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FORAMINIFERA IN AUSTRALIAN PERMIAN STRATIGRAPHY

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INTRODUCTION

Extensive deposits of Permian marine rocks containing foraminifera are known from Queensland, New South Wales, Tasmania and Western Australia. Permian foraminifera have not yet been found in Victoria but they were recently discovered in a bore on Yorke Peninsula, South Australia (Ludbrook, 1957). They are also known from subsurface material in Northern Territory. Characteristic foraminiferal assemblages have been found in many of the mappable lithological units and up to the present eight distinctive assemblages have been recognised; these should prove useful in stratigraphical work.

Arenaceous genera and species dominate assemblages in all outcrop deposits except those in the Mantuan Productus Bed and Cattle Creek Formation, Springsure area, Queensland, in the Fossil Cliff Formation, Irwin Basin and in the Callytharra Formation, Carnarvon Basin, Western Australia and in the Darlington Limestone, Tasmania. The assemblages in subsurface beds are characterised by calcareous imperforate and perforate forms the latter including genera of the family Lagenidae such as Nodosaria, Dentalina, Frondicularia, Geinitzina and Lenticulina (Astacolus).

Recently described new genera of arenaceous foraminifera (Crespin, 1958) will be of considerable local significance in stratigraphical work; the calcareous imperforate ones (Crespin and Belford, 1957) are already known to have wide distribution.

SUMMARY OF STRATIGRAPHICAL UNITS WITH CHARACTERISTIC FORAMINIFERA

Under this heading a short summary of the stratigraphical units of Permian rocks in each State is given. Many of these units contain characteristic foraminifera.

Queensland

Permian deposits are widely distributed in eastern Queensland. The only beds studied for foraminifera were those in the Springsure area (Hill, 1955, 1957; Crespin, 1945) and from the coalfield area near Collinsville in the north-eastern part of the Bowen Basin (Crespin, 1958).

Lithological units in the Springsure area are:

Bandanna Formation
Mantuan Productus Beds
Catherine Sandstone
Ingelara Formation
Aldebaran Sandstone
Cattle Creek Formation
Staircase Sandstone
Dilly Beds

Foraminifera have been found in the following formations:-

1. Mantuan Productus Bed - Frondicularia aulax Crespin, F.sutilis Crespin, Geinitzina striatosulcata Crespin, G.triangularis Chapman and Howchin, Lenticulina (Astacolus) initialis Crespin.

2. Ingelara Formation - Ammodiscus erugatus Crespin, A.multicinctus Crespin and Parr, Dentalina grayi Crespin, Frondicularia woodwardi Howchin, Geinitzina striatosulcata, Reophax minutissima Plummer.

3. Cattle Creek Formation - Ammobaculites woolnoughi Crespin and Parr, Ammodiscus multicinctus, Calcitornella stephensi (Howchin), Frondicularia aulax, F.hillae Crespin, F.sutilis, F.woodwardi, Geinitzina triangularis, Nodosaria springsurensis Crespin, Rectoglandulina serocoldensis (Crespin), Sacculinella australae Crespin.

4. Dilly Beds - Calcitornella stephensi, Frondicularia woodwardi, Geinitzina triangularis.

New South Wales

The names "Lower Marine Series" and "Upper Marine Series" are now obsolete, and new names have been given to the outcrop beds in the northern, central and southern coalfields of the Sydney Basin. (Hanlon and Booker in Hill, 1955; Hanlon, Joplin and Noakes, 1953; Crespin, 1958).

Extensive marine deposits are associated with the northern coalfields in the central Hunter River Valley and the foraminifera have been studied in some detail from surface and subsurface beds (Crespin and Parr, 1941; Chapman and Howchin, 1905; Crespin, 1943, 1945, 1947, 1958; Reynolds, 1956; Raggatt and Crespin, 1940, 1941).

The stratigraphical sequence in the Hunter River area is as follows:

Newcastle Coal Measures
Tomago Coal Measures
Maitland Group { Mulbring Subgroup / Branxton Subgroup
Dalwood Group

Arenaceous foraminifera dominate the assemblages in surface sediments of the Mulbring and Branxton Subgroups but calcareous forms are present in the latter. Calcareous species are prominent in subsurface beds referable to the Maitland Group. Calcareous and calcareous imperforate species are found in beds of the Dalwood Group. Numerous bores in the Hunter River area have been drilled through the Maitland Group but it has been difficult to divide the Group into the two subgroups by means of the foraminifera.

