager 1956). Baeza-Carratalá & Garcia Joral (2022) considered that (p.1018) “even though some external features of *V. uitoeensis* (MacFarlan, 1992) can fit into the generic concept of *Cirpa* herein considered, the broader and shallower fold (even rectimarginate in some other species), the presence of divided hinge plates, and the well-defined median septum supported by a deep septalium raise questions in these latest Triassic–Early Jurassic records”.

Dr Baeza-Carratalá (pers. comm. 27 June 2025) had noted the presence of a deeper septalium in some European specimens of *Prionorhynchia*, thus corroborating this genus as a good option to assign the Zealandian specimens.

Phylum BRACHIOPODA Duméril, 1806

Subphylum RHYNCHONELLIFORMEA Williams *et al.*, 1996

Order RHYNCHONELLIDA Kuhn, 1949

Superfamily RHYNCHOTETRAIDOIDEA Licharew, 1956

Family PRIONORHYNCHIIDAE Manceñido and Owen, 2002

***Prionorhynchia* Buckman, 1918**

1918 *Prionorhynchia* Buckman, p. 62.

1965 *Prionorhynchia* Buckman, 1918; Ager, p. H607.

1973 *Prionorhynchia* Buckman, 1918; Rousselle, p. 135.

2002 *Prionorhynchia* Buckman, 1918; Savage *et al.* p. 1252.

2013 *Prionorhynchia* Buckman, 1918; Alméras & Cougnon, p. 47.

Type species: *Terebratula serrata* J. de C. Sowerby 1825 in 1823–25 p. 168. Lower Jurassic of Lyme Regis, England.

***Prionorhynchia uitoensis* (MacFarlan, 1992)**

1992 *Vincentirhynchia uitoensis* MacFarlan, p. 151, pl. 17 1–8, fig. 11.1d.

For the description of *P. uitoensis* see MacFarlan (1992).

Remarks

This species is known only from New Caledonia, (Figure 2) where it occurs in the upper Aratauran and Ururoan (Sinemurian-Toarcian, Raine *et al.* 2015) but probably Sinemurian-Pliensbachian). The holotype is shown in Figure 3.1). Most localities are in the Uitoé Peninsula (MacFarlan, 1992).

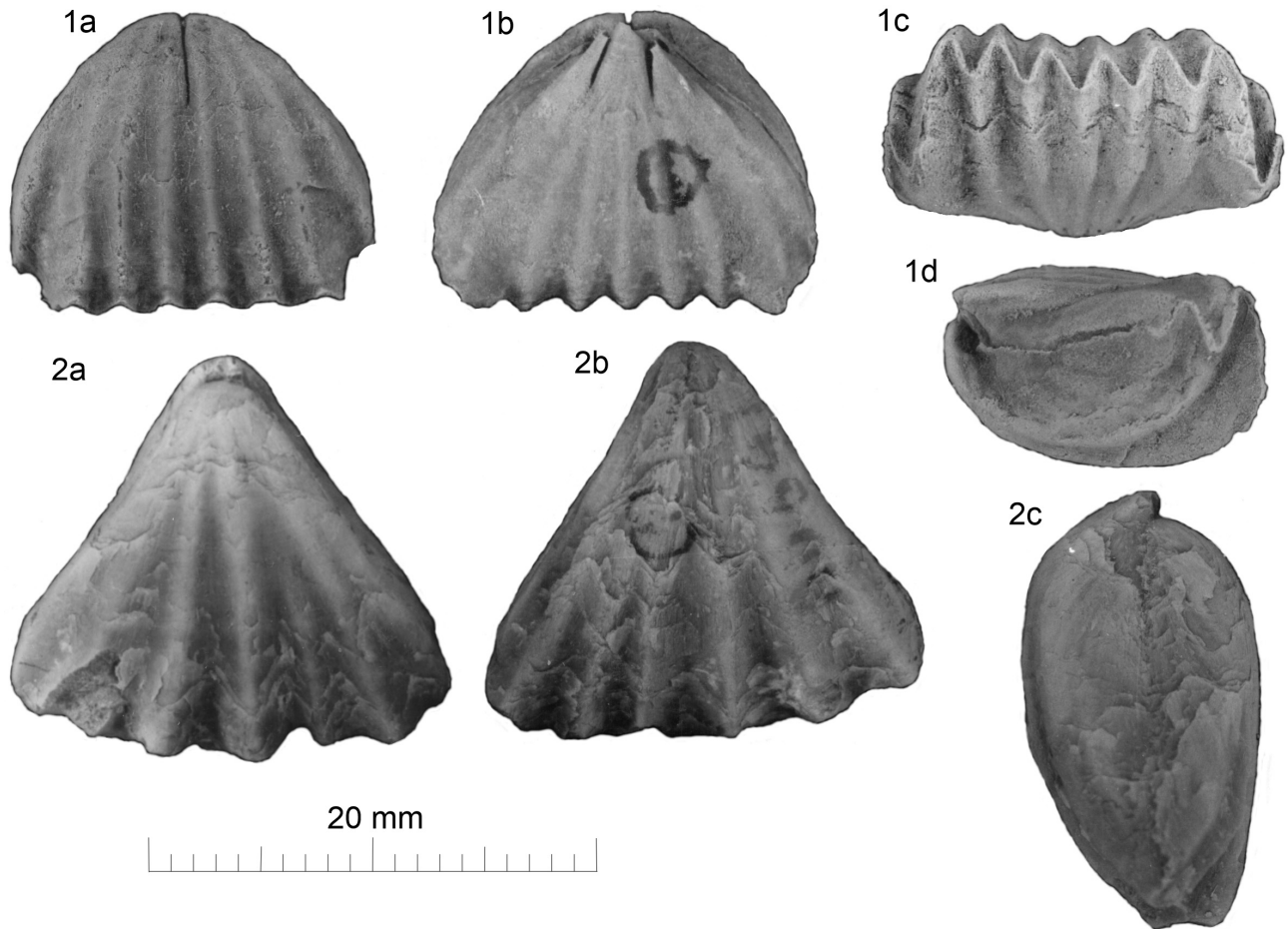


FIGURE 3. Holotypes of *Prionorhynchia uitoensis* and *P. toki*. **1** *Prionorhynchia uitoensis* Holotype, OU 17510 (NC/f647) (a) dorsal (b) ventral (c) anterior (d) lateral. **2** *Prionorhynchia toki* Holotype, AU B200 (R15/f8006) (a) dorsal (b) ventral (c) lateral.

***Prionorhynchia toki* (MacFarlan, 1992)**

1992 *Vincentirhynchia toki* MacFarlan, 1992 p. 152–154, pl. 17: 9–17, fig. 11.12e.

2009 *Vincentirhynchia toki* MacFarlan, 1992; MacFarlan *et al.* p. 266.

2023 *Prionorhynchia toki* (MacFarlan, 1992); Robinson *et al.* p. 253.

For the description of *P. toki* see MacFarlan (1992).

Remarks

The wedge shape and rectimarginate anterior commissure make this species readily identifiable. It is more sharply triangular than *P. uitoeensis* and has fewer but stronger costae (Figure 3.2). It is rare in the lower Ururoan *Pseudaucella* beds of the North Island, Pliensbachian) but more common in the Upper Ururoan (Toarcian). The sole Southland record is from Jewitt Road, southern Hokonui Hills (E46/f0056), and it has not been recorded from New Caledonia (MacFarlan 1992).

In the Early Jurassic of Zealandia, *Prionorhynchia* is found with the rhynchonellide *Furcirhynchia* (MacFarlan 1992), the spiriferinides *Spiriferina*, *Callospiriferina*, *Dispiriferina* and *Cisnerospira* (MacFarlan 2023a), and the terebratulides *Lobothyris* and *Loboidothyris* (MacFarlan 2019). These have a generally similar distribution, with a “core” in southern Europe and North Africa, and scattered occurrences on the west coasts of North and South America, Zealandia and East Asia from China to Indonesia. This may in part reflect the areas which have been studied intensively for Mesozoic marine faunas.

Herangirhynchia awakinoensis from north of Awakino

Superfamily RHYNCHONELLOIDEA d’Orbigny, 1847

Family RHYNCHONELLIDAE d’Orbigny, 1847

Subfamily RHYNCHONELLINAE d’Orbigny, 1847

Herangirhynchia MacFarlan, 1992

Type species: *Herangirhynchia herangiensis* MacFarlan, 1992. *Dactylioceras* bed, Ururoa Point, Kawhia, Upper Ururoan (Toarcian).

Herangirhynchia awakinoensis MacFarlan, 1992

Material

Herangirhynchia awakinoensis has until now been recorded only from a few outcrops in the Awakino Gorge, with most of the material coming from two quarries (MacFarlan 1992). A further specimen is here recognised from the coast north of Marokopa.

BR 3190, a ventral valve internal from R16/f6905, GS10043, ridge track above and to the east of Lake Harihari (Figure 4). Collected by B.E. Thomson January 1967. Note that this grid reference plots to the west of Lake Harihari. The margins of the specimen are damaged, and a distinct muscle field is shown on the posterior part (Figure 5.1).

Dimensions

Dimensions are shown in Table 1.

TABLE 1. Dimensions, *Herangirhynchia awakinoensis*.

specimen	Lv	Ld	W	H	b<	ms/dv	material	notes
BR3190	16.5+		17.3+		108		vv int	Margins damaged

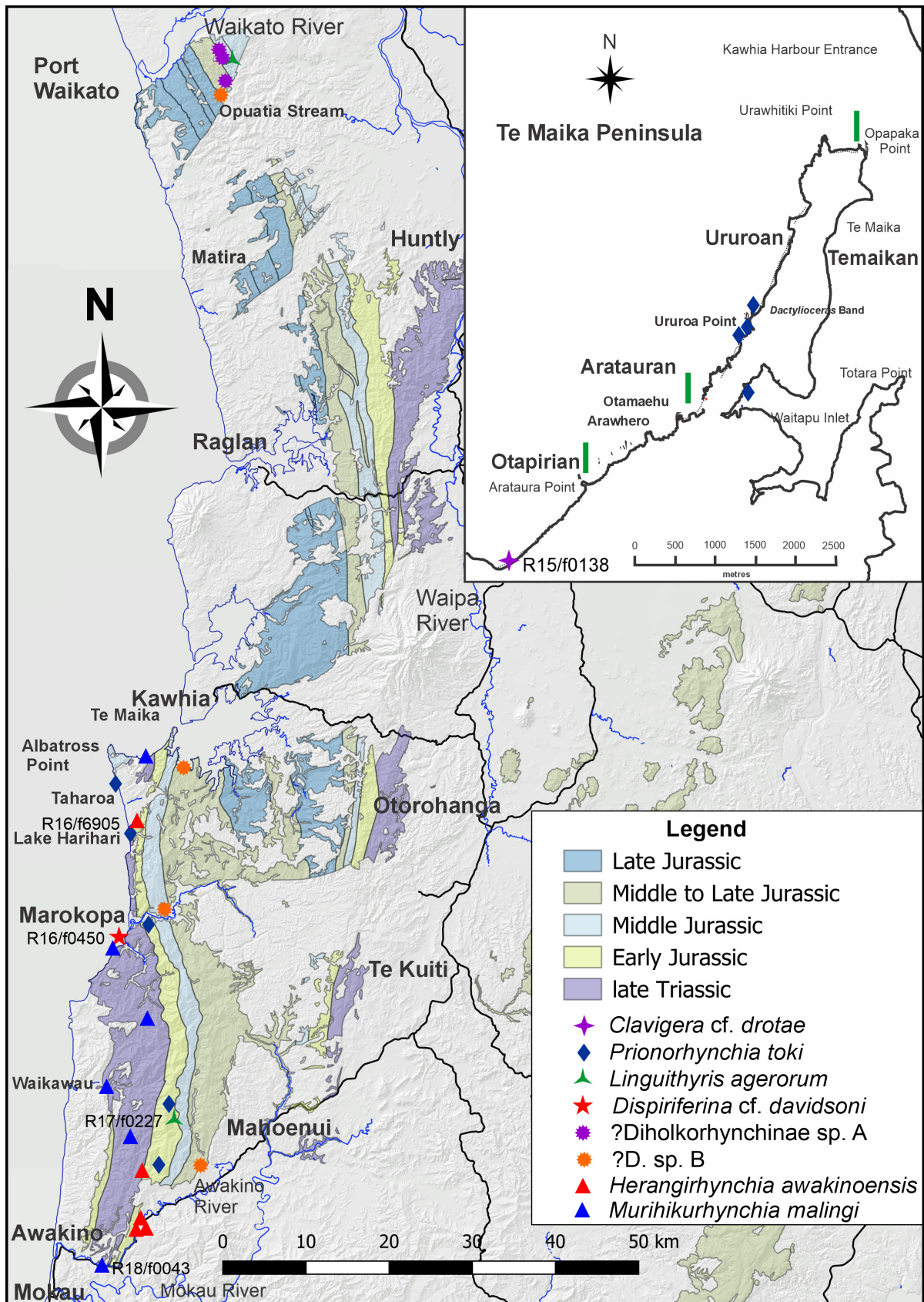


FIGURE 4. Kawhia Syncline showing brachiopod localities. Base: LINZ data, geology from GNS Q-Map. Fossil Record File numbers shown for specimens discussed in the text. Inset: Te Maika Peninsula in detail.

Remarks

Apart from two doubtful, poorly preserved specimens from a probably Temaikan locality in Southland, all previous records of this species come from the Upper Ururoan of the Awakino Gorge. This record from the coast some distance to the north extends the range. It occurs with a good Ururoan fauna which includes *Pseudaucella marshalli* and is therefore Lower Ururoan in the sense of Hudson (2003) (Pliensbachian-Toarcian), and stratigraphically below the Awakino Gorge localities.

Otapirian specimens of *Murihikurhynchia malingi*

Subfamily NUCLEOSORHYNCHIIINAE Xu, 1990

Murihikurhynchia MacFarlan, 1992

Type species *Murihikurhynchia malingi* MacFarlan, 1992, Trechmann Siltstone, Otamita Stream (Otamitan, late Norian).

Murihikurhynchia malingi MacFarlan, 1992

Material

BR3562 (GS 13113) from R18/f0043, Awakino Gorge (Figure 5.2.) Internal mould of dorsal valve and beak. Late Otapirian, but low in the range of both *Callospiriferina kawhiana* and *Otapiria dissimilis*. Collected by H.J. Campbell & J.I. Raine, 21 November 1981.

