FOSSILS FROM THE SOUTH ORKNEY ISLANDS: I. CORONATION ISLAND

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ABSTRACT. Poorly preserved marine fossils from the Gibbon Bay Shale and calcareous grit boulders in the Spence Harbour Conglomerate indicate a Mesozoic age. *Belemnopsis* (*?*) sp. indicates a probable Upper Jurassic–lowest Cretaceous age for the derived calcareous grit boulders. Bivalves from the Gibbon Bay Shale are undiagnostic but they are consistent with a Cretaceous age. There is no direct evidence for the age of the Spence Harbour Conglomerate on Coronation Island but it must be younger than the Gibbon Bay Shale and is probably Cretaceous.

IN 1957 D. H. Matthews collected some fragmentary fossils from the Gibbon Bay Shale at the eastern end of Coronation Island and from derived blocks of calcareous grit in the overlying Spence Harbour Conglomerate at Rayner Point (Fig. 1). Lithologically and petrographically

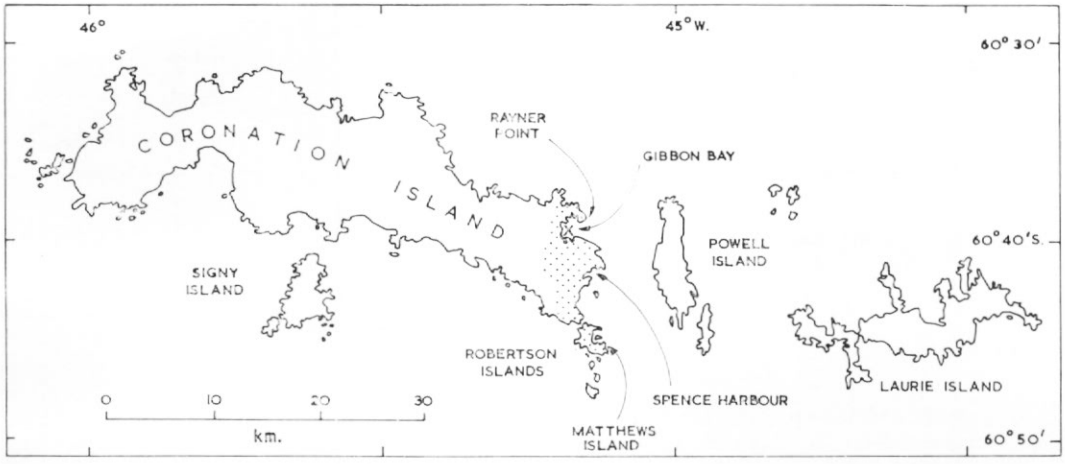

Fig. 1. Sketch map of the South Orkney Islands showing the probable extent of the Spence Harbour Conglomerate (stippled). Locality X is the collecting site for the Gibbon Bay Shale (after Thomson, 1973, fig. 18).

similar grit pebbles are incorporated in the Gibbon Bay Shale (Thomson, 1974) but no fossils have yet been obtained from them. The poor preservation of the fossils was far outweighed by their stratigraphical importance, and they have been frequently cited in geological descriptions of the South Orkney Islands (Adie, 1958, 1964; Matthews, 1959; Thomson, 1968, 1973, 1974). Over the years, these fossils have been examined by a number of experts, not all of whom were agreed on the identifications of individual specimens, although all concluded that they were Mesozoic in age. The fossils from the shales were generally regarded as Cretaceous, whereas those in the grit boulders were initially thought to be either Jurassic (Matthews, 1959, p. 434) or Cretaceous (Adie, 1958, p. 14). The aim of this note is to illustrate and briefly describe the better specimens, and to outline current thoughts on their age significance. A more recent collection, made by K. D. Holmes on Matthews Island (Thomson, 1971, p. 56), will be discussed in the second note of this series (Thomson, 1975).

