1948

LOADING JETTY AND EQUIPMENT
COCKATOO ISLAND WESTERN AUSTRALIA

Report of the

DEPARTMENT OF MINES

WESTERN AUSTRALIA

SENTED TO BOTH HOUSES OF PARLIAMENT BY HIS EXCELLENCY'S COMMAND

1950

—

WESTERN AUSTRALIA

REPORT

of the

Department of Mines

FOR THE YEAR

1948

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ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1948.

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DIVISION I.

STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines of the State of Western Australia for the Year 1948.

To the Hon. Minister for Mines.

Sir,—I have the honour to submit the Annual Report of the Department for the year 1948, together with reports from the officers controlling Sub-Departments, and comparative tables furnishing statistics relative to the Mining Industry.

Department of Mines,
Perth, 22nd April, 1949.

I have, etc.,
A. H. TELFER,
Under Secretary for Mines.

Division I.

The Honourable Minister for Mines:

I have the honour to submit, for your information, a report on the Mining Industry for the year 1948.

The estimated value of the mineral output of the State for the year was £4,252,914 (calculating gold at £4 4s. 11.45d. per fine ounce); a decrease in value of £23,706 compared with the preceding twelve months. The estimated value of the premium paid to gold producers amounted to £A4,332,231 bringing the gross value of all minerals up to £A8,585,145, a decrease of £A277,132 compared with the 1947 production.

There were increases in quantities and values of alunite, bentonite, coal, dolomite, gypsum, glass sand, iron ore, manganese, lead ores and concentrates, magnesite, sillimanite, tin, tantalite and vermiculite, and decreases in quantities and values of antimony, arsenic, clays, cupreous ore for fertilising, diatomaceous earth, felspar, glauconite, kaolin, kyanite, pyrites, red ochre, silver and talc. Asbestos, beryl and tungsten were produced in smaller quantity but realised greater value.

The estimated value of gold received at the Perth Branch of the Royal Mint and exported in gold-bearing material was £A7,156,909 (and equalled 83.36 per cent. of all minerals). (See footnote to Table 1 (a), Part II).

Other minerals realised: Coal, £880,236; pyrites, £164,203; lead, silver-lead, and silver-lead-zinc, £114,269; alunite, £49,430; silver, £44,198; asbestos, £37,761; gypsum, £35,173; iron ore, £26,165; tin, £12,985; manganese, £10,442; red ochre, £6,791; kyanite, £6,516; arsenic, £4,494; clays, £4,113; tungsten, £3,913; antimony, £3,582; felspar, £3,538; magnesite, £3,176; cupreous ore for fertilising, £2,204; beryl, £2,034; tantalite, £1,139; vermiculite, £876; bentonite, £806; talc, £732; glass sand, £644; dolomite, £536; kaolin, £292; and sillimanite, £13.

Dividends paid by Mining Companies amounted to £836,939, a decrease of £57,146 when compared with the previous year. (See Table 6, Part II.)

To the end of 1948, the total amount distributed by gold mining companies was £44,188,093. To the same date the value of the mineral production amounted to £246,026,835, of which gold accounted for £221,747,099 based on normal values; but premiums on sale of gold during years 1920-1924, plus payments under the Gold Bounty Act, 1930, and further premiums since that time, increase the total value of gold and mineral production by £76,083,576.

GOLD.

The quantity of gold reported as being received at the Perth Branch of the Royal Mint (660,332.07 fine ounces) together with that contained in bullion, concentrates and other gold-bearing materials exported for treatment (4,653.72 fine ounces) totalled 664,985.79 fine ounces, failed to equal that of 1947 by 38,900.59 fine ounces (*vide* Table 1 (a) of Part II).

Similarly, the total gold yield for the year reported directly to the Department by the producers was 662,740.82 fine ounces, which constituted a decrease of 39,011.69 fine ounces in comparison with the previous year's figures (*vide* Table 3 of Part II).

The non-collation of the two totals mentioned above (very slight on this occasion) is principally due to the fact that the gold reported as being received at the Mint and exported for treatment, is not all necessarily produced during the calendar year under review, a certain quantity being in the transitory or near transitory stage from the producer at the end of the year. For this reason, the former total is accepted as the official production of the State, whilst the latter is utilised mainly in tracing the gold back to its source, i.e., individual mine production to which respective ore tonnage can be applied. The calculated average value per ton of ore treated in the State as a whole showed a slight decrease from 23.777 shillings per ton in 1947 to 23.004 shillings per ton in 1948, calculating gold at the rate of £4 4s. 11.45d. per fine ounce, but the premimum rate which remained unchanged throughout the year (153.37 per cent.) would more than double this estimate. For East Coolgardie Goldfield (which produced approximately 66 per cent. of the State's yield of gold), the calculated average value of the ore decreased from 23.558 shillings to 22.793 shillings per ton. The estimates for Murchison (Big Bell Mines Ltd. and Hill 50 G.M., N.L.), Mt. Margaret (Sons of Gwalia), and Dundas (Central Norseman Gold Corporation), were 15.739s. (16.389s.), 33.633s. (32.220s.), and 28.711s. (27.189s.) respectively. Figures for 1947 are shown in parenthesis.

The tonnage of ore reported to have been treated in 1948, viz., 2,447,545 tons, was 59,761 tons less than the previous year and formed ·57 per cent. of the State record tonnage established in 1940.

Increased tonnages were reported from the following Goldfields:—Pilbara 852, Murchison 55,954, East Coolgardie 118, and Dundas 3,216, whilst those reporting decreased figures were Kimberley 136, Ashburton 120, Peak Hill 879, East Murchison 26,026, Yalgoo 90, Mt. Margaret 22,766, North Coolgardie 4,979, Broad Arrow 14,080, North-East Coolgardie 93, Coolgardie 18,117; Yilgarn 32,271; Phillips River 88, and Outside Proclaimed Goldfields 256.

Despite the fact that the East Coolgardie Goldfield covered its previous year's output, only three of the nine larger producing companies on the Golden Mile exceeded their 1947 tonnage, the remaining six reporting slightly smaller quantities; the Murchison increase was due to the enlarged tonnage of the Big Bell G.M. supported by the Triton until the closing of the latter during the year, whilst the Central Norseman Gold Corporation accounted for the rise in the Dundas output.

The closing of the Emu G.M. and the Ora Banda Amalgamated adversely affected the East Murchison and Broad Arrow Goldfields respectively, and a similar effect was noted in the Yilgarn field where the Edna May (W.A.) Amalgamated ceased operations, which fact, coupled with the loss of the Evanston G.M. output for portion of the previous year, the lower figures from the Burbidge G.M., caused the largest tonnage decline among the Goldfields for the period under review.

In the Mt. Margaret Goldfield the Sons of Gwalia reported their lowest output for 25 years.

It is exceedingly disappointing to record a drop in the gold yield as compared with 1947. With the existing state of affairs, viz., rising costs and a static price, such reduction was inevitable, and I am afraid will be progressive until such time as costs reduce or the price of gold is by some manner or means increased.

The Commonwealth Government, during the year, agreed to provide limited assistance to such of the large mines as were able to prove to the satisfaction of the Commonwealth Treasury that they were marginal, but while this help is acceptable it is purely to keep employing mines operating, and does not provide the fillip required to encourage new operations or expansion of present ones. Another drawback is that it does not apply to the small mines, which, while similarly affected by present-day conditions, have no reserves to draw upon.

From the point of view of gold deposits and prospective new mines, the industry is in a healthy condition, as while some ore bodies, such as Wiluna, Triton and Bayleys, have been exhausted, their places could be filled by other new ones such as Mt. Charlotte, Porphyry, Bullfinch, Nevoria, etc., if conditions were propitious.

Labour is still scarce, and to overcome the deficiency efforts are being made in certain cases to obtain overseas labour by way of immigration.

During the year, the Government financially assisted the Lakewood Firewood Company Pty. Ltd. by way of loan to purchase the assets of the Goldfields Firewood Supply Company at Lakewood, the latter having decided to cease operations. The assistance was provided because firewood was the fuel used in the Kalgoorlie Power Station from which the local mines obtained their power. The total assistance approved was £160,000.

MINERALS.

Activity in the production of minerals was more than maintained during 1948, and production in value was higher than that of 1947 by £141,518. This is a better return than we have experienced for over 40 years.

Over 2,000 tons of lead ore and concentrates was produced and sold valued at £114,269, while at the end of the year a further 800 tons estimated at £40,000 was awaiting realisation. The price rose during the year from £A104 to £A149, and lead mining is generally proving profitable to our operators who are located mainly in the Northampton and Ashburton fields.

The Department has rendered quite a considerable amount of financial aid to the numerous lead mines in these districts to ensure that they will be able to catch the market at its height.

Manganese is another mineral in demand in Australia, and as a result the old Horseshoe deposit is again being worked, and looks likely to be Australia's main supplier for the time being.

Great activity in regard to beach sand deposits occurred, following the Department's geological examination of same. Numerous holdings have been applied for by local and Eastern States' interests and there appears to be little doubt that a number of the deposits will be worked on a considerable scale for the paint constituents which they contain, particularly ilmenite.

The Cockatoo Island iron project is expected to commence production in 1949. Progress in regard to erection of the large plant and buildings has proceeded satisfactorily, although slowed down somewhat because of the difficulty these days in obtaining machinery and materials generally.

The blue asbestos mine in the Hamersley Ranges maintained continuous operation, but has not yet reached maximum production. The modern township designed at the mouth of the Gorge is now in full course of erection.

COAL.

The coal output for 1948 totalled 732,938 tons valued at £880,236, and exceeded the 1947 production by 2,432 tons. To meet future requirements, a considerably greater tonnage must be produced annually.

The Black Diamond Open Cut came in production towards the end of the year, while drilling and exploratory operations on its prospecting areas were continued by a Goldfields Syndicate with satisfactory results.

A modern diamond drilling plant capable of drilling the field to bedrock was ordered by the Department from Canada during the year, and a comprehensive drilling compaign with Canadian drillers in charge will commence in May, 1949.

Modern trackless mining equipment for the Wyvern Colliery, one of the Griffin Coal Mining Company's mines, was ordered, but delivery cannot be obtained until towards the end of 1949. When installed, the production from this mine will considerably increase.

PETROLEUM.

Intense geological and aerial survey operations were continued by two influential companies on areas in the North and North-Western portions of the State, and these in one case will, in 1949, be followed by deep drilling.

The Freney Kimberley Company installed its drilling Superintendent and crew at the bore site at Nerrima, and it is expected that all arrangements will be in hand for drilling to re-commence there early in 1949.

GENERAL.

Expansion in the Department's activities continued, particularly in the Chemical, Analytical and Mineralogical laboratories, the School of Mines, Kalgoorlie and Norseman, and the Geological Survey Branch.

Due to various causes, little progress was made in the negotiations with the McIntyre Institute in regard to Aluminium Therapy.

Advice received at time of writing this report makes it quite possible that a visit from the Institute's Chief Medical Officer, Dr. Robson, will shortly take place. Dr. Robson will then investigate our industrial conditions and advise if the therapy is likely to be effective here, and if so, the requirements in the methods of treatment and installation of plant.

MINING DEVELOPMENT ACT.

The expenditure incurred in rendering assistance to mine owners and the industry generally under the provision of this Act totalled £40,798 17s. 9d. and in the preceding year £21,544 1s. 10d.

PART II.—MINERALS.

TABLE 1.—*Quantity and Value of Minerals, other than Gold and Silver, produced and/or exported during Years* 1947 *and* 1948.

Description of Minerals.	1947.		1948.		Increase or Decrease for Year compared with 1947.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£A.	Tons.	£A.	Tons.	£A.
Alunite (Crude Potash)	1,724·70	41,212	1,778·30	49,430	+ 53·60	+ 8,218
Antimony	119·82	9,731	41·90	3,582	— 77·92	— 6,149
Arsenic	1,191·13	28,738	214·00	4,494	— 977·13	— 24,244
Asbestos (Anthophyllite)	75·00	988	284·24	4,173	+ 209·24	+ 3,185
Asbestos (Chrysotile)	†79·07	6,179	71·31	5,591	— 7·76	— 588
Asbestos (Crocidolite)	888·99	30,226	607·30	27,997	— 281·69	— 2,229
Bentonite	44·75	134	268·75	806	+ 224·00	+ 672
Beryl Ore	44·89	1,525	34·85	2,034	— 10·04	+ 509
Clays	6,277·50	6,064	4,858·50	4,113	— 1,419·00	— 1,951
Coal	730,506·32	840,249	732,938·42	880,236	+ 2,432·10	+ 39,987
Copper Fertiliser	*917·00	6,071	258·65	2,204	— 658·35	— 3,867
Diatomaceous Earth	5·00	50	Nil	Nil	— 5·00	— 50
Dolomite	56·85	285	107·25	536	+ 50·40	+ 251
Felspar	1,226·00	4,291	1,011·00	3,538	— 215·00	— 753
Glass Sand	364·40	469	516·90	644	+ 152·50	+ 175
Glauconite	350·50	8,762	319·00	7,975	— 31·50	— 787
Gypsum	20,281·50	28,774	25,521·50	35,173	+ 5,240·00	+ 6,399
Iron Ore	Nil	Nil	7,222·20	26,165	+ 7,222·20	+ 26,165
Jarosite	9·54	37	Nil	Nil	— 9·54	— 37
Kaolin	581·00	310	146·00	292	— 435·00	— 18
Kyanite	2,931·00	14,597	1,125·00	6,516	— 1,806·00	— 8,081
Lead / Silver Lead / Silver Lead Zinc Ore and Concentrates	22·36	†952	2,191·55	114,269	+ 2,169·19	+ 113,317
Magnesite	73·00	73	961·82	3,176	+ 888·82	+ 3,103
Manganese	Nil	Nil	1,644·85	10,442	+ 1,644·85	+ 10,442
Pyrites Ore and Concentrates	44,337·00	187,621	37,499·00	164,203	— 6,838·00	— 23,418
Red Ochre	1,027·10	10,856	566·37	6,791	— 460·73	— 4,065
Sillimanite	Nil	Nil	2·00	13	+ 2·00	+ 13
Talc	213·00	813	72·00	732	— 141·00	— 81
Tantalite	Nil	Nil	4·31	1,139	+ 4·31	+ 1,139
Tin	23·63	5,565	36·99	12,985	+ 13·36	+ 7,420
	Units.		Units.		Units.	
Tungsten Ores (Scheelite)	642·54	3,840	492·85	3,913	— 149·69	+ 73
	Tons.		Tons.		Tons.	
Vermiculite	82·00	492	151·00	876	+ 69·00	+ 384
Total	....	1,238,904	....	1,384,038	....	+ 145,134

TABLE 1 (a).—*Quantity and Value of Gold and Silver exported and minted during Years* 1947 *and* 1948.

	Fine ozs.	£A.	Fine ozs.	£A.	Fine ozs.	£A.
Gold (exported and minted)	703,886·38	‡7,575,574	664,985·79	‡7,156,909	— 38,900·59	— 418,665
Silver (exported and minted)	199,301·57	47,814	193,818·93	44,198	— 5,482·64	— 3,616
Total	....	7,623,388	....	7,201,107	....	— 422,281

‡ Included in the value of Gold shown are the following estimated premiums :—1947, £A4,585,657 ; 1948, £A4,332,231.
† Adjusted figures.
* Includes 409 tons valued at £2,968 late reported for years, 1944, 1945, 1946.

TABLE 2.—*Value and Percentage of Mineral Exports in relation to the Value of Total Exports from Western Australia.*

Year.	Total Exports. †	Mineral Exports (exclusive of Coal).	Percentage.
	£	£	
1902	9,051,358	7,530,319	83·20
1903	10,324,732	8,727,060	84·53
1904	10,271,489	8,625,676	83·98
1905	9,871,019	7,731,954	78·33
1906	9,832,679	7,570,305	76·99
1907	9,904,860	7,544,992	76·17
1908	9,518,020	7,151,317	75·13
1909	8,860,494	5,906,673	66·66
1910	8,299,781	4,795,654	57·78
1911	10,606,863	7,171,638	67·61
1912	8,941,008	5,462,499	61·09
1913	9,128,607	4,608,188	50·48
1914	8,406,182	3,970,182	47·23
1915	6,291,934	2,969,502	47·19
1916	10,878,153	6,842,621	62·92
1917	9,323,229	5,022,694	53·87
1918	6,931,834	2,102,923	30·34
1919	14,279,240	6,236,585	43·67
1920	15,149,323	3,096,849	20·44
1921	10,331,405	1,373,810	13·30
1922	11,848,025	2,875,402	24·27
1923	11,999,500	3,259,476	27·16
1924	13,808,910	1,424,319	13·24
1925	13,642,852	173,126	1·27
1926	14,668,184	1,597,698	10·89
1927	15,805,120	472,041	2·99
1928	16,911,932	996,099	5·88
1929	16,660,742	1,802,709	10·82
1930	19,016,639	6,370,396	33·49
1931	14,266,650	4,333,421	30·37
1932	16,771,465	5,657,870	33·74
1933	18,098,214	5,328,869	29·44
1934	16,784,705	5,759,324	34·31
1935	17,611,547	5,698,721	32·36
1936	19,564,716	7,130,381	36·45
1937	21,594,942	9,026,313	41·80
1938	24,220,864	10,417,458	43·01
1939	23,244,509	11,969,562	51·49
1940	25,800,562	12,480,721	48·37
1941	24,536,777	12,411,316	50·58
1942	20,681,284	8,476,622	40·99
1943	18,014,340	6,539,295	36·30
1944	19,453,001	(a) 1,282,867	6·59
1945	20,170,624	(b) 205,587	1·02
1946	26,342,125	(b) 211,890	0·80
1947	42,389,125	‡4,162,892	9.82
1948	56,597,941	(b)342,646	0.61
Total since 1902	756,707,505	244,848,462	32.36

Exclusive of Arsenic prior to 1935. † Including Ship's Stores. (a) Approximately 25 per cent. of gold production for year exported. (b) No gold bullion exported. ‡ Approximately 50 per cent. only of gold bullion production exported.

Comparative Statistical Diagrams

showing:

OUTPUT AND VALUE OF GOLD AND OTHER MINERALS, LANDS LEASED FOR GOLD MINING IN WESTERN AUSTRALIA

and the

GOLD PRODUCTION OF AUSTRALASIA FOR THE YEAR 1948

Fig. 1 Output of Gold from various Goldfields as reported to Mines Dept.

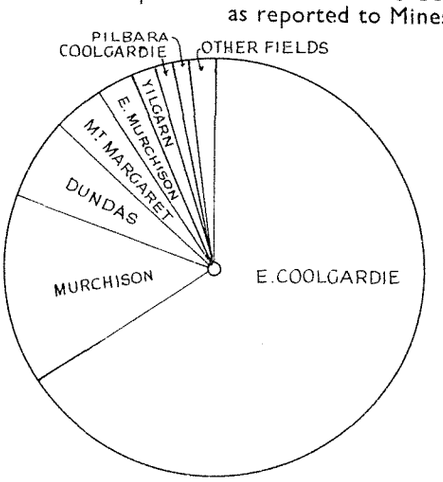


Fig. 2 Gold produced from various Goldfields as given by the Export and Mint Returns

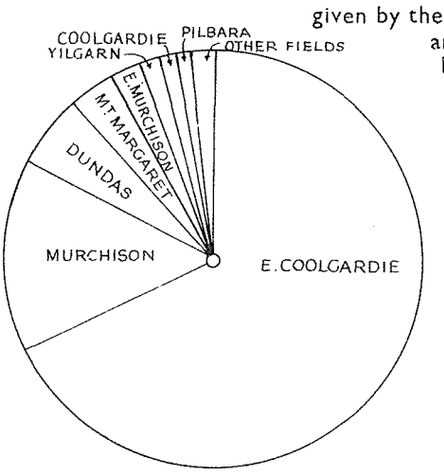


Fig. 3 Value of Gold and other Minerals

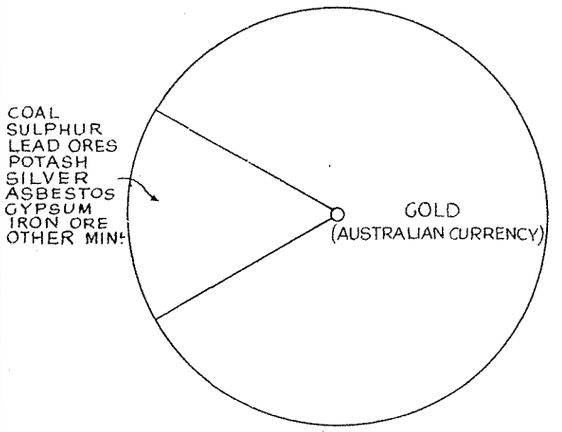


Fig. 4 Value of Minerals other than Gold

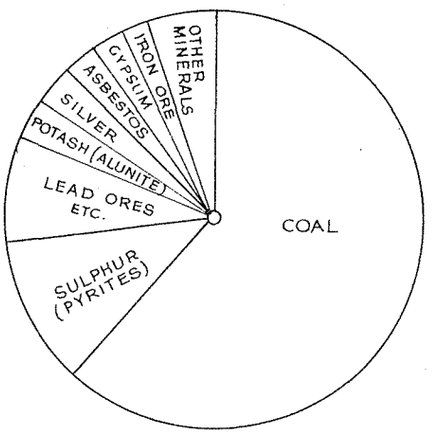


Fig. 5 Areas of land leased for Goldmining on various Goldfields

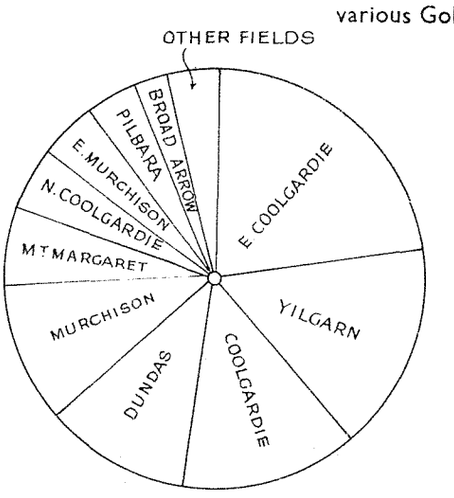


Fig. 6 Output of Gold in the States of Australia and the Dominion of New Zealand

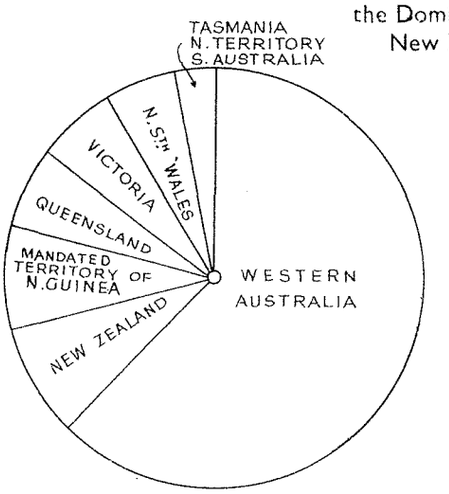


DIAGRAM OF GOLD OUTPUT

Showing Tonnage Treated (as reported to Mines Dept.); the Total Output of Gold Bullion, Concentrates etc., entered for export and received at the Perth Mint, and the Estimated Value thereof, in Australian Currency.

