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CRETACEOUS MICROPALEONTOLOGY, MURCHISON RIVER AREA, W.A.

by

D.J. Belford.

CANBERRA.

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INTRODUCTION

During the 1954 field season, the Cretaceous stratigraphy of the Murchison River area was investigated by a party comprising M.C. Konecki, S.D. Henderson, T. Quinlan and the writer. Samples collected during the survey have been examined; not all the Foraminifera have yet been determined, but this report gives the results obtained so far. Species not named have been given a number; of these, some are undoubtedly new, while others will be named as work progresses. A comparative collection has been started, to aid in identifying and comparing species from other areas, and to enable the variation and range of each form to be determined. In the faunal lists given below, only named species are included, as others, although perhaps useful for local correlation, are not at present of any value for comparison with other areas, either in the same basin or overseas.

The Cretaceous sequence in the Murchison River area consists of an apparently conformable succession of quartz sand, greensand, radiolarite, shale and chalk. Six formations have been recognised; these are, in descending stratigraphical order:-

Toolonga Chalk
Alinga Greensand
"Woonano Shale"
Thirindine Radiolarite
"Yandilla Greensand"
Butte Sandstone.

Distinct faunal assemblages have been recognised, and the observed ranges of selected species have been compared with their known world-wide ranges; this has enabled the age of the beds to be established, particularly in the upper part of the section. A chart summarises the results obtained and gives lithological and suggested palaeontological correlations. The conclusions reached may require revision if the vertical ranges of species in this area are extended as a result of more detailed sampling.

MICROFOSSILS IDENTIFIED*

The first samples examined were from a measured section at Toolonga Point, where the fauna from each formation is as follows:-

Butte Sandstone. No Foraminifera have been observed in samples from this formation.

Yandilla Greensand. Sample No. MR.32. No Foraminifera, but Radiolaria abundant; Dictyomitra australis Hinde and Cenosphaera sp. are the dominant forms. Glauconitic casts of Radiolaria are common.

Thirindine Radiolarite. Sample Nos. MR.34, 35, 36, 37, 38. No Foraminifera; Radiolaria abundant, sometimes poorly preserved. The dominant forms are again Dictyomitra australis and Cenosphaera sp. with Spongodiscus sp. also present.

Woonana Shale. Sample No. MR.39. Abundant poorly preserved Radiolaria, mainly Cenosphaera sp. with rare Dictyomitra australis. The following Foraminifera were also observed:

Ammodiscus cretaceus Cushman (r)
Pelosina lagenoides Crespin (v)
Guembelina globulosa (Ehrenberg) (v)
Haplophragmoides sp. (v)
Globigerina sp. (v)
Robulus sp. (young specimen) (v)

Alinga Greensand. Three samples, MR.40, 41, and 42, were collected. Of these, 41 was unfossiliferous, and the others contained:-

Globigerina cretacea d'Orbigny (f)
Globigerinella aspera (Ehrenberg) (r)
Guembelina globulosa (Ehrenberg) (r)
Globotruncana marginata (Reuss) (v)
G. lapparenti lapparenti Brotzen (r)
G. lapparenti Brotzen bulloides Vogler (f)
Verneuilina parri Cushman (v)
Planulina taylorensis (Carsey) (r)
Globorotalites umbilicatus (Loetterle) (v)
Dorothia bulletta Carsey (v)

Toolonga Chalk. The three samples examined, MR.43, 44, and 45, contain a very rich fauna, but that of sample 45, which has been slightly travertinised, is rather poorly preserved. The

* In the faunal lists, the abundance of each species is given, the letters indicating:-
v = very rare (1-2 specimens)
r = rare (3-5 specimens)
f = frequent (6-10 specimens)
c = common (11-25 specimens)
a = abundant (more than 25 specimens)

assemblage is:

Globigerina cretacea d'Orbigny (f)
Globigerinella aspera (Ehrenberg) (f)
Guembelina globulosa (Ehrenberg) (r)
Globotruncana ventricosa White (c)
G. marginata (Reuss) (f)
G. lapparenti lapparenti Brotzen (f)
G. lapparenti Brotzen bulloides Vogler (f)
Verneuilina parri Cushman (f)
Bigenerina compressiuscula Chapman (r)
Clavulinoides trilaterus (Cushman) (f)
Planulina taylorensis (Carsey) (f)
Dorothia bulletta (Carsey) (v)
Frondicularia mucronata Reuss (v)
Marssonella oxycona (Reuss) (r)
Bouvigerina aspera (Marsson) (f)
Vaginulina suturalis Cushman (v)
Valvulineria allomorphinoides (Reuss)
Bolivinoides strigillata (Chapman) (v)
Neoflabellina rugosa (d'Orbigny) (v)
Spiroplectammina grzybowskii Frizzell (f)

A second section, about one mile south of Toolonga Point, was also measured and sampled, and the following assemblages have been determined:

Thirindine Radiolarite. Sample Nos. 13, 18. Radiolaria common to abundant: Dictyomitra australis and Cenosphaera sp.

