1959

WESTERN AUSTRALIA

REPORT

OF THE

GEOLOGICAL SURVEY BRANCH

FOR THE

YEAR 1958

EXTRACT FROM THE REPORT OF THE DEPARTMENT OF MINES

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DIVISION IV

Annual Progress Report of the Geological Survey Branch of the Mines Department for the Year 1958

CONTENTS

NOTE.

A change in the Mines Department's publication policy now re-establishes the practice in vogue up to and including 1953, whereby reports compiled for publication during the year are published with the Annual Report. The above reports are therefore published herewith. Reports for the years 1954, 1955, 1956 and 1957 have yet to be published. (20/1/59).

LIST OF PLATES

LIST OF FIGURES

DIVISION IV

Annual Progress Report of the Geological Survey Branch of the Mines Department for the year 1958

Under Secretary for Mines,

I have the honour to submit for the information of the Honourable the Minister for Mines, my report on the operations and progress of the Geological Survey for the year ended 31st December, 1958.

STAFF.

Strength as at 31st December.

Professional.

Ellis, H. A., B.Sc., A.O.S.M. (N.Z.)	Government Geologist		9
Berliat, K., D.Sc. (Switzerland)	Senior Geologist	....	
Sofoulis, J. B.Sc. (W.A.)	Geologist Grade 1	....	
de la Hunty, L. E. B.Sc. (W.A.)	Geologist Grade 1	....	
Low G. H., B.Sc. (W.A.)	Geologist Grade 1	....	
Noldart, A. J. B.Sc. (Syd.)	Geologist Grade 1	....	
Wyatt, J. D., B.A. (W.A.)	Geologist Grade 2	....	
Connolly, R. R.	Geologist Grade 2	....	
Bartram, G. D., B.Sc. (W.A.)	Geologist Grade 2	....	

Clerical.

Rasmussen, R. F.	Clerk	....	3
Potts, H. G.	Junior Clerk	....	
Miller, J. B. (Mrs.)	Typist	....	

Laboratory.

Fimmell, L. H.	Laboratory Technician		1

Promotions, Resignations, Appointments.

Mr. J. W. Duggan, Geologist, resigned on 2nd April, 1958.

Miss S. V. White resigned on 9th April, 1958 after a lengthy period of loyal and very efficient service as technical stenographer and typist.

Mrs. J. B. Miller replaced Miss White on 9th April, 1958.

PROFESSIONAL STAFF.

The approved establishment for professional officers as at 31st December, is as follows:—

Position	Occupant
Government Geologist	H. A. Ellis
Senior Geologist	K. Berliat
Geologist Grade 1	J. Sofoulis
Do. do.	L. E. de la Hunty
Do. do.	G. H. Low
Do. do.	A. J. Noldart
Geologist Grade 2	J. D. Wyatt
Do. do.	R. R. Connolly
Do. do.	G. D. Bartram
Do. do.	Vacant
Do. do.	Vacant
Do. do.	Vacant

Despite repeated attempts to fill the three Geologist Grade 2 vacancies by Australia-wide advertisement throughout the year, no suitable persons applied, and the requirements of the Hydrological Section had to be met from existing staff. This meant reduced activities in the other spheres of our operations.

The following tabulated statement shows the relation between the area of the State and the availability of geologists during the year:—

Period	No. of Geologists available including the Government Geologist	Area of State (sq. miles)	Square Miles per Geologist	Population of State
Jan.-Mar.	10	975,920	97,592	709,307
Apl.-Dec.	9	....	108,400	....

Activities of Professional Officers.

H. A. Ellis, Government Geologist.

In addition to head-office duties, I attended a Conference of State and Commonwealth Government Geologists in Adelaide in August. In July a visit was made to the Nullagine-Marble Bar area in connection with the Manganese Survey in progress there. Field inspections were made in Busselton area in connection with Water Supplies during February, in the Esperance district on the same subject during April, and in the Leonora district in connection with the Sons of Gwalia Gold Mine during May.

K. Berliat, Senior Geologist.

January.—Annual Leave. Preparatory work in connection with Hill River Hydrological Survey.

February-April.—Long Service Leave.

May.—Sick Leave.

June-December.—Hydrological Survey—Selection of water drill sites and drilling supervision, Hill River and Kalannie areas.

J. Sofoulis, Geologist, Grade 1.

January-February.—Office duties and compilation of reports.

March-June.—Hydrological field work, Eneabba-Hill River-Gingin areas.

July-September.—Survey of Belele, Meekatharra, Wiluna and Kingston 4-mile sheets in conjunction with C.S.I.R.O. Land Research Unit.

October-December.—Photogrammetric work in connection with above Survey.

L. E. de la Hunty, Geologist, Grade 1.

January.—Inspection manganese deposits Phillips River Goldfield.

February.—Report writing.

March.—Water Supply Beverley. Manganese investigations (Horseshoe deposit).

April.—Iron reconnaissance with South Australian Director of Mines.

May-October.—Field work on Manganese Survey Pilbara Goldfield.

November.—Report writing.

December.—Visited Bureau of Mineral Resources, Canberra, A.C.T.

G. H. Low, Geologist, Grade 1.

January.—Supervision and report writing of Bamboo Creek and Burnakura Diamond Drilling.

February-May.—Long Service Leave.

June.—Survey of Tallering Range Iron Ore Deposit.

July.—Various investigations connected with coal, oil and beach sands. Preparation of a Tectonic Map of Western Australia.

August.—Work on Tectonic Map. Supervision of Tallering Diamond Drilling. Investigation of Wildara Station Gold Find.

September.—Investigation of proposed new colliery areas at Collie. Work on Tectonic Map.

October.—Various investigations connected with coal and oil. Supervision of Tallering Diamond Drilling. Work on Tectonic Map.

November.—Indexing Bulletin 109. Investigation of Murchison River Phosphate Deposit.

December.—Western No. 4 Colliery investigation. Investigation of proposed new colliery area south-east of Cardiff. Supervision of Tallering Diamond Drilling.

A. J. Noldart, Geologist, Grade 1.

January-March.—Pilbara Goldfield Resurvey Bulletin compilation.

April-July.—Supervision Goldfields Drilling and Bulletin compilation.

August.—Preparation Leonora-Gwalia District Survey.

September.—Field work Leonora-Gwalia District and Goldfields Drilling Supervision.

October-December. — Supervision Goldfield Drilling—Bulletin compilation and compilation Explanatory Notes—Marble Bar Sheet.

J. D. Wyatt, Geologist, Grade 2.

January.—Office duties.

February.—Report on Water Supply at Dalwallinu, Wongan Hills and Moulyinning. Report writing and office duties.

March.—Examination of manganese deposits at Peak Hill and Tendindewa with L. E. de la Hunty. Office duties.

April.—Examination of various iron deposits in State with L. E. de la Hunty. Miscellaneous inspections.

May-July.—Miscellaneous investigations. Report writing.

August-November.—Mapping in Donnybrook area. Visit to Ord River damsite, Wyndham. Report writing.

December.—Examination of Serpentine damsite. Report writing and office duties.

R. R. Connolly, Geologist, Grade 2.

January-July.—Iron Survey, Tallering area. Mapping and miscellaneous inspections.

August-December.—Miscellaneous inspections and Coolgardie drilling programme.

G. D. Bartram, Geologist, Grade 2.

January.—Annual leave. Investigation of possible manganese, iron and uranium deposit, Norseman.

February.—Investigation Bremer Range iron deposit. Hydrological Survey, Hill River Area.

March-December.—Hydrological Survey of Hill River, Gingin, Dandaragan, Mendel-Wongoondy, Tenindewa-Bindoo Hill and Kalannie areas. Annual leave.

J. W. Duggan, Geologist, Grade 2.

January-March.—Diamond drilling supervision, Great Fingall and Mount Morgan.

FIELD WORK.

Field Work Completed during the year and in Progress as at 31st December.

(1) Completion of Diamond Drilling at Bamboo Creek.

(2) Completion of Diamond Drilling at Mt. Morgans.

(3) Completion of Diamond Drilling at Burnakura and Agnew.

(4) Commencement of Diamond Drilling at Coolgardie.

(5) Continuation of Diamond Drilling at Day Dawn.

(6) Preparation for Diamond Drilling at Yilgangie.

(7) Preparation for detailed geological survey of an area surrounding Leonora.

(8) Continuation of Iron-Ore Survey of the State.

(9) Continuation of Manganese-Chromite Survey of the State.

(10) Commencement of exploratory Diamond Drilling of the Tallering Range iron-ore deposits.

(11) Geological mapping, the collection of underground water data, and supervision of percussion drilling for water in various parts of the State.

Field Work Planned for 1959.

(1) Supervision of Diamond Drilling at Coolgardie, Yilgangie, Tallering Range, Day Dawn and any other operations arising out of the Mines Department's drilling policy.

(2) Continuation of geological work and supervision of water-boring in connection with the Water Drilling Section of the Mines Department and the Hydrological Section of the Geological Survey.

(3) Commencement of a Regional Geological Survey of an area between Coolgardie and Norseman covered by the 4-mile = 1 inch Sheets Boorabin, Widgiemooltha, Lake Johnston and Norseman.

(4) A geological survey of the country surrounding Leonora and the Sons of Gwalia Gold Mine.

(5) A regional geological survey of the Balfour Downs 4-mile = 1 inch Sheet in continuation of the search for manganese.

TRANSPORT.

Tabulated details of transport at present in use by the Geological Survey are as follows:—

Vehicle W.A.G.	Make and Type	Load (cwt.)	Mileage as at 31/12/58	Mileage for 1958	Date Vehicle Purchased	Remarks
3678	Dodge Utility	15	33,433	9,405	1955 (new)	
4475	Land Rover Utility	10	22,155	15,640	1957 (new)	
3535	Land Rover Utility	10	43,012	5,732	1955 (new)	
2044	Dodge Utility	18	73,787	3,577	1950 (new)	Disposed of 16/4/58
4793	International Utility	20	4,254	4,254	1958 (new)	Purchased 7/5/58
3135	Fargo Utility	15	55,347	10,207	1954 (new)	
2412	International Utility	14	95,643	1,791	1950 (new)	Disposed of 2/10/58
5009	International Utility	20	2,610	2,610	1958 (new)	Purchased 19/9/58
4691	International Utility	20	18,164	17,776	1957 (new)	
3876	Land Rover Utility	10	29,672	8,728	1956 (new)	
2393	International Utility	14	108,901	10,944	1950 (new)	
4559	Land Rover Utility	10	21,872	18,375	1957 (new)	
909	Willys Jeep	5	43,136	471	1953 (new)	

Total miles : 109,510.

SERVICE TO THE GENERAL PUBLIC, MINING INTERESTS AND GOVERNMENT DEPARTMENTS.

This Branch continues to render an extensive service under this heading in the form of consultations, written reports, field examinations and making publications available. The lag in publication of our reports is a serious handicap to our efficiency in dealing with many enquiries.

Hydrological Section.

Two officers of the existing staff of nine were continuously in the field in connection with the search for underground water during the year. The areas investigated were broadly, the coastal area south from Dongara to Gingin west of the Midland Railway Line, the Kalannie district and the Mullewa-Mingenew area.

The section has not been able to function as it was intended it should, on account of having to devote most of its time to the selection and supervision of three holes per location (block) on the basis of "no water-no pay."

A valuable aquifer containing potable subartesian water was discovered at around 600 feet in the Badgingarra Townsite area (about 30 miles north-west of Moora) in the initial stages of the work, but requirements of the Government's policy precluded its further exploration, and nothing further is known about its attitude or extent. This could be an important aquifer in an area in which shallower ground water is very scarce.

ACTIVITIES OF THE COMMONWEALTH BUREAU OF MINERAL RESOURCES.

The principal activities of the Bureau during the year were centred in some stratigraphic drilling in the Canning and Carnarvon Sedimentary Basins, airborne magnetometer and scintillometer surveys in the Eastern Goldfields, and detailed investigations of some major manganese deposits under the direction of an officer from this Survey. The airborne magnetometer surveys are being made at my request, as the technique is of great value in regional geological surveying.

PUBLICATIONS.

Issued during 1958.

Bulletin 110—The Geology of the Phillips River Goldfield, by J. Sofoulis, B.Sc.

Bulletin 111—The Exploratory Diamond Drilling of the Koolyanobbing Iron Ore Deposits for Pyrite, by H. A. Ellis, B.Sc., A.O.S.M.

Mineral Resources Series.

Bulletin 6—The Gypsum Deposits of Western Australia, by L. E. de la Hunty, B.Sc., and G. H. Low, B.Sc.

Geological Sketch Map of W.A. in 1 Sheet—40 miles to 1 inch.

Annual Progress Report of the Geological Survey of Western Australia for the year 1955—Administrative Section only.

Annual Progress Report of the Geological Survey of Western Australia for the year 1956—Administrative Section only.

In the Press.

Bulletin 109—Miscellaneous Bulletin—contains reports for 1954.

Bulletin 112—Miscellaneous Bulletin—contains reports for 1955.

Bulletin 113—Miscellaneous Bulletin—contains reports for 1956.

Compiling and Awaiting Authority to Print.

Reports for 1957—previously published as part of our Annual Report up to 1953 inclusive.

In Course of Preparation.

A bulletin on the Geology of the Nullagine and Marble Bar 4-mile = 1 inch military sheets.

A Mineral Resources Bulletin on the Iron Ore Resources of W.A.

A Mineral Resources Bulletin on the Manganese and Chromite Resources of W.A.

A Mineral Resources Bulletin on the Copper Deposits of W.A.

H. A. ELLIS,
Government Geologist.

19/1/59.

THE SEARCH FOR OIL IN WESTERN AUSTRALIA IN 1958.

By G. H. Low, B.Sc.,
Geological Survey of Western Australia.

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Introduction.

The oil search activities in W.A. during 1958 have been confined to drilling and survey operations by West Australian Petroleum Pty. Ltd., and to drilling operations by the Bureau of Mineral Resources.

Kalgoorlie Goldfields Petroleum Pty. Ltd., allowed their Permits 42H and 46H in the Eucla Basin to expire on 9th February, 1958 and Westralian Oil Ltd., allowed Permits 69H and 70H in the Canning Basin, to expire on 12th July, 1958.

Oil Drilling and Exploration (W.A.) Pty. Ltd., applied for, and was granted, on 15th September, 1958, seven Permits to Explore covering 91,240 square miles in the Eucla Basin.

West Australian Petroleum Pty Ltd. completed the hole at Learmonth (total depth 7,636 feet on 28th January), and have also completed test wells at Samphire Marsh (6,664 feet), Meda (8,809 feet), and Goldwyer (4,720 feet). This amounts to 20,699 feet of drilling during 1958.

The Bureau of Mineral Resources have completed stratigraphic holes at Wallal (total depth of Buromin No. 4A—2,229 feet), at Gwalia (2,070 feet) and at Mudenong (1,002 feet and 1,997 feet).

A summary of these holes and the results is as follows:—

Company: West Australian Petroleum Pty. Ltd.

Licence to Prospect: 52H.

Well: Learmonth No. 1 Test Well.

Position: Approx. Lat. 22° 10′ 58″ S. Approx. Long. 114° 03′ 30″ E. Height of derrick floor above sea level—75 feet.

Spudded in: 24th September, 1957. Completed at 7,636 feet on 28th January, 1958 in Permian Sandstone. Some minor amounts of gas were detected in cores.

Company: West Australian Petroleum Pty. Ltd.

Licence to Prospect: 53H.

Well: Samphire Marsh No. 1 Test Well.

Position: Approx. Lat. 19° 31′ 08″ S. Approx. Long. 121° 10′ 8″ E. Height of derrick floor above sea level—28 feet.

Spudded in: 18th February, 1958.

Status: Abandoned at 6,664 feet on 4th May, 1958 in Pre-Cambrian rocks. There were no indications of oil or gas.

Company: West Australian Petroleum Pty. Ltd.

Licence to Prospect: 54H.

Well: Meda No. 1 Test Well.

Position: Approx. Lat. 17° 24′ 00″ S. Approx. Long. 124° 11′ 30″ E. Height of derrick floor above sea level—100 feet.

Spudded in: 8th June, 1958.

Status: Completed at 8,809 feet on 19th November, 1958 in Pre-Cambrian rocks. Several gas and slight oil showings were recorded from the Laurel Formation (Lower Carboniferous) and from the Devonian section. An estimated three gallons of crude oil was recovered by a drill stem test at 5,110-5,133 feet in the Upper Member of the Laurel Formation.

Company: West Australian Petroleum Pty. Ltd.

Licence to Prospect: 55H.

Well: Goldwyer No. 1 Test Well.

Position: Approx. Lat. 18° 22′ 47″ S. Approx. Long. 122° 22′ 58″ E. Height of derrick floor above sea level—268 feet.

Spudded in: 17 August, 1958.

Status: Completed at 4,720 feet on 25th October, 1958 in Pre-Cambrian rocks. Traces of hydrocarbon were recorded at various depths in Ordovician limestone and shale between 2,910-4,013 feet.

Drilled by: Bureau of Mineral Resources.

Permit to Explore: 30H.

Well: B.M.R. No. 4A Stratigraphic Hole (Wallal). (B.M.R. No. 4 was spudded in on 1st April, 1958 and reached a total depth of 1,410 feet on 6th April, 1958. It flowed as an uncontrolled artesian bore and was subsequently plugged and abandoned.)

Position: Approx. Lat. 19° 44′ 12″ S. Approx. Long. 120° 44′ 28″ E. Height of derrick floor above sea level—32 feet.

Spudded in: 22nd April, 1958.

Status: Completed at 2,229 feet on 7th May, 1958 in Pre-Cambrian gneiss.

Drilled by: Bureau of Mineral Resources.

Permit to Explore: 30H.

Well: B.M.R. No. 5 Stratigraphic Hole (Giralia).

Position: Approx. Lat. 22° 40′ S. Approx. Long. 114° 15′ E. Height of derrick floor above sea level—not available.

Spudded in: 26th June, 1958.

Status: Completed at 2,070 feet on 11th August, 1958 in Carbonaceous rocks (Artinskian-Byro Group equivalent).

Drilled by: Bureau of Mineral Resources.

Permit to Explore. 28H.

Well: B.M.R. No. 6 Stratigraphic Hole (Muderong).

Position: Approx. Lat. 24° 06′ 55″ S. Approx. Long. 114° 46′ 20″ E. Height of derrick floor above sea level—not available.

Spudded in: 10th August, 1958.

Status: Completed at 1,002 feet on 20th August, 1958 in the Wandagee (Artinskian) Formation.

Drilled by: Bureau of Mineral Resources.

Permit to Explore: 28H.

Well: B.M.R. No. 7 Stratigraphic Hole (Muderong).

Position: Approx. Lat. 24° 5′ 55″ S. Approx. Long. 114° 46′ 30″ E. Height of derrick floor above sea level—not available.

Spudded in: 25th August, 1958.

Status: Completed at 1,997 feet on 14th September, 1958 in the Cundlego (Artinskian) Formation.

LIST OF PERMITS TO EXPLORE

The following companies and syndicates held Permits to Explore during 1958 (See Plate 1).

Company or Syndicate	Number of Permit to Explore	Date of Approval	Area Sq. Miles approx.
West Australian Petroleum Pty. Ltd.	27H	23/10/52	50,000
	28H	23/10/52	49,600
	29H	23/10/52	34,500
	30H	23/10/52	151,050
Jackson Explorations	133H	3/9/57	15,800
Kalgoorlie Goldfields Petroleum N.L.	42H	Expired	13,000
	46H	9/2/58	6,500
Westralian Oil Ltd.	69H	Expired	9,400
	70H	12/7/58	9,550
	106H	29/3/55	9,600
Gulf Oil Syndicate	127H	29/3/55	14,000
Oil Drilling and Exploration (W.A.) Pty. Ltd.	134H	15/9/58	13,000
	135H	15/9/58	13,000
	136H	15/9/58	13,000
	137H	15/9/58	13,000
	138H	15/9/58	13,000
	139H	15/9/58	13,000
	140H	15/9/58	13,240

LIST OF LICENCES TO PROSPECT

The following Licences to Prospect were held during 1958 (See Plate 1).

Company or Syndicate	Number of Licence to Prospect	Area Sq. miles approx.
Associated Freney N.L.	16H	225
	17H	225
	47H	120
West Australian Petroleum Pty. Ltd.	18H	120
	19H	195
	20H	175
	21H	193
	22H	187
	23H	195
	24H	187
	25H	186
	26H	191
	27H	193
	28H	196
	29H	190
	30H	199
	31H	190
	32H	193
	33H	198
	34H	193
	35H	187
	36H	187
	37H	189
	39H	192
	40H	166
	41H	142
	42H	192
	44H	196
	45H	187
	46H	194
	51H	191
	52H	190
	53H	195
	54H	196
	55H	197
	56H	200

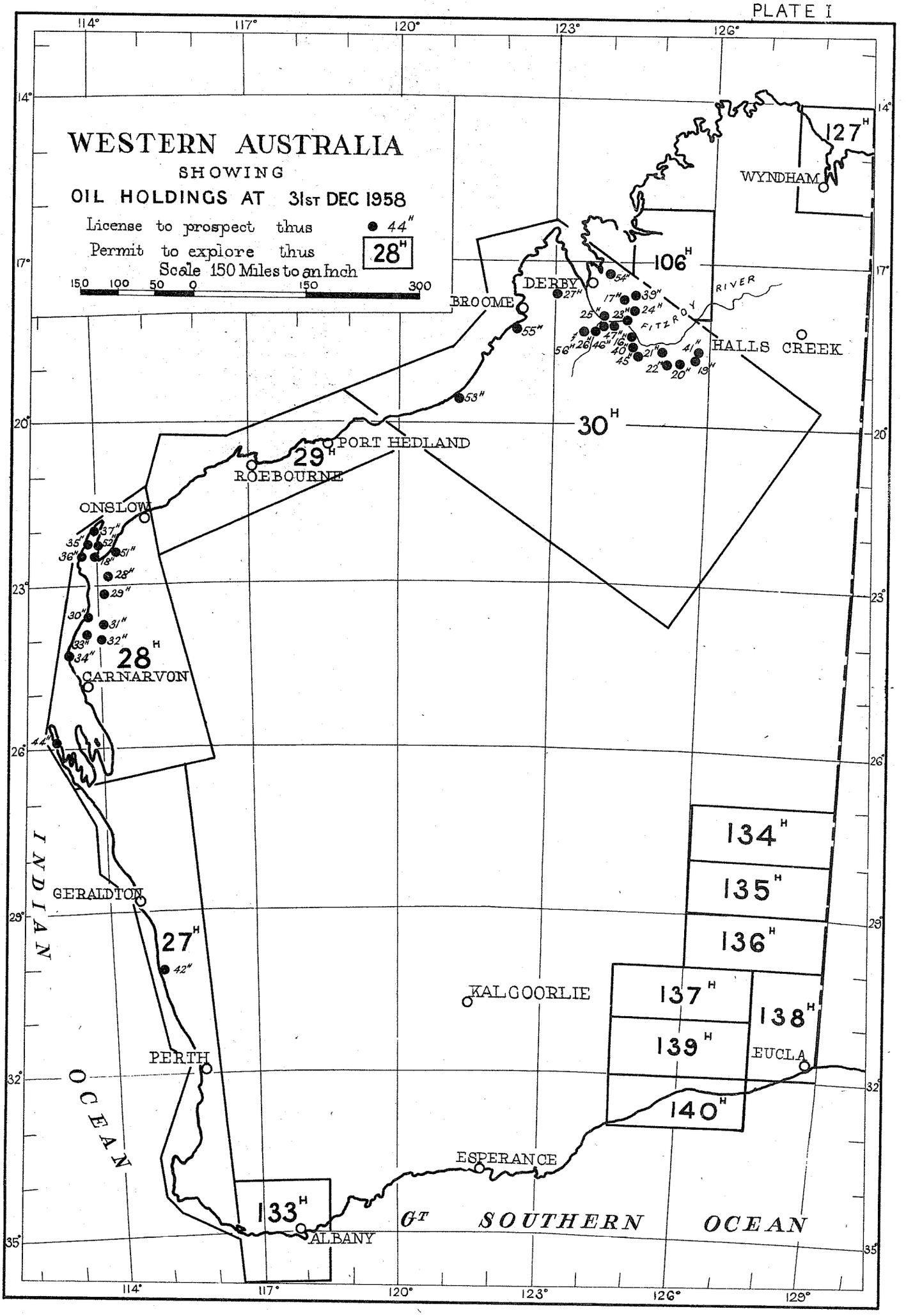
Other Activities:

West Australian Petroleum Pty. Ltd. continued geological and geophysical studies of their Permit Areas, particularly those lying in the Canning and Fitzroy Basins.

