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Fossil Localities of the Torlesse Group in the South Island

(With Map in Pocket.)

By J. D. CAMPBELL and GUYON WARREN

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Abstract

ABOUT 350 fossil localities are known in rocks of the Torlesse Group in the South Island. The fossils are preserved in a variety of lithologies and their mode of occurrence includes isolated shell fragments, shell-beds, and organic limestones. Some are life assemblages preserved at or near the place of living; others are redeposited and have been transported as dead shells. They range in age from Permian to Lower Cretaceous and allow recognition of at least nine zones. Many also occur in the Southland Syncline and comparable facies in Nelson and South Auckland, but some are apparently restricted to the Torlesse Group.

INTRODUCTION

THIS paper incorporates "A Census of Fossil Localities in Alpine Facies Rocks of the South Island", by J. D. Campbell, read before the Canterbury Branch on 6 August 1958. It is a review of the present status of paleontology of the South Island members of the Torlesse Group, rocks predominantly of greywacke composition which make up most of the higher land of Canterbury and Marlborough and parts of Nelson, Westland, and Otago. Earlier reviews have been published by McKay (1881), Benson (1921), and Wellman (1952).

Between the times of writing of McKay and Wellman the number of known fossil localities in Torlesse rocks of the South Island had increased only slightly. In the last decade or so, many localities have been added, notably in Canterbury. In large part credit must go to Wellman for the inspiration that led to the revival of interest in these rocks. He recognised the extent and significance of the Alpine Fault as a major structural boundary, and later demonstrated the differences in lithology, fossil content, and structure between the Permian to Jurassic sediments west and south of the schist in Nelson and Southland and those to the east, with which we are here concerned. He recognised the large measure of depositional and structural unity of this great mass of rocks and proposed the term Alpine Facies for them.

Interest in the greywackes has heightened as the four-mile mapping project of the Geological Survey has proceeded. Many new fossil localities have been found

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and Suggate (1961) has introduced the rock unit Torlesse Group (derived from Haast's Mount Torlesse Formation) to accommodate the greywacke and argillite east of the schist of the Southern Alps.

We are very grateful to Professor R. S. Allan for his interest and help while we were members of his department; he very generously made available to us a carefully prepared manuscript on the distribution of *Terebellina*.

The present census includes many records that have not previously been published. In compiling details of these, we have received ready co-operation from a large number of people, and wish to record our sincere gratitude. We must mention particularly the non-professional geologists, especially Messrs G. M. Mason and O. R. Wilkes, whose many discoveries accelerated interest in the Torlesse Group fossil localities of Canterbury and Nelson. Dr P. B. Maling, Messrs J. R. Jackson and T. J. H. Chinn have also made new information available. Increasingly the study of Torlesse rocks is being included in university theses, and we are pleased to record our gratitude to Messrs P. A. Maxwell, R. J. Ryburn, and Shu Yeoh Khoon for permission to include much new information. Messrs A. C. Beck, H. E. Fyfe, H. S. Gair, D. R. Gregg, W. D. M. Hall, G. J. Lensen, A. R. Mutch, L. E. Oborn, and Drs M. Gage and R. P. Suggate have each contributed data on fossil occurrences.

We are grateful for the help and company of field companions on many trips.

The value of this paper is greatly enhanced by the paleontological work of Drs C. A. Fleming, J. Marwick, G. Norris, I. G. Speden and J. B. Waterhouse, much of it done especially for this paper, and particularly by the careful checking of many Geological Survey collections by Dr G. R. Stevens.

We are indebted to Professor D. S. Coombs, Dr Fleming, and Mr Gregg for helpful discussions. Dr W. D. Means kindly commented on the problem of tectonic deformation. The plates were prepared by Mr R. H. Hardie.

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DEFINITION AND SCOPE OF TORLESSE GROUP

The Torlesse Group includes that part of the sequence deposited in the New Zealand Geosyncline that is predominantly of greywacke-argillite facies and is texturally less altered than the low-grade schist (Chlorite 2 Subzone of Hutton and Turner, 1936) into which it commonly grades to the south and west.

In Marlborough the major unconformity that marks the top of the Torlesse Group in other areas is lacking, and we follow Lensen (1962) in taking the group to include in that area rocks as young as Motuan (Lower Cretaceous), namely all rocks up to the top of the Good Creek Formation as redefined by Lensen and Hall (in prep.).

Definition of the Torlesse Group is of necessity partly geographical. Differences in mineralogy and texture between Torlesse sediments and those of the Southland and Nelson synclines may not always be detectable in specific instances of comparison. Coombs *et al.* (1959) have noted rather broad distinctive mineralogical features of Torlesse rocks; some of these are subtle in that they are expressed as differences in the proportion of various constituents. Wellman's (1952) subdivision of the New Zealand Permian to Jurassic stratified rocks

into two simple facies (three in 1956) is probably not applicable in detail. Not all sediments included in his Alpine Facies are redeposited; grading is by no means uncommon in his Hokonui Facies. Nor does fossil evidence support a rigid two- or three-fold geographic distinction of sedimentary environments. It seems useful nevertheless, as noted by Suggate (1961), to recognise the Torlesse Group as a unit because of its geographic discreteness, its lack of unconformities, its broad lithological distinctiveness, and not least its usefulness as a mapping unit.

Recognisable fossils have now been found in three areas in low grade (Chl 2) schist close to Torlesse Group sediments, and we have thought it useful to include these collections in the list.

Of these, the most important are fossils from the Kakahu area (S102) in weakly schistose greywacke, limestone, and chert. None of these collections are diagnostic as to age, and there seems yet to be little evidence, paleontological or otherwise, to support the assumption (cf. Wellman, 1953, 1962) that the Kakahu rocks do not form part of the Upper Paleozoic and Mesozoic Torlesse Group or its metamorphosed equivalents.

Two *Terebellina* collections in Chl 2 schist are also listed: one in the Arahura valley west of Browning Pass (S58/502), and another (doubtful) near Kellys Hill (S59/536).

NATURE OF TORLESSE GROUP FAUNAS

Fossil evidence suggests that the group represents a span including some of Permian time, Middle and Upper Triassic, Upper Jurassic, and Lower Cretaceous. No Lower Triassic or Lower or Middle Jurassic fossils have yet been found, but this cannot be taken to indicate that no rocks of these ages are present.

TABLE I.—FAUNAL ZONES IN SOUTH ISLAND ROCKS OF THE TORLESSE GROUP.

Zone Species	Local Stage in which Zone Species Occurs	Approximate Overseas Equivalent
Inoceramus ipuanus	Motuan (upper)	Albian
Inoceramus urius	Motuan (lower)	Albian
Inoceramus kapuus	Urutawan	Albian
Inoceramus warakius	Mokoiwian	Neocomian-Aptian
Buchia plicata	Puaroan (upper)	Lower Tithonian
Hibolithes brownei	Puaroan (lower)	Lower Tithonian
Inoceramus galoi	Heterian	Lower Kimeridgian
Monotis richmondiana	Warepan	Norian
Halobia sp.	Oretian-Otamitan	Carnian
Daonella apteryx	Kaihikuan	Ladinian
Atomodesma trechmanni	Not named	Kazanian

Several species not listed above are useful as zonal markers in the Torlesse Group, but are not known to occur elsewhere.

Marine invertebrates are much the most common fossils, but fronds and spores of land plants are preserved in some beds. An ichthyosaurian reptile is recorded from one locality (S72/498) in a rich Kaihikuan brachiopod–mollusc fauna; while recent discoveries include fish vertebrae, in a loose boulder near Arthurs Pass (S59/534), and a decapod crustacean, in a Jurassic conglomerate in the lower Hurunui River (S62/784).

The Torlesse fossils occur in a variety of rock types. Some assemblages appear to be preserved at or near the place of living, and many of these include invertebrates restricted to a shallow-water environment. Some forms, notably the annelids, may be truly deep water in habitat although this has yet to be convincingly demonstrated. For the most part the fossils are preserved in sediments that show strong evidence of redeposition, and little indication of their life environment remains.

Many of the forms found in the Torlesse Group are also known from the Southland Syncline and elsewhere where their succession is well established. Their occurrence in Torlesse rocks allows subdivision of the group into broad zones (Table I), and these are treated separately below.

*Permian Fossil Localities—Atomodesma Zone**

In South Canterbury and North Otago there are a number of localities from which fragments of a molluscan bivalve with a thick prismatic layer have been collected (see also Gair, 1964). In some cases the placing of these fossils in the genus *Atomodesma* can only be justified on stratigraphic evidence. It is interesting to note that as early as 1882 Alexander McKay believed these fossils to be the same as his "Dun Mountain *Inoceramus*" of Permian age. Reasonably well-preserved valves have been collected from the upper Pareora gorge (S110/524), found by G. M. Mason, and these are identified as *Atomodesma trechmanni* (Marwick).

The *Atomodesma* Zone for New Zealand as a whole is thought to extend through all of Permian time, Sakmarian to Tatarian inclusive (Waterhouse, 1964: 701); *A. trechmanni* occurs in rocks correlated with the Kazanian (Upper Permian).

The distribution of undoubted and suspected *Atomodesma* suggests a Permian age for all or most of the extensive area of Torlesse rocks in the eastern ranges between the Rangitata and Waitaki Rivers and for parts of the St. Marys Range. McKay's more northerly occurrence of "Dun Mountain *Inoceramus*" between the Cass and Bealey rivers in the Waimakariri valley (1882: 88; S66/97) has not been confirmed. McKay also recorded *Inoceramus* in limestone near Taylors Pass, Marlborough. He, and later Ongley, (*in* Wellman and Willett, 1947: 356) regarded the limestone as Permian but, on the re-assessment of the fossils, Lensen (1962) mapped it as Jurassic.

Grindley (1958: 43) has noted the finely comminuted nature of *Atomodesma* shells in the Howden Formation, Southland Syncline. Evidently these shells were readily broken and little information as to the depositional environment can be inferred from occurrences of fragments in Torlesse rocks.

Perhaps the most important Permian locality in Torlesse Group rocks is that near the Hae Hae te Moana River (S91/501), also discovered by G. M. Mason, where there is a deposit of comminuted brachiopod shell material. Rare complete single valves of *Spirifer*, and ?productid, terebratulid and rhynchonellid fragments are present in a grey-green conglomerate. The brachiopod shells show clear evidence of transport, but their concentration suggests that the organisms lived near the present outcrop.

Middle Triassic Fossil Localities—Daonella Zone

No fossils of Lower or early Middle Triassic age have been recorded from Torlesse rocks. The Middle Triassic indicator *Daonella* occurs through a minimum thickness of 2,100ft near Corbies Creek (S117) (R. J. Ryburn, pers. comm.).

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* A limestone containing Permian fusulines and corals has recently been discovered near Benmore Dam (see Hornibrook and Shu, appendix to this paper).

Daonella is a member of a fauna dominated by brachiopods but also including other bivalve molluscs, gastropods, and crinoids. This fauna, the richest in species in the Torlesse Group, has been recorded from three main areas. One of these, Rocky Gully, north-west of Mt Potts, (S72/498), was discovered in 1861 by Haast, and was among the earliest known Torlesse fossil localities. The rich assemblage contains at least 14 species including the saurian *Mixosaurus*(?) *hectori* Lydekker. Bivalves occur with valves conjoined and there are some juveniles present. The fossils do not certainly constitute a life assemblage—much of the bone is rolled—but have evidently not been transported far.

Some species have been found only at Mt Potts. *Spiriferina trechmanni* (Wilckens) is not known with certainty from any other locality and the earliest species of *Maoritrigonia* is of similarly restricted distribution (Fleming, 1962). *Spiriferina carolinae* Trechmann, a comparatively uncommon species in Southland, is one of the most abundant forms in the Mt Potts faunule. *Daonella, Spiriferina kaihikuana* Trechmann, *Athyris kaihikuana* (Trechmann), and *Dielasma zealandica* Trechmann are all common species in the Mt Potts fauna as they are in Kaihikuan assemblages in Southland, South Otago, and Nelson.

A less varied fauna of *Daonella* and brachiopods occurs in Carneys Creek, a tributary of the Havelock River on the flank of the Two Thumb Range. This locality (S72/505) is 12 miles west of Rocky Gully; it was discovered in 1961 by Dr P. B. Maling.

In both the Mt Potts and Carneys Creek collections there is a faint but clear lineation representing intersection of an incipient cleavage with bedding. Fossils lying in the bedding plane are distorted.

The third area in which *Daonella* occurs in Torlesse rocks is in North Otago in and near St Marys Range (S117). Fossils were first found in place high on Mt St Mary by Park in 1903. Faunal lists have been published by Park (1904), Trechmann (1918), and Wilckens (1927), and these were critically reviewed by Speden (1960). *Spiriferina kaihikuana* is an abundant form and *Athyris kaihikuana, Rhynchonella zealandica* (Trechmann), and *Dielasma zealandica* also occur there. Pelecypod shell-beds lacking brachiopods are present in the section.

The fossils near Mt St Mary are commonly grossly distorted. Tectonic distortion was dismissed by Gair and Gregg (1960) in favour of distortion by compaction, but this is not supported by examination of available material. This shows clear evidence of an incipient strain-slip cleavage expressed by alignment of micaceous minerals.

About 12 miles north-west of Mt St Mary richly fossiliferous beds occupy a downfaulted strip to the north-east of the Otematata Fault on both sides of Corbies Creek. *Daonella* (Plate 2) is associated with abundant brachiopods, including *Spiriferina kaihikuana, Athyris kaihikuana, Dielasma zealandica, Rhynchonella zealandica* and *Mentzeliopsis spinosa* Trechmann (Plate 1). This characteristic Kaihikuan element is part of a faunule that includes several molluscan species not known so far in rocks other than Torlesse Group. These include *Balantioselena gairi* Speden, *Kamupena greggi* Speden, and *Agonisca corbiensis* Fleming. As in the case of the Mt Potts assemblage, Corbies Creek fossils lack evidence of substantial transportation before burial. There has been little or no tectonic deformation, and in excellence of preservation as in richness of species Corbies Creek fossils are comparable with those in the Southland Syncline.