Woonana Shale. Sample Nos. 1, 3, 12. Common to abundant poorly preserved radiolaria, Dictyomitra australis and Cenosphaera sp. Foraminifera very rare, only Guembelina sp. and ?Anomalina sp. being observed.

Alinga Greensand. Sample Nos. 2, 10, 11. Sample 2 was unfossiliferous, and 11 contained only a small fauna:-

Foraminifera: Globotruncana lapparenti Brotzen bulloides Vogler (v)
Planulina taylorensis (Carsey) (r)
Radiolaria: Dictyomitra australis (v)
Cenosphaera sp. (v)

Sample 10, from the top of the formation, yielded a very rich fauna similar to that from the overlying Toolonga Chalk:-

Globigerina cretacea d'Orbigny (v)
Guembelina globulosa (Ehrenberg) (v)
Globotruncana marginata (Reuss) (r)
G. ventricosa White (v)
G. lapparenti Brotzen tricarinata (Quereau) (v)
G. lapparenti Brotzen bulloides Vogler (r)
Marssonella oxycona (Reuss) (c)
Planulina taylorensis (Carsey) (r)
Clavulinoides trilaterus (Cushman) (c)
Bigenerina compressiuscula Chapman (r)
Verneuilina parri Cushman (v)
Valvulineria allomorphinoides (Reuss) (v)

Gaudryina cf. laevigata Franke (r)
Globorotalites umbilicatus (Loetterle) (v)
Pleurostomella reussi Berthelin (v)
Goesella chapmani Cushman (v)
Vaginulina suturalis Cushman (v)
Bouvigerina aspera (Marsson) (v)

Toolonga Chalk. The assemblage from the two samples examined, MR.7 and MR.9, is similar to that recorded from this formation at Toolonga Point:-

Globigerina cretacea d'Orbigny (f)
Globigerinella aspera (Ehrenberg) (f)
Guembelina globulosa (Ehrenberg) (a)
Globotruncana aff. concavata Brotzen (r)
G. ventricosa White (f)
G. marginata (Reuss) (r)
G. lapparenti lapparenti Brotzen (v)
G. lapparenti Brotzen tricarinata (Quereau) (f)
G. lapparenti Brotzen bulloides Vogler (r)
G. arca (Cushman) (v)
Clavulinoides trilaterus (Cushman) (f)
Verneuilina parri Cushman (c)
Marssonella oxycona (Reuss) (f)
Bigenerina compressiusculla Chapman (c)
Dorothia bulletta (Carsey) (r)
Planulina taylorensis (Carsey) (f)
Valvulineria allomorphinoides (Reuss) (v)
Nodosaria prismatica Reuss (v)
Frondicularia mucronata Reuss (v)
Vaginulina suturalis Cushman (v)
Neoflabellina rugosa d'Orbigny (v)
Bouvigerina aspera (Marsson) (r)
Gaudryina cf. laevigata Franke (c)
Globorotalites umbilicatus (Loetterle) (v)
Bulimina reussi (Morrow) (v)
B. parva Franke (v)
Bolivinitella elegi (Cushman) (r)
Bolivinoides strigillata (Chapman) (c)
Globorotalites micheliniana (d'Orbigny) (v)

"Second Gully Shale". This name was given by Clarke and Teichert (1948) to a formation of soft green calcareous glauconitic silt and silty calcilutite, found above the Toolonga Chalk in this section. The fauna is similar to that of the Chalk, and the species determined from the two samples examined, MR.4 and MR.5, are:-

Globigerina cretacea d'Orbigny (c)
Globigerinella aspera (Ehrenberg) (c)
Guembelina globulosa (Ehrenberg) (c)
Globotruncana marginata (Reuss) (v)
G. ventricosa White (r)
G. lapparenti lapparenti Brotzen (c)
G. lapparenti Brotzen bulloides Vogler (c)
G. arca (Cushman) (r)
Spiroplectammina grzybowskii Frizzell (f)
Frondicularia mucronata Reuss (v)
Verneuilina parri Cushman (r)
Marssonella oxycona (Reuss)
Dorothia bulletta (Carsey) (f)
Neoflabellina reticulata (Reuss) (r)

Bulimina pervа Franke (r)
B. reussi (Morrow) (r)
Bouvigerina aspera (Marsson)
Valvulineria allomorphinoides (Reuss) (r)
Vaginulina suturalis Cushman (v)
Pullenia reussi Cushman and Todd (f)

Section at Pillaraw Hill

Only five samples were taken in this section, one from the "Yandilla Greensand", one from the Alinga Greensand, and three from the Toolonga Chalk. The fauna determined is as follows:-

"Yandilla Greensand". Sample No. MR.47. Unfossiliferous.

Alinga Greensand. Sample No. MR.48.

Globigerina cretacea d'Orbigny (v)
Globigerinella aspera (Ehrenberg) (f)

Toolonga Chalk. Sample Nos. MR.49, 50, 81.