SPENCE HARBOUR CONGLOMERATE

Three of the calcareous grit boulders, sampled by D. H. Matthews from the Spence Harbour Conglomerate at Rayner Point, contain identifiable fossils (Table I) including bivalves, belemnites and echinoid spines. The fossils are scattered through the rock and the bivalves also

TABLE I. FAUNAS OF THE CALCAREOUS GRIT BOULDERS

Boulder	*Specimen numbers*	*Lithology*	*Fauna*
1	H.1173.1–2 H.1186.3–14	Hard, grey gritty limestone	*Exogyra* sp. *Protocardia* (*?*) sp. *Belemnopsis* (*?*) sp. Echinoid spines
2	H.1332.1–5	Dark grey, calcareous sandy siltstone	*Entolium* sp. Oysters Bone fragments
3	H.1340.2a–f	Hard, coarse-grained calcareous grit. Shells form a coquina	*Oxytoma* sp. *Neithea* (*?*) sp. Oysters *Trigonia* (*?*) sp. (?) Echinoid spines

form thin coquinas, mostly as comminuted debris. The following forms have been identified among the larger fragments:

Oxytoma sp.
Entolium sp.
Neithea (*?*) sp.
Exogyra sp.
Trigonia (*?*) sp.
Protocardia (*?*) sp.
Belemnopsis (*?*) sp.
Echinoid spines.

Fragments here assigned to *Oxytoma* were overlooked in previous examinations. The two best specimens (H.1340.2d and e; Fig. 2a and b) are small internal and external moulds of right valves. The valve is flat and is only inflated in the region of the umbo. There is a long straight hinge line bordering the anterior and posterior auricles, the anterior one being small and spoon-shaped with a deep subauricular notch, whereas the posterior auricle is large, flat and wing-like. External ornament on the right valve is confined to feeble radial undulations. The left valve is not known with certainty, although it is probably represented by fragments with a typical oxytomid ornament of prominent widely spaced radial costae (Fig. 2a). This species shows a resemblance to several Neocomian *Maccoyella*s from northern Australia (Skwarko, 1966, pl. 6). *Maccoyella* is a characteristic Southern Hemisphere bivalve which has been recorded from South America, Australia and New Zealand, but not yet from Antarctica. However, an identification of the present species with *Maccoyella* is doubtful because of the long straight hinge line, with its horizontal rather than oblique anterior auricle, and the relatively wide subauricular notch (Fig. 2a and b).

Entolium occurs in a boulder of finer grain-size than those from which the other bivalves were obtained. Apart from small pieces of bone and possible ostreid shell fragments, it is the only identifiable fossil in the few small fragments available. The shell (Fig. 2c) has an apical angle of about 88° and has a smooth outer surface on which growth lines and faint radial striae are only visible under oblique lighting. Its auricles are limited dorsally by a straight line through the umbo and they are unequal in size; both have obtuse outer angles. Internally, there is at least one prominent auricular crus, on the side of the larger auricle.

Neithea is a doubtful identification which is based on fragments and one corroded external mould on specimen H.1340.2f. The fragments have an ornament, commonly found on *Neithea*-type pectinids, consisting of major radial costae with radial threads in the deeply grooved