There can be no real doubt that the Kaihikuan assemblages in Canterbury and North Otago lived at or near the place of burial. The presence of brachiopods in abundance and of limpets (*Patella nelsonensis* Trechmann) points to a shelf

environment closely similar to that envisaged for Eighty-eight valley, Caroline Cutting, and other Kaihikuan assemblages outside the area of Torlesse rocks. There is little paleontological evidence supporting recognition of two distinct facies in Kaihikuan times.

Carbonaceous beds containing well-preserved fronds and stems occur at Tank Gully near Mt Potts and at three localities in the middle Waitaki valley (S117), in each case in the same general area as *Daonella*-brachiopod occurrences. Only two of these plant collections have been described, those from Tank Gully (Arber, 1917; S72/499) and Benmore Dam (Bell, Harrington, and McKellar, 1956; S117/469), and both were placed in the Rhaetian. Plant beds near the Otematata River (S117/516) are mapped by Mutch (1963) as ?Herangi Series (Lower Jurassic) on the grounds of their lower induration than the surrounding Middle Triassic sediments. However, detailed study of the area shows an apparently conformable sequence from *Daonella*-bearing sediments to siltstones and mudstones with plant remains (R. J. Ryburn, pers. comm.). The plant beds are not likely to be greatly different in age from *Daonella* and this raises the possibility of a Middle or early Upper Triassic age for Waitaki valley plant beds in general.

No section has been described so far in which *Atomodesma*-bearing rocks are shown to be in unfaulted sequence with Triassic beds. Permian and Triassic rocks are closely associated in the Waitaki valley, but available evidence suggests that the younger rocks are invariably preserved in fault-bounded blocks.

Upper Triassic Fossil Localities

At least three zones (*Halobia, Monotis,* and *Terebellina*) can be recognised in Upper Triassic (Balfour Series) rocks. McKay's (1890: 143) mapping of "Otapiri Series" in Canterbury (termed "Wharfdale beds" by Hector, 1884: xiv) is based on a single determination of *Trigonia* from the Mt Thomas Range (S67/19). Dr J. Marwick (pers. comm.) found the fossil to be indeterminable.

(a) *Halobia Zone*: The Upper Triassic indicator *Halobia* was discovered by G. M. Mason in 1955 in argillite in fan gravels at Blackford Station on the lower slopes of the Hutt Range, 4 miles upstream from the Rakaia Gorge bridge (S74/519, Plate 2). In spite of extended searching the source of these boulders is still unknown. Speight (1920: 106) very tentatively recorded "an occasional finer marking which may belong to *Halobia*" on fracture surfaces of tuffaceous beds at High Peak Saddle, about 9 miles east of Blackford Station. We have been unsuccessful in several attempts to find fossils on High Peak Saddle, or indeed in the neighbouring ranges.

Notwithstanding the unsatisfactory state of our knowledge of the occurrence of *Halobia,* it can be stated that some of the Torlesse Group sediments belong to the *Halobia* Zone, which is represented in the Hokonui Facies by the Oretian and Otamitan stages and is approximately equivalent to Carnian on the international time-scale.

Paleoneilo mundeni Fleming, described from the Waiheke River (S53/501), has close affinity with an Otamitan species from Nelson, but it is not so far known in association with other species in Torlesse rocks.

(b) *Monotis Zone*: The discovery of limestone containing *Monotis* in the Okuku Valley in 1874 (S67/22, Plate 4) led McKay to suspect that extensive areas of the high country of Canterbury were Triassic in age. Work in the succeeding ninety

years has added several additional occurrences of *Monotis* in limestone and many more in greywacke and argillite. Some records are merely fragments of ribbed shell with the kind of convexity and rib shape found in *Monotis richmondiana* Zittel. Much more certain placing is possible for specimens from localities such as the Trent River (S52/500, 501), recorded by Wellman, Grindley, and Munden (1952), Trig P, Bruce Stream (S66/572, 573), Rough Creek, Arthurs Pass (S59/528), and Rotoiti (S33/524). In each of these, preservation is such that the presence of forms conspecific with *M. richmondiana* is established.

Trechmann (1918: 196) recorded *Monotis salinaria* Bronn from the Okuku material collected by McKay and described two varieties from the same collection. Marwick (1935: 301) noted the presence of a byssal notch in Okuku specimens and, in his revision of New Zealand representatives of *Monotis*, accommodated Trechmann's three varieties in *Monotis richmondiana* Zittel.

The Okuku limestone is a lens at least 20ft thick, and is composed very largely of valves of *M. richmondiana*. This almost certainly indicates local abundance of living generations of that species (see Campbell and Warren, 1955). Brachiopods and other benthic forms are also preserved in some tuffaceous *Monotis*-bearing limestones and, with the possible exception of *Monotis*, these probably constitute shallow-water assemblages preserved essentially where they lived. The mode of life of *Monotis* is not fully known, and floating in of dead shells from a planktonic habitat is a possible mechanism of accumulation in some cases (cf. Allan, 1956). *Monotis* occurs in a distinctive, poorly sorted, pebbly siltstone in several localities near Arthurs Pass (e.g., S59/561). The fossils are commonly broken single valves and these are scattered and disoriented, as are the pebbles in the siltstone. This presumably indicates burial in some form of submarine gravity slide.

M. richmondiana is the key fossil for the Warepan Stage, Norian on the world time-scale. The species zone is at least 670ft thick at Trig P, Bruce Stream, and may be very much greater near Arthurs Pass.

Monotis is perhaps the most interesting and important fossil in the Torlesse rocks, for several reasons. Its characteristic radial ribbing makes it easily detected, particularly by the interested amateur, on whom prospecting for fossils in these rocks largely relies, and it is now known near Rotoiti (S33), over a wide area between the Hurunui and Waimakariri rivers, and from a single loose specimen (S80/2) near the head of Lake Tekapo. It is the most common Torlesse fossil that also occurs in the Hokonui Facies, and comparison of the zone it identifies in each offers the best chance of deciding questions of detailed facies and thickness differences between the two sets of rocks.

(c) *Terebellina Zone*: Beds with the annelid *Terebellina* (Plate 3) constitute a highly important part of the Torlesse Group in spite of Haast's comment that they merely contain "markings or obscure exuviae of an annelid" (1879: 275). They contain at least two distinct organisms: the commoner was described as *Torlessia mackayi* by Bather in 1905. It was re-examined by Jaworski in 1915, who synonymised the generic name *Torlessia* with *Terebellina*, and considered an Indonesian species to be so like Bather's that he placed the Indonesian material in the species *mackayi*. *Terebellina* was described in 1904 (not 1910, cf. Howell, 1962: W161) from Liassic slates in Alaska. It should be noted, however, that Howell lists *Torlessia* as a valid genus (of the family of calcareous tubes Serpulidae) despite the fact that the tubes are agglutinated siliceous forms, as was pointed out by both Bather and Jaworski.

A second agglutinating worm named *Titahia corrugata* by Webby (1958) was described from a North Island locality but has also been found in a number of places in the South Island (Plate 2). Its relationship to the rather similar fossil *Dentalium batheri* Finlay, described by Bather in 1905 (as *D. huttoni*) from the Kowai River (S74/22), is unknown.

In spite of the paleontological work and of the stratigraphic importance of the annelids, they are not touched on in the two major monographs of the Triassic faunas of New Zealand (Trechmann, 1918; Marwick, 1953).

McKay (1881) considered the *Terebellina* beds to be younger than *Daonella* and older than *Monotis*, but the problem of the age relationship of *Terebellina* to *Monotis* is still not solved. Their particularly close association in the Ashley Gorge and Arthurs Pass areas leaves little doubt that the two fossils are not greatly different in age. It is unlikely, however, that their zones overlap since they seem to occur everywhere in discrete areas of outcrop.

For eastern central Canterbury at least, *Terebellina* beds can be mapped as a zonal unit. The beds are very commonly graded, but in many places (for example, in the Ashley Gorge, Hutt Stream, the upper Selwyn valley, and near the upper Kowai bridge) worm tubes can be seen to occupy all positions with relation to bedding. This contrasts with Webby's observations at Titahi Bay (1958) where the whole sequence was interpreted as a succession of turbidites and the worm tubes were found as a scum on the top of each unit. Some at least of the Canterbury *Terebellina* beds are not redeposited.

Neither *Terebellina* nor *Titahia* is known to occur in Hokonui Facies rocks. If a two-facies subdivision of South Island Triassic rocks were ever to have an organic rather than a lithological basis it is surely with the *Terebellina* beds and the very different Balfour Series equivalents in South Otago, Southland, and Nelson that this would be done. The apparent absence of the worms from the Hokonui Facies suggests that these organisms may have existed in a rather specialised environment. One of a number of possibilities is that of deeper water offshore. Reed (1957) has already suggested that some of the Torlesse rocks near Wellington may be deep-water mudstones. Annelids are known from the same general area, but the relationship of the tubes to the sediments they are preserved in is undescribed, and there is still no clear picture of their ecology.

Upper Jurassic Fossil Localities

There is no record of any fossil collection of undoubted Lower or Middle Jurassic age from South Island Torlesse rocks, but recent paleobotanical work by Dr G. Norris has shown that relatively rich assemblages of plant microfossils are present in the Torlesse Group, and further collecting may well produce material in this time range. So far, spores from a single locality, Alford Forest (S81/509), have been tentatively assigned to the Lower Jurassic; all other spore and microplankton collections in post-Triassic Torlesse rocks are thought to be no older than Upper Jurassic.

Inoceramus galoi Boehm occurs in boulders in the upper valley of the Kaiwara River, a tributary of the Hurunui River (S62/782; P. A. Maxwell, pers. comm.). The species is restricted to the Heterian Stage (correlated with the Lower Kimeridgian) in Hokonui Facies sequences. The presence of the *Idoceras* Zone of the Heterian (Fleming and Kear, 1960: 45) in Torlesse rocks is indicated by *Idoceras speighti* (Marshall) described from a boulder in the Hurunui River, downstream from the Kaiwara junction (S62/174).

Hibolithes brownei (Marshall), restricted to the basal zone of the upper part of the Puaroan Stage (Lower Tithonian) in the Kawhia-Waikato Heads sequence, is recorded from the Cheviot Hills (S62/530; Fleming, 1958: 386) and from the Kaiwara valley (S62/795), both occurrences in mudstone concretions known only as boulders.

Buchia plicata Zittel and *Belemnopsis* ex gr. *aucklandica* Hochstetter occur in boulders in conglomerate at the Hurunui swing bridge (S62/776; P. A. Maxwell, pers. comm.) in an area in which the earliest *in situ* collection (S62/505), made by Mr D. Hamilton, contained brachiopods, *Belemnopsis*, and phylloceratid ammonites (see McKellar, Mutch, and Stevens, 1962: 491). *Buchia plicata* marks the uppermost Puaroan zone at Kawhia.

Richly fossiliferous siltstones with *Malayomaorica* aff. *malayomaorica* (Krumbeck) occur on the Cheviot coast (S62/531, 532; Marwick *in* Fyfe, 1934), south of the Waiau mouth and in Gore Stream, Clarence valley (S41/531). *Malayomaorica* was locally gregarious, its crowded separated valves forming shell beds up to 4ft thick (as at S62/526; Plate 3). Near Cheviot siltstones with *Malayomaorica* are in sequence with and probably slightly older than concretionary siltstones with *Buchia* aff. *subpallasi* (Krumbeck), various distinctive species of *Inoceramus*, and *Anopaea* n.sp. (of Fleming, 1958). The two faunas lack forms on which to base close correlation with the Kawhia–Waikato Heads sequence, but recent collecting (P. A. Maxwell, pers. comm.) in the Kaiwara valley shows comparable species of *Inoceramus* and *Anopaea* in association with *Buchia plicata*.

Although field relations are imperfectly known, it is clear that Upper Jurassic time is represented in the north-eastern area of South Island Torlesse rocks by at least three of the molluscan zones established in the Kawhia–Waikato Heads sequence. The important Cheviot–Kaiwara region contains faunas including three species used as zonal indicators at Kawhia: *Inoceramus galoi, Hibolithes brownei,* and *Buchia plicata*. At least two other faunas that may prove to be useful stratigraphically are known, but neither can yet be placed in any zonal scheme. One of these (S62/534; near the Jed River) contains *Grammatodon*, a gastropod allied to *Trochotoma* (I. G. Speden, pers. comm.), *Psilotrigonia*, and brachiopods.

The second unplaced fauna comprises brachiopod-rich assemblages which characterise coarse-grained limestones in the Kaiwara valley and elsewhere. The limestones are invariably associated with basic, usually spilitic, volcanics, and in some places occur in interstices between pillows in lavas (as at S62/508). At least 5 species of rhynchonellids and terebratuloids are present. Some of these are large-shelled forms and locally they are preserved in large numbers with valves conjoined, rare pectinids being the only other fossils in the assemblage (S62/517). *Burmirhynchia warreni* and *Holcothyris*(?) *kaiwaraensis*, both of Campbell, 1965, are members of this assemblage.

Lensen (1962) mapped as Jurassic rocks including shell limestone near Taylors Pass, Marlborough (S28/479). The systematic placing of finely comminuted shell as either Permian *Atomodesma* or upper Mesozoic *Inoceramus* is a matter of some difficulty and the possibility of a Permian age for the Taylors Pass limestone cannot be completely dismissed.

