COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

RECORDS.

1959/37

LOWER ORDOVICIAN FOSSILS IN THE AREA OF BOULIA 4-MILE SHEET, QUEENSLAND

by

Joyce Gilbert-Tomlinson

LOWER ORDOVICIAN FOSSILS IN THE AREA OF BOULIA 4-MILE SHEET, QUEENSLAND.

by

Joyce Gilbert-Tomlinson

RECORDS 1959/37

CONTENTS

	Page
INTRODUCTION	1
NINMAROO FORMATION	1
Thickness and extent	2
Structural relationship with Upper Cambrian	2
Lithology and fossils	2
Age	4
Comparison with other areas	4
SWIFT BEDS	5
Thickness and extent	5
Structural relationship with Ninmaroo Formation	5
Lithology and fossils	5
Age	5
ORDOVICIAN PEBBLES IN MESOZOIC CONGLOMERATE	5
REFERENCES	6

LOWER ORDOVICIAN FOSSILS IN THE AREA OF BOULIA 4-MILE SHEET, QUEENSLAND.

by

Joyce Gilbert-Tomlinson

Records 1959/37

INTRODUCTION

Geological mapping of Boulia 4-mile Sheet, western Queensland, was carried out in 1957 by the Georgina Geological Party (leader J.N. Casey). Two formations of Ordovician sediments have been recognized - the Ninmaroo Formation and the Swift Beds. They constitute the most easterly known exposures of fossiliferous Ordovician in northern Australia.

Both formations are lower Ordovician in age. The Ninmaroo Formation is essentially Tremadocian, although its uppermost part may be early Arenigian; the Swift beds are early, but not initial, Arenigian. Late Arenigian and younger Ordovician fossils are not known to occur in situ in the area, but a pebble containing younger Ordovician fossils has been collected from a conglomerate that is considered to be Mesozoic (Cretaceous) in age.

The Ninmaroo Formation rests with apparent conformity on late Upper Cambrian limestone (Chatsworth Limestone) in the Black Mountain section; the Swift Beds are unconformable on the Ninmaroo Formation at Digby Peaks, but no angular discordance can be detected between the two formations in the area west of Black Mountain.

The fossils of the Ninmaroo Formation are well preserved. Those of the Swift Beds are mostly too fragmentary for determination, but comparatively well-preserved material has been secured from this formation at Digby Peaks by Mr.D.J. Taylor, palaeontologist to Frome-Broken Hill Pty.Ltd. The fossils include a graptolite, and, in order to present as complete a picture as possible of the Ordovician faunas of the Boulia area, advance notice of this first discovery of Ordovician graptolites in Queensland is incorporated in this report.

Few Ordovician fossils are described from northern Australia, and none at all from Queensland. The fossil identifications are therefore tentative, and the generic names here cited may be changed when the fossils are systematically studied.

NINMAROO FORMATION

The Ninmaroo Formation was first recognized, and named, by Whitehouse (1936, p.69), who recorded the presence of ellesmeroceroid nautiloids, echinoderm ossicles, and an orthoid brachiopod in the Black Mountain section. He concluded that the "Ninmaroo limestones" were Tremadocian in age.

Thickness and extent.

The Ninmaroo Formation, as mapped by the Georgina Geological Party, is about 2,000 feet thick. It is typically exposed in the folded and faulted country of Mt.Ninmaroo and Black Mountain (the Burke River Structures), where its lower contact with the underlying Upper Cambrian limestone is exposed in anticlinal cores. The upper contact against the overlying Swift Beds is also exposed in the Black Mountain section, on the western side of the mountain.

The above-mentioned exposures are part of a long belt stretching from Mt.Merlin/Signal Hill Ridge in the north to Mt.Datson and Dribbling Bore in the south. They form the eastern edge of a very large rock body, extensively developed on Glenormiston Sheet (west of Boulia Sheet) and from there extending north onto Urandangi Sheet and south onto Mt.Whelan Sheet. Near the Queensland/Northern Territory border the formation disappears under the younger Ordovician sediments of the Toko Range Syncline (Toko Group), and re-emerges in the Northern Territory. The most westerly known exposure occurs at Burnt Well (Tobermory Sheet), west of the Toko Range. Farther west still, in the area of the Dulcie Range (Huckitta Sheet), the formation cannot be recognized, and is apparently replaced by sandstone containing a different fauna.