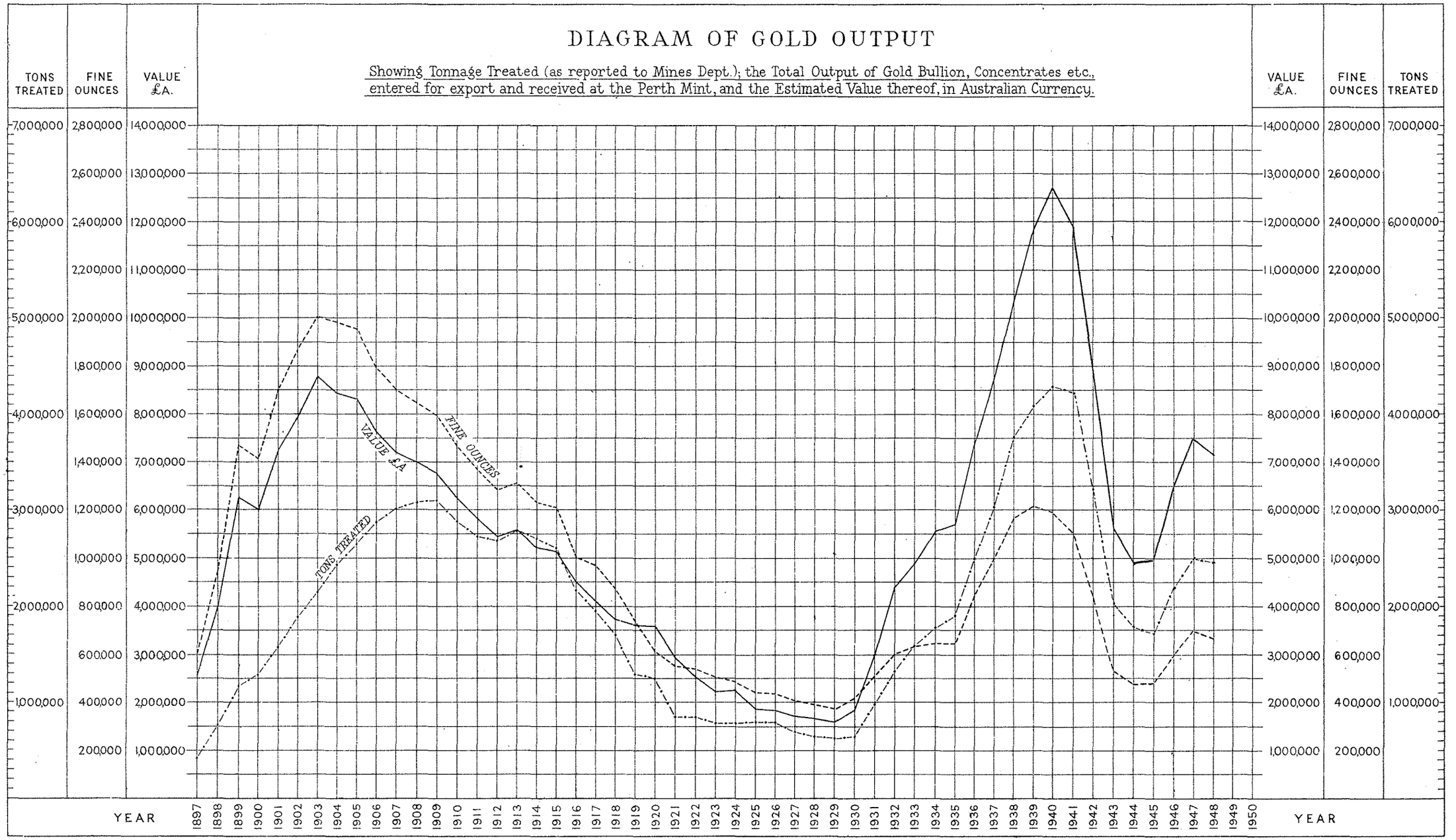


TABLE 3.

Showing for every Goldfield the amount of Gold reported to the Mines Department as required by the Regulations; also the percentage for the several Goldfields of the total reported, and the average value of the yield of Gold per ton of ore treated.

Goldfield.	Reported Yield.		Percentage for each Goldfield.		Average Value per ton of Ore Treated. (Gold at £4 4s. 11·45d. per fine oz.).	
	1947.	1948.	1947.	1948.	1947.	1948.
	Fine ozs.	Fine ozs.	%	%	Shillings.	Shillings.
1. Kimberley	*427	*496	.061	.075	*266.530	....
2. Pilbara	11,026	8,529	1.571	1.287	90.756	64.851
3. Ashburton	143	42	.020	.006	40.326	19.668
4. Gascoyne	....	....	....	....	....	....
5. Peak Hill	1,632	960	.233	.145	35.344	26.794
6. East Murchison	21,487	†17,910	3.062	2.703	48.285	†129.163
7. Murchison	92,378	99,081	13.164	14.950	16.389	15.739
8. Yalgoo	1,175	1,564	.167	.236	58.333	81.911
9. Mt. Margaret	34,442	26,940	4.908	4.065	32.220	33.633
10. North Coolgardie	8,144	6,116	1.160	.923	60.736	81·007
11. Broad Arrow	8,253	3,687	1.176	.556	38.451	67.420
12. North-East Coolgardie	911	908	.130	.137	87.629	97.522
13. East Coolgardie	449,816	435,257	64.099	65.675	23.558	22.793
14. Coolgardie	11,966	8,973	1.705	1.354	23.836	31.077
15. Yilgarn	22,056	12,077	3.143	1.822	26.842	27.333
16. Dundas	37,648	40,074	5.365	6.047	27.189	28.171
17. Phillips River	32	14	.005	.002	16.206	14.634
18. Outside Proclaimed Goldfield	216	113	.031	.017	35.042	36.090
Totals and Averages	701,752	662,741	100.000	100.000	23.777	23.004

* Principally Alluvial and Dollied. † Mainly from Sands treatment.

The total yield of the State is as shown in Table 1 (a), being the amount of gold received at the Royal Mint, gold exported in bullion and concentrates, and alluvial and other gold not reported to the Mines Department.

When comparisons are made as to the yield from any particular Field with the preceding year. the figures reported to the Department are used.

TABLE 4.

Average Quantities of Gold Ore raised and treated, and Gold produced therefrom, per man employed on the several Goldfields of the State, during 1947 *and* 1948.

Goldfield.	1947.				1948.			
	Tons of Gold Ore raised and treated.		Fine ounces of Gold produced therefrom.		Tons of Gold Ore raised and treated.		Fine ounces of Gold produced therefrom.	
	Per man employed under ground.	Per man employed above and under ground.	Per man employed under ground.	Per man employed above and under ground.	Per man employed under ground.	Per man employed above and under ground.	Per man employed under ground.	Per man employed above and under ground.
	Tons.	Tons.	Fine ozs.	Fine ozs.	Tons.	Tons.	Fine ozs.	Fine ozs.
1. Kimberley	22.71	7.57	71.24	23.75	....	....	124.00	35.43
2. Pilbara	141.38	58.98	151.04	63.00	161.93	83.38	123.61	63.65
3. Ashburton	150.50	75.25	71.44	28.58	90.50	45.25	21.00	10.50
4. Gascoyne	....	....	....	....	....	....	....	....
5. Peak Hill	206.46	122.59	85.90	51.00	138.36	63.42	43.64	20.00
6. East Murchison	420.06	120.78	238.73	68.65	206.67	64.37	314.21	97.87
7. Murchison	773.61	436.12	149.24	84.13	1,065.37	553.07	197.37	102.46
8. Yalgoo	90.09	42.79	61.86	29.38	85.37	45.06	82.32	43.44
9. Mt. Margaret	410.93	183.85	155.85	69.72	324.04	146.66	128.29	58.06
10. North Coolgardie	83.76	37.11	59.88	25.37	48.59	21.97	46.33	19.73
11. Broad Arrow	161.36	81.04	73.03	35.57	52.57	23.87	46.67	20.37
12. North-East Coolgardie	38.41	16.36	39.62	15.45	32.96	16.14	37.83	15.65
13. East Coolgardie	805.43	450.84	223.34	124.26	805.49	443.00	216.12	118.34
14. Coolgardie	352.45	167.24	98.89	46.92	181.70	86.67	66.47	31.71
15. Yilgarn	290.94	148.53	91.90	46.93	226.13	113.75	72.75	36.60
16. Dundas	355.39	239.09	113.74	76.52	382.43	259.33	126.82	86.00
17. Phillips River	56.67	21.12	10.81	4.05	16.40	6.83	2.80	1.17
18. Outside Proclaimed Goldfields	74.64	30.74	30.79	12.68	44.33	26.60	18.83	11.30
Total Averages	621.08	329.91	173.83	91.74	650.60	343.37	176.17	92.33

TABLE 5.

Output of Gold from the several States of Australia, the Northern Territory, Papua, the Mandated Territory of New Guinea, and the Dominion of New Zealand, during 1948.

State.	Output of Gold.	*Value.	Percentage of Total.	
			Output of Commonwealth.	Output of Australasia.
	Fine ozs.	£		
1. Western Australia	664,986	2,824,678	68.007	62.049
2. Victoria	68,580	291,309	7.014	6.399
3. New South Wales	57,462	244,083	5.876	5.362
4. Queensland	69,646	295,837	7.123	6.498
5. Tasmania	12,904	54,813	1.320	1.204
6. South Australia	2,036	8,648	.208	.190
7. Papua	164	697	.017	.015
8. Northern Territory	15,482	65,763	1.583	1.445
9. Mandated Territory of New Guinea	86,556	367,666	8.852	8.076
10. New Zealand	93,903	398,874	....	8.762
	1,071,719	4,552,368	100.000	100.000

* Exclusive of Premium.

TABLE 6.

Dividends, etc., paid by Western Australian Mining Companies during 1948, *and the Total to date.*

Mainly compiled from information supplied to the Government Statistician's Office by the Chamber of Mines of Western Australia.

Goldfield.	Name of Company.	Dividends Paid.	
		1948.	Grand Total to end of 1948.
		£	£
Pilbara	Various Companies	....	26,513
Peak Hill	do. do.	....	199,305
East Murchison	do. do.	....	1,914,053
Murchison	Hill 50 Gold Mine, N.L.	28,125	231,251
	Various Companies	....	2,714,945
Mt. Margaret	Sons of Gwalia, Limited	25,390	2,014,113
	Various Companies	....	958,286
North Coolgardie	do. do.	....	712,551
Broad Arrow	do. do.	....	92,500
North-East Coolgardie	do. do.	....	129,493
East Coolgardie	Boulder Perseverance, Ltd.	28,102	(a) 2,523,167
	Golden Horseshoe (New), Ltd.	11,459	(b) 4,044,377
	Gold Mines of Kalgoorlie, Ltd.	38,421	471,625
	Great Boulder Proprietary, Ltd.	78,124	7,082,837
	Kalgoorlie Enterprise Mines, Ltd.	11,000	276,375
	Lake View & Star, Ltd.	332,500	(c) 4,424,500
	North Kalgurli (1912), Ltd.	104,062	1,161,874
	Paringa Mining and Exploration Co., Ltd.	42,256	313,235
	Various Companies	....	11,899,105
Coolgardie	do. do.	....	388,770
Yilgarn	do. do.	....	(d) 1,205,556
Dundas	Central Norseman Gold Corporation	137,500	617,500
	Various Companies	....	786,162
	Totals	836,939	44,188,093

(a) Also £45,091 in bonuses and profit-sharing notes in years 1935–36. (b) Also £55,000 Capital returned in year 1932 and £42,000 in bonuses and profit-sharing notes in year 1934. (c) Also £75,000 in bonuses and profit-sharing notes and £93,750 Capital returned in years 1932–35. (d) Also £67,725 Capital returned in 1948 by Edna May (W.A.) Amalg. N.L.

TABLE 7.

Quantity and Value of Minerals, other than Gold and Silver, reported to the Mines Department during 1948.

Goldfield, District or Mineral Field.	1948.		Increase or Decrease as compared with 1947.	
	Quantity.	Value.	Quantity.	Value.
	tons.	£A.	tons.	£A.
ALUNITE (Crude Potash)—				
Yilgarn	1,724.70	41,212	+ 53.60	+ 8,218
ANTIMONY—				
Pilbara (Nullagine)	41.90	3,582	— 75.72	— 6,040
Outside Proclaimed Goldfield	....	....	— 2.00	— 109
ARSENIC—				
East Murchison (Wiluna)	214.00	4,494	— 976.00	— 24,220
Yilgarn	....	....	— 1.13	— 24
ASBESTOS (Anthophyllite) —				
Outside Proclaimed Goldfield	284.24	4,173	+ 209.24	+ 3,185
ASBESTOS (Chrysotile)—				
Pilbara (Marble Bar)	....	....	— .50	— 7
Outside Proclaimed Goldfield	71.31	5,591	— 7.26	— 581
ASBESTOS (Crocidolite)—				
Outside Proclaimed Goldfield	607.30	27,997	— 281.69	— 2,229
BENTONITE—				
Outside Proclaimed Goldfield	268.75	806	+ 224.00	+ 672
BERYL ORE—				
Pilbara (Marble Bar)	30.17	1,767	+ 14.13	+ 1,254
Coolgardie	4.68	267	— 24.17	— 745
CLAYS—				
Outside Proclaimed Goldfield	4,858.50	4,113	— 1,419.00	— 1,951
COAL—				
Collie	732,938.42	880,236	+ 2,432.10	+ 39,987
COPPER FERTILISER				
Peak Hill	258.65	2,204	— 658.35	— 3,867
DIATOMACEOUS EARTH—				
Outside Proclaimed Goldfield	....	....	— 5.00	— 50
DOLOMITE—				
Murchison (Mt. Magnet)	107.25	536	+ 50.40	+ 251
FELSPAR—				
Coolgardie	1,011.00	3,538	— 215.00	— 753
GLASS SAND—				
Outside Proclaimed Goldfield	516.90	644	+ 152.50	+ 175
GLAUCONITE—				
Outside Proclaimed Goldfield	319.00	7,975	— 31.50	— 787
GYPSUM—				
Yilgarn	15,870.00	24,527	+ 6,916.50	+ 11,097
Dundas	....	....	— 376.00	— 564
Outside Proclaimed Goldfield	9,651.50	10,646	— 1,300.50	— 4,134
IRON ORE—				
Outside Proclaimed Goldfield	7,222.20	26,165	+ 7,222.20	+ 26,165
JAROSITE—				
Phillips River	....	....	— 9.54	— 37
KAOLIN—				
Outside Proclaimed Goldfield	146.00	292	— 435.00	— 18
KYANITE—				
Outside Proclaimed Goldfield	1,125.00	6,516	— 1,806.00	— 8,081
LEAD ORE AND CONCENTRATES—				
Northampton	1,345.19	92,492	+ 1,339.30	+ 92,166
SILVER LEAD ORE—				
Kimberley	4.07	197	+ 4.07	+ 197
Pilbara (Marble Bar)	....	....	— 16.47	— 626
Ashburton	126.76	7,159	+ 126.76	+ 7,159
Outside Proclaimed Goldfield	2.07	63	+ 2.07	+ 63

TABLE 7—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported to the Mines Department during 1948—*continued.*

Goldfield, District or Mineral Field.	1948.		Increase or Decrease as compared with 1947.	
	Quantity.	Value.	Quantity.	Value.
	tons.	£A.	tons.	£A.
SILVER LEAD ZINC ORE—				
West Kimberley	713.46	14,358	+ 713.46	+ 14,358
MAGNESITE—				
East Coolgardie (Bulong)	....	....	— 73.00	— 73
Coolgardie	466.75	1,691	+ 466.75	+ 1,691
Outside Proclaimed Goldfield	495.07	1,485	+ 495.07	+ 1,485
MANGANESE—				
Peak Hill	1,600.00	10,150	+ 1,600.00	+ 10,150
Mt. Margaret	20.00	180	+ 20.00	+ 180
Outside Proclaimed Goldfield	24.85	112	+ 24.85	+ 112
PYRITES ORE AND CONCENTRATES—				
Dundas	37,499.00	164,203	— 6,838.00	— 23,418
RED OCHRE—				
Pilbara	....	....	— 2.10	— 15
Murchison (Cue)	381.37	4,109	— 442.03	— 4,014
North-East Coolgardie (Kurnalpi)	....	....	— 10.40	— 83
Outside Proclaimed Goldfield	185.00	2,682	— 6.20	+ 47
SILLIMANITE—				
Outside Proclaimed Goldfield	2.00	13	+ 2.00	+ 13
TALC—				
East Coolgardie	72.00	732	— 141.00	— 81
TANTALITE—				
Pilbara (Marble Bar)	.53	166	+ .53	+ 166
Greenbushes	3.78	973	+ 3.78	+ 973
TIN—				
Pilbara (Marble Bar)	34.99	12,389	+ 17.09	+ 8,280
Greenbushes	2.00	596	— 3.73	— 860
TUNGSTEN ORES (Scheelite)—	units.		units.	
Coolgardie	28.18	196	— 2.40	+ 66
Yilgarn	464.67	3,717	— 147.29	+ 7
VERMICULITE—	tons.		tons.	
East Coolgardie (Bulong)	60.00	330	+ 60.00	+ 330
Outside Proclaimed Goldfield	91.00	546	+ 9.00	+ 54

TABLE 8.

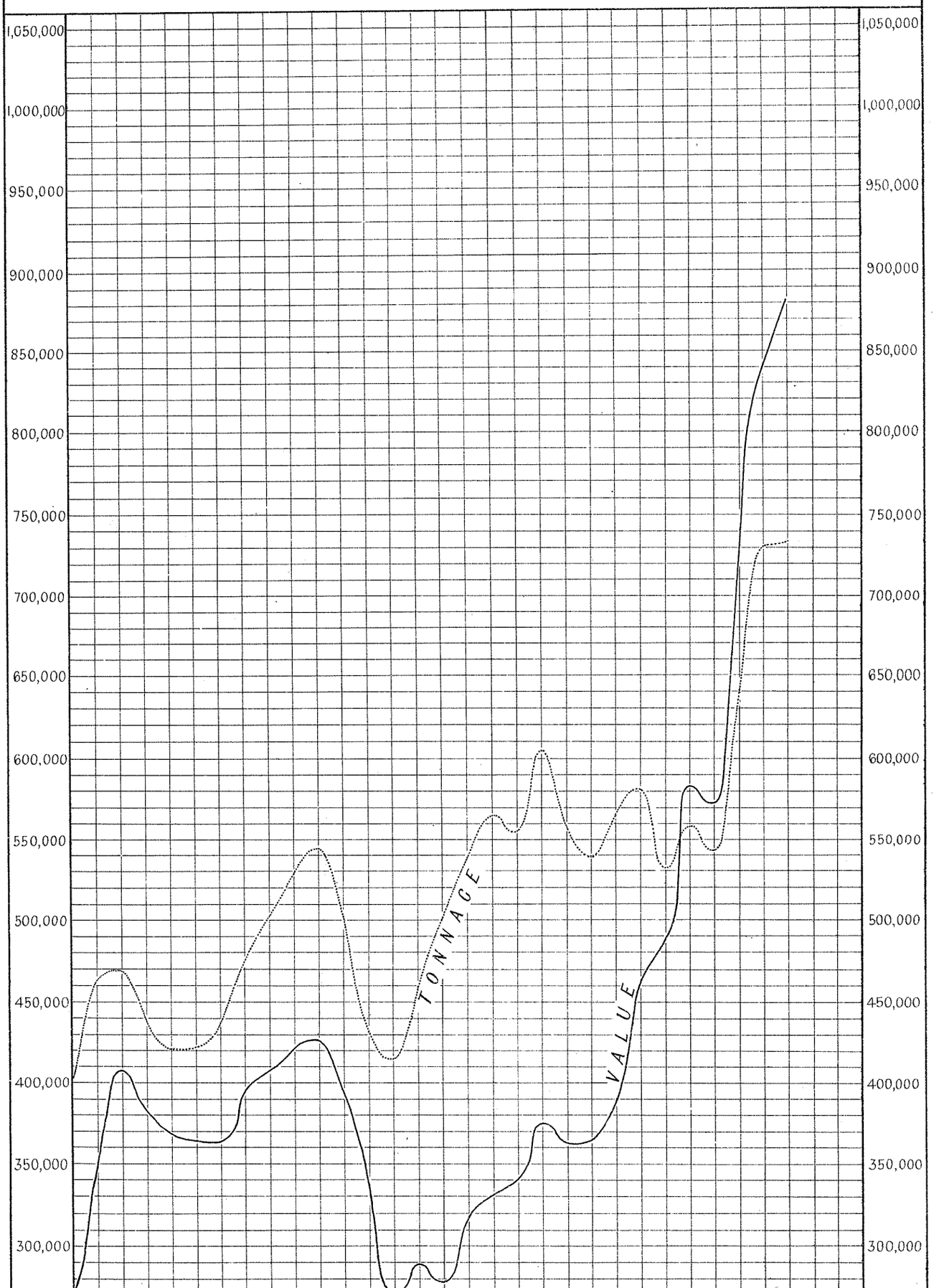
Quantity of Coal raised during 1947 *and* 1948, *estimated Value thereof, Number of Men employed, and Output per Man.*

Coalfield.	Year.	Quantity raised.	Estimated Value.	Men Employed.		Quantity Raised.	
				Above ground.	Under ground.	Per Man employed under ground.	Per Man employed above and under ground.
		tons.	£			tons.	tons.
Collie	1947	730,506	840,249	287	745	980	708
	1948	**732,938**	**880,236**	**296**	**768**	**954**	**689**

The quantity and value of coal raised during the year 1948 showed an increase amounting to 2,432 tons and £39,987 respectively. The average number of men employed during the year increased by 32, but the number of tons raised per man employed decreased by 19 tons when compared with figures for 1947.

GRAPH OF COAL OUTPUT

Showing Quantities and Values as reported to Mines Dept.



YEAR	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	YEAR
£A VALUE	270355	350346	407117	381555	368949	363255	363203	394400	407967	420145	426706	394758	336178	270630	289806	278704	318013	331565	340444	375083	362811	364500	389278	461495	489721	583075	572896	730104	840249	880236				£A VALUE
TONS	401713	462021	468817	438443	420714	421864	437461	474819	501505	528420	544719	501425	432400	415719	458399	500343	537188	565075	553510	604793	557535	539427	556574	581176	531546	558322	543363	642287	730506	732938				TONS

PART III.—LEASES AND OTHER HOLDINGS UNDER THE VARIOUS ACTS RELATING TO MINING.

TABLE 9.

Total Number and Acreage of Lease, Mineral Claims and Prospecting Areas held for Mining on the 31*st December,* 1947 *and* 1948.

Leases and Other Holdings.	1947.		1948.	
	No.	Acreage.	No.	Acreage.
Gold Mining Leases on Crown Lands	1,444	24,612	**1,379**	**23,857**
Gold Mining Leases on Private Property	13	336	**15**	**360**
Mineral Leases on Crown Lands	163	32,854	**179**	**33,122**
Mineral Claims	182	11,151	**207**	**12,673**
Prospecting Areas	†809	17,219	**‡687**	**17,724**
Totals	2,611	86,172	**2,467**	**87,736**

† Includes 47 Prospecting Areas for Minerals of a total of 1,172 Acres.
‡ Includes 92 Prospecting Areas for Minerals of a total of 2,169 Acres.

PART IV.—MEN EMPLOYED.

