NEW DISCOVERIES OF FOSSILS IN THE UPPER JURASSIC VOLCANIC GROUP OF ADELAIDE ISLAND

By M. R. A. THOMSON

ABSTRACT. New discoveries of fossils at eight localities in the Upper Jurassic Volcanic Group of Adelaide Island are described together with new collections from known localities. Ammonites and marine bivalves are reported for the first time and they confirm the Upper Jurassic age assigned to the volcanic sequence.

MOST of the fossils described here were collected on Adelaide Island (Fig. 1) by C. M. Bell from a thick sequence of volcanic rocks, which has been correlated with the Upper Jurassic Volcanic Group (Dewar, 1970). This 3,000 m. thick sequence was subdivided by Dewar (1970, p. 11, table II) into three "successions" (Sloman Glacier, Mount Liotard and Mount Bouvier summit) which were differentiated on lithological criteria.

Fossils have recently been collected or noted in three areas:

i. At eight localities along the western margin of the mountain range on the east side of Adelaide Island, in the Sloman Glacier and Mount Bouvier summit successions.
ii. On the Dion Islands in a sequence of lavas and tuffs correlated with the Mount Liotard succession.
iii. On an offshore island immediately west of the scientific station at the south-western corner of Adelaide Island.

There are few previous reports of fossils from the Upper Jurassic Volcanic Group of Adelaide Island and its offshore islands. Poorly preserved plants were observed by Nichols (1955, p. 46 and 49) on "two small islands about 10 miles [16 km.] southwest of Adelaide Island" [Dion Islands] but they were not described further. By analogy with the fossil plant beds of Mount Flora, Hope Bay, he thought that the plant-bearing volcanic sediments of the Dion Islands were probably Jurassic in age. Marine trace fossils and micro-fossils were recently described from fine-grained tuffs at the south-western corner of Adelaide Island (Thomson, 1969), and Dewar (1970, p. 15) has reported "pyritiferous traces of fragmented leaves and wood" in a bed of tuffaceous shale at Cape Alexandra.

The most important site to date is near the base of a 300 m. high bluff at the south-western corner of the Mount Bouvier massif (Fig. 2; T.535–37) and this is described here for the first time. At this locality a sequence of gently dipping tuffs, representing the lowest exposed part of the Sloman Glacier succession, contains bivalves, ammonites, trace fossils and carbonized plant stems. 2 km. to the east and about 500 m. higher (Mount Bouvier summit succession) a *Ptilophyllum*-like frond was collected. Only fragmentary plant remains were noted at the other localities (Fig. 1; T.531–34) in the Sloman Glacier succession, but the presence of a moderately well-preserved frond in the Mount Bouvier area suggests that better material may be present. While plant remains were collected at only a few localities along the 80 km. long mountain range of eastern Adelaide Island, the general impression gained in the field was that almost all bedded sedimentary volcanic sequences were potentially fossiliferous (personal communication from C. M. Bell).

A re-investigation of the previously reported plant-bearing sequences of the Dion Islands by C. M. Bell and A. C. Skinner led to the discovery of more fossiliferous localities (Fig. 1) but no identifiable specimens. The occurrence of very poorly preserved plant remains near the scientific station on Adelaide Island is based on field observations and is recorded here for completeness.

PALAEONTOLOGY

BIVALVIA

Fig. 3a–c

Six specimens of pale green tuff (T.535.1–4, T.536.1 and 2) from south-western Mount Bouvier contain poorly preserved internal and external moulds of inequivalve buchiid bivalves. The larger left valve of the species is higher than long, has an enrolled and inflated

