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PALAEONTOLOGICAL EXAMINATION OF BORES IN THE WESTERN PORTION OF THE EUCLA BASIN.

by

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Abstract

Drill cores from four bores in the Western Australian portion of the Eucla Basin and two bores in the South Australian portion reveal a sequence of over 1200 feet of Cretaceous mudstones, sandstones and greensands overlain by a maximum of 900 feet of Upper Eocene and Lower Miocene limestones. An unexpected thickness of 900 feet of post-Albian greensands and mudstones is present in Madura No.1 Bore. These are believed to be equivalent in part at least to the greensands of the Gingin District.

1. Introduction

Through the courtesy of the Government Geologist, Western Australia, cores from Madura No.1, Madura No.2, Exploratory Bore No.3. 337-mile peg Trans-continental Railway, 245 mile bore, Trans Railway and specimens from Murrawijinnie Cave, Murrawijinnie Bore and Delisser's Bore were made available for palaeontological study. The assistance of the Geological Survey of Western Australia in this matter is gratefully acknowledged.

2. Stratigraphic Sequence

(1) Basement

Highly metamorphosed Archaean basement rocks were entered at 1370 feet in 337 mile bore.

(2) Mesozoic shales and sandstones

The oldest sediments of the Eucla Basin so far determined were entered at the bottom of Madura No.1. Bore where fossiliferous carbonaceous sandstones of Aptian age occur below 1979 feet, resting on laminated shales, the thickness of which is not proved.

Overlying the Aptian are 1050 feet of paralic sandstones and glauconitic sandstones grading to greensands of possible Albian to Santonian age. The greensands are poorly fossiliferous with fish remains and, rarely, tests of arenaceous foramin-

ifera. In the upper portion of the interval the glauconite is characteristically bright green in colour. These greensands apparently thin out to the north as they are not present in the 337-mile bore.

Correlation with the Molecap Greensand is suggested for part at least of this interval. From the Molecap Greensand plesiosaur bones, fish bones, a belemnite and pelecypods have been reported (Fairbridge, 1953, p. X/2). In addition, the writer has recovered microscopic fish teeth and a small microfauna of planktonic and arenaceous foraminifera including Trochammina spp.

Bolivina sp. Buliminella obtusa (d'Orbigny)

Globigerina cretacea d'Orbigny,

Globorotalites conicus (Carsey)

Gümbelina globulosa Ehrenberg,

Planulina sp.

Many of the spherical glauconite grains are infillings of radiolaria whose lattice shell pattern is microscopically discernible on the surface of the glauconite grains.

The foraminifera suggest that the Molecap Greensand is not greatly older than the Gingin Chalk (Santonian). Globigerina cretacea ranges from upper Coniacian to lower Maestrichtian (McGugan,) 1957) which would place the Molecap not older than upper Coniacian (i.e. lower Senonian).

The Cretaceous glauconitic sands are overlain by Tertiary sands and limestones.

(3) Tertiary sands and limestones.

The base of the Tertiary is marked by 22 feet of limonitic quartz sand and gravel with polished limonite grains. Above this the Nilsen's Bluff Limestone of upper Eocene age, attains its maximum thickness of 873 feet in Madura No.1 Bore. The limestone is a chalky bryozoal calcarenite with flint bands. On the Nullarbor Plain it is overlain by the dense crystalline Nullarbor Limestone (Lower Miocene) which appears to have been removed from the Roe Plain by marine erosion. In this area Pleistocene shelly limestones rest directly on Nilsen's Bluff

limestone.

3. Examination of the Bores.

W.A. GOVERNMENT SURVEY

Exploratory Bore No.1 . Madura.

Location — Madura, about 30 chains south from face of Hampton Range escarpment.

110 feet above sea level

Reference 4880 Drilled P.W.D. 1902

0' - 8'	Light loam
8' - 30'	Cream shelly limestone, with chalky molluscan shells in a recrystallized matrix, of Pleistocene age.
30' - 508'	White bryozoal limestone. Only one sample available over the whole interval the exact depth of which is not stated. The limestone is composed almost entirely of remains of bryozoa. Diagenesis has proceeded too far for ready identification of the foraminifera which include Textularia sp., cf. Stomatorbina terrei (Cushman & Bermudez), Gyroidina sp. The boring entered the Wilson's Bluff Limestone (Upper Eocene) on this interval.
508' - 766'9"	Dense chalky limestone with chalcedonic bands, characteristic of the Wilson's Bluff Limestone.
766'9" - 908'	Greenish white partially recrystallized glauconitic, bryozoal limestone, with poorly preserved foraminifera dominated by planktonic species.

