COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1963/90

POSSIBLE TERTIARY MARINE FOSSILS FROM THE BRUNETTE LIMESTONE, BARKLY TABLELAND, NORTHERN TERRITORY.

by

A.R. Lloyd

POSSIBLE TERTIARY MARINE FOSSILS FROM THE BRUNETTE LIMESTONE, BARKLY TABLELAND, NORTHERN TERRITORY

by

A.R. LLOYD

RECORDS 1963/90.

CONTENTS

POSSIBLE TERTIARY MARINE FOSSILS FROM THE BRUNETTE LIMESTONE, BARKLY TABLELAND, NORTHERN TERRITORY

SUMMARY

A sample of richly fossiliferous limestone, conglomeratic in parts, from the Brunette Limestone, Barkly Tableland, Northern Territory, was examined to determine its age and environment of deposition. Gastropods, pelecypods, foraminifers and an ostracode were freed from the matrix for study. The rock is probably not older than Lower Miocene and not younger than Pliocene. From the fossil evidence, it is considered that the sample of limestone was deposited in a shallow water marine, lagoonal or brackish water environment near a freshwater source. These environments are found in the seas near river mouths or in near shore salt water lagoons with freshwater inlets. The Brunette Limestone, has previously been considered to be lacustrine in origin (Randal and Brown, 1962), therefore the presence of these marine organisms could be explained by a small marine transgression entering this lacustrine environment. However, the isolated nature of the outcrop does not allow a definite conclusion to be reached.

INTRODUCTION

One sample, B.M.R. F.22380 (Field No. BT169), from the Brunette Limestone, Barkly Tableland, Northern Territory, was submitted by M.A. Randal and R.A.H. Nichols for palaeontological examination. The rock, a limestone, conglomeratic in parts and very rich in molluscs, is almost a coquinite. The sample was collected on the Rockhampton Downs - Anthony Lagoon road, two miles at 038°T from No. 18 bore, 28.5 miles at 019° from Rockhampton Downs Homestead (Randal and Nichols, 1963).

Foraminifers were recognised in a thin section of the rock. Fine material collected from excavations around molluscan specimens was washed for microfossils and yielded numerous foraminifers and an ostracode.

OBSERVATIONS

The fossils found are:

Gastropoda:

An evolute, planispiral form similar to Planorbina, a freshwater genus (Davies, 1935, p.328, fig. 501). Similar evolute, planispiral genera are found in the marine environment e.g. Zertula (Powell, 1946, pl.19, figs. 14,15), but the specimen, although slightly damaged, appears to be closer to Planorbina.

A number of specimens, all of which are broken or damaged, are similar to the figured specimens of Lanistes and Diastoma (Davies, 1935, p.252, figs. 353 and 360 respectively). These genera are marine in habitat. Specimens similar to these were observed from cuttings from the top 280 feet of Beachport No.1 Well, South Australia. Ludbrook (1962) considered this interval to be Pleistocene to Recent in age and marine in origin.

Pelecypoda:

A number of specimens of pelecypods are present. They are either broken or infilled with matrix, making close study difficult. Some of the specimens are similar in shape and ornamentation to the figures of Nucula (Davies, 1935, p.132, fig. 172 and Ludbrook, 1955, pl.1, figs. 1-4 and pl.6, fig.1). The dentition consists of long lateral tooth, crossed by numerous fine striations or ridges, on each side of the umbo, and is similar to that shown on the figure of Legrandina turneri (see Powell, 1946, pl.25, fig.7). The fine striations or ridges simulate taxodont dentition. No teeth can be seen under the umbo because of the preservation. The pelecypods seem to be closer to marine genera than to freshwater genera and suggest a marine environment.

Foraminifera:

Numerous small specimens (the largest being 0.3 mm. in diameter) of Ammonia beccarii (Linne) were picked from the washings. This species, placed in the genera Rotalia and Streblus by some workers, has a widespread distribution in shallow water marine and shallow coastal and lagoonal brackish water environments today (Phleger, 1960; Todd, 1958; and LeRoy, 1941). It ranges from the Middle Miocene to the Recent (LeRoy, 1941, p.117; and Agip Mineraria, 1957, pl.41) and it has been observed in possible Lower Miocene rocks from New Britain.

Ostracoda:

One ostracode specimen was picked from the washings. P.J. Jones (in Appendix 1 to this report) identified it as a species of Haplocytheridea Stephenson, 1936, which he tentatively compared with H. okaloosensis (Stephenson), 1938, from the Middle Miocene of Florida. Jones concludes that Haplocytheridea indicates shallow water conditions in either a marine, estuarine, or brackish lagoonal environment. It indicates an age between Upper Cretaceous and Recent.