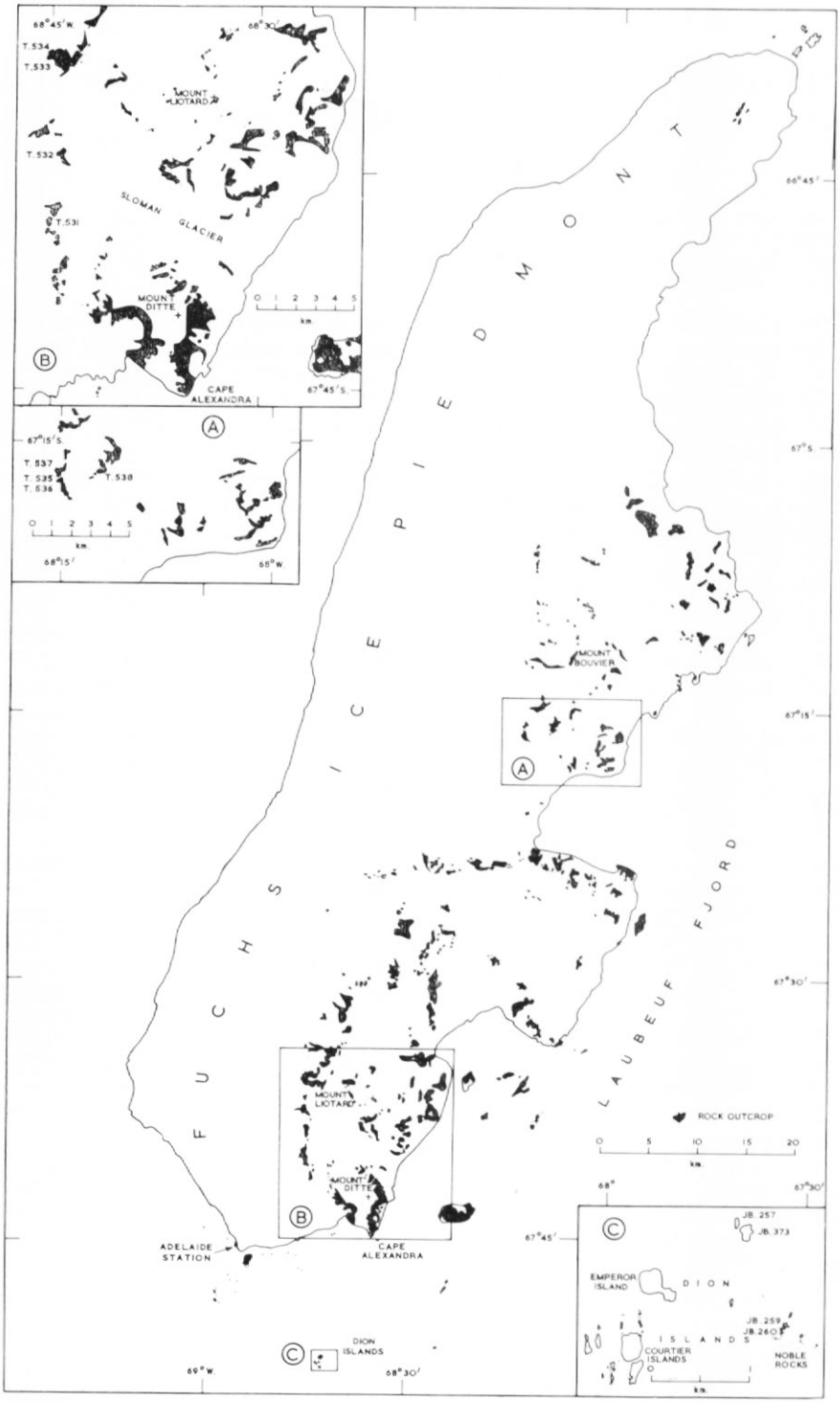

Fig. 1. Sketch maps showing the location of the fossiliferous localities in the Upper Jurassic Volcanic Group of Adelaide Island.