Pullenia sp.

Cassidulina sp.

Cibicides sp.

Globigerina mexicana Cushman

Globigerina sp.

Globigerinoides index Finlay

cf. Heronallenia pusilla Parr

903' - 904'8" Brown, calcareous grit. This is apparently the basal bed of the Wilson's Bluff Limestone. It consists of coarse grains of limonite from the underlying sands and polished coarse subrounded quartz grains in a calcareous matrix.
Moulds of pelecypod fragments are present.

904'8" - 927'3" Brown, coarse limonitic quartz sand and gravel, with glossy irridescent grains of limonite and glauconite altering to limonite. The sample is considerably contaminated from the overlying limestone.
The boring is considered to be still in the Eocene at this depth.
The name "Hampton Conglomerate" has been applied to the formation (Fairbridge, 1953, p X1/9), which bears a lithological similarity to the South Maslin Sands of the Adelaide Basin.

927' 3" - 928'6" Hard band.

928'6" - 963'6" Grey-green highly glauconitic silty sand. The sample is carbonaceous and consists of medium to coarse angular to subrounded quartz grains with abundant irregular grains of bright green glauconite, and in lesser abundance grey quartz grains, intergrowths of glauconite and hematite, large rounded grains of opaline quartz and pyrite. A single specimen of Haplophragmoides sp. cf Kunnaa Cushman & Waters and one test of an arenaceous foraminifer were recovered from the washings.

963' - 968' Greenish grey hard fine-grained glauconitic sandstone.

968' - 988' Greenish-grey highly carbonaceous glauconitic silty sandstone. Washings consist of bright green glauconite grains, silt particles, polished fine to medium subangular to subrounded clear quartz grains, a few arenaceous foraminifera including

Haplophragmoides sp., and fish remains

988' - 1016'8" Greenish-grey glauconitic silty grit. Washings bright green glauconite grains, silt particles, coarse subrounded both grey opaline and clear quartz grains with fractured surfaces muscovite and rarely arenaceous foraminifera. Haplophragmoides sp. cf. rugosa Cushman & Waters. Haplophragmoides sp., Haplophragmoides cf. glabra Cushman & Waters.

1016'8" - 1018'6" Hard ferruginous greensand, with dominant pale green glauconite and subrounded quartz grains in an ironstone matrix.

1018'6" - 1072'8" Grey-green fairly hard silty pyritic greensand, with chlorite, muscovite and fish remains. No foraminifera were recovered.

1072'8" - 1104' Grey-green soft unconsolidated silty greensand, with light green irregular glauconite grains, fine to medium angular to subrounded clear quartz with both polished and etched surface. Fish remains are present; no foraminifera were detected.

1104' - 1470' At 1104 feet there is a change in lithology and the greensands are replaced by a light grey carbonaceous mudstone with a hard band at 1365 - 1365'6"

1470' - 1471' Hard brown ferruginous band.

1471' - 1486' Dark grey soft mudstone.

The mudstone is carbonaceous and glauconitic with fine angular quartz grains, both dark and light green glauconite grains, pyrite, and considerable staining with green mineral.

An assemblage of small arenaceous foraminifera of Upper Cretaceous affinities is present.

Haplophragmoides spp.

Haplophragmoides cf. glabra
Cushman & Waters

Spiroplectammina cf. semicomplanata (Carsey)

Spiroplectammina sp.

Gaudryina sp.

Verneuilina sp.

Marssonella trochus (d'Orbigny)

Marssonella cf. elliserae Cushman

Trochammina sp.

1486' -1486'6" Hard band.

1486'6"-1523' Dark grey mudstone, carbonaceous and glauconitic as 1471-1486, with a similar microfauna:

Haplophragmoides spp.