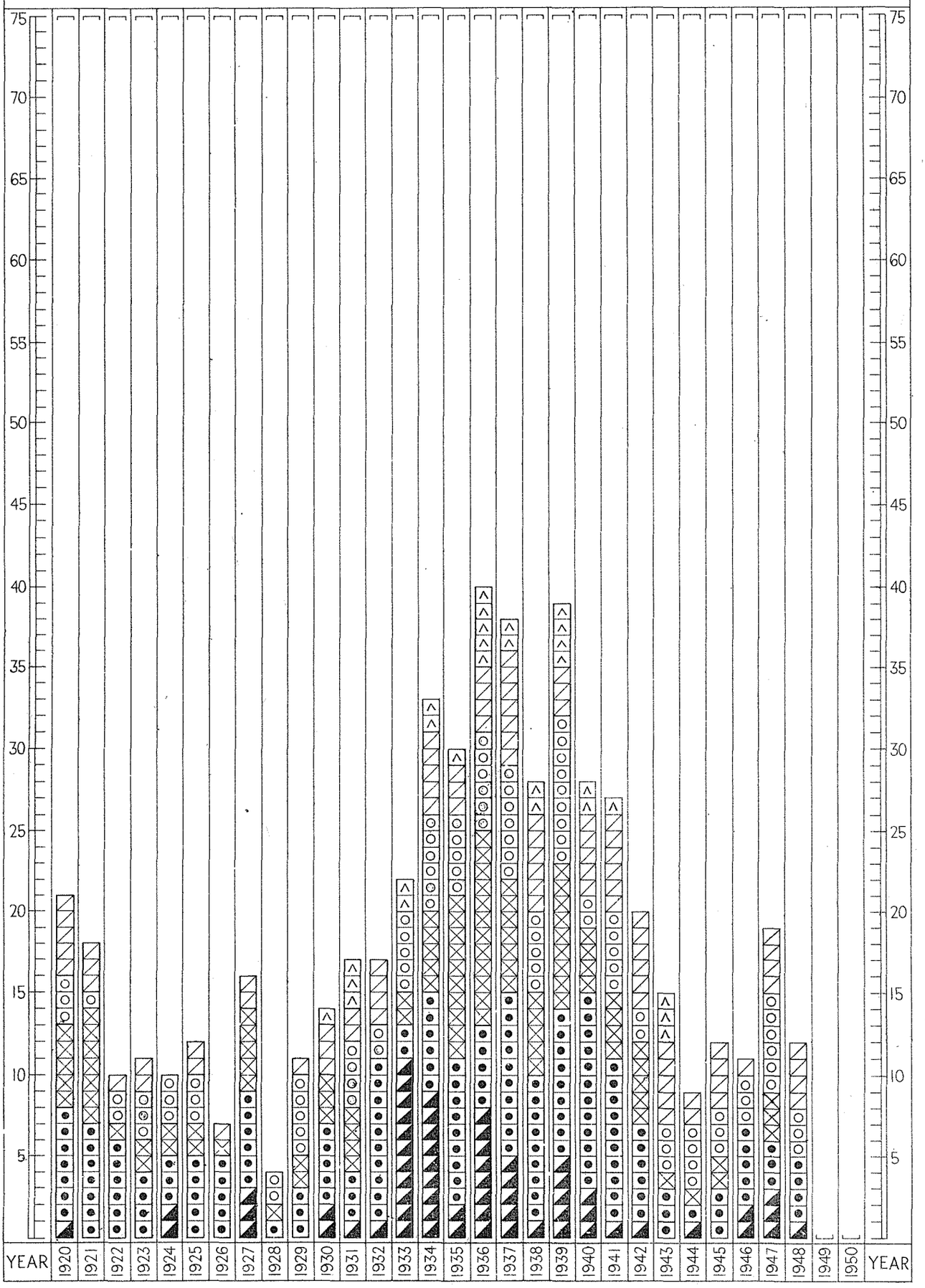
TABLE 10.

Average number of Men reported as engaged in Mining during 1947 *and* 1948.

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1947.	1948.	1947.	1948.	1947.	1948.
Kimberley	... ...	18	14	....	....	18	14
Pilbara	Marble Bar	80	62	....	....	80	62
	Nullagine	95	72	....	....	95	72
Ashburton	... ...	4	4	1	....	5	4
Gascoyne	... ...	....	....	....	....	....	....
Peak Hill	... ...	32	48	....	....	32	48
East Murchison	Lawlers	103	40	....	....	103	40
	Wiluna	173	109	....	....	173	109
	Black Range	37	34	....	....	37	34
Murchison	Cue	769	645	....	....	769	645
	Meekatharra	124	116	....	....	124	116
	Day Dawn	52	42	....	....	52	42
	Mt. Magnet	153	164	....	....	153	164
Yalgoo	... ...	40	36	....	....	40	36
Mt. Margaret	Mt. Morgans	101	106	....	....	101	106
	Mt. Malcolm	293	267	....	....	293	267
	Mt. Margaret	100	91	....	....	100	91
North Coolgardie	Menzies	131	114	6	7	137	121
	Ularring	71	70	4	5	75	75
	Niagara	29	32	....	....	29	32
	Yerilla	76	76	4	6	80	82
Broad Arrow	....	225	174	7	7	232	181
North-East Coolgardie	Kanowna	41	38	3	4	44	42
	Kurnalpi	13	11	2	5	15	16
East Coolgardie	East Coolgardie	3,565	3,632	17	10	3,582	3,642
	Bulong	33	30	5	6	38	36
Coolgardie	Coolgardie	236	255	....	....	236	255
	Kunanalling	19	28	....	....	19	28
Yilgarn	....	470	330	....	....	470	330
Dundas	....	492	466	....	....	492	466
Phillips River	....	8	12	....	....	8	12
State Generally	....	17	10	....	....	17	10
Total—Gold Mining	....	7,600	7,128	49	50	7,649	7,178
MINERALS OTHER THAN GOLD.							
Alunite	....	127	117	....	....	127	117
Arsenic	....	14	4	....	....	14	4
Asbestos	....	193	106	....	....	193	106
Bentonite	....	....	1	....	....	....	1
Beryl	....	2	2	....	....	2	2
Clays	....	5	5	....	....	5	5
Coal	....	1,032	1,064	....	....	1,032	1,064
Copper Ore	....	2	1	....	....	2	1
Dolomite	....	1	1	....	....	1	1
Felspar	....	3	3	....	....	3	3
Glass Sand	....	1	1	....	....	1	1
Glauconite	....	8	8	....	....	8	8
Gypsum	....	29	32	....	....	29	32
Iron Ore	....	....	24	....	....	....	24
Kaolin	....	....	1	....	....	....	1
Kyanite	....	13	8	....	....	13	8
Lead	....	13	60	....	....	13	60
Magnesite	....	....	3	....	....	....	3
Manganese	....	....	3	....	....	....	3
Pyrites	....	134	123	....	....	134	123
Red Ochre	....	6	4	....	....	6	4
Silver Lead	....	5	54	....	....	5	54
Talc	....	2	2	....	....	2	2
Tin	....	9	11	....	....	9	11
Tungsten Ore (Scheelite)	....	6	2	....	....	6	2
Vermiculite	....	1	2	....	....	1	2
Total—Other Minerals	....	1,606	1,642	....	....	1,606	1,642
GRAND TOTAL	....	9,206	8,770	49	50	9,255	8,820

DIAGRAM OF ACCIDENTS

Showing the number of Deaths, arranged in Six Classes, in the Mines of Western Australia, from 1920 onwards



PART V.—ACCIDENTS.

TABLE 11.

MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING 1947 AND 1948.

A.—*According to Locality of Accident.*

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1947.	1948.	1947.	1948.	1947.	1948.
1. Kimberley	1	....	....	11	1	11
2. West Kimberley	....	....	....	....	....	....
3. Pilbara	3	....	14	10	17	10
4. West Pilbara	....	....	....	....	....	....
5. Ashburton	....	....	....	....	....	....
6. Gascoyne	....	....	....	....	....	....
7. Peak Hill	....	....	....	....	....	....
8. East Murchison	....	....	32	4	32	4
9. Murchison	4	1	86	68	90	69
10. Yalgoo	....	....	....	....	....	....
11. Mount Margaret	2	....	33	32	35	32
12. North Coolgardie	....	....	5	2	5	2
13. North-East Coolgardie	....	....	....	....	....	....
14. Broad Arrow	....	....	3	1	3	1
15. East Coolgardie	7	8	521	459	528	467
16. Coolgardie	....	....	22	8	22	8
17. Yilgarn	....	....	2	15	2	15
18. Dundas	1	1	57	57	58	58
19. Phillips River	....	....	....	....	....	....
Mining Districts—						
Northampton	....	....	....	....	....	....
Greenbushes	....	....	....	....	....	....
Collie	....	....	281	223	281	223
South-West	1	2	14	5	15	7
Totals	19	12	1,070	895	1,089	907

From the above table, it will be seen that the number of fatal accidents for the year 1948 was 12, as against 19 in 1947. The number injured showed a decrease of 175. In the report of the State Mining Engineer, published as Division 11 of this Report, these accidents are classified according to their causes.

B.—*According to Causes of Accidents.*

Cause.	1947.		1948.		Comparison with 1946.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	3	5	1	4	— 2	— 1
2. Falls of Ground	3	97	4	79	+ 1	— 18
3. In Shafts	3	21	....	16	— 3	— 5
4. Miscellaneous Underground	6	745	3	582	— 3	— 163
5. Surface	4*	202†	4‡	213§	....	+ 11
6. Fumes	....	....	....	1	....	+ 1
Totals	19	1,070	12	895	— 7	— 175

* Includes 1 Fatal Accident in Quarries. † Includes 14 Serious Accidents in Quarries. ‡ Includes 2 Fatal Accidents in Quarries. § Includes 5 Serious Accidents in Quarries.

PART VI—STATE AID TO MINING.

(*A*) *State Batteries.*

The number of State Batteries existing at the end of the year was 20 with three leased. From inception to the end of 1948 gold and tin to the value of £13,601,799.995 including gold premium estimated at £3,781,060.784 have been received from the State Batteries. 2,786,049.94 tons of auriferous ore have been treated and have produced £9,726,284.051 plus estimated premium of £3,781,060.784 and 81,810.5 tons of tin ore produced tin to the value of £93,883.16 and residues to the value of £572.

During the year 40,634 tons of ore were crushed for 28,851.69 ounces of bullion estimated to contain 24,451.00 fine ounces of gold equal to 12 dwts. 0.8 grains per ton. The average value of tailings produced was 4 dwts. 2.9 grains making the average head value of 16 dwts. 3.7 grains. The estimated value of gold produced was 24,451.00 ounces by amalgamation and 6,440.61 ounces from tailings treatment a total of 30,391.61 ounces valued at £A332,495.

The working expenditure for all plants for the year was £78,557 2s. 6d. and the revenue was £57,526 18s. 5d. which shows a loss of £21,030 4s. 1d. on the year's operations.

The capital expenditure since inception of the scheme has been £552,979 4s. 8d.; £412,846 6s. 9d. from the General Loan Fund, £97,724 16s. 6d. from Consolidated Revenue, £28,621 13s. 5d. from assistance to gold mining industry and £13,786 8s. 0d. from Commonwealth assistance to metalliferous mining.

Head office expenditure including insurance under the Workers' Compensation Act and payroll tax was £6,076 4s. 6d. as against £6,053 17s. 3d. for 1947.

The working expenditure from inception to the end of the year exceeds revenue by £177,614 11s. 7d.

(*B*) *Geological Survey of Western Australia.*

The principal work of the geological survey for the year 1948 is covered by the following reports published in Division IV of this report:—

- Water Supply—Chapman Road Area, Geraldton District.
- A Spongolite Deposit East of Mt. Barker S.W. Division.
- The Availability of Beryl in Western Australia (with appendix by W. Johnson "Beryl Resources of the Yinnietharra Area.").
- A Manganese Deposit on P.A. 330 p.p. Tenindewa, S.W. Division.
- Consolidated Report on the Re-Survey of the Coolgardie District 1946-1948.
- Report on Block 59 Hampton Plain, Coolgardie District.
- Dredging Claims 11H and 19H, Minninup Beach near Bunbury S.W. Division.
- Miscellaneous Report—
  - Alleged Meteor Crater at Dulyalbin Yilgarn Gold Field.
  - Magnesite, Coolgardie District.
  - Note on Monazite in Cape Riche Pegmatites.
  - Location 48, Hampton Plains.
  - Vermiculite at Bulong (in conjunction with N. M. Gray).
- The Availability of Coal on the Collie Burn Leases.
- Diamond Drilling on the Collie Burn Leases, Collie Coalfield.
- Report on P.A. 53 Collie Coalfield.
- A reported Gold Find in the Upper Helena River Valley S.W. Division.
- Kyanite Deposits, North of Yanmah, Nelson District, S.W. Division
- Brickmaking Materials of the Cardup Area S.W. Division.
- Geological Reconnaissance of the Fly Brook and Nannup Coal Deposits, S.W. Division (in conjunction with L. E. de la Hunty).
- A Manganese Deposit on T.R. 1225H near Laverton, Mt. Margaret Goldfield (in conjunction with L. E. de la Hunty).
- Deposits of Heavy Minerals on D.C. 20H near Denmark S.W. Division.
- Report on the Calyerup Creek Gold Find S.W. Division.
- The Timoni workings of Mt. Ida Gold Mine Ltd. Menzies District N. Coolgardie Goldfield.
- A Geological and Topographical Map of an area surrounding the Iron King and Lady Miller Mines, Norseman, Dundas Goldfield.
- A Deposit of Anthophyllite Asbestos two miles North of Bindi Bindi, S.W. Division.
- Notes on the Emu Gold Mine, Agnew, East Murchison Goldfield.
- Examination of Bore Cores from the Phoenix G.M. Coolgardie, Coolgardie Goldfield.
- The Porphyry-Porphyrite Series of Coolgardie, Coolgardie Goldfield.
- Proposed Diamond Drilling of the Great Fingal Ore Body, Day Dawn, Murchison Goldfield.
- Report on the Bonnie Value Structure Group, Coolgardie Goldfield.
- Report on the Nepean Group Coolgardie Goldfield.
- Report on the White Hope Group Hampton Plains East Coolgardie Goldfield.
- Report on the Grosmont Group, Coolgardie Goldfield.
- Report on the Lloyd George and Reform Groups, Gibraltar, Coolgardie Goldfield.
- Report on Supposed Tantalite occurrence P.A. 4744E Parkeston, East Coolgardie Goldfield.

During the year the following publications were issued:—

- Annual Progress Report of the Geological Survey of Western Australia for 1945.
- Mineral Resources of Western Australia, Bulletin No. 4.
- The Dandaragan Phosphate Deposits, by R. S. Matheson B.Sc., Geological Survey of Western Australia.

The following publications are still in the Press:—

- Annual Progress Reports of the Geological Survey for 1946 and 1947.
- Geological Survey of Western Australia, Bulletin No. 102: The Greenbushes Mineral Field by R. A. Hobson B.Sc., (Hons.) and R. S. Matheson, B.Sc., Geological Survey of Western Australia (nearing completion).

The following reports have been compiled and await publication:—

- Geological Survey of Western Australia Bulletin on the Geology of Portion of the Mt. Margaret Goldfield, by R. A. Hobson, B.Sc., (Hons.) Geological Survey of Western Australia plus two atlases of maps.
- Geological Survey of Western Australia Bulletin on Some Economic Aspects of the Principal Tantalum Bearing Deposits of the Pilbara Goldfield, North-West Division, by H. A. Ellis, B.Sc., A.O.S.M., Geological Survey of Western Australia.
- Mineral Resources of Western Australia Bulletin, Moulding Sands by K. R. Miles, D.Sc., F.G.S., Geological Survey of Western Australia and H. A. Stephens, B.Sc., Council for Scientific and Industrial Research.
- Mineral Resources of Western Australia Bulletin, Silver-Lead and Zinc. By W. Johnson, B.Sc., (Hons.) Geological Survey of Western Australia.
- Mineral Resources of Western Australia Bulletin, Vermiculite, Talc and Soapstone, Fullers Earth, Bentonite. and Diatomite, by W. Johnson, B.Sc., (Hons.) Geological Survey of Western Australia.
- Atlas of Maps of Bulletin No. 101. (The Mining Groups of the Yilgarn Goldfield, North of the Great Eastern Railway) Geological Survey of Western Australia, Bulletin of A Geological Reconnaissance of Part of the Area included between the limits Lat. 24° OO'S., and Lat. 29° OO'S and between Long. 115° OO'E and Long. 118° 30'E., including parts of the Yalgoo, Murchison, Peak Hill and Gascoyne Goldfields, by W. Johnson B.Sc. (Hons.), Geological Survey of Western Australia.

Officers of the Survey have rendered varied types of practical assistance to individuals, syndicates and companies as well as other Government Departments who have been concerned with the exploration of mineral and water resources in all parts of the State.

(C) Assistance under the Mining Development Act, 1902.

The following statement shows the sums advanced during the year 1948 under this Act:—

	£	s.	d.
1. Advanced in aid of mining work, and equipment of mines with machinery	36,156	17	10
2. Subsidies on stone crushed for the public, being amounts paid to owners of plants crushing at fixed rates	536	8	9
3. Providing means of transport, equipment and sustenance for prospectors	4,049	3	3
4. Other assistance	56	7	11
	£40,798	17	9

The receipts under this Act, exclusive of interest payments, amounted to:

	£	s.	d.
1. Refund of Advances	3,862	17	8
2. Prospecting Refunds	1,327	8	3
	£5,190	5	11

PART VII—INSPECTION OF MACHINERY.

The Chief Inspector of Machinery reports that the number of useful boilers registered at the end of the year totalled 5,892 against 5,675 total for the preceding year, showing an increase after all adjustments of 217 boilers.

Of the total 5,892 useful boilers, 3,267 were out of use at the end of the year, 2,651 thorough and 161 working inspections were made and 2,625 certificates were issued.

Permanent condemnations totalled 23 and temporary condemnations 24. There were three reinstated. Four boilers were transferred beyond the jurisdiction of the Act.

The total number of machinery groups registered was 22,537 against 21,152 for the previous year, showing an increase of 1,385.

Inspections made total 13,818 and 3,835 certificates were granted.

The total miles travelled for the year were 65,914 against 67,762 miles for the previous year, showing decrease of 1,848 miles. The average miles travelled per inspection were 3.96 as against 4.62 miles per inspection for the previous year.

Three hundred and ten applications for engine drivers' and boiler attendants' Certificates were received and dealt with, and 293 certificates, all classes, were granted as follows:—

Winding Competency (including certificates issued under Regulation 40 and Section 60)	13
First Class Competency (Including certificates issued under Regulations 40 and 45, and Sections 60 and 63) ..	39
Second Class Competency (including cerrtificates issued under Regulation 40 and Section 60)	21
Third Class Competency (including certificates issued under Regulations 40 and 45 and Sections 60 and 63 of the Act)	26
Locomotive Competency (including certificates issued under Regulation 40 and Section 60)	5
Traction Competency (including certificates issued under Regulation 40 and Section 60)	—
Internal Combustion Competency (including certificates issued under Regulation 40 and Section 60)	57
Crane and Hoist Competency (including certificates issued under Regulation 40 and Section 60)	18
Boiler Attendants' Competency (including certificates issued under Regulation 40 and Section 60)	109
Interim	—
Copies	5
Transfers	—
Total	293

The total revenue from all sources during the year was £9,744 17s. 3d., as against £8,890 12s. 10d. for the previous year, showing an increase of £884 4s. 5d.

The total expenditure for the year was £13,276 6s. 7d. against £11,238 6s. 1d. for the previous year, showing an increase of £2,038 0s. 6d.

PART VIII.—THE GOVERNMENT CHEMICAL LABORATORIES.

The first complete year under the reconstitution of the Government Chemical Laboratories, whereby provision was made for the creation of five divisions, has now been concluded. Whilst all the divisional heads have been appointed, the problem of housing staff and equipment for the two new divisions, Industrial Chemistry and Fuel Technology, has not yet been completed. Much work has been done in this connection for the Fuel Technology Division, but as yet provision has not been made for the accommodation of the Industrial Chemistry Division. This is seriously hindering the activities of the Industrial Chemist and it is to be hoped that suitable accommodation will be provided at an early date.

The beneficial results of this reorganisation are shown by the increase in the volume of work received and the diverse nature of the calls for services by other departments, industry and the general public. Whilst the work of all divisions has expanded considerably the principal expansion has been in the direction of investigations into the various problems associated with industrial development and the utilisation of our natural fuels, chiefly Collie coal. In this respect we have been able to render a great deal of assistance to the Department of Industrial Development.

The principal activities of these laboratories during the year were as follows:—

Food, Drugs and Toxicology Division.

Food examinations covered a wide range, particularly to ascertain the composition of foodstuffs not covered by regulations and in some cases the suitability for use in Government institutions.

The survey of the composition of West Australian fruits was extended to cover grape fruit grown in a number of localities. These surveys have yielded valuable information in fixing export standards and in the valuation of natural fruit cordials.

This division's work leading to the adoption of preservatised ether for anaesthesia has been a considerable contribution towards safe anaesthesia in W.A. Toxicological and drug examinations have mainly been to assist district coroners and to identify and assay dangerous drugs.

The many phases of industrial hygiene have been broadly applied to cover air conditions in mines, ships and factories.

The biggest extension in the division's activity has been in the field of trade waste disposal and initiation and participation in a monthly survey in connection with Swan River pollution.

Agriculture, Forestry and Water Supply Division.

A larger number of water samples was examined this year, an increase of nearly 30 per cent. over last year. More than half these were submitted by farmers, market gardeners, graziers, etc., for examination as to their suitability for stock, irrigation and domestic purposes. The importance of water supplies to this State is a phase of the division's work which is of great value. The routine examination of existing supplies to cities and country towns was continued as was also the survey of waters from rivers and streams in the South-West portions of the State. Of special interest was the compilation and publication of a paper on the salinity standards for waters for various agricultural purposes.

A considerable amount of work was carried out for the Department of Agriculture on pastures, feeding stuffs and plant nutrition experiments. In the latter connection a number of samples of plant material was analysed for major and minor elements concerned with the Department's experiments on fertiliser treatment.

By arrangement with the Commonwealth Government and the Western Australian Department of Agriculture, a chemist was appointed early in the year for a five years' period to carry out chemical investigations on tobacco in connection with tobacco leaf production.

Mineralogy, Mineral Technology and Geochemistry Division.

There was a considerable increase in the number of samples received by this division during the year. This was accounted largely for by the number of samples submitted in connection with the radio-active mineral survey. This work is being carried out in conjunction with the Commonwealth Government and comprised the examination of beach and river sands. Tests for radio-activity have been carried out on numerous samples sent in by prospectors. An officer visited the Coolgardie Goldfield and spent three days with members of the Geological Survey testing the pegmatite formations in the vicinity with a portable Geiger Muller counter. This report is published as an appendix.

Specimens of alloys and metals for use in construction purposes for other Government Departments were tested for quality and corrosion.

An important function of the work carried out by this division was the examination of ores and minerals of economic value and scientific interest. In this respect a census of all minerals recorded in W.A. is kept and information given regarding quality and economic value and uses. Over 500 specimens of rocks, minerals and ores were submitted during the year for mineral identification and evaluation.

Industrial Chemistry Division.

The lack of suitable accommodation and adequate equipment was more in evidence this year than last, consequently the work done during the year was largely of a consultative nature.

Assistance was given to the Wood-Distillation, Charcoal-Iron and Steel Industry, Wundowie, during the year. Owing to a temporary staff shortage at the works an officer of this division spent a total period of five weeks assisting to establish better organisation of the laboratory and generally checking up on analytical procedure methods.

Of special interest was the work carried out on the industrial utilisation of W.A. bentonite and clays.

A number of requests by the Department of Industrial Development for help to industries were investigated.

Fuel Technology Division.

The division is now equipped to carry out all standard determinations required in the analysis of fuels and on aspects of the investigations of W.A. fuels, which require advanced research work.

Much valuable work has been undertaken on Collie coal, particularly in regard to its gasification, reactivity, drying and storage, and the ash fusion characteristics of coal from the siderite section of the Co-operative Mine. Coals from other localities have also been examined.

In the field of applied fuel technology, work has been done on slag formation and combustion behaviour during pulverised firing of Collie coal. Assistance has been given to the Wood-Distillation, Charcoal-Iron and Steel Industry, Wundowie, in the measurement of temperatures on wood carbonising retorts.

As a result of investigations and discussions with a number of authorities it is believed that Collie coal is suitable for pressure gasification with steam and oxygen and that the cost of gas making will not be greater than the present costs of making gas from New South Wales coal.

PART IX—SCHOOL OF MINES.

(a) Kalgoorlie.—The total number of attending students enrolled during 1948 was 420. In addition, 32 correspondence class students were registered.