Characteristic species in surface beds are as follows:

1. Maitland Group
(a) Mulbring Subgroup - Ammodiscus multicinctus, Ammobaculites woolnoughi, Digitina recurvata Crespin and Parr, Hyperammina hebdenensis Crespin, Thuramminoides sphaeroidalis Plummer, Tolypammina undulata Parr, Trochammina pulvilla Crespin and Parr.

(b) Branxton Subgroup - Ammodiscus multicinctus, Ammobaculites woolnoughi, Digitina recurvata, Frondicularia parri Crespin, F.woodwardi, Hyperammina hebdenensis, Lingulina antiqua Chapman and Howchin, Thuramminoides teicherti (Parr), Textularia bookeri Crespin, Trochammina pulvilla, Nodosaria raggatti Crespin, Rectoglandulina serocoldensis.

2. Dalwood Group - Ammobaculites woolnoughi, Calcitornella stephensi, Digitina recurvata, Earlandia condoni Crespin, F.woodwardi, Hemigordius schlumbergi (Howchin), Hyperammina fletcheri Crespin, Nodosaria tereta Crespin, Streblospira australae Crespin and Belford, Textularia bookeri, Trepeilopsis australiensis Crespin.

Tasmania

Permian rocks occur from Wynyard in the north-west to the south-western limits of the State, from Point Hibbs and the Henty River on the west coast to Coles Bay and Maria Island in the east and from the north coast to the south coast. It is only recently that sections have been studied in detail (Wells, 1957, McKellar, 1957; Banks and Hale, 1957) and at present no concise tabulation of stratigraphical units is available. Foraminifera have been studied only from isolated samples from different sections. Calcitornella stephensi is common in the Darlington Limestone and in the Brumby Formation of the Golden Valley Group. Foraminifera have been found in the Gray Limestone of the Elephant Pass. Crespin (1944) recorded foraminifera from a section near Oonah in the north-western region. These have been re-examined, (Crespin, 1958) and the dominating forms are a new species of the primitive genus Hippocrepinella, H.biaperta, and a new species of A.oonahensis. It has been suggested by Banks (personal communication) that these beds at Oonah are probably the oldest beds in the Permian sequence of Tasmania.

South Australia

Permian foraminifera (all arenaceous forms) were recently discovered in a bore at Minlaton, Yorke Peninsula (Ludbrook, 1957), giving the first evidence of the occurrence of marine Permian rocks in the State.

Western Australia

Considerable detailed stratigraphical work has been undertaken in Western Australia, especially since 1949, and at least five distinct sedimentary basins, all containing extensive Permian deposits have been recognised. They are:

1. Collie Basin
2. Irwin Basin
3. Carnarvon Basin
4. Canning Basin (including Fitzroy Basin)
5. Bonaparte Basin.

No authentic foraminifera have been found in beds of the Collie Basin (Chapman, 1907; Crespin, 1958).

Irwin Basin

Seven formations have been mapped in the Irwin Basin which is about 250 miles north of Perth. These are:

Wagina Sandstone
Carynginia Shale
Irwin River Coal Measures
HighCliff Formation
Fossil Cliff Formation
Holmwood Shale
Nangetty Glacials.

Crespin (1958) stated that no foraminifera had been found in formations above the Fossil Cliff Formation. More recent collections show them to be present in the Holmwood Shale and the Carynginia Shale.

Carynginia Shale - Ammodiscus nitidus Parr, Hyperammina cf. elegans (Cushman and Waters), Hyperammina sp,nov., H.fusta Crespin, H.expansa (Plummer), Hippocrepinella sp.nov., Proteonina arenosa Crespin, Spiroplectammina Crespin, Thuramminoides sphaeroidalis Plummer

Fossil Cliff Formation - Ammodiscus nitidus, Calcitornella stephensi, Frondicularia woodwardi, Geinitzina triangularis, Glomospirella nyei Crespin, Hemigordius schlumbergi, Hyperammina callytharraensis Crespin, Nodosaria irwinensis Howchin, N.tereta, Reophax sp.nov., Proteonina arenosa, Trepeilopsis australiensis Crespin.

Holmwood Shale - Ammodiscus nitidus, Glomospirella nyei, Hyperammina callytharraensis, Thuramminoides sphaeroidalis.

Nangetty Glacials - Hemigordius schlumbergi, Hyperammina elegantissima Plummer.