Haplophragmoides cf. glabra Cushman & Waters

Ammobaculites sp.

Spiroplectammina cf. semicomplanata (Carsey)

Spiroplectammina sp.

Dorothia spp.

Dorothia cf. glabrata Cushman

Trochammina spp.

Cibicides sp.

1523' - 1775' At 1523 the boring entered grey fine grained carbonaceous argillaceous sandstone.
Washings consist of fine angular quartz grains, much silty matter, iron oxide, small grains of pale green glauconite, muscovite, pyrite. The sample effervesces strongly on boiling in washing soda.
No foraminifera were detected.

1775' - 1839' Greenish grey fine grained sandstone.
As the previous sample, the sandstone is silty and glauconitic.

1839' - 1979' Grey sandy carbonaceous mudstone, with fine grains of pyrite and pale green glauconite. No foraminifera were observed, but the radiolaria Dictyomitra and Cenosphaera are present.

1979' - 1991' Dark grey-brown micaceous carbonaceous sandstone and grit.
Washings consist of angular quartz grains, botryoidal hematite, chlorite, kyanite, felspar, actinolite,

pyrite, and abundant arenaceous foraminifera mostly undescribed but similar to those occurring in the Lower Cretaceous of the Great Artesian Basin in South Australia.

Involutina sp.

Haplophragmoides dickinsoni Crespin

Haplophragmoides sp.

Textularia anaccoreasis Crespin

Siphotextularia sp.

Spiroplectammina spp.

Dorothia sp.

Trochammina cf. raggatti Crespin

Trochammina simata Crespin

Trochammina sp.

1991' - 1991'6" Hard band.

1991'6"- 2014' Brown silty fine sandstone

Washings consist of fine angular quartz grains, silty matter, limonite chlorite, muscovite.

Foraminifera

Involutina spp.

Haplophragmoides dickinsoni Crespin

Haplophragmoides spp.

Haplophragmoides Chapmani Crespin

Textularia anaccoreasis Crespin

Spiroplectammina sp.

Dorothia sp.

Marssonella cf. oxycona Cushman

Gaudryina cf. parallela (Reuss)

2014' -2015' Hard band.

2015' -2041' Brown incoherent sandstone.

Washings of angular quartz grains, limonite-stained felspar, chlorite, muscovite.

Foraminifera

Haplophragmoides dickinsoni Crespin

Haplophragmoides spp.

Textularia anaccoreasis Crespin

Marssonella cf. exsuai Cushman

Trochammina cf. rasnatti Crespin

Trochammina sp.

2041' - 2049' Sand debris from bottom of bore, apparently deepened as 2041' noted as being bottom of hole.

2049' - 2101' Grey fine laminated micaceous shale with coarse subangular quartz grains plant fragments and muscovite. As only a small amount of core available, sample was not washed for microscopic examination.

Correlation

From surface to 8 feet the bore was logged as passing through light loam.

Quarternary sediments.

Pleistocene 8 - 30 feet

Below 8 feet the boring passed through 22 feet of Pleistocene shelly limestone typical of that overlying Wilson's Bluff Limestone on the Roe (Eyre) Plain. As the Nullarbor Limestone appears to be absent south of the Hampton Scarp it is considered that the scarp represented the Pleistocene shore line and not in fault scarp as claimed by some writers.

Tertiary

1. Eocene(Wilson's Bluff Limestone) 30 -903 feet

Unfortunately only one sample was kept as typical of the interval 3.0 - 508 feet. This is the Wilson's Bluff Limestone of Upper Eocene age, to be correlated with the Tertachilla Limestones of the Adelaide Basin and part of the Bunclouch Group in the Murray Basin. The Limestone is glauconitic near the base which is marked by a basal grit 1 feet 8 inches thick.

2. Eocene.(Hampton Conglomerate") 904'8" - 927'3"

The formation name was applied by Fairbridge without definition or correlation. Correlation with Eocene sands of the Adelaide Basin is based mainly on lithology and on the fact that carbonaceous beds of Eocene age outcrop at Pidinga on the eastern margin of the Eucla Basin. The formation appears

to be 22 feet 5 inches thick in the bore.