During the latter half of the year it was announced that the Shell Company had joined with West Australian Petroleum Pty. Ltd. in the search for oil in Western Australia.

The Bureau of Mineral Resources conducted aerial geophysical surveys near the Western Australian-Northern Territory border in the Joseph Bonaparte Gulf area.

PLATE I


WESTERN AUSTRALIA
SHOWING
OIL HOLDINGS AT 31ST DEC 1958
License to prospect thus ● 44"
Permit to explore thus 28"
Scale 150 Miles to an Inch
150 100 50 0 150 300
114° 117° 120° 123° 126° 129°
14° 17° 20° 23° 26° 29° 32° 35°
WYNDHAM
127"
106"
DERBY
BROOME
HALLS CREEK
RIVER
FITZROY
30"
PORT HEDLAND
29"
ROEBOURNE
ONSLOW
28"
CARNARVON
GERALDTON
27"
PERTH
KALGOORLIE
134"
135"
136"
137"
138"
139"
140"
EUCLA
ESPERANCE
133"
ALBANY
INDIAN OCEAN
GT SOUTHERN OCEAN

It is expected that Oil Drilling and Exploration (W.A.) Pty Ltd. will initiate general search activities early in 1959.

REPORT ON A GOLD FIND ON WILDARA STATION, LAWLERS DISTRICT, EAST MURCHISON GOLDFIELD.

Approx. Lat. 121° 00′ E.
Approx. Long. 28° 08′ S.

By G. H. Low, B.Sc.,
Geological Survey of W.A.

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INTRODUCTION.

On 2nd August, 1958, applications were lodged at the Mining Registrar's Office in Leonora for seven Prospecting Areas (P.A. 1505-1511 inclusive), and on 15th August, for two Prospecting Areas (P.A. 1512, 1513), each of 24 acres, by native stockmen usually employed on either Stuart Meadows or Weebo-Wildara sheep stations. A further application, (P.A. 1514) was made on 22nd August.

Consequent upon considerable quantities of gold being lodged in the Leonora Branch of the National Bank, the find was visited by the Senior Inspector of Mines, representatives of the Native Welfare Department and law enforcement officers from Kalgoorlie. Reporters for local newspapers were soon on the scene and considerable publicity was given to the find, the area concerned being dubbed the "Goanna Patch" by the press because the first nugget was said to have been found by a native when engaged in digging out a goanna hole.

On 13th August, the author was instructed to investigate and report on the geology of the find.

PRODUCTION.

The total recorded gold production from this area up to 31st August, 1958, is as follows:—

GOLD FROM WILDARA STATION.

July, 1958.

Bullion:

75 oz. 0 dwts. 12 grs. = 65.09 fine oz.

August, 1958.

Bullion:

23 oz. 7 dwts. 0 grs.—assay not yet available.

Total Gross Weight Lodged:

98 oz. 7 dwts. 12 grs.

LOCATION AND ACCESS.

Location:

The Wildara Gold find area is located on Wildara Station, Lawlers District, East Murchison Goldfield. The centre of the area is approximately 31 miles S. 85° E. from Lawlers townsite, in approximate latitude, 121° 00 E.; approximate longitude, 28° 08′ S.

Maps:

Reference may be made to the following:—

1. Lands Department Lithograph 170/80 (Loc. 3197-97).
2. Lands Department 10 mile Topographic Series, Sheet 8 (Wiluna).
3. Geological Sketch Map of W.A., G.S.W.A. 1956.
4. Figure 1 of this Report.

Access:

The author reached the area via Wilsons Patch and Weebo Homestead. There is a more direct but less well marked track running north-westerly from Wilsons Patch, and a similar one running east-north-easterly from the Leonora-Lawlers Road, from about 15 miles south of Lawlers.

TOPOGRAPHY.

Excepting for a low range of hills lying some five to six miles to the west, the country in the vicinity of the Wildara gold find, which will be referred to subsequently as "The Patch," is flat to slightly undulating. There are no water courses worthy of the name, and neither are there any regular depressions such as might have been at one time occupied by intermittent swamps or lakes.

The soil is for the most part a rich reddish-brown loam, generously sprinkled with quartz and ironstone particles with a size range from sand to small boulder. It is a typical "in situ" soil derived from the decomposition of underlying basic igneous and sedimentary rocks.

Westwards of "The Patch," the surface rises very gradually towards the range of low hills. These trend north-north-west, and have a length of some 16 to 18 miles. The highest points are some 300 feet (estimated only) above the general level of the plain. There are some intermittent, poorly developed water courses, the most significant of which are the so called Cody Creek, a tributary of Marshall Creek, and Marshall Creek itself, which rises on the south-eastern slopes of the range (subsequently herein called Ryan Range), and runs southward and then south-westwards to eventually lose itself on the sand covered terrain west of Doyle Well.

GENERAL GEOLOGY.

General references to the geology of the country between Lawlers, Darlot and Wilsons Patch can be found in G.S.W.A. Bulletins Nos. 28 (C. G. Gibson) and 84 (E. de C. Clarke).

Briefly, the country at and around "The Patch" is part of a narrow strip (up to 20 miles in width) of greenstone country, which extends from the Leonora-Malcolm area to about 25 miles north-east of Wiluna, a distance of some 230 miles. (See the Geological Sketch Map of W.A.). The country surrounding this greenstone is a granitic complex which, though usually itself devoid of auriferous formations, is now generally acknowledged to be responsible for the gold mineralisation in the greenstones.

The greenstone complex which originally consisted of nearly horizontal interbedded basic lava flows, tuffs, and sediments, has been very strongly folded, sheared and fractured by a variety of forces, not necessarily contemporaneous, the most important of which apparently was compressional from practically east and west, so that the outstanding character of these metamorphosed greenstones as we see them now, is folding and schistosity along axes trending a few degrees west of north, and shearing and fracturing at various angles to this.

Subsequent to the regional metamorphism, late stage acid emanations (quartz veins, both auriferous and non auriferous, porphyry dykes and pegmatites) penetrated the ruptured greenstones to an extent dependant upon a number of variable factors including source-pressure, temperature and accessibility of channels. In this respect it is important to remember that the feeding channel of an auriferous quartz vein could have been of limited width and breadth and could have been entirely removed by subsequent erosion, and that any quartz vein we prospect today could be only the "keel" or bottom part of the original formation.

Ryan Range is separated from the greenstone of "The Patch" by a narrow intrusive tongue of granitic rock. The sedimentary character of many of the rocks in the range is obvious at many places, but there are also present serpentinous rocks, felspathic amphibolites and dense fine grained zoisitic epidiorities derived from igneous rocks of basic composition.

All the rocks in the range are highly folded (many small anticlines and synclines were observed), but over-all the beds strike 340°-350° and dip to the *west* at about 60°-80°. This could be the highly folded western limb of a major anticline.

These folded beds are intruded in places by prominent quartz reefs which follow the country strike and appear to be vertical (they cross gullies and ridges in a practically undeviating line).

THE GOLD DEPOSIT.

General:

As noted previously "The Patch" carries a mantle of residual soil which effectively covers about 95 per cent. of the geology in this area. Whatever readings the author was able to take, showed that the schistosity (corresponding to the trend of the two longer dimensions of platy or flaky minerals), was inclined to the *east* at steep angles (65°-80°) while the strike was about 350°. It is suspected that the bedding has the same attitude. (See Fig. 2.)

Country rock, as far as could be seen, consists of strongly metamorphosed doleritic lavas and agglomerates in which schistosity and mineral alteration has been developed to varying degrees.

Some small patches of soil have a lighter appearance than the remainder, and these were pointed out to the author and his attention was drawn to the fact that the original find of a 20 oz. nugget and numerous smaller pieces, was on one of these patches (on P.A. 1505, eight chains N.W. of the S.E. corner peg). The question asked was: did the light coloured patches reflect an underlying area of unusual mineral composition, and if so, was this responsible for the concentration of gold?

The clue to the answer of this query was in the number of goanna holes found in these patches. Soil on the surface is always apt to be more strongly coloured than the lower layers, and the goannas, in the course of their excavations had brought up quantities of lighter coloured underlying soil and scattered it haphazardly in the neighbourhood of their front doors. The question of favourable mineral environment for gold accumulation does not enter into it except that the goannas would presumably, all things being equal, burrow in the softest ground available. Such ground might be found bordering the lines of most intense shearing and fracturing, and such lines might, during the period of auriferous emplacement, have been more easily traversed by gold bearing solutions.

Two kinds of quartz veins were observed on "The Patch." These were all in the vicinity of P.A. 1505 (covering the original find). Elsewhere the soil cover was too extensive to permit of more than an occasional reading of the schistosity. The first type of vein varies in width up to a possible maximum width of three feet, and lies in the plane of the schistosity. One such vein was partially exposed by a five feet pit and six shallow (one foot) trenches for about 30 yards northwards from the S.E. corner peg of P.A. 1505. About 20 oz. of specks and slugs of gold had been recovered along this 30 yards, by turning over the soil and "specking" and by panning. Not all of the soil in this 30 yards had been treated in this manner, there were some sections over a yard in length which remained untouched. The vein as exposed in the pit was about six inches wide and according to the prospector was yielding free gold after dollying and panning.

Another vein of this type had been exposed in an eight feet shaft, some seven chains to the north-west. Another parallel one, about one chain further west, appeared on extension of line, to pass very close to the original find, the ground in the vicinity of which presented a very confused appearance, having been dug and panned over a considerable area.

A 10 feet shaft had been sunk near the western boundary of P.A. 1505, five chains south of the N.W. corner peg. This shaft was being carried down on a thin quartz vein. The soil around the collar of the shaft had yielded a nugget of approximately 19 oz., and several smaller specks.

The second type of quartz vein was wider, up to 12 feet, and its strike was 30° to 40° east of north. These veins were receiving very little attention from the prospectors, although one said he had got gold from one of them after dollying and panning, and the author found a small patch of pyrite at one locality (4.3 chains west of the N.E. corner peg of P.A. 1505).

Both types of vein were considerably iron-enriched (limonite) at the surface and carried both translucent glassy quartz, and sugary quartz. The author was told that the best "colours" were usually found in the iron-enriched sugary portions.

The Gold and its Occurrence:

By the courtesy of the Deputy Master of the Royal Mint, the author was able to see some of the Wildara gold before leaving for the field. This gold (gross weight 21.79 troy oz.), consisted of pieces, mostly with two long dimensions, ranging in length up to 1.5 inches. A few of the larger pieces were of the order of 1.5 by 1.0 by 0.5 inches, and some of these pieces showed the effects of hammering. Although some pieces were smooth and worn, the majority were quite irregular in shape. No "wire" or crystalline gold was seen. Some small pieces of ironstone and some quartz were seen enwrapped in the gold.

A 19 oz. nugget (this was weighed on ordinary office scales, and the troy equivalent calculated, so the result is approximate) was examined by the author in Leonora. This nugget, in which no foreign matter could be seen with the naked eye, was shaped somewhat like a small automatic pistol, its maximum measurements being approximately 4.5 by 2.5 by 1.5 inches. This nugget was found in the vicinity of the 10 feet deep shaft near the western boundary of P.A. 1505 described above.

It had no angular prominences and was in fact, within the shape of its overall dimensions, quite rounded and smooth. A number of smaller pieces collected in the same vicinity were very irregular, and looked like much of the gold viewed at the Mint.

Despite the rounding of this nugget, and some of the smaller pieces, the author is convinced that the richness of "The Patch" is due to a concentration of gold relatively in situ. There is nothing in the present topography to suggest "The Patch" area is the base of any ancient drainage system. There are no waterworn sand, gravel or conglomerate particles and in fact all rock pieces of these dimensions seen in or on the soil were angular decaying fragments of the underlying country.

This gold is *not* alluvial gold contained in an ancient stream bed, but is *eluvial* gold, representing the concentration of gold from the superficial portions of the rock by removal of the light material by rains and winds. It is evident that there has been much secondary enrichment resulting from solution and reprecipitation of pre-existing primary and detrital gold.

THE GOLD PROSPECTS

From the foregoing remarks it can be seen that all of the gold so far recovered has been found in the detrital soil of "The Patch" area, mostly on or near P.A. 1505. A number of thin auriferous quartz veins, running with the country, traverse the area, and the eroded portions of these were, presumably, the immediate source of the gold.

The extent and number of these auriferous veins is not known at present, but as far as they persist along the strike there is a chance of soil in their vicinity carrying eluvial gold.

Four pits were being sunk on four of these veins at the time of the author's visit. The deepest was only 10 feet down, so that the condition of the veins at depth is not known at present.

Costeaning in an east-west direction north and south of P.A. 1505 might disclose other auriferous quartz veins worthy of detailed attention. Because of the flat topography, the dip of the veins, and the width of the zone in which these occur, loaming on its own would give confusing results.

REPORT ON DIAMOND DRILLING FOR GOLD G.M.L. 924—TRUE BLUE—BAMBOO CREEK CENTRE, PILBARA GOLDFIELD

By G. H. Low, B.Sc.
Geological Survey of W.A.

CONTENTS

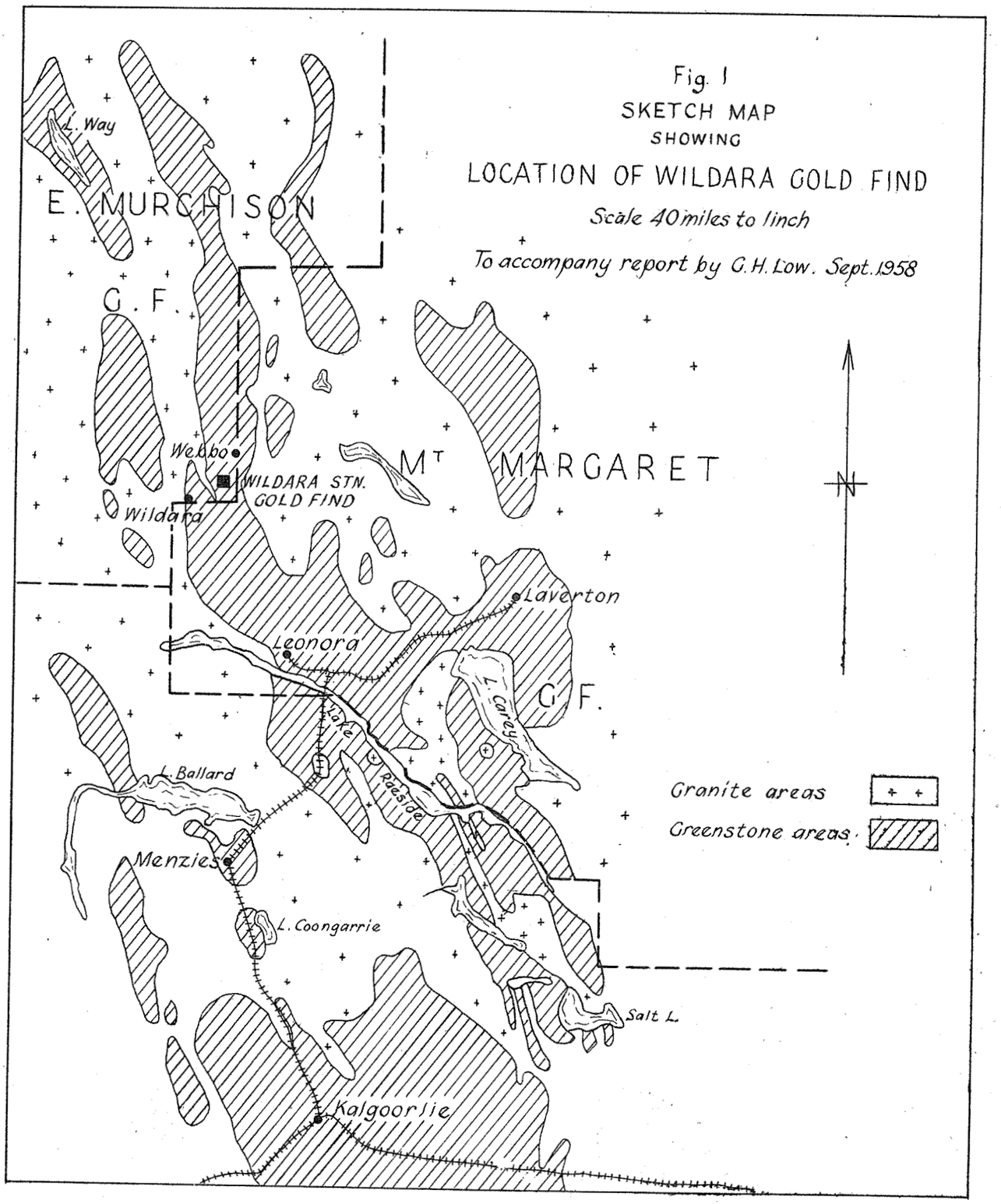


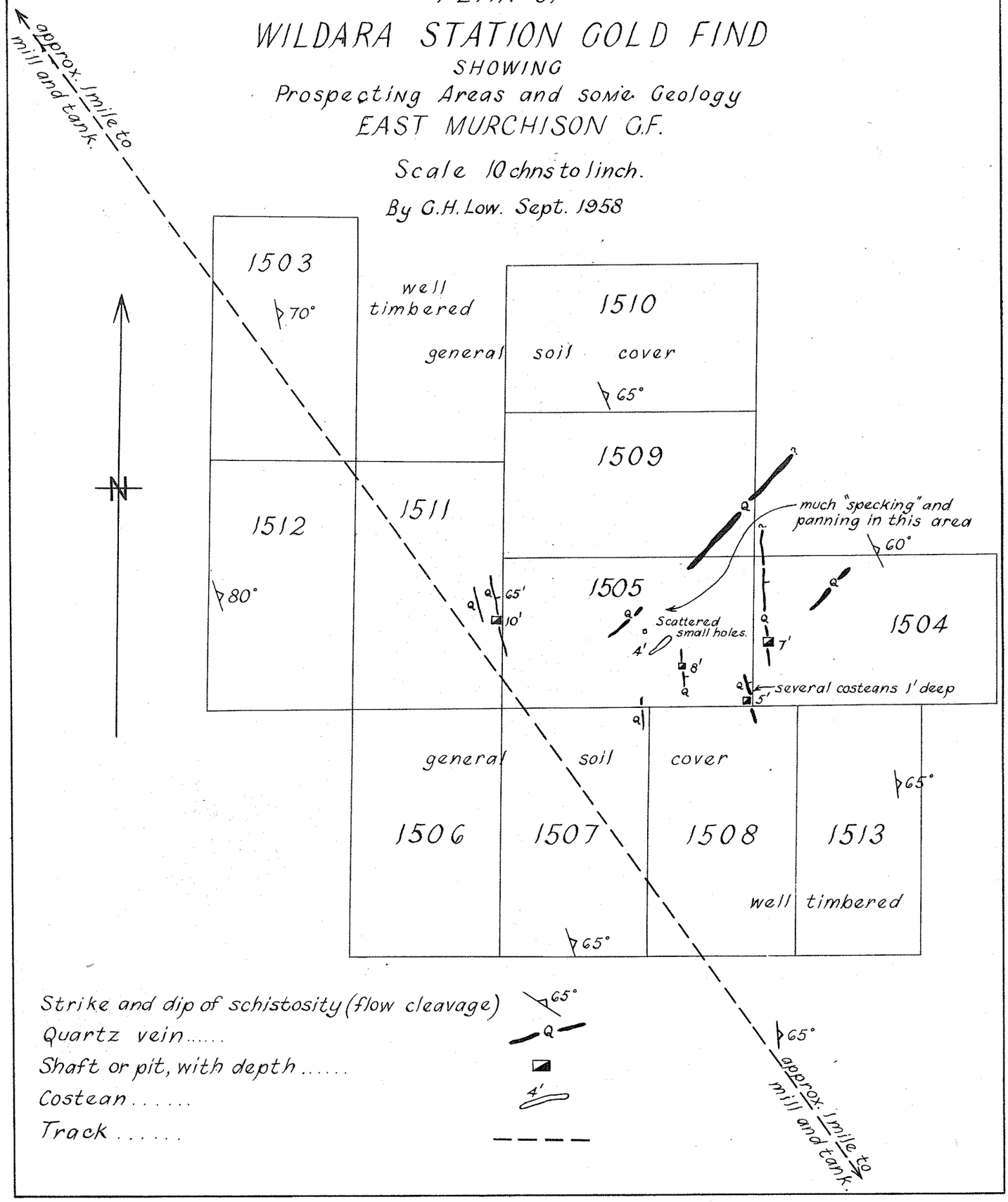
Fig. 1
SKETCH MAP
SHOWING
LOCATION OF WILDARA GOLD FIND
Scale 40 miles to 1 inch
To accompany report by G.H. Low. Sept. 1958
L. Way
E. MURCHISON
G. F.
Webbo
WILDARA STN.
GOLD FIND
Wildara
Mt MARGARET
N
Laverton
Leonora
L. Carey
G. F.
Lake Raeside
L. Ballard
Menzies
L. Coongarrie
Salt L.
Kalgoorlie
Granite areas
Greenstone areas

Fig. 2

PLAN OF
WILDARA STATION GOLD FIND
SHOWING
Prospecting Areas and some Geology
EAST MURCHISON G.F.

Scale 10 chns to 1 inch.

By G.H. Low. Sept. 1958



Introduction:

The True Blue Gold Mine, G.M.L. 924, is located at Bamboo Creek Mining Centre, some 40 miles north-east of Marble Bar in the Pilbara Goldfield.

Up to 31st December, 1956, 93.76 fine ounces of gold have been recovered over the plates from 2,378.75 tons of ore, and the sands treatment has recovered an average of one ounce per long ton.

An application was made to the Mines Department by a syndicate of option holders for assistance to prove ore ahead of the workings by diamond drilling. The mine was geologically examined by officers of the Survey and subsequently recommended by the Government Geologist as suitable for diamond drilling. An agreement on drilling on a pound-for-pound basis was finalised in July, 1957 but it was not until December, 1957 that a drill became available and work was commenced on the first hole.