Globigerina cretacea d'Orbigny (f)
Globigerinella aspera (Ehrenberg) (f)
Guembelina globulosa (Ehrenberg) (c)
Globotruncana marginata (Reuss) (f)
G. ventricosa White (r)
G. globigerinoides Brotzen (v)
G. lapparenti lapparenti Brotzen (r)
G. lapparenti Brotzen tricarinata (Quereau) (r)
G. lapparenti Brotzen bulloides Vogler (r)
Goesella chapmani Cushman (f)
Gaudryina rugosa d'Orbigny (r)
Marssonella oxycona (Reuss) (c)
Dorothia bulletta (Carsey) (f)
Bigenerina compressiuscula Chapman (f)
Verneuilina parri Cushman (f)
Clavulinoides trilaterus (Cushman) (r)
Valvulineria allomorphinoides (Reuss) (f)
Siphonodosaria aspera (Reuss) (v)
Nodosaria limbata d'Orbigny (r)
Frondicularia mucronata Reuss (r)
F. planifolium Chapman (v)
Neoflabellina rugosa (d'Orbigny) (c)
Citharina geisendorferi (Franke) (v)
Globorotalites umbilicatus (Loetterle) (r)
Planulina taylorensis (Carsey) (f)
Bouvigerina aspera (Marsson) (r)
Frondicularia sherborni Perner (v)
Spiroplectammina grzybowskii Frizzell (c)
Bolivinoides strigillata (Chapman) (r)

Three samples were collected from a scarp near the old emergency air-field. Two were taken from the Alinga Greensand, and one from the Toolonga Chalk. Another sample of the Chalk was collected on Mt. Jannawa, 10 feet above the base of the formation, and it has been included in this section. The following species have been determined:

Alinga Greensand: Sample Nos. MR. 23, 24.

Foraminifera: Globigerina cretacea d'Orbigny (f)
Globigerinella aspera (Ehrenberg) (v)
Guembelina globulosa (Ehrenberg) (r)
Globotruncana lapparenti Brotzen bulloides Vogler (v)
Planulina taylorensis (Carsey) (r)
Radiolaria: Dictyomitra australis (r)

Toolonga Chalk. Sample Nos. MR.22, 26.

Globigerina cretacea d'Orbigny (f)
Globigerinella aspera (Ehrenberg) (v)
Guembelina globulosa (Ehrenberg) (c)
Globotruncana marginata (Reuss) (r)
G. ventricosa White (f)
G. lapparenti lapparenti Brotzen (r)
G. lapparenti Brotzen bulloides Vogler (f)
G. lapparenti Brotzen tricarinata (Quereau) (f)
G. lapparenti n.sub-sp.? (v)
G. globigerinoides Brotzen (v)
Planulina taylorensis (Carsey) (c)
Marssonella oxycona (Reuss)
Verneuilina parri Cushman (c)
Gaudryina cf. rugosa d'Orbigny (r)
Dorothia bulletta (Carsey) (r)
Bolivinoides strigillata (Chapman) (c)
Neoflabellina rugosa (d'Orbigny) (v)
Valvulineria allomorphinoides (Reuss)
Eouvigerina aspera (Marsson) (c)
Goesella chapmani Cushman (f)
Gaudryina cf. laevigata Franke (r)
Spiroplectammina grzybowskii Frizzell (v)
S. laevis (Roemer) var. cretosa Cushman (v)
Bigenerina compressiuscula Chapman (v)
Clavulinoides trilaterus (Cushman) (v)
Massilina ginginensis Chapman (v)
Ramulina globulifera Brady (r)
Marginulina jarvisi Cushman (v)
Saracenaria triangularis (d'Orbigny) (v)
S. navicula (d'Orbigny) (v)
Gyroidina nitida (Reuss) (f)
Citharina geisendorferi (Franke) (v)
Frondicularia mucronata Reuss (r)
F. sherborni Perner (v)
F. goldfussi Reuss (v)
F. planifolium Chapman (r)
Robulus macrodiscus (Reuss) (v)
R. pondi Cushman (v)
Siphonodosaria aspera (Cushman) (f)
Dentalina basiplanata Cushman (f)
Nodosaria limbata d'Orbigny (r)
Dentalina cf. basitorta Cushman (v)
D. gracilis d'Orbigny (v)
Nodosaria obscura Reuss (v)
Ellipsoidella gracillima (Cushman) (v)
Dentalina lorneana d'Orbigny (v)
Nodosaria prismatica Reuss (v)

Three faunal assemblages can be recognised in this area; these are, in ascending stratigraphical order:

(1). The predominantly radiolarian assemblage extending through the Yandilla Greensand, Thirindine Radiolarite, and Woonana Shale, with rare Foraminifera in the last formation.

(2). The fauna extending through most of the Alinga Greensand, marked by the appearance of Globotruncana, and some other species which extend into the overlying Chalk, with very few Radiolaria.