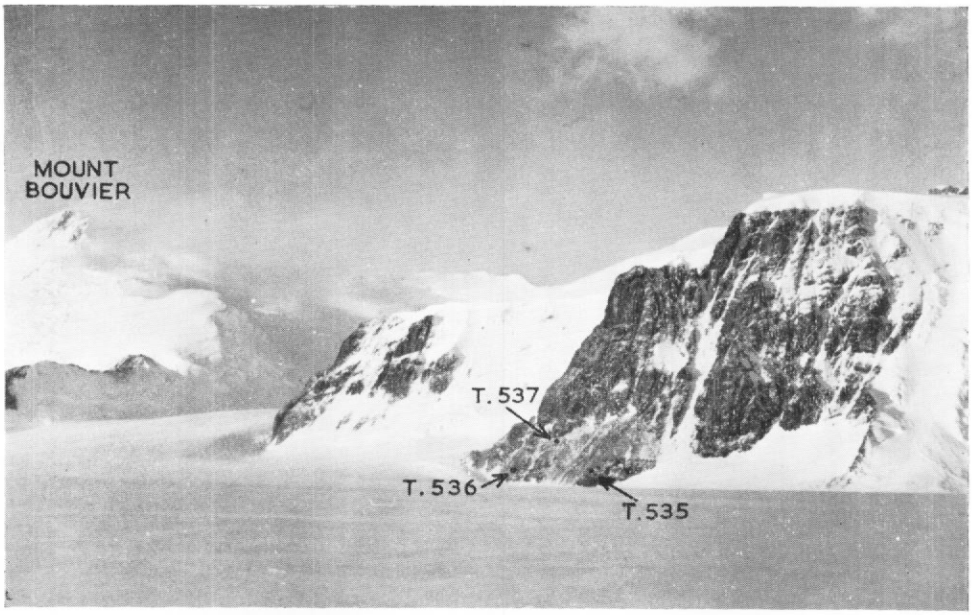

Fig. 2. The south-western corner of the Mount Bouvier massif showing the positions of the stations (T.535–37) from which the bivalves and ammonites were collected. The cliffs in the foreground are about 300 m. high and Mount Bouvier (left background) is about 2,070 m. (Photograph by C. M. Bell.)

umbo, and is ornamented with coarse concentric growth plicae. The only more or less complete right valve (Fig. 3b) is much flatter and is only slightly higher than long. It is preserved as an internal mould and is ornamented with growth striae which are crossed by feebly developed radial riblets, giving the concentric growth sections a crinkled appearance. Fragments of external mould have a similar ornament.

Because the anterior auricle of the right valve is incompletely preserved and the form of the ligament areas in both valves is unknown, it is not possible to make more than a tentative generic identification of the specimens. A trace of the anterior auricle of the right valve suggests that it was widely separated from the antero-dorsal margin of the shell. This feature and the fact that the concentric ornament is much better developed than the radial ornament are not diagnostic, but they are suggestive that the specimens are more likely to be a species of *Buchia* than *Aucellina*. There is also a striking similarity between the ornament of the present species and that of *Buchia subspitiensis* (Krumbeck, 1934, p. 442, pl. XV, fig. 7) from the Upper Jurassic of Misol.

In addition to *Buchia* (*?*) sp., two forms of *Inoceramus* are represented in the collection. The first (T.535.6; Fig. 3a) is a mytiliform species with a relatively long hinge line and coarse concentric growth plicae. The angle between its hinge line and the direction of maximum growth decreases with increasing size from about 45° near the umbo to about 30° at a shell length of 40 mm. It is considered to be conspecific with *Inoceramus* aff. *subhaasti* Wandel described from near Ablation Point, Alexander Island (Thomson and Willey, 1972, fig. 3). The Alexander Island specimen unfortunately lacks the posterior wing and thus it was not previously possible to orientate the specimen properly. Its probable conspecificity with the present one suggests that the Alexander Island example would also have had a long hinge line and a more acute direction of maximum growth than the true *I. subhaasti* (Wandel, 1936, pl. XV, figs. 1 and 2; pl. XVI, fig. 5a and b; pl. XVIII, figs. 1–3). The present specimen also lacks the projecting umbo of *I. subhaasti*. It is clearly not conspecific with Wandel's species, although it may be related to it, and therefore the cautious identification of the specimen from Alexander Island seems to have been justified.

Inoceramus sp. G, from the (?) Oxfordian of New Caledonia (Routhier, 1953, pl. II, fig. 7),