The thickness of 2,000 feet mentioned above refers to the Black Mountain section. The formation is about 1,200 feet thick in the Glenormiston exposures (Casey in Condon, 1958), and is probably even thinner in the Northern Territory, although no measurements are at present available for the western exposures.

Structural relationship with Upper Cambrian.

In the Black Mountain and Mt.Ninmaroo sections, the Ninmaroo Formation rests with apparent conformity on late Upper Cambrian limestone (upper part of Chatsworth Limestone). The Chatsworth Limestone in the Black Mountain is about 900 feet thick. It contains several horizons of late Upper Cambrian (Trempealeauan) trilobites, of a dikelocephalid (saukiine) fauna unique in Queensland but comparable with trilobites in the Upper Cambrian sandstones of central Australia - for example, the Ross River (Öpik, 1956) and the Huckitta area (Casey & Tomlinson, 1956). Orthoid brachiopods similar to those of the Huckitta area also occur in this upper part of the Chatsworth Limestone, but, unlike the central Australian sandstones, the Chatsworth Limestone contains no ribeirioids.

At present, the boundary between Cambrian and Ordovician is drawn between the highest trilobite bed and the lowest nautiloid bed, at a thin but prominent bed of dolomite. Between the two fossil horizons is a 200-foot sequence of sediments without diagnostic fossils. The boundary, as at present drawn, is convenient for mapping, but future study of the fauna of the uppermost trilobite bed in the Black Mountain section may necessitate an adjustment ofthe actual time-boundary.

Lithology and fossils.

Two main rock types are present in the Ninmaroo Formation: (i) a dark grey mottled limestone with softer interbeds, and (ii) a yellowish- or greyish-white limestone, consisting mainly of discrete echinoderm ossicles. The mottled limestone has a very high clastic fraction, as can be seen when the fossils are etched. In the Black Mountain section the mottled limestone is dominant in the lower part of the sequence, whereas the

lighter-coloured echinoderm limestone is confined to the upper part. Elsewhere, the stratigraphic relationship of the two rock types is less straightforward, and it is possible that they merely reflect different environments, and have no particular stratigraphic significance.

(i) In addition to Black Mountain, notable localities for the dark mottled limestone are Noranside Station (B 401), Digby Peaks (B 11, B 527), and Signal Hill Ridge (D 130), on the boundary between Boulia and Duchess Sheets. The fossils are almost invariably silicified.

The commonest fossils belong to three animal groups: gastropods, nautiloids, and ribeirioids. Preliminary examination indicates that these fossils are represented by numerous individuals of relatively few species. Gastropods are represented by large opercula resembling, but probably not strictly identical with, Ceratopea Ulrich. Probably two distinct genera are included under this name. No large shells that would fit these opercula have been noted in the Black Mountain section (see Yochelson & Bridge, 1957), but another genus, resembling Scaevogyra Whitfield, is present; it seems to be confined to a single bed (B 515 B). As noted by Whitehouse (loc.cit.), the nautiloid cephalopods are ellesmerocceroids. Several forms are present, but they have not yet been studied in detail. Three genera of ribeirioids are present: Eopteria Billings, Euchasma Billings (2 species), and, in higher levels, cf. Ribeiria Sharpe.

Other groups are rare, both in species and individuals. Brachiopods are represented by the syntrophioids Huenella Walcott and Syntrophinella Ulrich & Cooper (or Tetralobula U. & C.); monoplacophorans by Proplina Kobayashi and cf. Archinacella Ulrich & Schofield; trilobites by a leiostegiid (perhaps a new genus) and a possible asaphid (indet.); and echinoderms by cystid "roots". Calcareous algae occur as thin interbeds on Black Mountain (B 515A) and at Digby Peaks (B 527); the cell-structure (filaments) has been observed.

(ii) The light-coloured echinoderm limestone is characteristically developed in the upper levels of the Black Mountain section, on the western side (B 515 I, B 515 L, B 518). Some silicification is apparent, but it is by no means universal. Surface silicification is not uncommon.