Although Upper Jurassic fossils have been found in Torlesse rocks in a wide area of eastern Canterbury and Marlborough, and no certainly older post-Triassic fossils are known, no section has been described in which Upper Jurassic Torlesse rocks are shown to rest unconformably on Triassic or older beds.

Cretaceous Fossil Localities

Four species of *Inoceramus* (*warakius, kapuus, urius,* and *ipuanus*), all described by Wellman (1959) and known only from the Taitai and Clarence Series, occur in a number of Torlesse localities in Marlborough. The Motuan (Albian) key form *Aucellina euglypha* Woods is also present in several collections, and the belemnite *Dimitobelus superstes* (Hector) has been found in two localities in the upper Awatere valley.

As in the older rocks, the Cretaceous members of the group are in large part redeposited and the fossils scattered and commonly fragmented. The majority of Cretaceous fossil occurrences are from sequences in which late Motuan and post-Motuan Cretaceous marine beds are also known. The upper limit of the Torlesse Group is placed somewhat arbitrarily at the top of the Good Creek Formation so as to exclude sequences in which greywacke and argillite are uncommon.

CHECKLIST OF SPECIES AND SUBSPECIES DESCRIBED FROM SOUTH ISLAND TORLESSE GROUP LOCALITIES

Phyllotheca minuta E. A. N. Arber, 1917

Chiropteris lacerata E. A. N. Arber, 1913

Chiropteris biloba S. M. Bell, 1956

Chiropteris waitakiensis S. M. Bell, 1956

Linguifolium lillieanum E. A. N. Arber, 1913

Linguifolium waitakiense S. M. Bell, 1956

Taeniopteris thomsoniana E. A. N. Arber, 1917

Baiera robusta E. A. N. Arber, 1917

Torlessia mackayi F. A. Bather, 1905

Burmirhynchia warreni J. D. Campbell, 1965

Cyrtina trechmanni O. Wilckens 1927

Holcothyris(?) *kaiwaraensis* J. D. Campbell, 1965

Paleoneilo mundeni C. A. Fleming, 1954

Agonisca corbiensis C. A. Fleming, 1963

Trigonodus thomsonianus O. Wilckens, 1927

"*Chlamys*" *kakanuia* J. Marwick, 1956

Monotis salinaria var. *intermedia* C. T. Trechmann, 1918

Monotis salinaria var. *hemispherica* C. T. Trechmann, 1918

Balantioselena gairi I. G. Speden, 1962

Dalmasiceras speighti P. Marshall, 1924

Dentalium huttoni F. A. Bather, 1905 (= *D. batheri* H. J. Finlay, 1927)

Kamupena greggi I. G. Speden, 1962

Ichthyosaurus australis J. Hector, 1874 (= *Mixosaurus*(?) *hectori* R. Lydekker, 1889)

Table II.—List of Fossiliferous Localities and Collections

Notes

Number: This is the collection's number in the N.Z. Fossil Record system, consisting of the NZMS 1 (One-mile) sheet in which the collection was made, and a serial number. The master files for those sheets referred to in the table are held as follows: Sheets S27 to 42 at N.Z. Geological Survey, Lower Hutt; Sheets S52, 58, 72 at N.Z. Geological Survey, Greymouth; Sheets S99, 117, 126–8, 146 at Geology Department, University of Otago; and all others at Geology Department, University of Canterbury.

Grid Reference: This is normally the grid reference determined by the collector, but in some cases it has been altered slightly when a sheet on a revised grid has been published since the collection was made. Square brackets indicate that no grid reference was recorded by the collector, and the figure tabulated is the position as estimated by the compilers.

All grid references are in terms of the national yard grid and are derived as follows:

From published NZMS 1 sheets (1:63360):

S74—3rd edition.

S33, 53, 82, 102—2nd edition.

S101—1st edition.

S27, 28, 35–42, 54, 55, 61, 62, 75, 81, 91, 118, 127, 128, 146—provisional edition.

From published NZMS 2 sheets (1:25000):

S90.

From unpublished Lands and Survey Department 1:15840 maps, shortly to be published as NZMS 1 sheets:

S59, 60, 66, 67.

From unpublished sketch maps (1:63360) in the N.Z. Geological Survey, Christchurch:

S52, 58, 65, 72, 73, 79, 80, 89, 99, 100, 110, 117, 126.

These are in large part based on Lands and Survey Department cadastral maps, and most of the grid references quoted for these sheets will need revision when accurate topographic maps become available.

Collector: Collections are identified by initials as in the list below. The date of the collection or observation is followed, where applicable, by the collection's number in the registers of the N.Z. Geological Survey, Lower Hutt. A few early collections carrying GS numbers can no longer be located; this is indicated by an asterisk following the GS number.

In Place: Y = Yes; N = No; A = Almost (loose material believed to be very locally derived); P = Probably (where there is uncertainty, for any reason).

Latest Determination: Many of the collections are held in the N Z. Geological Survey, Lower Hutt, and most of these have recently been re-examined. For every collection, the determiner's name is abbreviated as below, and where the determination is quoted as a personal communication, the entry is followed by an asterisk. In other cases the determination is that appearing on the fossil record form, or in a published paper.

The initials refer as follows:

R. S. Allan
A. D. Allen
P. B. Andrews
E. T. Annear
W. J. Arkell
E. A. N. Arber
F. A. Bather
A. C. Beck
S. M. Bell
D. A. Brown
L. J. Brown
J. D. Campbell
C. Challies
G. A. Challis
P. M. Chandler
T. J. H. Chinn
A. E. Cockbain
K. Collier
B. W. Collins
D. S. Coombs
R. A. Cooper
T. Cooper
P. T. Cox
S. H. Cox
J. C. Craddock
R. S. Cranfield
B. Dunnett
H. T. Ferrar
E. B. Fitzgerald
C. A. Fleming
J. P. Fox
R. G. Frean
H. E. Fyfe
M. Gage
H. S. Gair
G. W. Gibson (GWGi)
A. E. Grady
D. R. Gregg
G. W. Grindley (GWGr)
J. von Haast (JvH)
W. M. Hall
D. Hamilton
H. J. Harrington
J. Healy (JHy)
J. Hector (JHr)
W. F. Heinz
J. Henderson (JHn)
W. A. Hodgson
A. D. L. Hooper
N. de B. Hornibrook
F. W. Hutton
G. D. Innes
J. R. Jackson
E. Jaworski
G. Jobberns
J. T. Kingma
Shu Yeoh Khoon
M. G. Laird
W. R. Lauder
G. J. Lensen
D. M. Leslie
A. R. Lillie
D. G. Lillie
R. Lydekker
V. R. McGregor
D. J. McIntyre
A. McKay
I. C. McKellar
J. Grant-Mackie
D. R. McQueen
P. B. Maling
J. Marwick
G. M. Mason
P. A. Maxwell
C. Moore
P. G. Morgan
F. W. Munden
A. R. Mutch
G. Norris
H. Nuttall
L. E. Oborn
M. Ongley
J. Park
D. R. Rodley
R. J. Ryburn
G. H. Scott
W. D. Sevon
I. G. Speden
R. Speight (RSp)
M. P. Stadnyk
G. R. Stevens
R. Stoneley (RSt)
R. P. Suggate
S. J. H. Sylvester
P. Thomas
J. A. Townrow
P. Vella
S. Walker
G. Warren
J. B. Waterhouse
H. W. Wellman
O. R. Wilkes
E. R. Williams

Number	Locality	Grid. ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S27/500	Trib. of Leatham R.	556734	ACB, DRR, 61 (GS9035)	Y	*"Rhynchonella"* sp. ?*Athyris* Pelecypod fragments	CAF, 64*	
S28/479	"In Taylor's Pass"	[c246847]	AM	Y	*Inoceramus* fragments	AM	McKay, 1890: 116
S28/506	Sugar Loaf	219879	MO, 44 (GS5510); GJL, 58 (GS5511)	Y	*Inoceramus* fragments	JBW, 64*	Wellman & Willett, 1947: 356 [as *Maitaia*]
S28/514	Sugar Loaf	223880	GJL, 58	Y	Plant fragments	GJL	
S28/560	Old quarry, Sugar Loaf	221874	JDC, 58	A	*Inoceramus* fragments	JDC	
S29/525	Wairau Bar	337995	ORW, 64 (GS9339)	N	?*Titahia*	GRS, 64*	
S33/499	Rotoiti, E side	[224626]	HEF, SJHS, ?29	N	*Monotis*	JHn, ?29	Wellman, Grindley & Munden, 1952: Pl. 43
S33/522	Upper Travers River	136432	ORW, 61 (GS9303)	N	*Terebellina mackayi*	CAF, 64*	
S33/523	Sabine R., near forks	076422	ORW, 61 (GS9297)	A	?*Terebellina*	CAF, 64*	
S33/524	St. Arnaud Range	226569	HN, 61 (GS7952)	N	*Monotis richmondiana*	CAF, 64*	
S33/525	Rotoiti, S end	203579	ORW, 61 (GS9289)	A	*Monotis richmondiana*	JDC	
S35/530	Awatere R., near Cam	978575	HWW, 52 (GS5909)	Y	*Inoceramus urius*	GJL, 64*	
S35/633	Awatere R., near Isis	995580	HWW, HEF, 56 (GS6537)	Y	*Inoceramus* sp. *Aucellina* sp. ?*Cyclorisina* fragment	CAF, 64*	

TABLE II.—*Continued.*

Number	Locality	Grid. Ref.	Collector	In	Pl. Fossils	Latest Determin.	References
S35/634	Penk River	c022610	GJL, 56 (GS6538)	Y	*Inoceramus ipuanus* var.	GJL, 64*	
S35/669	Ouse Stream, SE trib.	146449	GWGi, WMH, 59	Y	*Inoceramus ipuanus*	GJL, 64*	Hall, 1963: 31
S35/670	Ouse Stream	138440	GWGi, WMH, 59	Y	*Inoceramus kapuus*	GJL, 64*	Hall, 1963: 30
S35/703	Bridegroom Creek	125458	WMH, GWGi, 59 (GS7718)	Y	*Inoceramus urius*	GJL, 64*	Hall, 1963: 31
					Inoceramus sp.		
S35/706	Gladstone Stream	867445	GAC, 59	Y	*Pseudolimea* n.sp. aff. *echinata*	PV, 64*	
S35/711	Clarence R., near Ouse	109421	WMH, RAC, 60 (GS7719)	Y	*Inoceramus* fragments	GJL, 64*	
S35/718	Above Bridegroom Creek	123456	WMH, RAC, 59	Y	*Inoceramus ipuanus*	GJL, 64*	Hall, 1963: 31 [misprinted as S35/715]
S35/720	Kekerengu River	248443	GJL, WMH, 61 (GS7995)	Y	*Inoceramus ?kapuus*	GJL, 64*	
S35/722	Kekerengu River	247446	GJL, WMH, 61 (GS7996)	Y	*Inoceramus kapuus*	GJL, 64*	
S35/723	Hodder River	944546	ADA, 61	A	*Inoceramus ?ipuanus*	PV, 64*	
					Gastropod		
S35/724	Penk River	023608	ADA, 61	Y	*Aucellina* sp.	PV, 64*	
					Dentalium sp.		
					Dimitobelus superstes	GRS, 64*	
S35/725	Awatere R., near Cam	975572	ADA, 61	Y	*Aucellina euglypha*	PV, 64*	
S35/735	Penk River	007613	ADA, 61	Y	*Inoceramus* fragment	PV, 64*	
S35/739	Awatere River, near Hodder R.	935544	ADA, 61 (GS9064)	Y	*Inoceramus* fragments	PV, 64*	
					Aucellina euglypha		
					Anagaudryceras sp.		
					Dimitobelus superstes	GRS, 64*	
S35/749	Kekerengu River	250440	GJL, RPS, 62 (GS9043)	Y	*Inoceramus kapuus*	GJL, 64*	
S35/765	Penk River	023611	GJL, JCC, 63 (GS9190)	A	*Inoceramus* aff. *urius*	GJL, 64*	
S35/766	Awatere River	022593	GJL, JCC, 63 (GS9191)	Y	*Inoceramus* aff. *neocomiensis*	GJL, 64*	
S35/784	Awatere River, below Hodder R.	963562	GJL, JCC, 63 (GS9208)	Y	*Inoceramus urius*	GJL, 64*	
					Inoceramus ipuanus		
S35/862	Gladstone Stream	865443	GJL, 64 (GS9356)	Y	*Ctenoides* sp.	GRS, 64*	
S36/501	Dunsandel Stm (trib. of Waima River)	—	HWW, 56 (GS6543)	N	*Inoceramus urius*	CAF, 64*	
					Aucellina euglypha		
					Modiolus sp.		
					?Astarte		
S36/525	Blue Mountain Stream	258574	GWGi, WMH, 58 (GS7390)	Y	*Inoceramus* fragments	CAF, 64*	
					Aucellina aff. *pavlowi*		
S36/526	Near Waima R. mouth	381523	GJL, 58 (GS7387)	N	*Aucellina euglypha*	GJL, 64*	