Included in the attending students were 178 registered under the Commonwealth Reconstruction Training Scheme, of whom 117 were on full-time and 61 on a part-time basis.

New buildings were added to the school during the year, and a considerable amount of new equipment purchased.

A successful exhibition and demonstration of the work carried out at the school was held on the 27th and 28th August, and was well attended by the general public, while at the end of the school year, a special course was again provided for prospectors.

The Metallurgical Laboratory undertook 38 investigations into samples of ore at the request of the mine owners concerned, 27 being in connection with gold and 11 with other minerals.

(b) Norseman.—The total number of students enrolled was 102, an increase of 40 by comparison with 1947. An additional full-time lecturer is to be added to this school during 1949, and new subjects will be gradually introduced.

PART X—MINER'S PHTHISIS ACT AND MINE WORKERS' RELIEF ACT.

During the year all goldfields were visited by the mobile laboratory with the exception of the Ashburton, Gascoyne, Kimberley, West Kimberley, Phillips River, Pilbara and West Pilbara, and examinations conducted totalled 5,134 compared with 6,450 for the previous year.

The number of beneficiaries under the Miner's Phthisis Act on 31/12/1948 was 251, being 41 ex-miners and 210 widows.

STAFF.

During the year, Mr. T. N. Kirton, Inspector of Explosives, retired after many years of outstanding service with the Department. He was succeeded by Mr. F. F. Allsop, B.Sc. A.A.C.I., who had previously occupied the position of Analyst and Research Officer in the Department's laboratories.

The members of the staff of the Department throughout a busy year, rendered most efficient and loyal service, and I am most appreciative of their efforts.

In dealing with the various activities I have commented only on the principal items. Divisions II to X of the publication contain the detailed reports of the responsible officers.

A. H. TELFER,
Under Secretary for Mines.

Department of Mines.
22nd April, 1949.

Division II.

Report of the State Mining Engineer for the Year 1948.

The Under Secretary for Mines:

Sir,

I have the honour to submit for the information of the Hon. Minister for Mines, my Annual Report on this branch of the Mines Department for the year 1948.

A report on the mining activities in the State for the year, compiled by the Assistant State Mining Engineer, and based on information supplied by the Statistical Clerk and from reports from the Inspectors of Mines and from his own observations in the field, is submitted in its entirety as portion of such Annual Report.

ACCIDENTS.

The accident rate shows a gratifying decrease on that of the previous year both for fatal and serious accidents in all classes of mines.

The total death rate was 1.58 per 1,000 men employed as against 2.30 per 1,000 in 1947, while the serious accident rate was reduced by 10 per 1,000 men employed on the gold mines and by 58 per 1,000 on the coal mines.

ADMINISTRATION.

Regulations under the Mines Regulation Act, 1946, were completed during the year after several lengthy conferences with the Chamber of Mines and Australian Workers' Union representatives. The draft was in the hands of the Crown Law Department at the end of the year.

VENTILATION.

Ventilation on the gold mines has again received increasing attention and the appointment of ventilation officers by a number of the mines has had gratifying results. Inspector Lloyd's Annual Report, which is included in that of the Assistant State Mining Engineer shows that a definite move forward is taking place in this important branch of mining.

GOLD MINING.

Gold mining is passing through a very difficult period. Production of gold for the year dropped 39,000 fine ounces compared with the previous year's production.

Only three mines showed significant increases in output as compared with 1947, North Kalgurli being 12,200 ounces higher, Big Bell 10,700 ounces and Central Norseman 4,700 ounces. Gold Mines of Kalgoorlie and Paringa showed slight advances of 1,300 and 1,100 ounces, respectively. All others were below the previous year's production.

The industry generally is very perturbed about rising costs and lack of manpower, and continuous efforts are being made to solve the problem of its future. Certain assistance is being given by the Commonwealth to several individual big marginal mines but, although this help is very welcome, it does nothing to assist the smaller producers.

It is significant that, although the number of men employed in gold mining for the State showed a reduction during the year, the number of men employed on the East Coolgardie Goldfield actually increased by 58. This would indicate that men prefer to work where the best amenities are provided.

Among mines closed down during the year through apparent exhaustion of ore were Triton, Edna May Amalgamated and Phoenix. Emu Gold Mines at Agnew ceased operations owing to increased costs and lack of development. Blue Spec gold and antimony producer at Nullagine was closed on account of a major plant breakdown.

Prospective producers in Mt. Charlotte and Porphyry are marking time on account of the present unsatisfactory position. They are both low grade mines and it is problematical whether they can be successfully operated unless the price of gold rises or, alternatively, working costs are reduced.

New Coolgardie Mines have been actively developing during the year, and have purchased the Phoenix treatment plant, which was being reconditioned at the end of the year. Production will commence during the current year.

It is felt that the gold mining companies are making the best of a very difficult position and it is firmly hoped that some formula can be evolved which will enable this industry, so important to the State and to Australia, to get once more firmly on its feet.

COAL MINING.

Increasing attention has been given to coal mining and a number of schemes have been put forward with a view to increasing production to meet expanding demands.

Production for 1948 was slightly in excess of that for 1947, which was previously the record. This was largely due to a very much increased production from the Griffin Company's mechanised Wyvern Mine.

The Wallsend Open Cut ceased operations at the end of the year, but its place was immediately taken by the Black Diamond Open Cut which went into production at the same time.

Development on the Proprietary and Co-Operative mines is backward and is causing some concern. The development of No. 10 Section of the Proprietary has been impeded by faults. In order to make more coal available for extraction, permission was given to penetrate the five chain barrier between this section and the Old Proprietary workings, with a view to draining the latter and removing the necessity for a barrier. A borehole was driven into the old workings, but although it has been running for some months there is practically no diminution of pressure, indicating that as much water is entering the workings as is being drawn off.

The installation of the fan for the ventilation of the right hand side of the mine is not yet complete. This fan would make it possible to re-open No. 21 Section in this mine, which was closed down on account of defective ventilation, and make available a number of working places at present idle.

The workings in No. 11 Section are approaching the well developed No. 18 Section which was cut off by the creep in 1940. When this connection is through many more working places will be available on the Proprietary.

The Wyvern Mine is awaiting new mechanised equipment which will considerably increase its output.

Development of this company's new Phoenix Mine was commenced during the year and a very small production maintained. On the installation of the new equipment on the Wyvern, the present equipment from that mine will be transferred to the Phoenix, which will result in appreciable output from the latter mine.

The opening up of a new area in the Stockton Open Cut has made it possible for increased production when a special effort is called for.

The opening up of the Black Diamond Open Cut has been somewhat slow, but reserves, proved and indicated, are considerable and it is anticipated that a high rate of production will be possible from this area.

These two open-cuts will prove valuable in balancing production pending re-organisation of the field and the introduction of further mechanised equipment to step up production of underground workings to the desired proportions.

OTHER MINERALS.

The steady increase in the value of mineral production, other than that of gold and coal, is very pleasing. The value of such production reported during the year was £503,802 exclusive of silver produced as a by-product from gold, and also excluding lead concentrates of an estimated value of £48,000 in transit to market at the close of the year. The total value of production taking these factors into account amounted to approximately £600,000.

The successful commencement of operations for the production of pig iron by the Department of Industrial Development at Wundowie, which produced pig to the value of £26,165 in its first year, is very gratifying.

The same Department also increased the value of its production of potash at the Chandler alunite plant to nearly £50,000.

As anticipated there was a very big increase in the production of lead, including silver lead, the total value of ore and concentrates marketed being approximately £114,000, not including the £48,000 estimated value of concentrate in transit at the end of the year.

The great bulk of this material came from the revitalised old lead mines in the Northampton district, but appreciable quantities also came from the Ashburton Goldfield where, in addition to the re-opening of several old shows previously worked in a small way, a number of prospectors have commenced operations in virgin country.

The Braeside deposits, eastward from Marble Bar, have also received considerable attention and, although no production was reported for the year, the erection of a private concentrating plant in that area indicates some appreciable production during the current year.

The Devonian mine in the Napier Range, East of Derby, continued operations and the sale of picked ore to the value of £14,337 was reported. Unfortunately this ore, amounting to 713 tons, which contained 276 tons of metallic lead and 4,762 ounces of silver, also contained 151 tons of zinc, thus incurring a considerable penalty. This company has located a good water supply at the mine and is installing a plant on the property with the object of producing a high grade lead concentrate and also a zinc concentrate which will be a marketable commodity.

A substantially increased tonnage of lead concentrate is anticipated during the current year.

The production of tin has also been stimulated by the high price offering for the metal and concentrates to the value of approximately £13,000 were produced, principally from the Marble Bar area. There was a little production from Greenbushes, where the year's activities consisted principally of exploration and plant construction. A substantial production from this area should shortly accrue.

Asbestos production was fairly static, the value for the year totalling £40,761, of which the Hamersley Range blue contributed £27,997.

The world shortage of asbestos fibre has created interest and stimulated some activity in investigating the possibilities of North-West chrysotile. It is hoped and anticipated that some appreciable production may result.

Considerable activity has been displayed in the examination of South and South-West coast deposits of black sands, with the production of zircon and ilmenite-rutile concentrates in view. It is interesting to note that the ilmenite in the areas examined to date has been proved to be chrome-free, thus making it suitable for the manufacture of titanium white. It is rather early to pass an opinion on the potentialities of the areas tested, but they may prove to be of some considerable importance.

The production of manganese ore to the value of £10,442 from the Horsehoe deposit at Peak Hill is of some considerable interest and indicates the practicability of successful exploitation of this well known but hitherto neglected deposit.

Production of most other minerals was more or less static with the exception of antimony and arsenic, the production of which has for the time being practically ceased.

An interesting discovery by a prospector during the year was that of a deposit of optical calcite of apparently excellent quality. No Departmental inspection has yet been made but specimens received indicate that the find of this rare and high priced mineral may prove a very valuable one to the discoverer.

The great interest in economic and strategic minerals exhibited in the past few years and the post-war high price of base metals have given this industry a tremendous impetus, as is evinced by the fact that the value of production has risen five-fold in the past decade. The Department has given every encouragement and assistance possible to mineral producers and it is very pleasing to see its efforts meeting with such success.

GENERAL.

All officers of this branch have been very fully occupied during the year and I am very grateful for the co-operation received from them. The somewhat depressing position in which the gold mining industry finds itself has not decreased the work of Departmental technical officers, but has rather had the opposite effect and I may say that the whole of my staff has been working at high pressure and very loyally and efficiently.

I also wish to express appreciation of the whole-hearted co-operation and assistance given by the officers of all other Branches of the Department during the year.

JOHN S. FOXALL,
State Mining Engineer.

ANNUAL REPORT FOR 1948.
STATE MINING ENGINEER.

Mining activities in the State during the year 1948 are described in this report, which is based on information supplied by the Statistician and Inspectors of Mines.

STAFF.

The only change in staff during the year was occasioned by the resignation of Workmen's Inspector Vernon who had reached the retiring age. Workmen's Inspector McCabe was elected to fill the position and commenced duty at Collie on 19th July.

ACCIDENTS.

Fatal and serious accidents in mines and quarries reported to the Department are shown below. Corresponding figures for 1947 are shown in brackets.

There were 12 (19) fatal and 895 (1,070) serious accidents, including 1 (1) fatal and 228 (295) serious in coal mines and quarries.

Of the fatal accidents 10 (16) occurred in gold mines and 2 (1) in quarries.

The total number of serious accidents reported from the gold mines was 656 (775.) The average number of men employed was 7,178 (7,649) and the average accident rate per 1,000 men employed was thus 1.39 (2.09) for fatal and 91.39 (101.38) for serious accidents.

On the coal mines the number of serious accidents was 223 (281) while the average number of men employed was 1,064 (1,032). The average accident rate per 1,000 men employed was thus 206.48 (272.28) for serious accidents. There were no fatal accidents in coal mines.

A classification of the serious accidents showing the nature of the injuries is given in Table "A."

Table "B" shows the fatal accidents, the number of men employed and the death rate per 1,000 men employed for each year since 1929, classified according to employment in gold mines, in coal mines and other mines and quarries. The progressive figures are also given for each year.

FATAL ACCIDENTS.

Following is a brief description of all fatal accidents that were reported during the year :—

Name and Occupation.	Date.	Mine.	Details and Remarks.
		Explosives.	
Smith, Arthur James (Miner)	4–2–48	Big Bell	An explosion occurred while this man was charging a hole in a boulder on a grizzly.
		Falls of Ground.	
Devine, Joseph Patrick (Spaller)	9–2–48	Blue Rock Quarries	A rill of large rocks in the quarry face was being worked down with a bar. One rock weighing about a ton was dislodged. Devine had ample time to get clear but tripped on a stone on the quarry floor and fell in the path of the rock.
Tanner, Ronald Bartle (Miner)	31–5–48	Lake View & Star	This man was the operator of a mechanical shovel in a leading stope. He was found dead beside the machine and had obviously been struck by a heavy fall of ground from the hanging wall.
Grosina, Francesco (Miner)	23–6–48	Loganberry East	Two men working in a timbered stope were throwing talc from a recently fired place to a point near the underlay shaft. A fall occurred and both men were injured. Grosina died before he could be extricated.
Taylor, Leslie Colin (Scaler)	14–9–48	Lake View & Star	This man and his mate were working in a shrink stope from which truckers were pulling ore. Their job was to free any ore that hung up between the walls. A fall of rock from the hanging wall struck this man.
Mitchell, William James (Miner)	7–10–48	North Kalgurli	This man with his mate was endeavouring to bring down some heavy ground in a stope. He passed under the piece of ground to get a heavier bar and it fell just as he was under it.
		Miscellaneous Underground.	
Thurkle, Clifton Delmage (Miner)	25–2–48	Great Boulder	Timber was being hoisted into a stope by a rope running from a winch on the level through a block at the top of a manway. Two boards attached by a sling became caught in the manway and the driver lowered back hoping to clear the obstruction at the next attempt. The sling came loose and one of the boards escaped down the manway striking the winch driver.
Phillips, David John (Mechanic)	12–7–48	Central Norseman	Timber was being lowered in a skip on skids in an inclined winze. It was lashed on but at a flat part of the winze came out of the skip. This man entered the empty skip and was being hauled up the winze when the timber came away and struck him.
Perlotti, Giovanni (Miner)	15–12–48	Great Boulder	A ladder was being lowered into a winze to extend the existing ladderway. This man went down on the ladder to steady it but lost his balance and fell. He was not wearing a safety belt.
		Surface.	
Burton, Frederick Wilson (Foreman)	27–4–48	Roelands Quarry	A timber blasting screen was being shifted with a crane when it collapsed and fell on this man. The accident was due to the poor state of the timber in the screen.
Smith, Robert Stanley (Sawyer)	23–6–48	Lake View & Star	A log rolled forward on to a moving circular saw and was thrown into the air, striking this man.
Collins, Arthur James (Plant Hand)	15–7–48	Lake View & Star	This man's body was found in a cyanide vat. It is thought that he was descending by a ladder from a platform above the vat and, losing his balance, fell into the vat.

TABLE A

SERIOUS ACCIDENTS FOR 1948.

Goldfields.	Major Injuries—Exclusive of Fatal.																						
	Fractures.											Amputations.						Loss of Eye.	Serious Internal.	Hernia.	Dislocations.	Other Major.	Total Major.
	Head.	Shoulder.	Arm.	Hand.	Spine.	Rib.	Pelvis.	Thigh.	Leg.	Ankle.	Foot.	Arm.	Hand.	Finger.	Leg.	Foot.	Toe.						
East Coolgardie	....	1	....	7	....	7	....	1	6	3	8	....	....	5	....	....	....	....	....	6	1	9	54
Yilgarn	....	....	....	....	....	1	....	....	1	2	1	....	....	....	....	....	....	....	....	....	....	2	7
Coolgardie	....	....	....	1	....	....	....	....	1	....	....	....	....	1	....	....	1	....	....	....	....	....	4
Dundas	....	....	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	2	5
Broad Arrow	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Mt. Margaret	....	....	1	2	....	2	....	....	1	....	4	....	....	....	....	....	....	....	....	....	....	1	11
North Coolgardie	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Murchison	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Murchison	1	1	1	1	....	2	....	1	1	....	....	....	....	7	1	....	1	....	....	....	....	1	18
Pilbara	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1
South-West	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	2
Collie	....	2	....	12	....	8	2	....	3	1	3	....	....	2	....	....	....	1	....	4	1	12	51
Kimberley	....	....	....	....	....	....	....	....	1	....	....	....	....	1	....	....	....	....	....	....	1	1	4
Total	1	4	3	24	....	21	2	2	14	6	17	....	....	16	1	....	2	1	1	10	3	30	158

TABLE A.—*continued.*

SERIOUS ACCIDENTS FOR 1948.—*continued.*

Goldfields.	Minor Injuries.												
	Fractures.												
	Finger.	Toe.	Head.	Eyes.	Shoulder.	Arm.	Hand.	Back.	Rib.	Leg.	Foot.	Other Minor.	Total Minor.
East Coolgardie	12	7	7	12	12	14	111	67	9	79	55	20	405
Yilgarn	....	....	....	1	....	1	3	....	....	3	....	....	8
Coolgardie	1	....	1	....	....	....	....	1	....	1	....	....	4
Dundas	2	....	1	5	....	6	15	5	....	9	5	4	52
Broad Arrow	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Margaret	1	....	....	2	1	3	2	4	....	5	2	1	21
North Coolgardie	....	....	....	....	....	....	1	1	....	....	....	....	2
East Murchison	....	....	....	1	....	1	....	1	....	....	1	....	4
Murchison	6	5	3	....	1	6	5	4	....	8	4	8	50
Pilbara....	1	....	....	1	....	....	4	2	....	....	....	1	9
South-West	....	....	....	1	....	....	....	1	....	1	....	....	3
Collie	13	5	6	13	7	10	43	6	....	22	14	33	172
Kimberley	1	1	....	....	....	1	....	....	....	1	2	1	7
Total	37	18	18	36	21	42	184	92	9	129	83	68	737

TABLE B.

FATAL ACCIDENT RATE.

Year	Gold.						Coal.						Other Minerals.					
	Men Employed.		Fatal Accidents.		Death Rate per 1,000.		Men Employed.		Fatal Accidents.		Death Rate per 1,000.		Men Employed.		Fatal Accidents.		Death Rate per 1,000.	
	Current.	Progress.	Current.	Progress.	Current.	Progress.	Current.	Progress.	Current.	Progress.	Current.	Progress.	Current.	Progress.	Current.	Progress.	Current.	Progress.
1929	4,108	4,108	7	7	1·70	1·70	858	858	4	4	4·66	4·66	193	193	....	....	....	....
1930	4,452	8,560	14	21	3·14	2·45	896	1,754	....	4	....	2·28	94	287	....	....	....	....
1931	6,344	14,904	16	37	2·52	2·49	752	2,506	1	5	1·33	2·00	51	338	....	....	....	....
1932	7,983	22,887	16	53	2·00	2·31	604	3,110	....	5	....	1·61	108	446	1	1	9·26	2·24
1933	9,900	32,787	21	74	2·12	2·26	626	3,736	1	6	1·59	1·61	164	610	....	1	....	1·64
1934	12,523	45,310	30	104	2·39	2·29	624	4,360	....	6	....	1·38	158	768	3	4	19·00	5·21
1935	14,708	60,018	28	132	1·90	2·20	689	5,049	2	8	2·90	1·58	160	928	....	4	....	4·31
1936	15,696	75,714	38	170	2·42	2·24	768	5,817	....	8	....	1·37	188	1,116	2	6	10·64	5·38
1937	16,174	91,888	36	206	2·22	2·24	723	6,540	....	8	....	1·22	239	1,355	2	8	8·37	5·90
1938	15,374	107,262	23	229	1·50	2·13	765	7,305	1	9	1·31	1·23	288	1,643	4	12	13·88	7·30
1939	15,216	122,478	38	267	2·49	2·18	752	8,057	1	10	1·33	1·24	231	1,874	....	12	....	6·40
1940	14,593	137,071	25	292	1·71	2·13	713	8,770	3	13	4·21	1·48	193	2,067	....	12	....	5·81
1941	13,106	150,177	25	317	1·91	2·11	781	9,551	2	15	2·56	1·57	134	2,201	....	12	....	5·45
1942	8,123	158,300	18	335	2·21	2·12	822	10,373	2	17	2·43	1·64	155	2,356	....	12	....	5·10
1943	5,079	163,379	12	347	2·36	2·12	838	11,211	1	18	1·19	1·60	310	2,666	2	14	6·45	5·25
1944	4,614	167,993	7	354	1·52	2·11	880	12,091	1	19	1·13	1·57	436	3,102	1	15	2·29	4·83
1945	4,818	172,811	10	364	2·08	2·11	860	12,951	1	20	1·16	1·54	393	3,495	1	16	2·55	4·58
1946	6,961	179,772	10	374	1·44	2·08	955	13,906	1	21	1·05	1·51	708	4,203	....	16	....	3·80
1947	7,649	187,421	16	390	2·09	2·08	1,032	14,938	....	21	....	1·40	574	4,777	3	19	5·22	4·00
1948	7,178	194,599	10	400	1·39	2·06	1,064	16,018	....	21	....	1·33	578	5,355	2	21	3·46	3·92

TABLE C.

Fatal and Serious Accidents Showing the Causes and Districts in which they occurred.

District	Explosives.		Falls of Ground.		In Shafts.		Fumes.		Miscellaneous Underground.		Surface.		Total.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. East Coolgardie	....	2	4	28	....	4	....	1	2	330	2	94	8	459
2. Mt. Margaret	....	....	....	2	....	....	....	....	....	23	....	7	....	32
3. Coolgardie	....	....	....	....	....	1	....	....	....	2	....	5	....	8
4. North Coolgardie....	....	....	....	....	....	....	....	....	....	1	....	1	....	2
5. North-East Coolgardie	....	....	....	....	....	....	....	....	....	....	....	....	....	....
6. Broad Arrow	....	....	....	....	....	1	....	....	....	....	....	....	....	1
7. Dundas	....	....	....	5	....	7	....	....	1	26	....	19	1	57
8. Yilgarn	....	....	....	1	....	....	....	....	....	4	....	10	....	15
9. Murchison	1	1	....	7	....	3	....	....	....	43	....	14	1	68
10. East Murchison	....	....	....	....	....	....	....	....	....	....	....	4	....	4
11. Peak Hill	....	....	....	....	....	....	....	....	....	....	....	....	....	....
12. Yalgoo	....	....	....	....	....	....	....	....	....	....	....	....	....	....
13. Northampton	....	....	....	....	....	....	....	....	....	....	....	....	....	....
14. Greenbushes	....	....	....	....	....	....	....	....	....	....	....	....	....	....
15. South-West	....	....	....	....	....	....	....	....	....	....	2	5	2	5
16. Phillips River	....	....	....	....	....	....	....	....	....	....	....	....	....	....
17. Collie	....	1	....	36	....	....	....	....	....	150	....	36	....	223
18. Pilbara	....	....	....	....	....	....	....	....	....	3	....	7	....	10
19. West Pilbara	....	....	....	....	....	....	....	....	....	....	....	....	....	....
20. Ashburton	....	....	....	....	....	....	....	....	....	....	....	....	....	....
21. Kimberley	....	....	....	....	....	....	....	....	....	....	....	....	....	11
Totals for 1948	1	4	4	79	....	16	....	1	3	582	4	213	12	895
Totals for 1947	3	5	3	97	3	21	....	....	6	745	4	202	19	1,070

WINDING MACHINERY ACCIDENTS.

There were five accidents involving winding machinery, which are briefly described.

Overwinds.

(1) A cage under the control of a driver who was receiving instruction was overwound. The detaching gear operated and no damage was caused.

Cage hung up.

(1) A piece of timber fell down the shaft and wedged the skip in the compartment. Some damage was done to shaft timbers and winding rope.