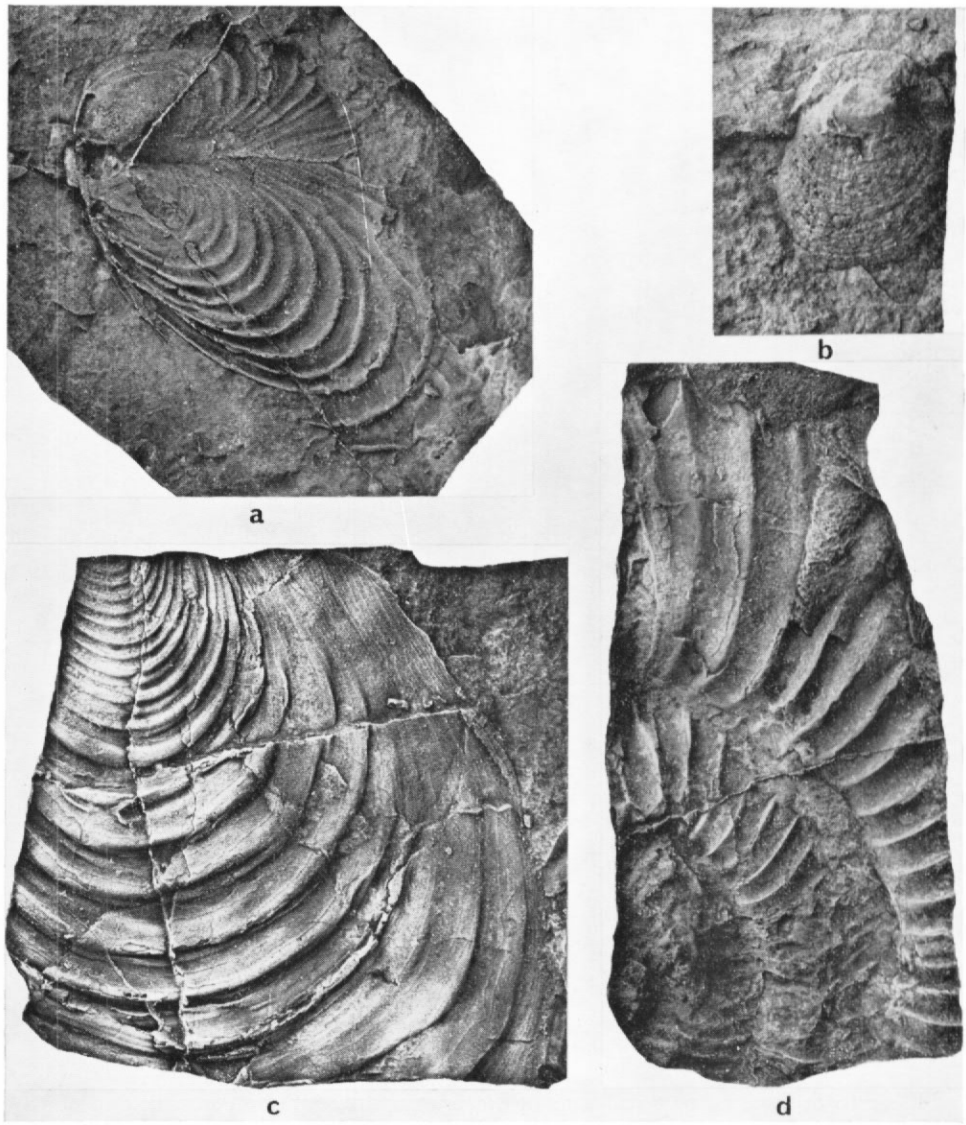

Fig. 3. a. *Inoceramus* aff. *subhaasti;* latex cast from the natural external mould of a pair of valves; × 1, coated (T.535.6).
b. *Buchia* (*?*) sp.; internal mould of a right valve; × 2, coated (T.535.1).
c. *Inoceramus* sp.; latex cast from a natural external mould; × 1, coated (T.535.10).
d. Latex cast from the natural external mould of a generically indeterminate perisphinctid ammonite; × 1, coated (T.537.1).

is another *subhaasti*-like specimen which lacks the postero-dorsal area of the shell. It appears to have been illustrated upside-down in Routhier's paper and the curve of its concentric plicae suggests a more oblique shell than in *I. subhaasti* proper, more like that of the present species.

The best example of the second species of *Inoceramus* (T.535.10; Fig. 3c) is an incomplete external mould of a large subquadrate to sub-circular individual. Its umbo is situated anteriorly, and behind this is an almost smooth, postero-dorsal wing-like area which merges with the feebly inflated main body of the shell. The ornament consists of coarse concentric plicae which

are finer and less prominent on the earlier (up to a height of 25 mm.) and postero-dorsal parts of the valve. Specimens T.535.11 and 12 each have one surface crowded with finely ornamented juveniles of this species. One of these (T.535.12) bears a pair of valves which are slightly displaced about the plane of commissure. The shell is equivalve and the umbones project beyond the hinge margin.