(3). The assemblage first appearing at the top of the Alinga Greensand, and extending through the Toolonga Chalk, containing additional species of Globotruncana, and other distinctive species, which in this area are restricted to the Toolonga Chalk. This very rich fauna has not yet been fully examined, so that the range of each form is not known. Forms are abundant and further work will probably reveal short-ranging species, or marked variation in the abundance of species throughout their range which will enable this formation to be zoned. At present a preliminary zoning can be made, using a few common, easily recognised and restricted forms, which are indicated on the attached chart. Any zones which may be recognised will at first be of only local value; and not until the total time range of each species is known from investigations in other areas can the zones be regarded as firmly established, and capable of wide application.

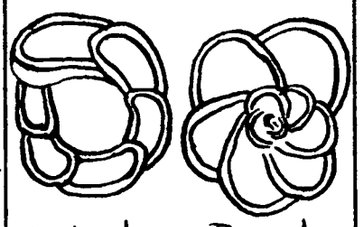
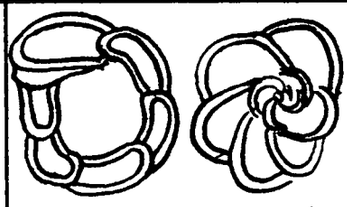
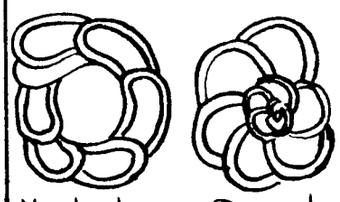
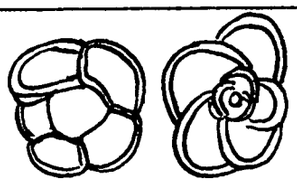
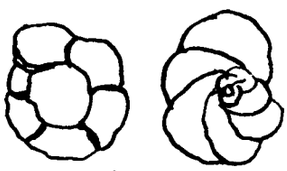
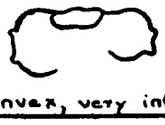
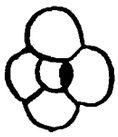
Of the species given above, the planktonic forms are regarded as the most important for determining the age of the beds. These forms have been closely studied in recent years, because they are not affected by facies change, have a potential world-wide distribution, and are rapidly dispersed. The value of species of Globotruncana, an extinct planktonic genus, is firmly established, and slight variations in form of a species have been found to be stratigraphically significant. For this, it is necessary to sub-divide species as finely as possible, and this has been done in Europe with the Globotruncana lapparenti group, which has been divided into several sub-species. Specific identifications are based on such features as number of keels, nature of dorsal and ventral sutures, and degree of convexity of surfaces; slight changes in form of the sutures, convexity of surfaces, or inflation of chambers, characterise the sub-species.

Although several species of Globotruncana have been identified from the present samples, including sub-species of G. lapparenti, more detailed work must be done before it is known if fine sub-divisions of zonal value can be recognised.

The taxonomy of the genus is confused; this makes its use difficult. Synonymous names have been applied to the same species, and different species have been described under the same name. For instance, the form recorded by Cushman from the Gulf Coast of America (Cushman, 1946) as Globotruncana marginata is now referred to G. lapparenti bulloides. Probably the greatest confusion surrounds the species G. arca. This was originally described by Cushman (1926) as a double-keeled, bi-convex form, but the name has also been applied to single-keeled forms similar to G.stuarti and G. rosetta. The error is probably Cushman's own, as in 1946 he figured two different species under the name G. arca, one being the species as originally defined, and the other a single-keeled form, later referred by Bolli (1951) to G. stuarti, and by Bandy (1951) to G. rosetta. Hamilton (1953) placed specimens with flat to "slightly" convex dorsal surfaces in G. rosetta; the dorsal surface of G. stuarti is distinctly conical. The name G. arca has been applied by the writer to double-keeled forms varying from bi-convex to more strongly dorsally convex, with beaded sutures; the ventral keel is often less well developed, and the ventral sutures often show a curvature similar to those of the G. lapparenti group.

Because Globotruncana is important, and correct identification necessary several identified specimens were forwarded for comment to Dr. H. Hagn, in Germany. He corrected the writer's identification of the sub-species of G. lapparenti, and also named the species G. aff. concavata, figures of which have not yet been found in available literature. Hagn's comment on this specimen was "the specimen shows much resemblance, but does not have a well-marked second keel", so it may prove to be a new species. The specific differences between the species of Globotruncana identified are tabulated on text-figure 1.

TEXT-FIGURE 1.