DISCUSSION

Randal and Brown (1962) considered that the Brunette Limestone was deposited in a series of freshwater or brackish water lakes and that the environment and lithology are similar to the Austral Downs Limestone which Noakes, Carter and Opik (1959, p.11) said was lacustrine in origin.

The following previously recorded occurrences of marine organisms, both living and fossil, in what are or considered to have been non-marine environments, are listed in order to give some possible explanation for this occurrence of marine organisms in an area in which the Tertiary has been previously regarded as non-marine.

Paten (1960, 1961) recorded algae, rare ostracods and "rotaline and globigerine foraminifer" from the Austral Downs Limestone outcropping on Roxborough Downs, north-west Queensland.

Ludbrook (1953), in her report on the sub-Recent sediments from Lake Eyre, South Australia, recorded a freshwater or brackish water gastropod, "probably Coxiella sp." from a "hard compact freshwater dolomitic limestone". This limestone is overlain by clay, above which there is a shell bed consisting mainly of the gastropod Coxiella gilesi (Angas). Throughout the sediments she recorded "oogonia of Chara, a freshwater or brackish-water plant, - - - - ; one species of ostracod belonging to the genus Cypris;

and calcified tests of a form of the brackish-water foraminifer '<u>Rotalia</u>' <u>beccarii</u>. - - - - In addition, isolated specimens of three foraminifera, <u>Cibicides</u> <u>refulgens</u> (Montfort), (?)<u>Elphidium</u> <u>advenum</u> (Cushman), and (?) <u>Nonion</u> <u>scapha</u> (Fichtel and Moll), - - - - and one ostracode belonging to the shallow-water marine species <u>Pontocypris attenuata</u> Brady, were recovered".

Howchin (1901) recorded foraminifers belonging to the genus <u>Elphidium</u>, ostracods and gastropods from the silt from the saline Yorktown Lagoon, South Australia. The forms, he said, were characteristically estuarine or shallow water marine in habitat in South Australia.

Gauthier-Lievre (1935) recorded foraminifers, both calcareous and arenaceous species, living in inland saline waters of the Algerian Sahara Desert.

Arnal (1961) described foraminifer, again both calcareous and arenaceous species (some similar to those recorded by Howchin (1901) and Ludbrook (1953)) living in the Salton Sea, Colorado Desert, California, where they were accidentally introduced, presumably by aeroplanes. The foraminifers are types which can tolerate a wide range of salinity, pH., and temperature and thus able to survive. They include a form close to <u>Ammonia</u> <u>beccarii</u>.

Bradshaw (1957) (quoted in Phleger, 1960, p.109) reported on his stidies of <u>Ammonia</u> <u>beccarii</u> in cultures in the laboratory. He found that this species had normal growth and reproduction in salinities between 20,000 p.p.m. and 40,000 p.p.m. Above and below these limits growth and reproduction activity fell off until growth finally ceased at salinities higher than 67,000 p.p.m. or lower than 7,000 p.p.m. Reproduction occurred only at salinities between 13,000 p.p.m. to 40,000 p.p.m. The salinity of most of the oceanic water is about 33,000 p.p.m. to 36,500 p.p.m. (Pleger, 1960, p.18). This showed that <u>A</u>. <u>beccarii</u> can tolerate brackish and saline waters as well as normal sea water.

Glaessner (1945, p.190-191) says "The overwhelming majority of foraminifera are adapted to normal salinity and cannot exist under conditions of a higher or lower salt-content in the sea water. A characteristic small group of species is found in brackish water. One of the most common brackish water species, which, however, is not restricted to this environment, is <u>Rotalia</u> <u>beccarii</u> Linne." He goes on to list recorded occurrences of foraminifers in non-marine environments including that of Gauthier-Lievre and concludes by saying "It is assumed that these faunas are survivors from the time when these areas were covered by the late Tertiary seas." Cushman (1955, p.46) similarly mentioned that these waters are supposed to be remnants of an old Miocene sea. Gauthier-Lievre (1935) could not find a reason for the occurrence of the foraminifers in the inland saline waters but discounted the possibility that birds were responsible for their introduction because of dessication en route. Cushman (1955, p.46) mentions the report of foraminifer from springs in the desert of Kara-kum, Central Asia, by Brodsky who said emphatically that birds did not transfer them from the ocean.