OU 47316 (E45/f 0383), JDC 3787, Otapiri Stream (Figure 5.3). The specimen is a double-valved shelly specimen and is early Otapirian. Collected by J.D. Campbell & D.A.B. MacFarlan 3 June 1983.

Dimensions of these specimens are shown in Table 2.

TABLE 2. Dimensions, *Murihikurhynchia malingi*.

specimen	Lv	Ld	W	H	b<	ms/dv	material	notes
BR3562	9.3	7.6	8.0		101	0.25	dv int	& beak exterior
OU 47316	9.0	7.6	7.1	2.1	80		b shelly	

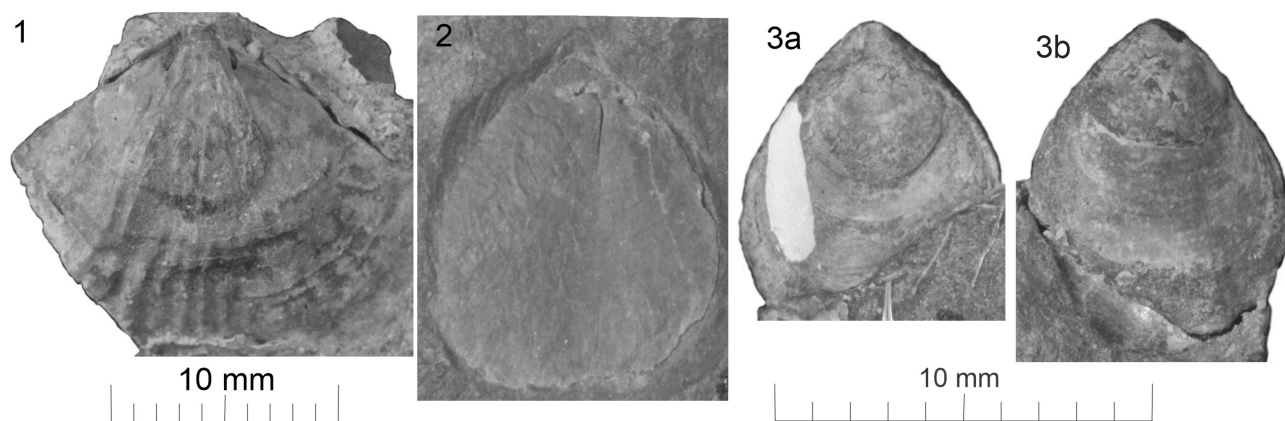


FIGURE 5. 1 *Herangirhynchia awakinoensis* BR3190 (R16/f6905) ventral valve interior. 2, 3 *Murihikurhynchia malingi* 2 BR3562 (R18/f0043) dorsal valve and beak internal. 3 OU 47316 (E45/f0383) (a) dorsal, (b) ventral.

Remarks

The rhynchonellide *Murihikurhynchia malingi* is widespread in the Otamitan stage (late Norian), with records from New Caledonia, and the Kawhia and Southland synclines, and single specimens from the Oretian and Warepan (MacFarlan 1992). In more recent work, two Otapirian (Rhaetian) specimens have been identified, one from Southland and one from the coast between Kawhia and Marokopa. These records extend the range of *Murihikurhynchia malingi* into the Otapirian.

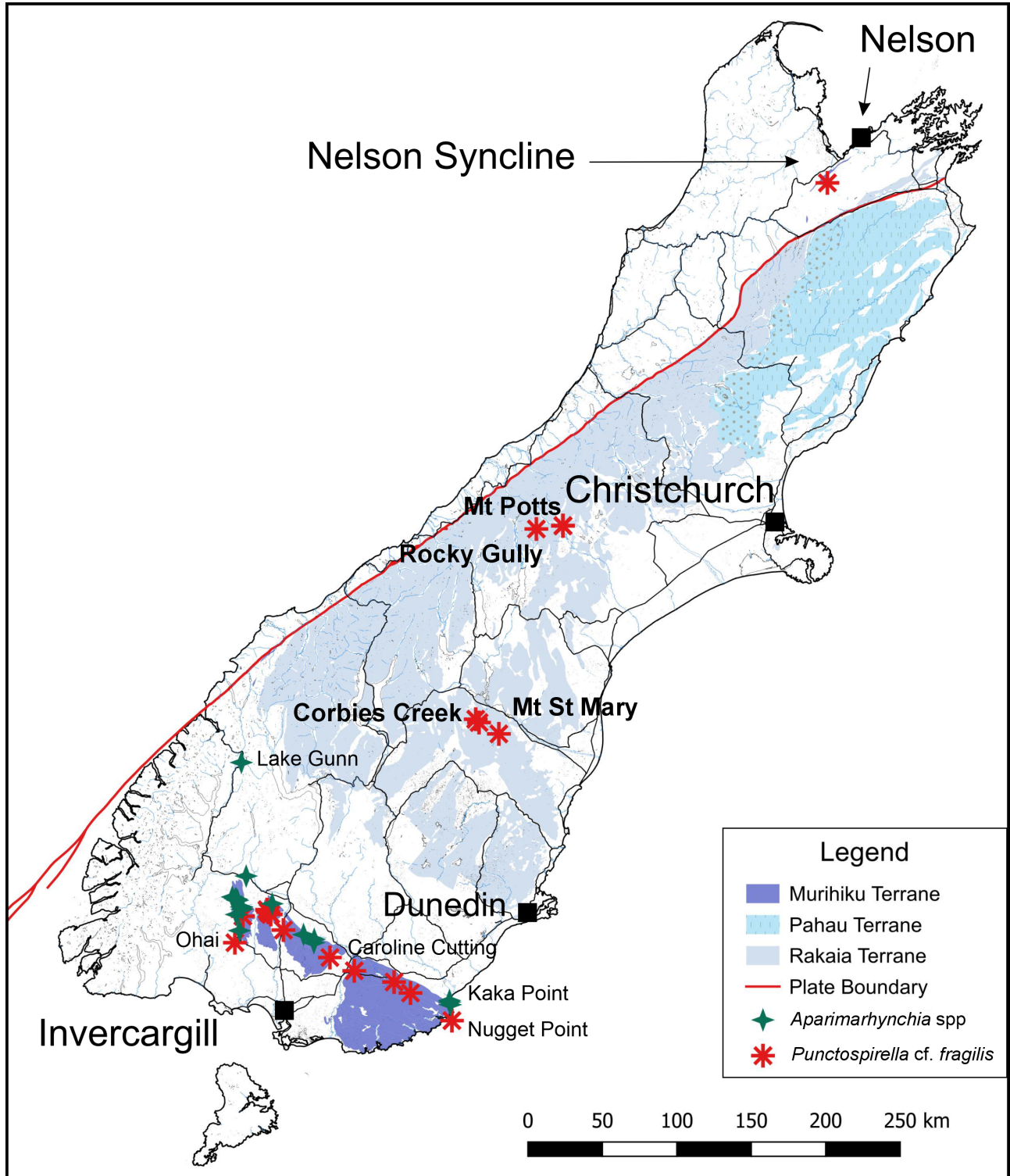


FIGURE 6. South Island showing distribution of relevant Triassic-Jurassic terranes and brachiopods discussed here. Base map from LINZ and Q-map data.

Aparimarhynchia dunrobinensis in the Kaka Point Fold Belt

The rhynchonellide *Aparimarhynchia dunrobinensis* is found in several Malakovian and Etalian (Olenekian and Anisian) localities in the Southland Syncline (Figure 6). It is an important index fossil in resolving the structure and stratigraphy of the Kaka Point Fold Belt (Figure 7) in South Otago (Campbell *et al.* 2003).

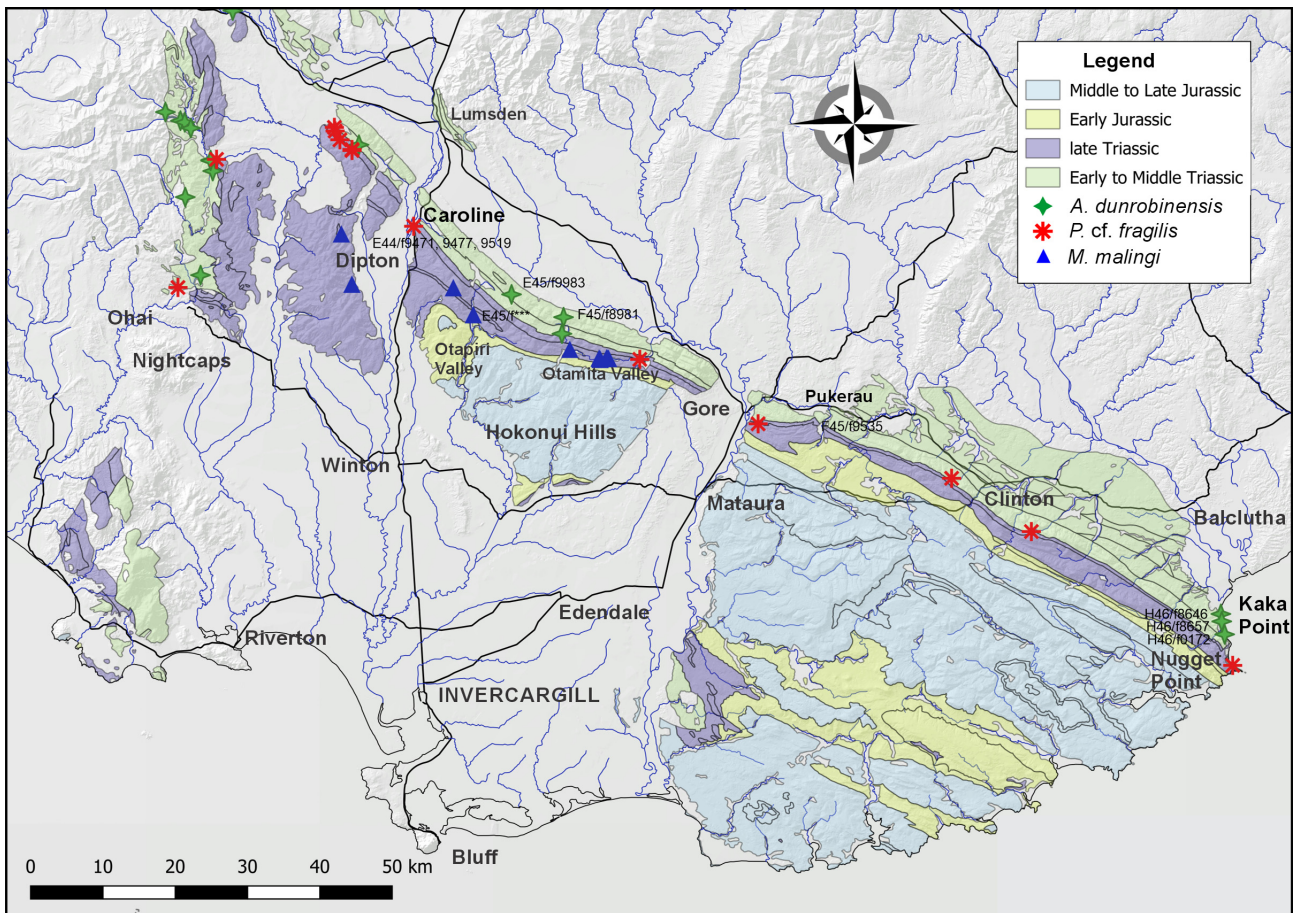


FIGURE 7. Southland Syncline showing brachiopod localities. Base: LINZ data with geology from GNS Qmap. Fossil Record File numbers shown for localities discussed in the text.

Superfamily NORELLOIDEA Ager, 1959.

Family NORELLIDAE Ager, 1959.

Subfamily PRAEMONTICLARELLIDAE Manceñido & Owen, 2002.

Aparimarhynchia MacFarlan, 1992

Type species *Aparimarhynchia dunrobinensis* MacFarlan, 1992. Malakovian-Etalian (Olenekian-Anisian), New Zealand.

Aparimarhynchia dunrobinensis MacFarlan, 1992

Holotype OU 15533, from D44/f0049, North Etal Creek, Wairaki Hills, Southland.

Material

H46/f8646 (JDC 1420) OU 15540 North end Tilsons Beach, Kaka Point. Collected by D.S. Coombs & J.D. Campbell, 1/1958. H46/f8657 (JDC 1435) OU 47325 collected by J.D. Campbell, R.H. Hori, 22/4/1996. South side of Kaka Point. Collected by J.D. Campbell & R.H. Hori, 22/4/1996. H46/f172 (JDC 3108) OU 47293–94, Wave cut platform at east end of Willsher Bay. Collected by J.D. Campbell & A. Grebneff 17/2/1998.

Description

See MacFarlan (1992) for description.

Dimensions

Dimensions of specimens discussed here are shown in Table 3.

TABLE 3. Dimensions, *Aparimarhynchia dunrobinensis*, Kaka Point.

specimen	Lv	Ld	W	H	b<	ms/dv	material	notes
OU 15540	8.2	7.8	8.1		102		b ext	
OU 47293	8.7+		8.1+		103		vv shelly	part of ant not exposed
OU 47294	6.5+		5.7+		92		dv ext	flattened, remnant shell
OU 47325	5.5	5.1	6.1		90		vv int, pt ext	Poss juv on same piece as int.

Range and Distribution

MacFarlan (1992, p.68) gave a time range for *A. dunrobinensis* of Early Triassic to middle Etalian. *A. dunrobinensis* is not found with the more abundant and widespread Upper Etalian species *Wairakirhynchia etaliana*.

In their definition of the Nelsonian stage (late Induan to Olenekian), Campbell and Owen (2003, p.101) state that “Unlike all other New Zealand Triassic stages, no brachiopods are known from the Nelsonian stage”.

The Malakovian (Olenekian to Anisian) faunas of the Ohai area, with good ammonoid faunas and abundant thick-shelled rhynchonellides are nearshore (MacFarlan, 1992) and the coeval rocks in other parts of the South Island are more offshore and generally very poorly fossiliferous.