Geology:

The country rock on G.M.L. 924 is a talc chlorite carbonate schist which is a low grade dynamothermal metamorphic derivative of basic lavas of the Warrawoona Series. The planes of schistosity strike 310° to 315° and dip either vertically or at steep angles to the east. Felspar porphyry also crops out at places on the surface.

The north-west by south-east shear pattern dominates the structure, but there are a number of complementary tension fractures, striking at about 255° and dipping northwards at about 35° to 45°, which are the main ore carriers. This ore bearing structure pattern differs markedly from that of the "main" line of ore bodies at Bamboo Creek which conforms with the schistosity.

Typical ore from the True Blue consists of blue grey quartz carrying pyrite and variable amounts of galena, wolframite, scheelite and gold.

The main shaft of the present True Blue workings has been sunk to 80 feet on the eastern side of a main central shear which strikes 310° and dips vertically. The ore body is stoped upwards for 30 feet from the 80 feet level. A narrow quartz vein (up to two feet thickness) follows the central shear and the prospector drove along this for some 10 feet at the 50 feet level before striking the cross quartz reef, the well defined hanging wall of which strikes 255° and dips 35° to the north, which constituted the ore in the 30 feet stope now opened up.

Selection of Drill Sites:

Because of the paucity of significant outcrops and the limited (and apparently haphazard) development in the mine, the selection of drill hole sites was a particularly onerous task. However, the type of ore (similar in many respects to the Bonnie Doone and Nil Desperandum ores), and the general structure pattern suggested that the main ore carriers would be cross reef structures, which are notoriously discontinuous except in the en echelon sense, and accordingly the first hole was planned to intersect the dip projection 80 feet ahead of the workings and some 20 feet east of the central shear. The second hole was planned to check a deeper continuation, again some 20 feet from the central shear which was regarded as a limiting structure, and the third hole was planned to intersect the ore body some 30 feet lower than in the second hole, but about 80 feet eastwards along the strike. The second and third sites were selected as earlier results became available. The limited distances between the target areas was due to the necessity of feeling the way, in uncertain structural conditions.

Drilling Results:

The bulk of the core is identified as talc chlorite carbonate schist carrying both regular and irregular carbonate and quartz carbonate veins. Felspar porphyry was found in the core of the first hole from 392 feet to the total depth of 405 feet, and also in the second hole from 236 feet to 276 feet. The third hole was planned to avoid cutting the porphyry. Pyrite in massive-crystalline and fine-granular form is common in all the core.

The mineralised portions are on the whole much better defined than those in the "main" line of lodes (which latter includes the Prophecy-Perseverance and Kitchener line). *Bedding adjacent to the more important mineralised portions is distinctly transverse to the schistosity, but some mineralisation along the schistosity is not entirely excluded.* Summarised core logs and the results of sample assays for each of the three holes, are given in the following tables:—

PILBARA DIAMOND DRILLING.

Locality: Bamboo Creek, G.M.L. 924 ("True Blue").
D.D.H. No. 20, Site B16 (True Blue No. 1). Machine Used: A2000.
Angle of Depression: 30°. Core Size: AXT.
Azimuth of Hole at Surface: S.47°E. Contractor: K. McCallum.
Date Commenced: 7/12/57. Date Completed: 23/12/57.
Location of Site B16: 265 ft. N.47°W. from centre of "True Blue" Main Shaft.

Core Log.

Depth From	Depth To	Width	Core Recovered	Description
ft.	ft.	ft.	ft. in.	
0	30	30	*Nil*	
30	154	124	81 6	Talc chlorite schist—dark grey or green, with some bright green serpentine developments. Some sedimentary remnants bedded at 70° to axis. Irregular quartz carbonate veinlets. Some pyrite. Schistosity at 35° to axis of core.
154	173	19	19 0	Irregular quartz veins in silicified schist. Some pyrite. Some irregular carbonate veinlets.
173	292	119	118 0	Talc chlorite schist—dark grey and green, with irregular quartz carbonate veins. Some light grey sheared rock at end.
292	303	11	11 0	Silicified talc chlorite schist carrying quartz and quartz carbonate veins with pyrite.
303	392	89	78 7	Talc chlorite schist—green to dark green. Irregular quartz carbonate veins. Some quartz carbonate veins carrying pyrite at 318 ft., 328 ft., 389 ft. Schistosity at 15° to core axis.
392	405	13	8 0	Felspar porphyry — grey-green with white felspar phenocrysts.
				END OF HOLE.

Assay Results.

Sample No.	Borehole Depth From	Borehole Depth To	Core Length	Assay/ long ton
	ft. in.	ft. in.	in.	dwts.
T.B. 1	154 0	157 0	36	Less than 0·1
T.B. 2	157 0	160 0	36	do.
T.B. 3	167 0	170 0	36	do.
T.B. 4	170 0	173 0	36	27·75
T.B. 5	292 0	295 0	36	2·80
T.B. 6	295 0	298 0	36	13·64
T.B. 7	298 0	301 0	36	2·35
T.B. 8	301 0	303 0	36	0·27
T.B. 9	318 0	321 0	36	0·92
T.B. 35	160 0	163 6	42	Less than 0·1
T.B. 36	163 6	167 0	42	do.
T.B. 37	173 0	176 0	36	do.
T.B. 38	176 0	179 0	36	do.
T.B. 39	179 0	182 0	36	do.
T.B. 40	182 0	185 0	36	1·64
T.B. 41	185 0	188 0	36	1·14
T.B. 42	188 0	191 0	36	Less than 0·1
T.B. 43	191 0	194 0	36	do.
T.B. 44	194 0	197 0	36	do.
T.B. 45	197 0	200 0	36	do.
T.B. 46	200 0	204 0	48	2·60
T.B. 47	204 0	207 0	36	10·01
T.B. 48	207 0	210 0	36	0·94
T.B. 49	210 0	213 0	36	Less than 0·1

PILBARA DIAMOND DRILLING.

Locality: Bamboo Creek, G.M.L. 924 ("True Blue"). D.D.H. No. 21, Site B16 (True Blue No. 2). Machine Used: A2000.

Angle of Depression: 59°. Core Size: AXT.

Azimuth of Hole at Surface: S.42°E. Contractor: K. McCallum.

Date Commenced: 27/12/57. Date Completed: 17/1/58.

Location of Site B16: 265 ft. N.47°W. from centre of "True Blue" Main Shaft.

Core Log.

Depth From	Depth To	Width	Core Recovered	Description
ft.	ft.	ft.	in.	
0	40	40	*Nil*	
40	150	110	107 3	Talc chlorite schist, grey-green with some green serpentine in places. Some pyrite with quartz carbonate veins. Schistosity at 30° to core axis. Some slight folding at 139 ft.
150	162	12	12 0	Silicified talc schist and blue-grey quartz veins carrying fine pyrite and arsenopyrite.
162	236	74	70 0	Talc chlorite schist—grey-green with irregular quartz carbonate veins. Some pyrite mineralisation at 171 ft., 177 ft., 224 ft. Schistosity at 30° to core axis.
236	276	40	38 6	Felspar porphyry—grey-green with white felspar phenocryst.
276	349	73	72 0	Talc chlorite carbonate schist, dark grey-green, with some pyrite with quartz carbonate at 286 ft. END OF HOLE.

Assay Results.

Sample No.	Borehole Depth From	Borehole Depth To	Core Length	Assay/ long ton
	ft. in.	ft. in.	in.	dwts.
T.B. 50	103 0	106 0	36	Less than 0·1
T.B. 51	106 0	109 0	36	do.
T.B. 10	150 0	153 0	36	0·34
T.B. 11	153 0	156 0	36	15·41
T.B. 12	156 0	159 0	36	4·82
T.B. 13	159 0	162 0	36	Less than 0·1
T.B. 14	171 0	174 0	36	do.
T.B. 15	177 0	180 0	36	3·27
T.B. 17	224 0	227 0	36	5·89
T.B. 16	286 0	289 0	36	1·86

PILBARA DIAMOND DRILLING.

Locality: Bamboo Creek G.M.L. 924 ("True Blue"). D.D.H. No. 22, Site B17 (True Blue No. 3). Machine Used: A2000

Angle of Depression: 35°. Core Size: AXT.

Azimuth of Hole at Surface: S.17°E. Contractor: K. McCallum.

Date Commenced: 28/1/58. Date Completed: 1/2/58.

Location of Site B17: 380 ft. N.25°W. of "True Blue" Main Shaft.

Core Log.

Depth From	Depth To	Width	Core Recovered	Description
ft.	ft.	ft.	ft. in.	
0	22	22	*Nil*	
22	187	165	131 0	Talc chlorite schist, serpentinous in places, light to dark green. Carbonate veins mainly in schistosity at 20° to 30° to core core axis.
187	188½	1½	1 6	Quartz carbonate vein in talc chlorite schist. Carrying pyrite.
188½	207	18½	6 6	Talc chlorite schist—green to dark green.
207	217	10	10 0	Quartz veins and silicified schist. Quartz dark blue grey. Carries pyrite and arsenopyrite. Bedding at 75° to 80° to core axis.
217	240	23	23 0	Talc chlorite schist—dark green with carbonate veins.
240	251	11	11 0	Quartz veins and silicified schist. Quartz—dark blue grey at 85° to core axis, carrying pyrite and arsenopyrite.
251	256	5	5 0	Talc chlorite schist. Some pyrite; partly silicified.
256	274	18	18 0	Quartz veins and silicified schist. As at 240 ft. to 251 ft.
274	306	32	32 0	Talc chlorite schist—dark grey green with irregular carbonate veins. Schistosity at 30° to core axis. END OF HOLE.

Assay Results.

Sample No.	Borehole Depth From	Borehole Depth To	Core Length	Assay/ long ton
	ft. in.	ft. in.	in.	dwts.
T.B. 18	187 0	188 6	18	Trace
T.B. 19	207 0	210 0	36	Trace
T.B. 20	210 0	212 0	24	Trace
T.B. 21	212 0	215 0	36	Trace
T.B. 22	215 0	217 0	24	1·1
T.B. 23	240 0	241 0	12	Trace
T.B. 24	241 0	244 0	36	10·93
T.B. 25	244 0	247 0	36	Trace
T.B. 26	247 0	250 0	36	Trace
T.B. 27	250 0	253 0	36	Trace
T.B. 28	253 0	256 0	36	Trace
T.B. 29	256 0	259 0	36	Trace
T.B. 30	259 0	262 0	36	Trace
T.B. 31	262 0	265 0	36	Trace
T.B. 32	265 0	268 0	36	1·93
T.B. 33	268 0	272 0	48	3·45
T.B. 34	272 0	274 0	24	16·89

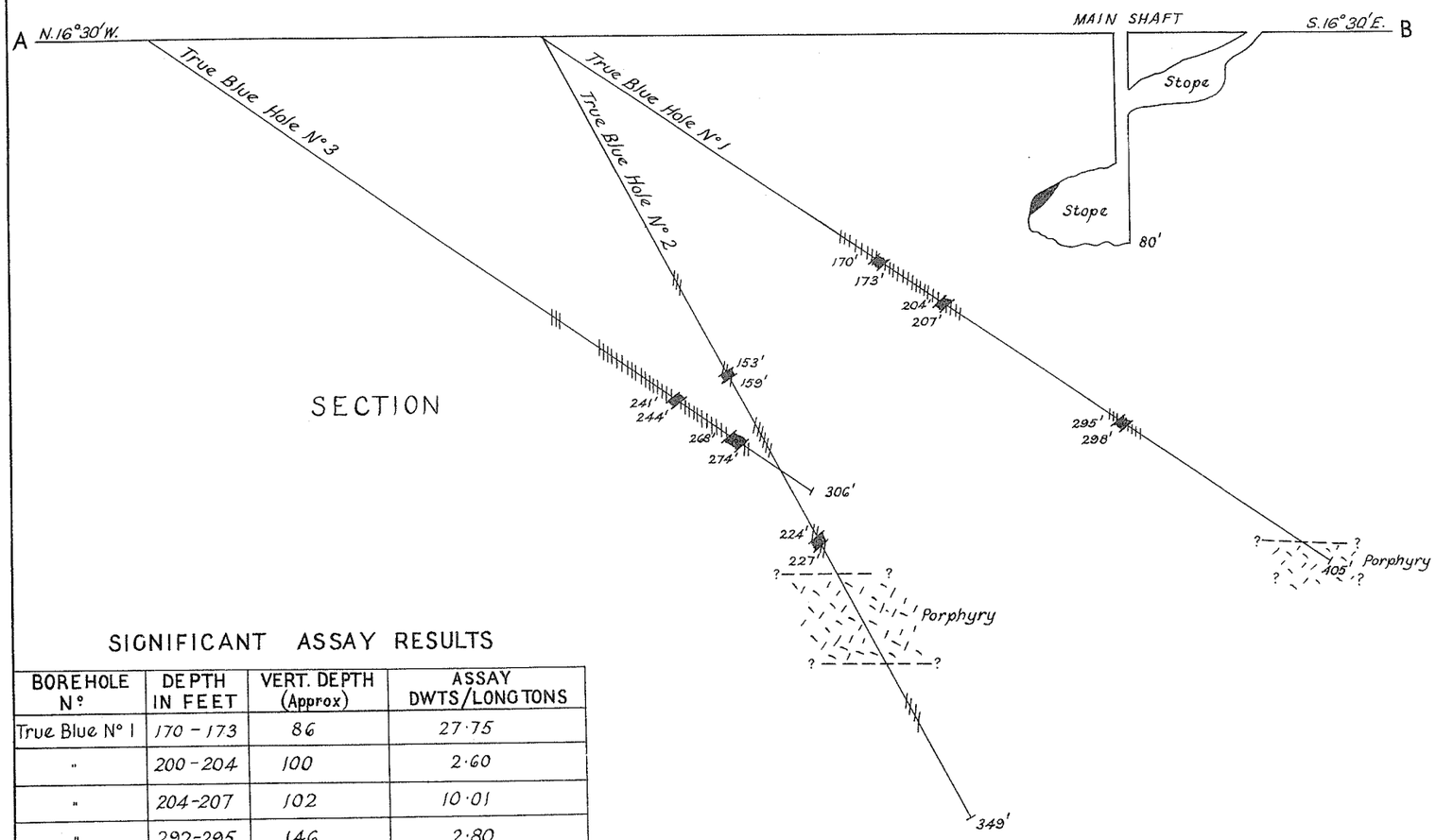
Interpretations of Results:

The drilling has confirmed that there are a number of parallel mineralised quartz veins with an average strike of 255° and dipping at about 35° to 40° to the north-north-east. A vertical central shear, striking 310°, also carries some gold. The True Blue main shaft has been sunk on the eastern side of this shear.

The structure pattern, viewed broadly, suggests that the main True Blue ore carriers are tension cracks developed as a result of earth movement, with the block on the northern side of the main shear, having moved westward relative to the block on the southern side.

The writers opinion is that the ore bodies, though rich in places, are small and discontinuous (in the mining sense). They could probably provide a good livelihood for a small active syndicate of workers, but in no way constitute a company mining proposition.

PLATE II



SECTION

SIGNIFICANT ASSAY RESULTS

BOREHOLE N°	DEPTH IN FEET	VERT. DEPTH (Approx)	ASSAY DWTS/LONG TONS
True Blue N° 1	170 - 173	86	27·75
"	200 - 204	100	2·60
"	204-207	102	10·01
"	292-295	146	2·80
"	295-298	148	13·64
"	298-301	150	2·35
True Blue N°2	153 - 156	131	15·41
"	156 - 159	135	4·82
"	177-180	153	3·27
"	224-227	195	5·89
True Blue N° 3	241-244	139	10·93
"	265-268	153	1·93
"	268-272	155	3·45
"	272-274	157	16·89

LEGEND

Assay in excess of 5dwts per long ton.....

Assayed Sections

Fault Line

G.S.W.A.

PLAN AND SECTION

OF

BOREHOLES N^os 1-3

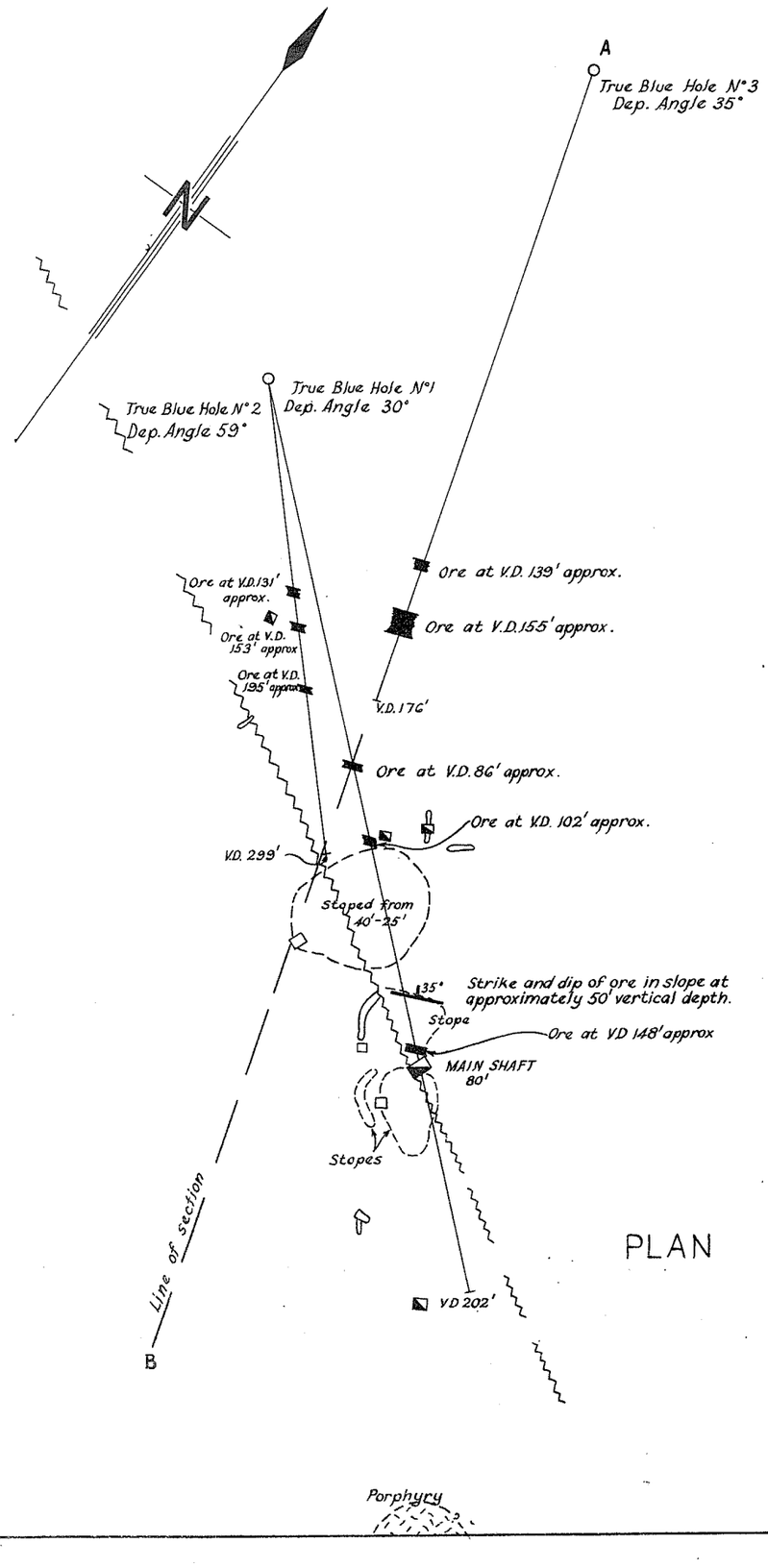
"TRUE BLUE" GML 924

BAMBOO CK – PILBARA G.F.

Scale: 60 feet = 1 inch

Survey and Geology by G.H. Low May 1958

N.B: Vertical Section plane is along azimuth of Hole N°3. Other details have been projected onto plane.



PLAN

MT. MORGANS DRILLING.

D.D.H. No. M1.

Hole No.: M1, Site No. 1. Machine Used: Mindrill A2000.

Position of Collar: On a bearing of 237° True from southern corner of G.M.L. 505F, distance 225 feet.

Angle of Depression: 45°. Core Size: AXT.

Azimuth: 241° (True). Contractor: L. C. Honey.

Depth: 756 feet.

Date Commenced: 2/12/57. Date Completed: 17/1/58.

Object: To test downward continuation of mineralisation and explore structure of lode system of main Mt. Morgans mine.

Logged by: J. W. Duggan.

Assays by: Kalgoorlie School of Mines.

Core Log.

From	To	Description
ft. ins.	ft. ins.	
0 0	67 0	Massive, medium to coarse grained greenstone.
67 0	108 0	Sheared medium to coarse grained greenstone—shearing at 50° to core axis.
108 0	176 6	Dense, massive fine grained greenstone.
176 6	184 0	Felspar porphyry.
184 0	198 0	Dense, massive fine grained greenstone.
198 0	207 6	Felspar porphyry.
207 6	313 10	Dense, massive fine grained greenstone.
313 10	322 0	Felspar porphyry.
322 0	382 6	Fine to medium grained massive greenstone.
382 6	394 3	Sheared fine grained greenstone—shearing at 45° to core axis.
394 3	411 10	Folded and faulted B.I.F. with some silicification and weak to fair mineralisation—bedding angle at 45° to core axis.
411 10	416 6	Mineralised porphyry.
416 6	418 3	Strongly folded, faulted B.I.F. with fair mineralisation—bedding angle averages 45° to core axis.
418 3	444 2	Mineralised porphyry.
444 2	477 7	Folded and faulted B.I.F. with some silicification and carbonation, fairly well mineralised. Bedding angle averages 45° to core axis.
477 7	478 9	Sheared fine grained greentone.
478 9	489 0	Massive fine grained greentone.
489 0	490 3	Siliceous, densely mineralised lode material, traversed by fine quartz veinlets.
490 3	501 10	Felspar porphyry.
501 10	504 5	Siliceous, densely mineralised carbonated lode material with bedding angle at 45° to core axis.
504 5	506 1	Sheared fine grained greenstone with a little mineralisation. Shearing at 45° to core axis.
506 1	509 6	Folded carbonated fine grained greenstone.
509 6	513 4	Felspar porphyry.
513 4	565 3	Well sheared fine grained greenstone—shearing at 60° to core axis.
565 3	575 9	Felspar porphyry.
575 9	610 7	Strongly sheared fine grained greenstone; possibly represents a strong fault. Angles of shearing to core axis at 580 ft. to 80° at 590 ft. to 80° at 600 ft. to 65°
610 7	611 11	Barren quartz vein.
611 11	624 0	Folded, fine grained greentone, bedding at 35° to core axis.
624 0	626 9	Felspar porphyry.
626 9	636 2	Folded, fine grained greenstone, bedding at 45° to core axis.
636 2	756 0	Dense massive fine grained greenstone.
		END OF HOLE.

Assay Results.

D.D.H. No. M1.

Mount Morgans.