Cretaceous

1. Santonian 927'3" - ? 1523'

At 927 feet 3 inches the boring passed into highly glauconitic silty sands grading into greensands. The sediments are carbonaceous with occasional arenaceous foraminifera and fish remains indicating deposition under paralic conditions. No direct correlation is possible from the foraminifera but it is suggested that the greensands may be equivalent to the Molecap Greensand of the Gingin - Dandaragan area.

Below 1471 feet the greensands are replaced by soft mudstones with a microfauna of small arenaceous foraminifera with Upper Cretaceous affinities.

2. ? Cenomanian - Albian 1523 - 1979 feet

The only faunal evidence which could be obtained for purposes of correlation within this interval is the presence of Dictyomitra sp. and Cenosphaera sp. which have been recorded from the Windalia radiolarite of the North West Division.

3. Aptian 1979 - 2014 feet.

At 1979 feet the boring passed into carbonaceous sandstones with abundant arenaceous foraminifera typical of Lower Cretaceous (Aptian) sediments of the Roma Series in the Great Artesian Basin in South Australia.

The whole of the Cretaceous sequence is paralic, all sediments being carbonaceous and mostly glauconitic.

Palynological study of the core of this bore should be undertaken to confirm the correlations based on arenaceous foraminifera and to establish the age of the sediments which did not appear to contain any foraminifera, particularly in the intervals 1104-1470, 1523-1979, 2049-2101 feet.

R.W. Fairbridge (Australian Stratigraphy 2nd ed. 1953 Univ. W.A. textbooks) gave the name "Madura Shale" (P. XI/9) without definition and contrary to the Australian Code of Stratigraphic Nomenclature to a formation claimed to underlie "the Eucla Limestone (and Hampton Conglomerate where present) " and to overlie the Loongana Conglomerate (p. S/9). It is uncertain to which portion of the Madura Bore this is intended to apply. The age of the "Madura Shale

is stated on p. X/9 to be Tertiary, on p. XI/9 to be Cretaceous.

W. A. GOVERNMENT SURVEY
BORE No.2 30 MILES NORTH OF MADURA
410 feet above sea level
REFERENCE 4625 DRILLED P.W.D.

0 - 6 feet	No core.
6 - 30 feet	Cream dense lime-stone with molluscan moulds and the foraminifera Marginopora vertebralis Blainville and abundant miliolidae. This is Nullarbor Limestone (Lower Miocene)
30 - 34 feet	No sample available
34 - 72 feet	Cream partially recrystallized limestone with Cibicides pseudoungerianus Cushman, Gypsina howchini Chapman, Amphistegina lessoni d'Orbigny, Operculina sp., Nonion sp.
72 - 75 feet	Hard white somewhat chalky limestone
75 - 104 feet	Cream partially recrystallized limestone with essentially the same microfauna as 34-72 feet poorly preserved but including Operculina and Amphistegina
104 - 130 feet	White limestone
130 - 175 feet	White limestone
175 - 185 feet	Cream hard recrystallized limestone with Guttulina sp. Cibicides pseudoungerianus Cushman, Neoretalia cf. howchini (Chapman, Parr & Collins), Amphistegina sp. and a shark's tooth.
185 - 200 feet	Cream limestone
200 - 216 feet	Hard cream limestone
216 - 230 feet	Cream recrystallized limestone with a poorly preserved coral.
230 - 246 feet	Cream soft limestone (small sample only)
246 - 260 feet	Cream soft limestone (small sample)
260 - 284 feet	Cream recrystallized limestone as 216-230 feet with a few bryozoa and foraminifera and an occasional glauconite grain. Diagenesis has proceeded too far for identification of the fauna.

284 -300 feet As previous sample

300 -318 feet no core available

318 -326 feet Pink recrystallized limestone with a few poorly preserved foraminifera and bryozoa.

326 -340 feet No core available

340 -360 feet Cream recrystallized limestone with echinoid spines, a few foraminifera too poorly preserved for identification. One species appears to be close to or identical with Cibicides pseudoconvexus Parr.

360 -410 feet No core available

410 -412 feet Cream recrystallized bryozoal limestone with poorly preserved small foraminifera with a Wilson's Bluff Limestone aspect.

