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REVIEW OF TYPE LOCALITIES AND STRATIGRAPHY OF THE CRETACEOUS OF THE GREAT ARTESIAN BASIN IN QUEENSLAND.

by

M.A. Reynolds

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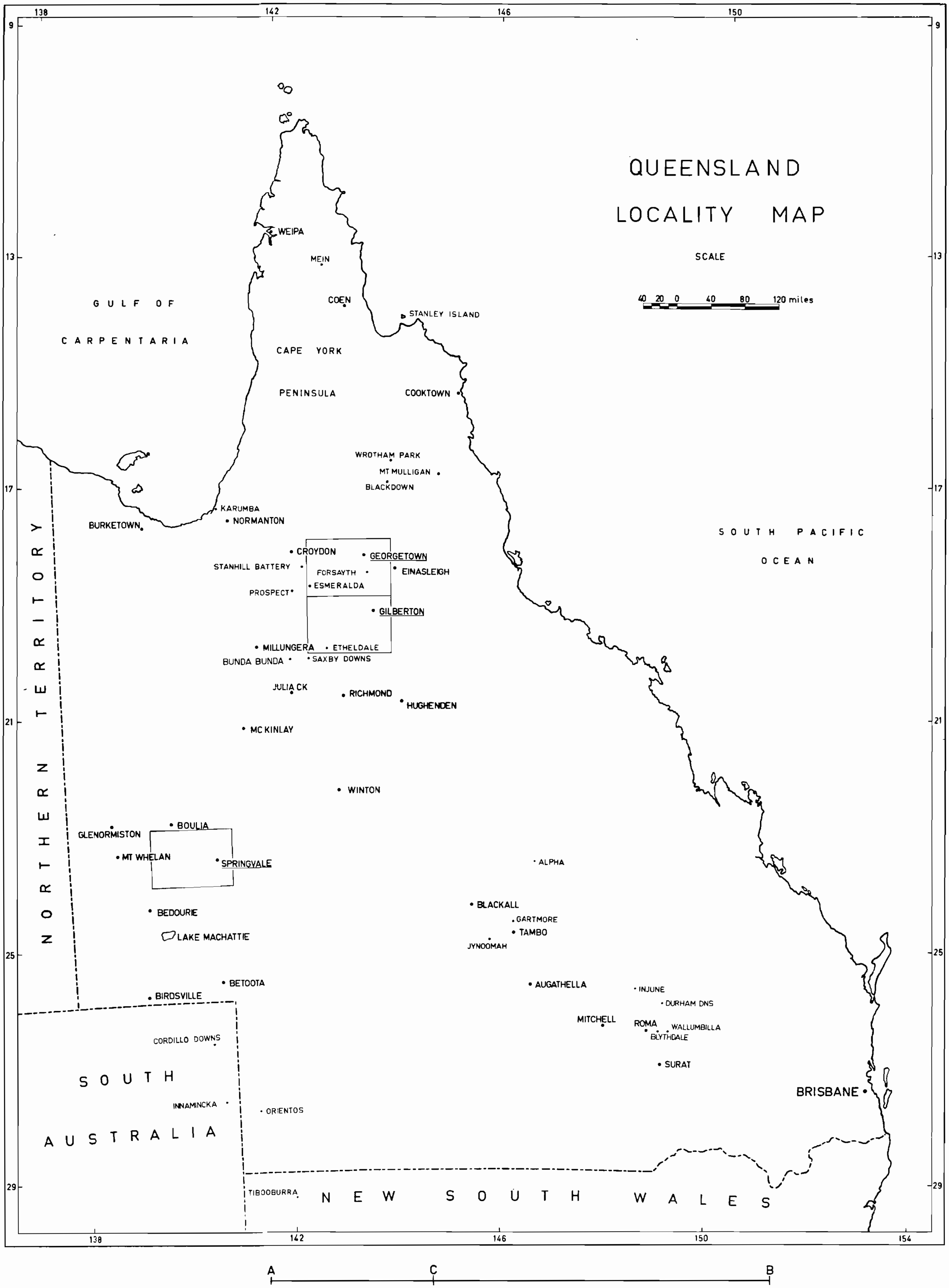
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ABSTRACT

The lithology, macrofossils and microfossils of the Blythesdale Group, Roma and Tambo Formations and Winton Formation are discussed in this report; the formations are compared with equivalent units elsewhere in the Great Artesian Basin in Queensland and a general stratigraphic review follows.

The position of fossiliferous clayey sandy beds at the top of the Blythesdale Group is uncertain - should they be left in the Blythesdale Group, made a separate unit: "Transition beds", or should they be included as the basal part of the Roma Formation?

The Roma and Tambo Formations (and their equivalents in the Great Artesian Basin) can only be divided at present on the basis of macrofossils in most places. Some minor lithological horizons are thought to be important as possible marker beds within the Great Artesian Basin:

(1) an interbedded shale and sandstone sequence with fossiliferous limestone nodules and glaucnonitic 'ashstone' near the base of the Roma Formation equivalent in the Gilberton 4-mile Sheet area;

(2) the Toolebuc Member of the Wilgunya Formation Boulia 4-mile Sheet area is probably the equivalent of the Kamileroi Limestone of the Carpentaria Basin, and these units are thought to occur at or near the base of beds equivalent to the Tambo Formation;

(3) an unfossiliferous calcareous sandstone unit near the top of the Tambo Formation and similar beds in the same stratigraphic position elsewhere.

The Winton Formation is difficult to recognise especially where above unfossiliferous Tambo Formation (or equivalent formations) and in weathered outcrop. The minor lithological unit (3) above may provide an easy means of separation.

I. INTRODUCTION

Combined Bureau of Mineral Resources and Geological Survey of Queensland field parties have been working in western and northern Queensland since 1956. Although Mesozoic and younger formations were studied and mapped, they were not given the attention that was accorded to Palaeozoic and Precambrian rocks. In 1959, R.J. Paten of the Queensland Survey and I concentrated on mapping Mesozoic and Cainozoic sediments in the Springvale 4-mile Sheet and Gilberton and Georgetown 4-mile Sheet areas. As this work was to be a prelude to further work in the Great Artesian Basin, brief surveys were conducted first in the type areas of the formations which extend over the main part of the Basin: at the base, fresh-water to marine (Upper Jurassic to Lower Cretaceous) sandstone, conformably overlain by Lower Cretaceous marine shale, which greades up into Upper Cretaceous freshwater shale and sandy beds. The basal unit is the upper part of the Blythesdale Group; the shale is divided into two units - Roma Formation and Tambo

Formation; above is the Winton Formation. The type localities were named by Whitehouse (1954). He does not give a type locality for the Winton Formation, but the area around Winton must be so regarded. We saw good outcrop of this formation during trips into western and south-western Queensland. Large sample collections were made in the type areas so that answers might be found to problems arising from Whitehouse's subdivision.

Whitehouse (1924) first noted a gap in the Lower Cretaceous marine shale succession (then part of the Rolling Downs Formation of Jack, 1886). The basal part of Aptian age he later (1926) called 'Roma Series' and the upper unit became the 'Tambo Series'. His division was based mainly on macrofossils, particularly ammonites from which he derived the European ages for the formations. The present names of the formations were applied in Whitehouse (1954). The decision, based mainly on fossils, has posed certain problems in regional correlations and general stratigraphic considerations:

(1) At the top of the Blythesdale Group is a unit which although a sandy bed, contains marine fossils distinct of Roma Formation type; should this unit be left in the Blythesdale Group which is composed mainly of fresh-water beds, can it be mapped as a separate formation (transition zone), or should it be included as the basal part of the Roma Formation.

(2) Are the faunal assemblages and/or lithology of the Roma and Tambo Formations distinctive enough to allow their recognition as formations in regional mapping?

(3) If the Tambo Formation does not contain macrofossils in some beds, how can it be separated from non-fossiliferous Winton Formation of the same lithology, particularly in weathered outcrop?

(4) Are there any good marker beds in these formations?

This is a preliminary report on results obtained to date on some aspects of the problems. Large contributions of fossil data have been supplied by Miss I. Crespin (1960) and by J.M. Dickins (1960); petrological information has been given by W.M. Dallwitz, W.R. Morgan and a student of the New England University, V.M. Bofinger, and chemical analyses have been done by S. Baker and A.McClure; some plant identifications have been made by Mrs. M.E. White, and I have been assisted by F. Olgers in the preparation of maps and figures. I acknowledge the help in the field of R.J. Paten of the Queensland Survey and thank all for their contributions to this work.

I was able to discuss the problems of Cretaceous Stratigraphy with Dr. N.H. Ludbrook of the South Australian Mines Department, Dr. M.F. Glaessner and Dr. M. Wade of Adelaide University in March-April, 1960; for their helpful suggestions I would also like to express my thanks.