Howchin (1901) thought that birds might have been responsible for the introduction of the foraminifers etc. into the saline lakes of Yorke Peninsula, South Australia. He went on to say, however, that some of the scattered saline areas could be explained as remnants of a retreating sea because the land had risen several feet since the Tertiary. Ludbrook (1953) did not commit herself on the origin of the foraminifers etc. in the Lake Eyre sediments, but she did not think their presence necessarily meant a marine environment. She did mention, however, that birds might have been responsible for carrying the foraminifers from Spencers Gulf to Lake Eyre via Lake Torrens. Paten (1961) thought that the association of the foraminifers with freshwater ostracods and charophyte algae indicated a brackish, continental environment for the deposition of the Austral Downs Limestone, basing his ideas on Glaessner (1945) and Ludbrook (1953).

From the above occurrences, it can be seen that some normally marine or brackish water foraminifers can exist in inland saline waters. In the case of the Salton Sea, California, the method of introduction is presumed to be known, but the method of introduction of the foraminifers in the other places such as the Sahara Desert is not known. Glaessner's assumption that these foraminifers are survivors from the time when the seas covered these areas seems to be a logical explanation for the introduction of the foraminifers into these now non-marine environments.

A study of a topographic map of South Australia shows that only a small rise in sea level would have been sufficient to introduce the foraminifers and the marine ostracode into Lake Eyre from Spencers Gulf via Lake Torrens in sub-Recent times.

CONCLUSIONS

The gastropods from the sample of Brunette Limestone, with the exception of the possible Planorbina which indicates a freshwater environment, appear to be closer to marine species; the pelecypods also seem to be closer to marine species. The ostracode belongs to a genus which indicates a shallow water marine, estuarine, or brackish lagoonal environment (Jones in Appendix I to this report). From this evidence, together with the foraminiferal evidence, it is considered that this sample of limestone was deposited in a shallow water marine, lagoonal or a brackish water environment near a freshwater source. These environments are found in the sea near river mouths or in near shore salt water lagoons with fresh water inlets. The environment of the Brunette Limestone has previously been considered to be lacustrine, therefore the presence of marine organisms could be explained by a small marine transgression entering this lacustrine environment. The age of the sample is probably not older than Lower Miocene and not younger than Pliocene. To account for the present height of 720 feet above sea level, the area could have been uplifted in Miocene or Pliocene times. The isolated nature of the outcrop from an area which was previously considered to have been non-marine in Tertiary times, does not allow a definite conclusion to be reached. A more detailed search for and study of the faunas from the Tertiary deposits of Northern Australia would give more information on which to base a conclusion.

REFERENCES

AGIP MINERARIA, 1957 - Foraminifera Padani (Terziario e Quaternario) Atlante Iconografico e Distribuzione Stratigrafica. Agip Mineraria, Milan.

ARNAL, R.E., 1961 - Limnology, Sedimentation, and Microorganisms of the Salton Sea, California. Geol.Soc.Amer.Bull. 72, 427-478.

BRADSHAW, J.S., 1957 - Laboratory studies on the rate of growth of the foraminifer, "Streblus beccarii (Linne) var. tepida Cushman". Journ.Paleontology, 31, 1138-1147.

CUSHMAN, J.A., 1955 - FORAMINIFERA, THEIR CLASSIFICATION AND ECONOMIC USE. Harvard University Press.

DAVIES, A.M., 1935 - TERTIARY FAUNAS Vol.1, The Composition of Tertiary Faunas. London, Thomas Murby & Co.

EAMES, F.E., BANNER, F.T., BLOW, W.H., and CLARKE, W.J., 1962 - FUNDAMENTALS OF MID-TERTIARY STRATISGRAPHICAL CORRELATION. Cambridge University Press.

GLAESSNER, M.F., 1945 - PRINCIPLES OF MICROPALAEONTOLOGY. Melbourne University Press.

HOWCHIN, W., 1901 - Suggestions on the Origin of the Salt Lagoons of Southern Yorke Peninsula. Trans.Roy.Soc.South Aust. 25(1), 1-9.

LEROY, L.W., 1941 - Small Foraminifera from the Late Tertiary of the Nederlands East Indies. Colorado School of Mines Quart. 36(1).

LUDBROOK, N.H., 1953 - Foraminifera in Sub-Recent Sediments at Lake Eyre, South Australia. Aust.Journ.Sci., 16(3), 108-109.

LUDBROOK, N.H., 1955 - The Molluscan Fauna of the Pliocene Strata underlying the Adelaide Plains. Part 2 - Pelecypoda. Trans.Roy.Soc.South Aust., 78, 18-87.

LUDBROOK, N.H., 1962 - Subsurface Stratigraphy and Micropalaeontological Study. Appendix 2, in Completion Report, South East Oil Syndicate Ltd, Beachport No.1 Well (unpubl.).

NOAKES, L.C., CARTER, E.K., and OPIK, A.A., 1959 - Explanatory notes on the Urandangi 4-mile Geological Sheet. Bur.Min.Resour.Aust., Explanatory Notes No.1.