Correlation

The poor state of preservation of most of the microfossils and the small size of the samples renders it difficult to distinguish clearly the boundary between the Nullarbor Limestone (Lower Miocene) which was entered at 6 feet depth, and the Wilson's Bluff Limestone in which the boring ceased at 412 feet. The following correlation is therefore tentative only.

0 - 216 feet Nullarbor Limestone (Lower Miocene)

Samples from 34 - 185 feet carry a microfauna of Lower Miocene age. From 6 to 34 feet the core is typical of the upper portion of the Nullarbor Limestone while the fauna of the less dense limestone from 34 to 185 feet with Batesfordian affinities occurs near the base of the Nullarbor Limestone elsewhere.

216 - 318 feet There is insufficient information available to determine the age of the limestone in this interval. The relatively poor fauna may indicate either transitional sediments of late Oligocene-early Miocene ("Longfordian") age or the weathered upper portion of the Wilson's Bluff Limestone:

318 - 412 feet Wilson's Bluff Limestone (Upper Eocene)

Although the faunas are poor, the lithology and condition of preservation of the microfauna permits determination of the Wilson's Bluff Limestone below 315 feet.

W.A. GOVERNMENT SURVEY.
EXPLORATORY BORE NO. 3.
337 MILES E.G. TRANSCONTINENTAL RAILWAY
REFERENCE 11229 DRILLED P.W.D. 1907.

? Surface — Reference 1/1243 1-8

1. Pink hard limestone with numerous corals bryozoa and molluscan moulds, including
   Corals: cf. Placotrochus sp.
   Pelecypoda: Fulvia sp. cf. tenuicostata(Lamarck)
2. Weathered recrystallized limestone with corals (Placotrochus etc.),bryozoa, molluscan moulds.
3-8 Selected specimens from the same limestone. These are all samples of weathered Nullarbor Limestone (Lower Miocene), presumably outcropping near the bore.

0 - 3 feet	Surface soil
3 - 50 feet	Dense pinkish cream crystalline limestone with abundant miliolidae and Haplophragmoides vertebralis Blainvillle: Nullarbor Limestone.
50 - 65 feet	No sample: logged as "soft limestone"
65 - 67 feet	White recalcified bryozoal limestone with Cibicides subconifer (?) Parr. Although the faunal evidence is slender, the appearance of the sample suggested that the boring has here entered the Wilson's Bluff Limestone (Upper Eocene)
67 -130 feet	Pink-cream bryozoal limestone
130 -149 feet	White bryozoal limestone
149 -413 feet	White bryozoal limestone (Wilson's Bluff Limestone)
413 -478 feet	Wilson's Bluff Limestone, with flints.
478 -530 feet	Dense white bryozoal limestone
530 -630 feet	No sample -logged as "soft limestone with flints.?
630- 813 feet	No sample (logged as soft green sandy shale)
813-816 feet	"Hard band" (no sample)
816-857 feet	"Sandy shale with hard bands" (no sample)

857 - 860 feet "Hard bands of shale" (no sample)

860 - 890 feet "Soft sandy shale"

? Sample of greenish grey sandstone with fine angular quartz grains, pale green irregular grains of glauconite.

892 - 905 feet "Soft sandy shale"

905 - 910 feet Hard greenish-grey limestone

910 - 1270 feet Grey carbonaceous mudstone, leaving little residue on washing.

Washings consist of fine angular quartz grains, pale green irregular glauconite grains, muscovite, pyrite, with the radiolaria Lithocyclia sp., Dictymitra sp. and small impoverished foraminifera Trochammina sp., Siphotextularia sp.

1270 - 1344 feet "Fine and coarse sands"

Sample 1290-1293 ft. is grey limestone 1293-1344 grey granite.

1344 - 1370 feet "Decomposed granite"

1370 - 1372 feet Gneissic Archaean basement.

Correlation

The loss of labels on some of the deeper core samples has made it difficult to relate these samples to the bore log.

Tertiary limestones

1. Nullarbor Limestone 3 - ? 50 feet.

Below surface soil and apparently outcropping in the vicinity of the bore is the Nullarbor Limestone of Lower Miocene age.

