

The Otapirian Stage of the Triassic System of New Zealand. Part II.

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Abstract

A basal Otapirian fauna is established for the Dipton-southern Taringatura Hills region. Fossil assemblages from sequences in the Kaihiku Ranges and at Nugget Point are shown to have forms in common with this fauna. The Otapirian faunal succession at Kawhia is described and a map is given. An upper Otapirian fauna is recognized.

INTRODUCTION

THIS paper is complementary to that of Campbell and McKellar which appears in Vol. 83 of this journal; its separate existence can only be justified by the difficulties inherent in joint authorship. Field work has been carried out over a period of years while collecting brachiopods in the Hokonui System. The writer is grateful to Professor D. S. Coombs and Mr. G. Warren, who have each contributed to the work by their company and help in the field, and to Professor R. S. Allan for criticism of the manuscript.

CORRELATION

The only precise criterion for defining the base of a stage in its type locality is the recorded incoming of a single species. On such a basis the lower boundary of the stage may move down the sequence should later work in the type section extend the range of the species. At any one time, however, there can be no ambiguity.

Correlation (on a regional as distinct from inter-regional scale) on the basis of the incoming of a single species is possible under certain conditions, notably where there is no facies problem. This may be the case if the fossils were pelagic or pseudoplanktonic in life or if the sediments in which they are preserved are in effect lithologically uniform. The first condition appears to have been met by the pteriids *Halobia lilliei* and *Monotis richmondiana* and possibly by *Mytilus problematicus*, three key species of the New Zealand Triassic (cf. Allan, 1953, p. 32). It cannot be shown yet that the distribution of the range of lithologies present in the Triassic rocks of Southland-Otago, Nelson and South Auckland brings about the first appearance of one species in different horizons at different places. Such differences should emerge as the appearances in time of brachiopods and other pelecypods in the various sequences are plotted against those of the pseudo-planktonic group.

When none of the species preserved is pelagic or pseudoplanktonic, correlation is best based on a number of species preserved in abundance.

The Otapirian Stage is defined in terms of the first appearance of a brachiopod (Campbell and McKellar, 1956). Thus correlation is safest where it is made on the presence in abundance of a number of forms. For this reason an attempt is made here to establish a basal Otapirian fauna.

Correlation will be weakest near the limits of the fauna's existence in time. In practice, however, it is necessary to designate a lower boundary for units of rock correlated with the stage, and this has been and will be done—albeit tentatively—on the basis of the local incoming of the key fossil or of some other member of the basal fauna. Correlation with the basal bed of the type sequence is not implied.

The upper limit of the Otapirian Stage will be determined by criteria still to be selected for defining the base of the Aratauran Stage in its type locality. In the meantime it is useful to recognize an upper Otapirian fauna. This is attempted in this paper; an assemblage from Kawhia is shown to be similar to assemblages high in the stage in and near its type section.

DIPTON

Cox (1878) and McKay (1878) mapped the western Hokonui Hills in considerable detail. The broad picture still stands and, in the Otapiri Valley at least, their detailed mapping has been confirmed by recent work. Modification of their interpretation is called for, however, in the area about Dipton township (Oreti in their reports).

Stage boundaries in the Dipton area are shown on a map of the north-west portion of the Hokonui Hills published recently (Campbell, 1955, p. 1036).

Warepan beds lie to the north and east of Dipton township; sandstones with *Monotis richmondiana* form the north bank of the Spirit Burn, 20 chains N.E. of the railway station (immediately N. of the tennis courts and sale yards, S160/528) and are seen again (S160/526) in a low rocky face 100 yards S.E. of the railway bridge over the Spirit Burn. About 50 chains S.E. of the bridge they crop out on the valley wall of a tributary of the Spirit Burn (S160/525).

The horizon in which Otapirian fossils make their first appearance in the area is exposed in a new cutting on the Dipton-Mossburn road, 125 yards S. of the east end of the Oreti River bridge (S160/527). The following fossils are preserved in deeply weathered coarse sandstone:

"Rhynchonella" sp.

"Terebratula" sp.

Spiriferina aff. *trechmanni* (Wilckens)

S. (Rastelligera) diomedea Trechmann

Clavigera tumida Hector

Myophoria sp.