S36/546	Blue Mountain Stream	257573	GJL, GWGi, WMH, 59 (GS7407)	Y	?*Anopaea* sp. *Buchia* cf. *subpallasi* ? cf. *Maccoyella*	CAF, 64*	
S36/556	Kekerengu River	254435	GJL, GWGi, WMH, 59 (GS7408)	Y	*Inoceramus ipuanus* var.	GJL, 64*	
S36/557	Kekerengu River	254435	GJL, 59 (GS7409)	Y	*Inoceramus ipuanus*	GJL, 64*	
S36/582	Kekerengu River	254435	GJL, WMH, 61 (GS7999)	Y	*Inoceramus ?kapuus*	GJL, 64*	
S36/583	Kekerengu River	250440	GJL, WMH, 61 (GS9001)	Y	*Inoceramus ?kapuus*	GJL, 64*	
S36/657	Blue Mountain Stream	260573	GJL, RPS, 62 (GS9049)	A	*Aucellina* aff. *pavlowi*	GRS, 64*	
S36/658	Tachalls Ck., S branch	338567	GJL, RPS, 62 (GS9050)	Y	*Inoceramus kapuus*	GJL, 64*	
S36/660	Tachalls Ck., S branch	340567	GJL, RPS, 62 (GS9051)	N	*Inoceramus ipuanus* var.	GJL, 64*	
S36/661	Tachalls Creek	336586	GJL, ETA, 62 (GS9052)	Y	*Inoceramus ?kapuus*	GJL, 64*	
S36/662	Tachalls Creek	325586	WMH, ETA, 62 (GS9053)	N	*Inoceramus ipuanus*	GJL, 64*	
S36/663	Tachalls Creek	326586	WMH, ETA, 62 (GS9054)	N	*Inoceramus ipuanus* *Inoceramus urius*	GJL, 64*	
S36/664	Tachalls Creek	326586	WMH, ETA, 62 (GS9055)	Y	*Inoceramus urius*	GJL, 64*	
S36/665	Tachalls Creek	335590	WMH, ETA, 62 (GS9056)	Y	*Inoceramus ?urius*	GJL, 64*	
S36/666	Tachalls Creek	337592	WMH, ETA, 62 (GS9057)	N	*Inoceramus ipuanus*	GJL, 64*	
S36/723	New Peggioh Rd., above Tachalls Creek	335587	RSt, 60 (GS8619)	Y	*Inoceramus ipuanus* fragment	JM, 64*	
S36/726	Tachalls Ck., S branch	338568	RSt, 60 (GS8622)	Y	*Inoceramus ipuanus* fragment	JM, 64*	
S36/729	Needles Ck., S branch	313600	RSt, 60 (GS8625)	N	*Inoceramus* cf. *ipuanus*	JM, 64*	
S36/730	Needles Creek	332611	RSt, 60 (GS8626)	Y	*Inoceramus* cf. *urius*	JM, 64*	
S36/733	Stm. to Marfells Beach	463698	RSt, 60 (GS8630)	Y	*Inoceramus* cf. *urius*	JM, 64*	
S40/502	Upper Wairau River	274283	DRG, GW, 59	Y	Plant fragments	GW	
S41/488	Valley of Elliott Stream	—	AM	Y	*Taeniopteris*	AM	McKay, 1890: 125
S41/531	Gore Stream	656103	GWGr, DRM, 53 (GS5828)	Y	*Inoceramus* sp. *Anopaea* aff. *verbeeki* *Buchia* aff. *subpallasi* [*Malayomaorica*] ?aff. *malayomaorica*	CAF, 58	Fleming, 1958: 380, 384, 390; Suggate, 1958: 399
S42/582	Clarence River, near Dee	070387	GJL, 60 (GS7723)	Y	*Inoceramus* cf. *warakius* fragment *Inoceramus* aff. *neocomiensis*	GJL, 64*	Hall, 1963: 30
S42/586	Near Fidget Stream	915250	WMH, 60 (GS7714)	Y	?*Anopaea* sp.	IGS, 61*	

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S52/500	Confirmation Rill, Trent River	[352591]	HWW, GWGr, FWM, 49 (GS4985)	Y	*Monotis*	HWW, 49	Wellman, Grindley & Munden, 1952
S52/501	Monotis Gulch, Trent River	[329589]	FWM, 46; HWW, GWGr, FWM, 49 (GS4986)	Y	*Monotis*	HWW, 49	Wellman, Grindley & Munden, 1952
S52/505	Trent River Gorge	[c308581]	HWW, GWGr, FWM, 49	Y	Large tubular fossil	HWW, 49	Wellman, Grindley & Munden, 1952: 220
S53/501	Slaty Creek, Waiheke River	523764	FWM, 52 (GS5803)	N	*Paleoneilo mundeni* (holotype)	CAF, 53	Fleming, Munden & Suggate, 1954
S54/507	Waiau River at Browns Stream	134613	RPS, 56 (L2218, 3872)	Y	*Cyathidites minor* *Cyathidites australis* *Osmundacidites wellmanii* *Apiculatisporis* sp. *Leptolepidites verrucatus* *Acanthotriletes* cf. *levidensis* *Lycopodiacidites bullerensis* *Lycopodiumsporites austroclavatidites* *Callialasporites segmentatus* *Ginkgocycadophytus nitidus* *Podocarpidites major* *Classopollis reclusus* *Baltisphaeridium* sp.	GN, 64*	
S54/513	Gorge Stream, tributary of Waiau River	c946680	GW, DRG, 60 (GS7739)	N	*Belemnopsis* ex gr. *aucklandica*	GRS, 62	McKellar, Mutch & Stevens, 1962: 491
S54/519	Waiau River, above Hope River junction	929747	HSG, MPS, 60 (P24213)	Y	Radiolaria	GRS, 64*	
S55/24	Kais Hill, Amuri Bluff	—	AM, 1876 (GS1*)	P	*Inoceramus;* ferns	AM	McKay, 1886: 64
S55/43	[=/556] Stanton River	[460634]	JHy, 39 (GS2136)	P	*Solemya;* tube	GRS, 64*	
S55/504	Mt Palm, E slopes	456588	JDC, 53	Y	Pelecypod (pectinid or pterioid)	JDC	
S55/505	Mt Palm, E slopes	456588	JDC, 53	Y	*Rhynchonella* sp. Pelecypod	JDC	
S55/515	Middle Waiau gorge	472588	RPS, 56 (GS6745)	A	?Terebratulid	GRS, 64*	

S55/516	Near Stanton River	477619	RPS, 56 (L2219, 3873)	Y	***Cyathidites minor*** *Cyathidites australis* *Osmundacidites wellmanii* *Baculatisporites comaumensis* *Apiculatisporis* sp. *Verrucosisporites* sp. *Callialasporites dampieri* *Callialasporites segmentatus* *Inaperturopollenites* sp. *Monosulcites* aff. *minimus* *Vitreisporites pallidus* *Hystrichosphaeridium pulcherrimum* *Hystrichosphaeridium* cf. *complex* *Dingodinium* sp.	GN, 64*
S55/556	[see /43]					
S55/579	Hundalee Stream at Main Road	728705	RPS, 60 (L2220, 3874)	Y	*Cyathidites minor* *Cyathidites australis* *Osmundacidites wellmanii* *Leptolepidites* sp. *Microreticulatisporites* sp. *Ginkgocycadophytus nitidus* *Hystrichosphaeridium* cf. *ferox* *Baltisphaeridium* cf. *neptuni*	GN, 64*
S55/580	Limestone Stream at Main Road	740719	ACB, 60 (L2221, 3875)	Y	*Cyathidites minor* *Cyathidites australis* *Deltoidospora* sp. *Osmundacidites wellmanii* *Leptolepidites verrucatus*	GN, 64*

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S55/580	(continued)				*Rubinella* sp. *Neoraistrickia* sp. *Lycopodiumsporites austroclavatidites* *Inaperturopollenites* sp. *Ginkgocycadophytus nitidus* *Podocarpidites major* *Classopollis reclusus* *Hystrichosphaeridium* cf. *complex* *Hystrichosphaeridium pulcherrimum* (?) *Hystrichosphaeridium* spp. *Baltisphaeridium* spp. *Micrhystridium* cf. *deflandrei* *Micrhystridium rari-spinum* *Pareodinia* sp. *Gonyaulax* sp.		
S58/502	Harman–Styx track	845330	GW, ACB, 61 (GS9403)	Y	*Terebellina mackayi*	GRS, 64*	
S59/498	Kelly Creek	—	AM, 1876 (GS291)	Y	*Terebellina mackayi* *Titahia corrugata*	GRS, 64*	Cox, 1877: 77–8; Hector, 1879: 30; Hector, 1886: 78, fig. 1
S59/499	"Boulder Creek", Arthurs Pass	[c053308]	TC, 21 (GS5710)	?	*Monotis richmondiana*	GRS, 64*	
S59/501	Lower Twin Creek, Arthurs Pass	052320	Roberts, 20; JDC, GW, 55	N	*Monotis richmondiana*	JDC	Speight, 1920: 106
S59/502	Temple Basin track	[c063322]	PT, 55 (GS6461)	N	*Monotis richmondiana*	CAF, 64*	
S59/503	Upper Bealey R. bridge	052303	RGF, 56	N	*Monotis richmondiana*	JDC	
S59/505	[=/514] Rough Creek, Arthurs P.	058276	CM, 57 (GS7069)	N	?*Monotis richmondiana*	CAF, 64*	
S59/506	Rough Creek, Arthurs Pass	057276	ORW, 57 (GS9313)	N	*Monotis richmondiana*	CAF, 64*	
S59/507	Rough Creek, Arthurs Pass	056276	JDC, ORW, 58	Y	*Monotis*	JDC	
S59/508	Halpin Creek, Arthurs Pass	069243	JDC, ORW, 58	N	*Monotis richmondiana*	JDC	
S59/509	Temple Basin	077328	JDC, ORW, 58	N	*Monotis richmondiana*	JDC	
S59/511	Mingha River	[c103271]	JRJ, 60 (GS9309)	N	*Monotis*	CAF, 64*	
S59/512	Birches Creek	173213	ORW, 58 (GS9292)	N	?*Monotis* fragment	CAF, 64*	
S59/513	Hawdon valley	c231312	ORW, 58 (GS9301)	Y	*Monotis richmondiana*	CAF, 64*	

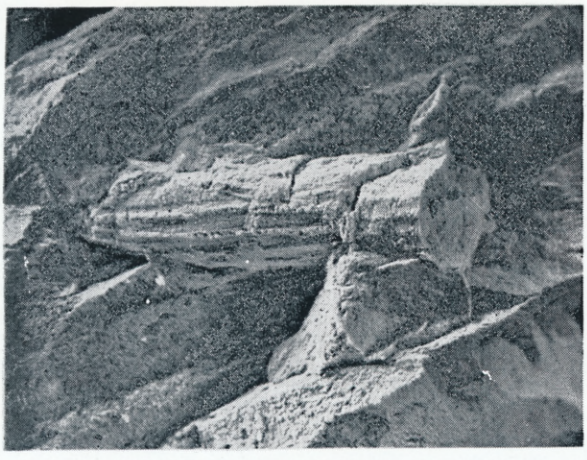
S59/514	[see /505]						
S59/515	Mt Rolleston, NE ridge	[c015341]	TJHC, 60 (GS9308)	Y	*Terebellina mackayi*	GRS, 64*	
S59/516	Track to Temple Basin	[c057322]	SW, 60	P	*Monotis richmondiana*	ORW, 64*	
S59/517	Mt Williams	113260	ORW, 60 (GS9295)	Y	*Monotis richmondiana*	JDC	
S59/518	Mt Wilson, E spur	—	ORW, 60 (GS9312)	Y	?*Monotis* fragment	JDC	
S59/519	Lake Minchin	283419	ORW, 58 (GS9310)	A	?*Monotis*	JDC	
S59/520	Mt Bealey	c054249	ORW, 58 (GS9293)	Y	*Monotis* fragments	CAF, 64*	
S59/521	Mt Bealey	c055254	ORW, 58 (GS9311)	Y	*Monotis* fragments	CAF, 64*	
S59/522	Hawdon valley	c239308	ORW, 58 (GS9305)	N	*Monotis richmondiana*	CAF, 64*	
S59/523	Hawdon R., E branch	c235305	ORW, 58 (GS9296)	N	*Monotis richmondiana*	CAF, 64*	
S59/524	Mt Bealey	[c043256]	JRJ, 59 (GS9306)	N	*Monotis* cf. *richmondiana*	CAF, 64*	
S59/525	Trib. of Kelly Creek	052453	ORW, 59 (GS9290)	N	?*Terebellina*	ORW, 64*	
S59/526	Kelly Creek	063455	ORW, 59 (GS9300)	N	?*Terebellina*	CAF, 64*	
S59/527	Main road at Kelly Creek	078462	ORW, 59 (GS9298)	N	?*Terebellina*	CAF, 64*	
S59/528	Rough Creek, Arthurs Pass	[053271]	JRJ, 59 (GS9288)	Y	*Monotis richmondiana*	JDC	
S59/529	Temple Basin	060322	ORW, 58 (GS9307)	P	*Monotis* cf. *richmondiana*	CAF, 64*	
		075325	ORW, 58 (GS9304)	Y	*Monotis* fragments	CAF, 64*	
S59/530	Temple Basin	235305	RSp, 20; ORW, 58 (GS9302)	N	*Monotis richmondiana*	JDC	Speight, 1920: 105
S59/531	East Hawdon valley				Plant fragments Annelids		
S59/532	Halpin Creek	072246	GW, 61 (GS9004)	N	"*Monotrypella*" *maorica*	GRS, 63	Stevens, 1963: 711
S59/533	Temple Basin	071326	GW, DRG, MG, 63 (GS9173)	Y	*Monotis* sp.	GRS, 64*	
S59/534	Rolleston River	[c040380]	BD, 63 (GS9274)	N	Fish vertebrae	GRS, 64*	
S59/535	Mt Williams	115263	ORW, 61 (GS9294)	A	?*Terebellina*	ORW, 64*	
S59/536	Kellys Hill	053477	ORW, 59 (GS9299)	A	?*Terebellina*	CAF, 64*	
S59/537	Trib. of Kelly Creek	019438	ORW, 59 (GS9291)	A	?*Terebellina*	CAF, 64*	
S59/538	Railway quarry, Aickens	103499	ORW, 59 (GS9314)	A	?*Terebellina*	CAF, 64*	
S59/539	Upper Crow River	013285	TJHC, 64	N	Plant fragments	GW	
S60/502	Okuku River	751219	JDC, GW, 52	N	*Monotis richmondiana*	JDC	
S60/503	Okuku R., upper gorge	724226	GW, 54	Y	*Monotis richmondiana*	JDC	
S60/516	Okuku R., middle gorge	743212	GW, 54	A	"*Terebratula*" sp.	JDC	
S60/517	Okuku R., upper gorge	712223	GW, 54	N	*Monotis richmondiana*	JDC	
S60/518	Okuku River	749217	GW, 54	N	*Inoceramus*, large frags.	JBW, 64*	
S60/519	Okuku R., upper gorge	699220	GW, 54 (GS6722)	N	*Belemnopsis* ex gr. *aucklandica*	GRS, 62	McKellar, Mutch & Stevens, 1962: 491
S60/520	West of Mt Mason	871328	GW, DRG, 59 (GS7667)	Y	*Monotis richmondiana*	IGS, 59*	
S60/556	Valley Creek, at ford	656423	GW, DRG, 60 (GS7776)	N	*Monotis richmondiana*	IGS, 60*	
S60/563	Valley Creek, E branch	663391	ACB, GW, DRR, 61 (GS9024)	Y	*Monotis richmondiana* *Manticula problematica*	GRS, 64*	