PATEN, R.J., 1960 - Lacustrine Sandstones and Limestones and Spring Sinters of Far Western Queensland IN The Geology of Queensland, Hill, D., and Denmead, A.K., ed. Journ.Geol.Soc.Aust. 7, 391-393.

PATEN, R.J., 1961 - The Tertiary Geology of Western Queensland. Bur.Min.Resour.Aust.Rec. 1961/52 (unpubl.).

PHLEGER, F.B., 1960 - ECOLOGY AND DISTRIBUTION OF RECENT FORAMINIFERA. Baltimore, The John Hopkins Press.

POWELL, A.W.B., 1946 - THE SHELLFISH OF NEW ZEALAND. New Zealand, Whitcombe and Tombs Ltd.

RANDAL, M.A., and BROWN, G.A., 1962 - The Geology of the Ranken 1:250,000 Sheet Area, Northern Territory. Bur.Min.Resour.Aust.Rec. 1962/55 (unpubl.).

RANDAL, M.A., and NICHOLS, R.A.H., 1963 - The Geology of the Ahoy and Brunette Downs 1:250,000 Sheet Areas, Northern Territory. Bur.Min.Resour.Aust. Rec. 1963/72 (unpubl.).

TODD, R., 1958 - Smaller Foraminifera IN Geology of Saipan, Mariana Islands. U.S.Geol.Surv.Prof.Paper 280(H), 265-320.

APPENDIX 1

THE OCCURRENCE OF THE OSTRACODE HAPLOCYTHERIDEA IN THE BRUNETTE LIMESTONE, BARKLY TABLELAND, N.T.

by

P.J. Jones.

A.R. Lloyd, in the course of examining sample No. BT 169 from the Brunette Limestone from the Barkly Tableland (Brunette Downs 1:250,000 Sheet), found one specimen of an ostracode, associated with numerous small specimens of the foraminifer Ammonia beccarii (Linne), and several specimens of gastropods and pelecypods.

Although only a single specimen is available for examination, it is fairly well-preserved and can be referred to a species belonging to the genus Haplocytheridea Stephenson, 1936. The complete carapace measured 0.72 mm long and 0.45 mm high, with a narrow marginal ridge, and separation of the valves showed a merodont-type of hinge, and a narrow duplicature. Although the specimen cannot be identified with certainty, it can be tentatively compared with Haplocytheridea okaloosensis (Stephenson) 1938, from the Middle Miocene Alum Bluff Formation of Florida.

The presence of the genus Haplocytheridea in the Brunette Limestone, indicates an age between Upper Cretaceous and Recent. More specimens are needed before a definite identification can be given. If the tentative comparison with Haplocytheridea okaloosensis is confirmed, an age no older than Miocene is suggested.

Ecologically, Haplocytheridea is not a well known genus. So far, the evidence indicates that this is a shallow-water genus found in marine and brackish-water conditions.

Swain (1955, p.617) reports H. bassleri and H. bradyi from lagoonal marshes and in shallow water parts of San Antonio Bay, Texas, around Matagorda Island. Benson (1959, p.48) in his ecological study of recent ostracodes from Todos Santos Bay, Baja California, Mexico, found H.palda in a marsh channel, and H.maia almost entirely restricted to the littoral zone, and particularly abundant in rocky tidal pools with a coarse sand bottom, rich in algae. Benson (1961, p.58) later pointed out that "the tolerance of ostracodes usually associated with estuaries and brackish lagoons for great changes in salinity allows them to live in lagoons too saline for most normal marine ostracodes." He reported that in Florida Bay, where waters are periodically saline in excess of 55,000 p.p.m. species of Haplocytheridea produce large populations.

In conclusion, the presence of a species of Haplocytheridea indicates shallow-water conditions in either a marine, estuarine, or brackish lagoonal environment. An age between Upper Cretaceous and Recent is indicated. If the tentative determination of H. okaloosensis (Stephenson) 1938 is confirmed by more specimens, an age no older than Miocene is suggested.

REFERENCES

BENSON, R.H., 1959 - Ecology of Recent ostracodes of the Todos Santos Bay region, Baja California, Mexico. Univ.Kansas Paleont.Contr., Arthropoda, Art.1, 1-80.

BENSON, R.H., 1961 - Ecology of ostracode assemblages. Treatise on Invertebrate Paleontology Part Q, Arthropoda 3, Crustacea, Ostracoda, Q56-63.

ELLIS, B.F., & MESSINA, A.R., 1952 et seq - Catalogue of Ostracoda, Amer. Mus.Nat.Hist. Spec.Publ.

SWAIN, F.M., 1955 - Ostracodes of San Antonio Bay, Texas. J.Paleont. 29, (4), 561-646.