The road and rail cuttings immediately west of Dipton railway station expose 90 feet of beds. The lowest bed crops out at the extreme east of the road cutting (S160/529) where light grey siltstone is seen with abundant plant fragments and a small pteriid shell distinct from *M. richmondiana*. It is conceivable that this fossil was taken by McKay to be *M. richmondiana* of G.S.373, "Oreti railway station". A less likely explanation for the consistent association of the railway station and *M. richmondiana* in the writings of Cox (1878, pp. 28, 45) and McKay (1878, pp. 69, 72, 89) is that beds with this fossil were then exposed north-east of the station in rail cuttings that are now deeply weathered banks.

The floor of the old building-stone quarry beside the road cutting west of the station, is composed of blue sandstone with *S. (Rastelligera) diomedea*. The same fossil is preserved in the spheroidally weathering massive blue-green sandstone of the quarry wall and rail cutting (S160/530, 531). The holotype of *Aulacoceras otapiriense* (Hector) was collected from G.S.372, "Oreti Railway Cutting", and this species was later taken by McKay as indicating the base of the Otapiri Series. It is clear from the text of their reports that Cox and McKay took the base of the blue-green sandstone as the lower boundary of the Otapiri Series, an horizon some 300 feet above that now taken as the basal bed. The map that accompanied the reports (1878, facing p. 48) shows the boundary between upper Wairoa Series (formation 8) and Otapiri Series (7) rather more than a mile south of the Dipton railway cutting. As this is at variance with the text, it can only be regarded as a draughtsman's error.

SOUTHERN TARINGATURA HILLS

An account of the geology of this little known area of Triassic rocks is in the press. Stratigraphically the region is broadly similar to the northern Taringatura Hills described by Coombs in 1950. Although Jurassic fossils do not occur in the southern Taringaturas, the Otapirian Stage is represented by some 2,000 feet of beds in the north and by about 3,000 feet in the south.

In the north a narrow outcrop of Warepan beds follows a sinuous course from the south-east corner of The Bog south-east and then south to the upper reaches of Taringatura Creek, where it ends abruptly against a fault. The basal bed of the Otapirian Stage crops out to the north and east of the well-exposed *Monotis rich-*

mondiana beds; it is a conspicuous horizon as its varied faunal content contrasts with the simple dominance of *M. richmondiana*.

In an outcrop on a northern spur of Taringatura Hill, 140 chains at 260° from Castle Downs homestead (S159/633) the following forms occur:

- "*Rhynchonella*" sp.
- "*Terebratula*" sp.
- Spiriferina* aff. *trechmanni* (Wilckens)
- S. (Psioidea)* aff. *nelsonensis* Trechmann
- S. (Rastelligera)* *diomedea* Trechmann
- Clavigera tumida* Hector
- Myophoria* sp.
- Pteria* cf. *contorta* (Portlock)
- Lima* sp.
- Torastarte bensoni* Marwick

The list includes all species mentioned above from the basal Otapirian bed in the Dipton area as well as species collected by Coombs (1950, p. 439) from a narrow band low in the Otapirian, 22 chains S.W. of Trig AA, northern Taringatura Hills. *Spiriferina* aff. *trechmanni* (Wilckens) refers to a large handsome undescribed species and is probably "*S. spatulata* Hector" of McKay (1881, p. 44), a *nomen nudum*. McKay's material was collected from a locality "one and a-half miles below Gore on the eastern bank of the Mataura", immediately overlying a bed termed "*Monotis* sandstone". Besides "*S. spatulata*", McKay collected *Aulacoceras otapiriense* (Hector), *Clavigera tumida* Hector and "*Rastelligera taylori* Hector". The last name, also a *nomen nudum*, refers to a species that has been re-collected by the writer and seems inseparable from *S. (Rastelligera)* *diomedea*.

On Little Cairn Peak (S159/739) the species noted for the basal Otapirian bed at S159/633 occur again, but are here preserved in different and differing proportions. *Lima* sp. and *C. tumida* are the dominant species, and each occurs in pockets to the exclusion of almost all other forms. *S. (Rastelligera)* *diomedea* and *S. (Psioidea)* aff. *nelsonensis*, are common in some lenses. In an outcrop 100 chains at 210° from Little Cairn Peak (S159/635) the same faunal assemblage is preserved with some additional species, but it is here dominated by terebratulids.

The Warepan beds that underlie the Otapirian beds of the three localities mentioned above (S159/633, 739, 635), contain a fauna consisting of *M. richmondiana* in profusion and rare brachiopods representing 5 or 6 lineages along with a few pelecypods. The extinction of *M. richmondiana* in the area appears to have been followed by a sudden expansion of the brachiopod fauna; at least 10 lineages are represented in the basal Otapirian beds, some of them in profusion. The pelecypod fauna also increased in variety, and one species became locally dominant.