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In	Pl.	Fossils	Latest Determin.	References
S60/564	Smothering Creek, at ford	671428	ACB, GW, DRR, 61 (GS9025)	N		*Monotis* fragments	GRS, 64*	
S60/565	Bridge Creek, at ford	699427	ACB, GW, DRR, 61 (GS9026)	N		*Monotis* fragments	GRS, 64*	
S61/155	Near Lookout Trig	273337	DH, 49	Y		"*Rhynchonella*" sp. Echinoid spine	JDC	
S61/554	Hurunui River, lower gorge	306365	DRG, GW, 60 (L2250, 3877)	Y		*Osmundacidites wellmanii* *Lycopodiumsporites* sp. *Monosulcites* aff. *minimus* *Podocarpidites major* *Baltisphaeridium* sp.	GN, 64*	
S61/555	Quarry, Waikari valley	090271	DRG, GW, 60 (L2251, 3878)	Y		*Osmundacidites wellmanii*	GN, 64*	
S62/96	Kaiwara valley	455393	HEF, 32 (GS5683)	P		[1]*Monotis richmondiana*	GRS, 64*	
S62/139	Kaiwara valley	458393	HEF, 32 (GS3427)	P		"*Rhynchonella*" sp. ?*Monotis calvata*	GRS, 64*	
S62/173	Near Hurunui R. mouth	—	JvH	P		Annelids	JvH	Haast, 1879: 275
S62/174	Hurunui R. near swing br.	[366356]	GJ	N		*Idoceras speighti* (holotype)	WJA, 53	Marshall, 1924: 615; Arkell, 1953: 260–2
S62/505	[=/512] Hurunui R. at swing br.	366357	DH, 54	Y		Brachiopods *Belemnopsis* Phylloceratids	GRS, 62 (in part)	McKellar, Mutch & Stevens, 1962: 491
S62/506	Kaiwara valley	455395	JDC, 55	P		*Burmirhynchia warreni* (holotype) *Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, 1965
S62/507	Kaiwara valley	456396	JDC, GW, 52	Y		*Burmirhynchia warreni* *Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, 1965
S62/508	Kaiwara valley	457394	JDC, GW, 52	Y		"*Rhynchonella*" spp. Echinoid spines	JDC	
S62/509	Hurunui R. at swing br.	367356	JDC, 53	Y		?*Inoceramus* fragments	JDC	
S62/510	Jed River	614387	JDC, 53	Y		"*Rhynchonella*" sp. "*Terebratula*" sp.	JDC	Fleming, 1958: 377
S62/511	Hurunui R. at swing br.	367356	HWW, BWC, 54 (GS6166)	Y		?*Buchia* sp.	CAF, 64*	
S62/512	[see /505]							
S62/513	Kaiwara valley	453395	JDC, 55	P		*Burmirhynchia warreni* *Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, 1965

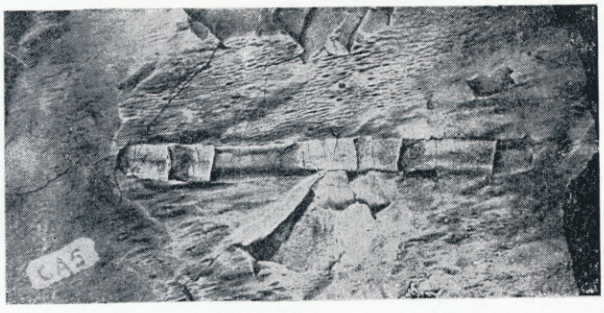
R. H. Hardie, photo.

Kaihikuan brachiopod shellbed, S117/613; road from Corbies Creek to Otematata valley. The fossils, occurring as natural moulds, include *Spiriferina kaihikuana* on left, *Athyris kaihikuana* on right. Natural size. (R. J. Ryburn coll.)



R. H. Hardie, photo.

Halobia sp., S74/519; fan gravels, Rakaia River, near gorge. × 2. (D. A. Brown coll.)
Daonella apteryx, S117/510; Corbies Creek. × 2. (R. J. Ryburn coll.)
Titahia corrugata, S66/560; Porter River. × 2. (G. H. Scott coll.)



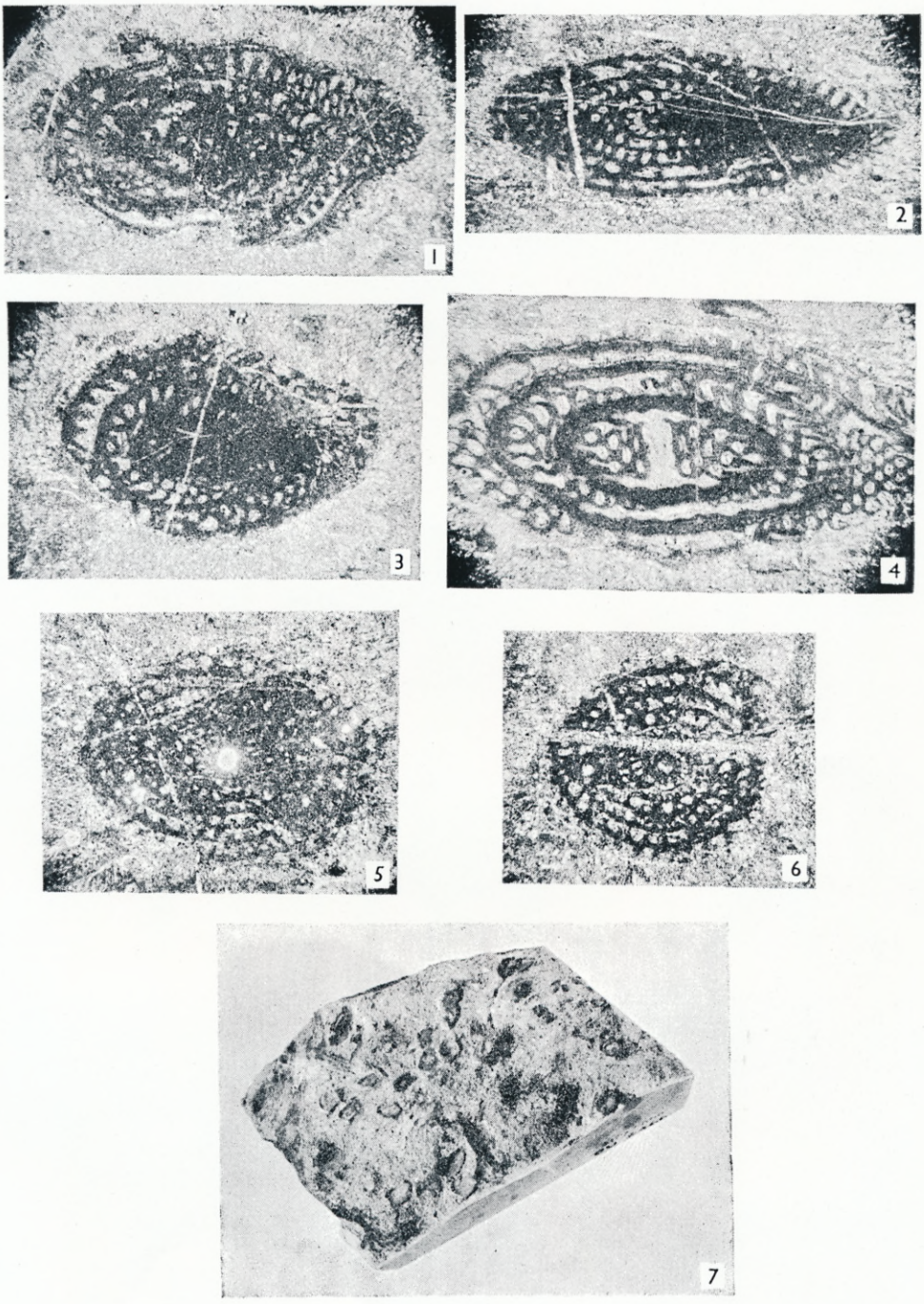
R. H. Hardie, photo.

Malayomaorica n. sp. cf. *malayomaorica*, S62/526; near Mt Beautiful. Natural size. (J. D. Campbell coll.)

Terebellina mackayi, S74/516; Mt Hutt. Natural size. (J. D. Campbell coll.)

R. H. Hardie, photo.

Monotis richmondiana shell limestone, S67/22; near Lees Pass, Okuku valley. Natural size.
(G. Warren coll.)



Permian Fusulinid Foraminifera from the Torlesse Group near Benmore Dam.

FIGS. 1–6.—Thin sections, × 7. (N.Z. Geological Survey Catalogue Nos. T1073/f1223–5).
FIG. 7.—Hand specimen, approximately half natural size.

S62/514	Kaiwara valley	455395	JDC, 55	P	*Burmirhynchia warreni* *Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, **1965**
S62/515	Kaiwara valley	455395	JDC, 55	P	*Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, **1965** Campbell, **1965**
S62/516	Kaiwara valley	456394	JDC, 55	P	*Burmirhynchia warreni*	JDC	
S62/517	Kaiwara valley	456394	JDC, 55	P	*Burmirhynchia warreni* *Holcothyris*(?) *kaiwaraensis* Pectinid ?*Oxytoma* sp.	JDC	Campbell, **1965**
S62/518	Kaiwara valley	456394	JDC, 55	P	*Burmirhynchia warreni* *Holcothyris*(?) *kaiwaraensis* (holotype) Pectinid *Lima* sp.	JDC	Campbell, 1965
S62/519	Kaiwara valley	456396	JDC, 55	Y	*Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, **1965**
S62/520	Kaiwara valley	457395	JDC, 55	Y	*Burmirhynchia warreni* *Holcothyris*(?) *kaiwaraensis*	JDC	Campbell, **1965**
S62/524	Coast near Mt Beautiful	671444	JDC, PBA, 57	Y	*Inoceramus* aff. *everesti* [*Malayomaorica*] **n.sp.** cf. *malayomaorica*	CAF, 58	Fleming, 1958: 376, 378
S62/525	Near Mt Beautiful	666444	JDC, PBA, 57	Y	*Inoceramus* n.sp. A, ?aff. *everesti* *Inoceramus* n.sp. B, ?aff. *gracilis* *Anopaea* n.sp.	CAF, 58	Fleming, 1958: 384–5, 391 (fig. 13), 392 (fig. 14). [*I.*n.sp. A locality **525 misprinted as 523 on p. 384**]
S62/526	Near Mt Beautiful	668444	JDC, PBA, 57	Y	*Inoceramus* **n.sp. A,** ?aff. *everesti* *Anopaea* n.sp [*Malayomaorica*] n.sp. cf. *malayomaorica*	CAF, 58	Fleming, 1958: 384–5, 391 (fig. 12), 392 (fig. 15)
S62/527	Near Mt Beautiful	665442	JDC, PBA, 57	N	?*Buchia* sp.	JDC	
S62/528	Woolshed Stream	620430	JDC, PBA, 57	N	*Buchia* aff. *subpallasi*	CAF, 58	Fleming, 1958: 376, 380, 392

[1] Not confirmed by recent detailed collecting.