(2) A cage hung up in the shaft and caused a tangle in the rope. Some damage was done to the rope. The cause of the accident was not discovered.

(3) A descending cage was caught up on a loose skid bolt. Some damage was done to the rope.

Miscellaneous.

(1) The shaft supporting the head sheave on an underlay shaft fractured as a result of fatigue.

PROSECUTIONS.

Five persons were prosecuted under the provisions of the Mines Regulation Act.

A miner was prosecuted for using a machine drill in a development end without the required mechanical ventilation.

The manager of a mine was prosecuted for failure to enforce provisions affecting sanitation.

A miner was prosecuted for firing at a time other than that laid down.

A miner was prosecuted for not using a safety cartridge when firing fuses.

A miner was prosecuted for not giving sufficient warning before firing a charge.

All prosecutions were successful.

Five persons were prosecuted under the provisions of the Coal Mines Regulation Act.

Two miners were prosecuted for not giving sufficient warning before firing a charge.

A wheeler and a deputy were prosecuted for offences arising out of failure to care for a horse that had been injured.

The manager of a mine was prosecuted for failing to provide first aid requirements.

All prosecutions were successful.

EXEMPTIONS.

In accordance with the provisions of Section 34 Subsection (4) of the Mines Regulation Act. 48 permits were issued exempting the holders from the operation of subsection (1b) of the same section.

In 1947 the number of permits issued was 79.

SUNDAY LABOUR.

Permission for Sunday labour was granted under the Mines Regulation Act on four Sundays for a total of 24 man-shifts. Twenty-seven permits were issued under the provisions of the Coal Mines Regulation Act.

ADMINISTRATION.

(Amendments of Acts.)

Inspection of Machinery Act, 1921-1947.

The scales of charges made pursuant to Section 36 and to Regulation 57 have been amended.

The scale of fees in the Seventh Schedule relating to the conduct of examinations has also been amended.

These amendments were gazetted on 29th October, 1948.

Mines Regulation Act, 1946.

A new regulation numbered 32A to provide for the application of aluminium therapy was gazetted on 25th March, 1948.

Regulation 17 was amended to provide for changes in the rate of pay for workmen's inspectors. The notice appeared in the *Government Gazette* of 21st May, 1948.

Mine Workers' Relief Act.

Regulation 12 and Scale 1 of the Second Schedule were amended to provide for changes in the rates of contribution and of benefit. The notice appeared in the *Government Gazette* of 24th December, 1948.

Coal Mines Welfare Act.

This Act to provide amenities for coal miners received assent on 10th January, 1948. Regulations under the Act were gazetted on 8th October, 1948. Inspector Gillespie has been appointed a member of the Board which administers the fund established by the Act.

VENTILATION.

Reports by Inspector Lloyd and Assistant Inspector Haddow are given below.

In reviewing results of inspections carried out in connection with ventilation during the past 12 months I have again to report steady progress, more especially with regard to secondary ventilation.

As a result of the continued efforts by this Department in measuring the volumes being discharged into dead-ends it is very gratifying to report that the use of the venturi blower is gradually being replaced by the installation of electric and air driven fans and also larger diameter air pipes.

The work of the ventilation officers attached to the various mining companies is now beginning to show marked results in more efficient ventilation of development ends; also ventilation of the mines generally and their efforts in this regard are to be commended.

During the year an investigation was carried out in connection with lead fumes in the assay office of one of the local mines and as a result of the determination, measures were taken to improve conditions with a view to minimising the hazard. In addition to ventilation inspections carried out in the East Coolgardie, Dundas, Mt. Margaret and Murchison Goldfields two visits were made to Wittenoom Gorge.

A tour of mining districts in the North-West and East Kimberleys extending over a period of seven weeks and including the White Asbestos Mine at Nunyerri, Blue Asbestos Mine, Wittenoom Gorge, Roebourne, lead shows in the Leopold ranges North of Derby, Halls Creek, iron ore deposit Cockatoo Island, Yampi Sound, lead shows and mines in the Marble Bar district was made in September.

A request was received from the management of Big Bell Mines regarding the carrying out of a ventilation survey with a view to obtaining data for improvement of ventilation, and the survey was made and a report submitted.

EAST COOLGARDIE GOLDFIELD,

Lake View & Star Gold Mine Ltd.

Hannans Star.

This shaft together with the internal shaft at the 1,100 level, continues to act as one of the three main intakes for the mines on the Western leases via connections at the 1,700 and 2,400 levels and consequently satisfactory ventilation conditions throughout the workings have been maintained.

Chaffers.

Owing to flood waters entering the mine in February last the fan situated at the 3,700 level was under water for eight months and consequently no work was carried on below the 2,400 level.

During this period every effort was made to keep adequate ventilation circulating throughout the workings. The fan at the 3,700 level has now been re-installed and with a delivery of some 63,000 c.f.m. conditions have reverted to normal.

Secondary ventilation has been improved by the installation of 12in. and 16in. Meco air-driven fans and further orders have been placed for supply of 8-12in. and 6-16in. fans.

Horseshoe No. 2.

The ventilation of workings in this mine due to the strong downcast has been maintained in a satisfactory manner and should be further improved on completion of the new fan installation at the Ivanhoe South Extended Shaft.

Ivanhoe South Extended—Ventilation Shaft.

It is anticipated that the stripping and re-timbering of this shaft, having a cross sectional area of 14ft. x 11ft. 6in. in the clear, to the 2,000 level will be completed early next year and following installation of the new fan—a No. 12 Richardson L. L. double width, capacity 180,000 c.f.m. powered by a 150 h.p. Auto Synchronous motor—will be put on load about March.

Ivanhoe.

Following completion of the Ivanhoe South Extended ventilation shaft, it is the intention of the company to utilize the Ivanhoe shaft as a downcast with a view to minimising the humidity which has always been a severe handicap in maintaining satisfactory ventilation of the lower levels of this mine owing to the fact that the main intake is provided by the return air from the three mines previously mentioned.

Lake View & Associated.

The ventilation of both mines, although operating under natural conditions and relying mainly on connections with adjoining mines has been maintained in a reasonable manner.

Secondary ventilation is provided by means of 12in. and 16in. air operated Meco fans delivered to ends by 10in. and 15in. Ventube.

Great Boulder.

Lane Shaft.

Providing the main intake for workings in the South end and Edwards shaft, conditions throughout these working places have been maintained in good order.

Edwards Shaft.

Although every effort has been made to downcast this shaft, following removal of the main fan from the 1,930 level to the 2,505, the volumes entering the shaft from the 1,200 level continues to upcast.

It is the intention of the company to instal a transformer with a view to increasing the speed of the fan but owing to delay in delivery of cable the installation has been held up.

Main Shaft.

During the year extreme difficulty has been experienced in the ventilation of workings in the 1,400, 1,600 and 1,750 levels in main lode with resultant high temperatures.

With a view to improving ventilation conditions in this area it is proposed to isolate these workings from the general ventilation set up by installing a 4½ Richardson fan.

In addition to delivery of 12-2½ Richardson fans and 2-4½ Richardson fans, the main fan at the 2650 level has been overhauled and a new rotor and casing installed.

Hamilton Shaft.

As a result of improved drainage in connection with slime filling, temperature conditions have improved and it is anticipated that following the installation of the transformer at Edwards shaft conditions should further improve.

Secondary ventilation throughout the four mines operating has been per medium of 12in. and 15in. air-driven fans but owing to the high cost in operating air-powered. fans it is the intention of the company to change over to electric fans.

In connection with ventilation and dust surveys carried out by the mine ventilation officer purchase of two Velometers and a Microscope were made during the year.

Boulder Perseverance.

Although operating under natural ventilation, conditions throughout the year have been maintained in a satisfactory manner.

The auxiliary ventilation provided mainly by 2½ Richardson fans with 12in and 15in sheet iron pipes was regarded as good.

Kalgoorlie Enterprise.

During the year the main fan at the 2,050 level was removed to the 900 level on the return side of the mine, but owing to the collapse of a sand-filled stope above the 700 level and through which the return air passes, conditions became impaired.

As it is impossible to reach the upcast shaft with a view to stripping except along the 300 level which is not connected to the surface a rise is to be constructed from the 400 level of the South Kalgurli workings.

This will enable the company to strip and retimber to the 500 level preparatory to continuing down to the 700 level through the sand-filled stope.

Should these proposals be found to be impracticable a winze will be sunk from the 500 to the 700 level on completion of which the new No. 5 Richardson will be installed to operate in parallel with the fan at the 900.

GOLD MINES OF KALGOORLIE.

Iron Duke.

The general ventilation, although operating under natural conditions has been satisfactory and the installation of four electric fans on four levels has further improved conditions.

New North Boulder.

The installation of two electric fans on the lower levels has assisted in maintaining satisfactory general ventilation and conditions should further improve when a proposed connection with the Oroya shaft is completed.

Oroya.

During the year a No. 3 Richardson fan was installed on the No. 3 level.

By means of 2-feet diameter pipes installed below the grizzleys at the 2 and 3 levels this fan draws off the resultant smoke and dust from blasting operations on the grizzleys and upcasts via the Waddington shaft thus preventing same from entering the downcast into the lower workings.

For stoping operations two air-driven Meco fans have been installed and orders have been placed for 7 small Richardson fans for use in development ends.

South Kalgurli.

The general ventilation of this mine, although working under natural ventilation conditions has been very satisfactory and ventilation of development ends has been further improved during the year by the installation of 18 Richardson 2 C. L. electric fans.

Throughout the year the management of this mine has forwarded to this department a monthly report on ventilation, temperatures and dust counts as prepared by the company ventilation officer. These reports indicate a keen desire to co-operate for improvement in ventilation conditions and are much appreciated by the officers of this department.

Haimault Shaft.

Following delivery of electric cable it is the intention to dispense with the use of venturis by installing electric fans in all development ends.

PARINGA MINING & EXPLORATION COMPANY.

Paringa & Federal Shafts.

Although general ventilation has been maintained in a reasonable manner the ventilation of development ends leaves much to be desired owing to the continued use of venturi blowers and small diameter pipes.

NORTH KALGURLI (1912) LIMITED.

Kalgurli, North Kalgurli, Union Jack.

As a result of installing larger diameter pipes—9¦in.—the ventilation of dead ends in these mines has been improved.

The stripping of the 400 North Winze from surface to the 256 level has provided the North Kalgurli workings with an upcast shaft delivering 12,000 c.f.m. It is also proposed to strip another winze from the surface with a cross sectional area of 7ft. x 5ft. to the 256 level.

Nine Richardson 2 C. L. fans have been placed on order in connection with secondary ventilation.

Mount Charlotte.

In consequence of the completion of the connection with the old Hannan's shaft at the 300 level the through ventilation has been very satisfactory but owing to the main shaft upcasting, arrangements are in hand to erect a sky shaft on the Hannans with a view to reversing the circuit.

BROKEN HILL PROPRIETARY, HANNAN'S NORTH.

Following the completion of a ventilation survey of this mine it was revealed that the main intake was via the Zone shaft and through old workings to the 10 level, while the main shaft although under the influence of the fans at the 11 and 12 levels remained practically static.

A request was made to remove the fan from the No. 11 to the No. 10 level and following the installation. assisted by attention to badly fitting doors on the upper levels the main shaft commenced to downcast strongly and satisfactory general ventilation conditions have been maintained.

DUNDAS GOLDFIELD.

Central Norseman Gold Mine.

Phoenix Shaft.

Throughout the year ventilation conditions have been maintained in a most exemplary manner and the completion of the North shaft to the No. 22 level with connections to the Northerly workings at this and 16 level horizons have been instrumental in further improving conditions.

As a result of these connections the fan at the All Nations Shaft was completely overhauled and by the installation of a larger motor the output has been increased from 28,000 c.f.m. at 1in. W.G. to 72,000 c.f.m. 3in. W. G.

In addition a number of stopings and regulator doors have been erected with a view to intaking along the lower levels.

With a view to minimising the dust hazard all machine miners are provided with an atomiser and an employee is engaged on a full time basis in the watering down of old stopes, travelling ways and points at which scrapers are in operation.

Princess Royal.

The main workings are still confined to the No. 7 and 9 level.

During the year the general ventilation of the mine was reversed in order to enable the construction of three rises above the No. 7 level. This was found necessary owing to the position of the proposed rises being on the return side of the mine.

Lady Millar.

This small mine, although operating under natural conditions has been satisfactorily ventilated by installation of secondary fans and connections to old workings.

In addition to the systematic sampling of dust in all working places, recording of temperatures and gas sampling by the Government Analyst the company has shown a very keen desire to improve ventilation conditions by purchasing the following instruments in connection therewith:—

1 Thermal precipitator with microscope.
1 Bulk dust sampler.
2 Watson circular konimeters.
3 Almor velometers.
1 Inclined manometer.
1 Vane anemometer.
3 Sling psychrometers.

As a result of the above equipment the dust counts in these mines have been reduced to almost a half on those recorded for last year and has provided means for carrying out investigations into the following:—

1. The production of dust from rock drills employing various precautionary modifications.
2. The collection of mine dust by electro static means.
3. The merits of various types of auxiliary fans.

NORSEMAN GOLD MINES.

Iron King.

Ventilation conditions have been maintained throughout the year in a very satisfactory manner.

The Campbell shaft continues to act as the main downcast to the bottom level—No. 5—where the air splits North and South.

The North shaft is equipped with a No. 6 Richardson multi-vane fan driven by a 17½ h.p. electric motor situated at the collar and is assisted by the installation of a 4½ Richardson C. L. fan in No. 5 level main North drive situated approximately 1,000 feet North of the Campbell shaft which acts as a booster. The South shaft situated near the Southern limits of the workings is also equipped at the collar with a 4 C. L. Richardson fan operated by a 7½ h.p. motor.

The auxiliary ventilation of the No. 5 level North drive 200 feet beyond the North shaft is provided by means of a 2½ Richardson C.L. fan discharging through a venturi 11in. diameter.

MT. MARGARET GOLDFIELD.

Sons of Gwalia.

Following the proposal to instal a booster fan at the No. 17 level considerable stripping was carried out to enlarge the airway connecting the West lode stopes with the South-West branch stopes. Stripping operations have now been completed and following delivery of a 72in. "Arex" variable pitch fan with suitable power cable, it is confidently anticipated that ventilation conditions in all working places below the 26 level will be much improved.

Temperatures in development ends have been kept within reasonable limits by the installation of larger pipes.

In the North end of the main lode stopes the subsidiary airway is being continued and at the South end of the South Gwalia stopes a similar airway is being carried up to serve as a permanent airway when the stopes are beaten out.

MURCHISON GOLDFIELD.

Big Bell.

In November last a comprehensive ventilation survey was completed on this mine and reported upon.

Previously the glory hole provided the main return but owing to collapse of the hanging wall and buffer pillars the glory hole has practically sealed all openings.

In order to provide an adequate return airway the sinking of a new ventilation shaft was commenced in Section 20 and will be put down to the No. 4 level.

A further proposal is to strip the 4½ winze from surface to the No. 4 level which will substantially improve the ventilation by acting as a downcast shaft in addition to the main shaft.

Hill 50 Mt. Magnet.

The general ventilation in this mine was found to be fairly reasonable but could be improved by paying more attention to doors and the installation of a larger fan.

Secondary ventilation of development ends also would be improved by provision of standard venturi blowers and venturi cloths.

A new shaft is being put down on the North end and when completed will improve the ventilation of the mine.

WEST PILBARA GOLDFIELD.

Blue Asbestos Mine, Wittenoom Gorge.

During the year two visits were made to this mine, in January and September, in connection with dust in treatment plant and ventilation underground.

On the second visit air sampling was carried out underground in connection with use of diesel locomotives.

Ventilation conditions underground both main and auxiliary were found to be satisfactory on both visits, but dust control in treatment plant was found to be most unsatisfactory.

An assurance was given by the management that the present plant would be operated only until such time that sufficient data had been obtained which would enable the company to design a new plant.

ACCIDENTS.

Accidents due to fumes as reported to this office during the year were as follows:—

	Serious	Minor.
East Coolgardie	Nil	28
Dundas	Nil	3
Coolgardie	Nil	1
Broad Arrow	Nil	Nil
Yilgarn	Nil	Nil
North-East Coolgardie ..	Nil	Nil
	Nil	32

In all cases these accidents were investigated but invariably the employee did not seek medical advice and returned to work the following day.

CONCLUSION.

During the year both assistant inspectors have completed inspections of mines in country centres in company with myself or the other inspectors and on the local mines have been engaged principally on dust sampling and ventilation surveys, also on investigations relative to fuming accidents.

The number of dust spots counted during the period under review totalled 262. Of this total, 35 spots showed counts of 1,000+p. p.e.c. Excluding from calculation these exceptionally bad places, the average count of the remaining 227 spots was 279 p. p.e.c.

Including these bad spots at 1,000 particles each, brings the average to 375 p. p.e.c.

Analysis of the summary shows that the highest average dust count is found in the column "level." This high average is due mainly to large volumes of dusty air being displaced on to the levels in close proximity to ore passes and a big percentage of the 1,000 + counts is also due to this cause. The passes are run at any time throughout the shift and until they are completely isolated and fitted with filtering devices the times of running should be restricted.

The general average of the dust counts shows no signs of lessening due to various causes. A prime necessity in improving the ventilation conditions is the need for a complete ventilation survey of each mine showing the direction and volumes of air travelling under summer and winter conditions. Until this is done the splitting of the air currents becomes very haphazard. A brattice erected here may effect improvement in this particular place, but cause conditions to deteriorate rapidly elsewhere. The provision of adequate return airways is another factor which is often overlooked in laying out the ventilation circuits.

Fuming cases reported to this office occupied a considerable amount of time and reports on 31 such cases were made in this period. None of these accidents were serious, but if more attention were paid to the ventilation almost all could have been avoided.

Owing to the shortage of galvanised iron and the precarious finances of some of the gold mines, the tubing used for secondary ventilation is in a very bad state, leading to a great loss of efficiency in ventilating "dead ends."

(Sgd.) J. E. LLOYD,
District Inspector of Mines,

DUST SAMPLING.

Summary of Samples taken during 1948.

Month.	Level.		Development.		Stoping.		Number of places showing count of 1,000+.		
	No.	Average Count.	No.	Average Count.	No.	Average Count.	Level.	Development.	Stoping.
January	....	....	....	....	....	....	....	....	....
February	3	397	16	289	15	252	1	....	2
March	2	325	4	316	3	419	2	....	1
April	2	119	12	281	12	198	2	....	1
May	..	....	4	200	5	233	....	....	....
June	9	464	7	261	9	163	5	....	2
July	3	424	12	228	23	289	2	1	1
August	5	329	13	271	13	261	2	1	1
September	1	407	9	304	14	268	2	2	....
October	....	....	2	245	6	163	....	1	....
November	1	540	5	466	17	273	3	....	3
December	....	....	....	....	....	....	....	....	....
Totals	26	289	84	282	117	252	19	5	11

SUMMARY OF DUST SAMPLES 1948.

Month.	Levels.		Development.		Stopes.		Samples showing count of 1,000+.		
	No. of Samples.	Average Count.	No. of Samples.	Average Count.	No. of Samples.	Average Count.	Level.	Develop-ment.	Stopes.
January	5	134	1	255	8	223	....	....	....
February	11	203	21	178	22	187	1	1	....
March	....	....	6	379	8	148	....	....	....
April	....	....	8	171	11	215	....	....	....
May	6	447	14	131	30	178	3	....	2
June	1	550	5	94	2	130	....	....	....
July	....	....	7	204	19	154	....	....	....
August	1	62	13	160	11	200	1	....	....
September	....	....	6	142	15	240	....	....	....
October	1	336	4	196	17	170	....	1	....
November	2	175	16	185	15	210	....	1	....
December	....	....	....	....	....	....	....	....	....
Totals	27	252	101	180	158	190	5	3	2

286 samples. Average dust count 193. 10 samples 1,000+.

GOLD MINING.

The ore produced during the year was 2,447,545 tons and the gold yield was 662, 741 fine ounces. Both tonnage and yield are lower than the corresponding figures of 2,507,306 tons and 701,752 fine ounces for 1947. The average grade of 5.42 dwts. per ton is less than the figure for the previous year which was 5.59 dwts. per ton.

This is a disappointing result, as the comparison of 1947 results with the preceding years indicated that some expansion of the industry might be anticipated in 1948. Among the major mines only six have maintained the output attained in 1947. They are Gold Mines of Kalgoorlie, North Kalgurli, Paringa, Big Bell, Central Norseman and Hill 50. The only mine to effect a significant increase (about 40%) was North Kalgurli. Big Bell with 16% increase and Central Norseman with 10% increase were both close to full scale production.

Most of the larger mines reported a decline in both tonnage and grade as compared with the figures for the previous year.

The number of men employed in the industry is estimated on the basis of monthly averages, at 7,178 as compared with 7,649 for the previous year.

Lack of sufficient manpower appears to be the dominant factor affecting production. Shortage of manpower for underground work has caused a concentration on those stopes where tonnage can be obtained with the least labour and, as a result, the average grade has declined. This view is confirmed by the average production per man. The tonnage treated and gold won per man employed are 340.93 and 92.31, respectively, and both are higher than the corresponding figures of 327.79 and 91.74 for last year.

Table "D" gives the statistics of gold production in the State year by year. The gold output is classified by districts according to the output for the individual mines in Table "E" and Table "F" gives a comparison of production, set out on that basis, for the past five years. There has been a slight increase of production from the smaller mines.

State Batteries treated 40,634 tons for a return of 24,451 fine ounces by amalgamation and cyanidation of tailings yielded 6,440 fine ounces. During the previous year 49,168 tons of ore were treated for 33,147 fine ounces by amalgamation and 7,450 fine ounces was recovered by cyanidation. The quantity of ore treated and the average grade are both lower than in 1947.

TABLE D.

Gold Production Statistics.

Year.	Tons Treated. (2,240 lb.)	Total Gold Yield.	Estimated Value of Yield.	Value of Yield per ton.	Number of Men Employed.	Average Value of Gold per oz.	Average Yield per ton of ore.
	tons.	fine oz.	£A.	shillings A.		shillings A.	dwt.
1929 ...	628,400	372,064	1,580,426	50·30	4,108	84·96	11·84
1930 ...	645,344	419,767	1,874,484	58·09	4,284	89·33	13·01
1931 ...	982,163	518,045	3,042,019	61·94	5,961	117·44	10·55
1932 ...	1,327,021	599,421	4,358,989	65·70	8,695	145·44	9·03
1933 ...	1,588,979	636,928	4,884,112	61·48	9,900	153·36	8·01
1934 ...	1,772,931	639,871	5,461,004	61·60	12,523	170·69	7·22
1935 ...	1,909,832	646,150	5,676,679	59·45	14,708	175·71	6·77
1936 ...	2,492,034	852,422	7,427,687	59·61	15,698	174·27	6·84
1937 ...	3,039,608	1,007,289	8,797,662	57·99	16,174	174·68	6·64
1938 ...	3,759,720	1,172,950	10,409,928	53·38	15,374	177·50	6·24
1939 ...	4,095,257	1,188,286	11,594,221	56·62	15,216	195·14	5·80
1940 ...	4,291,709	1,154,843	12,306,816	57·35	14,594	213·15	5·38
1941 ...	4,210,774	1,105,477	11,811,989	56·10	13,105	213·70	5·25
1942 ...	3,225,704	845,772	8,840,642	54·81	8,123	209·04	5·24
1943 ...	2,051,011	531,747	5,556,756	54·185	5,079	209·00	5·185
1944 ...	1,777,128	472,588	4,966,451	55·89	4,614	210·18	5·32
1945 ...	1,736,952	469,906	5,025,039	57·86	4,818	213·87	5·41
1946 ...	2,194,477	618,607	6,657,762	60·70	6,961	215·25	5·64
1947 ...	2,507,306	701,752	7,552,611	60·25	7,649	215·25	5·59
1948	2,447,545	662,714	7,132,748	58.28	7,178	215.25	5.42

TABLE E.