II. LITHOLOGY

The main purpose of this discussion is to describe what is known of major lithological units and consider whether certain beds within them are useful markers for regional correlation. As yet, only general litholgies of Upper Jurassic - Cretaceous formations are known. Some petrological and chemical analyses have been done but not enough information is available for many regional comparisons. Unfortunately a sedimentary petrologist to undertake this type of work is not available in the Bureau of Mineral Resources. The main value of petrological work is in relating precise information about rocks of their outcrop characteristics for purposes of correlation in the field and for recognising the same rocks in fresh samples from bores.

Results of analysis completed so far show that a detailed analysis of lithologies from Upper Jurassic-Cretaceous formations might be very useful. Two beds which may be good marker horizons have been identified over large distances. One is near the base of the Roma Formation or equivalent formation elsewhere in the Great Artesian Basin; the other is thought to be at the top of the Tambo Formation (or equivalent formations). The notes that follow are main of the formations in their type areas with brief remarks on the lithologies of other equivalent formations in the Basin.

1. Blythesdale Group. The type area given in Jack (1895) has been interpreted by Whitehouse (1954) to be 'along Blyth Creek, a few miles north of Blythdale railway station.' The name of 'Blythesdale' is thought by Whitehouse (p.9, footnote) to be acceptable for stratigraphic use. Only 8 feet of section was seen in the type area of the Blythesdale Group in 1959; it occurs in a gully (a tributary of Blyth Creek) 3 miles north-east of Blythdale railway station on the north side of the road that follows Blyth Creek. The 8 feet of section consisted mainly of grey to light brown fine-grained quartz sandstone with thin bands of clay pellets,? worm markings, fossil wood fragments and plant impressions. By comparison with Reeves; (1947) subdivision of the Group, this bed is in his 'Transition stage'.

Reeves divided the Group as follows:

Transition stage at top - soft arkosic sandstone, gray sandy clay shale, and lenses of coal - 550 to 600 feet thick;

Mooga sandstone - fine to medium-gained sandstone and sandy shale with quartz pebble conglomerate near base - 150 to 200 feet thick;

Fossil wood stage - sandy clay shale, fine-grained arkosic sandstone with coal and fossil wood lenses - 200 to 300 feet thick;

Gubberamunda sandstone - medium-grained water bearing sandstone - 200 feet thick.

The lowest part of the formation that we examined between Nareeten and Roma (along the Injune-Roma road) is in the 'Mooga sandstone'. The thickest of exposed sections is in the south bank of Bungeworgorai Creek 21½ miles along the road north from Roma: 60 feet of pebbly sandstone, claystone (partly soapstone)* and arkose, with 2 feet of carbonaceous shale and coal comprise the section; they underlie up to 40 feet of red sandy clay, sand and conglomerate of Tertiary age beneath a dissected erosion surface. Stratigraphically above the Bungeworgorai Creek section are:

cross-bedded sandstones and conglomerate with fossil wood and plant remains and thin shale interbeds**; some tough calcareous lenses; sections up to 40 feet thick; de Jersey (1959) identified two plant forms from these beds - Dicroidium feistmanteli and Podozmites sp.;

interbedded arkose and gey shale with carbonaceous matter and thin coal bands (less than 50 feet);

fine-grained quartz sandstone with irregular tubular marks and fine dark-coloured minerals which show small current bedding, generally soft with minor hard blocky to platy beds (no section greater than 50 feet seen);

Uppermost fossiliferous shaly sandstones, grey shales and arkose with tough lenses of light-coloured sandy and dark grey clayey limestone; few small outcrops not more than about 30 feet thick. Petrological analyses of hard bands showed them to be calcareous sandstone to impure limestone(detritus is of coarse angular to small, rounded quartz grains and grains of igneous rock and feldspar; the bands are clayey in parts). Fossils include the brachiopod Lingula sp., and molluscs Cyrenopsis, Fissilunula, "Mulletia", Panope, Pseudavicula, Tatella,"Yoldia" and belemnites. Microfossils were arenaceous foraminifera and Radiolaria. Jensen (1926) also refers to sand grains in this part of the section as remarkably rounded .

Because of the lensing nature of beds, correlation between sections is difficult. The total thickness for the above units is less than 230 feet; Reeves gives a thickness of about 700 feet for this part of the Blythesdale Group. The same beds are thought to be represented as follows in Associated Australian Oilfields N.L. Well No.4, Roma:

290-440 feet - Grey mudstone and dark shale with fine argillaceous sandstone as bands and laminae. Generally carbonaceous. Band of buff sandy limestone at 360 feet.

440-460 feet - Grey, medium-grained quartzose sandstone and dark grey mudstone.

460-535 feet - Dark and grey sandy mudstone and shale, with some fine sandstone. Coaly fragements at top - generally carbonaceous.

535-540 feet - White sandy limestone.

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* Some of the clayston has been analysed - see Appendix I

** Efflorescence from between these shales has also been analysed - see Appendix I.

540-675 feet - Grey, fine to medium argillaceous sandstone with dark and grey mudstone and shale. Some brown calcareous mudstone. Very calcareous brown sandstone at 615 feet. Brown sandy limestone 650-655 feet.

675-720 feet - Uncemented fine to medium sandstone. Grains of pale pink and grey quartz, chert and pyrite.

720-760 feet - Fine grey quartzose sandstone with black carbonaceous to coaly shale.

Total thickness 470 feet. This suggests that Reeves' estimated thickness is excessive.

Reeves (1947)and Whitehouse (1954) give the age of the Blythesdale Group as Upper Jurassic -Lower Cretaceous. The ages given for fossils collected in 1959 agree. De Jersey notes that Dicroidium is known from the Jurassic but not from the Cretaceous. As there is no evidence to the contrary, the lower beds in outcrops examined in 1959 can be regarded as Upper Jurassic as suggested. The uppermost shaly sandstones contain a fauna which is mostly Roma Formation type; they are of Lower Cretaceous age. The presence of Lingula may indicate that the environment of deposition was brackish water, or marine.

If a lower and upper limit to the uppermost fossiliferous shaly sandstones (equivalent of Reeves' 'Transition stage') could be established, these beds could be made a separate formation - a formation which shows the transition from fresh water to marine conditions. R.J. Day of Queensland University is doing some detailed work in the Roma area and may find these limits. Reeves' (1947) subdivision seems to be based mainly on old bore data; he gives no type localities for his units. In any case, the names are not formal stratigraphic names.

The change from fresh water to marine conditions is shown similarly in other areas in the Great Artesian Basin. Casey and parties (1960 a,b) show that in western Queensland deposition on the Boulia shelf area was spasmodic in lacustrine and swampy environments which changed from fresh water to brackish and then marine. The deposits are not very thick in outcrop but they are similar to the Roma area: Lower sandstones with plant fossils and shaley sandstones with worm and Rhizocorallium burrows are overlain by a ferruginous (limonite after glauconite) bed with large marine fossils. Although plant fossils are not regarded as very satisfactory for stratigraphic correlation, most of the forms recognised in the lower beds are generally common in the Jurassic but not in the Lower Cretaceous; they may indicate that the lower beds should be given an Upper Jurassic age (see White 1957, 1959, 1960). The marine fossils in the uppermost bed are of the Roma-type. The deposits have been called the Longsight Sandstone (Casey et al, 1960a); they were given the range in age from 'lower Jurassic to lower Cretaceous'. I have since shown (in G.S.A. 1960) that the basis for this age determination is wrong and that the age should be Upper Jurassic - Lower Cretaceous. Although the thickness of the Longsight Sandstone is generally less than 100 feet in outcrop, it increases to over 450 feet in the Basin east of the Boulia Shelf. Coal seams are recorded from the formation in some bores; uppermost green sand beds are recorded in two bores.

In the Gilberton and Georgetown 4-mile Sheet areas sections of the Gilbert River Formation showed about 140 feet of cross-bedded quartz sandstones overlain by about 100 feet of more arkosic sandstone with rare shale interbeds and, in the northern part of the Gregory Range, capped by fossiliferous marine sandstone. On the evidence of plant remains and macrofossils, the formation 'may range from Upper Jurassic to Lower Cretaceous' (Reynolds, 1960). This formation, also, is probably equivalent to the upper part of the Blythesdale Group.

Shaley fossiliferous sandstone similar to those in the uppermost Blythesdale Group occur in the south bank of the Balonne River on the north-eastern side of Surat township. They form part of the Griman Creek Group of Jenkins (1959). The 30 foot section consisted of interbedded fine-grained,micaceous sandstone, siltstone and shale with laminae rich in small plant fragments. Fossils - pelecypds (mainly Pseudavicula) and gastropods - occur near the middle of the section.