Carnarvon Basin

Extensive deposits of marine Permian are exposed in central and southern part of the basin and more than 3,000 feet of sediments have been proved by boring. (Condon, 1954, Teichert, 1952). The stratigraphical sequence of formations in the central portion of the basin is as follows:

Coolkilya Greywacke
Baker Formation
Norton Greywacke
Wandagee Formation
Quinnanie Shale
Cundlego Formation
Bulgadoo Shale
Mallens Greywacke
Coyrie Formation
Moogooloo Sandstone
Callytharra Formation
Lyons Group

Arenaceous species are predominant in outcrop material, except in the Callytharra Formation (Parr, 1942). The typical species found in the above formations are listed below; the interesting assemblage of species found in subsurface beds is listed separately.

Baker Formation - Ammodiscus nitidus, A.wandageeensis, Hyperammina acicula, H.coleyi, H.expansa, Reophax subasper, Thurammina phialaeformis, Thuramminoides sphaeroidalis, Trochammina obtusa Parr.

Wandagee Formation - Ammodiscus nitidus, Hyperammina acicula, H.coleyi, H.expansa, Reophax subasper, Thurammina phialaeformis, Thuramminoides sphaeroidalis, T.teicherti, Tolypammina undulata.

Quinnanie Shale - Ammobaculites woolnoughi, Ammodiscus nitidus, A.wandageensis, Glomospira adhaerens, Hyperammina acicula, H.coleyi, Psammosphaera pusilla Parr, Reophax subasper, R.tricameratus, Thurammina phialaeformis, Thuramminoides, Tolypammina undulata, Trochammina subobtusa.

Cundlego Formation - Ammobaculites woolnoughi, Ammodiscus nitidus, A.wandageeensis, Hemigordius harltoni Cushman and Waters, Glomospirella nyei, Hyperammina acicula, H.expansa, Nodosaria raggatti, Spiroplectammina carnarvonensis, Streblospira meandrina Crespin and Belford, Trochammina subobtusa.

Bulgadoo Shale - Ammobaculites woolnoughi, Ammodiscus nitidus, A.wandageeensis, Hyperammina acicula, H.expansa, H.elegans, Nodosaria raggatti, Pelosina hemisphaerica, Reophax ellipsiformis Crespin, Thurammina phialaeformis, Thuramminoides sphaeroidalis, Trochammina subobtusa.

Mallens Greywacke - Ammodiscus nitidus, Hyperammina acicula.

Coyrie Formation - Ammodiscus nitidus, Digitina recurvata, Reophax asper Cushman and Waters, R.ellipsiformis, Sacculinella australae, Spiroplectammina carnarvonensis, Textularia improcera Crespin, Thuramminoides sphaeroidalis.

Callytharra Formation - Ammobaculites eccentrica Crespin, Ammodiscus nitidus, Calcitornella stephensi, Earlandia condoni, Frondicularia woodwardi, Geinitzina triangularis, Giraliarella angulata, Hemigordius schlumbergi, Hyperammina callytharraensis, H.hadzeli Crespin, Nodosaria tereta, N.irwinensis, Placopsilina wooramelensis Crespin, Streblospira australae, Tetrataxis conica Ehrenberg, Trepeilopsis australiensis.

Upper Lyons Group - Calcitornella stephensi, Reophax tricameratus.

Two distinct assemblages, both dominated by calcareous species, were found in Giralia No.1 Bore, drilled by West Australian Petroleum Pty. Ltd. The assemblage in the upper part of the sequence is considered to be the equivalent of the Cundlego Formation-Bulgadoo Shale and that in the lower part to the Callytharra Formation. The characteristic species are:

Cundlego Formation-Bulgadoo Shale - Ammodiscus nitidus, Hemigordius harltoni, Flectospira prima Crespin and Belford, Frondicularia woodwardi, Hyperammina elegans, H.expansa, Nodosaria conico-densestriata Paazlow, N.crassula Crespin, N.decoris Crespin, N.raggatti, N.springsurensis, N.striatella Paazlow, Rectoglandulina serocoldensis, Reophax ellipsiformis, Thurammina phialaeformis.

Callytharra Formation - Calcitornella stephensi, Earlandia condoni, Geinitzina striatosulcata, G.triangularis, Giraliarella angulata, Hyperammina elegantissima, Spirillina Papillo-dentata, Streblospira australae, Tetrataxis conica.

Canning and Fitzroy Basins

Permian rocks are widely distributed in both surface and subsurface sections in the Canning Basin, particularly in the northern part (the Fitzroy Basin) (Guppy et al, 1952, 1958). The lithological units are:

Liveringa Formation
Noonkanbah Formation
Poole Sandstone
Nura Nura Member
Grant Formation

Foraminifera have been found in surface outcrops of all the above units except the Grant Formation. Arenaceous species predominate. However, in subsurface sections, calcareous and calcareous imperforate forms are common especially in the Noonkanbah Formation (Crespin, 1958); arenaceous species have recently been found in beds referable to the Grant Formation.