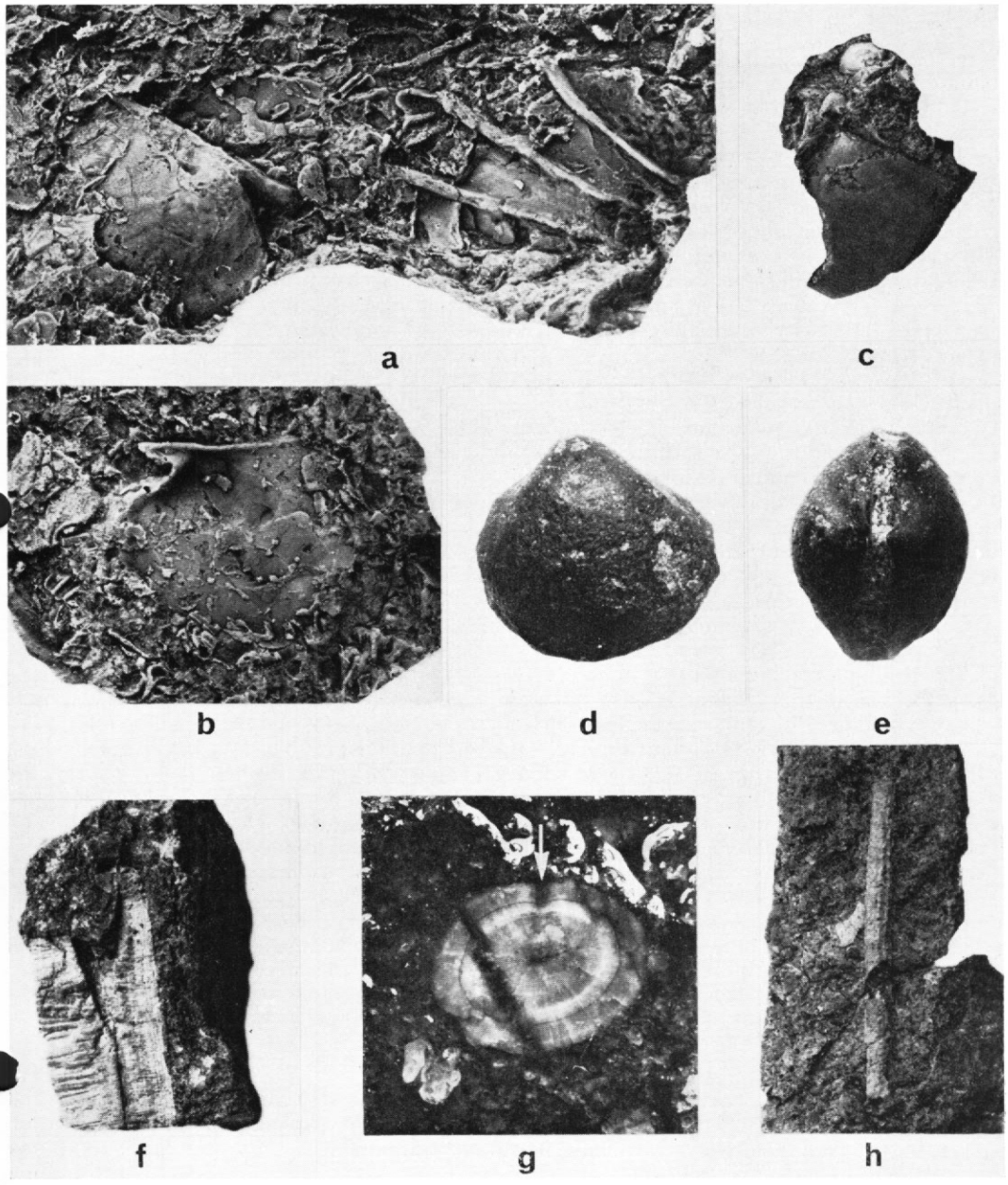

Fig. 2. Fossils from calcareous grit boulders in the Spence Harbour Conglomerate at Rayner Point.

a. *Oxytoma* sp.; latex cast from the external mould of a right valve (left) and an ornamented fragment of the left (right); × 4, coated (H.1340.2d).
b. *Oxytoma* sp.; latex cast from the internal mould of a right valve; × 4, coated (H.1340.2e).
c. *Entolium* sp.; latex cast from a fragmentary external mould; × 3, coated (H.1332.1).
d. *Protocardia* (*?*) sp.; lateral view of a discrete internal mould; × 3 (H.1186.11).
e. *Protocardia* (*?*) sp.; dorsal view of the same specimen as in Fig. 2d; × 3 (H.1186.11).
f. *Belemnopsis* (*?*) sp.; left lateral view of a fragment split longitudinally along the ventro-dorsal plane, displaying the alveolar cavity; × 2 (H.1186.9).
g. *Belemnopsis* (*?*) sp.; slightly oblique cross-section from the apical region of a guard showing the development of a median ventral groove (arrowed); × 4, under oil (H.1186.6).
h. Fragment of echinoid spine showing the poorly preserved external ornamentation; × 1·5 (H.1186.14).

intercostal areas. The external mould only shows the major costae but it has the sub-triangular shell outline found in *Neithea*.

Ostreid bivalves are recorded on the basis of thick fragments of shell with a laminar structure, and one specimen (H.1186.5) clearly indicates that some of these belong to *Exogyra s.l.* The specimen is an internal mould of the umbonal part of a shell, having an inflated form with a prominent curved umbonal carination; the area inside the carina is flattened. A small fragment of the thick laminar test is preserved on the counterpart (H.1186.4).