Identification of this species is hampered by the incomplete preservation of the best specimen and the strong flattening which all the specimens have undergone; the cracks visible on the illustration (Fig. 3c) were caused during fossilization and are not the result of fragmentation of the fossil during collection. It has several features of *I. haasti* Hochstetter (a relatively broad shell form, coarse adult ornament and a projecting umbo) but the plicae appear to be less prominent and more closely spaced than those of examples illustrated by Wandel (1936, text-figs. 4 and 5; pl. XIX and XX) from Indonesia and New Zealand.

Ammonoidea

Fig. 3d

Two species are present in the collection. The first (T.535.20 and 21) is a fragment of one whorl preserved in both internal and external moulds. It has an ornament of stout, closely spaced radial ribs and the arcuate form of the whorl is just perceptible, but it is too fragmentary to suggest even a tentative generic identification.

A second example (T.537.1; Fig. 3d), preserved in a dark brown tuff, is an external mould showing parts of four consecutive whorls. The shell form is multispiral and fairly evolute; there is a distinct ornament of bold, sharp distant ribs which have a triangular cross-section. The ribs curve concavely forwards as they rise from the umbilical seam and then lean gently forwards as they cross the flank towards the venter. Much of the ventral part of the outer whorl is missing but there is a suggestion that the third rib back from the aperture (counting along the umbilical margin) is branched, and one rib on the penultimate whorl is clearly bifurcate. A poorly defined rib, marking the apertural margin, appears to merge with the preceding one near the umbilical rim.

As with the previous specimen, it is not possible to identify this ammonite with any precision. However, the style of ribbing and the evolute coiling of the shell are suggestive of perisphinctid affinities and, in particular, they show general similarities with species of *Torquatisphinctes* and *Pachysphinctes* such as have been described from the Kimmeridgian of the Cutch, West Pakistan (Spath, 1931) and the Malagasy Republic (Collignon, 1959).

Trace Fossils

Associated with the marine shells described above are numerous trace fossils which appear as sinuous, worm-like burrow infillings, for the most part lying within the plane of the bedding. Dark-coloured tuffs (T.535.8–10 and 13) contain small varieties with dark cores and lighter-coloured rims like the vermicular structures described from Alexander Island (Taylor, 1967) and Adelaide Island (Thomson, 1969). When present in high concentrations they closely resemble Taylor's (1967, fig. 9f) example. The commonest type of trace fossil in the collection (T.535.6, 7 and 16–18) occurs in a pale grey tuff as white-weathering (or more rarely dark-coloured) vermicules about 1 or 2 mm. across and lying on bedding surfaces. These sub-horizontal burrows are probably unbranched but they sometimes appear to radiate from a centre; they lack the dark core of the types described above. Larger examples of the same kind of trace fossil (T.535.14 and 15) show up as brownish, horizontal burrow infillings in a light grey tuff. Again, these seem to radiate from a centre but in neither of the specimens can they be seen to anastomose.

Plantae

Fig. 4a and b

The best plant fossil yet collected from Adelaide Island is a *Ptilophyllum*-like frond (T.538.2; Fig. 4a) from the southern part of the Mount Bouvier massif. It is 65 mm. long and is preserved

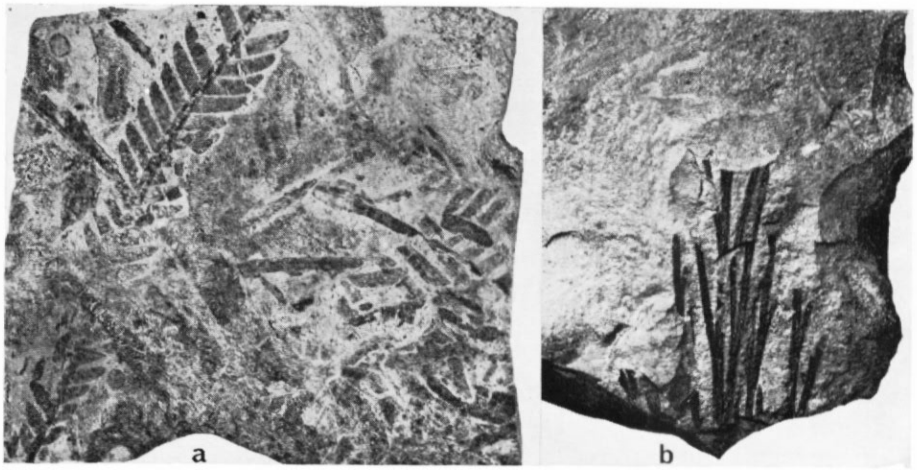

Fig. 4. a. *Ptilophyllum* (*?*) sp.; a frond in a crystal tuff; × 1 (T.538.2).
b. *Czekanowskia* (*?*) sp.; narrow bifurcating leaves with a single mid rib; × 1 (T.532.1).