2. Wilson's Bluff Limestone ?50-630 feet.

At 65 feet, possibly at 50 feet, the boring entered the Upper Eocene Wilson's Bluff Limestone of a maximum thickness of 580 feet in the Bore.

3. Mesozoic

(1) Albian (in part) 630-1270'

The material still available from depths below 630 and 910 feet is insufficient to determine the age of the shale with limestone bands apparently penetrated in this interval. If, as seems possible, the

two species *Aucella hughendensis* and *Maccoyella corbiensis*, were recovered here, an Upper Albian age is indicated

(2) ? Albian

The name "Loongana Conglomerate" was introduced by Fairbridge (1953, p. X/9) without redescription of the core for the "fine and coarse sand with hard bands and granite boulders" between 1260 and 1314 feet. Only 2 samples are now available, one of which is calcareous and the other granite. There is no evidence to suggest the presence of Aptian sediments.

4. Archaean basement.

At 1370 feet the boring entered highly altered basement rock with a calcareous matrix.

W.A. GOVERNMENT SURVEY
BORE REFERENCE 1/319.
245 mile bore, Transcontinental Railway

4 labelled samples.

0 - 4 feet Yellow-brown clacareous clay

4 - 42 feet Hard travertine

42 - 96 feet Fragments of cream-coloured, hard, dense fossiliferous limestone mixed with surface soil.

The limestone carries abundant miliolidae, together with *Marginopora vertebralis* Blainville.

This is Nullarbor Limestone,. of Lower Miocene age.

96 - 250 feet ,Cream-colourdd, chalky crystalline limestone with some glauconite. Organic remains are poorly preserved but bryozoa, echinoid spines fragments of brachiopod shells and the foraminifera *Spirillina* sp., cf. *Stomatorbina torrei* (Cushman & Bermudez), *Cibicides umbonifer* Parr, *Cibicides vortex* Dorreen, *Cibicides* sp., *Asterigerina adelaidensis* (Howchin), *Crespinella* sp. may be recognized. This is Wilson's Bluff Limestone, of Upper Eocene age.

MURRAMIJINNIE CAVE

Reference 1/1244

9. Cast of Pulinices sp. in crystalline limestone (Nullarbor Limestone)
10. Cast of volute indet.
11. Cast of venerid indet.
12. Distorted cast of gastroped indet
13. Cast of gastroped indet.
14. Cast of gastroped indet.
15. Recrystallized bryozoal limestone with fragment of Chlamys eyrei (Tate).
16. Piece of a stalactite.

Specimens 9-15 have been collected from the Nullarbor Limestone (Lower Miocene)

MURRAMIJINNIE BORE 60-100 FEET

depth in shaft
REFERENCE 1/1245

17. Nullarbor Limestone with Chlamys eyrei (Tate) and cast of probably Antigona sp.
18. Weathered recrystallized cream bryozoal limestone (Nullarbor Limestone) with Chlamys eyrei (Tate)
19. Nullarbor Limestone with Glycymeris sp. volute indet, and Marginopora vertebralis Blainville
20. Cast of Alcithoe (Cottonia) sp., Common at base of Nullarbor Limestone.
21. Limestone with Vasticardium sp. and Marginopora vertebralis Blainville
22. No sample.
23. Recalcified limestone, with venerid indet.
24. Recalcified limestone with venerid indet and Dentalium sp.
25. Recalcified limestone with gastroped indet.
26. Recalcified limestone with fragment of Antigona sp., pelecypod indet, bryozoa, mould of ? Placotrochus.

Specimens 17-26 are from the Nullarbor Limestone.