It is possible that some fragments on specimen H.1340.2f may represent a species of trigoniid. One poorly preserved internal mould is moderately inflated and has a narrow flattened triangular area along the posterior margin. This specimen has previously been compared to *Myophorella* (Willey, 1973) but further examination suggests that this is unlikely. Shell fragments, otherwise resembling those attributed to *Oxytoma*, have curved converging ribs similar to those of *Linotrigonia*.

The best-preserved specimen, yet in many ways the most difficult to identify, is H.1186.11, a discrete internal mould of a small inflated equivalve bivalve (Fig. 2d and e). The shell is sub-circular to triangular in outline with the umbones set slightly towards one end. Anteriorly, the margin is well rounded and curves smoothly into the ventral margin, whereas the postero-ventral corner of the shell is angular. No muscle scars are preserved on the internal mould and a fragment of the external mould (H.1186.13) is completely smooth. Without details of the dentition and surface ornament, it is impossible to identify this specimen generically. Although the shell shape resembles that of many of the Veneroida, it is possible to suggest widely differing relationships within that order, e.g. with *Thetis*, a Middle Cretaceous mactromyid, or *Protocardia*, a Mesozoic cardiid. Cox (1961, p. 26, pl. 4, figs. 3–5) has described a larger but almost smooth species of *Protocardia* (*P. wapeti*) from the Lower (?) Cretaceous of Western Australia. *Thetis* appears to be restricted to the Northern Hemisphere.

Apart from one undiagnostic fragment (H.1170.1) derived from the matrix of the conglomerate, all of the belemnites were obtained from one boulder. Several specimens show a characteristic development of a median ventral groove, indicating that they may be referred to *Belemnopsis* (*?*) sp. (e.g. H.1186.6; Fig. 2g). One fragment (H.1186.9), from the alveolar region of a moderately robust guard (split longitudinally along the ventro-dorsal plane), displays the alveolar cavity (Fig. 2f). Several partially preserved alveolar septa, about 5 mm. above the missing protoconch, show the development of an external siphuncle. The alveolus is acute and the protoconch is displaced ventrally. Although badly abraded, an incomplete cross-section in the upper stem region indicates an almost circular guard with a broad, shallow, *Belemnopsis*-like median ventral groove. Other fragments from stem and apical regions are slightly depressed.

The largest fragment of echinoid spine (H.1186.14; Fig. 2h) is about 31 mm. long and tapers from a diameter of 2·5 mm. to 1·9 mm. Surface ornamentation consists of longitudinal ribs, set about 1·3 mm. apart, and longitudinal threads (about 15 per mm.). An apparent tuberculation of the ribs and transverse grooving of the spine are believed to be the result of excessive corrosion. Cross-sections of the spines appear to be approximately oval.

Gibbon Bay Shale

With few exceptions, the fossils obtained from the Gibbon Bay Shale are fragmentary and very poorly preserved; from more than 70 fossiliferous shale chips collected, only about ten specimens are even tentatively identifiable. The fauna is limited to brachiopods, gastropods and bivalves, and includes the following forms:

Rhynchonellid (?) indet.	*Entolium* sp.
Gastropod indet.	*Exogyra* (*?*) sp.
Nuculana sp.	*Astarte* sp.

Except for some *Entolium* specimens, all of the fossils are extremely small and are typically only a few millimetres across. Fossils occur singly or in small groups and, when grouped, they are accompanied by an unusually high proportion of quartz grains and large mica flakes. Such associations are suggestive of concentration by current action.

Brachiopod remains are perhaps the most poorly preserved of any and are identified on the basis of their distinctive shell structure and coarsely costate ornament, similar to that on many

rhynchonellids (H.1169.14a and b). Shell fragments have a satin-like sheen and are composed of fine calcareous fibres variously aligned in the plane of the test.

The best gastropod (H.1169.38; Fig. 3a) is so small (about 1·3 mm. high) that it probably consists of little more than the protoconch and one complete whorl of the spire. An ornament of fine dense spiral threads is present on the largest whorl but the protoconch appears to be smooth. The aperture is not preserved and the specimen is probably not even generically determinable.