2. Roma and Tambo Formations. The beds which form the Lower Cretaceous marine formations are mainly grey to dark grey siltstaones; minor lithologies include fine-grained sandstones (some glauconitic) and limestones. Without macrofossils the Roma and Tambo Formations can not be separated easily in the field. However, insufficient detailed analyses of the sediments have been made to determine the real nature and source of the great thicknesses of shaly beds or whether any horizons have lithological properties distinctive enough for them to be used as marker beds. Some of the minor lithologies in thin bands throughout the sequence have been petrologically and chemically tested and may be important; they need more testing both in the laboratory and in the field.

a. Roma Formation

Whitehouse (1954,p.10) refers to the 'blue shales and concretionary limestone, with the Maccoyella barklyi fauna well exposed in the banks of Bungeworgorai Creek just north and south of the railway line' (west of Roma)as the 'type area' of the Roma Formation. He also observed that 'From the Roma to the Winton (Formation) there is a most uniform lithology in outcrop'. We examined the southern part of the area where the Roma - Mitchell road crosses Bungeworgorai Creek; the section was mainly powdery to flaky grey shale with minor lenses of calcareous siltstone to fine-grained sandstone and thin bands of brown-grey fine-grained glauconitic? sandstone which shows cross-bedding. Thin limestone bands with cone-in-cone structure were seen. Gypsum occurs as flakes and as coatings around limestone concretions and small lenses. Mr. M.A. Condon (pers. comm.) also noted: 'black bentonitic shale;.....hard slump balls and rolls of calcilutite and calcarenite' from the area. R.J. Day of Queensland University will probably contribute some more-detailed descriptions of the lithology of the Roma Formation in his present (1959-1960) work. But no obviously distinctive lithologies have so far been recorded from the Roma Formation in its type area.

One unusual bed is near the base of the Roma Formation (Gil 11 locality) on Etheldale Station near the southern-edge of the Gilberton 4-mile Sheet area. A sample from the bed is called 'slump-brecciated glauconitic acid ashstone' by Dallwitz and Bofinger (1960). It is in sandy shales with limestone lenses interbedded with fine-grained sandstones. Fossils include large ammonites (Australiceras). The bed may be equivalent to glauconitic sandy calcareous horizons which occur near the base of the marine shales in some bores in the Roma area and elsewhere in the Great Artesian Basin. Only petrological examination, however, would show whether these beds are 'ashstones'. The Graham's Creek Volcanics have been suggested (Reynolds, 1960) as a possible source for the ashstone. David (1950) refers to beds of 'tuffaceous sandstone' at the base of the "Roma Formation" at White Cliffs, New South Wales.

Other calcareous, sandy lenses occur in the Roma Formation; these also should be analysed to see if they are like the 'ashstones'.

Another distinctive bed seen in the type area of the Roma Formation is a sandy limestone intraformational conglomerate with rounded silty clay pebbles ('slump balls'); but similar beds also occur in the Tambo Formation. Belemnites or rolled belemnite fragments are commonly associated with these beds. Jack (1885) noted this lithology at other places within the Basin and Jack and Etheridge (1892 p. 400) refer to 'semi-vitreous sandstone containing Belemnites and nodules of limestone resembling "curling stones" in size and shape'.

Cone-in-cone limestone is not important as a marker horizon; it occurs throughout the marine shale succession and may or may not be associated with fossiliferous concretions. Bursill (in Bursill and Veevers, 1952) describes cone-in-cone structures in sideritic and calcitic rock in coal measures in the Parnell's Creek (Muswellbrook, N.S.W.) area and states: 'It seems likely that the conditions necessary for the formation of the initial plicate structures depend upon minute lenticulation of alternate sideritic and (probable) ashy clay that becomes altered to bentonitic clay in time.' In the Cretaceous marine shales, calcareous rather than sideritic clay was probably active in forming the structures. Bursill's suggested method of formation is also quoted: 'The lenticles of siderite above and below the clay layer meet from time to time forming nodes which act as centres of crystallization of the siderite. The outward growth of crystalline siderite will then naturally have a conical tendency as nodes further and further from the centre become incorporated, while the clay lenticles are isolated entirely.' Other possible methods of cone-in-cone origin are discussed by Twenhofel (1950); he shows that cone-in-cone structures could be developed in a calcareous bed by pressure of overlying sediments causing shear planes in fibrous calcite in the bed, and solution along the planes removing some calcite and leaving and insoluble residue of clay. Redeposition of calcite along shear planes also occurs.

b. Tambo Formation

In his definition of the type area of the Tambo Formation, Whitehouse (1954, p.10) states: 'The shales and concretionary limestones on Minnie Downs, south-west of Tambo/carrying the Myloceras fauna' represent the Tambo Formation.

Foot Note: At the town of Tambo itself the beds are possibly of the Roma Formation.'

The area to which Whitehouse probably refers is that which is now (1959) part of Jynoomah Station which adjoins Minnie Downs on its northern boundary. Macrofossils and samples for microfossil and petrological analyses were collected in 1959 during a traverse from Tambo to Jynoomah Station; outcrops of "Roma Formation", Tambo Formation and?Winton Formation were seen along this traverse.

Lenses of sandy limestone , which on fossil evidence belong to the Roma Formation, occu in the Tambo area and are very similar to some of the le ses in the overlying Tambo Formation. They are characteristi ally grey to brown fine-grained sandy limestone with some poorly developed current bedding and coquinoid bands up to 3 inches thick; some beds show sorting and fossil shells with convex side upwards, others show random arrangement of shells and fragments, or, in parts, a suggestion of imbricate arrangement. Morgan (1959) described a thin section of the limestone as follows: 'angular grains of quartz and anhedral to euhedral crystals of felspar, with lesser quantities of rounded grains of ferruginous glauconite, are set in a plentiful matrix of apparently crystalline, somewhat ferruginous calcite.' Calcite may be from recrystallized calcarenite according to Morgan; flakes of biotite occur. Estimated composition of the rock (from thin section) is 55% ferruginous calcite, 35% quartz and feldspar sand, 10% glauconite. Heavy minerals, mainly magnetite with rare leucoxene, zircon, chlorite, garnet, rutile, biotite, are not common. The rock was called a fine-grained, recrystallized quartz-plagioclase calcarenite. Only fossils can be used to differentiate such beds into either Roma or Tambo Formation.

The Toolebuc Member of the Wilgunya Formation is though to occur stratigraphically at the base of the Tambo Formation equivalent. Its general lithology is discussed in Casey, Reynolds, Dow, Pritchard, Vine and Paten (1960); I have discussed its distribution in the report on the Gilberton, Georgetown 4-mile Sheets. The typical pink limestone lithology of the Member was not seen in the type area of the Tambo Formation but it may not have been outcropping in the section which we examined. The limestone has common fossils Inoceramus and Aucellina some of which are relatively large. Another feature, shown by chemical analysis, is the high carbonate content. W.R. Morgan determined 97% carbonate (with uncommon iron oxide pseudomorphs of pyrites) in a sample from Hilary Tank (Mt. Whelan 4-mile Sheet), and 99% carbonate in sample S1 from the Springvale area. The types of carbonates were not determined. Weathered limestone from the surface at Exley Bore (just west of south-west corner of Gilberton 4-mile Sheet area) is composed of 90% $CaCO_3$, 4% $MgCO_3$ (analysis by A. McClure, 1960); this bed is though to be equivalent to the Toolebuc Member. Some water bores near the type area of the Toolebuc Member show green sandy lenses and thin limestone bands generally less than 700 feet above the base of the Wilgunya Formation; some of these bands may represent an extension of the Toolebuc Member into the Basin. Other equivalents may include the 'Avicula bed' (Jack and Etheridge, 1892, p.395) at Hughenden although its analysis showed only 70% carbonate (including 2½% $MgCO_3$), and the 'magnesian limestone' at Kamileroi (Jack, 1885). Stratigraphic sections in D.M.Q. (1956) show a coquinite band at, or just below, the base of the 'Tambo Formation' in the Warbreccan bores (W.O.L. 1 - 3); however, the fossils which form the coquinite should be known before this band is correlated with the

Toolebuc Member. The member may be represented in the Innamincka No. 1 Bore (Ludbrook, 1960) by the limestone rich in pyrites and with abundant Inoceramus prisms and Globigerina between 2,600 and 2,680 feet.

An unusual lithology occurs in a few samples from the Tambo Formation equivalent above the Toolebuc Member in the Springvale 4-mile area. It is composed almost entirely of Inoceramus prisms. Jack and Etheridge (1892, pp. 399, 400) refer to similar beds on Maraton Station and 8 miles west of the Williams River in north-west Queensland. The extent of the bed or beds rich in Inoceramus prisms and the stratigraphic position above the Toolebuc Member, however, is not known.

Sandy lenses appear to be more common in the Tambo Formation than in the Roma Formation. Some beds have a speckled appearance like "salt and pepper" sands. The sandy portion is mainly quartz but with a fair amount of feldspar. Similar beds are also found in the overlying Winton Formation; the only means of separating the Tambo Formation beds of this lithology from the Winton Formation is by finding marine fossils or their casts.