One good Malakovian fauna was collected by J.D. Campbell and J.R. Boles in 1969 (Boles 1974), from Fairplace Station, Hokonui Hills (F45/f8981, JDC 2333) This contains an ammonoid (aff. *Owenites*), a spiriferinide known from the Malakovian at Ohai, and *Aparimarhynchia dunrobinensis*. Other localities which are likely to be Malakovian are E45/f9983 (JDC 2459) Beer’s Track, Hokonuis (also mapped by Boles as Malakovian), and “Pukerau Baths” F45/f9535. These require re-evaluation, but in light of Campbell and Owen’s statement above, it is probably best to state the time-range of *Aparimarhynchia dunrobinensis* as Malakovian to middle Etalian (Olenekian to early Anisian according to Raine *et al.* 2015).

The rarer *A. takitimuensis* is only found in western Southland but is present in the Malakovian to Upper Etalian (MacFarlan 1992).

Remarks

OU 15540 was figured in MacFarlan (1992). Further specimens were collected by J.D. Campbell in the 1990’s as part of his and D.S. Coombs’s detailed field work into the Kaka Point Fold Belt (Campbell *et al.* 2003). The writer reviewed this material in 2002 at the request of Prof. Coombs and Andrew Grebneff. Identifications were published in Campbell *et al.* (2003) but no paleontological details were given then, so the material has been photographed and measured here for the first time (Figure 8).

Middle to Late Jurassic Norellidae

Subfamily DIHOLKORHYNCHIINAE Xu and Liu, 1983

A few small brachiopods from the Temaikan and Heterian of the Port Waikato area were assigned to the subfamily Norellinae by MacFarlan (1992). A few more specimens have since been found. Study of these has shown that two species can be recognised, with some material from Kawhia Harbour and the Awakino Valley (Figure 4). The material is insufficient to allow formal descriptions or a generic identification.

MacFarlan (1992) placed the first species in the subfamily Norellinae as defined in the 1965 edition of the Treatise on Invertebrate Paleontology, Part H Brachiopoda (Ager, 1965). In the revised Treatise (Manceñido *et al.* 2002), the Norellinae is defined as lacking a median septum. A median septum in the dorsal valve is present in both species described here.

Both species can be tentatively placed in the subfamily Diholkorhynchiinae, Xu and Liu, 1983, which is characterised by a dorsal sulcus and long smooth stage with costae anteriorly, and a definite median septum (Manceñido *et al.* 2002, p. 1314 and Fig 892.2). There is some resemblance in external form to the Chinese Anisian genus *Diholkorhynchia* Yang and Xu, 1966 and the Middle Jurassic *Gnathorhynchia* Buckman, 1918.

The material is too poor to allow placement in a genus or formal description of either species.

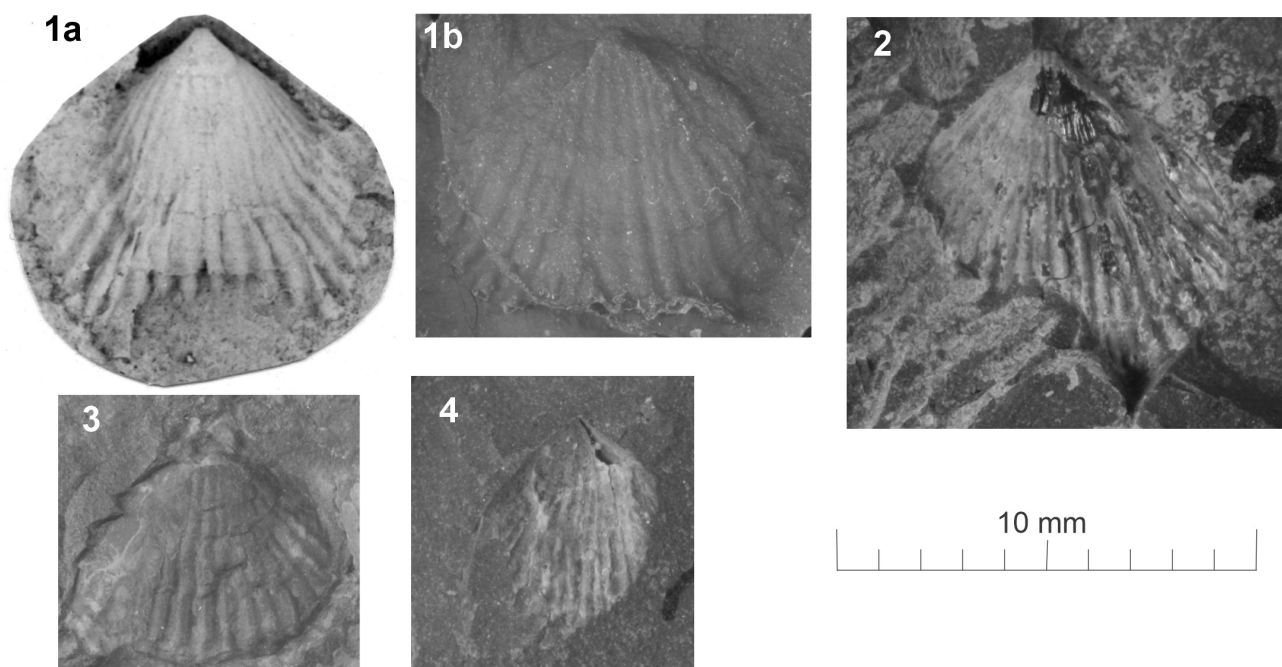


FIGURE 8. *Aparimarhynchia dunrobinensis*. **1** OU 15540 (H46/f8646) latex mould of exterior (a) ventral valve (b) dorsal valve. **2** OU 47293 (H46/f0172) ventral view. **3** OU 47325 (H46/f8657A) ventral view. **4** OU 47294 (H46/f0172) dorsal view.

Norellidae (?Diholkorhynchiinae) sp. A

1992 Norellinae gen et sp. indet.; MacFarlan p. 267, pl. 32. 13–16, Fig. 25.1 a–c.

2009 Norellinae gen et sp. indet.; MacFarlan *et al.* p. 266.

2023 Norellinae gen et sp. indet. A.; Robinson *et al.* p. 254.

Material

R13/f0037 (AU 7440) B294, ventral valve interior and part exterior, finely capillate. Opuatia Stream, Port Waikato, uppermost Kt-Kh. Collected by J.A. Grant-Mackie May 1980. R13/f0079 (AU 630) B295–296, B931–934, some unmeasured specimens. Small quarry, Klondyke Rd, Port Waikato. Upper Kt. Collected by AU field party May 1962.

R13/f6912 (GS10250) BR2302, dorsal valve interior. Klondyke Rd, Port Waikato. Collected by D.R. Petty, R. Crabbe, B.C. Waterhouse & G.R Stevens 1964.

Description

For detailed description seen MacFarlan (1992).

Transversely elliptical outline, exterior generally smooth. Dorsal valve broadly and shallowly sulcate, with prominent median septum (Figure 9: 1–4). B294 shows weak capillae on a remnant of shell material, but the exterior of the remainder of the shell is smooth.

Dimensions

Dimensions of measured specimens are shown in Table 4.

TABLE 4. Dimensions, ?*Diholkorhynchiinae* sp. A.

specimen	Lv	Lp	W	H	b<	ms/dv	material	notes
B294	12.9		18.3		126		vv int, pt ext	Weak capillae on remnant shell material
B295	9.6		10.7+	4.2		0.4	b int	beak, flank damaged
B296	4.8		4.5	1.1		0.3	b int	juvenile
B931		10.5	10.9+			0.5	dv int	1 flank broken
B932		8.9	10.0			0.6	dv int	Margins damaged
B933		5.1	5.3			0.6	dv int	ant margin damaged
BR2302		8.5	12.5			0.7	dv int	

Range and Distribution:

Upper Temaikan to possibly Heterian, (Bajocian to Oxfordian) Klondyke Rd and Opuatia Stream, Port Waikato.

Norellidae (?*Diholkorhynchiinae*) sp. B

2009 Norellinae gen. et sp. indet.; MacFarlan *et al.* p. 266.

2023 Norellinae gen. et sp. indet. B; Robinson *et al.* p. 254.

Material

R13/f223b (AU 11600) B709 shelly dorsal valve, capillate. Opuatia Stream, Port Waikato. Upper Temaikan. Collected N. Hudson 17/5/1989. R15/f8548 (GS5914) BR3563 shelly dorsal valve. North coast of Heteri Pt, uppermost Heterian. Collected by K.J. McNaught March 1952. R17/f8588B (AU 9377) B710–711 internal moulds. Rauroa Stream, Awakino Valley, Upper Temaikan. Collected by J.A. Grant-Mackie, N. Hudson, A.B.S. Clarke 21/1/1981.

Description

Small rhynchonellide with subcircular outline, with both valves finely costate. Dorsal valve with shallow sulcus, median septum about 0.3 length of valve. Ventral valve with divergent dental plates (Figure 9: 5–7).

Dimensions

Dimensions of measured specimens of ?Diholkorhynchiinae sp. B are shown in Table 5.

TABLE 5. Dimensions, Diholkorhynchiinae sp. B.

spn no	Lv	Lp	W	H	b<	ms/dv	material	notes
BR3563		9.3	11				dv shelly	finely costate
B709		7.7	8.4				dv shelly	part decorticated
B710		5.9	8.2			0.3	dv int	left flank damaged
B711	5.3		5.7		100		vv int	& part ext, costae on flanks

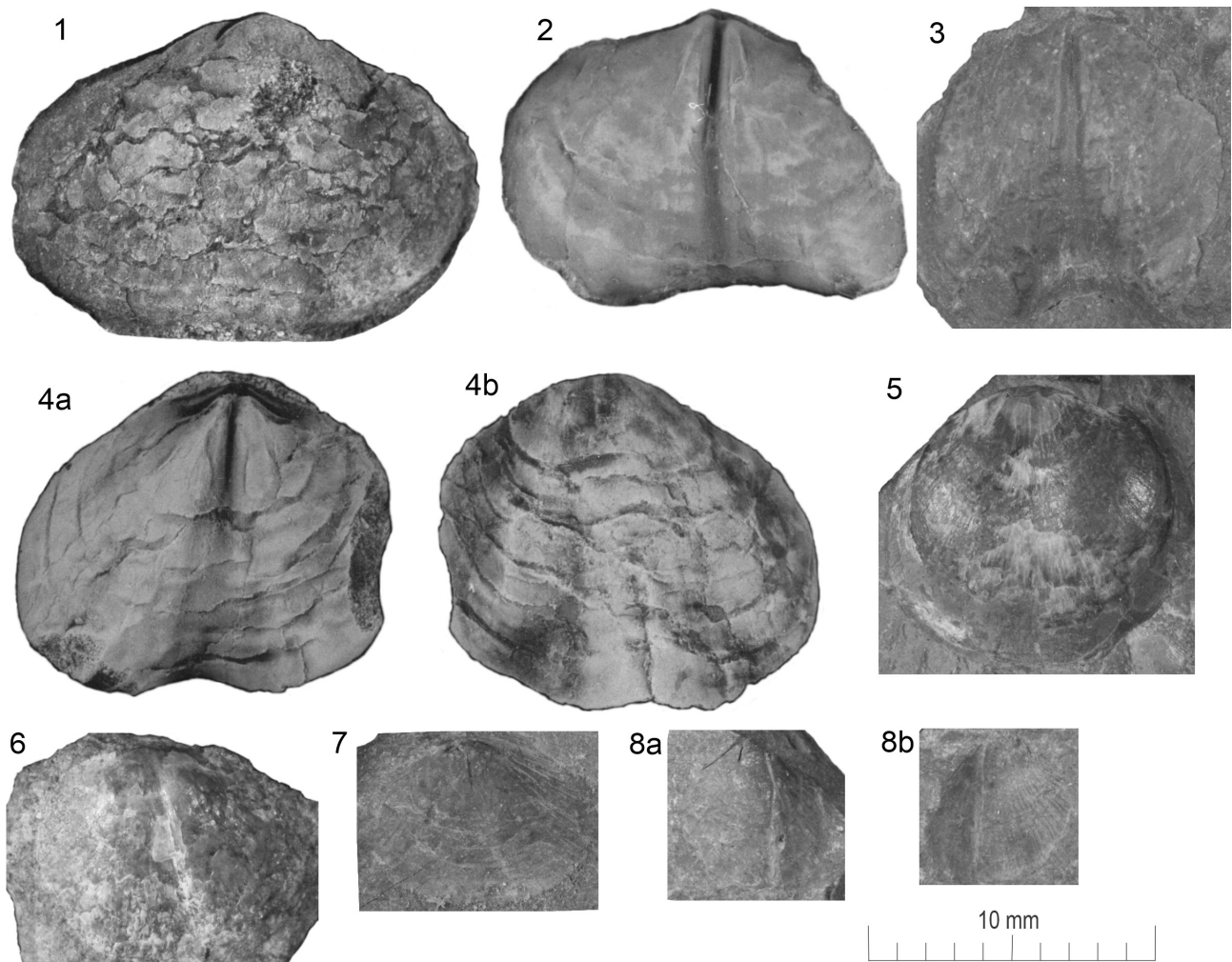


FIGURE 9. 1–4 ?Diholkorhynchiinae sp. A **1** B294 (R13/f0037) ventral valve interior. **2** BR2302 (R13/f6912) dorsal valve interior. **3** B931 (R13/f0079) dorsal valve interior. **4** B295 R13/f0079) double-valved internal mould (a) dorsal (b) ventral. **5–7** ?Diholkorhynchiinae sp. B **5** BR3563 (R15/f8548) shelly ventral valve. **6** B709 (R13/f223b) shelly dorsal valve. **7** B710 (R17/f8588b) dorsal valve internal. **8** B711 (R17/f8588b) ventral valve (a) internal (b) exterior.

Range and Distribution

Upper Temaikan to uppermost Heterian (Bajocian to Kimmeridgian). The localities cover the length of the Kawhia Syncline from Port Waikato to the Awakino Valley.

Remarks

These two species are represented by sparse, poor material, and are tentatively referred to the Diholkorhynchiinae on shape and the presence of a shallow sulcus and median septum on the dorsal valve. The two species differ in that Species B develops fine costellae anteriorly. Species A is generally wider in proportion than Species B, which tends to be subcircular. More and better material is required for description of these species (and possibly of a new genus).

***Clavigera drotae* Avias, 1952 from the Otapirian (Rhaetian) of Ducos and Hugon, New Caledonia**

Order ATHYRIDIDA Boucot, Johnson and Staton, 1964.