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S62/529	Cheviot Hills, W slope	—	AM, 1882 (GS502)	N	*Buchia* aff. *subpallasi*	CAF, 58	Fleming, 1958: 375, 380, 390
S62/530	Woolshed Stream	618429	HEF, JM, 34 (GS3429)	N	*Hibolithes brownei*	GRS, 62	Fleming, 1958: 376, 386, 390 McKellar, Mutch & Stevens, 1962: 490
S62/531	Coast near Mt Beautiful	671445	HEF, JM, 34 (GS3446)	N	*Inoceramus* fragments [*Malayomaorica*] aff. *malayomaorica*	CAF, 58	Fleming, 1958: 376, 378, 379, 390
S62/532	Coast near Mt Beautiful	671442	HEF, JM, 34 (GS3441)	N	*Inoceramus* fragments [*Malayomaorica*] aff. *malayomaorica*	CAF, 58	Fleming, 1958: 376, 379, 390
S62/534	Jed River	613386	JDC, 57	Y	"*Rhynchonella*" sp. "*Terebratula*" sp. *Grammatodon* sp. *Psilotrigonia* n.sp. Gastropods Echinoid spine	JDC CAF, 64*	
S62/591	Gower River tributary	493470	HEF, LEO, 59 (F13915)	Y	?*Karrerulina* sp.	NBH, 64*	
S62/626	Hurunui River near swing bridge	365356	DRG, 60 (L1982, 3871)	Y	Plant fragments (no microfossils)	GN, 64*	
S62/643	Port Robinson	624338	DRG, 56 (L2222, 3876)	Y	Plant fragments (no microfossils)	GN, 64*	
S62/644	Hurunui River near swing bridge	365357	GW, DRG, 60 (L2252, 3879)	Y	*Cyathidites minor* *Osmundacidites wellmanii* *Lycopodiumsporites austroclavatidites* *Baltisphaeridium* sp. Silicified wood	GN, 64*	
S62/645	Hurunui River near swing bridge	362357	GW, DRG, 60 (L2253, 3880)	Y	*Cyathidites australis* *Osmundacidites wellmanii* *Podocarpidites major*	GN, 64*	
S62/646	Hurunui River near swing bridge	355360	GW, DRG, 60 (L2254, 3881)	Y	*Osmundacidites wellmanii* *Araucariacites* sp. *Monosulcites* aff. *minimus*	GN, 64*	

S62/647	Hurunui River near swing bridge	368356	GW, DRG, 60 (GS7767)	Y	*Hibolithes* aff. *brownei*	GRS, 64*	McKellar, Mutch & Stevens, 1962: 491
S62/648	Hurunui River near swing bridge	368356	GW, DRG, 60 (GS7766)	Y	Worm tubes	GRS, 64*	
S62/776	Hurunui River near swing bridge	367356	JTK, PAM, 63 (GS9212)	Y[1]	*Buchia plicata* *Belemnopsis* ex gr. *aucklandica*	GRS, 64*	
S62/777	Kaiwara valley	386386	PAM, WDS, 63 (GS9328)	N	*Inoceramus* n.sp. A of Fleming, 1958: 384 ?*Buchia*	GRS, 64*	
S62/778	Kaiwara valley	456404	PAM, AEC, 63 (GS9329)	N	*Belemnopsis* sp.	GRS, 64*	
S62/779	Kaiwara valley	454406	PAM, 63 (GS9330)	N	*Buchia plicata*	PAM, 64*	
S62/780	Kaiwara valley	452408	PAM, 63 (GS9331)	N	?*Buchia plicata*	GRS, 64*	
S62/781	Kaiwara valley	456404	PAM, AEC, 63 (GS9332)	N	*Anopaea* n.sp. of Fleming, 1958: 385	GRS, 64*	
S62/782	Kaiwara River	424422	PAM, WDS, 63 (GS9333)	N	Terebratulid *Buchia plicata* *Inoceramus galoi* ?*Buchia* *Belemnopsis* sp.	GRS, 64*	
S62/783	Kaiwara valley	456403	PAM, 63	N	*Stomiosphaera*	PAM, 64*	
S62/784	Hurunui River near swing bridge	367356	PAM, 63 (GS9334)	Y	Decapod crustacean	PAM, 64*	
S62/785	Hurunui River near swing bridge	366357	PAM, 63 (GS9335)	Y	Shell fragments Calcareous tubes	GRS, 64*	
S62/788	Hurunui River near swing bridge	366355	PAM, 64 (L4330)	Y	Spores Microplankton	DJM, 64*	
S62/792	Kaiwara valley	350392	PAM, JTK, 64 (GS9408)	N	*Belemnopsis* ex gr. *aucklandica*	GRS, 64*	
S62/793	Kaiwara valley	451386	PAM, 64	N	*Buchia* aff. *subpallasi*	PAM, 64*	
S62/794	Kaiwara valley	451386	PAM, 64	N	Crinoid fragments	PAM, 64*	
S62/795	Kaiwara valley	447422	PAM, 64 (GS9409)	N	*Hibolithes brownei* *Grammatodon* (*Indograммatodon*) sp.	GRS, 64*	
S62/796	Kaiwara valley	415365	PAM, 64 (GS9406)	N	*Inoceramus* sp., cf. *galoi* ?*Buchia* *Belemnopsis* sp.	GRS, 64*	
S62/797	Kaiwara valley	447423	PAM, AEC, 64 (GS9407)	N	Pelecypods	GRS, 64*	
S62/798	Kaiwara valley	457393	DRG, GDI, 60 (GS9411)	A	"*Rhynchonella*" sp.	GRS, 64*	

[1] Boulder in conglomerate.

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S65/1	Mungo Pass	[c748151]	PGM	Y	*Terebellina mackayi* *Dentalium* or *Titahia*	GRS, 64*	Morgan, 1908: 79–80, pl. 18
S65/2	Mathias Pass	[c662093]	?FWH	?	Annelid tubes	FWH	F. W. Hutton, MS notes
S65/3	Wilberforce River	—	?FWH	?	*Dentalium batheri*	FAB	Bather, 1905
S65/502	Griffiths Creek	c802173	MG, JPF, 52 (GS5574)	A	cf. *Titahia corrugata*	GRS, 64*	
S65/503	Mt Oakden, fan	c933938	ACB, PBA, DRG, 61 (GS7851)	N	*Terebellina mackayi* *Titahia corrugata*	IGS, 61*	
S65/504	Boundary Stream, fan	c919019	PBA, 61 (GS7852)	N	*Terebellina*	GRS, 64*	
S65/505	North Mathias River	[c680055]	ADLH, 61	N	*Terebellina*	ADLH	
S66/97	Cass-Bealey road	—	AM	Y	[*Atomodesma*]	AM	McKay, 1881: 88
S66/560	Near Porter River bridge	201914	CAF, MG, 56 (GS6622); JDC, GHS, 56	N	*Terebellina mackayi* *Titahia corrugata*	JDC	Webby, 1958: 512
S66/561	Bruce Stream, N branch	044164	JRJ, 57; JDC, MG, 57	N	*Monotis richmondiana*	JDC	
S66/572	Trig P, Bruce Stream	046171	JDC, PBA, 58	Y	*Monotis richmondiana*	JDC	Campbell, 1959: 203
S66/573	Trig P, Bruce Stream	c049171	JDC, PBA, 58	Y	*Monotis richmondiana*	JDC	
S66/613	Rubicon Pk. (Mt Torlesse)	[285902]	ERW	P	*Terebellina mackayi*	RSA, 64*	
S66/614	Puffers Creek, Avoca	c341002	JDC, MG, 57	N	*Terebellina mackayi*	JDC	
S67/19	Mt Thomas Range, W side	—	AM, 1879 (GS460*)	?	*Trigonia* Plant fragments	AM	McKay, 1881: 106
S67/22	[= /513] Lees Pass	783159	AM, 1874 (GS151), and 1879 (GS455); JDC, GW, 54	Y	"*Terebratula*" sp. *Monotis richmondiana* ?*Monotis calvata*	JDC	McKay, 1877: 39, 40; 1881: 100, etc.; Marwick, 1953; Campbell & Warren, 1955
S67/23	Ashley Gorge	—	AM, 1871 (GS807*); FWH	Y	[*Terebellina*] *mackayi* (holotype)	EJ	McKay, 1881: 90, 91; Bather, 1905; Jaworski, 1915
S67/24	Gorge of Glentui River	—	JvH	Y	Annelids	JvH	Haast, 1872b: 85
S67/25	Ashley R. in Lees Valley	c633040	ACB, HWW, 49	N	*Monotis*	HWW, 49	Wellman, Grindley & Munden, 1952: 226
S67/26	Ashley Gorge, N side	649932	RSA, 49	Y	*Terebellina mackayi* Worm trails	JDC	
S67/512	Ashley Gorge road	[620919]	JM, HWW, 49 (GS5772); DRG, HSG, 59	Y	*Terebellina mackayi*	GRS, 64*	
S67/513	[see /22]						
S67/514	Lees Pass	784160	JDC, GW, 54	Y	*Monotis* fragments	JDC	
S67/515	Lees Pass	782168	JDC, GW, 54	Y	Polyzoans "*Terebratula*" sp. *Monotis richmondiana* *Monotis calvata*	JDC	Campbell & Warren, 1955: 532

S67/516	Lees Pass	782171	JDC, GW, 54	Y	*"Rhynchonella"* sp. *"Terebratula"* sp. ?Pectinid ***Monotis richmondiana*** ***Monotis calvata*** ?Ostreid	JDC	Campbell & Warren, 1955: 532
S67/519	N of Lees Pass	761194	GW, 55	Y	Polyzoans *"Terebratula"* sp. Mytiliform shells	JDC	
S67/520	Lees Pass	787164	GW, 55	Y	Polyzoans Pelecypods	JDC	
S67/521	Lees Pass	787164	GW, 55	Y	Polyzoans Mytiliform shells	JDC	
S67/538	Lees Valley Road	603939	DRG, 60 (GS7770)	Y	*Terebellina mackayi*	GRS, 64*	
S67/539	Lees Valley Road	612935	RSp, ?24; DRG, 60 (GS7771)	Y	*Terebellina mackayi*	IGS, 60*	Speight, 1926: 360
S67/540	Lees Valley Road	615928	DRG, 60 (GS7774)	Y	*Terebellina mackayi*	IGS, 60*	
S67/541	Ashley Gorge	649932	DRG, 60 (GS7773)	Y	*Terebellina mackayi*	IGS, 60*	
S67/555	Lees Valley	573982	DRG, GW, 61 (GS9005)	Y	*Monotis* sp.	GRS, 64*	
S67/556	Lees Valley Road	572982	DRG, GW, 61 (GS9006)	Y	*Monotis richmondiana* Plant fragments	GRS, 64*	
S67/558	Lees Valley Road	599942	DRG, GW, 61 (GS9007)	Y	*Terebellina mackayi*	GRS, 64*	
S67/560	Coopers Creek, E branch	[c521909]	TJHC, 62	N	*Terebellina*	TJHC	
S72/496	"Mt Forbes" [Mt D'Archiac]	—	JvH, 1861	?	Serpulidae	JvH	Haast, 1862: 124
S72/497	Forbes River	—	FWH	?	[*Terebellina*]	FWH	
S72/498	[= /500, /501, /506] Rocky Gully, Mt Potts	c445635	JvH, 1861; 1872 (GS136); AM, 1877 (GS401); JDC, 52; ACB, DRG, DRR, 62 (GS9028, 9029); etc.	Y	*Rhynchonella zealandica* *Rhynchonella nuggetensis* *Mentzeliopsis spinosa* *Spiriferina kaihikuana* *Spiriferina carolinae* *Spiriferina trechmanni* (holotype) *Athyris kaihikuana* *Dielasma zealandica* ?*Nuculana* sp. *Daonella apteryx* *Maoritrigonia* sp. *Triaphorus* sp. *"Trochus"* sp. *Mixosaurus*(?) *hectori* (holotype) Bone fragments	JDC CAF, 62 RL	Haast, 1862: 125; McKay, 1878 Fleming, 1962: 3 Hector, 1874: 355; Lydekker, 1889: 113

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S72/499	[= /510] Tank Gully, Mt Potts	c443620	AM, 1877 (GS402); DGL, 11; ACB, GWGr, 62	Y	*Phyllotheca minuta* (holotype) *Linguifolium lillieanum* (holotype) *Chiropteris lacerata* (holotype) *Dictyophyllum acutilobum* *Cladophebis australis* *Taeniopteris thomsoniana* (holotype) *Baiera robusta* (holotype) *Elatocladus conferta* *Dicroidium odontopteroides*	EANA, 17 JAT, 57	McKay, 1878; Arber, 1917: 5–8 Townrow, 1957: 33
S72/505	Carneys Creek, Havelock River	c260612	PBM, 61; ACB, JDC, DRR, GW, 62 (GS9027)	A	*Rhynchonella nuggetensis* *Mentzeliopsis horrida* *Mentzeliopsis parki* *Spiriferina kaihikuana* *Athyris kaihikuana* *Dielasma* sp. *Nucula* sp. *Nuculana* sp. *"Chlamys" kakanuia* *Daonella apteryx* *Praegonia coombsi* *Panope* sp. *Trochus* sp. Nautiloid Crinoid	JDC	
S72/507	Fitzgerald Stm., Godley R.	c135624	ACB, GW, 61 (GS9089)	A	Annelid tubes		
S72/508	Carneys Creek, Havelock River	c258607	ACB, JDC, GW, DRR, 62	Y	*Mentzeliopsis parki* *Daonella* sp. *Panope* sp.	GRS, 64* JDC	