One of the most distinctive beds seen in the field so far occurs at or near the top of the Tambo Formation. It, also, is calcareous, sandy, but with carbonate possible more as calcite cement than in the lenses referred to above; fresh outcrop (as large nodular concretions or lenses) is very tough. Some samples show euhedral or "embayed" plagioclase crystals which may be authigenic (thin section descriptions by W.R. Morgan and V.M. Bofinger). Magnetite is relatively common and glauconite occurs in some samples. The following samples collected in 1958, 1959 are thought to belong to this horizon: S27, S11'oa , S204 ·? S224, S236, S237 (Springvale 4-mile Sheet), Mac 2 (Machattie) and Tam 6 and 7 (Tambo Formation type area). Crespin (1960) has recorded microfossil casts, but no tests, from some of these samples. The grey carbonaceous and calcareous mudstone with abundant plant remains, medium-grained angular quartz grains, green minerals (not glauconite), calcite, pyrite, magnetite between 1700 and 1720 feet in Innamincka No.1 Bore (Ludbrook, 1960) may be related to the horizon; the first foraminifer appears in this bed.

Aerial photographs covering the 1959 traverse in the Tambo Formation type area showed 3 distinct patterns:

(a) grey mottled with lighter small wavy to folded lines

(b) black due to dense brigalow scrub

(c) grey slightly mottled in part.

Pattern (a) is attributed to shales with calcareous and limestone lenses; it ranges from "Roma Formation" to Tambo Formation. The lower part of the "Roma Formation" north of Tambo is covered by Tertiary sandstone and its pattern is not known.

The scrub is confined to low rises of sandy beds which, in weathered outcrop, are like typical Winton Formation beds but which contain Tambo Formation type fossils. The pattern probably represents weathered sandy beds of the Tambo Formation north-east and east of Jynoomah homestead and weathered Winton Formation south and west of the homestead.

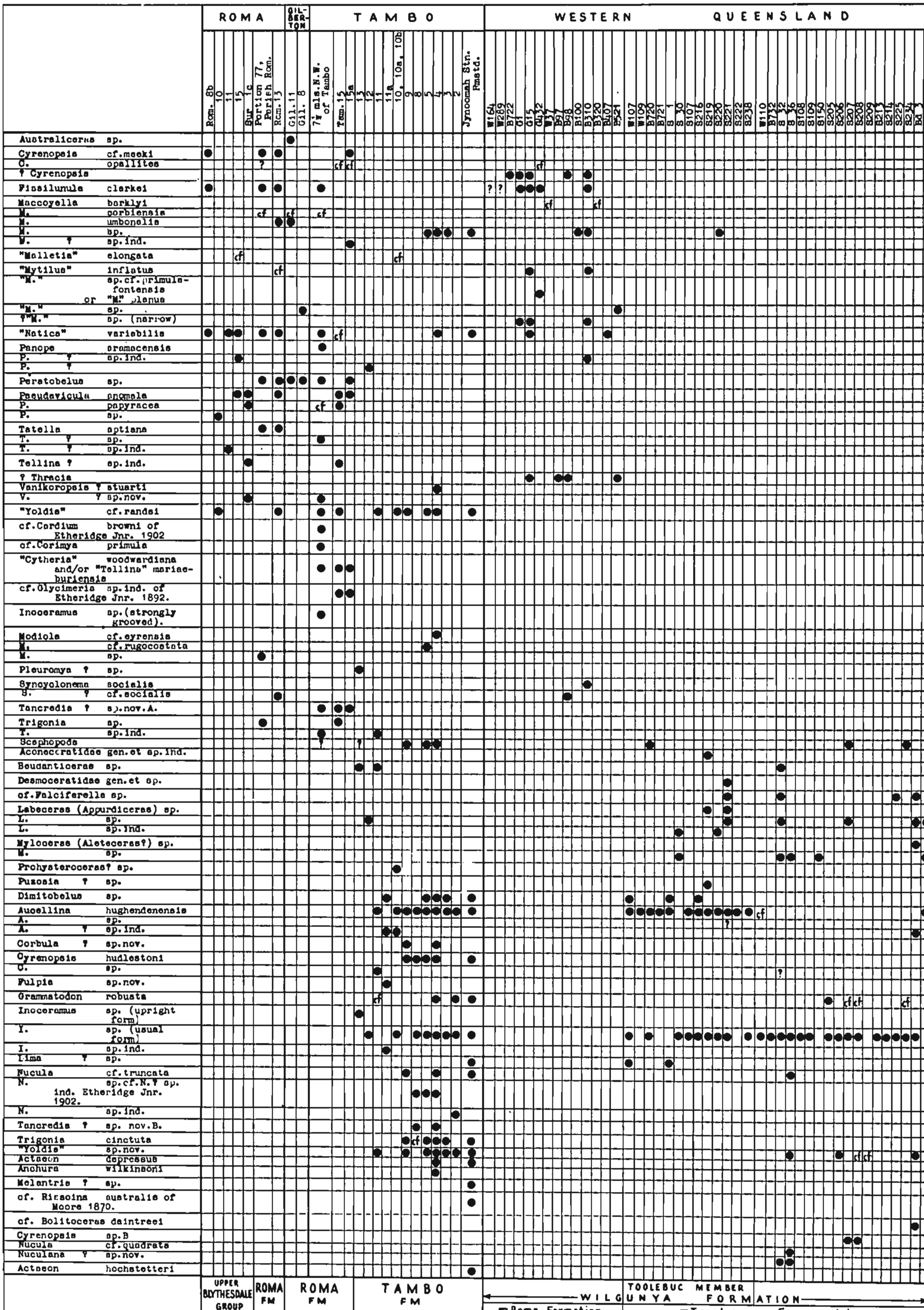
Pattern (c) is formed by shale mainly, with a bed (or lenses) of the distinctive calcareous sandstone which occurs at or near the top of the Tambo Formation - this bed probably causes the mottled pattern.

If my interpretation of the pattern shown on aerial photographs is correct the beds between Tambo and Jynoomah Station form part of a syncline with a southerly plunge, or form the northern part of a basin.

3. Winton Formation. Whitehouse (1954) does not give a type area for the Winton Formation; the "type" lithology is given as the 'blue shales and sandstones with intercalated coal seams met with in the bores in and about Winton.' Jack (1885) originally described the beds with coal seams from the formation from wells in Winton. Characteristic lithologies were seen in 1959 during traverses in western Queensland and north-east South Australia. A good description is given in G. S. A. (1958, p.97): 'It consists of shales, siltstones, sandstones and occasional layers of sandy limestone. On the surface they are almost indistinguishable from their marine Roma and Tambo counterparts, except in the higher percentage of sandstones, the occurrence of thin coal seams and carbonaceous shales and absence of marine faunas.' Fossil plants include Brachiphyllum and Elatocladus, and some freshwater mollusca of the genus Unio occur. Jack (1930) notes that the Winton Formation beds are generally grey-green rather than the grey-blue colour of the underlying marine shales. The formation contains several sandstone aquifers; Jack states that the basal sandstone is quite distinctive and often identified from bores. This may be the equivalent of the sandy bed which I have described at the top of the Tambo Formation. The maximum thickness given for the "Winton Formation" - 3,860 (?) feet - is in the Patchawarra bore in South Australia.

4. Weathered outcrop. One of the greatest difficulties still associated with field mapping is the identification of the Roma, Tambo and Winton Formations, particularly their shaly beds, in weathered outcrop. In western Queensland most outcrops appear to have been part of a laterite profile subsequently affected by silicification. The beds are generally leached to such an extent that macrofossils and calcareous foraminifera have lost their shells and are hard to recognise as casts; even physical properties of some of the beds are obscured and their identification is only possible by chemical analysis. In some places, casts of fossils have been found and these have enabled the stratigraphic position of the beds to be determined.

Some of the silicified or partly silicified and white, lateritised rocks from western Queensland have been referred to as 'radiolarites'. In thin section these rocks appear to be finely granulated opal and are isotropic; some contain radiolarian tests. The finely granulated opal texture can be seen in Plate I within and outside of radiolarian tests; one test in Figure 2 appears to be partly assimilated into the matrix and faint traces of what may have been radiolaria can be seen in the matrix in Figure 3. However, the mere presence of amorphous opal in thin section cannot always be attributed to assimilated siliceous microfossils. Condon, (1954, p.9) defines radiolarite as 'Siliceous organic rock consisting mainly of the tests and fragments of radiolaria with or without diatoms, foraminifera, sponge spicules, other pelagic fossils, clay, sand and organic residues' (after 'Murray and Renard, 1891, p.203.') The lateritised rocks from western Queensland are not com-



Identifications by Hill (1960), Dickins (1960) and some field determinations. Compiled by M.A. Reynolds.

Bureau of Mineral Resources, Geology & Geophysics. August, 1960.