From	To	Core Length	True Width	Assay
ft. ins.	ft. ins.	ins.	ins.	dwts./ton
394 3	396 3	24	17	Trace
396 3	398 3	24	17	3·29
398 3	400 3	24	17	2·75
400 3	402 3	24	17	Trace
402 3	404 3	24	17	Trace
404 3	406 3	24	17	Trace
406 3	408 3	24	17	0·45
408 3	410 3	24	17	1·63
410 3	411 10	19	13	5·40
411 10	411 2	24	17	Trace
414 2	416 6	24	17	1·63
416 6	418 3	24	17	Trace
418 3	420 3	24	17	Trace
420 3	422 3	24	17	Trace
422 3	424 3	24	17	Trace
424 3	426 3	24	17	Trace
426 3	428 3	24	17	Trace
428 3	430 3	24	17	Trace
430 3	432 3	24	17	Trace
432 3	434 3	24	17	Trace
434 3	436 3	24	17	Trace
436 3	438 3	24	17	Trace
438 3	440 3	24	17	Trace
440 3	442 3	24	17	Trace
442 3	444 2	23	16	Trace
444 2	446 2	24	17	3·80
446 2	448 2	24	17	Trace
448 2	450 2	24	17	0·25
450 2	452 2	24	17	1·72
452 2	454 2	24	17	Trace
454 2	456 2	24	17	Trace
456 2	458 2	24	17	Trace
458 2	460 2	24	17	Trace
460 2	462 2	24	17	Trace
462 2	464 2	24	17	3·94
464 2	466 2	24	17	1·40
466 2	468 2	24	17	4·28
468 2	470 2	24	17	0·20
470 2	472 2	24	17	Trace
472 2	474 2	24	17	Trace
474 2	476 2	24	17	Trace
476 2	477 7	17	12	0·70
477 7	478 9	14	10	Trace
489 0	490 3	15	11	Trace
501 10	502 8	10	7	Trace
502 8	503 6	10	7	Trace
503 6	504 5	11	8	Trace
504 5	506 1	20	14	Trace
610 7	611 11	16	11	Trace

MT. MORGANS DRILLING.

D.D.H. No. M2.

Hole No.: M2, Site No. 1. Machine Used: Mindrill A.2000.

Position of Collar: On a bearing 237° True from southern corner of G.M.L. 505F, distance 225 feet.

Angle of Depression: 60°. Core Size: AXT.

Azimuth: 241°T. Contractor: L. C. Honey.

Date Commenced: 18/1/57. Depth at 27/2/58: 908 feet.

Object: To test downward continuation of mineralisation and explore structure of main Mt. Morgans mine.

Logged by: J. W. Duggan.

Assays by: School of Mines, Kalgoorlie.

Core Log.

From	To	Description
ft. ins.	ft. ins.	
0 0	92 0	Massive, coarse grained greenstone.
92 0	111 2	Bedded, fine grained sandstone, bedding angle at 60° to core axis
111 2	215 2	Massive, medium grained greenstone.
215 2	286 0	Dense, massive fine grained greenstone.
286 0	307 9	Porphyry.
307 9	423 6	Dense, massive fine grained greenstone.
423 6	458 0	Massive, medium grained greenstone.
458 0	460 5	Porphyry.
460 5	487 3	Dense, massive fine to medium grained greenstone.
487 3	498 6	Dense, massive fine grained greenstone.
498 6	500 11	Porphyry.
500 11	512 0	Dense, massive fine grained greenstone.
512 0	527 5	Porphyry.
527 5	537 2	Sheared, fine grained greenstone, shearing at 40° to core axis.
537 2	539 0	Sheared, mineralised, fine grained greenstone.
539 0	557 9	Mineralised, silicified B.I.F., bedding angle 35° to 45° to core axis.
557 9	565 0	Porphyry.
565 0	569 6	Sheared, fine grained greenstone, shearing at 50° to core axis.
569 6	577 8	Massive, medium grained greenstone.
577 8	588 0	Porphyry.
588 0	607 2	Silicified, mineralised B.I.F., bedding angle 50° to core axis.
607 2	620 10	Porphyry.
620 10	635 2	Silicified, mineralised B.I.F., bedding angle 50° to core axis.
635 2	643 6	Sheared, fine grained greenstone, with some mineralisation.
643 6	648 9	Porphyry.
648 9	653 6	Sheared, fine grained greenstone, shearing at 60° to core axis.
653 6	657 0	Porphyry.
657 0	711 11	Sheared, fine grained greenstone, shearing at 60° to core axis.
711 11	721 0	Porphyry.
721 0	751 7	Sheared, fine grained greenstone, shearing angles 50° to 60° to core axis.
751 7	753 6	Sheared, mineralised fine grained greenstone.
753 6	761 3	Porphyry.
761 3	766 0	Silicified, mineralised B.I.F., bedding angles 30° to 60° to core axis.
766 0	848 5	Sheared, fine grained greenstone.
848 5	908 6	Dense, massive, fine grained greenstone.

Hole in progress, will continue to at least 1,000 feet.

Assay Results.
D.D.H. No. M2.
Mount Morgans.

From	To	Core Length	True Width	Assay	
ft. ins.	ft. ins.	ins.	ins.	dwts./ ton	
537 2	539 0	22	15	Trace	
539 0	541 0	24	17	1·49	
541 0	543 0	24	17	2·08	
543 0	545 0	24	17	3·25	
545 0	547 0	24	17	1·20	225 in. at
547 0	549 0	24	17	1·12	3·5 dwts.
549 0	551 0	24	17	Trace	
551 0	553 0	24	17	Trace	
553 0	555 0	24	17	1·20	
555 0	557 9	33	23	16·31	
588 0	590 0	24	18	2·06	
590 0	592 0	24	18	Trace	
592 0	594 0	24	18	1·02	
594 0	596 0	24	18	0·86	230 in. at
596 0	598 0	24	18	Trace	0·45 dwts.
598 0	600 0	24	18	Trace	
600 0	602 0	24	18	0·60	
602 0	604 0	24	18	Trace	
604 0	606 0	24	18	Trace	

From	To	Core Length	True Width	Assay	
ft. ins.	ft. ins.	ins.	ins.	dwts./ ton	
606 0	607 2	14	10	Trace	
620 10	622 10	24	18	Trace	
622 10	624 10	24	18	Trace	
624 10	626 10	24	18	Trace	172 in. at
626 10	628 10	24	18	Trace	Trace
628 10	630 10	24	18	Trace	
630 10	632 10	24	18	Trace	
632 10	635 2	28	21	Trace	
635 2	636 7	17	Unknown	Trace	12 in. Recovered
636 7	638 6	23	Unknown	Trace	16 in. Recovered
638 6	639 6	12	Unknown	Trace	9 in. Recovered
639 6	640 4	10	Unknown	Trace	2 in. Recovered
640 4	642 0	20	Unknown	Trace	10 in. Recovered
642 0	643 6	18	Unknown	Trace	
751 7	753 6	23	20	Trace	
761 3	763 7	28	22	Trace	57 in. at
763 7	766 0	29	23	0·49	0·25 dwts.

MT. MORGANS DRILLING

D.D.H. No. M3

Hole No.: M3, Site No. 2.

Position of Collar: On a bearing 228½° True from southern corner of G.M.L. 505F, distant 80 feet.

Angle of Depression: 60°. Machine Used: Mindrill A2000.

Azimuth: 241° T. Core Size: AXT.

Date Commenced: 18/3/58. Contractor: L. Honey.

Object: To test the downward continuation of mineralisation and explore the structure at depth of the main Mt. Morgans mine.

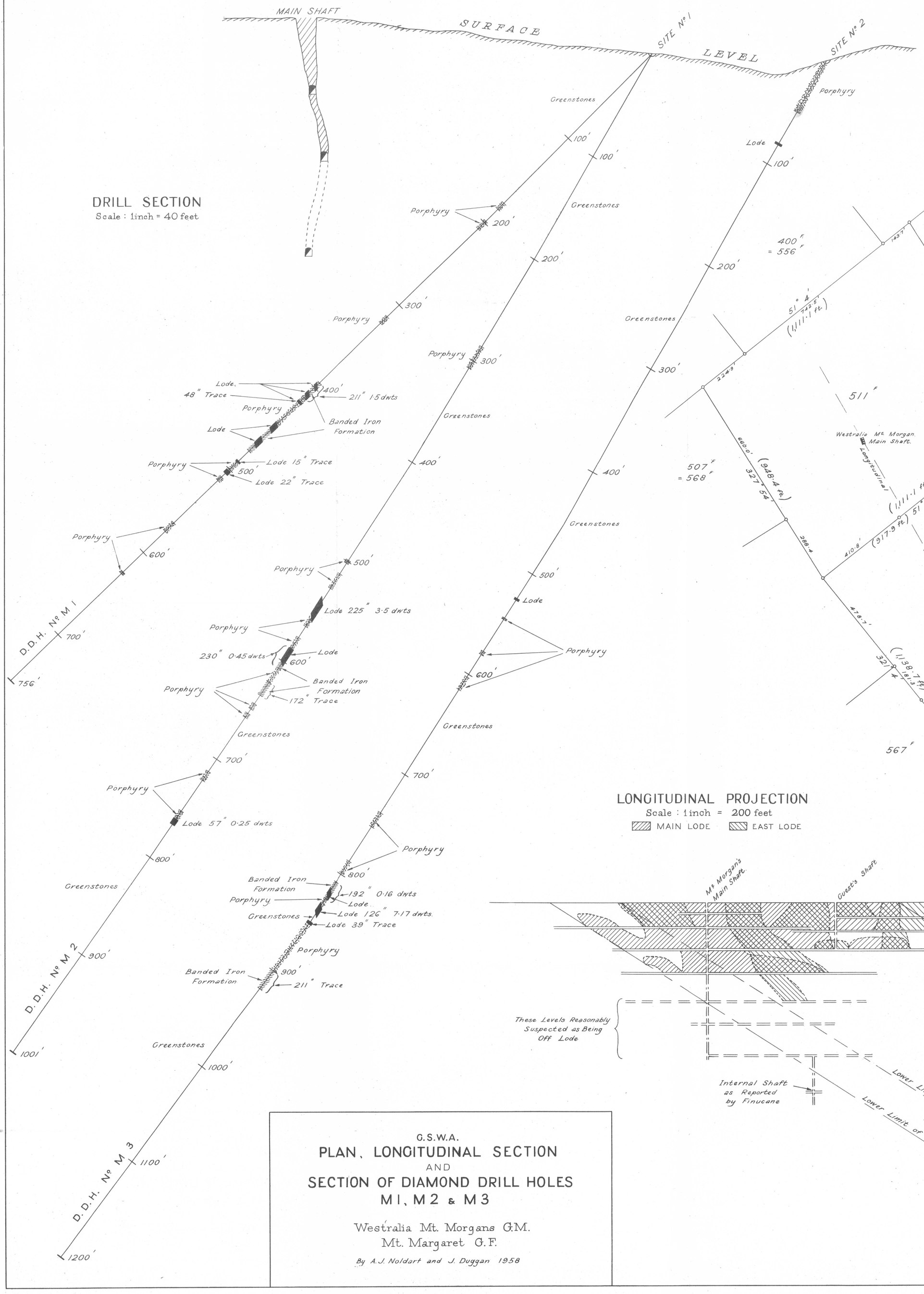
Logged by: A. J. Noldart. Completed depth: 1206 feet.

Assays by: School of Mines, Kalgoorlie. Date of Completion: 3/5/58.

Summarised Core Log

From	To	Description
ft. in.	ft. in.	
0 0	50 0	Weathered and kaolinised porphyry.
50 0	73 6	Medium grained greenstone with blebs of ferro-magnesian minerals —porphyritic in texture.
73 6	77 6	Fine grained greenstones.
77 6	80 10	Medium grained blebby greenstone as above.
80 10	82 4	Highly siliceous with coarse pyritic mineralisation.
82 4	121 3	Medium grained blebby greenstone as above.
121 3	130 0	Fine grained dark (volcanic ?) greenstone—very sharp contact with rocks above and below bedding 52° to core axis. Cleavage 60°–70°.
130 0	294 5	Medium grained green blebby greenstone as above with occasional fine grained bands.
294 5	358 0	Actinolite schist—gradation from above.
358 0	388 6	Sheared actinolite schist.
388 6	518 0	Fine-medium grained greenstones.
518 0	524 6	Dark grey, fine grained (volcanic ?) greenstone.
524 6	526 0	Highly siliceous with coarse pyrite.
526 0	527 6	Ditto, grading to fine grained greenstones.
527 6	542 10	Fine-medium grained greenstones.
542 10	544 4	Black felspar porphyry.

DRILL SECTION
Scale : 1 inch = 40 feet



PLAN
Scale : 1 inch = 200 feet.

LONGITUDINAL PROJECTION
Scale : 1 inch = 200 feet

MAIN LODE EAST LODE

G.S.W.A.

PLAN, LONGITUDINAL SECTION AND SECTION OF DIAMOND DRILL HOLES M1, M2 & M3

Westralia Mt. Morgans G.M.
Mt. Margaret G.F.

By A.J. Noldart and J. Duggan 1958

From	To	Description
ft. in.	ft. in.	
544 4	577 8	Fine grained siliceous greenstone.
577 8	580 6	Black siliceous felspar porphyry.
580 6	582 9	Sheared greenstone.
582 9	602 3	Porphyritic greenstone.
602 3	615 3	Black felspar porphyry—sharp contact with rocks above and below bedding 45° to core axis.
615 3	738 3	Medium-fine grained greenstone with occasional small shears.
738 3	751 9	Black felspar porphyry.
751 9	787 0	Medium-fine grained greenstone.
787 0	799 3	Sheared greyish felspar porphyry—quartz schist like.
799 3	807 6	Medium-fine grained greenstone becoming sheared.
807 6	823 6	Contorted greenish B.I.F. with pyrite.
823 6	829 9	Sheared greyish felspar porphyry—quartz schist like.
829 9	840 3	Black B.I.F. contorted in part.
840 3	847 0	Highly sheared greenstone.
847 0	850 3	Quartz lode with pyrite.
850 3	882 0	Sheared greyish felspar porphyry—quartz schist.
882 0	900 0	Felspar porphyry.
900 0	919 0	Sheared and contorted green B.I.F. 2 inches, quartz 918 feet 11 inches.
919 0	988 0	Highly sheared greenstone.
988 0	1,010 0	Tuffaceous greenstone sheared in places.
1,010 0	1,057 6	Sheared medium grained greenstone. (Tuffaceous ?).
1,057 6	1,065 0	Greyish sheared medium grained greenstone.
1,065 0	1,066 0	Sheared pale green greenstone.
1,066 0	1,206 0	Footwall country rock.
		END OF HOLE.

Assay Results

D.D.H. No. M3, Site 2

Mt. Morgans

Sample	From	To	Core	Assay	
No.	ft. in.	ft. in.	in.	dwts./ton	
M89	80 10	82 4	18	Trace	
M90	358 0	361 6	42	Trace	
M91	521 6	524 6	36	Trace	
M92	524 6	526 0	18	Trace	
M93	580 6	582 9	27	Trace	
M94	807 6	810 6	36	Trace	Average
M95	810 6	813 6	36	Trace	0·16 inches
M96	813 6	816 6	36	Trace	dwt./ton
M97	816 6	820 0	42	0·45	over
M98	820 0	823 6	42	2·06	192 inches.
M99	823 6	826 6	36	Trace	
M100	826 6	829 9	39	Trace	
M101	829 9	832 6	33	2·53	Average 7·17
M102	832 6	835 0	30	21·17	dwt./ton
M103	835 0	837 6	30	Trace	over
M104	837 6	840 3	33	5·60	126 inches.
M105	840 3	843 9	42	Trace	
M106	843 9	847 0	39	Trace	
M107	847 0	850 3	39	Trace	
M108	850 3	853 10	43	Trace	
M109	900 0	903 3	39	Trace	
M110	903 3	906 6	39	Trace	
M111	906 6	909 9	39	Trace	
M112	909 9	913 0	39	Trace	
M113	913 0	916 3	39	Trace	
M114	916 3	919 3	36	Trace	
M115	919 3	922 3	36	Trace	
M116	922 3	925 3	36	Trace	
M117	925 3	928 3	36	Trace	
M118	928 3	931 3	36	Trace	
M119	1,054 6	1,057 6	36	Trace	
M120	1,057 6	1,061 0	42	Trace	
M121	1,061 0	1,065 0	48	Trace	
M122	1,065 0	1,066 0	12	Trace	

NOTES ON THE SUPPLY OF ARTESIAN AND SUB-ARTESIAN WATER IN THE FITZROY BASIN

J. Wyatt—Geologist, G.S.W.A.

Introduction:

The successful exploitation of artesian and sub-artesian water supplies in the Fitzroy Basin presents a far greater problem than that of the Canning Basin, south of Broome.

Therefore, whilst it is believed that the Fitzroy Basin is more suited to irrigation as regards both water supplies and soil types, the recovery of this water will require a more specialised approach under geological supervision.

It is for this purpose that three maps have been produced to accompany this report, they are as follows:—

Plate 1.—Shows the generalised geology of the basin.

Plate 2.—Outlines the areas most suitable for the location of bores to tap the Poole Sandstone aquifer and includes topographic contours at 100′ intervals.

Plate 3.—Is a structure contour map of the top of the Poole Sandstone, the most important aquifer in the area.

This appraisal and the accompanying maps have been prepared by the writer from information supplied by W.A. Petroleum Ltd., and from data contained in the Bureau of Mineral Resources "Preliminary Report on the Geology of the Fitzroy Basin" by D. J. Guppy, 1953.

Explanation of Accompanying Plates 1, 2 and 3:

Plate 1.—This is a genaralised geological map of the area showing the main age groups and some of their more important formations:—

Pre-Cambrian.—Oldest rocks in the area consisting of meta-igneous and meta-sedimentary types. Contain surface water only and are not source beds for artesian water.

Devonian ((1)and (2)).—The Devonian formations are characterised by a rapidly changing facies and rough topography which limits the areas suitable for bore locations.

The Devonian succession is divided into two broad subdivisions numbered 1 and 2 on Plate 1:—

(1) Conglomeratic formations which are excellent sources of water when found interfingering with impervious rocks of division 2. The choice of location of sites in these rocks is difficult and should only be attempted under geological supervision.

(2) Poor source beds, in which drilling should only be carried out with the aim to intersecting an aquifer at a lower horizon, either within the formation or below it.

Permian ((3), (4), (5) and (6)).—This age group contains the most reliable source beds in the area, namely the Poole Sandstone, Grant and Liveringa formations, a high percentage of successes having been gained with holes drilled into aquifers of this age. Only one formation, the Noonkanbah has been classed as unsatisfactory, as it consists mainly of shales of low permeability.

(3) and (4) The Grant Formation and the Poole Sandstone respectively, are primarily sandstones with numerous horizons from which supplies of water can be expected. As the Poole Sandstone is younger and overlies the Grant Formation, therefore presenting a shallower drilling target, it has been chosen as the most useful aquifer in the basin.

(5) The Noonganbah Formation for the most part is impermeable and unreliable.

(6) The Liveringa Formation is classed as a successful aquifer, but not always as a source of potable water. Therefore, although a shallower drilling prospect, it is not favoured over the Poole Sandstone.

Mesozoic ((7), (8), (9) and (10)).—Usually a reliable source of water but contains several saline beds.

That portion of the Mesozoic which outcrops in the south-western corner of Plate 1, also is prone to sand up in artesian bores, due to insufficient hydrostatic head. A more attractive prospect in this area would be to intersect the Poole Sandstone below, where in the Jurgurra Creek region its top is only from 0 to 1000' below sea level.

Those beds of Mesozoic which overlie the Permain in the Derby region are, however, the main source beds of the Derby town supply, and could be exploited if necessary.

Plate 2.—Having decided on the Poole Sandstone as the most favourable aquifer to exploit, Plate 2 was prepared, outlining those areas most suitable for drilling.

In choosing locations within this area, several factors must be taken into consideration:—

(1) Sites must be chosen topographically below the intake beds of the aquifer in question, (i.e. below points where the aquifer outcrops at the surface). Otherwise there will be insufficient hydrostatic head to make the well flow.

(2) Sites should be chosen, if possible, in structural lows within the aquifer, that is, synclinal structures would be more suitable than anticlinal.

(3) The aquifer must be sealed by some impermeable rock type overlying it.

Therefore, bearing these points in mind, it is possible to eliminate various sections of Plate 2.

The north-eastern third of Plate 2 has been classed as unsuitable, due either to the non-artesian nature of the Pre-Cambrian rock types, or to the fact that we have Poole Sandstone outcropping in topographically high areas.

The south-western third of Plate 2 has been classed as unsuitable, due to the fact that the greater part of the area is overlain by Mesozoic rock types in topographic highs, therefore, holes tapping the Mesozoic aquifers would no doubt sand up. As mentioned previously, holes could tap the Poole Sandstone below the Mesozoic cover. This leaves a broad area in the centre of Plate 2, which extends in a south-easterly direction from Derby to Christmas Creek, and has been classed as suitable for the location of drill sites.

Plate 3.—This Plate shows the subsurface structure contour of the top of the Poole Sandstone, outlining areas of synclinal or anticlinal folding within the Poole. It also outlines areas where the Poole Sandstone approaches closest to the surface.

Conclusions:

It is important to note that the above statements refer to exploiting of the Poole Sandstone. Boring into the Grant, which underlies the Poole, could be carried out if necessary, although the holes would be deeper.

Shallower holes on the fringes of the basin, along a line extending through Gogo Homestead, Laurel Downs and possibly Kimberley Downs, could be drilled to tap the Grant instead of the Poole and anywhere within the basin selected sites could possibly be chosen to tap other younger or older aquifers.

Further, it must be noted that this report is based on drilling information available to date, as this information is by no means comprehensive. The areas indicated on the accompanying maps are not to be considered as certainties for the striking of ample water supplies.

This report and maps should be used as a guide to likely drill locations, the actual sites chosen being subject to geological approval.

REPORT ON THE SANDSTONE DEPOSITS OF DONNYBROOK

By J. D. WYATT, B.A.
Geological Survey of W.A.

Summary:

In an effort to map the various sandstone outcrops in the Donnybrook area and to arrive at some conclusions as to the future of the sandstone industry, the author was instructed to spend some time in the Donnybrook district carrying out field work.

The Donnybrook sandstone and its various associated sedimentary members extend over a distance of some 23 miles in a line running north and south. The beds dip generally in a westerly direction at 10 degrees and overlie the granite basement to the east.

The outcrops are visible across strike for an average width of ¼ mile before they dip below a thick cover of sand and laterite.

The outcrops are not continuous, but occur as isolated patches of massive stone, some of which have a quarry situated to exploit the best of the outcrop.

Both gold mining and sandstone quarrying have been carried out in the area. The gold mining lasting only a few years after the turn of the century, and the quarrying, on a small scale being carried out up until the present time.

Several hundred million tons of stone has been shown to be available in three localities in the immediate vicinity of Donnybrook, and if a good, steady demand for the stone can be brought about, then the industry should be assured of a bright future.

Location:

Donnybrook is situated on the Bunbury and Bridgetown railway and is 26 miles south-east of Bunbury, and 143 miles by rail from Fremantle.

In addition to its rail facilities, the town is also well served by sealed all-weather highways.

The most important deposits of sandstone are located within five miles of the railway station and are either adjacent to good gravel or sealed roads, or easily accessible by bush tracks.

Donnybrook townsite is situated on the eastern edge of the coastal plain amongst the foothills of the Darling Scarp, some 200 feet above sea level, and is the centre of a prosperous fruit growing and stock raising industry.