S72/509	Havelock River, above Carneys Ck.	c293645	ACB, JDC, GW, DRR, 62	N	*Spiriferina kaihikuana* *Daonella* sp.	JDC	
S72/522	Upper Godley Glacier	[c161653]	CC, 64 (GS9338)	Y	*Terebellina mackayi*	GRS, 64*	
S72/523	Ramsay Glacier moraine	c489870	MG, WFH, 49	N	cf. *Titahia corrugata*	JDC	
S73/20	"Black Hills"	—	AM, ?1874	?	Annelids	AM	Cox, 1884: 26
S73/504	Cascade Glen (Redcliffe)	988748	AM, 1874; HSG, 61 (GS7842); DRG, 63	Y	*Terebellina mackayi* *Anaptychus*	IGS, 61* CAF, 63	McKay, 1877: 40 Fleming, 1963a: 706
S73/505	Ashburton R., N branch	904636	HSG, 61 (GS7843)	Y	*Terebellina mackayi*	IGS, 61*	
S74/5	Lake Lyndon	—	JHr, 1872 (GS234B)	?	*Terebellina mackayi*	GRS, 64*	
S74/21	Big Ben Range	—	?JvH	?	[*Terebellina*]	?JvH	Hector, 1885: 339
S74/22	Kowai River	—	FWH	?	*Dentalium batheri* (holotype)	FAB	Bather, 1905: 540; Finlay, 1927: 521
S74/23	Mt Torlesse, near summit	—	HTF, 01	Y	[*Terebellina*] *mackayi*	EJ, 15	Bather, 1905
S74/24	Mt Torlesse, "SE end"	—	JvH, ?1861; JHr, 1869 (GS429*)	?	[*Terebellina*]	JHr	Haast, 1872a: 73, 79; Hector, 1885: 339
S74/25	Acheron River	—	JvH	Y	Annelid	JvH	Haast, 1872a: 73
S74/26	Rakaia Gorge, west end	—	JvH, ?1870; PTC, ?24	Y	[*Terebellina*] *mackayi*	PTC, 26	Haast, 1872a: 79; Cox, 1926: 94
S74/27	Road to Porters Pass	[c237836]	JHr, 1868	?	Plant remains	JHr	McKay, 1881: 91 (footnote)
S74/28	"Kowai Valley"	—	JHr, 1868	?	*Tentaculites*	JHr	McKay, 1881: 91 (footnote)
S74/29	Porters Pass, near summit	[c215852]	AM	?	Annelid	AM	McKay, 1881: 92
S74/30	High Peak Saddle	[243658]	RSp, 20	Y	*Monotis* and/or *Halobia*	RSp	Speight, 1920: 106; 1928: 10
S74/507	Bush Stream	182716	JDC, 52	Y	*Terebellina mackayi*	JDC	
S74/508	Upper Selwyn River	165695	JDC, 52	Y	*Terebellina mackayi* *Dentalium batheri*	JDC	
S74/512	Rakaia R., near gorge	103622	JDC, GW, 54	Y	*Terebellina mackayi*	JDC	
S74/513	Rakaia R., near gorge	100625	JDC, GW, 54	Y	*Terebellina mackayi*	JDC	
S74/514	Rakaia R., near gorge	080633	JDC, GHS, 55	Y	*Terebellina mackayi*	JDC	
S74/515	Mt Hutt, east slopes	060649	JDC, GHS, 55	Y	*Terebellina mackayi*	JDC	
S74/516	Mt Hutt, east slopes	055657	JDC, GHS, 55	Y	*Terebellina mackayi*	JDC	
S74/517	Mt Hutt, east slopes	056665	JDC, GHS, 55	Y	*Terebellina mackayi*	JDC	
S74/518	Mt Hutt, east slopes	048660	JDC, GHS, 55	Y	*Terebellina mackayi*	JDC	
S74/519	Rakaia R., near gorge	080633	GMM, 55; JDC, GW, 55; DAB, 56	N	"*Terebratula*" sp. *Halobia* sp.	JDC	
S74/532	Kowai River	252820	JDC, 57	Y	*Terebellina mackayi* Plant fragments	JDC	
S74/534	Head of Acheron River	154814	ORW, 56	A	*Terebellina mackayi*	JDC	
S74/555	Hutt Stream	048698	GW, 60 (GS9090)	Y	*Terebellina mackayi*	GRS, 64*	
S74/557	Acheron River	098747	ACB, 60 (GS7772)	A	*Terebellina mackayi*	IGS, 60*	

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S74/626	Upper Kowai River	252820	JDC, DSC, 57	N	Radiolaria	JDC	Coombs *et al.*, 1959: 65
S75/1	North of Oxford	—	AM	Y	[*Terebellina*]	AM	McKay, 1881: 93
S75/2	Waimakariri Gorge	[c486775]	R. Stern, 53	N	*Monotis richmondiana*	JDC	
S75/501	Waimakariri Gorge	486775	JvH; AM; JDC, 54	Y	*Terebellina mackayi*	JDC	McKay, 1881: 91, 92
S75/502	Eyre River	453892	JDC, MG, 58	Y	*Terebellina mackayi*	JDC	
S75/514	Coopers Creek	525891	DRG, HSG, 59 (GS7764)	N	*Terebellina mackayi*	IGS, 60*	
S79/1	" S base of Mt Cook "	—	JvH	?	" Fucoid plants "	JvH	Haast, 1872a: 5
S79/2	Mueller Glacier	—	FWH	?	[*Terebellina*] *mackayi*	FAB	Bather, 1905
S79/508	Mt Kitchener	—	ARL, 56	Y	*Terebellina mackayi*	ARL	
S79/509	Malte Brun, W ridge	—	ARL	Y	Worm tracks	ARL	Lillie, 1962: 260
S80/1	[Observation Hill]	—	JvH	?	[*Terebellina*]	JvH	Haast, 1862: 124
S80/2	Stony Stream, Macaulay R.	—	RSp, 20	N	*Monotis*	RSp	Speight, 1921: 41, 43
S80/507	Erebus Range	—	VRM, 61	Y	Worm tracks	VRM	
S80/508	Stony Stream, Macaulay R.	—	VRM, 61	Y	?Worm burrows	VRM	
S81/509	Alford Forest	949480	GW, DRG, 61 (L2808)	Y	*Cyathidites minor* *Cyathidites australis* *Todisporites* sp. *Osmundacidites wellmanii* *Lycopodiumsporites austroclavatidites* *Callialasporites segmentatus* *Araucariacites australis* *Monosulcites* aff. *minimus* *Ginkgocycadophytus nitidus* *Vitreisporites pallidus* *Classopollis reclusus*	GN, 64*	
S81/511	Taylors Stream	959508	DRG, HSG, 61 (GS7994)	N	*Terebellina mackayi*	GRS, 64*	
S82/504	Pudding Hill Stream	016532	SHC; RSp; GW, DRG, 61 (GS9008)	Y	*Terebellina mackayi*	GRS, 64*	Cox, 1884: 26
S82/506	Pudding Hill Stream	016533	GW, DRG, 61 (GS9009)	Y	*Terebellina mackayi*	GRS, 64*	
S82/505	Pudding Hill Stream	016548	GW, DRG, 61 (GS9010)	Y	*Terebellina mackayi*	GRS, 64*	
S82/507	Pudding Hill Stream	016551	GW, DRG, 61	Y	*Terebellina mackayi*	GW	
S89/502	Annette Plateau	[c731287]	ARL, 61	Y	*Terebellina mackayi*	ARL	
S89/503	Annette Plateau	[c721294]	ARL, 61	Y	*Terebellina mackayi*	ARL	

S89/504	Dobson River	675222	DRG, 63 (GS9171)	N	*Terebellina mackayi*	GRS, 64*	Grindley, 1963: 894
S89/505	Dobson River	694247	DRG, 63 (GS9172)	N	*Terebellina mackayi*	GRS, 64*	Grindley, 1963: 894
S89/506	Upper Dobson valley	705256	GWGr, 63	N	Plant fragments		
S89/509	Whale Stm., Tasman valley	765059	DRG, 64 (GS9340)	A	*Terebellina mackayi*	CAF, 64*	
S89/510	Jacks Stm., Tasman valley	731035	HSG, ETA, 64 (GS9404)	A	*Terebellina mackayi*	GRS, 64*	
S89/511	Jacks Stm., Tasman valley	765013	HSG, ETA, 64 (GS9405)	A	*Terebellina mackayi*	GRS, 64*	
S90/519	Mt Hay, Lake Tekapo	[c174052]	GMM, 58	Y	?Shell fragments	JDC	
S90/520	Trib. of Sutherland Ck.	127284	ACB, LJB, 63	A	Plant fragments	ACB	
S91/7	Four Peaks Range	—	JvH	?	"Fucoid plants"	JvH	Haast, 1872a: 5
S91/501	Ridge above Hae Hae te Moana R.	628008	GMM, 55; GMM, MG, JDC, 58	Y	?Rhynchonellid ?Productid *Spirifer* sp. Terebratulid ?Pectinid *Atomodesma* fragments Gastropod	JDC	
S91/502	Lynn Creek, Mt Peel	765179	GMM, 55	N	*Atomodesma* fragments	JDC	
S91/520	Mowbray River tributary	553073	HSG, 60	Y	*?Atomodesma* fragments	HSG	Gair, 1962: 184
S91/536	Waihi River tributary	629018	GMM, MG, JDC, 58	Y	*?Atomodesma* fragments	JDC	
S91/537	Mowbray River tributary	553070	HSG, 60	Y	*?Atomodesma*	HSG	Gair, 1962: 187
S99/499	West of Lake Ohau	—	AM, 1868 (GS808*)	?	[*Terebellina*]	AM	McKay, 1882: 79
S99/501	Shingle Hill, Lake Ohau	—	EBF, 60 (GS9336)	A	*Terebellina mackayi*	GRS, 64*	
S99/502	Ridge W of Lake Ohau	—	EBF, 60 (GS7943)	A	*Terebellina mackayi*	GRS, 64*	
S99/503	Ridge W of Lake Ohau	—	KC, 60 (GS9337)	A	*Terebellina mackayi*	GRS, 64*	
S100/501	Ben Ohau Range	—	GMM, 58	A	*Terebellina mackayi*	JDC	
S101/610	Dalgety Stream, gorge	285778	LEO, GW, 56 (GS6499)	Y	*Atomodesma*	JBW, 64*	
S102/605	Kakahu River	635813	GW, DRG, 62 (GS9166)	N	Crinoid stems	JBW, 64*	
S102/607	Kakahu River, quarry	627817	HWW; JJR, MGL, HSG, 63 (P28964)	Y	?Crinoid fragments	GRS, 64*	Wellman, 1952: 12
S102/608	Kakahu River	636812	GW, DRG, 62 (P28336)	Y	?Radiolaria	GRS, 64*	
S110/524	Upper Pareora gorge	c414577	GMM, 57; HSG, JBW, 61 (GS5082)	Y	*Atomodesma trechmanni*	JBW, 64*	
S117/469	Near Benmore Dam	[c875296]	HJH, ICM, 48 (B42); DSC, AEG, 63	Y	*Cladophlebis australis* *Chiropteris biloba* (holotype) *Chiropteris waitakiensis* (holotype) *Thinnfeldia odontopteroides* *Thinnfeldia lancifolia* *?Thinnfeldia* sp. *?Callipteridium* sp.	SMB	Bell, Harrington & McKellar, 1956

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S117/469 (continued)					*Linguifolium lillieanum* *Linguifolium waitakiense* (holotype) Corystospermaceae *Ginkgo digitata* *Carpolithus* sp.		
S117/473	Terrace, Wharekuri	—	AM, 1880 (GS552*)	N	*Spiriferina* *Athyris,* etc.	AM	McKay, 1882: 77
S117/475	Mt St Mary	—	JP, 03 (GS780)	Y	*Mentzeliopsis spinosa* *Spiriferina kaihikuana* ?*Spiriferina fragilis* "*Chlamys*" *kakanuia* (holotype) *Lima* sp.	IGS, 60	Park, 1904; Wilckens, 1927: 41; Marwick, 1956; Speden, 1960; Fleming, 1963b: 846.
					Agonisca corbiensis *Agonisca thomsoniana* Nautiloid	CAF, 63	
S117/503	Mt St Mary	c972106	DRG, HSG, ARM, LEO, PMC, 57 (GS7079)	Y	*Rhynchonella* cf. *zealandica* *Mentzeliopsis spinosa* *Spiriferina kaihikuana* *Athyris kaihikuana* cf. *Daonella* Astartid Gastropod	IGS, 60	Gair & Gregg, 1960; Speden, 1960: 522
S117/509	[= /562] Corbies Creek	773246	DRG, HSG, 58 (GS7304); DSC, AEG, 63	Y	*Dielasma* sp. *Balantioselena gairi* *Agonisca corbiensis* (holotype) *Permophorus* sp. Pelecypod *Kamupena greggi* (holotype)	IGS, 62	Gair, Gregg & Speden, 1962: 95; Fleming, 1963b

S117/510	Corbies Creek	771244	DRG, HSG, 58 (GS7204)	Y	*Rhynchonella* cf. *zealandica* *Mentzeliopsis spinosa* *Dielasma* cf. *himalayana* *Grammatodon* sp. Trigoniid *Daonella apteryx* *Permophorus* sp. *Balantioselena gairi* (holotype) *?Dentalium* sp. *Kamupena greggi*	IGS, 62 CAF, 64*	Gair, Gregg & Speden, 1962: 95–6
S117/511	Kurow Hill	073103	AM, 1880; ARM, ICM, 55; ARM, HSG, DRG, 58 (GS7205); etc.	Y	*?Cladochonus* *?Atomodesma* fragments	JBW, 64*	McKay, 1882: 78
S117/515	N of Mt St Mary	c935150	HSG, DRG, 58 (GS7325)	Y	*?Mentzeliopsis*	IGS, 59*	Gair & Gregg, 1960: fig. 1
S117/516	Road, Corbies Creek to Otematata Valley	c809199	DRG, HSG, 58	Y	*Cladophlebis australis* *Dicroidium odontopteroides* *Chiropteris* sp. *Linguifolium waitakiense* *?Desmiophyllum* sp. *?Stenopteris* sp. *Taeniopteris* sp.	SMB, 64*	Gair, Gregg & Speden, 1962: 94
S117/517	Near Potato Pit Hill	c981370	DRG, HSG, 58 (GS7327)	Y	*?Cladochonus* Shell fragments Crinoid	JBW, 64*	
S117/518	Road cutting, Otematata	c880250	WRL, 49; HSG, DRG, RSC, 58 (GS7326)	Y	*Mentzeliopsis* aff. *spinosa* *Spiriferina* cf. *kaihikuana*	IGS, 59* JDC	Gair, Gregg & Speden, 1962: 94
S117/519	Mt St Mary	c962108	HSG, DRG, 58 (GS7334)	Y	*Rhynchonella* sp. *Spiriferina kaihikuana* *Spiriferina* cf. *parki* *Athyris kaihikuana* *"Chlamys" kakanuia* *?Pteria* sp. Crinoid fragment	IGS, 60	Speden, 1960: 522