Classification of Gold Output for 1948 by Goldfields and Districts.

Goldfield or District.	Unclassified, Sundry Claims, Alluvial, etc. (fine ozs.)	Under 100 ozs.		100–500 ozs.		500–1,000 ozs.		1,000–2,000 ozs.		2,000–3,000 ozs.		3,000–4,000 ozs.		4,000–5,000 ozs.	
		No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).
Kimberley Goldfield	496	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ashburton Goldfield	1	1	42	....	....	....	....	....	....	....	....	....	....	....	....
Pilbara Goldfield—															
Marble Bar	108	8	185	4	920	....	....	....	....	1	2,635	....	....	....	....
Nullagine	202	9	363	3	417	1	524	....	....	....	....	1	3,174	....	....
Peak Hill Goldfield	33	8	150	4	777	....	....	....	....	....	....	....	....	....	....
East Murchison Goldfield—															
Lawlers	265	3	64	2	351	1	579	....	....	....	....	....	....	....	....
Wiluna	185	6	184	4	859	1	808	....	....	....	....	....	....	....	....
Black Range	55	2	98	3	1,110	....	....	1	1,533	....	....	....	....	....	....
Murchison Goldfield—															
Cue	861	6	101	1	117	1	502	1	1,077	....	....	....	....	....	....
Meekatharra	360	10	276	10	2,329	2	1,373	....	....	....	....	....	....	....	....
Day Dawn	208	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Magnet	326	13	480	5	1,093	....	....	....	....	....	....	....	....	....	....
Yalgoo Goldfield	187	3	80	3	554	1	743	....	....	....	....	....	....	....	....
Mt. Margaret Goldfield—															
Mt. Morgans	150	2	20	1	367	1	552	2	2,650	....	....	....	....	....	....
Mt. Malcolm	219	4	58	5	913	....	....	....	....	....	....	....	....	....	....
Mt. Margaret	242	8	332	3	1,009	2	1,249	1	1,040	....	....	....	....	....	....
North Coolgardie Goldfield—															
Menzies	623	9	288	2	590	1	668	....	....	....	....	....	....	....	....
Ularring	104	3	127	6	1,166	1	501	....	....	....	....	....	....	....	....
Niagara	152	1	32	3	614	....	....	....	....	....	....	....	....	....	....
Yerilla	181	4	138	1	217	1	716	....	....	....	....	....	....	....	....
Broad Arrow Goldfield	712	16	546	10	1,779	1	649	....	....	....	....	....	....	....	....
North-East Coolgardie Goldfield—															
Kanowna	98	5	160	1	117	1	533	....	....	....	....	....	....	....	....
Kurnalpi	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Coolgardie Goldfield—															
East Coolgardie	10,849	20	631	9	1,576	2	1,028	1	1,417	....	....	....	....	....	....
Bulong	30	3	112	....	....	....	....	....	....	....	....	....	....	....	....
Coolgardie Goldfield—															
Coolgardie	802	24	851	4	1,037	1	910	....	....	....	....	....	....	1	4,225
Kunanalling	602	4	121	2	425	....	....	....	....	....	....	....	....	....	....
Yilgarn Goldfield	845	29	1,016	8	1,830	....	....	2	3,583	2	4,803	....	....	....	....
Dundas Goldfield	245	3	34	2	645	....	....	....	....	....	....	....	....	....	....
Phillips River Goldfield	....	2	14	....	....	....	....	....	....	....	....	....	....	....	....
State Generally	113	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	19,254	206	6,503	96	20,812	18	11,335	7	11,300	3	7,438	1	3,174	1	4,225

Goldfield or District.	5,000–10,000 ozs.		10,000–20,000 ozs.		20,000–30,000 ozs.		30,000–40,000 ozs.		40,000–50,000 ozs.		50,000–100,000 ozs.		Over 100,000 ozs.	
	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).	No. of Producers.	Gold (fine ozs.).
Kimberley Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ashburton Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pilbara Goldfield—														
Marble Bar	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Nullagine	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Peak Hill Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Murchison Goldfield—														
Lawlers	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Wiluna	....	....	1	11,819	....	....	....	....	....	....	....	....	....	....
Black Range	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Murchison Goldfield—														
Cue	....	....	1	15,652	....	....	....	....	....	....	1	51,770	....	....
Meekatharra	....	....	....	....	....	....	1	3,340	....	....	....	....	....	....
Day Dawn	1	5,798	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Magnet	....	....	1	13,417	....	....	....	....	....	....	....	....	....	....
Yalgoo Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Margaret Goldfield—														
Mt. Morgans	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Malcolm	....	....	1	18,139	....	....	....	....	....	....	....	....	....	....
Mt. Margaret	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North Coolgardie Goldfield—														
Menzies	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ularring	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Niagara	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yerilla	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Broad Arrow Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North-East Coolgardie Goldfield—														
Kanowna	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Kurnalpi	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Coolgardie Goldfield—														
East Coolgardie	....	....	3	48,607	1	22,508	1	32,324	1	40,412	2	138,261	1	137,502
Bulong	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Coolgardie Goldfield—														
Coolgardie	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Kunanalling	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yilgarn Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Dundas Goldfield	....	....	....	....	....	....	1	39,150	....	....	....	....	....	....
Phillips River Goldfield	....	....	....	....	....	....	....	....	....	....	....	....	....	....
State Generally	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	1	5,798	7	107,634	1	22,508	3	74,814	1	40,412	3	190,031	1	137,502

TABLE F.

Classification of Gold Output, 1944-1948.

Range of Output.	1948.			1947.			1946.			1945.			1944.		
	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.	No. of Producers.	Production.	Percentage of Total.
Fine ozs.		Fine ozs.			Fine ozs.			Fine ozs.			Fine ozs.			Fine ozs.	
Over 100,000	1	137,502	20.7	1	141,436	20.1	1	119,992	19.4	....	....	....	....	....	....
50,000 to 100,000	3	190,031	28.8	1	94,051	13.4	1	87,343	14.1	2	159,901	34.1	2	155,870	33.0
40,000 to 50,000	1	40,412	6.1	2	86,657	12.2	....	....	....	....	....	....	....	....	....
30,000 to 40,000	3	74,814	11.3	3	107,047	15.3	3	110,878	18.0	2	66,080	14.0	1	39,030	8.3
20,000 to 30,000	1	22,508	3.4	2	46,415	6.6	5	123,100	19.9	5	115,034	24.5	5	123,141	26.0
10,000 to 20,000	7	107,634	16.2	7	103,154	14.7	5	73,179	11.9	2	30,389	6.5	4	56,193	12.0
5,000 to 10,000	1	5,798	0.9	4	24,826	3.5	5	36,670	5.9	8	57,364	12.2	5	43,313	9.1
4,000 to 5,000	1	4,225	0.6	1	4,645	0.7	2	9,946	1.5	....	....	....	3	13,125	2·8
3,000 to 4,000	1	3,174	0.5	2	7,448	1·1	....	....	....	1	3,779	0.8	....	....	....
2,000 to 3,000	3	7,438	1.1	2	4,359	0.6	2	5,234	0.8	1	2,739	0.6	2	4,990	1.0
1,000 to 2,000	7	11,300	1.7	6	8,754	1.2	7	7,929	1.3	4	5,331	1.1	3	4,435	0.9
500 to 1,000	18	11,335	1.7	11	8,428	1.2	13	8,847	1.4	8	5,736	1.2	11	7,614	1.6
100 to 500	96	20,812	3.1	75	16,510	2.4	83	18,528	3.0	57	12,771	2.7	72	15,598	3.3
Under 100	206	6,503	1.0	259	7,805	1.1	272	8,022	1.3	175	5,545	1.2	155	4,753	1.0
Sundry Claims, etc.	....	19,254	2.9	....	41,217	5.9	....	9,391	1.5	....	5,238	1.1	....	4,696	1.0
Total	349	662,740	100.0	376	701,752	100.0	399	618,607	100.0	214	469,907	100.0	263	472,588	100.0

TABLE G.

Mines Producing 5,000 ounces and Upwards for the Past Five Years.

Mine.	1948.			1947.			1946.			1945.			1944.		
	Tons treated.	Ounces Gold.	Dwts. per ton.	Tons treated.	Ounces Gold.	Dwts. per Ton.	Tons Treated.	Ounces Gold.	Dwts. per Ton.	Tons Treated.	Ounces Gold.	Dwts. per Ton.	Tons Treated.	Ounces Gold.	Dwts. per Ton.
1. Big Bell Mines, Ltd.	424,584	51,770	2·44	357,623	41,048	2·30	153,588	19,633	2·55	....	....	....	....	....	....
2. Boulder Perseverance, Ltd.	135,832	32,324	4·76	137,456	33,498	4·88	101,144	29,106	5·75	85,806	23,666	5·52	75,987	20,389	5·37
3. Central Norseman Gold Corporation, N.L.	118,763	39,150	6·59	107,750	34,411	6·39	105,640	35,959	6·95	73,488	24,669	6·71	71,521	29,675	8·30
4. Comet Gold Mines, Ltd.	2,471	2,635	21·33	2,768	3,744	27·05	12,075	7,698	12·75	10,515	6,370	12·12	12,968	13,125	20·02
5. Edna May Amalgamated Gold Mines, N.L.	3,247	2,714	16·71	17,498	6,774	7·74	11,464	4,613	8·05	10,861	3,779	6·96	12,409	4,271	6·88
6. Gold Mines of Kalgoorlie	161,516	40,412	5·00	158,337	39,138	4·94	151,871	36,758	4·84	109,334	25,357	4·64	98,554	22,969	4·66
7. Great Boulder Pty., Gold Mines, Ltd.	326,685	81,457	4·99	367,293	94,051	5·15	343,506	87,343	5·09	276,778	71,560	5·17	248,313	64,878	5·22
8. Hannans North (Broken Hill Pty., Ltd.)	42,963	12,878	6·00	44,307	13,893	6·27	36,504	13,047	7·15	....	....	....	....	....	....
9. Hill 50 Gold Mine, N.L.	50,771	13,417	5·28	50,659	13,673	5·39	44,842	12,819	5·72	31,108	8,430	5·42	32,082	9,571	5·98
10. Kalgoorlie Enterprise, Ltd.	53,884	16,692	6·20	57,277	17,807	6·22	51,112	16,530	6·46	40,889	11,861	5·80	37,349	9,490	5·08
11. Lake View and Star, Ltd.	502,534	131,387	5·23	518,431	141,436	5·46	453,317	119,992	5·29	279,579	75,602	5·41	278,171	76,502	5·50
12. Mountain View	1,395	5,798	83·12	1,922	12,795	133·14	1,423	4,883	68·63	1,495	7,745	103·62	....	....	....
13. North Kalgurli (1912), Ltd.	211,784	56,804	5·36	151,710	44,608	5·87	123,550	38,160	6·18	107,737	31,064	5·77	91,444	27,443	6·00
14. Paringa Mining and Exploration, Ltd.	100,642	22,508	4·47	99,702	21,429	4·39	99,568	22,529	4·52	81,378	20,550	5·05	....	....	....
15. Phoenix Gold Mines, Ltd.	12,865	4,225	6·57	28,085	6,785	4·83	29,520	7,586	5·14	29,431	8,263	5·61	28,507	8,061	5·66
16. South Kalgurli Consolidated, Ltd.	77,395	19,037	4·93	79,173	19,503	4·93	75,915	18,571	4·89	63,253	18,528	5·85	56,685	15,603	5·51
17. State Batteries	40,634	24,451	12·03	49,168	33,147	13·48	45,477	23,671	10·41	20,078	18,113	18·04	18,262	15,595	17·08
18. The Sons of Gwalia	60,093	18,139	6·03	81,510	24,986	6·13	87,683	27,056	6·17	67,871	20,792	6·13	72,653	22,657	6·24
Total	2,328,058	575,798	4·95	2,310,669	602,726	5·22	1,928,199	525,954	5·46	1,289,601	376,349	5·84	1,134,905	340,229	6·00
Other Sources (excluding large retreatment plants)	119,487	52,588	8·80	196,637	63,336	6·44	266,278	66,823	5·02	446,991	72,740	3·25	642,223	108,688	3·38
Total (excluding large retreatment plants)	2,447,545	628,386	5·13	2,507,306	666,062	5·31	2,194,477	592,777	5·40	1,736,592	449,089	5·17	1,777,128	448,917	5·05
Golden Horseshoe Sands Retreatment	....	9,982	....	....	10,648	....	....	8,810	....	....	8,079	....	....	9,183	....
Lake View and Star Retreatment	....	6,113	....	....	7,330	....	....	12,212	....	....	12,738	....	....	14,488	....
Wiluna Gold Mines Retreatment	....	11,820	....	....	10,262	....	....	....	....	....	....	....	....	....	....
State Batteries Tailings Treatment	....	6,440	....	....	7,450	....	....	4,808	....	....	....	....	....	....	....
GRAND TOTAL	2,447,545	662,741	5·42	2,507,306	701,752	5·60	2,194,477	618,607	5·64	1,736,592	469,906	5·41	1,777,128	472,588	5·32

TABLE H.

Development Footages Reported by the Principal Mines.

Goldfield.	Mine.	Shaft Sinking.	Driving.	Cross-cutting.	Rising and Winzing.	Diamond Drilling.	Total.
		Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
Peak Hill	Anglo-Westralian Mining Pty., Ltd.	70	563	418	....	607	1,658
East Murchison	Beth-Heno	....	60	10	....	....	70
	Essex Gold Mine	....	77	98	51	....	226
	Mount Harris Gold Mine	30	80	....	100	....	210
	Venaurum Gold Mine	....	....	....	....	300	300
Murchison	Big Bell Mines, Ltd.	51	2,916	1,907	2,121	1,153	8,148
	Hill 50 Gold Mines, N.L.	161	1,012	1,031	956	1,996	5,156
	Mountain View	145	261	....	99	....	505
	Triton Gold Mine, N.L.	....	109	77	44	....	230
Mount Margaret	Boomerang Gold Mine	....	....	....	15	....	15
	Brothers Gold Mine	50	15	20	....	....	85
	Democrat Gold Mine	....	200	....	70	....	270
	Dragon Gold Mine	25	160	50	110	....	345
	Happy Find Gold Mine	60	150	35	180	....	425
	Lancefield Gold Mine	175	140	....	....	....	315
	Morgood Gold Mine	60	50	....	....	....	110
	North Democrat Gold Mine	....	50	50	15	....	115
	Second Fortune Gold Mine	75	....	50	....	....	125
	Sons of Gwalia, Ltd.	248	327	634	229	631	2,069
	Tempus Gold Mine	150	....	....	....	....	150
North Coolgardie	First Hit Gold Mine (Morley's Find)	25	30	15	....	....	70
	Mabel Gertrude Gold Mine	65	20	5	....	....	90
	Paramount Gold Mine	110	50	....	80	....	240
	Rabbit Gold Mine	80	38	12	....	....	130
	Timoni Gold Mine	268	582	204	388	....	1,442
East Coolgardie	Boulder Perseverence, Ltd.	....	3,159	....	1,979	8,062	13,200
	Caledonian Gold Mine	15	193	60	45	....	313
	Gold Mines of Kalgoorlie, Ltd.	....	4,040	2,014	1,424	14,296	21,774
	Great Boulder Pty. Gold Mines, Ltd.	58	5,875	1,821	3,129	20,546	31,429
	Hannans North	....	951	447	213	2,444	4,055
	Haoma Gold Mine	170	306	164	78	347	1,065
	Kalgoorlie Enterprise Mines, Ltd.	83	2,079	232	782	7,347	10,523
	Lake View & Star, Ltd.	....	12,303	2,853	7,269	7,512	29,937
	North Kalgurli (1912), Ltd.	....	5,541	1,565	2,302	8,939	18,347
	Paringa Mining & Exploration Co., Ltd.	240	2,923	1,407	832	7,729	13,133
	South Kalgurli Consolidated, Ltd.	108	2,524	764	826	4,679	8,901
	Wiluna Gold Mines, Ltd. (Mount Charlotte)	189	1,152	595	310	..	2,246
Coolgardie	Barbara & Surprise (New Coolgardie G.M., N.L.)	313	616	302	192	3,017	4,440
	Burbanks (New Coolgardie Gold Mines, N.L.)	....	....	....	....	3,409	3,409
	Fair Play Gold Mine	185	....	40	....	....	225
Yilgarn	Clamps Central	40	60	....	40	....	140
	Copperhead Mine	....	566	497	109	3,751	4,923
	Pilot Mine	....	....	....	....	892	892
	Radio Deeps Mine	....	....	....	....	2,598	2,598
	Sunshine Reward Amalgamated	15	193	60	45	....	313
	Three Boys Mine	....	152	41	26	....	219
Dundas	Central Norseman Gold Corporation, N.L.	1,128	2,719	842	1,000	10,811	16,500
	Norseman Gold Mines, N.L. (Iron King)	....	1,028	90	383	1,440	1,941
	Totals	4,392	53,272	18,410	24,442	112,506	213,022

The number of mines producing 5,000 ounces and over for the year was 15, which is five less than last year. Edna May Amalgamated, Emu Gold Mines, Evanston Gold Mines, and Phoenix Gold Mines have all closed because of the exhaustion of their ore bodies.

Table "G" shows the output of the principal mines of the State, and Table "H" gives the development figures.

Among the smaller mines the most successful were:—

	Tons.	Ounces.
Apples	138	1,533
Blue Spec	4,483	3,174
Burbidge	23,115	2,089
Carnation	811	743
Comet	2,471	2,635
Daisy	800	501
Edwards Reward	4,598	1,814
Haoma	730	527
Happy Find	207	1,034
Lady Betty	71	533
Lady Mary	396	513
Lancefield	2,265	732
Local Lady	769	1,408
New Mexico	173	650
Prohibition	2,150	818
Radio	1,635	1,769
Rand No. 3	2,156	1,077
Two Chinamen	307	501

OPERATIONS OF THE PRINCIPAL MINES.

East Coolgardie Goldfield.

The total ore treated in this district during 1948 was 1,622,259 tons and the yield 435,257 fine ounces, which is an average return of 5.37 dwts. per ton. In the previous year 1,622,141 tons were treated for a return of 449,816 fine ounces, which is an average yield of 5.35 dwts. per ton.

The number of men employed was 3,678 as against 3,620 in the previous year

About 66 per cent. of the State's production was derived from this Goldfield, the proportion being slightly greater than for last year.

EAST COOLGARDIE DISTRICT.

Lake View & Star with a production of 502,534 tons of ore yielding 131,387 fine ounces, or an average return of 5.23 dwts. per ton maintained its position as the premier mine of the State. The tonnage is almost equal to that treated in the previous year but the yield has been less with a resultant decline in grade of 0.23 dwts. per ton.

The western group contributed 60 per cent. of the ore milled and 40 per cent. was obtained from the Lake View and Associated mines. Owing to shortage of labour work was concentrated on shrinkage stopes which yielded 70 per cent. of the total ore.

Development footage was greater than for last year and the principal work was done on the minor lodes of the western system. Work was confined mainly to the extension of known lode systems and there has been a substantial addition to the proved ore reserves, which now stand at a little over 1¼ million tons averaging 5.04 dwts.

High grade ore over a width of 24 feet was exposed in No. 1 West Branch of No. 3 Lode.

The internal shaft on the Chaffers mine has been sunk a further 641 feet and the workings have now reached a depth of 4,168 feet.

Great Boulder which treated 326,685 tons for a return of 81,457 fine ounces, at an average of 4.99 dwts. per ton, is the second largest producer. Comparison with the figures for the previous year of 367,293 tons for 94,051 fine ounces at an average of 5.15 dwts. per ton, shows a decline in tonnage yield and grade.

Normal development and stoping have continued in all parts of the mine. A new store building has been constructed and an engineering work shop is in course of construction.

North Kalgurli treated 211,784 tons for a recovery of 56,804 fine ounces at an average grade of 5.36 dwts. per ton, and achieved third place in the list of gold producers. The corresponding figures for 1947 were 151,710 tons for 44,608 fine ounces, the average grade being 5.87 dwts. per ton. Comparison shows a significant increase in both tonnage and gold yield. The average grade has declined by half a pennyweight.

Routine development and general mining were carried out from North Kalgurli and Kalgurli shafts. The Union Jack shaft was closed toward the end of the year. A new steel head frame has been completed at the Croesus Proprietary shaft but the mine has not been placed in operation.

Gold Mines of Kalgoorlie with 161,516 tons treated for a yield of 40,412 fine ounces at an average of 5.00 dwts. per ton also improved on the figures for the previous year, which were 158,337 tons for 39,138 fine ounces at an average of 4.94 dwts. per ton.

Operations were continued from Iron Duke, New North Boulder and Oroya South shafts and some ore was won from the Australia East open cut.

Normal development produced satisfactory results with high grade ore in the No. 324 Lode in the upper levels of the Iron Duke shaft.

A new head frame and electric winder have been installed at the Iron Duke shaft.

A 420 Kilowatt alternator has been added to the power plant and the capacity of the mill has been raised from 12,000 to 12,200 tons per four-weekly period.

Boulder Perseverance treated 135,832 tons of ore for a yield of 32,324 ounces at an average of 4.76 dwts. per ton, which is almost the same as the corresponding figures of 137,456 tons for 33,498 ounces at an average of 4.88 dwts. per ton for 1947.

Stoping and development were carried out on all levels from 200 feet to 2,200 feet with notable developments on the East Branch of the Lake View Lode at the 300-foot level and on the Furness Lode, at the 1,100 level.

Paringa milled 100,642 tons which is slightly greater than the figure of 99,702 tons for the previous year. The yield of 22,508 ounces is also greater than for the previous year when 21,429 ounces were recovered. The grade has improved from 4.39 to 4.47 dwts. per ton.

The Paringa North shaft has been connected to the South shaft on the 800 level and the Federal shaft has been sunk a further 148 feet to 686 feet.

Development and stoping were carried on as usual for satisfactory results.

The mine has operated at a loss which has been recouped under the Commonwealth Assistance Scheme.

Kalgoorlie Enterprise declined slightly in tonnage yield and grade, the figures for the current year being 53,884 tons for 16,692 ounces at an average of 6.20 dwts. per ton; and for the previous year being 57,277 tons for 17,807 fine ounces at an average of 6.22 dwts. per ton.

The Victoria shaft was sunk a further 83 feet to 2,477 feet and the plat cut for the 23 level.

Stoping and development work was carried out on all levels from 11 to 23.

This mine operated under the Commonwealth Assistance Scheme.

Hannans North mined and treated 42,963 tons for a return of 12,878 fine ounces, which is an average of 6.00 dwts. per ton. The figures for 1947 were 44,307 tons for 13,893 ounces at an average of 6.27 dwts. per ton. A decline in both tonnage and grade is shown.

South Kalgurli is also receiving Commonwealth subsidy. Its production figures of 77,935 tons for 19,037 fine ounces, at an average of 4.93 dwts per ton are substantially as for the previous year when 79,173 tons were treated for a return of 19,503 ounces at an average of 4.93 dwts. per ton.

The main shaft was sunk to 2,287 feet and a plat cut and level developed at 2,180 feet. Principal developments were on the 2,050 level where values generally were low, and on the 427-foot level where good values and widths were disclosed on the No. 2 East Lode and the Hainault Cross Lode.

Mount Charlotte has been developed by the connection of the main shaft and the old Mount Charlotte shaft on the 300 level. Cross-cuts have been driven to the limits of the ore and widths of 50 feet to 60 feet averaging 4.25 dwts. per ton have been reported. Development is proceeding at the 500-foot level. A change house, tool sharpening shop and general store have been built and a power house is in course of erection.