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posed mainly of radiolaria or their fragments and cannot, therefore, be called 'radiolarites'. Radiolaria are fairly common in the microfossil assemblages of some unaltered or only partly altered beds, particularly in the lower part of the Wilgunya Formation (equivalent to Roma Formation) and Toolebuc Member (equivalent to base of Tambo Formation); but, radiolarites, as defined, have not yet been found. Lateritised rocks with traces of radiolaria in amorphous opal matrix should perhaps be called "radiolarian porcellanite", "radiolarian siliceous rock" or "radiolarian chert" depending on the rock type.

The absence of microfossils from weathered beds may, or may not, indicate the Winton Formation. Although microfossils such as foraminifera and radiolaria have not been found in the Winton Formation, their absence may be due to assimilation during weathering. However, if unfossiliferous weathered beds are more sandy than usual (with kaolinised arkosic sandstone in many places), and are stratigraphically above Tambo Formation beds, they have been mapped as Winton Formation.

III MACROFOSSILS.

Complete lists of fossils found in marine beds in 1958, 1959 and a few comments on the faunal assemblages in various formations have been made by Dickins (1960). Chart No. 1 has been prepared from these lists. The change in faunal assemblages shown between the Roma Formation (and the equivalent lower part of the Wilgunya Formation) and the Tambo Formation (and Toolebuc Member, upper Wilgunya Formation) will probably not be quite as marked when more information becomes available. For example; Pseudavicula anomala is recorded by Ludbrook (1960) with a fauna including the ammonite Falciferella breadeni which is typical of the Tambo Formation; she also found Tatella maranoana which is common in the Roma Formation, with Tambo-type fossils higher in the section. Also, Nucula quadrata occurs with an assemblage of Roma type fossils from Lake Eyre in South Australia (Adelaide University collections) whereas it is with Tambo faunas in the Chart. However, the Pseudavicula anomala, Tatella maranoana and Nucula quadrata forms from South Australia have not been compared with forms from Queensland and differences may occur in them. Some of the more common or important fossils occurring in the marine Cretaceous formations are discussed hereunder.

The fossiliferous sandy beds capping True Blue Hills and Mt. Angus (east of Croydon) and Brennan's Knob (Georgetown 4-mile area) and the upper part of the Longsight Sandstone in western Queensland can be correlated with the upper part of the Blythesdale Group in the Roma area. With the exception of the brachiopod Lingula and pelecypod Cucullaria, all fossil forms identified from these beds occur in the Roma Formation. Sandy and shaly beds at Surat and at Geo 13 locality (Georgetown) are correlated with the upper part of the Blythesdale Group on the basis of their lithology or the lithology of associated beds and because their faunas contain forms which are common in the Roma Formation. The most common fossils found in the upper part of the Blythesdale Group and equivalent beds are: Cyrenopsis cf. meeki, Fissilunula clarkei, "Natica" variabilis, Pseudavicula anomala, P. papyracea. Fossil wood and burrows have also been found; some indeterminate fossil logs were examined by White (1960) - see Appendix II. As pointed out by Dickins, more work may enable some differentiation to be made between the faunas of the upper part of the Blythesdale

Group and those of the Roma Formation.

The more sommon forms in the Roma Formation appear to be Cyrenopsis cf. meeki, Fissilunula clarkei, cf. Maccoyella barklyi, Mytilus inflatus (this species is very common in Roma-type assemblages in the South Australian part of the Great Artesian Basin), Pseudavicula anomala, P. papyracea, Tatella, "Yoldia" cf. randsi (but it is even more common in the Tambo Formation), Tancredia? sp. nov. A, "Natica"variabilis, Vanikoropsis? sp. nov. The belemnite Peratobelus is common; the ammonite Australiceras was collected at Gil.11 locality with a Roma-type fauna. The sponge Purisiphonia is recorded only from the Roma Formation and sponge spicules have been found in beds low in the Wilgunya Formation (below the Toolebuc Member).

The Toolebuc Member is distinguished by the presence of abundant Aucellina and Inoceramus. Dickins notes that Aucellina does not occur and Inoceramus (a strongly grooved type) is rare in the Roma Formation. On the available evidence of ammonites and belemnites, the Toolebuc Member is considered equivalent to part of the Tambo Formation; its stratigraphic position appears to be in the basal part of the Tambo Formation. It marks a change in fauna from Roma-type to Tambo-type in the Wilgunya Formation. Deepening of the Basin is suggested by Dickins as the cause of formation of the Toolebuc Member - he gives the evidence of poor supply of sand in the limestone and the forming of an environment unsuitable for pre-existing faunas as reasons for this suggestion. The faunal change may have been due also to breakdown in pre-existing barriers to migration, rapid change in climate, or, combinations of factors. Evidence for such a breakdown in barriers is given by the sudden invasion by the planktonic foraminifer Globigerina planispira into the Toolebuc Member sea within the main part of the Great Artesian Basin. Deepening of the Basin at the same time is suggested by the predominance of G. planispira in the Member and the general absence of arenaceous foraminifera. There is no evidence that the sea transgressed far beyond the limits of the outcrops of the Toolebuc Member in western Queensland. Apart from Aucellina and Inoceramus no other pelecypods have been recorded from the Toolebuc Member except for Rocellaria?and a specimen of Maccoyella in sample S220 and this could be a remanie specimen. Rocellaria? sp. which Jack and Etheridge (1892) place in the pelcypod Order Pholadacea is from the Toolebuc Member in the Springvale area. Cephalopods include Aconeceratidae, Desmoceratidae, cf. Falciferella, Labeceras, Myloceras, Puzosia, Dimitobelus. Fish scales, teeth, bone fragments, vertebral discs are common in some areas; fossil wood and burrows also occur.

Dickins states that the presence of Aucellina, "Yoldia" sp. nov., Inoceramus, Myloceras, Labeceras,and cf. Bolitoceras, in beds of the Wilgunya Formation above the Toolebuc Member indicates that the beds can be related to the Tambo Formation. Other fairly common forms which are found in the Tambo Formation are: eroded smooth specimens of Maccoyella, and "Yoldia" cf. radsi, Cyrenopsis hudlestoni, C. sp. B, Fulpia sp. nov., Grammatodon robusta, Nucula cf. truncata, and N. sp. cf. N.? sp. ind. of Etheridge Jnr (1902), Tancredia? sp. nov. B., Nuculana? sp. nov., Trigonia cinctuta, Actaeon depressus, A. hochstetteri, Anchura wilkinsoni, "Natica" variabilis. Ammonites include also Beudanticeras, Prohysteroceras?, cf. Falciferella and the common belemnite is Dimitobelus. Fish scales, teeth, bone fragments, vertebral discs and fossil wood have also been recorded. Equisitalean wood from the Tambo Formation has been examined by White (1960) - see Appendix II.

IV. MICROFOSSILS.

Although a large number of genera and species of foraminifera and some other microfossils have been identified from the Lower Cretaceous marine beds in the Great Artesian Basin, their stratigraphic importance is by no means clear. Only a few complete sections of these beds have been systematically sampled for microfossil analysis. This is because complete sections do not occur in outcrop in any one locality; only bores that start in Upper Cretaceous non-marine beds and penetrate the marine sequence below can provide the samples necessary for such analysis. As drilling for stratigraphic information in the search for oil progresses, more details of the microfossil succession in the marine beds will become available. Until then the significance of species found in outcrop samples must remain in doubt. A chart of the type prepared for macrofossils was drawn up for the microfossils; it did not show any significant results. The study of the assemblages may be useful at this stage for determining the environment of deposition.

Large collections of samples for microfossil analysis were made in 1959 in the Blythdale, Roma and Tambo areas, in the Springvale 4-mile Sheet area in the western part of the Great Artesian Basin and to the north in the Gilberton, Georgetown 4-mile areas around the edge of the Gregory Range. The microfossils found in these and other samples collected from the Great Artesian Basin in Queensland in recent years have been identified and listed by Crespin (1960). This comprehensive list and the studies of Ludbrook (1960) on bores in South Australia show some interesting features which will be useful when more detailed work can be done. Dr. Evans of the Bureau of Mineral Resources is currently engaged on the identification of microplankton and spores from bores in the Great Artesian Basin; this work will provide an important complement to that already done by Crespin and Ludbrook.

A brief examination of the results of microfossil determinations already complete has shown the following points:

(1) In general, arenaceous forms range throughout the marine succession. Their preponderance in certain places such as the Mt. Whelan 4-mile area in western Queensland may result from the marginal position of the beds or brackish water conditions. Glaessner (1945) points out, however, that arenaceous foraminifera are not always related to the '"arenaceous" character of the deposit' but, where dominant in an assemblage, may indicate cold-water conditions.

(2) Some arenaceous genera and species may be stratigraphically important. These include Ammobaculoides pitmani, A. romaensis, A. coonanaensis, Bigenerina loeblichi and Verneuilina howchini.