Species	No of Keels	Profile	Dorsal and Ventral views	Remarks
Globotruncana lapparenti lapparenti.	2	 Very flat dorsal and ventral surfaces.	 Ventral Dorsal. Ventral sutures very strongly curved.	
G. lapparenti tricariata	2.	 Flat dorsal, slightly convex ventral surface.	 Ventral Dorsal Ventral sutures strongly curved, thickened at umbilical margin.	Thickening of ventral sutures gives appearance of third "keel" in cross-section.
G. lapparenti bulloides	2.	 Inflated chambers, particularly on dorsal side	 Ventral Dorsal Ventral sutures strongly curved, often depressed in later chambers.	Dorsally, resembles G. marginata, distinguished by curvature of ventral sutures.
G. marginata.	2.	 Bi-convex, inflated dorsal and ventral chambers.	 Ventral Dorsal. Ventral sutures radial or only slightly curved, often depressed	The inflated chambers give a globigerinid appearance.
G. ventricosa.	2.	 Flat dorsal, very convex ventral surface	 Ventral Dorsal. Ventral sutures curved, sometimes raised near umbilicus	Curvature of ventral sutures may resemble lapparenti-type.
G. globigerinoides.	2.	 Biconvex, very inflated dorsally and ventrally	 Ventral. Ventral sutures depressed, radial.	Keels weakly developed. Described simply as a "keeled Globigerina".

An interesting feature of these specimens is the frequent presence of an umbilical cover-plate. This feature was included in the description of the genera Rotalipora Brotzen and Thalmaninella Sigal, as distinguishing them from Globotruncana, but its presence in Globotruncana has been mentioned before (Cushman, 1940). Other features, such as apertural characteristics, and course of ventral suture lines, still separate these genera.

Another important genus is Bolivinoides, which is used for detailed zoning of the Upper Cretaceous in Europe. Edgell (1954) investigated its occurrence in the Carnarvon Basin and identified and determined the stratigraphical range of five species, in samples from the Giralia anticline and the Brickhouse bore, near Carnarvon. One of these species, Bolivinoides strigillata, occur in the Murchison River area, and its significance will be discussed later.

AGE OF THE FAUNA.

Assemblage (1) gives no clue to its age and an age must be assumed for these beds from a knowledge of the age of the overlying beds. More definite conclusions can be drawn from assemblage (2), containing Globotruncana lapparenti lapparenti, G. lapparenti bulloides, G. marginata, Globigerina cretacea, and Globigerinella aspera. None of these species are known below the Turonian, and Globigerinella aspera does not extend below the Upper Turonian. The base of the Upper Turonian is placed below samples containing this assemblage, and the lower beds containing an indefinite assemblage are regarded as ?Cenomanian-Lower Turonian.

Assemblage (3) contains distinctive species which enable it to be sub-divided into stages. Species additional to those already mentioned are Globotruncana ventricosa, G. lapparenti tricarinata, and G. globigerinoides. The most important of these is G. ventricosa, which, although it has been recorded from the top of the Turonian (Brotzen, 1936) is usually not found below the Coniacian. Hamilton, (1953) indicated in a chart its

occurrence in the Upper Turonian, but stated its range to be Coniacian to Maestrichtian. G. globigerinoides also is not found below the Coniacian, but it does not occur as low in the section as does G. ventricosa, and the base of the Coniacian is therefore drawn below the samples containing the latter species.

There may be an hiatus between the Alinga Greensand and the Toolonga Chalk in the Murchison River area, indicated by a layer of phosphatic nodules at the base of the Chalk. The evidence of the foraminifera, neither proves the existence of a break, nor gives any estimate of its duration if it does exist. The chart shows that the species are too long-ranging to enable short time breaks to be recognised.

The species Bolivinoides strigillata has been found in all sections examined, in the upper part of the Chalk. In Europe, this species ranges from the Upper Santonian to Lower Campanian, and its appearance here has been taken as marking the beginning of Upper Santonian time. Slightly higher in the section, Globotruncana arca (Cushman) has been found associated with Bolivinoides strigillata in one sample; it also occurs higher in the section without Bolivinoides. G. arca is a Campanian-Maestrichtian guide form, but as it is rare, and has not yet been found in all sections, Upper Santonian and Campanian have not been separated. It is associated with Neoflabellina reticulata in the "Second Gully Shale". N. reticulata is said to be restricted to the Maestrichtian (Reiss, 1952; Pozaryska, (1954), and the "Second Gully Shale" is tentatively regarded as Maestrichtian in age. This age determination would be confirmed if other species, such as Globotruncana stuarti, G. conica or Bolivinoides draco draco were discovered.

The species recorded here are all long-ranging, and it has not been possible to make small time divisions. It is not claimed that the age divisions given above will not be changed; rather, it is hoped that further information will enable additional or more precise age divisions to be made. The method used here, or relating observed ranges to known world-wide

ranges and thus establishing some time divisions as a basis for future work, is thought to be the best approach to the problem. Using this method, the Cretaceous sequence has been divided into: Cenomanian-Lower Turonian/Upper Turonian/Senonian (Coniacian-Lower Santonian)/Senonian (Upper Santonian-Campanian/?Maestrichtian.

ADDITIONAL SAMPLES EXAMINED.

Samples collected from other localities have been examined.