It is probable that the invasion of the Dipton-Taringatura region by the basal Otapirian fauna was accompanied by the appearance at the type locality of the stage (6 miles away) of the key fossil, *S. (Rastelligera)* *diomedea*, a constant member of the fauna. It would be hazardous, however, to attempt bed by bed correlation over greater distances on the basis of the entry of benthonic forms. In such cases, groups of beds, such as those containing the basal fauna, can be correlated.

NUGGET POINT

A basal Otapirian faunal assemblage is preserved in beds at the south end of Roaring Bay, Nugget Point. As noted by Park (1904, 1910) and Mackie (1935), highly fossiliferous grey-green sandstones with an abundance of *Clavigera tumida* form the southernmost outcrops in the bay that can be reached at ordinary low tide. Besides *C. tumida* the following are preserved in conspicuous, slightly overturned beds (G.S. 133, S179/559):

- Spiriferina* aff. *trechmanni* (Wilckens)
- S. (Psioidea)* aff. *nelsonensis* Trechmann

S. (Rastelligera) diomedea Trechmann
Myophoria sp.

All the species are represented in Taringatura collections. Allan (1945, p. 17) designated a specimen from Nugget Point to be lectotype of *S. (Rastelligera) diomedea*, and it can be confidently stated that the species is based on material from a basal Otapirian horizon.

KAIHIKU RANGES

The conspicuous mixed brachiopod element of the Taringatura fauna is almost absent from fossil assemblages of the Kaihiku Ranges that are thought to be basal Otapirian. It was found recently by G. Warren and the writer that the most abundant fossil in beds overlying those with *Monotis richmondiana* (G.S.1438, S179/582, 583) and lying below beds with *Pseudauccella marshalli* (S179/598) is the species of *Myophoria* that occurs in the basal Otapirian fauna of Taringatura. It occurs in abundance in a group of beds that crop out on the hill track leading to the north face of Rocky Dome from Lochindorb homestead. (A map of the area about Lochindorb station will be published in due course in a description of the type locality of the Warepan Stage.) The outcrops are in cuttings beside the track on the south face of the Rocky Dome ridge, 50 chains at 18° from Lochindorb homestead (S179/587, 588, 589). Other forms preserved there include:

S. (Rastelligera) sp.
Triaphorus sp
Pteria cf. *contorta* (Portlock)
Anodontophora sp.

Members of this assemblage were collected from localities (S179/585, 586, 590, 591, 593) extending for about 3 miles along the strike. Correlation with the basal Otapirian is supported by the occurrence of *S. (Rastelligera) diomedea* and *Clavigera tumida* in one locality (S179/592) within the narrow belt of Otapirian beds. The horizon in which the few specimens of brachiopods were found is in about the same position stratigraphically as the beds with abundant *Myophoria* sp.

KAWHIA

The Kawhia coastal section through Otapirian beds has been described in detail by McKay (1884), Trechmann (1918), Henderson and Grange (1926), and Marwick (1953). From this section Trechmann noted *Arcastes* cf. *rhaeticus* and *Mentzelia* cf. *ampla* and described *M. kawhiana*. Professor Coombs and the writer recently collected from some of the more obvious fossil localities.

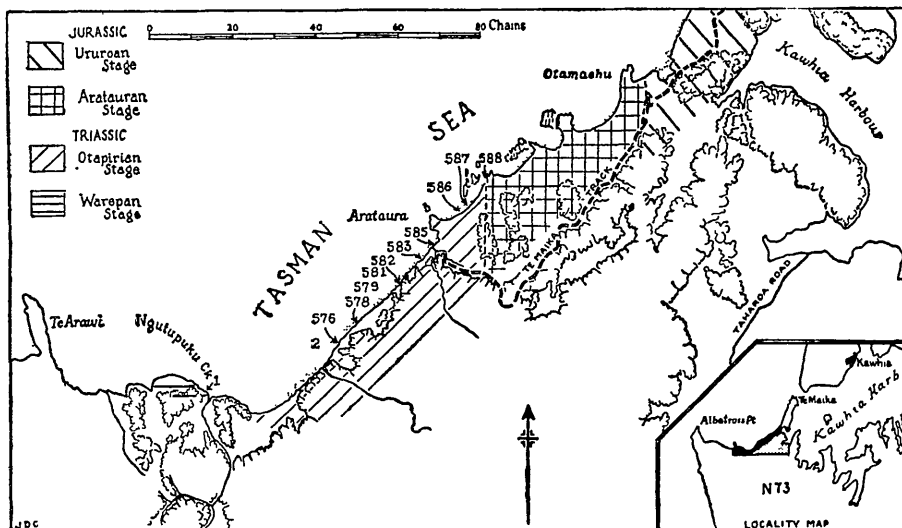
The base of the Otapirian Stage cannot be fixed in the coastal sequence; there is a gap in the section stratigraphically above the beds with *Monotis richmondiana* which crop out (N73/1) to the west of Ngutupuku Creek. The following Otapirian fossils were found north-east of a stream, the mouth of which lies 30 chains E. of Ngutupuku Creek (N73/2):