History:

The mining activities associated with Donnybrook, both for gold and the quarrying of building stone, appear to have become established around the turn of the century.

It is recorded that gold was first discovered by a party of prospectors in 1897, but the date of the first major quarrying venture is less certain.

It is most likely that the quarrying was at first carried out to supply local needs and as the sandstone's usefulness became known, the industry grew.

Several prominent Perth buildings were either faced with or built of Donnybrook Sandstone, the earliest of note being the Police Courts in 1905. Amongst others since then were the Post Office and the Houses of Parliament.

Quarrying was never carried out on a large scale however, only select areas of stone being removed one at a time, from various localities throughout the district.

Physiography:

(1) Topography.

Situated amongst the foothills of the Darling Scarp, the country in the vicinity of Donnybrook consists essentially of a highly dissected plateau between 1,000 feet to 1,500 feet above sea level.

PLATE IV

FITZROY BASIN

WESTERN AUSTRALIA

GENERALISED GEOLOGICAL MAP

P€		PRE-CAMBRIAN
1	Conglomeratic Facies	DEVONIAN
2	Other formations	
3	Grant formation	PERMIAN
4	Poole Sandstone	
5	Noonkanbah formation	
6	Liveringa formation	
7	Blina Shale	TRIASSIC
8	Erskine Sandstone	
9	Other formation	JURASSIC
10	Meda formation	CRETACEOUS

☼ Known Artesian Bore [S.A. Sub Artesian]

8 0 8 16 24

Scale of Miles

Compiled by J.D. Wyatt geologist G.S.W.A. from B.M.R Map of Fitzroy Basin 1956 and report by D.J. Guppy (1953).

KING SOUND

PRE-CAMBRIAN ROCKS

NOT SOURCE BEDS FOR ARTESIAN WATER

P€

OLD NAPIER

NEW NAPIER DOWNS

DERBY

MAY HALL'S 1056' 69,400 g.p.d.

MEDA No1 1696' 50,000 g.p.d. [S.A]

MEDA

MEDA R.

LENNARD R.

MAY R.

KIMBERLY DOWNS

67 MILE BORE 3012' 124,000 g.p.d.

YEEDA

To Broome

GREAT NORTHERN HIGHWAY

BLINA

ELLENDALE

CAMBALLIN

LIVERINGA

FITZROY RIVER

MYROODAH

LAUREL DOWNS

FOSSIL DOWNS

FITZROY CROSSING

MARGARET RIVER

GOGO

McHUGH No1 140 7200 g.p.d 2·6 grs [S.A]

Jurgurra Creek

NERRIMA

LITTLE FLOW

GREEN SPRING

BARNES BIG FLOW

JUBILEE DOWNS

NOONKANBAH

Christmas Creek

PRICES CK W.W. 108 AMPLE POTABLE [S.A.]

CHRISTMAS CREEK

BOHEMIA DOWNS

PLAN I

PLATE V

FITZROY BASIN

WESTERN AUSTRALIA

Showing most likely areas for location of water within the Poole Sandstone aquifer.

P€ — Areas of Pre-Cambrian Rocks or areas outside scope of the Report

* Outcropping Rocks of Poole-Sandstone or older.

* Areas underlain by Poole Sandstone [Most suitable for drilling]

100' — Topographic contours 100' intervals W.A.P.E.T. Geophysical control.

B.M.R. Geological map interpolated from 250' contour intervals

Established fault position approx.

1 0 1 2 3

Scale of Miles

* See accompanying notes regarding other aquifers within these areas.

Compiled by J.D. Wyatt Geologist G.S.W.A. July 1958 from information supplied by W.A.P.E.T. Pty Ltd.

KING SOUND

P€

FRASER R.

DERBY

MEDA

KIMBERLEY DOWNS

LENNARD RIVER

Alexander Creek

Blackwater R.

BLINA

ELLENDALE

Creek

Mc. Haraman

LIVERINGA

FITZROY RIVER

MYROODAH

LAUREL DOWNS

FOSSIL DOWNS

MARGARET RIVER

GOGO

JUBILEE DOWNS

Berar

Charnley Bore

NERRIMA

NOONKANBAH

Jurgurra Creek

FENTON FAULT

Christmas Creek

CHRISTMAS CREEK

100' 200' 300' 400' 500' +500' 200'-100.0'

PLAN 2

PLATE VI

FITZROY BASIN

WESTERN AUSTRALIA

STRUCTURE CONTOUR MAP OF TOP OF POOLE SANDSTONE

REFERENCE

Outcrop line of top of Poole Sandstone.

-1000' Structure contours of top of Poole Sandstone related to sea level 1000' intervals (500 ft intervals where necessary)

MEDA Nº1
-2125' Bore site showing height of top of Poole Sandstone above or below sea level.

Scale of Miles: 8 0 8 16 24

Compiled by J.D. Wyatt Geologist G.S.W.A. July 1958 from information supplied by WADET Pty Ltd

PLAN 3

123° 124° 125° 126°
18° 19°

KING SOUND
DERBY
Alexander Creek
LENNARD RIVER
PARKER RIVER
MEDA Nº1 -2125
67 MILE +190
A.F.O. SISTERS -1533
FITZROY RIVER
A.F.O. MYROODAH -2293
Mt Handman Creek
B.M.R. Nº1 487
Charnley River
Jurgurra Creek
FENTON FAULT
A.F.O. Nº1 -600'
F.K.O. NERRIMA -418'
MARGARET RIVER
Anna Plains
F.O. Nº3 +800'

Rugged, soil covered and laterite capped hills abound throughout the district; these are drained by short actively eroding streams which flow only in winter.

Between these hills and in the vicinity of the main water courses and their tributaries, small rich alluvial flats exist; these are used both for orchards and where water-logged, for grazing.

On the slopes of the steeper hills the sand and laterite cover has been eroded away to expose granite gneiss basement rocks.

Access is only made possible by the use of timber tracks which traverse the more inaccessible portions of the district.

(2) Drainage.

The area is drained by two main streams, namely the Capel and the Preston rivers and their numerous tributaries.

Both these rivers flow off the escarpment in a general westerly direction to the coast some 15 to 20 miles distant.

The rivers are permanent and in their lower reaches on the coastal plain, are used for irrigation.

(3) Vegetation.

The district supports a heavy growth of Jarrah, Red Gum and Blackboy, especially on the well drained slopes and summits of the laterite and sand covered hills.

Towards the base of these slopes on the richer alluvial soils and swampier portions of the water courses, a heavy growth of ferns, grasses and swamp vegetation flourishes.

On many properties, thick stands of pines have been planted in past years, and in some cases these are now being cut and sold to local mills.

On all cleared ground, orchards have been established for the growth of apples, citrus and stone fruits.

High level grazing is carried out on the cleared, stonier slopes which support a heavy grass growth during winter. This enables the flatter, richer ground on the lower slopes and alluvial flats to be used for orchards.

GEOLOGY.

The geology of the area is not complex and can be divided into three recognisable units:—

1. *Kainozoic.*
   - (a) Residual Soils.
   - (b) Recent Sands.
   - (c) Laterites.
   - (d) Pebble and Boulder Beds.
2. *Jurassic (?)*
   - (a) Donnybrook Sandstones.
   - (b) Blackwood Shale (?)
3. *Pre-Cambrian.*
   - Granite gneisses (with associated dykes of younger age).

1. Kainozoic.

(a) Residual Soils.—These are deposited as alluvial flats adjacent to the main water courses of the district. In many places these become low-level swamps throughout the winter, drying out only during the summer.

In various localities heavy clay soils are common, these being the result of disintegration of the more basic members of the Pre-Cambrian basement rocks.

It is these well drained clay soils that are most suitable for the establishment of citrus groves and apple orchards.

(b) Recent Sands.—The occurrence of a thick sand cover on most of the hills in the area and in various low lying areas adjacent to outcrops of Donnybrook sandstone, is presumed to be a reflection of the underlying rock types even though the different sand members observed are not always so easily differentiated.

In some localities, a thick cover of pure white sand in the vicinity of sandstone outcrops has no doubt originated from a breakdown of this rock type, whilst the yellow sand encountered east of the main sandstone deposits, and overlying granite gneiss, is also likely to have its origin in those rocks.

However, some ten miles north of Donnybrook in the vicinity of Maxicar, several outcrops of a highly ferruginous sandstone were observed, the sand in their vicinity being yellow in direct contrast to the white sand of the less ferruginous Donnybrook building stone.

Therefore there is no hard and fast rule with which to tell the underlying rock type from superficial cover.

It is also possible that this sand cover is of a lacustrine or estuarine origin and is related in age to the obviously more recent sandy, pebble and boulder beds which have been observed in the Capeldene area south of Donnybrook.

(c) Laterites.—Practically all the hills in the district of any considerable height are covered with a massive laterite cover.

Both east and west of the known sandstone outcrops, laterites are prominent.

The western boundary of the Donnybrook sandstone in all cases dips beneath a thick cover of sand or laterite.

As mentioned previously, in the vicinity of Maxicar and north as far as Brunswick Junction, there are several outcrops of a highly ferruginous sandstone which in places has been almost completely lateritised.

(d) Pebble Beds.—South of Donnybrook in the Capeldene area, numerous large waterworn pebbles of quartzite are associated with thick, white to grey sand deposits.

These deposits extend in a north-west trending belt across the strike of the Donnybrook sandstones.

Various ideas as to their origin can be advanced as follows:—

(1) That the pebble beds mark the old course of the Blackwood River prior to the formation of the Darling Scarp.

(2) That these beds are deposits of estuarine or lacustrine origin.

(3) That the deposits are the result of a change in the conditions of sedimentation, at the close of the period during which the sandstones were deposited.

The first two theories would place these pebble beds in the Kainozoic, whilst the latter theory would place the beds with the Donnybrook sandstone, that is Jurassic or Cretaceous.

It is the author's opinion that the beds are of a more recent origin and therefore, theories one and two are favoured.

A further possibility is that the various outcrops of pebble beds cannot be correlated and that all three theories are correct. There is no doubt that the Capeldene deposits and the deposits outcropping in the railway cutting west of Donnybrook are entirely dissimilar in character.

2. Jurassic (?)

(a) Donnybrook Sandstone.—The Donnybrook sandstone occurs as a series of isolated outcrops extending in a northerly direction over a distance of some 23 miles.

Due to the thick sand and laterite cover, the sandstones can rarely be traced for more than a hundred yards down dip before they disappear below this cover.

Several outliers occur east of these main outcrops and these undoubtedly overlie the granite basement rocks.

These outliers can be observed at Brookhampton on Location 567, at Newlands immediately adjacent to the railway bridge, and over a fairly large area between Thompson's Hill and the Torrindon track on properties variously owned by Messrs. Jarvis, Mitchell and Langridge.

The Donnybrook sandstone is described by Simpson E. S. *(Misc. Rep. 61-70 G.S.W.A. 1917)* as "a felspathic sandstone whose principal bonding is kaolin or halloysite. Its colour varies from pure

white to deep buff or exceptionally deep pink, the paler coloured stone invariably darkening evenly on exposure to the air. Its grain size varies from very fine to moderately coarse. The stone is available in large blocks of even quality, current bedding and sandballs being rarely seen, and flinty patches, never. (However, it was noted by the author that siliceous sandstone is fairly common in the vicinity of the gold workings where it is shot with numerous small quartz veins).

"The stone is easily worked by machine or hand when freshly quarried, but hardens distinctly on exposure to dry air."

The average dip of these beds is 10°W and the strike is generally north, or a few degrees east or west of this direction.

The sequence is variable in thickness, but sections of several hill slopes show exposures of at least 200 feet, whilst drill holes in the Donnybrook townsite record 441 feet of interbedded sandstones and shales.

Several instances of ripple marking were observed, all of which indicated the beds to be right side up. The outlier at Brookhampton varied in character from most other outcrops of sandstone, in that the massive sandstone was interbedded with numerous thinly bedded shale bands showing strong ripple marking. It was from this outcrop that footprints of a four legged mammal were first observed some years previously.

Although a careful examination was made of each deposit no fossils were observed, however, mollusc fossils have recently been discovered in the ferruginous grits near Maxicar.

Several miles north of Donnybrook after a break of some two miles in the general continuity of the main sandstone outcrops, there occur isolated instances of an extremely ferruginous coarse grained sandstone.

These isolated outcrops occur on strike with the main deposits around Donnybrook and have therefore been correlated with them.

Several fossils of comparable age have also been discovered in recent years which further confirms the correlation, even though the two sandstones differ so greatly in character.

(b) Blackwood Shale.—In two or three instances, namely in gold mining shafts, bore cores and in one creek bed a black shale was observed underlying the Donnybrook sandstone.

In places, namely from debris surrounding old gold mining shafts, this shale is highly carbonaceous and burns feebly with a smoky flame.

This shale has been correlated with the Blackwood shale of Fairbridge (1953).

It is most probable that the shale encountered in bore holes in the Donnybrook townsite can be correlated with this Blackwood Shale.

Both the Donnybrook sandstone and the Blackwood shale are members of the Capel River Group of Fairbridge (1953).

3. Pre-Cambrian.

Granite-gneiss and associated intrusives.—Along the eastern boundary of the Donnybrook sandstone there occur several outcrops of granite gneiss which have been intruded by basic hornblende dykes and numerous parallel quartz veins.

A careful examination of the granite gneiss-sandstone boundary shows that the sandstone overlies the granite unconformably with a gentle dip to the west.

Several outliers of sandstone, east of the main sandstone outcrops also lie unconformably on the granite basement at an angle of approximately 24 degrees.

In one instance an inlier of granite was observed surrounded by gently dipping sandstones.

STRUCTURAL GEOLOGY.

Faulting.

During the gravity survey of the Perth basin carried out by the Bureau of Mineral Resources in 1953, the recorded anomaly placed the Darling Fault as passing immediately west of Donnybrook townsite.

This could account for the fact that no sandstone outcrops have been reported west of a north-south line through Donnybrook, although as stated earlier, heavy sand and laterite cover obscures all outcrops to the west.

As it is believed that several movements have occurred along the Darling Fault Line, then this last movement would have been in Jurassic or early Cretaceous times.

ECONOMIC GEOLOGY.

Freestone Quarrying.

From 1900 up until the present time, with the exception of some spasmodic activity which accompanied the building of various prominent Perth buildings, the quarrying of sandstone in the district has been of a minor nature.

Throughout the length of the survey eight quarries were examined, varying in size from that of Messrs. A. T. Brine's Quarry at Irishtown, which consists of two adjacent workings 200 feet by 120 feet by 20 feet deep and 85 feet by 90 feet by 15 feet deep respectively, to that of the Pink Quarry which consists of no more than a small excavation in the side of a hill.

The colour of the sandstone varied from pure white to deep brown. Iron staining being common, consisting of both darker patches and rhythmic streaking.

The grain size varied from fine to coarse with no definite increase in grain size with depth.

Overburden varied from nil to ten feet, with five feet being an average for all localities.

The quarrying has never been carried out on a large scale, therefore no consideration has been given to completely working out any one area.

In all cases, waste material has been indiscriminately dumped in the vicinity of the workings, making the reopening of these quarries a very tedious and expensive business.

The limiting factors which govern both the quarrying of the freestone and its suitability in relation to Donnybrook sandstone are as follows:—

(a) Availability and Accessibility.

In this respect the working of Donnybrook sandstone is not controlled by this factor.

For the most part all the important deposits are easily accessible, if not by sealed main highways then by well formed roads or tracks. Nowhere is an economic prospect more than five miles from Donnybrook.

Whilst the actual terrain may be rugged, the access roads are always immediately adjacent.

(b) Depth of Overburden.

The thickness of overburden in areas of deep weathering and associated laterite cover, is always a problem. However, in the quarries examined overburden did not exceed ten feet and usually averaged five feet in thickness.

(c) Jointing.

The spacing of joints within the sandstone is extremely important, although the close spacing of joints is not so detrimental now, as most sandstone is being used for facing purposes so that large massive blocks are not required. Nowadays, the use of massive blocks is restricted, the majority of blocks being used as facework. These facing blocks are much thinner, usually two feet by two feet by four inches. Therefore, it is possible to work a sandstone with a closer joint pattern.

On the whole, the Donnybrook stone is fairly massive, the more fissile members being restricted to isolated outcrops of no value.

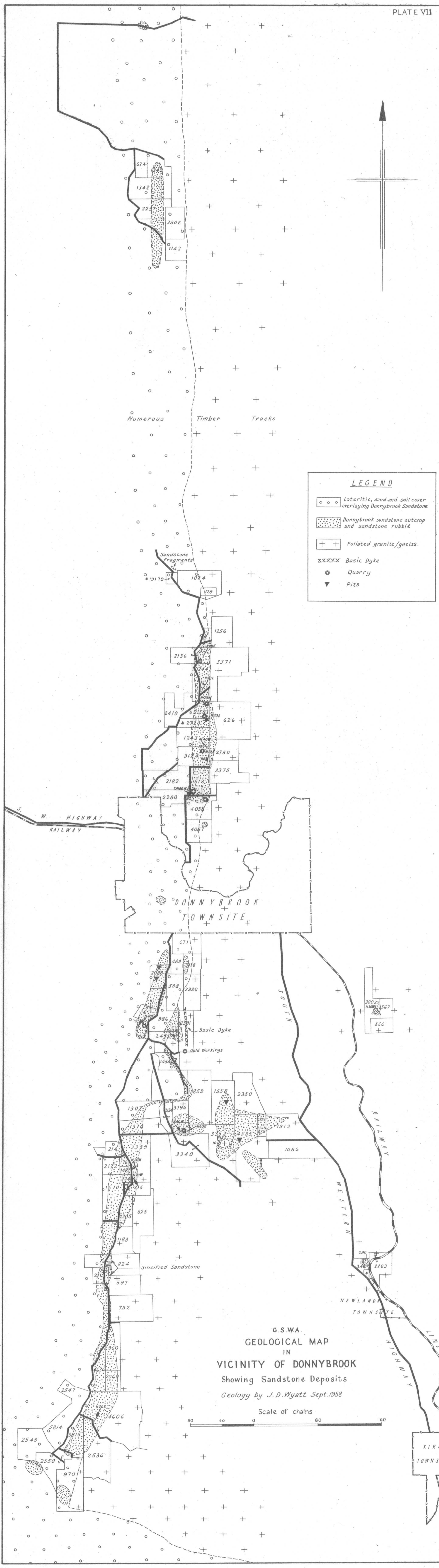
The occurrence of hair line cracks, has however, proved to be a problem. These occur as zones of weakness in an otherwise massive sandstone.

These zones only show up whilst actually quarrying and are not usually visible in surface outcrops.

(d) Grainsize and Porosity.

Variation in grainsize, coupled with the type of cementing material is important in building stones, as this controls the porosity.

PLATE VII



G.S.W.A.

GEOLOGICAL MAP IN VICINITY OF DONNYBROOK

Showing Sandstone Deposits

Geology by J.D.Wyatt Sept.1958

Scale of chains

80 40 0 80 160

Of all the quarries examined only one was condemned as being too porous for exterior work; that was the Pink Quarry on Location 3795.

Simpson, in G.S.W.A. Bulletin No. 74, 1917, states that stone from this quarry "on soaking with water loses the greater part of its coherence."

Although the porosity varies greatly from quarry to quarry, no other sample was condemned on these grounds.

(e) Foreign Bodies within the Sandstone.

(1) Pyrite.—The occurrence of pyrite in sandstone is always detrimental, mainly due to the oxidation and subsequent staining. Donnybrook stone is not affected in any major way by this fault.

Rhythmic iron staining however, is sometimes highly desirable especially in ornamental facework. Portions of Brine's Irishtown Quarry show excellent examples of rhythmic iron staining.

(2) Mica.—The occurrence of mica flakes which may cause the stone to split when placed on end is also detrimental, although at no time was mica in evidence in any of the quarries examined.

(3) Sandballs.—Sandballs are fairly rare, but can be observed in some quarries. As long as they are not too numerous, blocks containing sandballs can be used in work other than facing.

Location and Description of Quarries:

(a) Goldfields Quarry (Location 17665).—Situated approximately 2½ miles south of Donnybrook on the western side of Crendon Road, this quarry is to date little more than a small opening in the side of a hill some 150 feet long by 50 feet wide, with overburden averaging from four feet to five feet in thickness.

The stone is buff coloured and is the heaviest and coarsest grained of all the quarries, it is also the least porous. (Simpson, G.S.W.A. Bull. 74, 1917.)

Stone from this quarry has been used in the lower portion of the Government Stores Building, Perth.

(b) Pink Quarry. (Location 3795).—An excellent outcrop of stone on the side of a steep hill, although practically no work has been carried out on the site.

Jointing approximately 10 feet apart strikes N8OE and dips 85°S.

The sandstone is red to pink in colour and extremely soft. It is fairly fine grained and shows ripple marking.

The overburden varies from three feet to five feet in thickness.

It is extremely porous and upon absorption of water loses its coherence. It is therefore suitable for internal work only.

Of all the quarries, access to this location is poorest.

(c) A. T. Brine's Quarry. (Location 3124).—This quarry is by far the largest in the district and presents the best exposures of sandstone in the area.

The quarry is divided into two workings, southern and northern, which are approximately 200 feet apart.

The southern quarry is 200′ by 120′ by 20′ deep and has an overburden of from eight feet to ten feet in thickness, the northern quarry is 85′ by 90′ by 15′ deep and has an overburden of from 7 feet to 10 feet in thickness. It is also partially filled with water to a depth of eight feet.

The sandstone in this locality is particularly massive with irregular jointing some five feet apart. Its colour varies from white to buff, with rhythmic iron staining being common.

Grain size is variable and has a tendency to increase with depth. However, sudden changes in grain size are common in bands.

Stone from this site has been used in the Police Courts, A.M.P. Buildings and St. George's House, Perth.

Access is excellent, although the site chosen limits the amount of stone which can be extracted without quarrying too far below access road level. No use has been made of gravity by excavating into a hill-side face.

(d) Government Quarry. (Reserve 2720).—This is a large quarry 180′ by 150′ by 20′ deep. Overburden varies from five feet to ten feet in thickness.

Access is excellent, with a well formed gravel road leading right to the quarry.

The workings consist of a main quarry, with several further excavations extending for about ½ mile north along a small permanent stream.

This quarry furnished the stone for the General Post Office, Perth.

The stone is white to creamy brown in colour, fine grained, tough, dense and hard.

Some rhythmic iron staining is evident, but only in a minor way.

Joints are spaced about five feet apart at right angles to each other. The thickness of the section exposed is at least 30 feet.

The quarry is situated right on the edge of the granite/sandstone boundary, within two hundred feet of the contact.

(e) Vincent's Quarry. (South end of Location 1244).—Only a small amount of quarrying has been carried out, several excavations being evident, the largest some 20′ by 30′ by 10′ deep.

Overburden is for the most part negligible.

The stone is from white to buff in colour and the grain size varies from extremely fine grained to fairly coarse in texture.

It is a hard, dense stone and should be capable of taking a fine finish.

(f) Arnott's No. 1 Quarry. (Location 4058).—This is a small quarry, situated some ¾ mile south of A. T. Brine's Quarry.

Its dimensions are 40′ by 20′ by 10′ deep with an overburden of four feet.

The stone is light buff in colour and of medium grain size.

Access is fair to within ¼ mile of the site.