Suborder ATHYRIDIDINA Boucot, Johnson and Staton, 1964.

Superfamily ATHYRIDOIDEA Davidson, 1881.

Family DIPLOSPIRELLIDAE Schuchert, 1894.

Subfamily CLAVIGERINAE Waterhouse, 1975.

***Clavigera* Hector, 1879**

Type species. *Clavigera bisulcata* Hector in Thomson, 1913, Benmore Cutting, Hokonui Hills, Otapirian (Rhaetian). *Clavigera bisulcata* is now seen as a synonym of *Clavigera planchesi* (Deslongchamps 1864) (Campbell, 1991).

***Clavigera drotae* Avias in Avias & Drot 1952**

1952 *Clavigera droti* Avias in Avias & Drot, p. 247, 248.

1953 *Clavigera drotae* Avias; Drot, p. 93, 94, pl. 22, figs. 2a–d.

Holotype: MHNP B08473 (Avias JA5645), a double-valved shelly specimen.

Avias in Avias & Drot (1952) proposed the new species *Clavigera droti*, with a minimal description and no figure. No holotype was designated. The name appears to be an inadvertent error, which was corrected to *Clavigera drotae* by Drot (1953) who published a full description (p. 93–94) based on 15 well-preserved specimens and further fragments from île Hugon. The locality is incorrectly stated in the caption to Plate XXII as île Lepredour. The species has received little attention since then.

Material

In a search of Otapirian (Rhaetian) material in the University of Auckland fossil store, a total of 23 measurable specimens were noted from NC/f0007A (île Hugon) and NC/f0087A (AU 7168) île Ducos. (Figure 2). These fit well with Drot's description and figures of *C. drotae*. *Clavigera planchesi* is abundant in these localities and is clearly different (see below).

NC/f0007A (AU 7149) B833–843: 11 specimens & uncatalogued material, île Hugon Collected by J.A. Grant-Mackie 1979.

NC/f0087A (AU 7168) B799–810: 12 specimens & uncatalogued material, île Ducos. Collected by J.A. Grant-Mackie 19/10/1979.

Dimensions

Dimensions of figured specimens are shown in Table 6. Dimensions of all measured specimens will be presented in a planned update to MacFarlan (2022).

TABLE 6. Dimensions, *Clavigera drotae*.

Specimen	Lv	Ld	W	H	Ha	Wp	b<	material	notes
B799	40.5	36.7	36.3	24.6	2.0	15.1	132.0	b shelly	slightly decorticated
B800	32.6	29.5	35.5	17.1			142.0	b shelly	
B806	34.1	31.4	33.1	21.9		13.4	132.0	b shelly	
B833	40.7	37.7	36.1	21.4		15.6	128.0	b shelly	
B835	43.7	40.6	39.3	24.5			127.0	b shelly	
B836	42.3	37.8	37.1	24.4			140.0	b shelly	
B840	34.4	32.8	38.9	19.8			128.0	b shelly	

Range and Distribution.

Drot's original material consists of 15 well-preserved specimens and fragments from the Rhaetian of île Hugon. NC/f0007A from Hugon includes reworked *Monotis* and the upper Otapirian *Callospiriferina kawhiana*. NC/f0087A from île Ducos is just above the topmost *Monotis* beds and is lower Otapirian (Campbell and Grant-Mackie 1984, Ernst *et al.* 2015, MacFarlan 2023b).

Remarks

This species has an elongate-elliptical to rounded heptagonal outline and relatively short hingeline, with the maximum width at the midline of the shell. This is quite unlike the long hingeline and transversely elongate outline of *Clavigera planchesi*. The costae are of similar form to those in *C. planchesi* but much weaker, and are not evident in some specimens.

Clavigera cf. drotae from the Otapirian south of Kawhia

A single specimen from the coast south of Arataura Point, Kawhia (Figure 4) resembles *C. drotae*, but is more strongly folded.

Material

R15/f0138 (AU 1554) B902, shelly double-valved specimen and partial ventral valve exterior, with some loss of shell material (Figure 10.8).

Dimensions

Dimensions are shown in Table 7.

TABLE 7. Dimensions, *Clavigera cf. drotae*.

specimen	Lv	Ld	W	H	Ha	Wp	b<	material	notes
B902	41.1	34.9	38.8+	15.4			133.0	b shelly, pt vv ext	Flanks damaged

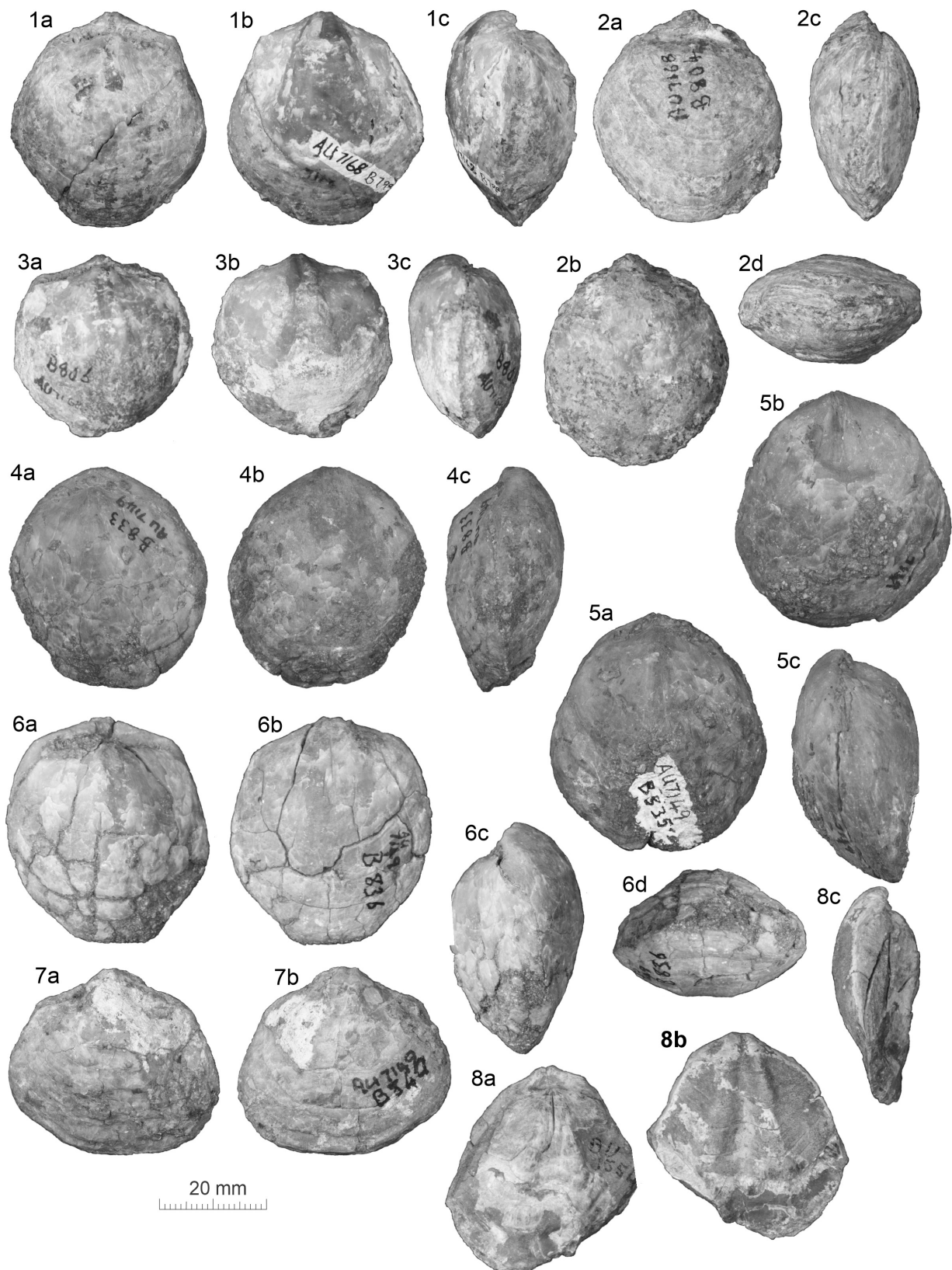


FIGURE 10. *Clavigera drotae* and *C. cf. drotae*. **1** B799 (NC/f0087A) shelly specimen (a) dorsal (b) ventral (c) lateral. **2** B804 (NC/f0087A) shelly specimen (a) dorsal (b) ventral (c) lateral (d) anterior. **3** B806 (NC/f0087A) shelly specimen (a) dorsal (b) ventral (c) lateral. **4** B833 (NC/f0007A) shelly specimen (a) dorsal (b) ventral (c) lateral. **5** B835 (NC/f0007A) shelly specimen (a) dorsal (b) ventral (c) lateral. **6** B836 (NC/f0007A) shelly specimen (a) dorsal (b) ventral (c) lateral (d) anterior. **7** B840 (NC/f0007A) shelly specimen (a) dorsal (b) ventral. *Clavigera cf. drotae* **8** B902 (R15/f0138) shelly specimen (a) dorsal (b) ventral.

Remarks

This specimen resembles *C. drotae* in most respects but is more strongly folded, and here is referred to as *C. cf. drotae*. It comes from the southern part of the Otapirian section on the open coast south of Kawhia (Martin, 1975), below the late Otapirian zone of *Callospiriferina kawhiana* and *Otapiria dissimilis*.

Punctospirella Dagys, 1974 in the New Zealand Kaihikuan

Order SPIRIFERINIDA Ivanova, 1972

Superfamily PENNOSPIRIFERINOIDEA Dagys, 1972

Family PENNOSPIRIFERININAE Dagys, 1972

Subfamily PUNCTOSPIRELLINAE Dagys, 1974

Punctospirella Dagys, 1974

1974 *Punctospirella* Dagys, p. 136, Fig. 91, pl. 39: 2, 3.

2006 *Punctospirella* Dagys, 1974; Carter, p. 1925.

Type species: *Terebratulites fragilis* von Schlotheim, 1813. Middle Triassic, Germany.

Dagys (1974) proposed the new Middle Triassic genus *Punctospirella*, with *Spiriferina fragilis* (Schlotheim, 1813) as type species. This change affects the forms identified in New Zealand by Trechmann (1918) and Wilckens (1927) and from New Caledonia by Piroutet (1917) and Drot (1953) as *Spiriferina fragilis*, *S. cf. fragilis* and *S. ex aff. fragilis*. The generic name *Punctospirella* has not previously been applied in Zealandia.

Punctospirella cf. fragilis (Schlotheim, 1813)

1813 *Terebratulites fragilis* Schlotheim, p. 104.

1871 *Spirifer fragilis* (Schlotheim, 1813); Quenstedt, p. 500, pl. 53: 39–41.

1890 *Spiriferina fragilis* (Schlotheim, 1813); Bittner, p. 29, pl. 35: 2–4.

1974 *Punctospirella fragilis* ((Schlotheim, 1813); Dagys, p. 136, fig. 91, pl. 39: 2, 3.

Zealandian synonymy

1917 *Spiriferina ex aff. fragilis* (Schlotheim, 1813); Piroutet, pp. 69–70.

1918 *Spiriferina fragilis* (Schlotheim, 1813); Trechmann, p. 218, pl. 23: 6.

1927 *Spiriferina fragilis* (Schlotheim, 1813); Wilckens p. 35.

1927 *Spiriferina ex aff. fragilis* Schlotheim; Wilckens p. 41, pl 9.5.

1945 *Spiriferina fragilis* (Schlotheim, 1813); Allan, p. 20.

1953 *Spiriferina fragilis* (Schlotheim, 1813); Marwick, p. 37.

1953 *Spiriferina cf. fragilis* (Schlotheim, 1813); Drot, p. 91.

2009 *Spiriferina fragilis* (Schlotheim, 1813); MacFarlan *et al.*, p. 265.

2023 *Spiriferina fragilis* (Schlotheim, 1813); Robinson *et al.*, p. 253.

Punctospirella fragilis is known from the middle Triassic (Anisian-Ladinian) of central and eastern Europe (Bittner 1890, Palfy 2003, Carter 2006, Kaim, 1997), Turkey (Arthaber 1915), Iran (Siblík 1991) (all generally Tethyan), Singapore (Newton 1923, *vide* PBDB) and China (Sun *et al.* 2009).

Trechmann (1918) recorded *Spiriferina fragilis* from “the Kaihiku beds, in which it occurs commonly at most localities” (p. 219). Trechmann figured an example from Caroline Cutting. Trechmann’s figured specimen is in the Natural History Museum, London.

Wilckens (1927) figured *Spiriferina ex aff. fragilis* from the Kaihikuan of Mt St Mary. Wilckens plate 9.5 of

S. ex aff. fragilis, is weakly costate and has little resemblance to *S. fragilis* as figured by Trechmann. Wilckens also noted from Mt Potts “Various very badly preserved casts are referable to *Spiriferina*. Some of these resemble *Spiriferina kaihikuana* Trechmann. Others may be Trechmann’s *Spiriferina fragilis* (which probably is another species). Exact determination is impossible” (p. 35).

Allan (1945) listed *S. fragilis* without comment, and Marwick (1953) commented that (p. 37) “until a critical examination can be made from adequate material, however, Trechmann’s identification may stand”.

Piroutet (1917) lists *Spiriferina fragilis*, *Spiriferina cf. fragilis* and *Spiriferina ex aff. fragilis* from the Triassic of New Caledonia. *S. cf. fragilis* was briefly described and figured by Drot (1953).

As Trechmann (1918) noted differences between his specimens and the European species, it would be better to list the New Zealand material as *Punctospirella cf. fragilis*, as was also done by Wilckens (1927). There is enough material in OU and GNS collections, including many recollections of the Trechmann’s locality at Caroline Cutting, for a reappraisal of the Zealandian material, which may well represent at least one new species. This is beyond the scope of the current work.

Like many well-known 19th century genera, *Spiriferina* is now much restricted in scope. It is seen as an Early Jurassic genus (Carter, 2006, Baeza-Caratalá *et al.* 2016b) and is used in this sense by MacFarlan (2023a). This means that species assigned to *Spiriferina* by Trechmann (1918) (*S. carolinae*), Wilckens (1927) (*S. novoseelandica*), and Marwick (1953) (*S. trechmanni*) should also be reevaluated.