Crespin (1953, 1955, 1956, 1958, 1960) has referred to most of these forms and Ludbrook (1960) lists some of them in samples from the Delhi-Frome-Santos Innamincka No.1 Bore (north-east South Australia). With the possible exception of A. romaensis, all have been restricted to beds which are thought to be equivalent to the Roma Formation, or, in South

Australia, no higher than 'Lower Albian". The following have been found in association with Roma-type macrofossils - A. romaensis A. pitmani, B. loeblichi from the Roma area, V. howchini from Gil 11 locality and Crespin and Dickins (1955) record a species of Bigenerina like B. loeblichi with macrofossils Corbicula? cf. meeki* and Tatella? sp. nov., from Soldier's Cap, 25 miles south-east of Cloncurry. In the Innamincka Bore, V. howchini and B. loeblichi first appeared in the interval 2680-2770 feet; they were given the age '(?) Lower Albian' because the uppermost occurrence of these two species in the Ooodnadatta bore is in the glauconitic zone which the Journal of the Geological Society calls '"Terebratella beds" (Lower Albian)', (G.S.A., 1958). The Journal regards the zone as a transition stage between the Roma Formation (Aptian) and the Tambo Formation (Middle and Upper Albian). A. romaensis is the only one of the above species which may occur higher - Ludbrook shows cf. A. romaensis from 2051 '9" in the Innamincka Bore in the 'Upper Albian' part of the section. A. coonanaensis, however, occurs only in that part of the Innamincka section which is referred to Aptian age.

Textularia anacooraensis which Ludbrook records as fairly low in the Aptian in the Innamincka Bore may also be important.

(3) Calcareous forms which may be important in the Roma Formation or equivalent beds are Darbyella sp. 1, Eponides sp., Esosyrinx, Globigerina aff. washitensis, G. cf. graysonensis, Patellina jonesi, Tristix excavatum.

(4) The only foraminifera recorded from the Toolebuc Member are Globigerina planispira, G. cf. planispira and G. infracretacea. Radiolaria are fairly common. Samples from this bed also contain abundant to common Inoceramus prisms and fish remains. I have discussed the extent of the Toolebuc Member in the Gilberton-Georgetown report (1960); it is regarded as the basal bed in the Tambo Formation equivalent whereever it occurs. In these places also, the above species of Globigerina do not occur below the Toolebuc Member. The reason for this is not clear because G. planispira occurs throughout the marine Lower Cretaceous beds in the Karumba bore. I suggested that its occurrence in the Karumba bore in beds equivalent to the Roma Formation may have been due to the oceans having access to the Carpentaria Basin (in which the Karumba bore was drilled) at the time of the deposition of the Roma Formation; a barrier, the Euroka Shelf, may have precluded its entry into the main southern part of the Great Artesian Basin. Ludbrook (1960) shows a species of Globigerina, G. sp. ranging from Aptian to Middle Albian in the Innamincka Bore; this occurrence suggests that either the above explanation is not valid or that perhaps another barrier, not yet recognished, separated the Innamincka part of the Basin from the Central part in Roma times.

(5) Jack's Bore, Canary Station and composite samples S243, S245 (from Bores 2 and 1 respectively on Warra Station)- Springvale 4-mile Sheet area - yielded Lagena globosa, Robulus gunderbookaensis, Nodosaria aff. obscura, Arenobulimina sp., Neobulimina minima - species which were not found in other samples; as these bores started in the Toolebuc Member, the species can be attributed either to the Toolebuc Member or underlying formation (equivalent to Roma Formation).

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* Referred to in Crespin and Dickins (1955) as Corbicula? cf. meeki; Dickins (1960) now places this species in the genus Cyrenopsis.

Glaessner (1945) gives the age of Arenobulimina as Albian to Upper Cretaceous.

(6) Glaessner also gives the age of Valvulineria as Albian, Upper Cretaceous to Recent; Crespin (1960) records V. infracretacea in samples from Exley bore (385-395 feet) and W37 locality, and (1958) from various horizons in the Karumba bore - all in beds which I consider equivalent to the Roma Formation. Ludbrook's (1960) age for this species is Middle Albian - Aptian.

(7) Outcrop samples of the Tambo Formation and equivalent formations above the Toolebuc Member were generally poor in microfossils, and many specimens were badly preserved. Some of the more common species were Haplophragmoides sp., Robulus gaultinus, Trochammina minuta, Vaginulina exilus var. crispata, Verneuilinoides aff. perplexa, (Crespin, 1960).

(8) The occurrence of ?glauconitic or altered glauconitic casts of microfossils in several samples was considered under Lithology. While the forms themselves are not diagnostic, the appearance of their casts in these samples may be important.

(9) Some other microfossils have been identified but their importance is not yet clear.

a. Radiolaria are fairly common in beds referable to the Roma Formation and in that formation in its type area. As explained under Lithology, some samples in which they occur have been called "radiolarites." Their relative abundance in the Roma Formation beds has not been explained. Volcanic activity which formed the Graham Creek Volcanic Series during the time of the Blythesdale Group deposition may have been sufficiently intense to supply an environment with enought silica to support plentiful radiolaria. Radiolaria are also abundant in the Toolebuc Member of the Wilgunya Formation in western Queensland. They are rare above the Toolebuc Member in the Boulia, Springvale areas, and are not known as yet from beds equivalent to the Tambo Formation elsewhere.

In the Innamincka bore, radiolaria are known from 2730 feet and below (Ludbrook, 1960). At 2730 feet, they are in the ?Lower Albian zone of transition between the Roma and Tambo Formation equivalents.

Crespin (1958) first records radiolaria in AAO No. 8 bore Karumba in the 1955-1668 foot interval. The stratigraphic position of this interval is at the base of beds equivalent to the Tambo Formation.

Elliott (1959) who studied radiolaria in Mesozoic beds in the Middle East came to the conclusion: 'as absolute indicators of age, without associated evidence, radiolaria as commonly preserved in the Middle East are of very little use.'

b. The only discovery of diatoms made by Crespin (1960) was in Gil 11 sample; two forms were recognised. The sample is from beds in Mill Mill Creek near the south edge of the Gilberton 4-mile Sheet area. The beds are interbedded sandstone, limestone and 'slump-brecciated glauconitic acid ashstone' (Dallwitz and Bofinger, 1960); they are related to basal beds of the Roma Formation.

c. Only a few ostracods have been found in samples; they are of no use for correlation.

Fragments of macrofossils have been found in some microfossil samples and may be important. Abundant Inoceramus prisms generally suggest beds of the Tambo Formation or equivalent in bores from which other evidence of stratigraphic position is lacking. In some beds, notably above the Toolebuc Member in western Queensland, the prisms are so thick that they form a "Inoceramus prism limestone". Inoceramus has been recorded in beds below the Toolebuc Member, but it is rare and prisms from this source occur only spasmodically. Fish scales are generally abundant in limestone which forms part of the Toolebuc Member. Sponge spicules are rare in beds low in the Wilgunya Formation and equivalent to the Roma Formation.

The absence of microfossils is also considered useful when trying to differentiate between marine Tambo Formation and fresh-water beds of the Winton Formation.

V. STRATIGRAPHY.

A correlation of Upper Jurassic - Cretaceous formations in the Queensland part of the Great Artesian Basin is shown in Charts Nos. 2 and 3. Wavy lines indicate unconformities, broken lines show that the nature of the boundary is not known, and a query in the boundary means that its position is uncertain.

Chart 2 shows some of the earliest names applied to formations and how they compare with -

a. European subdivisions of the Cretaceous;

b. stratigraphic columns of Bryan and Jones (1946), David (1950), and Whitehouse (1954);

c. formations of other Mesozoic basins.

The spacing of the European subdivisions may give the wrong impression of the time span involved during these stages. Moore, Lalicker and Fischer (1952) show spacing of fossil-bearing divisions in Mesozoic rocks in their Figure 1 - 16. The Neocomian, Aptian and Turonian divisions are about the same size, the Albian is larger and the Cenomanian is larger than the Albian. The Upper Cretaceous is shown as a larger section than the Lower Cretaceous. The spacing of these subdivisions, presumably based on fossils and their ranges, is probably more realisitic; in Chart 2, the European subdivisions are spaced according to the stratigraphic columns and their correlation.

The position of the boundary between the Blythesdale Group and Roma Formation of Whitehouse (1954) is uncertain because Whitehouse has described Australiceras from the upper part of the Blythesdale Group whereas the Australiceras and the lower stages determined by him were in the Roma Formation. This position has not been clarified since the stage names have been abandoned.