Sample MR.77, from the "Woonana Shale" was unfossiliferous. Samples MR.65, 67, 69, and 70, all from the Alinga Greensand, were either unfossiliferous, with a very glauconitic residue, or contained only poorly preserved radiolaria.

Sample MR.68, from a scarp near the Weerinogudda Dam, yielded the following assemblage:

Guembelina globulosa (v)
Globotruncana ventricosa (v)
G. lapparenti lapparenti (v)
G. marginata (v)
Planulina taylorensis (f)
Eouvigerina aspera (c)

All these species range through the Chalk, and it is not possible to determine the exact stratigraphical level of this sample; but it is most probably Lower Senonian.

Samples MR.74, 87, and 88, from the upper part of the Chalk, have been travertinised, and the foraminifera are encrusted, and specifically unidentifiable.

In the Shark Bay area, a small scarp on the coast near the Hamelin Pool Telegraph Station was measured and sampled. The species determined from samples SB.39, 40, 41, 42, 43, and 44 are:-

Guembelina globulosa (f)
Globigerina cretacea (v)
Globigerinella aspera (r)
Globotruncana lapparenti lapparenti (f)
G. lapparenti tricarinata (r)
G. lapparenti bulloides (r)
G. arca (r)
G. ventricosa (r)
G. marginata (v)
Neoflabellina reticulata (v)
Spiroplectammina grzybowskii (f)

Dorothia bulletta (f)
Bouvigerina aspera (r)
Verneuilina parri (r)
Marssonella oxycona (v)
Frondicularia sherborni (v)
Palmula cf. pilulata (v)

The species Neoflabellina reticulata occurs only in the upper part of the section, and the assemblage is regarded as Senonian (Campanian)-Maestrichtian in age. This section is correlated with the upper part of the Toolonga Chalk, and the "Second Gully Shale".

Samples SB.47 and 48, from a scarp along the Geraldton-Carnarvon road, near Yaringa North Homestead, gave a similar assemblage.

Two samples, SB.52 and 53, were taken from the bottom of quarries on the Geraldton-Carnarvon road. 52 was unfossiliferous, and 53 gave an assemblage similar to that from the Hamelin Pool section.

Three samples were taken from a water bore on "Coburn" Station. Two, SB55 and 57, were unfossiliferous, the former being very glauconitic. 54 contained abundant, poorly preserved radiolaria, and very rare, poorly preserved foraminifera, among which Planulina taylorensis was identified. This is considered to be a sample of Alinga Greensand. From another bore on the same station (new No.6) a sample from a depth of about 300 feet contained Globotruncana area, the general assemblage being the same as that previously recorded.

Samples MR.121, 147, 149, 151, and 152, from the Coolcalalaya-Yallalong area, were all unfossiliferous.

CORRELATION WITH OTHER AREAS.

The micropalaeontology of the Giralia anticline has been investigated by Edgell (1952). In this area, the assemblages are somewhat different from those recorded in the Murchison River area, particularly in the lower part of the section. Foraminifera are common through the Muderong Shale, Windalia Radiolarite and Gearle Siltstone in the Giralia anticline, but are absent in the "Yandilla Greensand" and Thirindine Radiolarite in the Murchison

River area, and occur only rarely in the "Woonana Shale". The forms Pelosina lagenoides and Ammodiscus cretaceus were recorded by Edgell from the Muderong Shale and Gearle Siltstone and have also been found in the "Woonana Shale" at Toolonga Point. Radiolaria occur throughout both intervals, and also belemnites, the latter being more common in the Gearle Siltstone and the Alinga Greensand.

The fauna of the Alinga greensand has some species in common with that determined by Edgell from 189 feet below the top of the Gearle Siltstone, notably Globigerina cretacea, Globigerinella aspera, and Planulina taylorensis. In addition, Edgell recorded Globotruncana arca, which indicates that the beds are not older than Campanian, and the base of this stage would have to be placed lower in the Gearle than is shown by Edgell.

The form was referred to as a "dwarfed specimen", and it may therefore be some other species. In this case, the other planktonic forms would at least indicate that the beds are not older than Upper Turonian.

Comparison of the microfauna of the Korojon Calcarenite and the Toolonga Chalk shows further differences between the two areas. This may be expected, as the disconformity between the Gearle Siltstone and Korojon Calcarenite is not present in the Murchison area, where there is at most only a small hiatus between the Alinga Greensand and the Toolonga Chalk. The species Bolivinoides strigillata, which is first known in Upper Santonian time, has not been recorded from the Giralia anticline. An examination of available faunal slides of the Korojon Calcarenite showed the presence of Globotruncana arca at the base of the [redacted] of the formation, where it was previously recorded by Edgell. (This identification was also confirmed by Dr. Hagn.) It is intended, if possible, to obtain specimens of G. arca from America for comparison with the Australian form. If these should also be identical, the identity of the Australian form may be regarded as established, and beds containing it may be regarded as Senonian (Campanian)-Maestrichtian in age.