Material Examined

E44/f9477 (Maling T1) T1.17, T1.19 near Caroline Cutting, Oreti Valley. Collected by P.B. Maling, 1934. E44/f9471 (Maling T7) T7.19 Caroline Cutting, Oreti Valley. Collected by P.B. Maling, 1934. E44/f9519 (JDC 729) C403, C431 Caroline Cutting. Collected by J.D. Campbell (18/2/1952 or one of many recollections).

Description

Small to medium-sized spiriferinide (Figure 11). Length of measured specimens 9–13 mm, width 13–21 mm. Shell with long straight hingeline and rounded cardinal extremities, rounded flanks and anterior margin. Maximum width just anterior of hingeline. Dorsal valve convex, with narrow fold, and three or four strong costae with rounded crests on each flank. Ventral valve more inflated with high apex, broad flat area and narrow v-shaped sulcus, 3 to 5 strong costae with narrow rounded crests on each flank. Ventral area broad, flat or slightly concave. Anterior commissure deflected by narrow v-shaped uniplication. Anterior part of ventral valve with fine, foliaceous growth pauses. Dorsal valve exterior not seen.

Dorsal valve with high striated cardinal process, triangular septalium, strong hinge plates. Ventral valve with broad, flat or convex area, open triangular delthyrium. Dental plates short. Median septum high, narrow, does not meet dental plates, with prominent muscle scars on either side.

Shell coarsely punctate. Remnants of matrix infilling punctae are preserved on Maling T1.19 (Figure 12A). No indications of spines were seen.

Dimensions

Dimensions of specimens shown in Figure 11 are shown in Table 8.

TABLE 8. Dimensions, *Punctospirella cf. fragilis*.

specimen	Lv	Ld	W	H	Ha	Wp	b<	material	notes
Maling T1.17	10.4		19.0		7.3	6.2	180.0	vv int	large callused area at post
Maling T1.19	10.5		13.7		4.1	4.8	180.0	vv int	
Maling T7.19	9.0+	9.6	18.3		6.1	5.3	180.0	b int	distorted, ant part pt exposed
C403	11.8		20.5		8.4	8.9	180.0	vv int	& exterior
C431		10.2	18.5			3.7	180.0	dv int	

Range and Distribution

Punctospirella cf. *fragilis* is recorded from the Kaihikuan of the Murihiku Terrane of the Nelson and Southland synclines (Campbell & Force, 1973, Force & Campbell, 1974) and from the Rakaia Terrane of Canterbury and North Otago (Figure 6, Figure 7). The Kaihikuan is correlated with the late Ladinian and Carnian by Raine *et al.* (2015), but the characteristic Kaihikuan shellbed fauna that includes *Punctospirella* cf. *fragilis* is Late Ladinian (Campbell, 1994, Cooper *et al.* 2004).

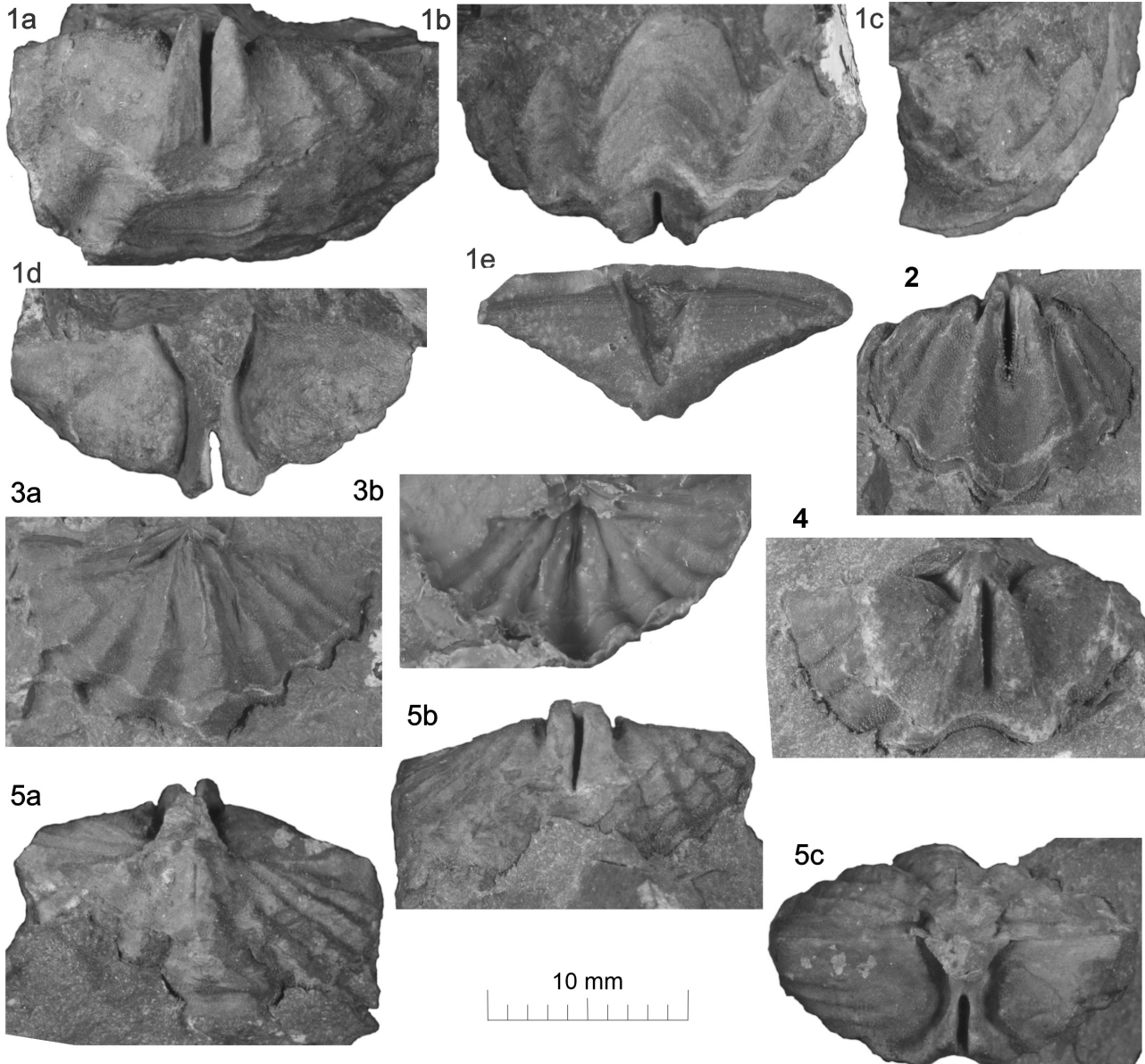


FIGURE 11. *Punctospirella* cf. *fragilis* **1** C403 (E44/f9519) dorsal valve (a) ventral (b) anterior (c) posterior (d) lateral (e) latex of exterior, posterior view. **2** Maling T1.19 (E44/f9477) ventral valve internal. **3** C431 (E44/f9519) dorsal valve internal (a) dorsal view (b) latex of internal. **4** Maling T1.17 (E44/f9477) ventral valve internal, ventral view. **5** Maling T7.19 (E44/f9471) double-valved internal mould (a) dorsal (b) ventral (c) lateral (d) posterior.

Remarks

The New Zealand material examined here has a much stronger fold and sulcus than some European and Chinese material (Palfy 2003, Sun *et al.* 2009). Internal characters compare well with those illustrated in Sun *et al.* (2009, fig. 6). *P. fragilis* from Turkey has a strong rounded fold and sulcus similar to those in Zealandian specimens (Arthaber, 1915).

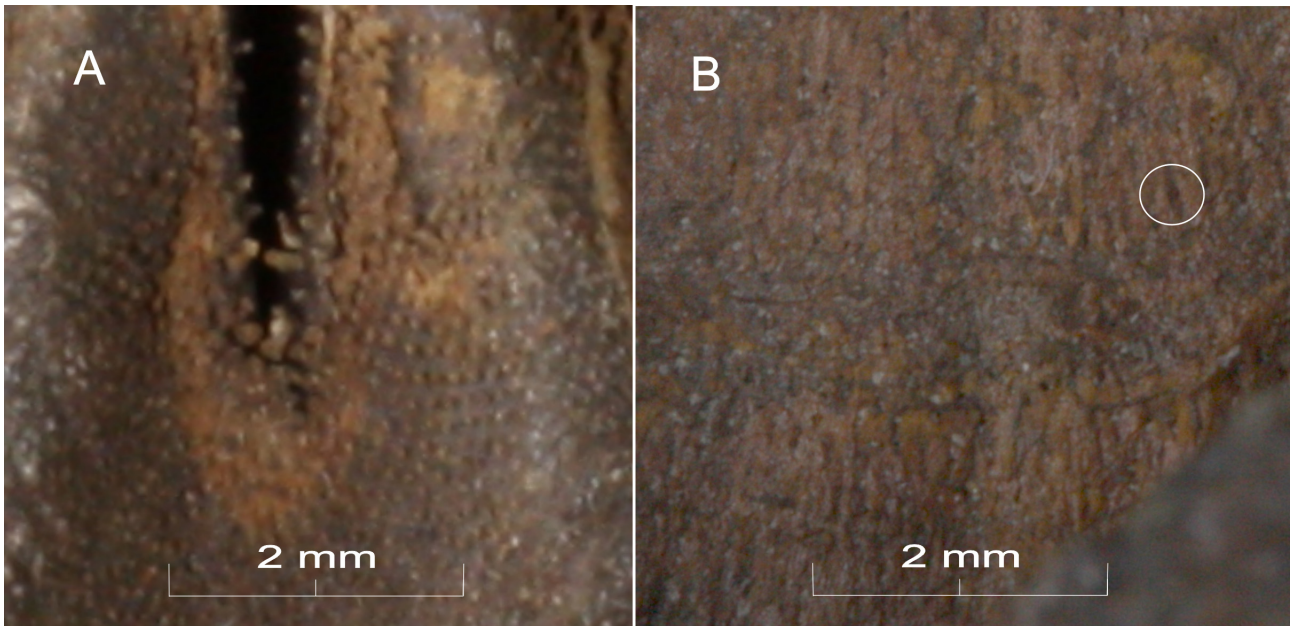


FIGURE 12. microornamentation of spiriferinides. **A** *Punctospirella* cf. *fragilis*. Maling T1.19. Part of ventral valve interior showing punctae. Note matrix infilling punctae at median septum. **B** *Dispiriferina* cf. *davidsoni*. Ventral valve exterior of part of B930 showing spine bases and traces of spines. Spine trace with remnant of matrix infilling is circled.

***Dispiriferina* cf. *davidsoni* from the Otapirian (Rhaetian) of Marokopa**

Family LEPISMATIDAE Xu and Liu, 1983

Subfamily DISPIRIFERININAE Carter, 1994

***Dispiriferina* Siblík, 1965**

Type species *Spiriferina davidsoni* Eudes-Deslongchamps 1855, Early Jurassic, France (OD).

1965 *Dispiriferina* Siblík p. 79.

1977 *Dispiriferina* Siblík, 1965; Rousselle p. 159.

2006 *Dispiriferina* Siblík, 1965; Carter, p. 1929.

2013 *Dispiriferina* Siblík, 1965; Alméras & Cougnon, p. 24.

2023 *Dispiriferina* Siblík, 1965; MacFarlan, p. 29.

***Dispiriferina* cf. *davidsoni* Deslongchamps, 1855**

Material

A single specimen from the Otapirian of Marokopa has recently been identified as *Dispiriferina* cf. *davidsoni*. It was found in a collection being prepared for transfer to Auckland University. AU B930, R16/f 0450, WP 260. Large outcrop on beach north of Waipaua Stream, Marokopa (Figure 4). A double-valved internal mould and largely complete external. Collected by the author and Clemens Ullmann 6/11/2010.

Description

Small spiriferinide, wider than long (Figure 13). Dorsal valve evenly convex posteriorly, ventral valve with high

posteriorly directed umbo, shallow sulcus anteriorly. Hingeline straight, reaching nearly full width of valve, anterior commissure shallowly uniplicate. Interarea high, triangular, laterally convex with narrow area. Costae angular with rounded crests, with about 5 on each flank, three costae in sulcus, two on fold. Costae extend to beak on ventral valve. Dorsal valve hingeplate with large sockets, ventral valve with short, high dental plates, short median septum. Dental plates do not meet median septum. Delthyrium open, triangular. Probably punctate or pustulose, but punctae very poorly preserved.

The ventral valve is covered in fine, apparently tubular spines. The bases of these and some traces of the spines can be seen (Figure 12B), one with a fine central plug of matrix. Spines are more poorly shown on the dorsal valve. Spines are of the order of 0.05–0.1 mm in diameter, with a visible length of about 0.5 mm.