"*Rhynchonella*" sp.
"*Terebratula*" sp.
S. (Rastelligera) sp.
Anodontophora sp.
Triaphorus sp.

Mentzelia kawhiana makes its first appearance in a bed that is exposed in the cliffs about 28 chains S.E. of the south wall of Arataura (N73/578). It is preserved with *Clavigera tumida* and a handsome rhynchonellid which has been collected with *M. kawhiana* at the type locality of the stage. *Otapiria dissimilis* makes its first appearance in a faunule containing the brachiopods just mentioned, and was collected from a locality (N73/582), 14 chains S.W. of the south wall of Arataura. The same four species were found at localities as far north-east as N73/583, 100 yards S.E. of the mouth of the small stream that is followed by the track from Te Maika; the beds

containing them form the cliffs for about 6 chains. These are the beds that Marshall and Trechmann called "*Arcestes* and *Hectoria*" beds and G.S.1025 (Marwick, 1953, locality for *M. kawhiana*) probably refers to part of them.

The faunule comprising "*Rhynchonella*" sp., *M. kawhiana*, *C. tumida*, and *O. dissimilis* is a distinctive one; with the exception of *C. tumida*, each species is readily distinguished from those of the basal fauna of the stage. The four species have already been noted (Part I) as occurring in an horizon high in the Otapirian beds at Taylors Stream (S169/611) and all are represented high in the sequence at the type locality and on Benmore. Clearly the assemblage existed as such at Kawhia and in Southland. So far *O. dissimilis* is known only from Kawhia and the Otapiri-



TEXT-FIG. 1 —Geological sketch map of part of the coast between Albatross Point and Te Maika, Albatross Survey District. Topography based on the Mosaic, N.Z.M S 3, N73/5 Fossil localities are indicated by fossil record form numbers (e.g., 582) for One Mile Sheet N73.

Taylors Stream area. *M. kawhiana* has been collected from one of the fossil localities mentioned by Coombs (1950, p. 439) in the Taringatura Hills. It is clear from his careful work that the horizon is high Otapirian (4,650 feet above the base). An upper Otapirian age is possible for assemblages including abundant *M. kawhiana* from Waimumu saddle, eastern Hokonui Hills, noted by Watters (1952, p. 472).

In the Kawhia section *O. dissimilis* was collected from a locality north-east of the Te Maika track and south-west of the south wall of Arataura (N73/585). This is presumably the locality recorded by Marwick (1953, p. 95) as an occurrence of the Aratauran species, *O. marshalli* (Trechmann). Good material leaves no doubt that this is the Otapirian form.

O. dissimilis was collected from two localities (N73/586, 587), 100 and 120 yards respectively N.E. of the north wall of Arataura. A new fauna comprising rhynchonellids, small pelecypods (? *Posidonomya* sp.) and a large ammonite (our only example is badly crushed) enters in beds that are exposed at about 13 chains N.E. of the north wall of Arataura (N73/588). Tentatively the lower boundary of the Aratauran Stage is placed at the base of the beds containing this fauna.

FAUNAL CHECK LISTS

The following species comprise the basal Otapirian fauna:—

- "*Rhynchonella*" sp.
- "*Terebratula*" sp.

Spiriferina aff. *trechmanni* (Wilckens)
S. (Psoidea) aff. *nelsonensis* Trechmann
S. (Rastelligera) *diomedea* Trechmann
Clavigera tumida Hector
Myophoria sp.
Pteria cf. *contorta* (Portlock)
Lima sp.
Torastarte bensoni Marwick

The following species comprise an upper Otapirian fauna:
 "Rhynchonella" sp.
Mentzelia kawhiana Trechmann
Clavigera tumida Hector
Otapiria dissimilis (Cox)

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