R.O. Brunnschweiler, (in Condon, 1954), regarded the Korojon as Santonian in age on the evidence of the few ammonites found in the formation. The presence of Globotruncana arca suggests that the Korojon Calcarenite may be Campanian, the disconformity representing at least Coniacian-Santonian and perhaps some part of the Lower Campanian. This is supported by the absence of Bolivinoides strigillata from the Giralia anticline, and if it were correct, the disconformity between the Korojon Calcarenite and the Miria marl could not represent the interval Upper Santonian-Lower Middle Campanian as suggested by Brunnschweiler. It is suggested that the lower part of the Toolonga Chalk, containing Bolivinoides strigillata, was deposited during the time of the non-depositional interval in the Giralia area.

The determination by Edgell of Globotruncana arca in the Gearle Siltstone has not been confirmed, but if correct it would extend the base of the Campanian still further, and the non-depositional interval suggested here would be wrong. There are some irregularities in the Globotruncana succession as presented in the Giralia report, and examination of the original material would be necessary to clarify them. After further work, Edgell prepared a distribution chart in which the range of some species was altered from that originally given, and additional species of Globotruncana were recorded. The ages assigned to the various formations were not altered, and the chart still does not contain sufficient information to enable detailed comparisons to be made.

In the Giralia area, deposition continued into Maestrichtian time, as shown by the occurrence of Globotruncana stuarti, G. conica and Bolivinoides draco draco and Neoflabellina reticulata in the Miria Marl. Only the last species has so far been found in the Murchison River area, but this is sufficient evidence for the tentative recognition of Maestrichtian age. In the Giralia area, there was a second depositional break, between the Korojon Calcarenite and Miria Marl, and it is

suggested that it was of short duration, towards the end of the Campanian. Brunnschweiler regarded the Miria Marl as late Campanian and early Maestrichtian in age, so the main differences of opinion concern the age of the Korojon Calcarenite, and the duration of the non-depositional interval between the Korojon Calcarenite and Miria Marl.

The Rough Range No.1 well gave a complete Cretaceous sequence, but the ranges of species are in doubt, as they may continue through the section owing to contamination of samples. The lower part of the section is again different. The well samples contain numerous arenaceous foraminifera, whereas they are absent in the Murchison River area. No assemblage observed in this area can be compared with that occurring in the well below the depth of 2,000 feet, and this assemblage has not yet been found in any surface samples. Radiolaria are more abundant in the lower formations in the Murchison area than in samples of the Windalia Radiolarite or Gearle Siltstone from the well. Some species of Foraminifera, such as Verneuilina parri, Planulina taylorensis, Dorothia bulletta, Spiroplectammina grzybowskii, Globigerina cretacea, and Bouvigerina aspera occur in the upper Gearle Siltstone and Korojon Calcarenite in the well, and in the Alinga Greensand and Toolonga Chalk in the Murchison area.

The faunas of the Gingin Chalk and the Toolonga Chalk are very similar. The species Massilina ginginensis and Bigenerina compressiuscula were first described by Chapman (1917) from the Gingin Chalk. Cushman later (1936) described Verneuilina parri and Goesella chapmani. These four species occur in the Toolonga Chalk, and other species in common are Marssonella oxycona, Gumbelina globulosa, Dorothia bulletta, Dentalina lorneiana, Nodosaria obscura, N. prismatica, Frondicularia archiaciana, F. sherborni, Vaginulina suturalis, Marginulina jarvisi, Saracenaria triangularis, Neoflabellina rugosa, and Globigerina cretacea. Which species of Globotruncana, or of other diagnostic genera, are present in the Gingin Chalk is not known and a precise age cannot be assigned to it; but it

can at least be regarded as of Senonian age.

Bolivinoides strigillata has been recorded from the Brickhouse bore (Edgell, 1954). This indicates beds of either Upper Santonian or Lower Campanian age, but as the complete assemblage is not known, the age cannot be stated definitely. The occurrence of this species suggests either that there is no depositional break here or that the break is of shorter duration than in the Giralia area.

Although they are of no value in establishing detailed world-wide age correlations, it may be mentioned that several benthonic species of foraminifera recorded in the Murchison area occur also in Upper Cretaceous beds in the Gulf Coast region of the United States.