Belisser's Bore at 147 feet

Reference 1/1246

27. Cast of large gastropod ?Turbo sp.

28. Portion of Nautilus sp. cf. geelongensis Foord

These belong to the Nullarbor Limestone

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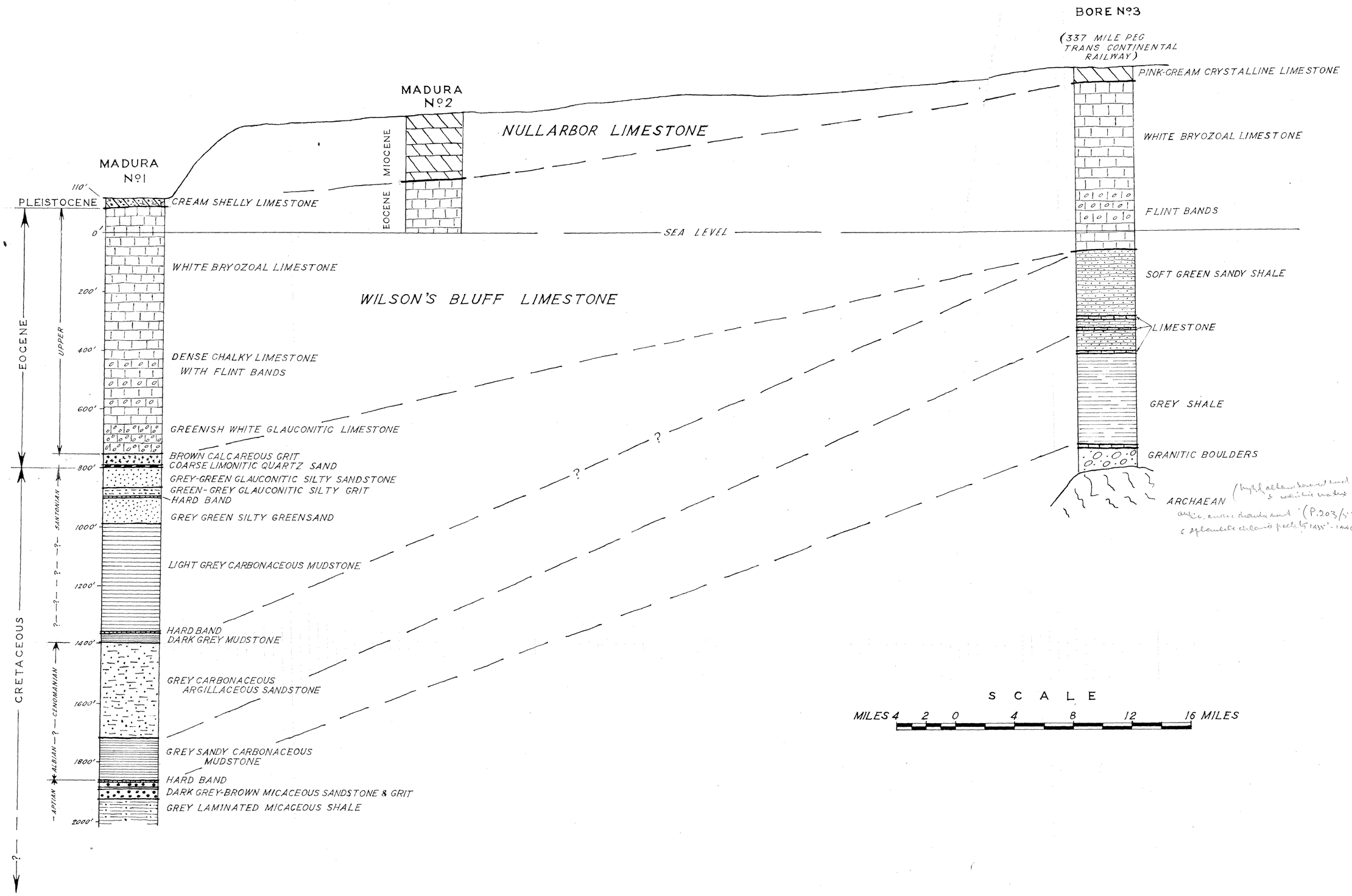

To accompany report , G.S. 780 (Pal. 8/57), by N.H. Ludbrook.

S.A. DEPARTMENT OF MINES

Associated Drawing	No.	No.	Amendment	Exd.	Date	Req. No. D.M. Compiled from	SECTION FROM MADURA TO 337 MILE PEG TRANS—CONTINENTAL RAILWAY WESTERN AUSTRALIA

Approved	Passed		Scale 4 miles to 1 inch
		Drn.	57-303
		Tr. M.J.T.	994-1
Director of Mines		Ckd.	
		Exd.	Date 27 · 9 · 1957