The following species have been recorded from surface beds:

Liveringa Formation (Lower part). - Hyperammina fusta Crespin, Reophax subasper.

Noonkanbah Formation - Ammodiscus erugatus, A.nitidus, Dentalina grayi, Digitina recurvata, Hyperammina acicula, H.coleyi, H.elegans, H.expansa, Pelosina hemisphaerica, Rectoglandulina serocoldensis, Reophax ellipsiformis, R.tricameratus, Thurammina phialeformis, Thuramminoides sphaeroidalis, T.teicherti, Trochammina subobtusa.

Poole Sandstone, Nura Nura Member - Calcitornella stephensi, Hemigordius schlumbergi.

Characteristic species of subsurface sections of the Noonkanbah Formation are:

Calcitornella heathi Cushman and Waters, C.stephensi, Dentalina grayi, D.habra Crespin, Flectospira prima Crespin and Belford, Frondicularia impolita Crespin, F.parri, F.semicostulata, F.woodwardi, Geinitzina caseyi Crespin, G.striatoculcata, G.triangularis, Glomospirella nyei, Hemigordius harltoni, Nodosaria fisheri Crespin, N.raggatti, N.spiculata Crespin, Plummineralla kimberleyensis Crespin, Pseudohyperammina radiostoma Crespin, Rectoglandulina serocoldensis, Streblospira kimberleyensis Crespin and Belford, S.meandrina, Thurammina phialaeformis.

Bonaparte Basin

Except for small mesa-cappings of Lower Cretaceous sediments and areas of alluvium, Permian rocks occur in the entire coastal strip about 35 miles wide, extending from the Fitzmaurice River in the south to the Daly River in the north (Noakes, Opik, and Crespin, 1952; Traves, 1955). The lithological units are:

Port Keats Group
Weaber Group

Foraminifera have been found only in a bore at Port Keats (Etheridge, 1907) in beds referable to the Port Keats Group. The species are: Ammodiscus nitidus, Calcitornella stephensi, Hyperammina acicula.

COMMENTS ON GENERA AND SPECIES OF PERMIAN FORAMINIFERA IN AUSTRALIA

Some observations made during the recent study of Permian foraminifera in Australia are worthy of note.

1. No fusulinid foraminifera have yet been found in the Permian of Australia (Chapman and Parr, 1937; Crespin, 1958). Endothyrid foraminifera associated with genera which range from Carboniferous to Permian have been recorded from the Carboniferous.

2. Certain genera of the family Lagenidae, such as Nodosaria, Dentalina, Frondicularia, Lingulina, Lenticulina (Astacolus) and Geinitzina are well developed in subsurface deposits in both eastern and Western Australia. Many of the species are strikingly ornamented. These include the European species Nodosaria striatella Paazlow and N.conico-densestriata Paazlow. The subgenus Astacolus has not previously been recorded from beds older than Jurassic. Geinitzina is restricted to the Upper Palaeozoic. The species Spirillina papillo-dentata Crespin 1958 closely resembles the Recent S.tuberculata Brady.

3. Calcareous imperforate genera, restricted to the Upper Palaeozoic, include Calcitornella, Plummerinella, Orthovertella, Trepeilopsis, Hemigordius and Earlandia.

4. Arenaceous foraminifera are characteristic of all Permian assemblages in Australia. The genera include Ammodiscus, Ammobaculites, Digitina, Hyperammina, Reophax, Spiroplectammina, Textularia, Thurammina and Thuramminoides. Spiroplectammina is very rare and Digitina is restricted to the Upper Palaeozoic. Hyperammina occurs in great abundance in certain beds in the Wandagee area, Carnarvon Basin, Western Australia and in the Hunter River area, New South Wales. On occasions, fragments of this genus are the only foraminifera present in sediments.

5. Several new genera were discovered during the recent investigation of the Permian deposits. Two calcareous imperforate genera, Flectospira and Streblospira, were described by Crespin and Belford (1957). The former is so far restricted to beds in Western Australia but the latter genus is widely distributed. Arenaceous genera Giraliarella, Pseudohyperammina and Sacculinella have been described by Crespin (1958).

6. North American Permian and Pennsylvanian species of arenaceous and calcareous imperforate foraminifera have been found in the Australian assemblages. They include Hyperammina elegantissima Plummer, H.elegans (Cushman and Waters), H.expansa (Plummer), Reophax fittsi (Warthin), R.asper Cushman, Calcitornella elongata Cushman and Waters and Hemigordius harltoni Cushman and Wabers.

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