as a greenish (? chloritic) film on a bedding surface in a crystal tuff. The pinnae are distant and appear to have more or less truncated bases attached to the top of the rachis. On a few pinnae there are indications of parallel elongate venation.

A hard, fine-grained buff to greyish tuff from a locality 8·5 km. west-south-west of Mount Liotard (T.532) contains considerable quantities of comminuted and carbonized plant debris on some bedding surfaces. Much of this is unidentifiable but one rock fragment (T.532.1; Fig. 4b) bears carbonized impressions of narrow strap-like leaves, with a single prominent mid rib, which bifurcate narrowly once or twice along their length. The specimen may be tentatively compared with *Czekanowskia* or some of the Ginkgoales with deeply dissected leaves (such as *Baiera*), although the lower part is missing and it is not possible to see if and how all of the leaves are joined at their bases. The single median rib suggests closest affinities to *Czekanowskia* (Harris, 1935, p. 48).

The remainder of the plant material from Adelaide Island comprises compressed and carbonized branch and twig fragments, and pieces of longitudinally striated material which may be the leaves of some kind of *Equisetites* (T.532.9). Collections from the Consort Islands (JB.257 and 373) and Noble Rocks (JB.259 and 260), in the eastern part of the Dion Islands (Fig. 1), contain large indeterminate carbonaceous compressions which presumably represent tree trunks. Examples up to 1 m. across were noted in the field.

Summary and Conclusions

Macro-invertebrate fossils are described from the Upper Jurassic Volcanic Group of Adelaide Island for the first time. These comprise Bivalvia (*Buchia* (*?*) sp., *Inoceramus* aff. *subhaasti* and *Inoceramus* sp.) and two indeterminate species of Ammonoidea. Trace fossils, broadly similar to those already described from Adelaide Island (Thomson, 1969), were found in association with the Mollusca. New discoveries of plant fossils along the western margin of the eastern mountain range of Adelaide Island have also been described in conjunction with more extensive collections from both new and previously known localities in the Dion Islands.

Volcanic rocks occurring throughout the Antarctic Peninsula have been correlated with the Upper Jurassic Volcanic Group on grounds of lithological and geochemical affinities. Even now, direct evidence for the age of this volcanic group is available at few localities and it has only been successfully dated radiometrically at Jason Peninsula (Adie, 1971). Despite the generally poor preservation of the fossils described here, they are good enough to give an indication of age and to confirm the Upper Jurassic age previously assigned to the volcanic rocks of Adelaide Island. The most useful fossils for this purpose are the species of *Inoceramus*,

one of which (*I.* aff. *subhaasti*) has also been found in Alexander Island where it was considered to be of Upper Oxfordian to Kimmeridgian age (Thomson and Willey, 1972). The second does not compare closely with known species of *Inoceramus* but it does show some similarities to the Upper Oxfordian–Kimmeridgian species *I. haasti;* it is distinctive enough to be recognized again should it be described from elsewhere. The buchiid bivalves are generically indeterminate but they have an ornament comparable to that of the Upper Jurassic *Buchia subspitiensis.* Neither of the ammonites is identifiable generically. One of them (T.537.1; Fig. 3d) could be interpreted as some form of Kimmeridgian perisphinctid.

From lithological considerations, Dewar (1970, p. 62) had already concluded that sediments within the volcanic sequence of Adelaide Island were deposited in a coastal environment. This suggestion was confirmed by the finding of marine trace fossils and micro-fossils near the Adelaide Island scientific station (Thomson, 1969) and is now reinforced by the discovery of marine bivalves and ammonites in tuffs of the Mount Bouvier massif. The presence of plant remains in these same tuffs emphasizes the proximity to land of the area of deposition.

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