Except for shortage of labour a much greater output might have been obtained. Some output was also lost as the result of flooding caused by extremely heavy rain in the month of February. Production has been maintained at the same level as for last year by drawing on readily accessible ore and in most cases this has occasioned some reduction in the grade. The introduction of mechanical methods of ore handling has also helped to increase output. North Kalgurli is to be congratulated on its excellent effort in a field where production, generally, has declined.

In the *Mount Monger* district the *Haoma* and the *Daisy* both obtained over 500 ounces from ore of about 15 dwt. grade. A considerable tonnage of ore has been developed on the Haoma.

Bulong District.—The total ore crushed in this district was 840 tons which returned 142 fine ounces.

MURCHISON GOLDFIELD.

A considerable increase in the quantity of ore milled has been reported on this goldfield. In spite of a slight reduction in the average grade the gold yield is also higher than for the previous year. The figures for the current year are 534,816 tons of ore treated for a yield of 99,081 ounces, the average grade being 3.71 dwts. per ton, while in the previous year 478,862 tons of ore yielding 93,378 fine ounces was produced for an average return of 3.86 dwts. per ton.

The gold produced amounts to 15 per cent. of the State's total yield and this field has maintained its position as the second producer in the State.

The number of men employed was 967 as against 1,098 in the previous year.

Cue District provided 471,296 tons of ore which yielded 70,080 fine ounces, the average grade being 2.98 dwts. per ton. The corresponding output for the previous year was 416,843 tons and the yield 58,149 ounces, which is an average grade of 2.78 dwts. per ton.

The principal output from this district, and indeed from the Murchison field, was derived from Big Bell and Triton mines.

Big Bell mined and treated 424,584 tons for a return of 51,770 ounces, the average grade being 2.44 dwts. Both tonnage and grade show a substantial increase over the figures for the previous year, which were 357,623 tons for 41,048 ounces at an average of 2.30 dwts. per ton.

The main shaft was sunk a further 51 feet to 1,054 feet. It is intended to continue to approximately 1,250 feet.

A fifth diesel electric unit was added to the power house.

The treatment plant was operated at full capacity during at latter part of the year.

This mine is one of those which benefits under the Commonwealth Assistance Scheme.

Triton Gold Mines was able to bring production up to about 5,000 tons per month and for the year treated 42,378 tons for a return of 15,652 ounces, which is an average of 7.38 dwts. per ton. The figures for the previous year are 55,961 tons treated for 14,382 ounces at an average of 5.14 dwts. per ton.

The rise in grade reflects the increased costs due to shortages of labour and supplies and increases in rates of wages and commodity prices. Supplies of ore had almost been exhausted when a major breakdown occurred in the power plant and the mine was closed down.

In the *Meekatharra District* the ore treated amounted to 9,234 tons and the gold returned was 7,678 ounces, which is an average of 16.63 dwts. per ton. *Meekatharra Sands Retreatment* recovered 3,340 ounces from the retreatment of residues and the remainder came from several small mines of which the most important was *New Brew* with 206 ounces from the treatment of 153 tons averaging 26.92 dwts. per ton.

Day Dawn District treated 1,611 tons for the spectacular return of 6,006 ounces at an average of 74.56 dwts. per ton. Practically the whole output came from the Mountain View which sent 1,395 tons of ore averaging 83.12 dwts. per ton to the Cue State Battery. The return of gold was 5,798 ounces. The corresponding figures for the previous year were 1,922 tons treated for a return of 12,795 ounces at an average of 133.14 dwts. per ton.

A new engine has been installed at the mine. The added power will permit the unwatering of the number 7 level of the old Fingall mine.

Mount Magnet District with 15,316 ounces from 52,675 tons of ore averaging 5.81 dwts. per ton practically duplicated the previous year's figures of 52,275 tons for 15,410 ounces at an average of 5.81 dwts. per ton.

The principal producer was *Hill* 50 with 50,771 tons averaging 5.28 dwts. per ton for a return of 13,417 ounces. The tonnage was practically as for the previous year but grade was down slightly. The figures for the previous year were 50,659 tons of ore at 5.39 dwts. per ton for 13,673 ounces.

A new main shaft of three compartments, which is intended to connect with existing workings at the 600 level was started in May and is still in progress at about 160 feet.

DUNDAS GOLDFIELD.

Dundas Goldfield is third in order of production. The production this year was 120,849 tons, which yielded 40,074 ounces of gold at an average of 6.63 dwts. per ton. The figures for the previous year were 117,633 tons of ore averaging 6.40 dwts. per ton for a return of 37,648 ounces. The increase in gold won is due partly to some increase in tonnage treated, but mainly to an increase in the grade of ore treated.

The number of men employed was 466.

Central Norseman is the only large mine in the gold field. During the year it produced 118,763 tons of ore which yielded 39,150 ounces at an average of 6.59 dwts. per ton. The figures for the previous year were 107,750 tons for 34.411 ounces at an average of 6.39 dwts. per ton. The bullion from the mine contains a considerable amount of silver and the silver yield for the year was 29,925 ounces.

In addition to a successful year of ore production this mine has carried out important developments. Driving on the 25 level in the *Phoenix Mine* has developed an excellent shoot of ore of 9 dwts. grade over a width of 5 feet.

The new shaft was deepened from 800 feet to 1,308 feet, where it connected with the pilot rise from the 16 level. The rise was then stripped advancing the shaft to 1,787 feet below the surface. Mullock was passed down to the 22 level and hoisted through the Phoenix Shaft.

At the *Princess Royal Mine* the drive at the 7 level was in ore of average grade. The high grade ore indicated by the diamond drill at 505-feet horizon was not encountered.

The 9 level has been tested by a winze and by diamond drilling.

One stope above the 7 level was worked throughout the year, the ore produced being 6,996 tons.

The *Lady Miller* mine was developed at No. 2 and No. 5 levels, but no major ore bodies were disclosed. Ore won amounted to 6,650 tons.

MOUNT MARGARET GOLDFIELD.

In this goldfield the ore treated was 68,049 tons and the average grade 7.92 dwts. per ton, the yield being 26,940 ounces. During the previous year the ore treated was 90,814 tons which yielded 34,442 ounces at an average of 7.59 dwts. per ton. In spite of the decline in tonnage and grade and the consequent reduction in the gold output, this goldfield retains its position as fourth on the list.

The number of men employed was 464 as against 494 in the previous year.

Mount Morgans District with a production of 2,247 tons yielding 3,739 ounces at an average of 33.2 dwts. per ton as compared with 2,734 tons for 1,396 fine ounces in the previous year, has done very well. Several small mines produced high grade ore and there were fair returns of prospectors' gold and gold from tailings treatment. The Linden area where the *Democrat* leases and *Local Lady* are situated, was the main centre of production.

Mount Malcolm District produced 62,072 tons yielding 19,329 ounces at an average of 6.23 dwts. per ton. Comparison with the figures for the previous year of 83,006 tons of ore for a return of 26,204 ounces at an average of 6.33 dwts. per ton shows a considerable decrease in tonnage but little change in the grade of ore mined.

The main producer was the *Sons of Gwalia* with 60,093 tons for 18,139 ounces at an average grade of 6.03 dwts. per ton, as compared with 81,510 tons for 24,986 ounces at an average of 6.13 dwts. per ton for the previous year. It is this decline that is reflected in the figures for the district generally.

The development programme lagged somewhat on account of shortage of labour but a fair amount of work, including some on the mullock system, was done.

YILGARN GOLDFIELD.

Production for the year was 37,538 tons, which yielded 12,077 fine ounces, an average of 6.34 dwts. per ton. The production in the previous year was 69,809 tons for a return of 22,056 fine ounces at an average of 6.32 dwts. per ton. In spite of the considerable decrease this goldfield retains its place as fifth in the list of producers.

The number of men employed was 330 as compared with 410 in the previous year.

The *Burbidge Gold Mines* treated 23,115 tons of lateritic ore for a return of 2,089 fine ounces, which is an average of only 1.8 dwts. per ton. The successful treatment of ore of this grade indicates very economical operation.

Edwards Reward with 1,814 ounces from the treatment of 4,598 tons of ore averaging 7.9 dwts. per ton was a little below last year's figures, but has carried out considerable development work. The programme aims at a new shaft to 350-foot level and when it is completed the output should be increased to about double the present output.

The consistent *Radio* again produced 1,769 ounces from 1,635 tons, an average of 21.6 dwts per ton. The output is slightly higher than for the previous year and the grade about the same.

Radio Deeps failed to reach the position of the lode with their shaft and subsequent drilling failed to locate the rich Radio shoot.

The smaller shows in the goldfield continued as usual and the decline in production is due to the closing of the *Evanston* mine.

Investigation work is proceeding on the *Copperhead, Pilot, Corinthian, Fraser's* and *Nevoria,* and it is hoped that these mines will be brought into production in the coming year.

COOLGARDIE GOLDFIELD.

There was a considerable fall of production in this goldfield, the figures for this year being 24,529 tons for 8,973 ounces at an average of 7.32 dwts. per ton as compared with 42,646 tons for 11,966 ounces at an average of 5.61 dwts. per ton in the previous year. The decline was due to the closure during the year of the *Phoenix* mine owing to the exhaustion of the payable ore. The number of men employed was 283 as compared with 255 in the previous year.

Barbara, Surprise and *Burbanks* mines are being developed by New Coolgardie Gold Mines. The ore from these leases will be crushed at the plant on the Phoenix mine.

The main shaft on the Surprise mine is down to 325 feet and the level development at 150 foot and 300 foot horizons has been commenced.

Gold Mining Lease 334, which adjoins the Barbara was purchased from Hampton Gold Mining Areas Ltd.

The *Fair Play* mine at Higginsville treated 3,234 tons of ore averaging 1.6 dwts per ton for a return of 255 ounces. A new underlay shaft has been sunk to a depth of 185 feet.

The *Lister* mine which has been a good producer for several years was closed owing to unsatisfactory developments.

The *Cardiff Castle* proved too low in grade and has also been closed down.

The *Jenny Wren* was purchased by Coolgardie Gold Mines Ltd., but operations were mainly on preparatory work. The ore treated for the year was 41 tons which yielded 51 ounces. Dollied and specimen gold amounting to 32 ounces was also obtained.

EAST MURCHISON GOLDFIELD.

The production in this goldfield amounted to 11,800 tons of ore on which basis it would rank seventh on the list of producers. The gold produced was 17,910 ounces which is considerably higher than the returns from Yilgarn and Coolgardie. The average grade is 30.36 dwts. per ton. In the previous year the production was 37,806 tons, yielding 21,487 ounces at an average of 11.37 dwts. per ton. The number of men employed was 183 while 313 men were employed in the previous year.

The increase in the average grade is due to the inclusion of 11,820 ounces of gold, mainly from re-treatment, by the *Wiluna Gold Mines.*

Lawlers District returned 1,213 ounces from the treatment of 3,758 tons of ore averaging 6.48 dwts. per ton. In the previous year 6,730 ounces of gold was obtained from 27,516 tons of ore averaging 8.20 dwts. per ton.

The *Emu* mine, the principal producer closed down very early in the year owing to the exhaustion of the available ore. Two small mines *Beth Heno* and *Mount Harris* were the only other producers.

Wiluna District with 13,855 ounces from 5,292 tons at an average of 52.5 dwts. per ton produced more gold than in the previous year when 12,607 ounces was obtained from 7,249 tons at an average of 34.82 dwts. per ton. Most of the gold was obtained from re-treatment of the Wiluna tailings and among the other mines the most successful was the *International* with 808 ounces from 3,116 tons.

Black Range District with 2,677 ounces from 2,730 tons of ore averaging 19.62 dwts. per ton was a little below the previous year's output. The corresponding figures are 2,150 ounces from 3,040 tons of ore averaging 14.3 dwts. per ton. Rich patches of ore were struck on the *Apples,* which treated 138 tons for 1,533 ounces and on the *Lady Mary,* which treated 148 tons for 513 ounces. *Doolette South* returned 304 ounces from 372 tons of ore.

PILBARA GOLDFIELD.

The ore treated in this goldfield amounted to 11,173 tons and the gold obtained was 8,529 ounces which is an average of 15.27 dwts. per ton. Comparison with the corresponding figures for the previous year of 10,521 tons of ore treated for a return of 11,026 ounces at an average of 21.32 dwts. per ton shows an increase in tonnage treated. The grade of ore has declined considerably and the gold yield is consequently reduced.

The number of men employed was 134 as compared with 175 in the previous year.

In the *Marble Bar District* the principal producer was the *Comet* which treated 2,471 tons of ore averaging 21.4 dwts. per ton for a return of 2,635 ounces. This ore was obtained from remnants of the old ore body in the upper levels of the mine. The *Federation* with 291 ounces from 240 tons was the only other successful mine.

Nullagine District produced 6,329 tons of ore which yielded 4,360 fine ounces at an average of 13.75 dwts. per ton. In the previous year 5,679 tons of ore was treated for a return of 5,621 ounces at an average of 19.8 dwts. per ton.

The *Blue Spec* mine which produced 4,483 tons of ore yielding 3,174 fine ounces was closed down as the result of a serious break down in the power plant. The smaller mines did fairly well, the most successful being the *Barton* with 524 ounces from 1,056 tons of ore.

NORTH COOLGARDIE GOLDFIELD.

In this goldfield 6,414 tons of ore were treated for a return of 6,116 ounces which is an average of 19.07 dwts. per ton.

In the previous year the ore treated was 11,392 tons and the gold recovered 8,144 ounces, an average return of 14.30 dwts. per ton.

The number of men employed was 310, while 321 were employed in the previous year.

Menzies District produced 1,847 tons of ore, which yielded 2,169 ounces of gold, being an average of 23.5 dwts. per ton.

First Hit with 146 tons for 201 ounces and *Timoni* with 900 tons for 668 ounces were the best producers. On the latter mine work was concentrated on development which included 268 feet of shaft sinking.

There was a fair return from prospectors' parcels and retreatment of tailings also produced some gold.

Ularring District produced 1,822 tons of ore yielding 1,799 ounces of gold at an average of 19.8 dwts. per ton, as compared with 6,726 tons for 4,933 ounces at an average of 14.7 dwts. per ton in the previous year. Several small mines situated in this district are consistent producers. The most successful were *First Hit,* 127 tons for 225 ounces, *Paramount* 377 tons for 285 ounces, *Two Chinamen* 307 tons for 501 ounces, and *Oakley* 226 tons for 227 ounces.

Niagara District reported 797 ounces of gold from the treatment of 947 tons of ore, averaging 16.8 dwts. per ton. The previous year's return was 550 ounces from 899 tons of ore at an average of 12.25 dwts. per ton.

There is thus a considerable increase in the amount of gold produced. The most successful mine was the *Altona* with 350 tons for 388 ounces.

Yerilla District produced 1,798 tons which yielded 1,252 ounces at an average grade of 13.95 dwts. per ton. In the previous year the ore treated was 1,190 tons and the gold recovered 595 ounces, the average grade being 10 dwts. per ton. Here, also, there is a considerable increase, the main contribution coming from the *Yilgangie Queen* where tributers obtained 753 tons which yielded 716 ounces. Construction work was continued at the Porphyry mine but no ore was produced.

BROAD ARROW GOLDFIELD.

This field produced 4,153 tons of ore, which yielded 3,686 ounces, an average of 17.75 dwts. per ton. This shows a considerable decline from the figures for the previous year when 18,233 tons were treated for a return of 8,252 ounces at an average of 9.05 dwts. per ton.

The number of men employed has decreased to 181 from last year's figure of 232.

Ora Banda Amalgamated has not been able to resume operations since the plant was damaged by fire. About 20 small mines are included in the list of of producers of which the most important is *New Mexico* with 173 tons for 650 ounces.

PEAK HILL GOLDFIELD.

In this goldfield the ore treated amounted to 3,044 tons and the gold recovered was 960 ounces, which is an average of 6.31 dwts. per ton. In the previous year the ore treated was 3,923 tons and the gold recovered 1,632 ounces, the average being 8.32 dwts. per ton. The number of men employed was 48.

Although the output was low, considerable interest attaches to the work done by Anglo Westralian in the *Horseshoe Lights*. Surface prospecting and shallow workings have given satisfactory results and development will be continued.

YALGOO GOLDFIELD.

In this goldfield the treatment of 1,622 tons returned 1,564 ounces which is an average of 19.28 dwts. per ton. In the previous year 1,712 tons were treated for a return of 1,175 ounces at an average of 13.73 dwts. per ton.

The number of men employed was 36 as against 40 in the previous year.

The best return was obtained from the *Carnation* which treated 811 tons of ore for a return of 743 ounces.

NORTH-EAST COOLGARDIE GOLDFIELD.

The ore treated in this goldfield amounted to 791 tons, which yielded 908 ounces, being an average of 22.96 dwts. per ton. In the previous year 911 ounces was recovered from the treatment of 884 tons of ore averaging 20.63 dwts. per ton.

The number of men employed was 58, only one less than the figure recorded for the previous year.

The whole of the output came from the *Kanowna District*, the most successful mine being the *Lady Betty* which treated 71 tons of ore for 533 ounces, including 314 ounces of dollied and specimen gold.

Kimberley, Ashburton, Gascoyne, Phillips River Goldfields and places outside proclaimed goldfields produced 665 ounces of gold, including 425 ounces of dollied and specimen gold from the Kimberley Goldfield.

COAL MINING.

The output of coal from the Collie Coalfield during 1948 is compared with the output for 1947 in the following table:—

Mine.	1948		1947	
	Tons.	Value.	Tons.	Value.
		£A.		£A.
Proprietary	139,616	167,804	156,242	178,816
Co-Operative	80,885	96,062	103,984	123,471
Cardiff	97,135	116,043	87,020	102,093
Stockton	106,248	126,547	100,239	118,760
Stockton Open Cut	111,422	132,295	96,461	114,543
Wallsend Open Cut	34,421	40,876	51,884	61,446
Black Diamond Open Cut	105	124	....	....
Total Amalgamated Collieries	569,832	679,751	595,830	699,129
Griffin	89,435	109,931	91,641	95,623
Wyvern	72,192	88,735	43,035	45,857
Phoenix	1,480	1,819	....	....
Total Griffin Collieries....	163,939	200,485	134,676	141,120
GRAND TOTAL	732,939	880,236	730,506	840,247

The total output for the year was 732,939 tons which, as it exceeds the previous year's total of 730,506 tons by 2,433 is again a record. The output from underground mines was 586,991 tons which is an increase of 4,830 tons over the amount of 582,161 tons produced from underground in the previous year.

Amalgamated Collieries produced 423,884 tons of coal from underground mines and this is less by 23,601 tons than the amount produced from the same sources in 1947.

The output of the Griffin Collieries rose from 134,676 tons for 1947 to 163,107 for the present year. The increase of 28,431 tons has been the main factor in producing the present record.

The production of open-cut coal declined from 148,345 tons to 145,948 tons.

The following table shows the position:—

Source of Coal.	1948.	1947.	Remarks.
	Tons.	Tons.	
Amalgamated Collieries Mines	423,884	447,485	Decrease of 23,601
Griffin Mines	163,107	134,676	Increase of 28,431
Total Underground Coal	586,991	582,161	Increase of 4,830
Open Cut Coal	145,948	148,345	Decrease of 2,397
GRAND TOTAL	732,939	730,506	Increase of 2,433

Important features of the year's work are the decline of production from Proprietary and Co-Operative and the increase from the Wyvern mine.

Supplies of imported coal were somewhat uncertain and the total coal available has been barely sufficient to meet requirements.

The average number of men employed during the year was 1,080 of whom 313, including 86 in open-cuts, were employed on the surface while 767 were employed underground.

In the previous year 1,032 men were employed, of whom 287, including 73 in open-cuts, were employed on the surface, while 745 men were employed underground.

The increase of 48 men is made up of 26 surface men and 22 underground. The number of men working in open-cuts increased from 73 to 86.

The average output per men employed for this year was 679 tons as compared with 708 tons in the previous year. The decrease is due to the added development work done both in mines and open-cuts.

The operations of the principal mines were as follows:—

Proprietary Mine.

Only 48 places were available in this mine at the end of the year. The large reduction in the number of working places is due to the working out of places on the barrier below the old Proprietary workings and to the fact that 21 Section is not yet ready.

A pair of bords was driven through the barrier towards the old Proprietary mine and a connection was made by a drill hole. Water is draining away through a pipe of small diameter but there has been little change in the level of the water.

The ventilation shaft is down to level but the installation of the fan has not yet been effected.

On the left hand side work continues in 11 Section and development is proceeding towards 18 Section.

In spite of a decline in production from 156,242 tons for the previous year to 139,616 tons for the present year this mine remains the largest producer on the field.

Co-Operative Mine.

In this mine also the number of working faces has been considerably reduced. There are now 26 working places as against 45 at the end of 1947.

The dewatering of the old "Siderite" section now known as No. 3 East is proceeding and tunnels are being driven to the rise to prepare for operations in this area.

There is also a possibility that the Moira seam may be worked at a point where it is brought into a convenient position by faulting.

Output declined from 103,984 tons in 1947 to 80,885 tons for 1948 and this mine is now lower in production than either Stockton or Cardiff.

Stockton Mine.

This mine is in a very sound position as regards development. The opening up of No. 1 seam in 4 left and the re-opening of the stone drive section have provided ample working places.

The production for the year was 106,248 tons, which is greater than the corresponding figure of 100,239 tons for the previous year. This mine is now second as regards rate of production.

Cardiff Mine.

The extraction of top coal has proceeded throughout the year and the output increased from 87,202 tons in 1947 to 97,135 tons in 1948.

Preliminary work for the investigation of the second seam has been commenced.

Griffin Mine.

A fault encountered in the face of 10 Gannon Bord section cut off several places and caused some reduction of employees. Output declined from 91,641 tons in 1947 to 89,435 tons in 1948.

Wyvern Mine.

The output from this mine increased considerably, the figure for the year being 72,192 tons, while the figure for the previous year was 43,035 tons. Development work has been directed toward straightening the main dip in preparation for a third length of conveyor belt. A Joy loader, which will supersede the scraper loaders now in use, has been placed in the mine but the complementary equipment has not yet been obtained.

Phoenix Mine.

This new mine on the top seam was commenced during the year.

Preliminary work on the tunnel produced 1,480 tons of coal.

It is intended to use scraper loaders from the Wyvern in this mine when the new trackless mining equipment is installed in the Wyvern.

Open Cuts.

Stockton Open Cut has been of great value in that coal could be obtained quickly here when it was not available at other places, owing to holidays. The old open-cut is reaching the limit of economic working, although there is still some pillar coal available.

In the new cut on the opposite side of the railway line coal can be obtained with very little stripping.

The Wallsend Open Cut was exhausted during the year.

A considerable amount of development work has been done on the Black Diamond Cut. Work has been started in the Western end where the grades are steepest. This gives relatively little coal for each ton of stripping and the heavy grade makes the operation of mechanical plant somewhat difficult. This cut, however, is on virgin ground and is not drained by a mine below it as the other cuts were. The present workings are close to the Collie River and will provide a sump to which the rest of the area can be drained. As the work proceeds in an Easterly direction flatter grades will be encountered.

Attached to this report are plans showing in outline the area from which coal was mined during the year.

MINERALS OTHER THAN GOLD OR COAL.

The value of minerals other than gold or coal produced during the year was £503,802. In addition to this there are lead concentrates valued at £48,000, which are in transit so that the total value of minerals produced is approximately £552,000. Silver included in gold bullion, which totalled 193,819 fine ounces valued at £44,198, is not included in the above figure.

Notes on the various minerals are given below.

Alunite.

The State Alunite Industry treated 39,131 tons of alunite at its Chandler plant for the return of 1,778 tons of salts containing about 30 per cent. potash and valued at £49,430.

Antimony.

Blue Spec Gold Mines shipped 114 tons of antimonial concentrate containing 41.9 tons of antimony valued at £3,582. The mine is at present closed down on account of a serious accident to the generating plant.

Arsenic.

Operations for the recovery of arsenic at the Wiluna Gold Mine have ceased. The output for this year was 214 tons, valued at £4,494.