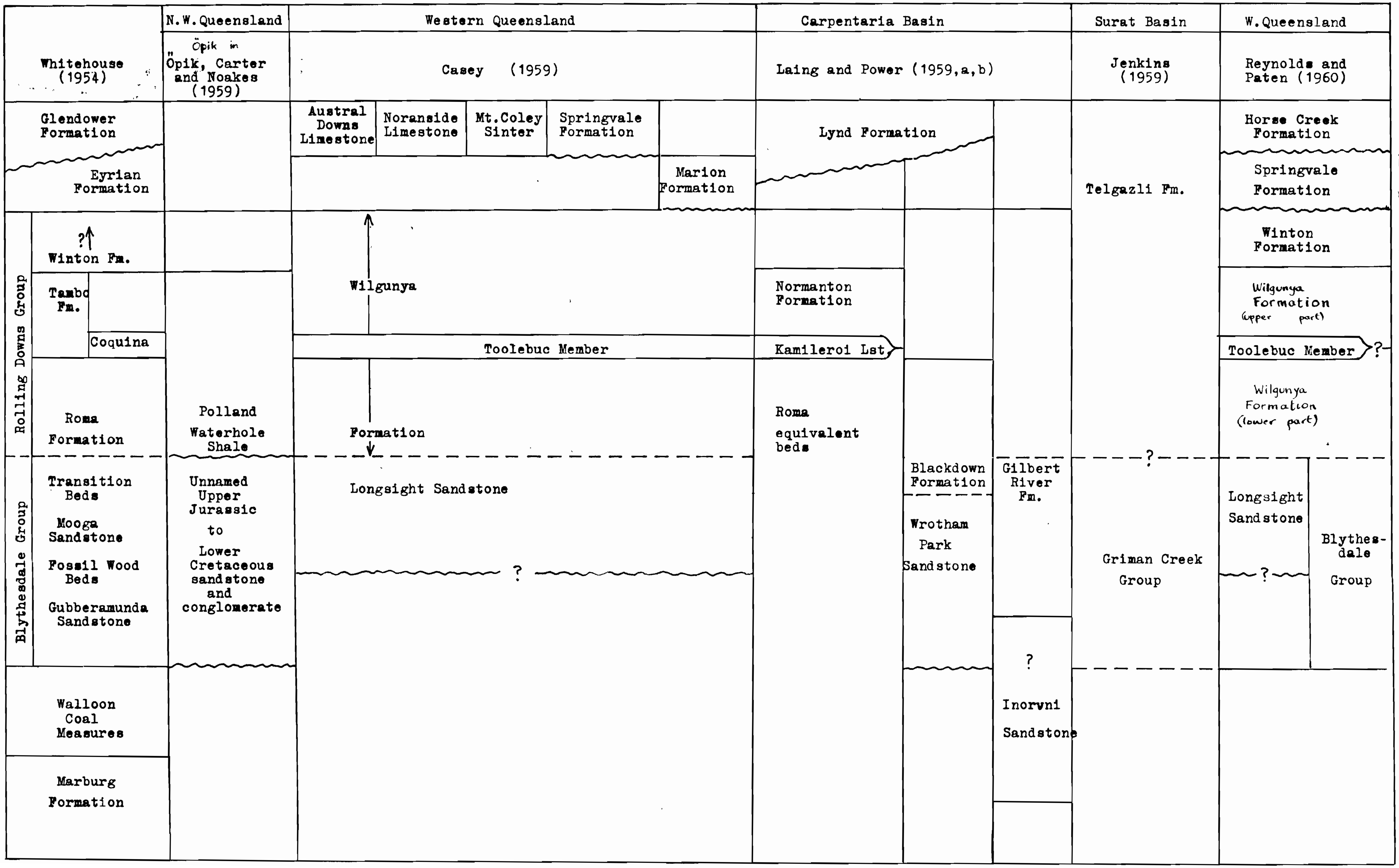
Whitehouse applied the names 'Blythesdale Group', 'Roma Formation', 'Tambo Formation' and 'Winton Formation' to the 4 main units in the upper part of the Great Artesian

CHART NO. 2. CORRELATION OF QUEENSLAND UPPER MESOZOIC AND TERTIARY UNITS USED BY VARIOUS AUTHORS BEFORE 1955 WITH EUROPEAN SUBDIVISIONS.

PERIOD		EUROPEAN DIVISIONS FOR REFERENCE	GREAT ARTESIAN BASIN: PRE – 1900 DIVISIONS	GREAT ARTESIAN BASIN: BRYAN AND JONES (1946)	GREAT ARTESIAN BASIN: DAVID ED. BROWNE (1950)	GREAT ARTESIAN BASIN: WHITEHOUSE (1954)	OTHER MESOZOIC BASINS: DAVID ED. BROWNE (1950)	OTHER MESOZOIC BASINS: BRYAN AND JONES (1946) Maryborough (Surface only)	BRYAN AND JONES (1946) Rockhampton	BRYAN AND JONES (1946) Cape York
TERTIARY			Desert Sandstone Daintree (1872)	Eyrian Series	Glendower Series; Eyrian Series	Glendower Formation; Eyrian Formation		Basalt		
CRETACEOUS	UPPER	Turonian								
CRETACEOUS	UPPER	Cenomanian		Winton Series	Winton Series	?↑ Winton Fm.	Styx River Coal Measures		?↑ Styx Series	Mein Beds
CRETACEOUS	LOWER	Albian (U, M, L)	Marathon beds (U); Hughenden beds; Etheridge (1872); Rolling Downs Formation, Jack (1886)	Tambo Series	Non-sequence; Tambo Series; Non-sequence	Rolling Downs Group: Tambo Fm.; Coquina; Non-sequence	Burrum Series	?↑ Burrum Series		
CRETACEOUS	LOWER	Aptian	Wallum-billa beds (M*); Tate River Series, Etheridge (1880)	Roma Series: Ammonitoceratan Stage; Tropeum Stage; Australiceratan Stage; Ancyloceratan Stage; ?Coilotan Stage	Roma Series: Ammonitoceras Stage; Tropeum Stage; Australiceras Stage; Ancyloceras Stage	Rolling Downs Group: Roma Formation ? Blythesdale Group: Transition Beds	Maryborough Series; Graham's Creek Volcanic Series	Maryborough Series		Plutoville Beds (Lacustrine); Rokeby Beds (Marine)
CRETACEOUS	LOWER (Neocomian)	Barremian; Hauterivian; Valanginian	Gordon Downs Beds; Dalrymple sand-stone, Woods (1880); Blythesdale Bray-stone, Jack (1895)	Blythesdale S.: Transitional Phase	Blythesdale Series (and Plutoville beds?)	Blythesdale Group: Mooga Sandstone	Stanwell Series	Graham's Creek Series	Stanwell Series	
JURASSIC	UPPER		?	Blythesdale S.: Friable and porous sandstones, grits and conglomerate	Walloon Series: Upper Stage; Middle Stage	Blythesdale Group: Fossil Wood Beds; Gubberamunda Sandstone				
JURASSIC	MIDDLE			Cunno S.: Sandstones, calcareous shale and mudstone with coal. Rhaetosaurus horizon	Walloon Series: Lower Stage	Walloon Coal Measures		Tiaro Series		
JURASSIC	LOWER			Attica Series friable sandstone	Marburg and Bundamba Series and other localities	Marburg Formation		Tiaro Series		
TRIASSIC	UPPER			Dooloogarah Series		Marburg Formation		Myrtle Creek Series		

*Maryborough beds.

CHART NO.3: CORRELATION OF UPPER MESOZOIC AND TERTIARY UNITS DESCRIBED SINCE 1955 IN THE QUEENSLAND PART OF THE GREAT ARTESIAN BASIN WITH WHITEHOUSE'S (1954) SUBDIVISION.



Basin. The Blythesdale Group is shown as Upper Jurassic - Lower Cretaceous in age, the Roma Formation is given an Aptian age, the Tambo Formation middle to upper Albian, and the Winton Formation is shown as Upper Cretaceous. The upper part of the Blythesdale Group differs from the overlying Roma Formation in lithology but not in fossil assemblage (although larger collections may show otherwise); Roma and Tambo Formations can only be divided at present on the basis of macrofossils in most places (although the Toolebuc Member and Kamileroi Limestone units which are thought to occur near the base of beds equivalent to the Tambo Formation may prove to be good marker horizons); the Winton Formation is difficult to recognise especially where above unfossiliferous Tambo Formation and in weathered outcrop (although a lithologically distinct unfossiliferous horizon at the top of the Tambo Formation could, after further testing, be a good marker horizon. As a basis for comparison of units in the two charts, Whitehouse's (1954) column is included in both.

Chart 3 has been prepared to show how names given to formations in various parts of the Great Artesian Basin compare. The list of names applied to formations which can be related to Whitehouse's units is increasing. This is mainly because surveys in various parts of the Great Artesian Basin in Queensland are not prepared to use Whitehouse's units even though the lithologies seem to be the same and similar fossil assemblages occur in the beds; but these parts are generally great distances from the type areas. Whitehouse extended his units across the Great Artesian Basin on the basis of his widespread field work and correlation of logs of hundreds of bores for water within the Basin. The danger in this approach is that minor, perhaps significant, changes in lithology may be missed. The stage has been reached, however, that the addition of further names to the stratigraphy will lead to duplication of effort and possibly confusion. More detailed work on the basic units in each known area (studies of macrofossils, microfossils and lithologies) and fitting them by reliable correlation into a framework within the Basin is now require. As further information becomes available, as it undoubtedly will during the present intensive search for oil, it can be fitted into this framework.