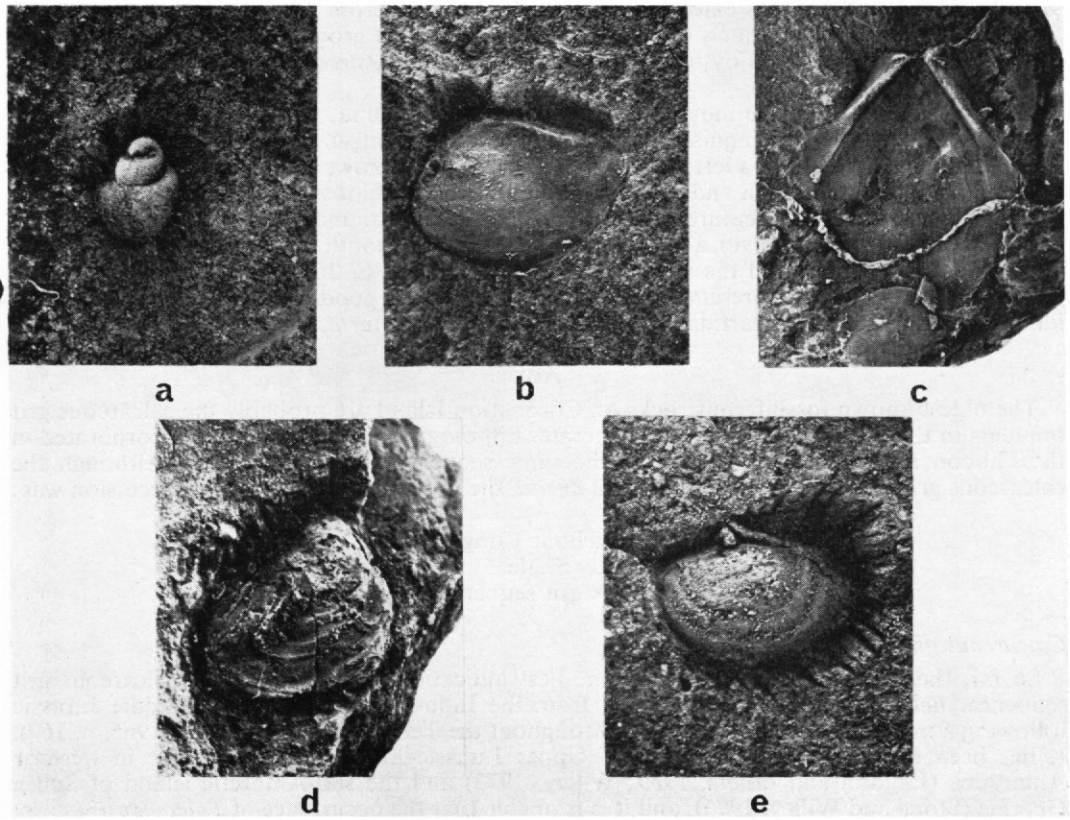

Fig. 3. Fossils from the Gibbon Bay Shale.
a. Minute indeterminate gastropod; × 10, coated (H.1169.38).
b. *Nuculana* sp.; left valve; × 8, coated (H.1337.2a).
c. *Entolium* sp.; latex cast from an internal mould showing details of the auricles; × 3 ,coated (H.1169.15).
d. *Exogyra* (*?*) sp.; right valve; × 8, coated (H.1169.16a).
e. *Astarte* sp.; internal mould of a left valve showing the dentition. Note that the positive features on the hinge plate represent sockets and *not* teeth; × 8, coated (H.1169.1a).

One of the most common species in the fauna is that referred to *Nuculana*. Several fragments have been recognized but only one more or less complete valve is preserved (H.1337.2a; Fig. 3b). It is 3·5 mm. long and 2·7 mm. high. Anteriorly, the valve is inflated and its margin is well rounded, but posteriorly it is more angular and slightly rostrate. Along the postero-dorsal margin there is a very narrow area separated from the main flank by a carination. In the postero-ventral sector of the shell, below this carination, the shell surface is slightly concave. Strictly speaking this species cannot be identified with the Nuculanidae, rather than with the Malletiidae, without proving the presence of a resilifer. However, the shell shape is more typical of the Nuculanidae. One specimen (H.1169.39a), which appears to be an internal mould

fragment of *Nuculana*, shows a row of small denticles along one margin, possibly representing remains of the taxodont dentition.