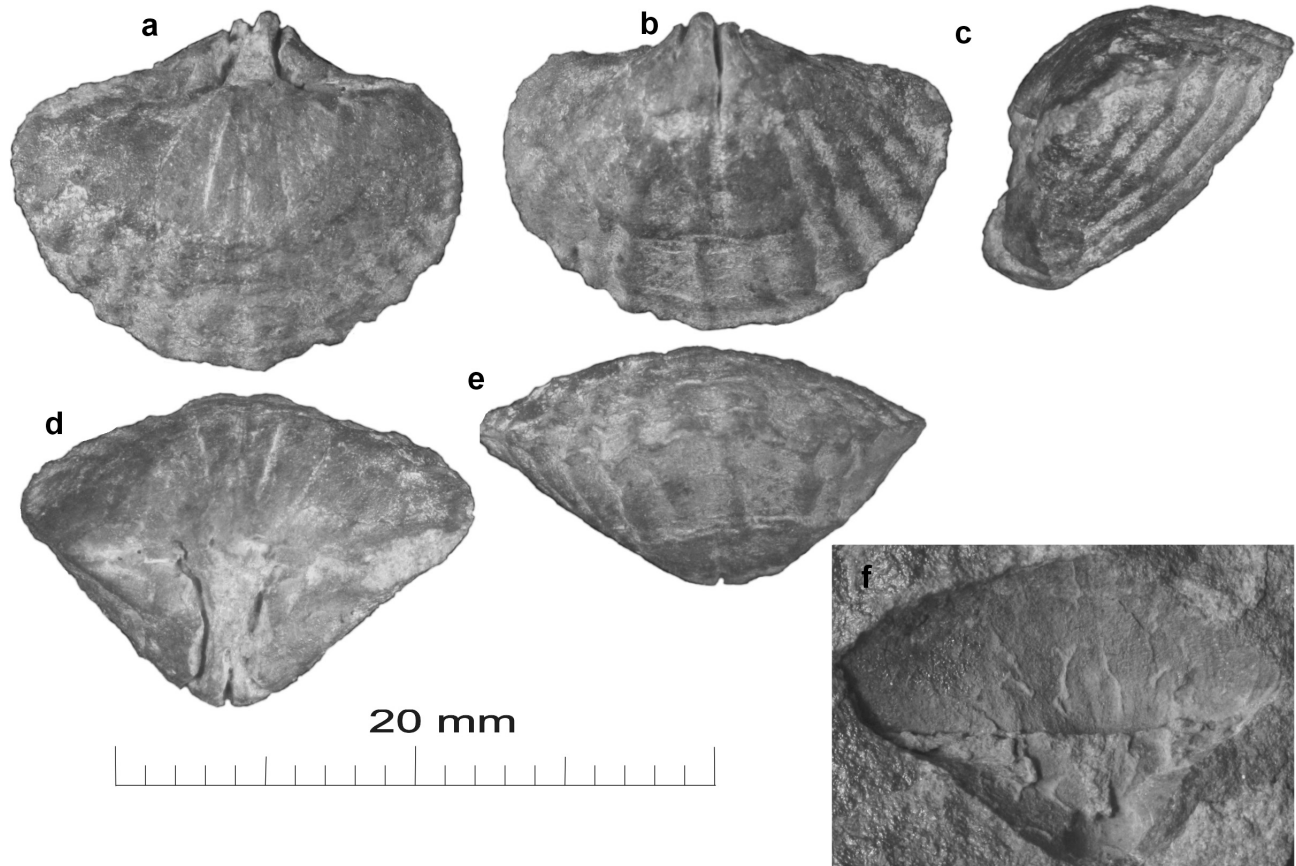


FIGURE 13. *Dispiriferina* cf. *davidsoni* AU B930 (R16/f450) Marokopa coast. (a) dorsal (b) ventral (c) lateral (d) posterior (e) anterior (f) oblique posterior view of external mould.

Dimensions

Dimensions of *D.* cf. *davidsoni* are shown in Table 9.

TABLE 9. Dimensions, *Dispiriferina* cf. *davidsoni*.

specimen	Lv	Ld	W	H	Ha	Wp	b<	material	notes
AU B930	11.6	9.5	14.8	7.4	4.1	7.1	115.0	b int	& almost complete ext

Distribution

The sole specimen was found within the *Callospiriferina kawhiana* zone at Marokopa and is upper Otapirian (Rhaetian) in age. See MacFarlan (1998) for stratigraphy.

Remarks

The single specimen is close to *Dispiriferina davidsoni* as illustrated by Siblík (1965), but is less strongly plicate. It is smaller than the other form recorded from New Zealand, *D. cf. chilensis* from the Aratauran of Ben Bolt (MacFarlan 2023a) which has a more subcircular outline and a proportionately shorter hingeline.

The genus *Sinuocosta* Dagens, 1963 also has a multicostate fold and sulcus. Species of *Sinuocosta* have numerous, often weak costae and the fold and sulcus are poorly defined.

Dispiriferina is known from the Early Jurassic of Southern Europe (Almérás & Cougnon, 2013, Baeza-Caratalá *et al.* 2016a), Morocco (Rousselle 1977), Turkey (Vörös and Kandemir 2011) as well as Chile (Aberhan 1993) and New Zealand.

Spiriferinide from the Aratauran (Hettangian) of Baie Inaccessible, New Caledonia.

Superfamily SPIRIFERINOIDEA Davidson, 1884

Family SPIRIFERINIDAE Davidson, 1884

Subfamily SPIRIFERININAE Davidson, 1884

Spiriferina d'Orbigny, 1847

Type species: *Spiriferina walcotti* J. de C. Sowerby 1823 in 1823–25, p. 106. Lower Jurassic, England.

Campbell (1997, p.231) suggested that *Psioidiella* “was still extant in New Caledonia in the Hettangian”. No details were provided. J.D. (Doug) Campbell’s field books are held by the Geology Department, University of Otago, and the late Dr R.E. Fordyce provided me with a scanned copy. These meticulously kept field books are the essential guide to Doug Campbell’s collections. Field Book 10 records *Psioidiella* from JDC 3202, NC/f384, east coast Baie Inaccessible, along with an Aratauran fauna including psiloceratid ammonites. This collection could not be found before publication of MacFarlan (2023a), but shortly afterwards was located by Dr Jeffrey Robinson.

cf. *Spiriferina arakiwa* MacFarlan 2023

Material

OU 47324 (JDC 3202, NC/f384). A single ventral valve with heavily corroded shell. (Figure 14) from Pointe Noire, east shore of Baie Inaccessible, New Caledonia (Figure 2). Collected by J.D. Campbell & H.J. Campbell, December 1975.

Dimensions

Dimensions are shown in Table 10.

TABLE 10. Dimensions, cf. *Spiriferina arakiwa*.

specimen	Lv	Ld	W	H	Ha	Wp	b<	material	notes
OU 47324	23.3+		32.5+			5.4	143	vv shelly	Corroded, margins damaged

Description

Outline rounded-pentagonal, hingeline nearly full width of shell. About four rounded costae on each flank, the inner two strongest, defining a shallow, narrow sulcus, outer costae becoming weaker. Punctae not seen. Hinge and hinge-plate not exposed, outline damaged. Interarea not exposed but apparently low.



FIGURE 14. ?cf. *Spiriferina arakiwa* from Pointe Noire (OU 47324). Ventral valve, corroded.

Remarks

The hingeline is not exposed, and the specimen shows nothing diagnostic of *Psioidiella*. The outline and ribbing are more like those of the Early Jurassic spiriferinide *Spiriferina arakiwa*. This is present in the Ururoan of the Kawhia and Southland Synclines (MacFarlan 2023a) but has not previously been recorded from New Caledonia, or from the Aratauran of New Zealand. The collection also includes *Otapiria marshalli*, *Vincentirhynchia pomeyrol* and psiloceratid ammonites, indicating an Aratauran age.

The locality is close to the better-known Pointe Noire locality NC/f0499, which has an ammonite fauna of Middle to Upper Hettangian age (Liassicus to Angulata chronozone, Meister *et al.* 2010).

A second New Zealand specimen of *Linguithyris agerorum*

Order TEREBRATULIDA Waagen, 1883

Suborder TEREBRATULIDINA Waagen, 1883

Superfamily DYSCOLIOIDEA Fischer & Oehlert, 1891

Family NUCLEATIDAE Schuchert, 1929

Linguithyris Buckman, 1918

Type Species: *Terebratula bifida* Rothpletz, 1886.

Linguithyris agerorum Manceñido, 1993

A small brachiopod identified as *Linguithyris agerorum* was found after MacFarlan (2019) was published. It is probably a juvenile.

Material

AU B821, a double-valved shelly specimen from R17/f227 (AU 7634) (Figure 15) from a western tributary of the Awakino River. Collected by F. Hasibuan, 7/12/1979.

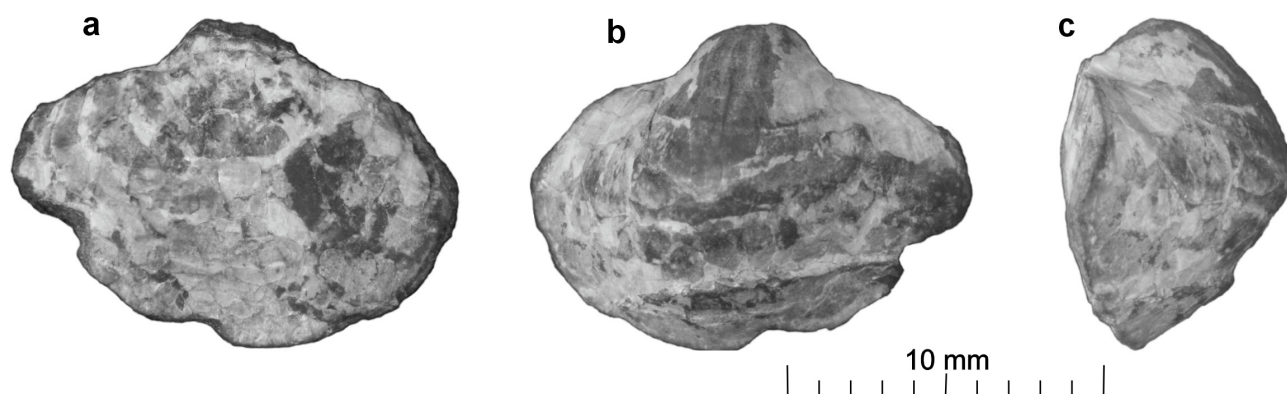


FIGURE 15. *Linguithyris agerorum*. AU B821 (R17/f227) partly decorticated double-valved specimen: (a) dorsal (b) ventral (c) lateral.

Description

See Manceñido (1993) and MacFarlan (2019).

Dimensions

Dimensions are shown in Table 11.

TABLE 11. Dimensions, *Linguithyris agerorum*.

specimen	Lv	Lp	W	H	b<	ms/dv	material	notes
AU B821	10.3	9.2	14	7	120		b pt shelly	probable juvenile

Remarks

The associated fauna listed in FRED includes the rhynchonellides *Herangirhynchia herangiensis* and *Furcirhynchia ururoaensis*, the terebratulide *Rugithyris hasibuani* and bivalves *Asoella* sp. and *Pseudolimea* sp. These are characteristic of the Upper Ururoan (Toarcian) in the sense of Hudson (2003).

This is the second specimen of *Linguithyris agerorum* found in New Zealand, after the holotype described by

Manceñido (1993). The species is also present in the Aratauran of Uitoë Peninsula, New Caledonia (MacFarlan, 2019). See Figure 2 for New Caledonia localities and Figure 4 for location of this specimen and the holotype.

Conclusions

This paper reports a series of observations on the Zealandian Triassic and Jurassic brachiopod fauna, made mainly in the course of systematic surveys of other groups. All the material comes from existing collections, showing the value of well-curated systematic and stratigraphic collections.

In the Early Jurassic of Zealandia, *Prionorhynchia* adds another element to the group of brachiopods with a distribution centered on southern Europe and North Africa, and scattered occurrences on the west coasts of North and South America, Zealandia and East Asia from China to Indonesia. As well as *Prionorhynchia*, these include the rhynchonellide *Furcirhynchia* (MacFarlan 1992), the spiriferinides *Spiriferina*, *Callospiriferina*, *Dispiriferina* and *Cisnerospira* (MacFarlan 2023a), and the terebratulides *Lobothyris* and *Loboidothyris* (MacFarlan 2019).

Aparimarhynchia dunrobinensis from the Kaka Point Fold Belt is figured, and the time range of *Aparimarhynchia* is considered to be Malakovian to Etalian (Olenekian to Anisian).

Two Middle to Late Jurassic species of Norellidae are recognised and placed in the subfamily Diholkorhynchiinae.

Clavigera drotae is figured from New Caledonian material held in New Zealand. A single specimen from the Late Triassic of Kawhia is referred to *Clavigera* cf. *drotae*

The cosmopolitan Middle Triassic spiriferinide genus *Punctospirella* is recognised in the Zealandian Kaihikuan fauna. The type species *P. fragilis* is known from the Middle Triassic of central and Eastern Europe and Asia. It is recommended that the Zealandian material is referred to *Punctospirella* cf. *fragilis* pending a full revision.

A single specimen of *Dispiriferina* extends the range of that genus into the Late Triassic. It is interesting that the Early Jurassic genus *Callospiriferina* is also recorded (as *C. kawhiana*) from the upper Otapirian (late Rhaetian) of Zealandia (MacFarlan 2023a).

The stratigraphic and geographic ranges of *Herangirhynchia awakinoensis*, *Murihikurhynchia malingi* and *Linguithyris agerorum* are extended.