At the above-mentioned localities, discrete echinoderm ossicles constitute the greater part of the rock. No complete calices have been found. Of other groups, the commonest fossil is an orthoid brachiopod externally resembling the Finkelnburgia of the overlying Swift Beds (q.v.); it is commonly associated with the echinoderm ossicles to the exclusion of other fossils. Elsewhere, at the Swift Hills and in the upper levels at Digby Peaks, for example, orthoids and echinoderms are associated with "Ceratopea" and nautiloids resembling those of the dark mottled limestone. Loc.B 230 (Swift Hills) also contains a fragmentary fossil which may be an undescribed ribeirioid or even a pelecypod. The only identifiable trilobite is an undescribed kainellid (at B 171, 8½ miles north of Black Mountain, and at B 72, 6½ miles south-east of Digby Peaks). At B 171, this trilobite is associated with an undescribed ostracod.

Age

The Ninmaroo faunas are "Pacific" in aspect and can be dated as lower Canadian by the North American scale. This is roughly equivalent to Tremadocian of the European scale. The ostracod at Loc.B 171 suggests an early Arenigian age for the uppermost part of the formation.

Exact dating of the bulk of the formation, and particularly of its lower part, in terms of the standard European section is not possible, mainly because of the lack of fossils common to the Pacific and European sequences. The Eopteria-Ceratopea association suggests that basal Canadian (and therefore basal Ordovician as understood in North America) is not represented in the Ninmaroo Formation (Twenhofel et al., 1954), and this inevitably prompts the question: "Is there a faunal break between Cambrian and Ordovician in the Black Mountain section?".

No unequivocal answer can yet be given. In the first place, future study may prove that the uppermost trilobite bed, now dated as late Upper Cambrian, should instead be assigned to the earliest Ordovician. On the other hand, the fauna of this bed may still be Cambrian in age and the basal Ordovician may be represented by the almost-unfossiliferous 200-foot interval immediately above it.

Finally, it is by no means certain that the Cambrian-Ordovician boundary of the Pacific scale coincides exactly with that of the European scale. Hence, the Eopteria-Ceratopea fauna may be older than shown on the North American Ordovician Correlation Chart (Twenhofel et al., loc.cit.)

Faunal evidence for a break is thus inconclusive at present. Nevertheless, the composition of the faunas, as well as the lithology, indicates a marked change in environment during the course of deposition of the Black Mountain sequence. There is a striking contrast between the "dirty" Ordovician limestone with abundant ribeirioids and almost no trilobites and the comparatively clean Cambrian limestone with abundant trilobites and no ribeirioids. It strongly suggests tectonic unrest in late Upper Cambrian or early Ordovician time, and the possibility of a consequent elision of faunas cannot be neglected.

Comparison with other areas

Among the known Tremadocian formations of northern Australia, the Ninmaroo is unusual both in lithology and fauna. It is the only known Tremadocian carbonate sequence; in central Australia (the MacDonnell Ranges and the Dulcie Range, for example) the Tremadocian is represented by sandstones containing different trilobites and ribeirioids.

The Ninmaroo Formation provides the only Australian records of Eopteria and Ceratopea, and the only concentration of ellesmeroceroids. In the wealth of ellesmeroceroids it is comparable with occurrences in eastern Asia, North America, and the Arctic. In composition the faunas are very similar to those of the Wanwanian Series of southern Manchuria (Kobayashi, 1933) and the Beekmantown Group of North America (Sando, 1957).

SWIFT BEDS

The Swift Beds were named by the Georgina (1957) Geological Party (Casey, 1958).

Thickness and extent

The formation is about 60 feet thick. The main occurrences are in the Swift Hills; at Digby Peaks, where the hills of this name are composed of Swift Beds; and on the western side of Black Mountain. The Kelly Creek Formation of Glenormiston Sheet and the Toko Range is to be correlated with the Swift Beds and probably the two formations are part of the same rock body. Farther west, in the Dulcie and Tarlton Ranges, for example, the formation hasnot been identified.

Structural relationship with Ninmaroo Formation

At Digby Peaks the Swift Beds rest with a marked unconformity on the Ninmaroo Formation; elsewhere, no angular discordance can be detected.