(g) No. 1 Quarry (Alexander's). (Location 1244 North).—Although reported in G.S.W.A. Bulletin 74, by E. S. Simpson, this quarry was not found by the author.

However, it is considered to contain excellent even grained, light brown stone which has been used in both the Art Gallery and the Technical School in Perth.

It is superior in both hardness and durability to the stone contained in other quarries, and was therefore rather more expensive to work.

Access could be rather more difficult, but a fair bush track goes to within ¼ mile of the recorded site.

(h) No. 2 Quarry (Alexander's). (Centre of Location 1244).—This quarry is some 150′ by 60′ by 10′ deep and is partially filled with water to a depth of five feet. Overburden is uniformly six feet to eight feet thick.

The stone is white in colour and fine grained in texture.

Three sets of joints were noted, namely N30E and dipping vertically, N50W and dipping vertically, and N2OE and dipping flatly to the west.

Economically Suitable Quarrying Sites.

Taking into consideration all the factors relating to access, tresspass on private property and availability of suitable quantities of stone, the following sites can be considered worthy of further investigation for suitable quarry location.

(a) Location 17665 (Goldfields Quarry) and extending some 800 yards north of this location.

This location is situated only 2½ miles south of Donnybrook along the Upper Capel Road and can be considered the most attractive site in the area.

The location covers the eastern slope of a fairly steep, laterite covered hill. Sandstone outcrops consisting of boulders, some in situ and loose rubble occur up the hillside for some 300 yards.

Towards the top of the hill several pits have been dug, probably whilst prospecting for gold. It was towards the northern limits of the area on Location 2088 that the sandstone rubble adjacent to these pits showed numerous quartz veinlets, which if persistent would probably mark the western limits of commercially useful stone.

Using the results of laboratory tests carried out on this stone and as contained in G.S.W.A. Bull. 74, 1917 which states that 1 cubic foot of stone weighs 144 lbs., a conservative estimate of the tonnage contained in this location after stripping the overburden would be 100 million tons.

(b) This area extends from Location 4058 to Location 1256, a distance of some 3 miles and covers a strip some ¾ mile wide.

The observed exposures of sandstone are fairly continuous and in practically all instances are situated on land not utilized for farming purposes, and well supplied by established tracks and roads in varying states of repair.

Several old abandoned quarries are situated within the area and with careful examination it should not be difficult to pick new sites.

No estimate of available tonnage is possible, due to lack of detailed information between observed outcrops, but it would not be less than twice the tonnage of Location 17665.

(c) One further area where excellent white, fine grained stone is available is situated approximately ¾ mile north-west of Newlands, immediately adjacent to the railway bridge and between the railway and the main road.

Access is excellent and whilst no tonnage was estimated, a short exploratory programme would most likely uncover an economic prospect.

Gold Mining.

As already stated, gold as discovered in the Donnybrook district some time during 1897.

An examination by State Government geologists revealed that the gold occurred in quartz veins both within the sandstone and the adjoining granite.

In 1899, the Assistant Government Geologist, Mr. T. Blatchford stated that a quartz lode existed in the sandstone at Jackson's Claim, which extended to a depth of 70 feet, and it was his belief that these reefs were fissure veins.

However, in G.S.W.A. Bulletin 16, Mr. Gibb Maitland reported that "gold of an aborescent variety" occurred in samples from the Donnybrook Goldfield which would point to a secondary origin.

Other authors have indicated that the quartz lodes were a secondary infilling of joints and openings within the sandstone.

Forman (Ann. Prog. Rep. G.S.W.A. 1935), stated that the lode material was a chalcedonic quartz which would further indicate a cold solution of circulating waters.

All workings are now filled in and access is impossible. Therefore, the only evidence now available for inspection is that of quartz veinlets in the sandstone outcropping at the surface and the spoil from various shafts throughout the area.

No conclusions could be gained from an examination of this evidence.

Further, as the survey was primarily an economic appraisal of the sandstone deposits of the area, no great attention was given to the abandoned gold mines or the original of the gold, other than that given whilst mapping the granite/sandstone contacts, or abandoned shafts within the sandstone boundaries.

Conclusions.

An examination of the area has shown that many old quarries were sited in low lying areas over outcropping stone, which although free of overburden did not utilize the natural land slopes and accompanying gravity advantages which were elsewhere available. Subsequently, quarrying became uneconomical below a certain depth and the quarries were abandoned.

Furthermore, the small scale of operations in numerous localities and the accompanying selection of the best stone available with no consideration to the future, has also contributed largely to the dwindling of the industry.

The cost of reopening abandoned quarries has further been made more difficult due to the indiscriminate dumping of waste stone in the immediate vicinity of the quarry workings. It was noticed however, that in quarries now being worked this practice was no longer in force.

Whilst it is imperative that the future exploitation of sandstone resources at Donnybrook be placed on a sounder basis, the problems peculiar to any such small scale operation must be considered.

Firstly, without the expenditure of a considerable sum of money, no new quarry site could be adequately examined as to its areal extent, depth and quality of the stone it contains.

Secondly, no operator would be prepared to expend this money unless firm orders guaranteeing a reasonable term of life for the industry could be secured.

Until such orders are forthcoming, it is unlikely that the industry will grow beyond the present small scale intermittent quarrying of the most easily accessible stone. In which case as soon as operating costs rise to an uneconomical level, then that site will be abandoned and a new area opend up.

It is the author's opinion that ideally, any new deposit should be fully explored both by vertical and horizontal diamond drilling in the initial phases, to assess the extent and depth of the deposit (to an economical level), including the thickness of overburden.

Once a site has been chosen on this basis, then drilling should be continued ahead of the working face, in order to anticipate joint spacing, changes in grain size or other factors which could be detrimental to the quality of the stone produced.

The above method is believed to have been employed on a minor scale by Messrs. A. T. Brine and Son, without much success, but it is believed that with careful supervision, drilling could be an extremely useful adjunct to sandstone quarrying.

The selection of sites is also an important factor in the development of a new quarry. It has been previously noted that old quarry sites did not make full use of sloping ground and its accompanying gravity advantages.

Previous operators have been forced to abandon quarries containing good stone, due to uneconomical working at depths below access road level.

A more detailed examination of surface indications would pay dividends in the selection of a quarry site.

Areas immediately adjacent to zones of possible weakness and flexuring, should be avoided.

These zones are not so evident in the Donnybrook area, but certain areas adjacent to the granite/sandstone contact with numerous quartz veinlets in both rock types with an accompanying silification of the sandstone would be a poor site for a new quarry.

From the foregoing observations it will be seen that no easy solution to future quarrying problems is envisaged. The economic factors which will control any future successful exploitation of Donnybrook Sandstone, will depend on the following:—

(1) Adequate finance.
(2) An assurance of orders to warrant expenditure of this finance.
(3) A detailed initial examination of any new site.

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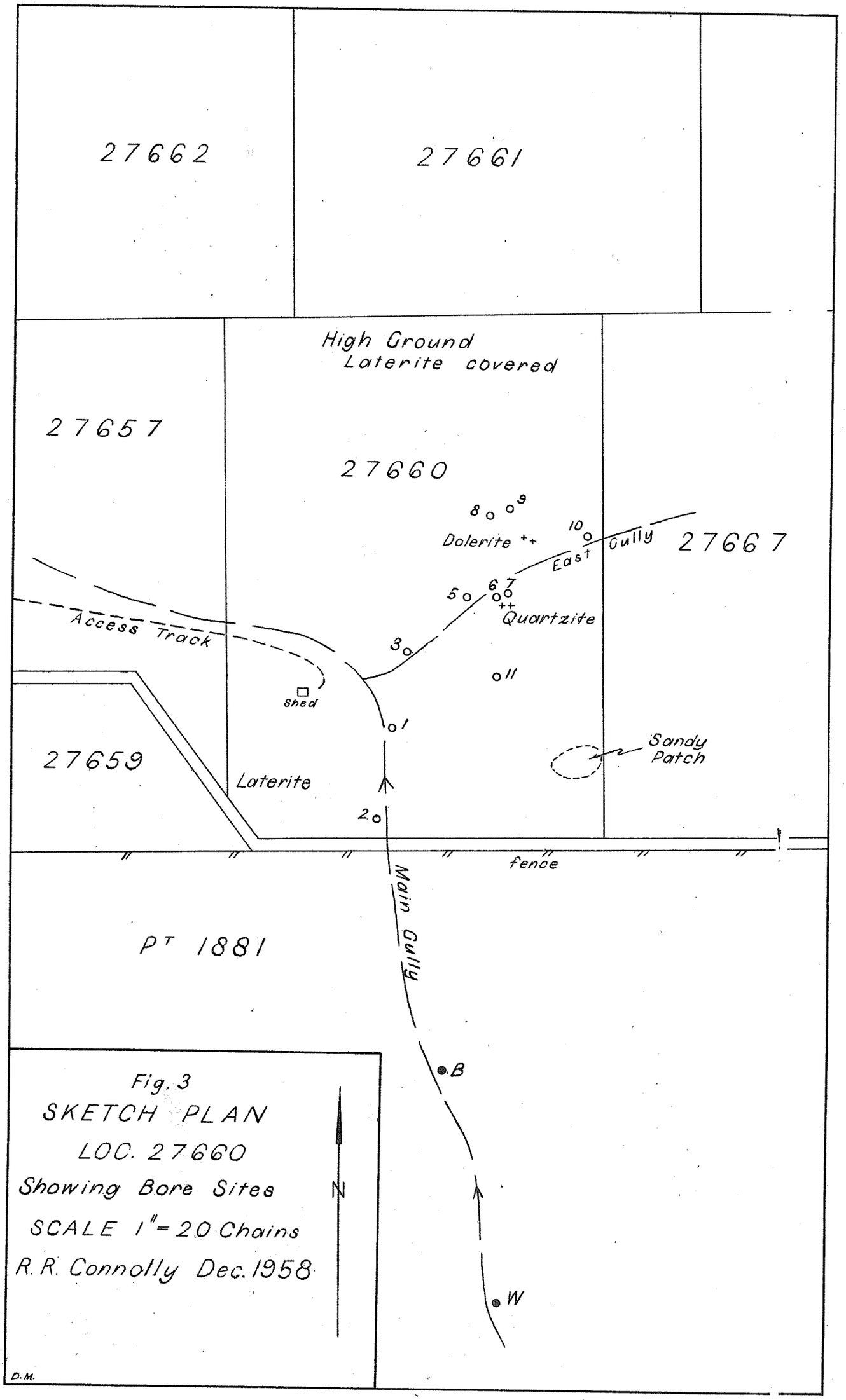
27662
27661
High Ground
Laterite covered
27657
27660
27667
Dolerite
East Gully
Quartzite
Access Track
Shed
Laterite
Sandy Patch
27659
fence
Main Gully
PT 1881
B
W
N
Fig. 3
SKETCH PLAN
LOC. 27660
Showing Bore Sites
SCALE 1" = 20 Chains
R. R. Connolly Dec. 1958
D.M.

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REPORT ON INSPECTION OF AVON LOCATION 27660 FOR WATER SUPPLY.

by R. R. Connolly, Geological Survey of W.A.

Introduction:

Location 27660 is reached via the main Perth-York Road to the 35 mile peg, thence north for 1½ miles along a graded link road, thence 1¼ miles easterly along a track, the turn off being signposted with the owner's name. The block is held under conditional purchase agreement by Mr. R. Foyel. Some clearing and pasturing has been undertaken by the owner on the 600 acre block and he is desirous of establishing a water supply of approximately 3,000 gallons per day, before proceeding to fencing. To this end he requested assistance from the Mines Department and the author was instructed to inspect the block and advise the applicant on the water potentialities.

The inspection was made on 18th December, 1958, in the company of the owner.

Water Potentialities:

Mr. Foyel had already had 11 bores put down on the property without success in locating a suitable supply of water. The positions of these bores are shown approximately on the accompanying sketch plan. The plant used was reported to be a very light one, drilling a two inch hole. Brief details of this drilling are set out in the following table:—

Hole No.	Depth	Water Supply	Salinity grains per gall.	Cuttings	Remarks
	ft.				
1	56	good	1,000	White clay with coarse quartz and mica	In decomposed, coarse grained granite
2	66	good	820	do. do. do.	Sandy top soil
3	66	good	greater than 1,000	White clay with quartz and mica	In decomposed, medium grained granite
4	102	good	750	White to pink clay	In decomposed, fine grained granite
5	30	dry	....	Pink clay with rounded quartz grains	In weathered grainte and alluvium. Bottomed on hard rock.
6	32	dry	....	White clay with fine quartz grains	In weathered grainte. Bottomed on hard rock
7	7	dry	....	....	Commenced in quartzite outcrop and unable to penetrate to any depth
8	40	dry	....	Light brown clay with some quartz fragments	Bottomed on hard rock
9	40	dry	....	do. do. do.	Bottomed on hard rock. In fairly close proximity to dolerite outcrop
10	58	dry	....	White-pink clay	Bottomed on hard rock in fine grained, weathered granite
11	45	dry	....	Not sighted	Bottomed on hard rock

Bores Nos. 1 to 3 are located in the lower portions of a well defined valley, the head of which lies 1½ miles to the south of the south boundary of Location 27660. These three bores show a very steady increase in salinity going downstream. Bores No. 5 to 10 are located in an east-west tributary valley and all except Nos. 6 and 7 are well sited to obtain water. Conditions in this area are identical with those to be found in the main valley to the south, where the adjoining holder has two successful water points of low salinity. It is difficult to understand how bores Nos. 5 to 10 failed to produce water, as the potential is good. It is the author's opinion that the light plant used was incapable of penetrating the full depth of decomposition, and thus obtain water.

Bore No. 4 is on higher ground and struck saline (750 grains/gallon) water at 102 feet. This bore as located, should have struck fresher water than this, and the only reason that can be advanced for the salinity is penetration of a basement trough of stagnant water.

Bore No. 11 sited in a shallow gully on higher ground failed to obtain water, although the potential was good. The same remarks apply here as to bores 5 to 10.

General:

With a rainfall in excess of 30 inches and a well defined drainage pattern in the southern half of the location, a sufficient supply of ground water should exist to satisfy the holder's requirements. The rock types are generally granites, or granite gneiss, with some dolerite dykes, and in one locality a quartzite (Whitestone Phase?) outcropped. Fresh rock exposures are poor, the block for the most part presenting a laterite cover over a fair depth of weathered rock. The extent of the dolerite dykes is not thought to be great, as the laterite is poor in iron and the soil generally light in colour.

From cuttings from existing bores, the weathered zone consists of light brown to white clay, with muscovite mica plates and quartz fragments. This would not be a very porous aquifer, and this lack of porosity resulting in slow ground water movement would account for the steady increase in salinity moving downstream in the main gully.

Recommendations:

Mr. Foyel was advised to confine his future efforts at obtaining ground water to the east gully. A heavier plant in the hands of an operator prepared to tackle up to 20 feet of fractured hard rock boring would be needed to deepen existing holes Nos. 5, 10, 8 and 9, in that order. In the event of the supply from bores being inadequate, wells in the vicinity of bore No. 10 would have to be considered.

REPORT ON INSPECTION OF TEMPORARY RESERVE 1632H AND OTHERS FOR GYPSUM, BOOLOGOORO, N.W. DIVISION.

By R. R. Connolly.
Geological Survey of W.A.

INTRODUCTION.

Three areas, the southernmost commencing at the 35 mile post on the Carnarvon-Onslow telegraph line and extending along this line to the 47 mile post, have been pegged on the ground as temporary reserves for gypsum. Of these, the northernmost, centred about the 47 mile peg was applied for and subsequently granted as Temporary Reserve 1632H for a period of three months as from 24th September, 1958. The southernmost area was applied for as a temporary reserve, but at the time of inspection had not been granted. The central area about the 42 mile peg has apparently not been registered with the Mines Department.

All three areas have been claimed with the declared intention (if granted) of selling the rights to an American plaster manufacturing company, provided that the company establishes a treatment plant in this State.

ACCESS.

The deposits are located approximately 50 miles north of Carnarvon by vehicle track, which passes close by Boolathana homestead. This track would be negotiable by heavy transport in dry weather, but impassable in wet weather, and slow at any time. The main Carnarvon-Onslow road is approximately 15 miles to the east of the deposits and if heavy haulage from the gypsum deposits to Carnarvon were ever contemplated, a link to the main road would be desirable.

THE DEPOSITS.

The area was inspected in November, 1958 by the author, assisted by Mr. K. Grimbly. It had been the intention to sample any deposits in a grid pattern using a two inch auger with extension handle, capable of boring to a depth of 12 feet, this implement having been successfully used by Messrs. de la Hunty and Low in the course of a gypsum survey in the southern part of the State[1].

It was very soon found however, that the gypsum deposits of this area are of such a nature that penetration using an auger bit was not possible, and accordingly the sampling was severely restricted.

The three areas were mapped by pace and compass along a base line provided by the telegraph line which has 26 posts to the mile, the mile posts being marked. The results of the survey have been plotted at a scale of 40 chains to an inch on the accompanying plan which shows the lateral limits of the gypsum deposits and the location of test points. For convenience, the deposits have been numbered from 1 to 3, commencing at the northern deposit, and hereafter the individual deposits will be referred to be these numbers.

No. 1 DEPOSIT.

The temporary reserve surrounding this deposit is centred approximately about the 47 mile peg on the Carnarvon-Onslow telegraph line and covers an area of approximately 600 acres. The country is gently undulating with numerous claypans, one of which lies immediately to the north-west of the reserve. Vegetation consists of saltbush, samphire and occasional stunted mulga. Some fixed red sand dunes occur on the eastern edge of the reserve, the dune pattern trending north in conformity with the general dune pattern for the whole of the area in the vicinity of Salt Marsh salt lake.

No dune deposits of seed gypsum or kopi were observed in this reserve, the gypsum occurring as a hard bedded crystalline deposit overlain by a thin layer of kopi in some places, and in other parts by clayey soil. Rabbit warrens and sink holes have exposed the gysum beds in the southern part of the area, elsewhere the gypsum being poorly exposed. The total area mapped as bedded gypsum either at or near the surface is approximately 850,000 square yards.

Eleven test points were selected in this area and three samples taken. The positions of the test points are shown on the accompanying plan and the results obtained are as follows:—

Test Point. Results.

1. In slight depression.
   0'-6'—Deep brown to red clay.
2. On small hummock.
   0'-5'—Clay.
3. Alongside telegraph line.
   0'-2' 6"—Sandy clay.
   2' 6"-4' 0"—Red sand.
   4' 0"-6' 0"—Red sandy clay.
4. On flat ground with powdery soil.
   0'-2' 0"—Gypseous clay soil.
   2'-2' 3"—Crystalline Gypsum.
   2' 3"-2' 9"—Solution cavity.
   2' 9"- ? —Hard crystalline gypsum, Unable to penetrate with auger.
5. On small hummock.
   0'-2' 6"—Fine gypseous lime sand with some shell fragments.
6. On claypan.
   0'-0' 4"—Gypseous sand with shell fragments.
   0' 4"-6' 0"—Yellow clay with no gypsum apparent. Wet at 3' 6".
7. On sand dune with very fine powdery surface.
   0'-6' 0"—Fine to medium grained red sand.
8. Flat ground alongside telegraph line. Trench in hard picking ground as auger unable to penetrate.
   0'-0' 6"—Gypseous sand.
   0' 6"-2' 0"—Bedded crystalline gypsum with some clayey bands.
9. On flat ground.
   0'-1' 0"—Gypseous sand.
   1' 0"- ? —Hard bedded crystalline gypsum. Unable to pene- with auger.
10. On edge of sink hole.
    0'-0' 4"—Gypseous soil.
    0' 4"-2' 0"—Bedded crystalline gypsum with some clay seams.
11. In sink hole area.
    0'-1' 6"—Bedded crystalline gypsum.

Samples were taken from test points 7, 8 and 10, the results of analyses as supplied by the Government Chemical Laboratories being shown in the appended table.

The total thickness of this deposit was not measured due to the tough nature of the bedded gypsum, but over the area outlined on the accompanying plan the thickness would not be less than two feet and is probably more. For the purpose of a preliminary tonnage estimate however, a thickness of two feet has been taken and a conversion factor of 16 cubic feet per ton for the gypsum in situ has been used.

Using these figures, a total of 956,250 tons is obtained. It is considered that this would be an available tonnage as the depth is certainly greater than the two feet used, which would more than offset cavities and surface irregularities.

The grade of this deposit would be of the order of 85 per cent. gypsum, similar to sample No. 4 which was taken by channel sampling the side of a trench put down in bedded gypsum in situ, whereas sample No. 5 was taken from the edge of a sink hole and exposed material from this point may have been cleaned by weathering effects.

Sample No. 3 was taken to ascertain the gypsum content of a typical lake edge sand dune.

No. 2 DEPOSIT.

This deposit is centred about the 42 mile post on the telegraph line and is similar in mode of occurrence to the No. 1 deposit. At the No. 2 deposit, vegetation is thicker and a large part of the gypsum would be lost in cleaning off the scrub. Some gypsum has already been removed from the vicinity of test point 14 to satisfy a small demand for Kopi by the plantations at Carnarvon. In this locality, hummocks of kopi overlie the bedded crystalline gypsum, previous production having been confined to these small kopi mounds.

Three test points were selected and two samples taken from this deposit, results of the examination being as follows:—

Test Point. Results.

12. Scattered outcrops of kopi overlain by red sand.
    0'-2'—Kopi.
    2'-?—Red sand.
13. Sink holes in bedded gypsum with kopi infilling.
    0'-3'—Kopi and small crystalline gypsum.
    3'-?—Red sand.

[1]L. E. de la HUNTY and G. H. LOW: The Gypsum Deposits of Western Australia. Mineral Resources of W.A. Bulletin No. 6, Department of Mines 1958.