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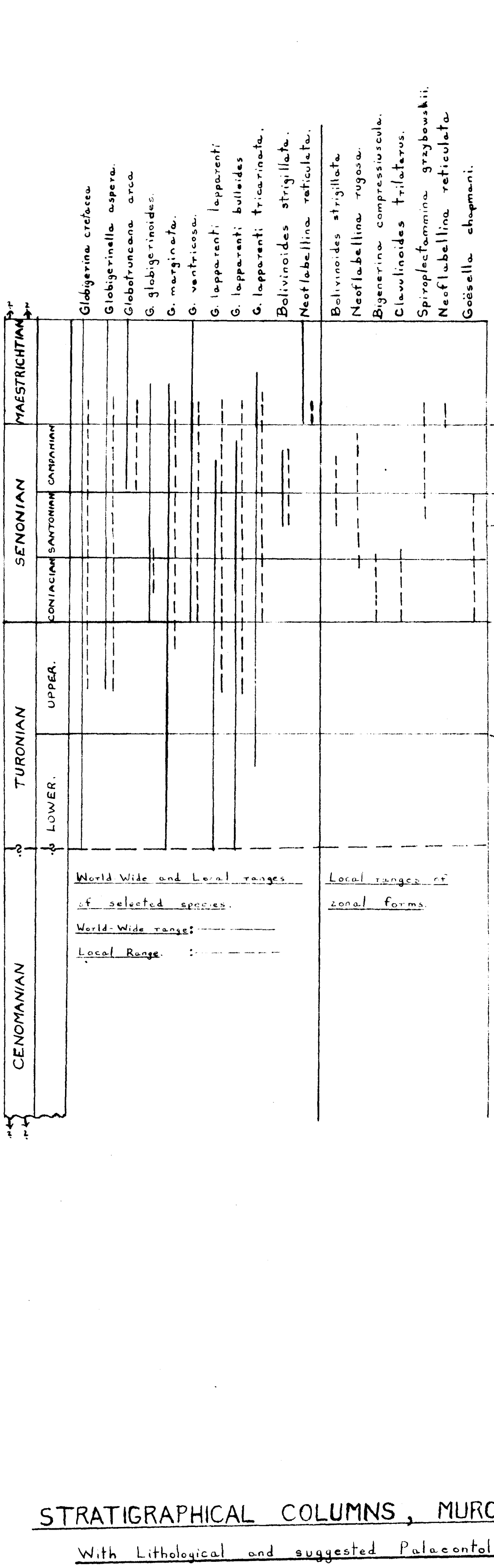

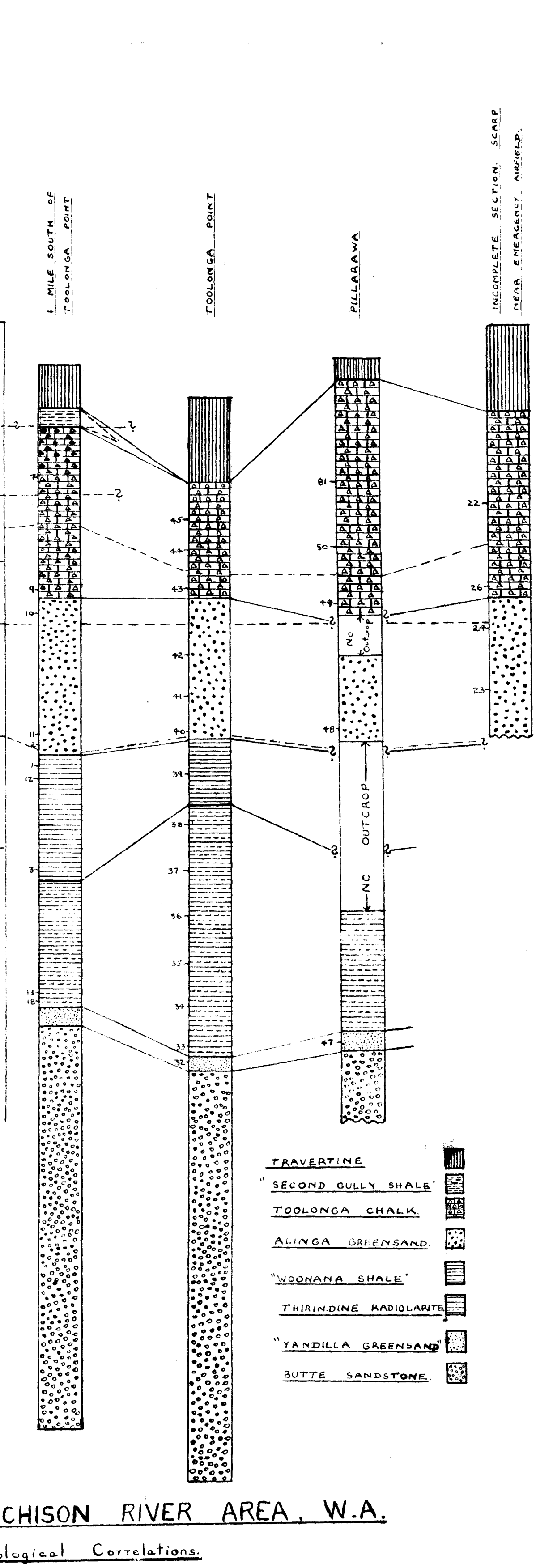

STRATIGRAPHICAL COLUMNS, MURCHISON RIVER AREA, W.A.

With Lithological and suggested Palaeontological Correlations.

Lithological Correlation: ————————

Palaeontological " : — — — — — —

SCALE : 1 inch = 20 feet.

All Samples have prefix MR.