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APPENDIX I

Chemical analyses of samples from the Roma area, Queensland, (Yingerbay 1-mile Sheet).

Sample No. / Locality	Rom 2 Efflorescence from shales in cutting, 1½ mls. S. of Nareeten	Rom 4 Clay from south bank of Bunge-worgorai Ck., 22 mls. N. of Roma. (coarse fraction)	Rom 4 Other clay from same locality.
SiO_2	26.40	55.26	51.09
Al_2O_3	7.07	17.85	21.94
Fe_2O_3	1.18	2.52	2.13
FeO	n.d.	0.18	0.21
CaO	33.00	1.61	1.69
MgO	1.05	1.94	1.80
Na_2O	0.84	0.90	0.88
K_2O	1.26	0.40	0.59
TiO_2	0.36	0.52	0.28
P_2O_5	0.03	0.02	0.04
MnO	0.02	0.01	0.02
CO_2	22.20	n.d.	n.d.
SO_3	n.d.	n.d.	n.d.
Loss 100^{o}	0.50	12.08	10.50
Loss 1000^{o}	28.98	6.53	8.19
Total	100.69	99.82	99.36

n.d. = not determined

Note: loss at 1000 ^{o}C includes CO_2; therefore CO_2 figure is not included in total.

A. McClure
(Analyst).
4/3/60

APPENDIX II

Plant Fossil Collections from the Great Artesian Basin, Queensland.

Extract from report by M.E. White, 7/4/60.

Roma 4-mile sheet.

Locality Rom 8b: 10 miles north of Roma, on road to Injune (opposite Euthulla Siding). From freshwater-marine Blythesdale Group beds.

Two large portions of fossil log, internal preservation poor, are indeterminate.

Tambo 4-mile sheet.

Locality Tam 11a: 9 miles south of main Blackall Road. From side of road to Minnie Downs. From conglomerate in shales with fossiliferous calcareous bands. (Lower Cretaceous Tambo Formation).

A small, slightly compressed cylinder of Equisetalean wood has a node indicated by a faint transverse groove. Some preservation of cell structure is evident and sections will be cut for microscopic examination. A second specimen is a small piece of Equisetalean wood also showing a node.

N.B. Although some cell structure is preserved in many of these specimens and microscopic investigation is possible, it is not expected that the results would be of more than academic value, as the very conservative structure of wood does not allow dating of the specimens. The Equisetalean wood will be fully investigated as little is known of wood of this sort and the results might be of considerable botanical interest.

PLATE I. Photographs of radiolarian-rich rock from Winning Station, W.A. (Photographs, Miss I. Crespin.)

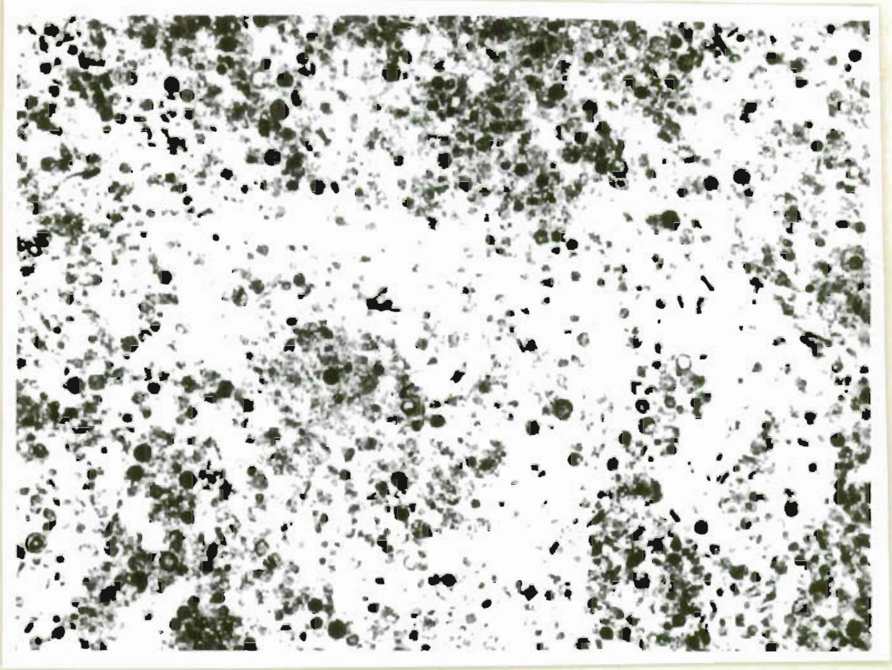

Figure 1. Radiolarian-rich rock; about x 5 magnification.

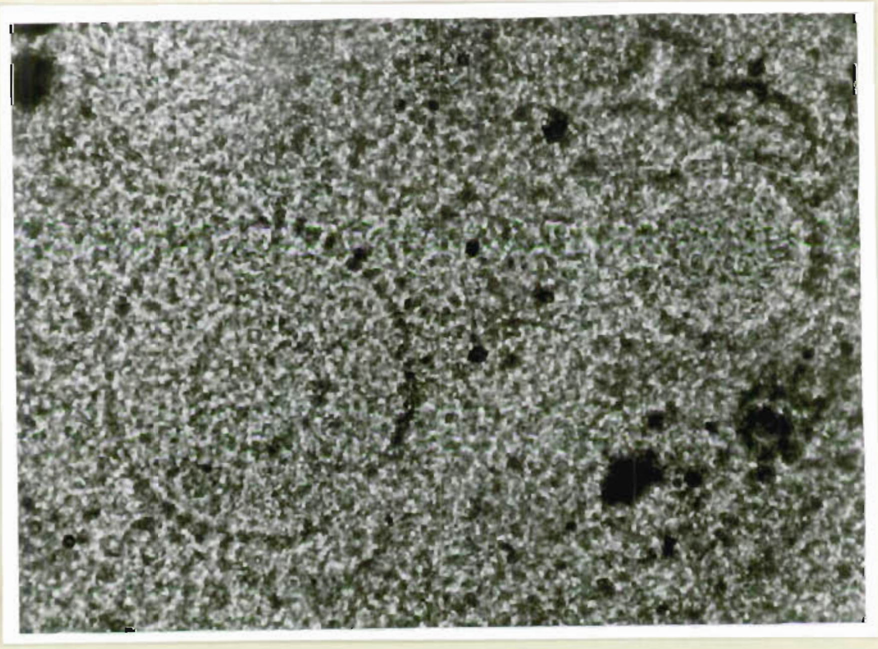

Figure 2. Radiolarian-rich rock showing similarity of rock within and outside test; about x 100 magnification.

Plate I - Continued

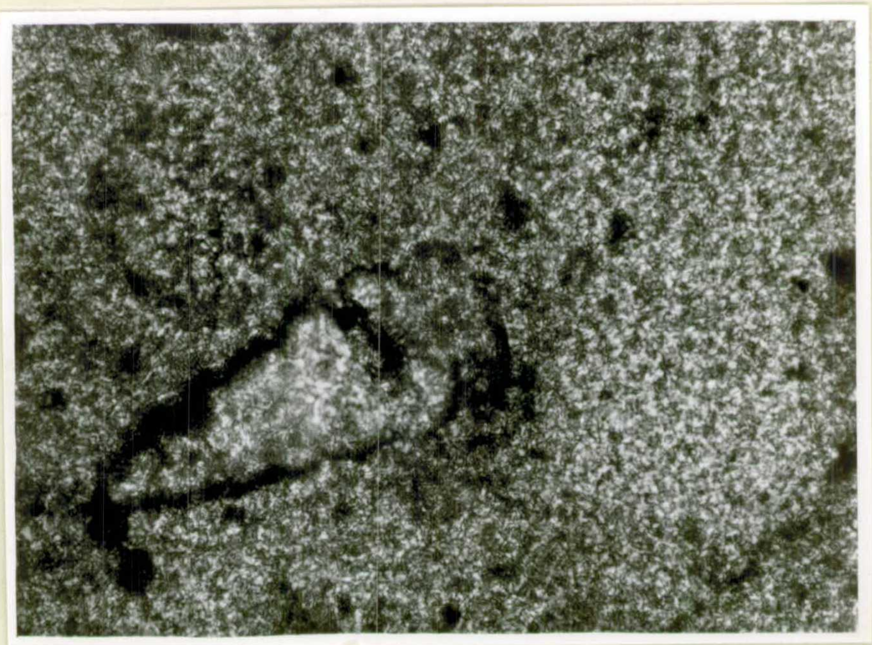

Figure 3. Radiolarian-rich rock showing similarity of rock within and outside test; about x 100 magnification. (As for Figure 2.)