PLATE VIII

PLAN SHOWING

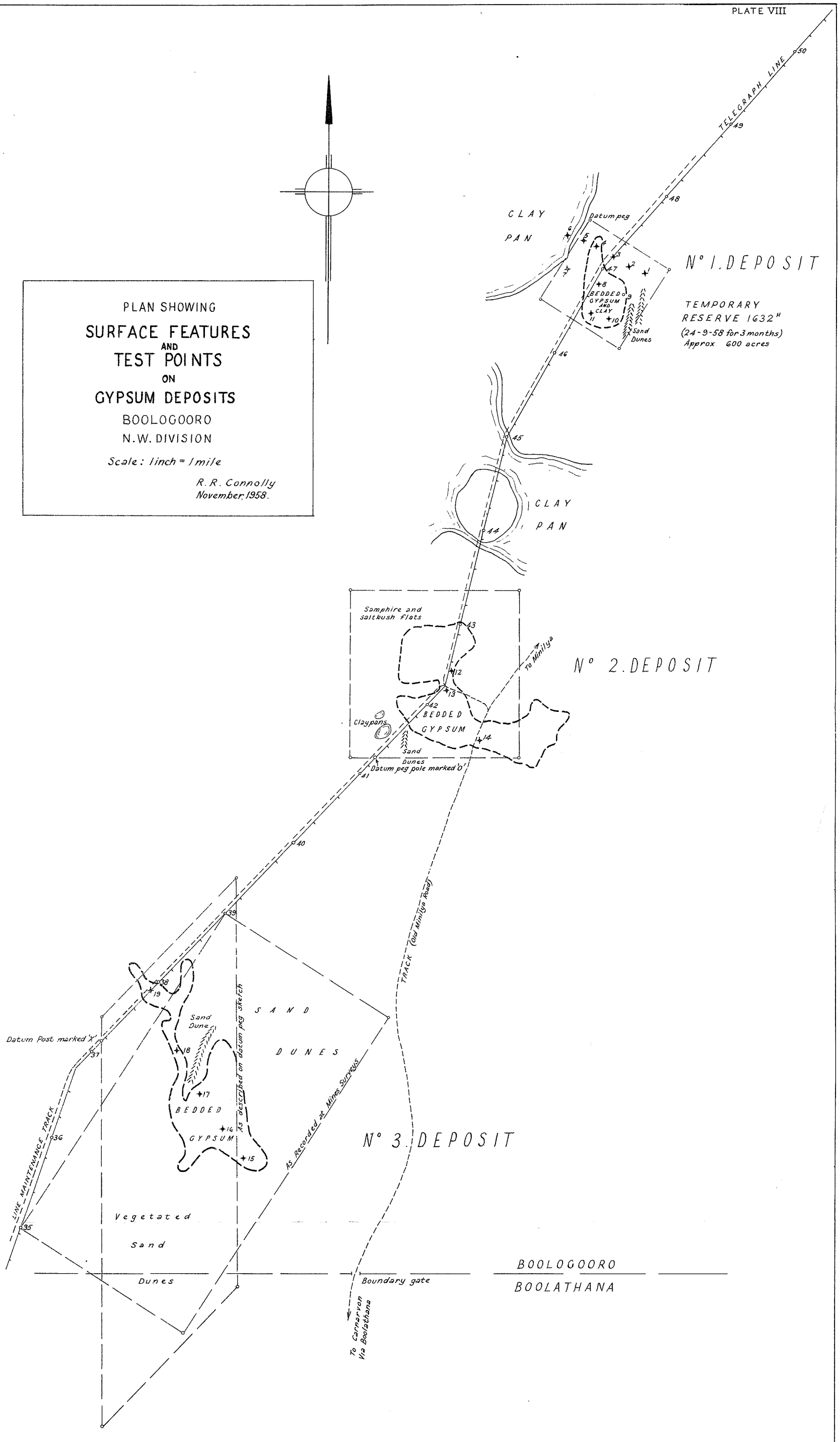
SURFACE FEATURES AND TEST POINTS ON GYPSUM DEPOSITS

BOOLOGOORO

N.W. DIVISION

Scale : 1inch = 1mile

R. R. Connolly
November, 1958.



14. Kopi hummock.
0'-3'—Clean kopi.
3'- ?—Hard bedded crystalline gypsum.

Samples were taken from points 13 and 14, the results of analyses being appended.

The areal extent of this deposit is approximately 3½ million square yards. The thickness, ascertained at points 12 and 13 varies between two and three feet, and at point 14 is greater than three feet. For the purposes of a tonnage estimate, an overall thickness of 2 feet will be taken, upon which a quantity of four million tons is calculated as possible reserves.

The grade of this deposit would be of the order of sample No. 8 (78.8 per cent. gypsum) with higher grade kopi available in small quantities.

No. 3 DEPOSIT.

This is the best of the three deposits and the greater part of the outcrop lies within an area pegged and applied for as a temporary reserve (1659H), but subsequently refused. The applicants were advised to apply for smaller areas as mineral claims, but at the time of writing they had taken no further action.

The deposit lies immediately to the south-west of the 38 mile post on the telegraph line, the outcrop appearing to be confined to a former drainage depression trending north. Five test points were selected and two samples taken, results of the examination at the test points being as follows:—

Test Point. Results.

15. 0'-1'—Kopi.
1'-7'—Granular gypsum, variable grain size with some thin clayey bands.
7'-12'—Stiff red clay with some coarse gypsum crystals.

16. Edge of sink hole.
0'-1' 6"—Hard consolidated Kopi crust.
1' 6"-3' 0"—Hard bedded crystalline gypsum.

17. On hummocky ground.
0'-2'—Kopi.
2'-? —Hard bedded crystalline gypsum, unable to penetrate with auger.

18. Trench 3' deep put down with pick and shovel in hummocky ground.
0'-0' 3"—Gypseous soil.
0' 3"-1' 6"—Kopi with hard cemented bands.
1' 6"-3' 0"—Hard bedded crystalline gypsum.

19. As for 17.

Sample No. 7 was a channel sample down the side of the trench at point 18, and is considered to be representative of the bedded crystalline gypsum of this deposit. The bottom of this trench was still showing bedded gypsum when further work on this trench was abandoned due to the extremely tough nature of the ground. Sample No. 6 consisted of auger cuttings from one foot to seven feet at point 15. This gypsum was not the bedded type and is thought to be a small dune type deposit near the southern edge of the original lake. It was easily penetrated with the auger in comparison to the bedded deposits which proved incapable of penetration by this means.

The areal extent of the deposit is approximately 2¾ million square yards with a thickness of at least three feet, giving a possible reserve total of 4½ million tons.

GENERAL.

All three deposits consist essentially of hard bedded coarsely crystalline gypsum forming parts of a previously developed lake pattern now re-exposed. The present lake system appears to be quite unfavourable towards the deposition of gypsum in commercial quantities, and no seed dunes of the type commonly found in the southern inland part of the State were seen.

Substantial quantities of gypsum of reasonable purity exist on each of the deposits, although the grade is below that at present demanded by the local trade. Exploitation of these deposits would appear to be dependent on the finding of a new and large market for gypsum, and interested parties have this requirement in mind. A considerable amount of testing with suitable equipment would be needed to prove the possible reserves arrived at in this present investigation, although dimensions as outlined are thought to be conservative.

TABLE OF ANALYSES

Government Chemical Laboratories

Lab. No.	G.S.W.A. Sample No.	Gypsum $CaSO_4 \cdot 2H_2O$ %	Total Lime CaO %	Sodium Chloride NaCl %	Acid Insoluble %	Iron Fe %	Test Point No.	Remarks
15306	3	6·0	12·4	0·93	59·0	2·33	7	1' 0" to 6' 0" Red sand typical of local dunes
15307	4	84·2	30·2	0·14	6·30	0·63	8	0' 6" to 2' 0" Bedded crystalline gypsum
15308	5	90·5	31·4	0·03	3·60	0·33	10	0' 4" to 2' 0" Down side of sink hole
15309	6	95·0	32·6	0·07	0·75	n.d.	15	1' 0" to 7' 0" Auger cuttings—dune type ?
15310	7	97·9	32·2	0·06	0·56	n.d.	18	1' 6" to 3' 0" Hard bedded gypsum—sample downside of trench
15311	8	78·8	29·1	0·08	11·3	n.d.	13	0' 0" to 3' 0" Mixed kopi and small crystalline gypsum
15312	9	94·7	32·0	0·29	0·94	n.d.	14	0' 0" to 3' 0" Kopi hummock

All analyses made on air dried samples. n.d. = not determined.

NOTES ON A RECONNAISSANCE FOR GYPSUM TO THE WEST AND NORTH OF SALT MARSH SALT LAKE N.W. DIVISION.

By R. R. Connolly,

Geological Survey of W.A.

In conjunction with an examination of temporary reserves for gypsum on Boologooroo station, a reconnaissance on the coastal strip to the west of Salt Marsh salt lake was made. The assistance of local pastoralists by way of track and fence information was sought and freely given.

Generally the area is very poor in gypsum, no dune type deposits being sighted, and the lake beds consisting of clay with some coarse gypsum crystals and shell beds, made up of reconsolidated shell fragments from underlying sedimentary rocks. Fixed sand dunes with a north-south orientation make vehicle access difficult and mask most of the underlying rocks.

Two deposits were noted and a sample taken from each one. Both deposits were poorly exposed at the surface, but could be extensive under cover.

The first deposit on Quobba station is situated 10 miles at N27°E from Quobba homestead, and is reached from the old Gnaraloo road, which runs along the western edge of Salt Marsh lake. From this road a rough fence track proceeds west along the nine mile fence to the gypsum outcrop, a distance of three miles. The track is only suited for four wheel drive vehicles, as several loose sand dunes are crossed, two of which are very steep. The gypsum outcrops in a large sink hole approximately 500 yards long and 30 yards wide, and averaging eight feet deep. This sink hole is in the centre of a wide (½ mile) valley which is mainly sand covered and is between two north-south dunes.

The sides of the sink hole show a hard packed granular gypsum with no apparent bedding topped by three feet of consolidated kopi. Some edges of the sink hole are extensively undermined by solution cavities, one going back 30 feet beneath the gypsum. Highly saline water in encountered 4 feet below the bottom of the sink hole.

A channel sample taken from the side of the sink hole (eight feet vertical) and extended to water level by auger (four feet vertical) gave the following results on analysis by the Government Chemical Laboratories.

Lab. No.	G.S.W.A. Sample No.	Gypsum $CaSO_4$-$2H_2O$ per cent.	Total Lime CaO per cent.	Sodium Chloride NaCl per cent.	Acid Insol. per cent.	Iron Fe	Remarks
15304	1	91·1	32·4	1·60	1·17	n.d.	On air dried sample

n.d. = not determined.

Sand cover prevented the areal extent of this deposit from being ascertained, but there is possibly a large quantity of this grade within the valley.

The second deposit is located on Warroora Station on the Minilya-Warroora Road three miles west of the Lyndon River crossing. To the north of the road and plainly visible therefrom, a six foot deep pit roughly 30 yards square has been put down to obtain gypsum for road surfacing across a clay flat. On the sides of this pit underlying one foot of gypseous clay, 3½ feet of mixed kopi and crystalline gypsum is exposed. The deposit is bedded and overlies a dark red clay. There are no seed dunes associated with the bedded deposit.

A channel sample gave the following results on analysis by the Government Chemical Laboratories.

Lab. No.	G.S.W.A. Sample No.	Gypsum $CaSO_4$-$2H_2O$ per cent.	Total Lime CaO per cent.	Sodium Chloride NaCl per cent.	Acid Insol. per cent.	Iron Fe	Remarks
15305	2	95·5	31·4	1·15	1·33	n.d.	On air dried sample

n.d. = not determined.

The areal extent of this deposit is large, the flats extending several miles to the north and a similar distance to the south of the road. The flats are 2½ miles wide in an east-west direction and they form the northern limit of the large Salt Marsh salt lake.

A very large quantity of bedded crystalline gypsum would be available from this deposit, but as the exact boundaries of the deposit were not mapped, no possible reserve figure is presented.

Conclusions:

Both of these deposits are large and of good grade, but that on Quobba is very difficult of access and the other is a considerable distance from Carnarvon, the nearest port. It is doubtful if either deposit will be used in the foreseeable future.

REPORT ON EXAMINATION OF M.C. 31 FOR BUILDING STONE 9 MILES W.N.W. OF NORTHAMPTON.

By R. R. Connolly,
Geological Survey of W.A.

Location and Access:

M.C. 31 is identical with the ground shown as Reserve 9106 on Mines Litho N5 and is accessible from Northampton via the Lynton station road for 10 miles thence southerly for 1.2 miles, thus arriving at the north-west corner of the claim.

The Reserve which was gazetted in 1904 for the purpose of recreation has apparently never been used as such and, with the exception of the north-west corner which is under cultivation, the ground is in its virgin state and unfrequented.

Geology:

The claim lies within an area of sedimentary rocks consisting of sandstones, conglomerate and shales classed by West Australian Petroleum Pty. Ltd., following extensive field work in the locality, as Jurassic in age. The sediments strike to the north and dip to the west at a very low angle (one or two degrees). Granite outcrops less than a mile to the east, but the actual contact between the Jurassic and the rock beneath was obscured in this locality.

The sandstone member of the succession was well exposed in several small gorges incised into a plateau formed at the top of a thin (five feet) pebble conglomerate bed immediately overlying the sandstone. The sandstone, which constitutes the proposed building stone, varies in colour from pink through white and cream to buff. It is made up of subangular to rounded quartz grains with a rather weak siliceous cement. Grain size varies from ¼ mm. to 3 mm. and some unfilled intergranular spaces are evident under a hand lens. The lack of a complete cement and the rather poor sorting of the grains leads to slight friability on a sharp edge of the stone, but on a flat face this is not evident.

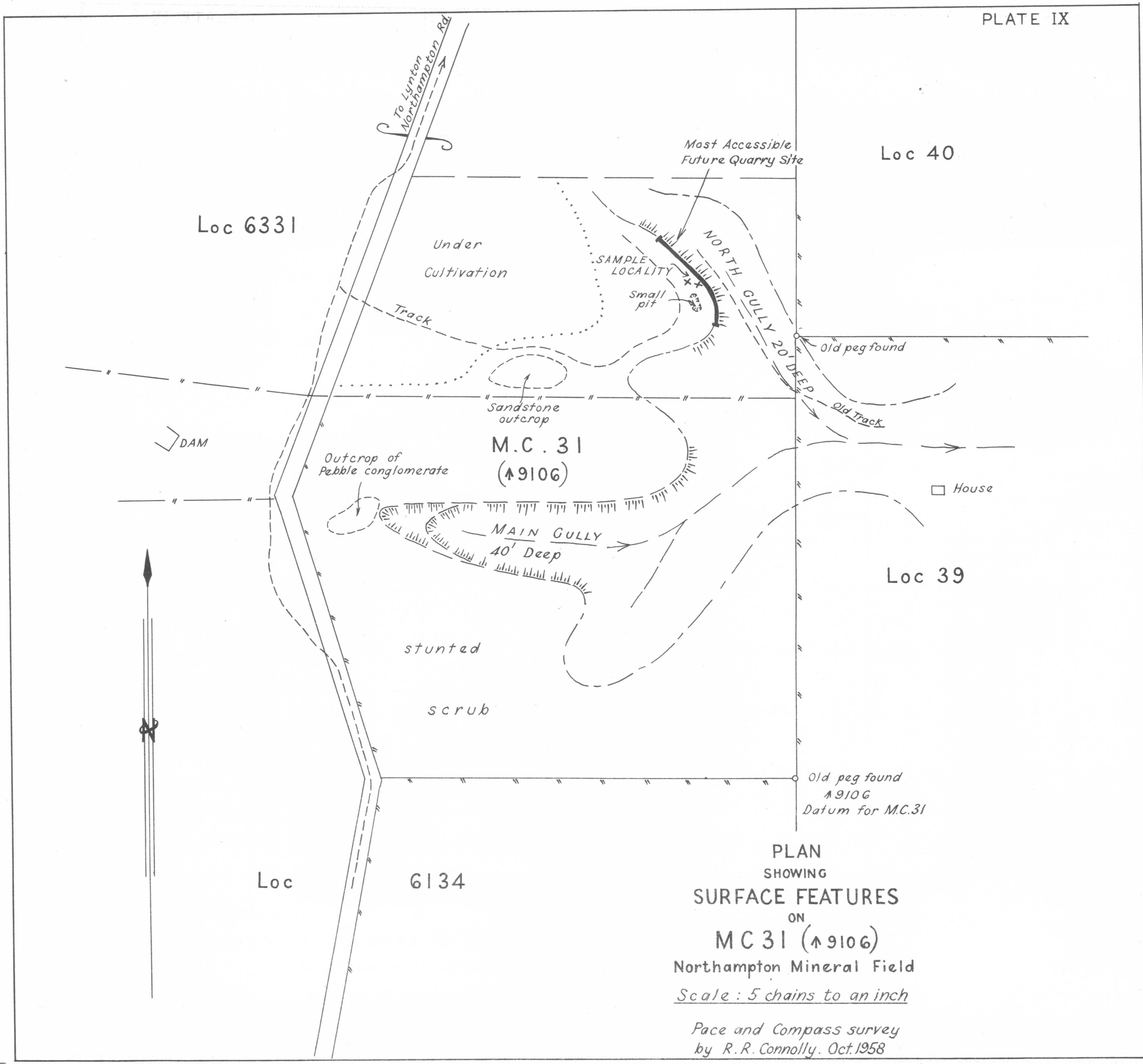
The bedding thickness of the sandstone varies from two inches to three feet with thin bedding predominating over the 40 feet total thickness exposed. In the thin bedded sections exposed, current bedding as the result of an east to west current, is evident. This, plus the presence of the conformable overlying pebble conglomerate bed indicates a fairly shallow water depositional environment and the possibility of variation in texture of the rock both laterally and in depth, must not be overlooked in the utilization of this stone.

Examination of the Claim:

The writer was guided to the claim by Mr. J. Maver, who also indicated the main features of the area. Mapping of the area and sampling took two days (4th and 5th October). Mapping was confined to a pace and compass survey, the results being plotted on the accompanying map at a scale of five chains to an inch. Bulk samples were taken in the vicinity of a small pit from which had been taken sufficient stone to construct two houses in Northampton township. Every attempt was made to secure samples of fresh rock, but as they were necessarily taken from close to the surface, freshness could not be guaranteed.

Samples were submitted to the Government Chemical Laboratories for testing of mineral and physical properties and the results of this work appear as an appendix to this report.

PLATE IX



PLAN
SHOWING
SURFACE FEATURES
ON
MC 31 (↑9106)
Northampton Mineral Field

Scale : 5 chains to an inch

Pace and Compass survey
by R.R. Connolly. Oct. 1958

Identical material was sent to Wilson Gray & Co. Pty., for cutting into cubic blocks and then submitted to the Materials Testing Section, University of W.A. Engineering School for compression tests and the results of this work are also appended.

Economic Considerations:

The stone on M.C.31 is ideally exposed from the quarrying point of view and a good 20 feet vertical face could be easily opened in the north gully as shown on the accompanying plan. An access way through the adjoining lot 39 would need to be arranged.

Uniformity of colour would be difficult to attain so far as the pink variety is concerned, as this is confined to beds of only a few feet in thickness. There is however, a practically unlimited supply of cream and buff coloured sandstone available.

There is a possibility of improvement in the quality of the stone as fresher rock is exposed, but as mentioned earlier, some variations may be expected due to the manner of deposition of the sediments.

Several buildings in Northampton have already been constructed with this stone and present a quite attractive appearance. Fretting, particularly along the mortared joints, is evident in some cases, but here the stone blocks had been irregularly trimmed and it is considered that on an accurately sawn face, fretting would not occur.

Cracks filled with secondary silica (known to the stone trade as "shakes") do occur in this rock, these and a slight friability on a sharp edge, constituting the most serious disadvantages of the stone for dimension use. In cutting also, the stone was found to be highly abrasive.

A discussion of the marketability of this stone is outside the scope of this report, but it is the author's opinion that due to distance from Perth and the existing demand, which is small and irregular, no large production from this claim can be expected.

Conclusions:

On M.C.31 there exists a large quantity of sandstone which is only slightly inferior to the better known Donnybrook sandstone. A limited quantity of pink coloured stone could be quarried and this may find a special market. Generally, however, the stone would not compete with the more accessible Donnybrook sandstone under existing demands for building stone of this nature.

Appendix 1.

Building Stone—Northampton.

Sample of Sandstone from MC31, 9 miles W.N.W of Northampton Lab. No. 13645.

Mineral Description:

A pink porous rock containing quartz grains which were originally rounded but are now strongly interlocking due to later crystal growth.

Properties as a Building Stone:

1. Apparent density (a)—2.33 equivalent to—146 lb./c. ft.

2. Density of powdered material (b)—2.63.

3. Porosity $= \frac{\text{volume of pores}}{\text{volume of stone}} = \frac{b - a}{b} \times 100$ = 11.4 per cent.

4. Water absorbed—4.8 per cent.

5. Rate of absorption—1¼ c. in./sq. ft./24 hr. under 1 in. head.

6. Soundness—No significant disintegration was evident after treatment as specified in ASTM C88-55T. This test measures the resistance of the rock to disintegration after a series of immersions and dryings in saturated solutions of sodium sulphate or mangesium sulphate and is a form of accelerated weathering test.

Conclusions:

The above tests reveal no reason why this stone should not be suitable for building purposes.

G. H. PAYNE,
Deputy Government Mineralogist.

Appendix 2.

Test No. A14827.

Compression strength with bedding plane horizontal (load applied vertically).

66 tons/sq. ft. (large block); 95 tons/sq. ft. (small block).

Compression strength with bedding plane vertical (load applied vertically).

45 tons/sq. ft. (large block); 43 tons/sq. ft. (small block).

It has been found in a series of tests conducted some years ago that the compressive strength of Donnybrook Sandstone and Cottesloe Sandstone gives results as below:—

Donnybrook Sandstone—Compressive Strength 160-700 tons/sq.ft. Mean for 20 specimens 350 tons/sq. ft.

Cottesloe Sandstone—Compressive Strength 3-25 tons/sq. ft. Mean 20 tons/sq. ft.

K. L. COOPER,
Professor of Civil Engineering.

J. R. ESPIE,
Testing Officer.

REPORT ON ALLEGED DAMAGE FROM BLASTING AT LOCKYER HOUSING AREA, ALBANY, SOUTH-WEST DIVISION.

By R. R. Connolly,
Geological Survey of W.A.

Introduction:

The State Housing Commission surburb of Lockyer is situated approximately 1¾ miles to the north-west from Albany and consists of over 400 timber framed fibro and weatherboard dwellings, a school and small shopping centre.

Complaints have been received by the Commission's Building Supervisor at Albany of damage to certain dwellings allegedly as a result of quarrying operations being conducted by Australian Blue Metal Ltd., at their Maxwell Street quarry 1¼ miles to the south-east.

The Commission referred the matter to the Chief Inspector of Explosives, who stated that while complaints of this nature were usually innocently exaggerated due to personal factors, additional information by way of quarrying methods used, distance of dwellings from blasting operations and geology of the area would be required before any assessment of the problem could be undertaken.

The purpose of this examination was primarily to map the rock types of the area embracing both quarry and housing sites, and secondly to ascertain the blasting methods used.

The area was examined on September 18, 19, 1958. Lands Department plans of Albany townsite Sheets 1 and 3 (1 inch = 6 chains) give the required survey information and reference will be made to areas marked thereon.

Quarrying Operations:

The quarry, situated 15 chains due west of Mount Melville trig station, is six chains wide, three chains deep and 70 feet high at the eastern or working face. The rock is a coarse porphyritic granite with feldspar phenocrysts up to two inches in a groundmass of quartz (½ inch) and a little biotite. From five to ten feet of decomposed granite overburden exists above the working face, this being removed by pushing into the quarry and dumping over the western edge of the quarry floor prior to drilling and firing down the face. A very clean and level quarry floor is maintained.

Blasting of the face is done at three weekly intervals shortly after five p.m. on the appointed day. The method used is to bench a part of the face in a set of three 20 foot high steps each ten feet back from the existing face and approximately a chain wide. Commencing with a vertical face, the top bench is removed then the next lower bench and finally the foot bench when a new vertical face is obtained.

For the firing of each bench, eight to ten vertical holes approximately seven feet apart are drilled 10 feet back from the face to a depth of 18 feet. These holes are "bulled" then loaded with 300 to 350 lb. of 1⅛ in. x 8 in. monograin 60 or monograin 75 explosive. The charge is fired by short delay electric detonators and approximately 1,000 tons of rock is thus brought down. This method of firing is one which is generally accepted as being the best for reduction of ground vibration in addi-

tion to giving better fragmentation and thus decreasing the necessity for subsequent secondary blasting.[1]

Secondary blasting, that is the breaking up of larger rock fragments with explosives, is done by drilling to the centre of the fragment loading with a half stick of explosive and detonating with ordinary fuse. Twenty or thirty of these "pops" may be fired at the same time resulting in a series of loud explosions, but practically no ground vibrations are experienced with this type of blasting.