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S117/523	Benmore-Black Forest rd	c915348	RPS, LEO, 59	Y	*?Atomodesma* fragments	JBW, 64*	
S117/560	and /561 Awahokomo Creek	—	JDC, GHS, 56	N	*Rhynchonella zealandica* *Spiriferina kaihikuana* *Athyris kaihikuana* *Dielasma zealandica* *Agonisca thomsoniana* *?Pteria* sp.	JDC	
S117/562	[see /509]						
S117/594	Benmore–Black Forest rd	c920381	GMM, 63	A	*?Atomodesma* fragments	GMM	
S117/598	Corbies Creek	768240	RJR, 63; RJR, JDC, 64	Y	*Rhynchonella zealandica* *Rhynchonella* sp. *Mentzeliopsis spinosa* *Spiriferina kaihikuana* *Athyris kaihikuana* *Dielasma zealandica* *?Lima* sp. *Daonella apteryx*	JDC	
S117/599	Corbies Creek	770242	RJR, 63; RJR, JDC, 64	Y	*Rhynchonella* sp. *Daonella* sp.	JDC	
S117/601	Corbies Creek	773246	RJR, 63; RJR, DSC, 63; RJR, JDC, 64	Y	*Agonisca corbiensis* Trigoniid *Kamupena greggi*	JDC	
S117/603	Road, Corbies Creek to Otematata valley	787227	RJR, 63; RJR, DSC, 63; RJR, JDC, 64	Y	*Rhynchonella zealandica* *Mentzeliopsis spinosa* *Spiriferina kaihikuana* *Dielasma zealandica* *Agonisca corbiensis* *Daonella apteryx* ?Astartid *Kamupena greggi*	JDC	
S117/605	Road, Corbies Creek to Otematata valley	789226	RJR, 63; RJR, JDC, 64	Y	*Rhynchonella zealandica* *Mentzeliopsis spinosa* *Spiriferina kaihikuana* *Spiriferina* aff. *fragilis* *Dielasma zealandica* ?Nuculanid	JDC	

					Trigoniid ***Chlamys* sp.** ***Daonella apteryx*** ?Astartid ***Balantioselena gairi*** ***Kamupena greggi*** *Isocrinus* sp.	
S117/606	Road, Corbies Creek to Otematata valley	802207	RJR, 63; RJR, JDC, 64	Y	*Spiriferina kaihikuana*	JDC
S117/609	**Road, Corbies Creek to Otematata valley**	797221	RJR, 63; RJR, DSC, 63; RJR, JDC, 64	Y	*?Monotrypella* sp. *Rhynchonella zealandica* *Mentzeliopsis spinosa* *Spiriferina kaihikuana* *Spiriferina carolinae* *Athyris kaihikuana* *Dielasma zealandica* *Dielasma* cf. *himalayana* *Patella nelsonensis* Crinoid	JDC
S117/613	Road, Corbies Creek to Otematata valley	788221	RJR, DSC, 63	Y	*Rhynchonella zealandica* *Spiriferina kaihikuana* *Spiriferina carolinae* *Athyris kaihikuana* *Dielasma zealandica*	JDC
S117/631 [see /516]						
S117/645	W of Otamatapaio River	727258	RJR, 64	A	*Rhynchonella zealandica* *Mentzeliopsis spinosa* *Dielasma* sp. *Daonella apteryx* *Isocrinus* **sp.**	JDC
S117/662	Parsons Rock Creek	941124	ARM, 58	Y	*Spiriferina kaihikuana*	ARM
S117/663	Rocky Point, Kurow	096114	ARM, 58	Y	*?Atomodesma* fragments	ARM
S117/664	Black Jacks Point	878335	DML, SYK, 64	Y	*?Dicroidium*	JDC
S117/665	Benmore Dam	878290	SYK, 64	Y	*?Dicroidium*	JDC

TABLE II.—*Continued.*

Number	Locality	Grid Ref.	Collector	In Pl.	Fossils	Latest Determin.	References
S118/549	Hakataramea Gorge	[126125]	AM, 1880; ARM, ICM, 55 (GS6366)	Y	*?Atomodesma* fragments	JBW, 64*	McKay, 1882: 78
S118/574	Hakataramea Gorge	126116	GDI, 58	A	*?Atomodesma* fragment	JBW, 64*	
S118/587	[= /595] Quarry, Kurow	102103	ICM, ARM, 55 (GS6353); ARM, PMC, 58	Y	*Atomodesma* fragment	JBW, 64*	
S118/593	Otaio River	482318	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S118/594	SE of Hakataramea Gorge	134103	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S118/595	[see /587]						
S118/596	W of Hakataramea Gorge	118123	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S118/597	Otaio River	487349	ARM, PMC, 58	Y	*?Atomodesma* fragments	ARM	
S118/598	Otaio River	482330	ARM, PMC, 58	Y	*?Atomodesma* fragments	ARM	
S126/504	Awakino River	[070100]	ICM, ARM, 55 (GS6354)	Y	*?Cladochonus* *Atomodesma* fragments	JBW, 64*	
S127/374	Station Peak, "at S foot"	—	AM, 1880		[*Atomodesma*] fragments Plant remains	AM	McKay, 1882: 78
S127/624	Near Station Peak	183087	DRG, HSG, 58		*?Cladochonus* *?Atomodesma*	JBW, 64*	
S127/625	Near Station Peak	173098	DRG, HSG, 58	Y	*?Atomodesma* fragments	DRG	
S127/643	SE of Hakataramea Gorge	135096	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S127/644	Road, SW of Station Peak	163065	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S127/645	Grassy Hill Road	354965	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S128/496	W of Waimate	—	AM, 1880	Y	[*Atomodesma*] fragments	AM	McKay, 1882: 78
S128/512	Waimate-Arno road	559053	DRG, 58	Y	*?Atomodesma* fragments	JBW, 64*	
S128/513	Waimate-Arno road	578068	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S128/514	Waimate-Arno road	558052	ARM, 58	Y	*?Atomodesma* fragments	ARM	
S146/560	Blue Mountain, Dunback	316310	?PGM, 19; WAH, 61	Y	?Gastropods Crinoid fragments	?PGM WAH, 64*	Morgan, 1919: 269

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J. D. CAMPBELL,
Geology Department,
University of Otago,
Dunedin, New Zealand.

GUYON WARREN,
N.Z. Geological Survey,
P.O. Box 2110,
Christchurch, New Zealand.

APPENDIX

Fusuline Limestone in the Torlesse Group near Benmore Dam, Waitaki Valley

By N. de B. HORNIBROOK and SHU YEOH KHOON

VERBEEKINID or Neoschwagerinid fusulines were discovered by Y. K. Shu in a limestone in the Torlesse Group some two miles south-east of Benmore Dam in May, 1964. The same limestone contains polycoeliid rugosan corals and crinoid columnals. The fossils indicate a Permian age for the limestone.

A fault block of siltstone, sandstone, pebbly conglomerate, limestone lenses and volcanics lies to the east of a fault block of conglomerate and sandstone from which Mesozoic (?Rhaetian) plant remains collected by Harrington and McKellar at locality S117/469 were described by Bell (in Bell, Harrington and McKellar, 1956). The creamy white recrystallized limestone forms a thin discontinuous band traceable for more than a mile, some two miles south-east of Benmore Dam. Fusulines occur in one locality in the upper reaches of Akatarewa Stream, S117/666, and their tests constitute somewhat less than half the volume of the rock.

The following description was made by one of us (N. de B. H.):

Oval shaped fusulinidae, approximately 1 cm long, are plainly visible on the weathered surfaces of the limestone; but in thin section it was found that recrystallisation had obscured most of the detailed structure of the fossils.

The largest specimen measured is 11 mm long by 4 mm wide and the test wall is approximately 0.075 mm thick.

Although sections through more than 20 specimens were examined, it was not possible to determine which genus they belong to. As far as could be determined not more than one form is present.

It is concluded that this form belongs either to the Verbeekinidae (Permian) or the Neoschwagerinidae (Mid-Upper Permian) because of its thick walls and thick swollen septa (or possibly septula). Preservation is not sufficiently good in any of the equatorial sections available to distinguish septula from septa. Seven whorls were counted on one specimen in equatorial section and the proloculus was measured on another specimen as 0.35 mm. In the best saggittal sections observed there is a tendency for the septa to become convoluted towards the poles of the test as in the Verbeekinidae.

A superficial resemblance to both *Pseudodoliolina* and *Neoschwagerina* was noted but the material examined did not allow a definite identification to be made.

The only other New Zealand occurrences of fusulines known so far are those in limestones of the Waipapa Group, in Sheets N8, N11, N16, Northland (Hornibrook, 1951; Hay, 1960).

At a locality two and a half miles south-east of Benmore Dam, S117/667, along strike from locality 666, the limestone contains indeterminate shell fragments and rare solitary corals. The following description was kindly supplied by Professor Dorothy Hill:

Family Polycoeliidae. A solitary Rugosan with tachylasmoid major septa of unequal length and long thickened minor septa. No sign of dissepiments.

Professor Hill first recognised the fusulines. They indicate a Permian age, whereas the corals can only be placed as ?Silurian to Permian.

The following data may now be added to the list of fossil localities in the Torlesse Group of Campbell and Warren:

S117/666, Akatarewa Stream, 909273, Y. K. Shu, 1964, in place, Verbeekinid or Neoschwagerinid fusuline, N. de B. Hornibrook, 1964.

S117/667, 9 chs N of Waitaki River, 896263, Y. K. Shu, 1964, in place, Polycoeliid rugose coral, D. Hill, 1964.

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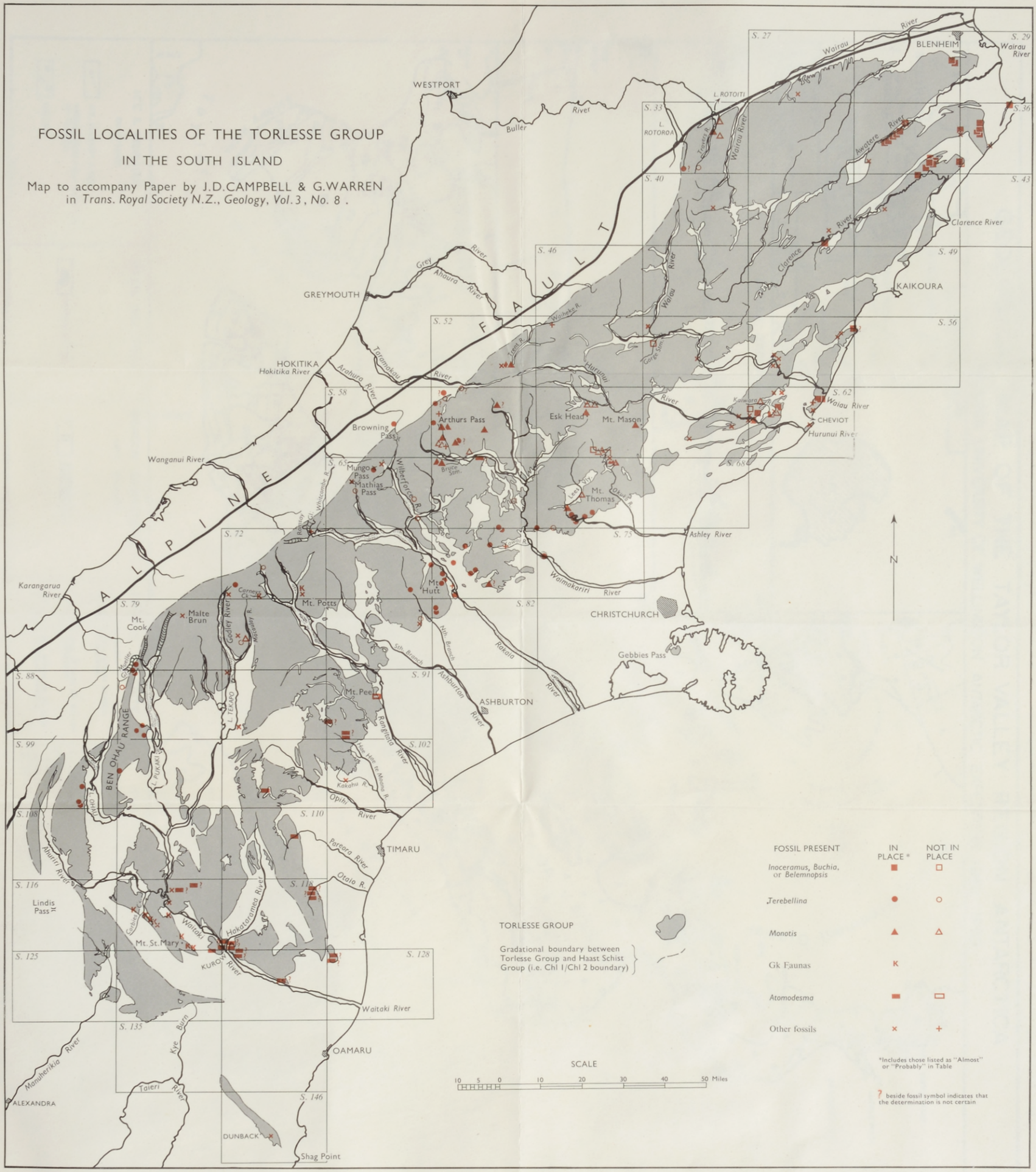
Mr N. de B. HORNIBROOK,
N.Z. Geological Survey,
Box 368,
Lower Hutt.

Mr SHU YEOH KHOON,
Geology Department,
University of Otago,
Dunedin.

FOSSIL LOCALITIES OF THE TORLESSE GROUP

IN THE SOUTH ISLAND

Map to accompany Paper by J.D.CAMPBELL & G.WARREN
in *Trans. Royal Society N.Z., Geology, Vol. 3, No. 8.*



Drawn by D. M. Slade, Cartographic Section, D.S.I.R.

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