Lithology and fossils

The main rock-type is an impure limestone, recrystallized and commonly silicified, containing abundant fragments of fossils which are mostly indeterminable. An interbed of pink siltstone containing comparatively well-preserved fossils occurs at Digby Peaks.

In the limestone, the commonest fossil is the brachiopod Finkelnburgia Walcott (or a closely related genus); other fossils include syntrophioid brachiopods, gastropods, nautiloids, possible ribeirioids, asaphid and kainellid trilobites, and echinoderm ossicles.

The fossils in the pink siltstone were collected by Mr.D.J. Taylor; they include a kainellid trilobite (probably a new genus), an asaphid trilobite, and a graptolite identified by Mr.Taylor as Sigmagraptus cf. laxus (T.S.Hall)(personal communication).

Age. Sigmagraptus laxus is a Victorian species of the Bendigonian Stage, which is dated as early, but not initial, Arenigian (lower part of the zone of Didymograptus extensus). Approximately the same age can be derived from the shelly fossils of the formation and its correlate, the Kelly Creek Formation (Casey in Condon, 1958) of the Toko Range. As far as can be determined, the fossils of the Swift Beds are similar to those of the upper part of the Ninmaroo Formation and suggest that, in spite of the spectacular unconformity at Digby Peaks, the time-interval between the deposition of the two formations was short.

ORDOVICIAN PEBBLES IN MESOZOIC CONGLOMERATE

Pebbles containing Ordovician fossils have been collected at one locality on Boulia Sheet and at another on Glenormiston Sheet. They both occur in the basal conglomerate of the Cretaceous Longsight Sandstone.

The Boulia material consists of a single pebble of sandstone in scree on the south-western side of Black Mountain, overlying the Swift Beds (B 519 A). It contains numerous indeterminate pelecypods, a gastropod resembling Helicotoma Salter, and fragments of asaphid trilobites. It is probably derived from the Nora Formation of the Toko Group, which is provisionally dated as late Arenigian to early Llanvirnian (passage from lower to middle Ordovician).

The Glenormiston material (Roxborough Downs, G 300) consists of two lithologies, each with its own fauna. The first is a sandy limestone with chert blebs, containing a possible Raphistomina, another gastropod (indet.), a fragmentary endoceroid nautiloid, and the ribeirioid Euchasma. It is probably derived from the Kelly Creek Formation, the Toko equivalent of the Swift Beds. The second is a sandstone, containing the pelecypod Ctenodonta, an indeterminate gastropod, two undescribed asaphid trilobites, and another trilobite, possibly a bathyurid. The trilobites are typical of the Nora Formation.

REFERENCES

CASEY, J.N., 1958 - Summary of activities, 1957, Georgina Basin area. Bur.Min.Resour.Aust., Rec.1958/3 (unpubl.)

CASEY, J.N., and TOMLINSON, Joyce Gilbert-,1956 - Cambrian geology of the Huckitta-Marqua region, N.T. N.T. CAMBRIAN SYMPOSIUM, 20th int.geol. Congr., Mexico, part II, p.55.

CONDON, M.A., 1958 - Summary of activities, sedimentary basins, 1958. Bur.Min.Resour.Aust. Rec.1958/116 (unpubl.)

KOBAYASHI, T., 1933 - Faunal study of the Wanwanian (basal Ordovician) series with special notes on the Ribeiridae and the ellesmerocceroids. J.Fac.Sci.Imp.Univ.Tokyo, sec.II, 3,249.

"OPIK, A.A., 1956 - Cambrian geology of the Northern Territory. CAMBRIAN SYMPOSIUM, 20th int.geol.Congr., part II, p.25.

SANDO, W.J., 1957 - Beekmantown Group (Lower Ordovician) of Maryland. Geol.Soc.Amer., Mem.68.

TWENHOFEL, W.H.,et.al., 1954 - Correlation of the Ordovician formations of North America. Bull.geol. Soc.Amer.,65, 247.

WHITEHOUSE, F.W.,1936 - The Cambrian faunas of north-eastern Australia, Parts I and II. Mem.Qld.Mus., 11, 59.

YOCHELSON, E.L. and BRIDGE, J.,1957 - The Lower Ordovician gastropod Ceratopea. U.S.geol.Surv., Prof.Pap. 294-H.