From the quarry, rock is carted to the crusher immediately to the south and thence by truck transported to various road metal dumps in the district.

At the time of inspection, the quarry manager stated that contracts for supply of stone in the district had almost been fulfilled and that quarrying operations would cease in approximately one month. The quarry would then be unused for some years.

Geology of the Area:

Only three types of outcrop have been noted in the area, viz. granite, white sand (mostly overlying clay) and clay sometimes capped with laterite.

The granite is a coarse porphyritic variety, the feldspar phenocrysts having a north-south lineation where observed at Mt. Melville and at the quarry. Reserves 2681 and 21300 surrounding Mt. Melville contain many bare granite outcrops, but elsewhere exposures are poor. The whole area under consideration is almost certainly underlain by granite but based on soil, vegetation and to some extent topography, granite at the surface has been limited for the purposes of this examination to an area bounded to the west by McKeown Road, to the north by Mawson Street and to the east by Albany Highway. No joint pattern was noticed and at the quarry the working face is quite massive and free from flaws of any kind.

In the lower lying areas the granite is overlain at the surface by a fine grained clay-free sand of maximum observed thickness 8 feet, and at a slightly greater depth by an unknown thickness of clay. In the flat, marshy area adjoining Hanrahan Road, the sand is often coloured black with decayed vegetable matter, but on higher ground, where relatively uncontaminated, it is white. The thickness of this sand varies considerably and on the south sloping, built up area of Lockyer, it is absent in some places, exposing laterite overlying clay.

That the suburb is underlain by clay at a comparatively shallow depth is evidenced by the fact that early attempts at dry well drainage were unsuccessful and a deep sewerage system was found necessary. Clay is apparently closest to the surface in a strip of land running slightly south of east through lots 344, 337, 350, 114, 138, 219 and 253 as surface seepage of water from higher ground is evident along this line. Significantly, the most consistent reports of damage emanate from dwellings in close proximity to this line. The appearance of clay at or near the surface along this line, may suggest that the granite (from which the clay is derived) may here be found at a comparatively shallow depth, although only one small granite fragment was found along this line and it may have been transported.

Briefly then, the geology of the area may be outlined as follows: A prominent granite ridge with a northerly trend is flanked at its northern extremity by a predominantly clayey southerly sloping (2½°) dwelling area, which in some places has a thin veneer of fine sand. A small subsurface offshoot granite ridge with a westerly trend, may run through the middle of the housing area.

Damage Reports:

A complete assessment of complaints had not been made at the time of examination and this will need to be done in the event of resumption of quarrying operations in the future. The Housing Commission Building Supervisor reported one instance of partial ceiling collapse due to clout heads pulling through the plaster board, allegedly as a result of blasting vibrations. Other damage was mainly cracking of plasterboard walls at joins over doorways or above and below windows. Some brick chimneys had settled slightly, but the Supervisor did not attribute this to quarrying activities.

In short, no damage has occurred that could not be as well attributed to foundation movement in wet clay on a slope.

Conclusions and Recommendations:

It is considered most unlikely, based on calculation by a recognised formula, that ground vibrations resulting from face firing at the Maxwell Street quarry are of an amplitude greater than one thousandth of an inch at any part of the Lockyer housing area compared with a maximum of eight thousandths generally permissible in the vicinity of quarries in other parts of Australia.

The surface and immediate subsurface geology of the housing area is such that some distortion in timber framed dwellings is almost inevitable, particularly in a seepage zone, and the effect of blasting in the vicinity would only be that of very slight acceleration of a natural phenomenon.

It is recommended that in the event of resumption of quarrying operations, actual measurement of ground vibrations at the housing site be made before any further action is undertaken. Meanwhile, following the closure of the quarry for some years, it would be interesting to keep a close measure of existing wall cracks to check on possible variations with seasonal climatic changes or other natural variables.

REPORT ON APPLICATION FOR THREE PROSPECTING AREAS FOR MANGANESE, IRON, AND URANIUM, NORSEMAN.

By G. D. Bartram, B.Sc.,
Geological Survey of W.A.

Introduction:

In December 1957, Mr. F. H. Baker of Norseman submitted an application for three prospecting areas, P.A. 2382, P.A. 2383 and P.A. 2384, for iron, manganese and minerals of uranium. These areas were examined by the author on 21st January 1958.

Location:

The prospecting areas are situated roughly 13 miles N.W. of Norseman. Access is by way of a rough bush track which leaves the main highway at a point opposite the 448 mile peg on the railway line. The track runs roughly due west for one mile. From that point the prospecting areas are reached by walking a further 1½ miles west along the bed of a creek.

Geology:

The areas are situated in an elevated hilly region which lies about 2 miles west of Lake Cowan and about two miles S.W. of Mt. Thirsty. The drainage is to the north-east into Lake Cowan.

The country rocks are basic lavas which have been strongly sheared in a general direction 10° west of north. These lavas outcrop mainly on the higher ground, the valleys being either covered by soil and rubble or in places by a ferruginous laterite.

The prospecting areas are mainly soil covered except for one hill, which lies on the boundary of P.A. 2382 and P.A. 2383, and which is capped by the ferruginous laterite mentioned above. The rubble covering the remainder of the area consists of basic lava, ferruginous laterite and quartz pebbles. Below the laterite level there are minor outcrops of country rock.

Manganese:

Manganese was observed in two areas on P.A.2383. The first is near the southern boundary of this area, and consists of a small outcrop of kaolinised country rock containing a low percentage of manganese.

The main body occurs at the foot of the laterite capped hill mentioned above, the manganese outcropping irregularly over an area of about 30 yds x 15 yds.

[1] Reid, A. G.: Some aspects of blasting in built up areas with particular reference to ground vibrations. Proceedings, Australasian Institute of Mining and Metallurgy No. 186, June, 1958.

The manganese shows a rapid lessening of quality with depth. On the surface it is of a moderate grade, the main impurity being iron. However, at a depth of one to two ft. below the surface kaolinised country rock is present in which the percentage of manganese is very low.

Iron:

The hill that lies on the boundary of P.A. 2382 and P.A. 2383 is capped by a ferruginous laterite. This varies from a massive hematitic rock to a pisolitic limonite. The areal extent of this capping would not exceed one acre and the thickness, although hard to estimate, probably would not be more than 10-15 ft. at the most.

Minerals of Uranium:

Using an Austronic Geiger Counter, a background count was obtained at a suitable distance from the prospecting areas. On testing the area in question thoroughly with the Geiger, no variation from this background count was noted. No uranium mineralisation was observed.

Conclusions:

(1) The manganese is present in far too small a quantity and the average quality is too low for the deposit to be of any economic value.

(2) The quantity of iron present is negligible compared to the amount required for an economic deposit in this area.

(3) The prospects for finding uranium on these prospecting areas are nil.

REPORT ON PHOSPHATE DEPOSITS, LOWER MURCHISON RIVER AREA.

Approx. lat. 27° 35′ S.
Approx. long 114° 10′ E.

By G. H. LOW, B.Sc.,
Geological Survey of W.A.

CONTENTS

INTRODUCTION.

In September, 1958, a request was made to the Mines Department by the Northampton Road Board, through Mr. W. H. Sewell, M.L.A., for a geological examination of phosphate rock occurrences in the Lower Murchison River Area. The request was agreed to by the Mines Department and accordingly the writer was instructed by the Government Geologist to examine all known occurrences and prospect the area for further concentrations.

The writer spent seven days, from 14th October to 20th October in this area, operating from a base camp at Tutula Well on the north side of the Murchison River about six miles from the mouth.

GENERAL INFORMATION.

Interest in the phosphate rock occurrences in this area was initiated in 1932, when the late Dr. E. S. Simpson, Mineralogist, visited the Murchison River and inspected sections of Cretaceous rocks exposed at Thirindine Point and Alinga Point (see map). A Mr. Pepper, who had accompanied Mr. Simpson, subsequently suggested to the secretary of the Northampton Road Board that the phosphate deposit indicated to him by Dr. Simpson might be economically useful.

Mr. Simpson recorded his observations in an article published in the Journal of the Royal Society of Western Australia, in 1934. He does not suggest in his report that the deposits might be of economic importance.

In 1943, when, because of the war, the problem of importation of phosphate rock became acute, the Northampton Road Board referred the matter of the Murchison River deposits to the Department of Supply and Shipping, who passed the query on to the Mines Department.

Subsequently Mr. F. G. Forman, the Government Geologist at that time, Dr. K. Teichert, Paleontologist with the University of Western Australia, and Mr. J. C. Dulfer, a representative of the British Phosphate Commission, visited the area specifically to report on the economic aspect of the Phosphate occurrence. Mr. Dulfer expressed his opinion in a report to the W.A. Mines Department, a copy of which was subsequently made available to the Northampton Road Board, and his findings (in part) were: "The deposits of phosphate are so scattered that they offer no immediate help in the present shortage of phosphate rock . . . ." This report is dated 27th July, 1943, a time when the general shipping position, and particularly that available for carrying phosphate rock, was acute.

Mr. Forman's comments included the following: "A few nodules, possibly phosphatic, were discovered and their source located. As a result of the recent inspection I am more convinced than ever of the absence of any phosphatic bed in the series which might be of possible economic importance. The nodules seen by us were very scarce and do not form a continuous bed, as is the case at Dandaragan. In my opinion, the Cretaceous Strata in the Murchison River District are not worthy of further examination for commercial phosphate deposits . . . ." (Mines Dept. sub-file 119/43).

Since 1943, the Murchison River area has been examined by geologists of the Commonwealth Bureau of Mineral Resources, of West Australian Petroleum Pty. Ltd., and others; and the Cretaceous Stratigraphy has been resolved and the area geologically mapped in detail. These findings and the maps were available to the writer at the time of his investigation.

In its latest request to have the area examined geologically for phosphate rock, the Northampton Road Board, upon request by the Government Geologist, indicated White Cliff, Toolonga Bluff, Thirindine North, and an area four miles from Murchison House Station as the most important localities of occurrence. All of these are mentioned in Mr. Dulfer's report.

SITUATION AND ACCESS.

Reference may be made to the following maps:—

1. Lands Department Lithograph, 56/300;
2. 4 Mile Strategic Series of Australia, Ajana;
3. Geological Sketch Map of W.A. 1 inch = 40 miles, G.S.W.A. 1957.

The Murchison River enters Gantheaume Bay, on the west coast of W.A., 80 miles N.N.W. of the port of Geraldton. Approximate latitude 27° 30′ S., approximate longitude 114° E.

The area considered in this report is roughly rectangular. The southern boundary runs east and west two miles south of the Murchison River mouth; the northern boundary is parallel to this 34 miles to the north; the eastern boundary is 18 miles east of the mouth; and the western boundary is the coastline. This is subsequently referred to simply as the Area.

Access to the southern part of the Area is by the North West Coastal Highway to Ajana, thence 37 miles by poor sand track to the Murchison House river ford. Alternative access, to the north-eastern port of the Area is northwards for 28 miles along the Highway from Ajana, thence 30 miles by poor sand track to the Weerinoogudda Dam area. General vehicular movement within the Area is impossible without four wheel drive.

GEOLOGY.

The following reports contain references to the geology of the Lower Murchison River Area:—

1907—Maitland, A. G.: Possibility of the Occurrence of Artesian Water in the Northampton and Geraldine Districts. *G.S.W.A. Bull. 26,* pp. 7-9.

1934—Simpson, E. S.: Contributions to the Mineralogy of W.A., Series VIII. *J. Roy. Soc. W.A. 20,* pp. 49-51.

1936—Hobson, R. A.: Summary of Petroleum in W.A., to January, 1935. *G.S.W.A. Ann. Rept. 1935,* pp. 22-30.

1936—Raggatt, H. G.: Geology of the North West Basin of W.A. *J. Roy. Soc. N.S.W. 70(1),* pp. 100-174.

1937—Forman, F. G.: Artesian and Sub-Artesian Water Possibilities, Woodleigh Station, Murchison District. *G.S.W.A. Ann. Rept. 1936,* pp. 9-11.
1943—Young, C. P.: Rept. on Murchison River and Pt. Hedland Phosphate Deposits, W.A. Unpublished Rept. to W.A. Mines Dept.
1943—Dulfer, J. C.: Phosphate Deposits Near the Mouth of the Murchison River, W.A. Unpublished Rept. to W.A. Mines Dept.
1943—Forman, F. G.: Phosphate Deposits Near the Mouth of the Murchison River, W.A. W.A. Mines Dept. Sub-file 119/43.
1944—Teichert, C. and Matheson, R. S.: Upper Cretaceous Icthysaurian and Plesiosaurian from W.A. *Aust. Jour. Sci. 6,* pp. 167-170.
1948—Clarke, E. de C. and Teichert, C.—Cretaceous Stratigraphy of the Lower Murchison River Area. *J. Roy. Soc. W.A., 32,* pp. 19-47.
1952—Brunnschweiller, R. O.: Notes on the Cretaceous-Tertiary Megafauna of the North West Basin of W.A. Bur. Min. Resources Records, 1952/28.
1953—Fairbridge, R. W.: Australian Stratigraphy. Uni. of W.A., Text Books Brd., Chap. 7 and 10.
1954—Condon, M. A.: Progress Rept. on the Geology of the Carnarvon Basin. Bur. Min. Resources Rept. No. 15, pp. 103-116.
1955H—Belford, D. J.: Cretaceous Micropaleontology, Murchison River Area, W.A. Bur. Min. Resources. Records 1955/27.
1955—Condon, M.A. and Henderson, S.D.: Cretaceous Formations, Murchison House Area, W.A. Bur. Min. Resources Records, 1955/40.
1958—Johnstone, D., Condon, M. A. and Playford, P. E.: Stratigraphy of the Lower Murchison River Area and Yaringa North Station, W.A. *Jour. Roy. Soc. W.A.,* Vol. 41, Pt. 1, pp. 13-16.

The oldest formation known to outcrop in the Area is a medium to coarse grained quartz sandstone which dips at about three degrees to the north-west. This formation, called the Tumblagooda Sandstone by Clarke and Teichert, is unconformably overlain by Cretaceous rocks, and may be evonian or Silurian in age.

The Birdrong Formation, lying at the base of the Cretaceous, is a poorly bedded, fine to medium grained quartz sandstone, containing in places some siltstone, glauconite and conglomerate.

The Birdrong is conformably overlain by the Thirindine Formation which consists mainly of bedded radiolarite with some bentonitic shales.

A siltstone and greensand formation, called the Alinga Formation, conformably overlies the Thirindine. It contains a thin bed with phosphatic nodules in the top few inches.

The Toolonga Calcilutite disconformably overlies the Alinga. The Calcilutite has a chalk bed at its base, about 25 feet thick, immediately overlying the band of phosphatic nodules. The upper part of the Toolonga contains flint nodules and the fossils Gryphaea, Ostrea, Echinoid Spines, and fragments of Inoceramics and Marsupites.

The top of the Toolonga Calcilutite is travertinised at the Tertiary erosion surface.

Over the biggest portion of the Area these Cretaceous rocks are overlain by variable thicknesses of Coastal Limestone, duricrust or laterite, and red and white sands. The maximum exposure of the Cretaceous rocks is in a narrow strip along an escarpment on the north-west side of the Murchison River Valley. These exposures form the dissected south-eastern edge of a plateau which extends to the northern boundary of the Area, and slowly rises from south-west to north-east. It has an elevation of about 300 feet near Alinga Point.

For a more detailed account of the geology and physiography, readers are referred to the report by Condon and Henderson (1955).

THE PHOSPHATE OCCURRENCES.

Phosphate nodules were found either in situ at the top of the Alinga Formation or occasionally amongst the rubble on the slopes of the hills. Some apatised wood was also found at Alinga Point and Second Gully.

The phosphate nodules, of variable shape and up to 3 lb. in weight, occur in a greensand matrix in a band which varies in thickness up to an observed maximum (in the Second Gully) of eight inches. A six inch band was seen at Alinga Point, and a similar one at Toolonga Point. Most of the nodules are grey to black in colour on the exposed surface, and a pale yellow grey on a fresh fracture.

North-eastwards of Toolonga Point, along the line of Cretaceous outcrops as far as Weerinoogudda, traces of phosphatic material were noticed in different localities on rubble on the hill slopes. This generally occurred as a thin white coating of amorphous collophanite on a lime rich centre.

These traces and phosphatic material were detected by the application of a few drops of 50 per cent nitric acid to powdered ammonium molybdate on the rock. The bright yellow of ammonium phospho-molybdate indicated the presence of phosphorus.

A search for possible "placer" concentrations of the phosphatic nodules along present or ancient water courses, or along fossil beach lines, proved fruitless.

Four hand picked samples from the better parts of the nodule bed were collected for analysis by the Government Chemical Laboratories. The localities and the results are shown in the Appendix. These are not representative of the deposit as a whole.

SUMMARY.

A detailed examination of the Cretaceous Formations in the Lower Murchison River Area was made to assess the economic potential of the phosphorite deposits. The writer had the use of aerial photographs (60 chain), line compilations (20 chain) stratigraphical analyses by various geologists of the Bureau of Mineral Resources.

Numerous field tests on suspected phosphatic material were made with powdered ammonium molybdate and nitric acid.

It was found that phosphatic material (in the form of nodular concretions and apatised wood) was restricted to a thin (maximum observed, eight inches) band at the top of the Upper Cretaceous Alinga Greensand, and to the talus slopes below the Greensand. The Greensand can be traced (discontinuously) from Alinga Point to the Weerinoogudda Dam, but only traces of phosphatic material could be detected north-eastwards from Toolonga Point to Weerinoogudda. No gravel or conglomerate concentrations of the nodular material could be found.

CONCLUSIONS.

As far as can be seen, no economic concentration of phosphatic material occurs in the Lower Murchison River Area, and there is no valid reason for supposing that further investigation, by boring or any other means, would disclose such a concentration.

Appendix to the Report on Phosphate Deposits, Lower Murchison River Area.

Report on 4 Samples of Phosphate Rock from Lower Murchison River Area. Received 1/12/1958

Lab. Nos. (1958)	16312	16313	16314	16315
Marks	MR1	MR2	MR3	MR4
	(Alinga Point)	(Toolonga Point)	(1·5 miles N.W. of Yalthoo Well)	(2·0 miles N.N.W. of Tutula Well)
P_2O_5—total	18·8	9·64	28·0	27·8
P_2O_5—sol. in 2E. HNO_3	18·8	9·29	27·6	27·7
P_2O_5—insol. in 2E. HNO_3, sol. in HCl	Trace	0·05	0·08	0·11
P_2O_5—insol. in 2E. HNO_3 and HCl	*Nil*	0·30	0·36	Trace
K_2O—sol. in HCl	0·12	0·20	0·13	0·18
CaO—total	44·0	37·2	45·5	46·0
CO_2—	15·0	20·5	5·33	5·56
H_2O—combined	2·63	2·58	3·15	3·13
H_2O—moisture	0·95	2·10	1·11	1·07

All Results are expressed as percentages on the samples as received.

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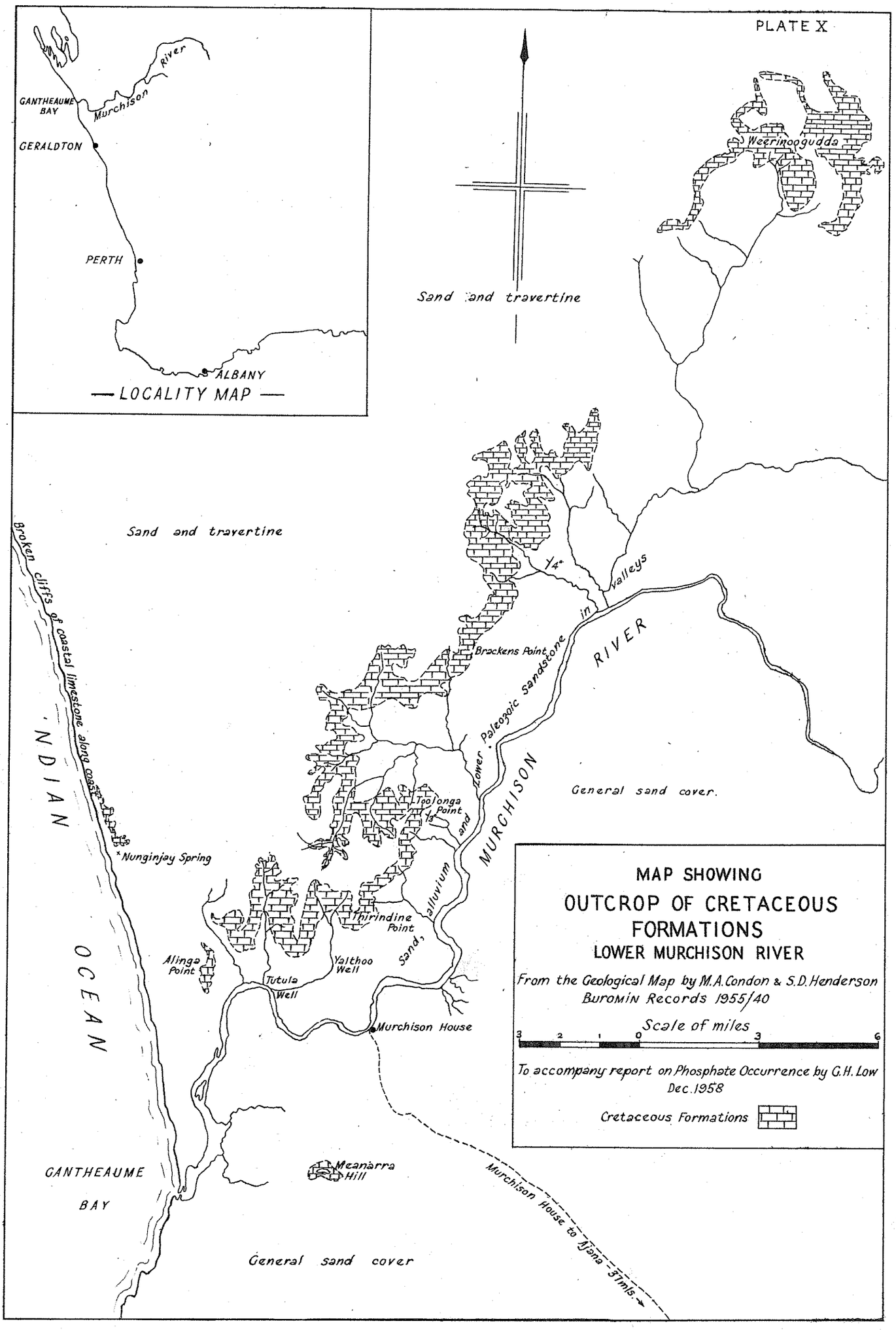
PLATE X



MAP SHOWING
OUTCROP OF CRETACEOUS FORMATIONS
LOWER MURCHISON RIVER

From the Geological Map by M.A. Condon & S.D. Henderson
Buromin Records 1955/40

Scale of miles

3 2 1 0 3 6

To accompany report on Phosphate Occurrence by G.H. Low
Dec. 1958

Cretaceous Formations