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References

- Aberhan, M. (1993) Faunal replacement in the Early Jurassic of northern Chile: implications for the evolution in Mesozoic benthic shelf ecosystems. *Palaeogeography Palaeoclimatology Palaeoecology*, 103, 155–177.
[https://doi.org/10.1016/0031-0182\(93\)90141-5](https://doi.org/10.1016/0031-0182(93)90141-5)
- Ager, D.V. (1956) A Monograph of the British Liassic Rhynchonellidæ, Part I. *Monographs of the Palaeontographical Society*, 110 (476), i–xxvi + 1–50.
<https://doi.org/10.1080/25761900.2022.12131669>
- Ager, D.V. (1959a) The classification of the Mesozoic Rhynchonelloidea. *Journal of Paleontology*, 33 (2), 324–332, pl. 49.
- Ager, D.V. (1959b) Lower Jurassic Brachiopods from Turkey. *Journal of Paleontology*, 33 (6), 1018–1028.
- Ager, D.V. (1965) Mesozoic and Cenozoic Rhynchonellacea. In: Moore, R.C. (Ed.), *Treatise on Invertebrate Paleontology. Part H. Brachiopoda*. The Geological Society of America, New York, New York and The University of Kansas Press, Lawrence, Kansas, pp. 597–625.
- Ager, D.V. (1967) A Monograph of the British Liassic Rhynchonellidæ, Part IV. *Monographs of the Palaeontographical Society*, 121 (519), 137–169.
<https://doi.org/10.1080/25761900.2022.12131706>
- Ager, D.V. & Sun, D.-L. (1988) Distribution of Mesozoic brachiopods on the northern and southern shores of Tethys. *Palaentologia Cathayana*, 4, 23–51.
- Allan, R.S. (1945) Palaeozoic and Mesozoic brachiopod faunas in New Zealand, with an index to the genera and species. *Transactions of the Royal Society of New Zealand*, 75 (1), 1–22.
- Alm eras, Y. (1988) Jurassic brachiopods from the Klo Tho-Mae Sot Area. *CCOP Technical Bulletin*, 20 (Appendix 8), 211–216, pl. 46.
- Alm eras, Y. & Cougnon, M. (2013) Les Brachiopodes jurassiques (Spiriferida et Rhynchonellida) Principaux genres et leur evolution. Les esp ces, extension verticales et r partitions g ographiques. *Documents des Laboratoires de G ologie, Lyon*, 170, 1–227, pls. 1–17.
- Arthaber, G. (1915) Die Trias von Bithynien (Anatolien). *Beitr ge zur Pal ontologie und Geologie  sterreich-Ungarns und des Orients*, 27, 85–206.
- Avias, J. & Drot, J. (1952) Sur la pr sence du Rh tien en Nouvelle-Cal donie. *Comptes Rendues sommaires de la Soci t  g ologique de France*, 1952, 247–248.
- Baeza-Carratal , J.F., Garc a Joral, F. & Tent-Mancl s, J.E. (2016a) Lower Jurassic brachiopods from the Ibero-Levantine Sector (Iberian Range): Faunal turnovers and critical bioevents. *Journal of Iberian Geology*, 42 (3), 355–369.
<https://doi.org/10.5209/JIGE.54666>
- Baeza-Carratal , J.F., Mance ido, M.O. & Garc a Joral, F. (2016b) *Cisnerospira* (Brachiopoda, Spiriferinida), an atypical Early Jurassic spire bearer from the Subbetic Zone (SE Spain) and its significance. *Journal of Paleontology*, 90 (6), 1081–1099.
<https://doi.org/10.1017/jpa.2016.109>
- Baeza-Carratal , J.F. & Garc a Joral, F. (2022) The last representatives of the Superfamily Wellerelloidea (Brachiopoda, Rhynchonellida) in the westernmost Tethys (Iberian paleomargins) prior to their demise in the early Toarcian Mass Extinction Event. *Journal of Paleontology*, 96 (5), 991–1023.
<https://doi.org/10.1017/jpa.2022.24>
- Bittner, A. (1890) Brachiopoden der Alpinen Trias. *Abhandlungen der kaiserlich-k niglichen geologischen Reichsanstalt*, 14, 1–325, pls. 1–41.
- Boles, J.R. (1974) Structure, stratigraphy, and petrology of mainly Triassic rocks, Hokonui Hills, Southland, New Zealand. *New Zealand Journal of Geology and Geophysics*, 17 (2), 337–374.
<https://doi.org/10.1080/00288306.1974.10430397>
- Boucot, A.J., Johnson, J.G. & Staton, R.D. (1964) On some atrypoid, retzioid, and athyridoid Brachiopoda. *Journal of Paleontology*, 38, 805–822, figs. 1–6, pls. 125–128.
- Buckman, S.S. (1918) The Brachiopoda of the Namyau Beds, Northern Shan States, Burma. *Memoirs of the Geological Survey of India, Palaeontologia Indica*, New Series, 3 (2), pp. 1–299. [published for 1917]
- Campbell, H.J. (1994) *The Triassic and Jurassic bivalves Daonella and Halobia in New Zealand, New Caledonia and Svalbard*. *Institute of Geological & Nuclear Sciences Monograph 4*. Institute of Geological & Nuclear Sciences, Lower Hutt, 166 pp., 12 pls.
- Campbell, H.J. & Grant-Mackie, J.A. (1984) Biostratigraphy of the Mesozoic Baie de St. Vincent Group, New Caledonia. *Journal of the Royal Society of New Zealand*, 14 (4), 349–366.
<https://doi.org/10.1080/03036758.1984.10421736>
- Campbell, H.J. & Owen, S.R. (2003) The Nelsonian Stage: A new Early Triassic local stage for New Zealand, *Journal of the Royal Society of New Zealand*, 33 (1), 97–108.
<https://doi.org/10.1080/03014223.2003.9517723>
- Campbell, J.D. (1991) Latest Triassic (Rhaetian) brachiopods of New Zealand and New Caledonia. In: Mackinnon, D.I., Lee, D.E. & Campbell, J.D. (Eds.), *Brachiopods through Time*. Balkema, Rotterdam, pp. 389–392.
- Campbell, J.D. (1997) Otapirian Stage, its Fauna and Microflora. In: Dickins, J.M., Yang, Z.Y., Yin, H.F., Lucas, S.G. & Acharyya, S.K. (Eds.), *Late Palaeozoic and Early Mesozoic circum-Pacific events and their global correlation*. Cambridge

- University Press, Cambridge, pp. 229–234.
<https://doi.org/10.1017/CBO9780511564413.025>
- Campbell, J.D., Coombs, D.S. & Grebneff, A. (2003) Willsher Group and geology of the Triassic Kaka Point coastal section, south-east Otago, New Zealand. *Journal of the Royal Society of New Zealand*, 33 (1), 7–38.
<https://doi.org/10.1080/03014223.2003.9517719>
- Campbell, J.D. & Force, E.R. (1973) Kaihikuan Stage (Middle Triassic): Definition and type locality. *New Zealand Journal of Geology and Geophysics*, 16 (2), 209–219.
<https://doi.org/10.1080/00288306.1973.10431453>
- Carter, J.L. (2006) Pennospiriferinoidea. In: Kaesler, R.L. (Ed.), *Treatise on Invertebrate Paleontology. Part H. Brachiopoda 5. Revised*. Geological Society of America, Boulder, Colorado and Paleontological Institute, Lawrence, Kansas, pp. 1910–1929.
- Carter, J.L., Johnson, J.G., Gourvenec, R. & Hou, H.-F. (1994) A revised classification of the spiriferid brachiopods. *Annals of Carnegie Museum*, 63, 327–374.
<https://doi.org/10.5962/p.215817>
- Clowes, C.D., Crampton, J.S., Bland, K.J. Collins, K.S. Prebble, J.G., Raine, J.I., Strogon, D.P., Terezow, M.G. & Womack, T. (2021) The New Zealand Fossil Record File: a unique database of biological history. *New Zealand Journal of Geology and Geophysics*, 64 (1), 62–71.
<https://doi.org/10.1080/00288306.2020.1799827>
- Cooper, R.A. (Ed.) (2004) *The New Zealand Geological Timescale. Institute of Geological & Nuclear Sciences Monograph 22*. Institute of Geological & Nuclear Sciences, Lower Hutt, 284 pp.
- Dagys, A.S. (1963) *Verkhnetriasovye brakhiopody yuga SSSR [Upper Triassic brachiopods of the southern USSR]*. Akademiia Nauk SSSR, Sibirskoe Otdelenie. Izdatel'stvo Akademii Nauk SSSR, Moscow, 248 pp., 106 figs., 31 pls. [in Russian]
- Dagys, A.S. (1972) Iavlennia metakhoreza sredi triasovikh spiriferinid [The phenomenon of metachoresis among Triassic spiriferinides]. In: Problemy Paleozoogeografii Mesozoia Sibiri [Problems of Paleozoogeography in the Mesozoic of Siberia]. *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Institut Geologii i Geofiziki, Trudy*, 111, pp. 34–44, 4 figs. [in Russian]
- Dagys, A.S. (1974) Triasovye brakhiopody (morfologiya, sistema, filogeniya, stratigraficheskoye znachenie i biogeografiya) [Triassic Brachiopoda (morphology, systematics, phylogeny, stratigraphic distribution, and biogeography)]. In: *Akademiia Nauk SSSR Sibirskoe Otdelenie Institut Geologii i Geofiziki (IGIG) Trudy [Institute of Geology and Geophysics, Academy of Sciences of the USSR, Siberian Branch, Transactions]*, 214, pp. 1–386, figs. 1–171 figs., pls. 1–49. [in Russian]
- Davidson, T. (1881) On genera and species of spiral-bearing Brachiopoda from specimens developed by Rev. Norman Glass: with notes on the results obtained by Mr. George Maw from extensive washing of the Wenlock and Ludlow shales of Shropshire. *Geological Magazine*, New Series, Decade II, 8 (1), 1–13.
<https://doi.org/10.1017/S0016756800112993>
- Davidson, T. (1884) A Monograph of the British Fossil Brachiopoda. Vol. 5. Part 3. Appendix to the Supplements. General Summary. Catalogue of British Fossil Brachiopoda. In: *Monographs of the Palaeontographical Society*, 38 (181), pp. 243–476, pls. 18–21.
<https://doi.org/10.1080/02693445.1884.12027986>
- Deslongchamps, E. (1855) [1854] Notice sur un genre nouveau de brachiopodes. Avec la description de quelques espèces nouvelles de la Grande Oolithe et du Lias de Normandie. *Annuaire de l'Institut des Provinces et des Congrès Scientifiques*, 1855, 529–553, 1 pl.
- Deslongchamps, E. (1864) Fossiles Triasiques recueillis à l'île Hugon. *Bulletin de la Société Linnéenne de Normandie*, 8, 332–378, pls. 13–17.
- Drot, J. (1953) Annexe Paléontologique; Descriptions des brachiopods du Trias et de l'infralias de Nouvelle-Calédonie. In: Avias, J., Contribution à l'étude stratigraphique et paléontologique des formations antécrotacées de la Nouvelle Calédonie Centrale. *Science de la Terre*, 1 (1–2), pp. 1–276.
- Duméril, A.M.C. (1806) *Zoologie analytique ou méthode naturelle de classification des animaux*. Allais, Paris, xxiv + 344 pp.
- Ernst, A., Schäfer, P. & Grant-Mackie, J.A. (2015) New Caledonian Triassic Bryozoa. *Journal of Paleontology*, 89 (5), 730–745.
<https://doi.org/10.1017/jpa.2015.50>
- Fischer, P. & Oehlert, D.-P. (1891) *Brachiopodes*. In: Milne-Edwards, A. (Ed.), *Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882, 1883*. Masson, Paris, pp. 1–139.
- Force, E.R. & Campbell, J.D. (1974) Some faunas and formations of Kaihikuan Age (Middle Triassic) in the Murihiku Supergroup, *New Zealand Journal of Geology and Geophysics*, 17 (2), 389–402.
<https://doi.org/10.1080/00288306.1974.10430399>
- García Joral, F., Goy, A. & Ureta, S. (1990) Las sucesiones de braquiópodos en el tránsito Lías-Dogger en la Cordillera Ibérica. *Cuadernos de Geología Ibérica*, 14, 55–65.
- García Joral, F. & Goy, A. (1994) The associations of brachiopods from the Toarcian-Aalenian transition in the Fuentelsaz section (Iberian Range, Spain). [Les associations de brachiopodes au passage Toarcien-Aalénien Dans La Section De Fuentelsaz (Chaîne Ibérique, Espagne)]. *Geobios*, 27 (Supplement 2), 223–228.
[https://doi.org/10.1016/S0016-6995\(94\)80141-X](https://doi.org/10.1016/S0016-6995(94)80141-X)

- García Joral, F. & Goy, A. (2000) Stratigraphic distribution of Toarcian brachiopods from the Iberian Range (Spain) and its relation to depositional sequences. *GeoResearch Forum*, 6, 381–386.
- García Joral, F., Goy, A., Rosales, I., Barnolas, A., Sevillano, A. & López-García, J.M. (2022) Early Toarcian (Jurassic) brachiopods from the Balearic Islands (Spain) and their paleobiogeographic context. *Journal of Iberian Geology*, 48, 445–460.
<https://doi.org/10.1007/s41513-022-00197-0>
- García Joral, F., Baeza-Carratalá, J.F. & Giannetti, A. (2023) Compositional and taphonomic gradients show fluctuating depositional conditions on Middle Jurassic brachiopod-rich accumulations from Northern Calcareous Alps (Austria-Germany), *Historical Biology*, 36 (8) 1570–1582.
<https://doi.org/10.1080/08912963.2023.2221274>
- Gordon, D.P. (Ed.) (2009) *New Zealand inventory of biodiversity. Vol. 1. Kingdom Animalia: Radiata, Lophotrochozoa, Deuterostomia* Canterbury University Press, Christchurch, 566 pp.
- de Gregorio, A. (1930) Fossili triassici della zona a Rhynchonellina bilobata Gemm. dei dintorni di Palermo. *Annales de Géologie et de Paléontologie de Palerme*, 55, 1–18, pls. 1–4.
- Hector, J. (1879) On the fossil Brachiopoda of New Zealand. *New Zealand Institute, Transactions and Proceedings*, 11, 537–539.
- Hudson, N. (2003) Stratigraphy and correlation of the Ururoan and Temaikan Stage (Lower-Middle Jurassic, ?Sinemurian-Callovian) sequences, New Zealand. *Journal of the Royal Society of New Zealand*, 33 (1), 109–147.
<https://doi.org/10.1080/03014223.2003.9517724>
- Ivanova, E.A. (1972) Osnovnyye zakonomernosti evolyutsii spiriferid (Brachiopoda). [Main features of spiriferid evolution (Brachiopoda)]. *Paleontologicheskii Zhurnal*, 1972 (3), 28–42, 5 figs. [in Russian]
- Kaesler, R.L. (Ed.) (1997–2006) *Treatise on Invertebrate Paleontology. Part H. Brachiopoda. Vols. 1–5. Revised*. Geological Society of America and Paleontological Institute, Boulder and Lawrence, 2859 pp. [539 + 2320 pp.]
- Kaim, A. (1997) Brachiopod-bivalve assemblages of the Middle Triassic Terebratula Beds, Upper Silesia, Poland. *Acta Palaeontologica Polonica*, 42 (2) 333–359.
- Kamyshan, V.P. & Babanova, L.I. (1973) *Sredneiuskie i Pozdneiuskie Brakhiopody Severo-Zapadnogo Kavkaza i Gornogo Kryma [Middle Jurassic and Late Jurassic brachiopods of northwestern Caucasus and montane Crimea]*. Izdatel'skoe Ob"edinenie "V. Shkola", Izdatel'stvo pri Khar'kovskom Gosudarstvennom Universitete, Khar'kov, 175 pp., 18 pls. [in Russian]
- Kelly, M., Mills, S., Terezow, M., Sim-Smith, C. & Nelson, W. (Eds.) (2023) The Marine Biota of Aotearoa New Zealand. Updating our marine biodiversity inventory. *NIWA Biodiversity Memoir 136*. NIWA, Wellington, 494 pp.
- Kuhn, O. (1949) *Lehrbuch der Paläozoologie*. E. Schweizerbart, Stuttgart, v + 326 pp.
- Licharew, B.K. (1956) Nadsemeistvo Rhynchonellacea Gray, 1848 [Superfamily Rhynchonellacea Gray, 1848]. In: Kiparisova, L.D., Markovskii, B.P. & Radchenko, G.P., (Eds.), *Materialy po Paleologii, Novye Semeistva i Rody [Materials for Paleontology, new families and genera]*. Trudy Vsesoiuznogo Nauchno-Issledovatel'skogo Geologicheskogo Instituta (VSEGEI). New Series. Vol. 12. Materialy (Paleologiiia). Vsesoiuznyi Nauchno-Issledovatel'skii Geologicheskii Institut (VSEGEI), Saint Petersburg, pp. 56–61. [in Russian]
- MacFarlan, D.A.B. (1992) Triassic & Jurassic Rhynchonellacea (Brachiopoda) from New Zealand & New Caledonia. *Royal Society of New Zealand Bulletin*, 31, i–x + 1–310.
- MacFarlan, D.A.B. (1998) Mesozoic stratigraphy of the Marokopa area, southwest Auckland, New Zealand. *New Zealand Journal of Geology and Geophysics*, 41 (3), 297–310.
<https://doi.org/10.1080/00288306.1998.9514812>
- MacFarlan, D.A.B. (2016) Middle and Late Jurassic terebratulides from New Zealand. *Palaeoworld*, 25 (4), 467–495.
<https://doi.org/10.1016/j.palwor.2016.07.001>
- MacFarlan, D.A.B. (2019) Early Jurassic Terebratulide Brachiopods from Zealandia. *Rivista Italiana di Paleontologia e Stratigrafia*, 125 (3), 551–586.
<https://doi.org/10.13130/2039-4942/12160>
- MacFarlan, D.A.B. (2021) *Measurement data for Zealandian Mesozoic brachiopods*. GNS Science Report 2021/45. GNS Science, Lower Hutt, 11 pp.
- MacFarlan, D.A.B. (2023a) Latest Triassic and Early Jurassic Spiriferinida (Brachiopoda) of Zealandia (New Zealand and New Caledonia). *Zootaxa*, 5277 (1), 1–58.
<https://doi.org/10.11646/zootaxa.5277.1.1>
- MacFarlan, D.A.B. (2023b) Otapirian (Rhaetian) Terebratulida (Brachiopoda) of Zealandia. *Zootaxa*, 5374 (1), 1–34.
<https://doi.org/10.11646/zootaxa.5374.1.1>
- MacFarlan, D.A.B. & Campbell, J.D. (2003) *Zeilleria spiculata*, a new terebratulide brachiopod from the latest Triassic-earliest Jurassic of New Zealand. *Journal of the Royal Society of New Zealand*, 33 (1), 213–221.
<https://doi.org/10.1080/03014223.2003.9517728>
- MacFarlan, D.A.B., Bradshaw, M.A., Campbell, H.J., Cooper, R.A., Lee, D.E., MacKinnon, D.I., Waterhouse, J.B., Wright, A.J. & Robinson, J.H. (2009) Phylum Brachiopoda : lamp shells. In: Gordon, D.P. (Ed.), *New Zealand inventory of biodiversity. Vol. 1. Kingdom Animalia: Radiata, Lophotrochozoa, Deuterostomia* Canterbury University Press, Christchurch, pp. 255–267.