Entolium is the only species in the collection which reaches any size. The largest fragment (Fig. 3c) is 10 mm. across, has an apical angle of 80° and was probably about 12 mm. high. The external surface is smooth apart from an extremely faint ornament, like that of the species from the boulder in the Spence Harbour Conglomerate (Fig. 2c). Two specimens (H.1169.15 and 29) show details of the auricles. These have a horizontal dorsal margin or may be feebly projected above the umbo, and are separated from the disc by strong auricular crura. Each bears a sharply ridged cardinal crus extending about half the way across the auricle from the umbo.

A small (4 mm.) flat obliquely ovate valve with tightly bent growth ridges (H.1169.16a; Fig. 3d) belongs to some form of oyster. It may either be a small *Ostrea* or more probably the right valve of *Exogyra*.

Astarte appears to be the most common species in the fauna, perhaps because even small fragments are readily distinguished by their coarse concentric ribbing. One more or less complete internal mould of a left valve (H.1169.1a; Fig. 3e) shows details of the dentition. It is 3·2 mm. long, 2·5 mm. high and oval in outline; faint indications of coarse concentric ribs or folds are visible. The main features of the hinge plate are a prominent median triangular socket (for tooth 3b of the right valve), a long slightly bent posterior tooth (4b) with an elongate socket or ligament pit behind, and the suggestion of a small tooth (? 2b) in front of the triangular socket. Unfortunately, the preservation of this dentition is not good enough to make a confident identification within the Astartidae, and the generic name, *Astarte*, is used in a very wide sense.

Age

The oldest known fossiliferous rocks on Coronation Island are probably the calcareous grit boulders in the Spence Harbour Conglomerate. Lithologically similar pebbles incorporated in the Gibbon Bay Shale may belong to the same sequence (Thomson, 1974). Although the calcareous grits have not yet been mapped *in situ*, the probable stratigraphical succession was:

Spence Harbour Conglomerate
Gibbon Bay Shale
Calcareous grit sequence.

Calcareous grit sequence

So far, the belemnite fragments give the best indication of the age of the calcareous grit sequence. *Belemnopsis* was first reported from the Indo-Pacific area in the Middle Jurassic following a marked belemnite radiation throughout the Tethyan realm (Stevens, 1965, p. 169). It has been recorded from sediments of Upper Jurassic–lowest Cretaceous age in western Antarctica (Laudon and others, 1969; Willey, 1973) and the sub-Antarctic island of South Georgia (Stone and Willey, 1973), and it is probable that the occurrence of *Belemnopsis* (*?*) sp. in Coronation Island is of a similar age.

The bivalves can add little to this age estimate except that they are consistent with the range suggested. *Oxytoma s.s.*, to which the present species probably belongs, is not known to range above the Lower Cretaceous.

Gibbon Bay Shale

It is not easy to deduce the age of the Gibbon Bay Shale directly from its fauna. It is believed to be younger than the calcareous grit sequence (Upper Jurassic–lowest Cretaceous), and the characteristic bivalve, *Entolium*, is not known to range above the Cretaceous. Thus a Cretaceous age for the Gibbon Bay Shale seems most probable. In species of *Entolium* from the Lower Cretaceous of Alexander Island, the cardinal crura are set on a platform raised above the general surface of the auricles, whereas those of the present species are set directly on the auricles. Unfortunately, too little is known of the internal characters of *Entolium* to say whether these features may have any stratigraphical significance. If the overlying Spence Harbour Conglomerate is Middle to Upper Cretaceous in age (below), the probability is that the Gibbon Bay Shale is Lower Cretaceous.

Spence Harbour Conglomerate

No direct evidence for the age of the Spence Harbour Conglomerate on Coronation Island has yet been found. The only fossil recovered from the conglomerate matrix is a badly abraded belemnite guard fragment which is generically indeterminate. It is similar to those in the calcareous grit boulders and is probably derived. Stratigraphically, the conglomerate post-dates the Gibbon Bay Shale, and indirect fossil evidence from Matthews Island (Thomson, 1975) suggests a possible Middle to Upper Cretaceous age.

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