- Manceñido, M.O. (1991) The succession of Early Jurassic brachiopod faunas from Argentina. *In*: MacKinnon, D.I., Lee, D.E. & Campbell, J.D. (Eds.), *Brachiopods through Time*. A.A. Balkema, Rotterdam, pp. 397–404.
- Manceñido, M.O. (1993) First record of Jurassic nucleatid brachiopods from the Southwest Pacific with comments on the global distribution of the group. *Palaeogeography, Palaeoclimatology, Palaeoecology* 100 (1/2), 189–207.
[https://doi.org/10.1016/0031-0182\(93\)90042-H](https://doi.org/10.1016/0031-0182(93)90042-H)
- Manceñido, M.O. & Owen, E.F. (2002) Rhynchonelloidea. *In*: Kaesler, R.L. (Ed.), *Treatise on Invertebrate Paleontology. Part H. Brachiopoda 4. Revised*. Geological Society of America, Boulder, Colorado and Paleontological Institute, Lawrence, Kansas, pp. 1279–1308.
- Manceñido, M.O., Owen, E.F., Dagys, A.S. & Sun, D.-L. (2002) Norelloidea. *In*: Kaesler, R.L. (Ed.), *Treatise on Invertebrate Paleontology. Part H. Brachiopoda 4. Revised*. Geological Society of America, Boulder, Colorado and Paleontological Institute, Lawrence, Kansas, pp. 1308–1325.
- Martin, K.R. (1975) Upper Triassic to Middle Jurassic stratigraphy of south-west Kawhia, New Zealand. *New Zealand Journal of Geology and Geophysics*, 18 (6), 909–938.
<https://doi.org/10.1080/00288306.1975.10423534>
- Marwick, J. (1953) *Divisions and faunas of the Hokonui System (Triassic and Jurassic)*. New Zealand Geological Survey Paleontological Bulletin 21. New Zealand Geological Survey, Wellington, 141 pp.
- Meister, C., Maurizot, P. & Grant-Mackie, J.A. (2010) Early Jurassic (Hettangian–Sinemurian) ammonites from New Caledonia (French Overseas Territory, Western Pacific). *Paleontological Research*, 14 (2), 85–118.
<https://doi.org/10.2517/1342-8144-14.2.085>
- Newton, R.B. (1923) On marine Triassic shells from Singapore. *Annals and Magazine of Natural History*, Serie 9, 12 (69), 300–321.
<https://doi.org/10.1080/00222932308632948>
- Oppel, A. (1861) Ueber die Brachiopoden des untern Lias. *Zeitschrift der deutschen geologischen Gesellschaft*, 13 (4), 529–550, pls. 10–13.
- d’Orbigny, A. (1847) Considérations zoologiques et géologiques sur les brachiopodes ou palliobranches, parts 1–2. *Comptes Rendus Hebdomadaires des Séances de l’Académie des Sciences, Paris*, Series 2, 25 (5 & 7), 193–195 & 266–269. [also published in *Annales des Sciences Naturelles*, Series 3, 8, 241–270.
- Palfy, J. (2003) The Pelsonian brachiopod fauna of the Balaton Highland. *Geologica Hungarica, Series Palaeontologica*, 55, 139–158.
- Piroutet, M. (1917) *Étude Stratigraphique sur la Nouvelle-Calédonie*. Protat Freres, Macon, 313 pp.
- Quenstedt, F.A. (1851–1852) *Handbuch der Petrefaktenkunde. 1st Edition*. H. Laupp’schen, Tübingen, 528 pp., 52 pls. (1851), 264 pp., 10 pls. (1852). [pp. 1–528, pls. 1–52 (1851), pp. 529–792, pls. 53–62 (1852)]
- Quenstedt, F.A. (1868–1871) Die Brachiopoden. *In: Petrefaktenkunde Deutschlands. Vol. 2 (1)*. Fuess, Leipzig, pp. 1–748 pls. 1–61, pp. 1–160 (1868), pp. 161–464 (1869), pp. 465–748 (1870), pl. 37–61 (1871).
- Raine, J.I., Beu, A.G., Boyes, A.F., Campbell, H.J., Cooper, R.A., Crampton, J.S., Crundwell, M.P., Hollis, C.J. & Morgans, H.E.G. (2015) *Revised calibration of the New Zealand Geological Timescale: NZGT2015/1. GNS Science Report 2012/39*. Institute of Geological & Nuclear Sciences, Lower Hutt, 53 pp.
- Robinson, J., MacFarlan, D.A.B. & Waterhouse, J.B. (2023) Chapter 15. Kingdom Animalia, phylum Brachiopoda (lamp shells). *In*: Kelly, M., Mills, S., Terezow, M., Sim-Smith, C. & Nelson, W. (Eds.), *The Marine Biota of Aotearoa New Zealand. Updating our marine biodiversity inventory. NIWA Biodiversity Memoir 136*. NIWA, Wellington, pp. 239–254.
- Rothpletz, A. (1886) *Geologisch-palaeontologische Monographie der Vilser Alpen, mit besonderer Berücksichtigung der Brachiopoden-Systematik*. *Palaeontographica, Stuttgart*, 33, 1–180. pls. 1–17.
- Rousselle, L. (1973) Le genre *Prionorhynchia* dans le Toarcien et l’Aalenien inférieur de Haut-Atlas central et oriental. *Notes du Service géologique de Maroc*, 34 (No. 254), 135–149.
- Rousselle, L. (1977) Spiriférines du Lias moyen et supérieur au Maroc (Rides Pré-rifaines; Moyen Atlas) et en Espagne (Chaîne Celtibérique orientale). *Notes du Service Géologique du Maroc*, 38, 153–175.
- Savage, N.M., Manceñido, M.O., Owen, E.F. & Dagys, A.S. (2002) Rhynchotetradioidea. *In*: Kaesler, R.L. (Ed.), *Treatise on Invertebrate Paleontology. Part H. Brachiopoda 4. Revised*. Geological Society of America, Boulder, Colorado and Paleontological Institute, Lawrence, Kansas, pp. 1246–1256.
- Savage, N.M., Manceñido, M.O., Owen, E.F., Dagys, A.S. & Sun, D.-L. (2002) Wellerioidea. *In*: Kaesler, R.L. (Ed.), *Treatise on Invertebrate Paleontology. Part H. Brachiopoda 4. Revised*. Geological Society of America, Boulder, Colorado and Paleontological Institute, Lawrence, Kansas, pp. 1256–1279.
- von Schlotheim, E.F. (1813) Beiträge zur Naturgeschichte der Versteinerungen in geognostischer Hinsicht. *In*: Leonhard, C.C. (Ed.), *Taschenbuch für die gesammte Mineralogie mit Hinsicht auf die neuesten Entdeckungen. Vol. 7. No. 1*. Hermannsche Buchhandlung, Frankfurt am Main, pp. 1–134, 4 pls.
- Schuchert, C. (1894) A revised classification of the spire bearing Brachiopoda. *The American Geologist*, 13, 102–107.
- Schuchert, C. & LeVene, C.M. (1929) Brachiopoda (Generum et Genotyporum Index et Bibliographia). *In*: Pompeckj, J.F. (Ed.), *Fossilium Catalogus. I: Animalia. Part 42*. W. Junk, Berlin, pp. 1–140.
- Selden, P.A. (Ed.) (2007) *Treatise on Invertebrate Paleontology. Part H. Brachiopoda. Vol. 5. Supplement. Revised*. Geological Society of America, Boulder, Colorado and Paleontological Institute, Lawrence, Kansas, pp. 2321–3226.
- Siblík, M. (1964) Liassic brachiopods from the upper part of the Bela Valley (Belanská Dolina) in the Veľká Fatra Mts.

- Geologický prave, Zpravy*, 31, 157–181, pls. VII–VIII.
- Siblík, M. (1965) Some new Liassic brachiopods: *Geologický Sborník*, 16 (1), 73–82.
- Siblík, M. (1991) Triassic brachiopods from Ahgdarband (NE-Iran). *Abhandlungen der Geologischen Bundesanstalt*, 38, 165–174.
- Siblík, M. (2008) A Jurassic Brachiopod Fauna from the Mitterwand Area near Hallstatt (Upper Austria). *Jahrbuch der Geologischen Bundesanstalt*, 148 (1), 59–87.
- Sowerby, J. de C. (1823–1825) *The Mineral Conchology of Great Britain. Vol. 5*. Published by the author, London, 168 pp., pls. 407–503.
- Sun, Z. Hao, W., Sun, Y. & Jiang, D. (2009) Silicified Anisian (Middle Triassic) spiriferinid brachiopods from Guizhou, South China. *Acta Palaeontologica Polonica*, 54, 61–68.
<https://doi.org/10.4202/app.2009.0107>
- Thomson, J.A. (1913) Materials for the Palaeontology of New Zealand. *New Zealand Geological Survey Palaeontological Bulletin 1*. New Zealand Geological Survey, Wellington, 104 pp.
<https://doi.org/10.5962/bhl.title.103721>
- Trechmann, C.T. (1918) The Trias of New Zealand. *Quarterly Journal of the Geological Society, London*, 73 (3), 165–246, 9 pls, map, sect.
<https://doi.org/10.1144/GSL.JGS.1917.073.01-04.10>
- Vörös, A. & Kandemir, R. (2011) A new Early Jurassic brachiopod fauna from the Eastern Pontides (Turkey). *Neues Jahrbuch für Geologie und Paläontologie Abhandlungen*, 260, 343–363.
<https://doi.org/10.1127/0077-7749/2011/0146>
- Waagen, W.H. (1883) Salt Range Fossils. I. Productus-Limestone Fossils. *Geological Survey of India, Memoirs, Palaeontologia Indica*, Series 13, 4 (2), 391–546, pls. 29–49.
- Waterhouse, J.B. (1975) New Permian and Triassic brachiopod taxa. *University of Queensland, Department of Geology Papers*, 7 (1), 1–23, 2 pls.
- Wilckens, O. (1927) Contributions to the palaeontology of the New Zealand Trias. *New Zealand Geological Survey Paleontological Bulletin*, 12, 1–65.
- Williams, A., Carlson, S.J., Brunton, C.H.C., Holmer, L.E. & Popov, L.E. (1996) A supra-ordinal classification of the Brachiopoda. *Philosophical Transactions of the Royal Society of London*, Series B, 351 (1344), 1171–1193, 6 figs.
<https://doi.org/10.1098/rstb.1996.0101>
- Xu, G.-R. (1990) Phenetic-cladistic systematics and geographic patterns of Triassic rhynchonellids. In: MacKinnon, D.I., Lee, D.E. & Campbell, J.D. (Eds.), *Brachiopods through time. Proceedings of the 2nd International Brachiopod Congress*. A.A. Balkema, Rotterdam, pp. 67–79.
- Xu, G.-R. & Liu, G.-C. (1983) [Some Problems in the Research of Triassic brachiopods]. In: Yang, Z.Y., Yin, H.F., Wen, S.X., Yang, S.G., Xu, G.R. & Liu, G.C. (Eds.), [*Triassic of the South Qilian Mountains*]. Geological Publishing House. Beijing, pp. 67–83. [in Chinese with English summary]
- Yang, Z.-Y. & Xu, G.-R. (1966) *Triassic Brachiopods of central Guizhou (Kueichow) Province, China*. Science Press. Beijing, 151 pp., 14 pls. [in Chinese with English summary]