Asbestos.

Anthophyllite asbestos amounting to 284 tons and valued at £4,173 was obtained from Bindi Bindi.

The only producer of Chrysotile was L. G. Hancock's mine at Nunyerri, which produced 71 tons of fibre valued at £5,591.

Australian Blue Asbestos has continued throughout the year with development work which yielded 607 tons of fibre valued at £27,997.

Diamond drilling has been employed to test the ore body, and the second seam has been opened up.

The townsite at the entrance to Wittenoom Gorge is established and growing steadily.

Bentonite.

The Marchagee leases produced 269 tons of bentonite valued at £806. Local applications of this mineral to industrial purposes have been developed.

Beryl.

Ores of beryllium amounting to 35 tons and containing 336 long-ton units of beryllium oxide were produced from Wodgina, Cooglegong, Mount Francesco and Coolgardie. The value was £2,034.

Clays.

Fireclay and pottery clay used in the manufacture of refractory bricks and bauxitic clay used in the manufacture of cement were obtained from various places in the Darling Ranges. Some pottery clay was also obtained at Goomalling. The total produced was 4,859 tons valued at £4,113.

Copper.

Carbonate copper ores amounting to 259 tons were mined for use as fertilizers. The average grade was 11.36 per cent. and the total value was £2,204. The ore was obtained from Ilgararie and Kumarina in the Peak Hill Goldfield.

Dolomite.

Dolomite, which is used in the steel industry, is obtained from Mount Magnet. During the year 107 tons valued at £536 was obtained.

Felspar.

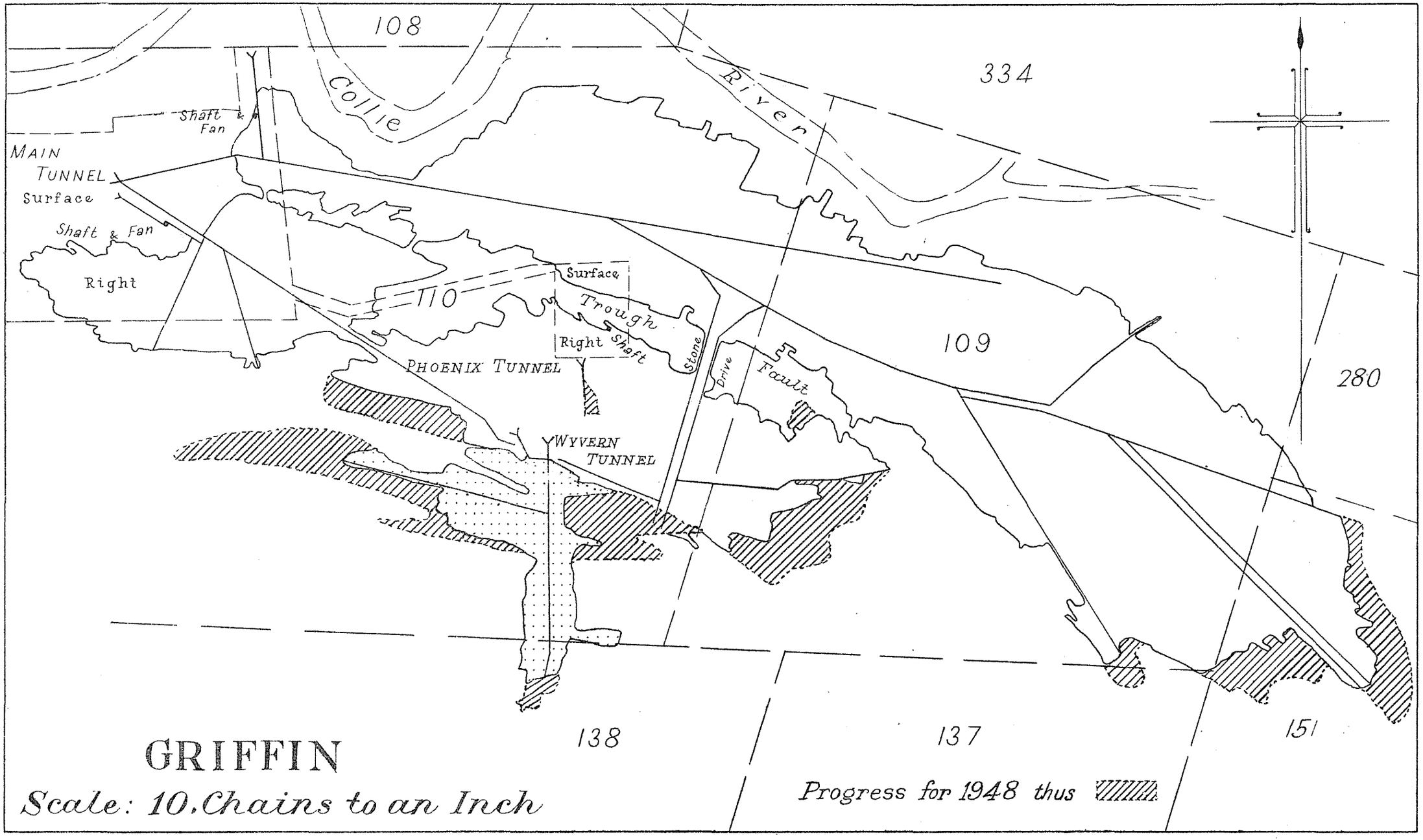
Australian Glass Manufacturers produced 1,011 tons valued at £3,538 from the quarry at Londonderry.

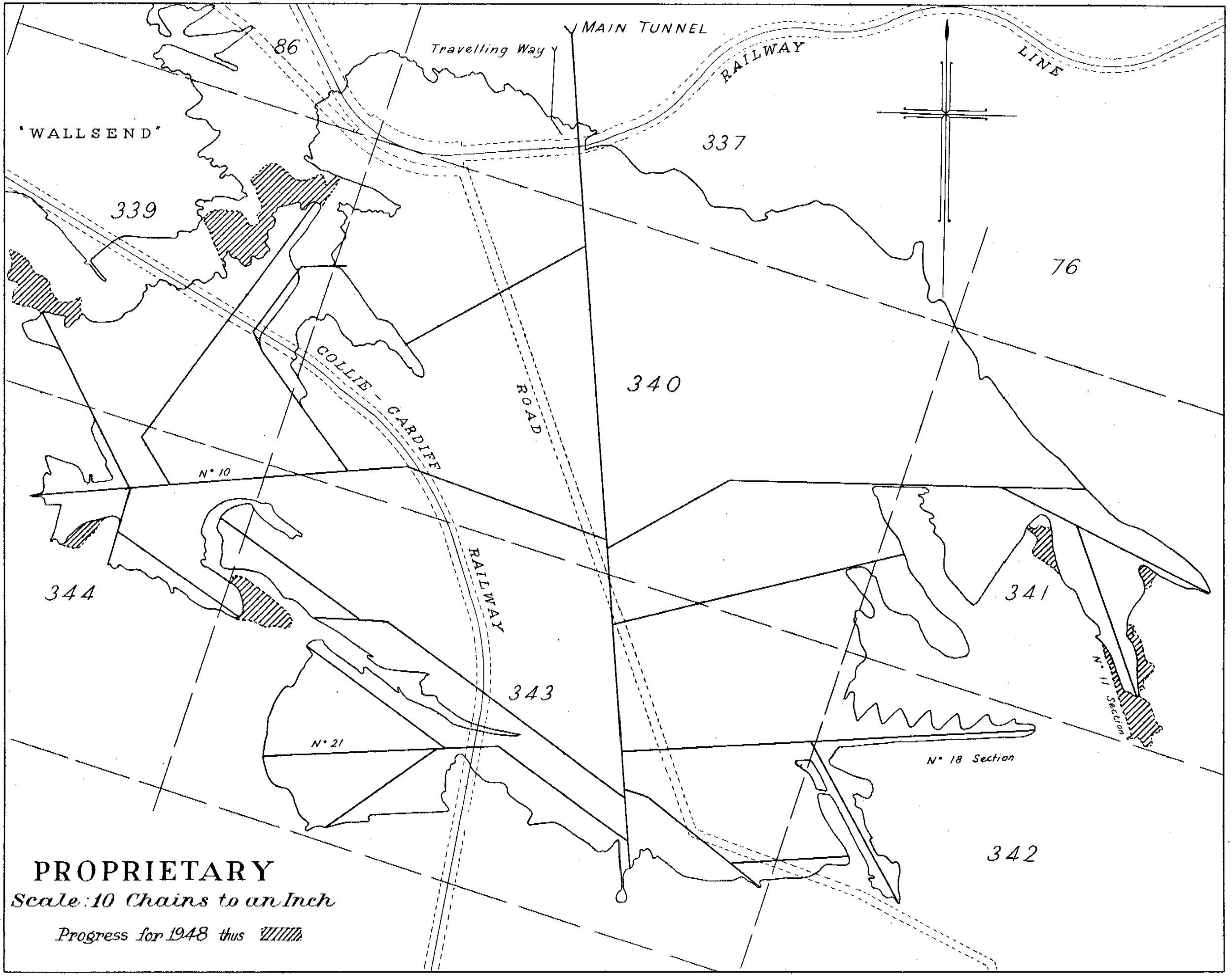
Glauconite.

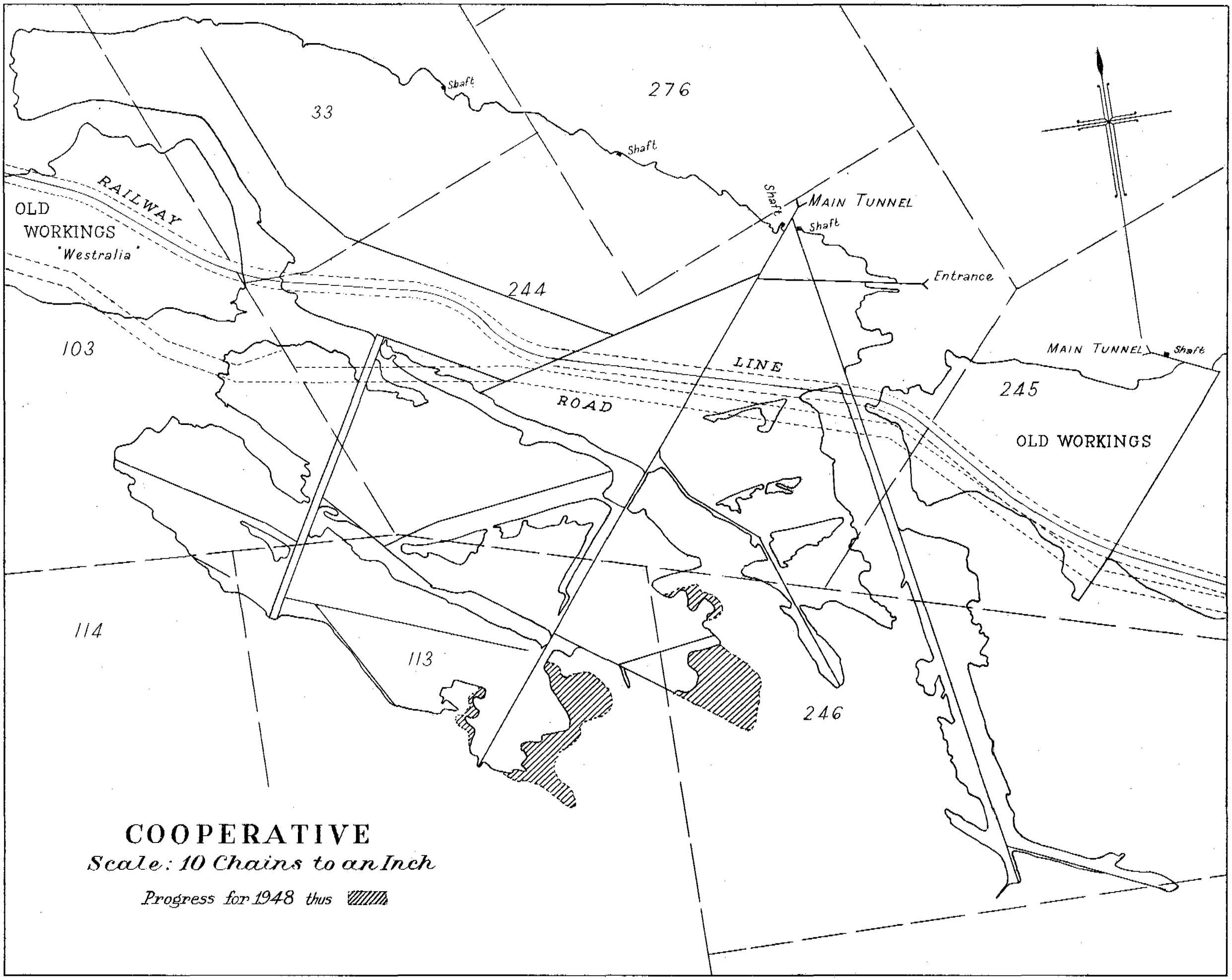
The processing plant at Midland Junction treated 1,595 tons of Gingin greensand for the recovery of 319.00 tons of glauconite valued at £7,975.

Gypsum.

Local manufacturers of plaster board obtained 25,521 tons of gypsum valued at £35,173, from the central portion of the State. The production for the previous year was 20,282 tons so that there has been a considerable increase in the use of this material.


108
Collie
River
334
Shaft & Fan
MAIN TUNNEL
Surface
Shaft & Fan
Right
110
Surface
Trough
Right Shaft
Stone
Drive
Fault
PHOENIX TUNNEL
WYVERN TUNNEL
109
280
138
137
151
GRIFFIN
Scale: 10. Chains to an Inch
Progress for 1948 thus


MAIN TUNNEL
Travelling Way
RAILWAY
LINE
86
"WALLSEND"
339
337
76
340
COLLIE - CARDIFF
ROAD
RAILWAY
N° 10
344
343
341
N° 21
N° 11 Section
N° 18 Section
342
PROPRIETARY
Scale: 10 Chains to an Inch
Progress for 1948 thus


Shaft
276
33
Shaft
Shaft
MAIN TUNNEL
Shaft
RAILWAY
OLD
WORKINGS
'Westralia'
244
Entrance
103
LINE
ROAD
MAIN TUNNEL
Shaft
245
OLD WORKINGS
114
113
246
COOPERATIVE
Scale: 10 Chains to an Inch
Progress for 1948 thus

77

288

ROAD

LINE

289

RAILWAY

79

TOP SEAM

291

78

Loc

4382

MAIN TUNNEL

OPEN CUT

358

359

271

TOP SEAM

Internal Shaft

360

322

STOCKTON

Scale: 10 Chains to an Inch

Progress for 1948 thus ////

127

128

129

Loc

MAIN TUNNEL

Travelling Way

Air Shaft

4386

373

COLLIE

201

Extraction of Tops

ROAD

202

CARDIFF

Extraction of Tops

203

RAILWAY

224

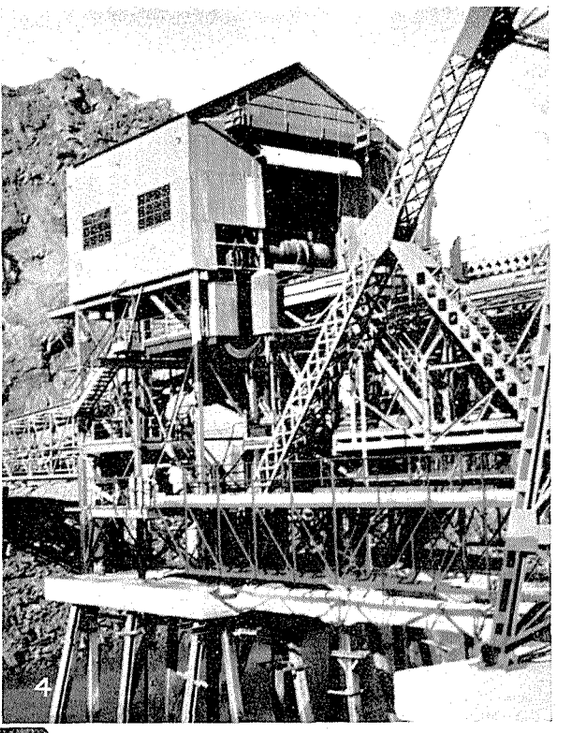
225

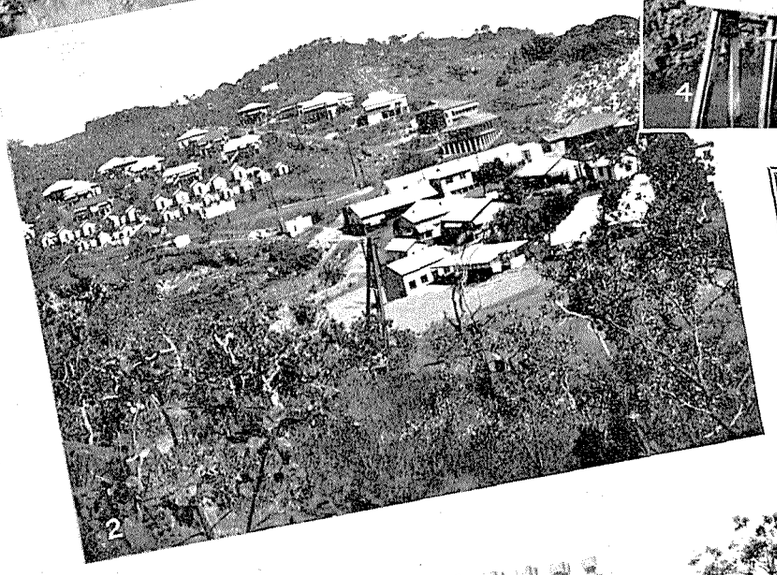
203

CARDIFF

Scale: 10 Chains to an Inch

Progress for 1948 thus ////////





COCKATOO ISLAND

IRON DEPOSIT PROJECT.

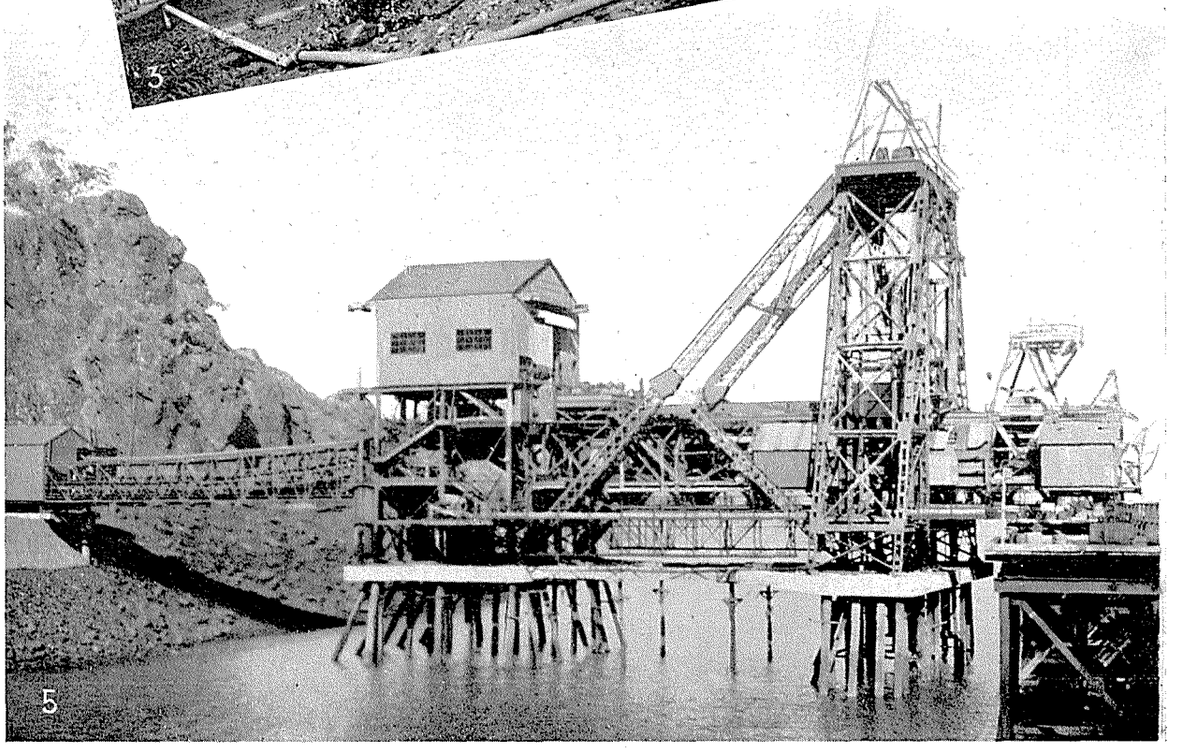
(1) Crushing plant.

(2) Residential Area.

(3) Power House.

(4) Weightometer House.

(5) Loading plant at Jetty.



Aerial photograph showing lead-bearing lode, Wyloo area.

Glass Sand.

Glass sand obtained from Wanneroo and Lake Gnangara amounted to 517 tons valued at £644.

Iron.

The State Charcoal and Iron Industry smelted 7,222 tons of iron ore to produce 3,333 tons of pig iron valued at £26,165.

The installation at Cockatoo Island built by Australian Iron & Steele is ready for production and it is anticipated that the export of iron ore will commence during the coming year.

Kaolin.

The Mount Kokeby deposits yielded 146 tons valued at £292.

Kyanite.

A total of 1,125 tons valued at £6,516 was obtained from the Yanmah area.

Lead.

The high price of lead has stimulated interest in the production of lead ores and several new mines have been opened up. The total production was 2,192 tons valued at £114,331. There is also 869 tons of ore valued at £48,000 in transit which is not included in the above figures. Lead, therefore, becomes one of the most important of our minerals.

The principal producer has been the *Protheroe* mine in the Northampton Mineral Field which produced 1,248 tons of concentrate valued at £86,603. This accounts for the major part of the production. The Protheroe mine is only a small mine, although very rich, and this serves to illustrate the potential value of our lead deposits.

The Northampton Mineral Field, produced 1,345 tons valued at £92,492.

Producers in the Uaroo, Kooline and Wyloo areas shipped 133 tons of lead valued at £7,419. This ore also contained 1,225 ounces of silver.

An interesting occurrence in this area was the discovery of a line of lead bearing country by observation from the air. An aerial photograph showing the vein on which lead occurs is attached to this report.

In the Napier Range area 713 tons of ore containing 276 tons of lead, 151 tons of zinc and 4,762 ounces of silver was produced. The value of this ore was £14,358.

Manganese.

There has been a strong demand for manganese ore and the deposits at Peak Hill were worked for an output of 1,600 tons. Small parcels were also obtained from Mount Lucky and Teninderwa. The total production amounted to 1,645 tons valued at £10,442.

Some of the production was intended for overseas markets but in view of the shortage of Australian manganese the export of ore has been prohibited by the Commonwealth Government.

Magnesite.

Production for the year amounted to 962 tons, valued at £3,176. The Coolgardie area was responsible for 467 tons and 495 tons was obtained from Northam for use in the Wundowie charcoal iron plant.

Pyrites.

Norseman Gold Mines, produced 37,499 tons of selected ore and concentrates estimated to contain 15,729 tons of sulphur valued at £164,203. In the previous year 86,952 tons of ore and concentrates containing 19,009 tons of sulphur and valued at £187,621 was produced. Developments have been satisfactory and a good reserve of ore has been established.

Ochre.

Both Wilgie-mia and Opthalmia Range deposits were worked to produce a total of 566 tons valued at £6,792.

Sillimanite.

Clackline refractories produced two tons of sillimanite ore valued at £13 from Clackline.

Silver.

Silver in gold bullion amounted to 184,821 ounces and 5,987 ounces was contained in lead concentrates.

Tin.

The high price of tin stimulated tin production and 36 tons of tin ore was produced in the Marble Bar district principally from Moolyella. Considerable prospecting and preparatory work was done on the Greenbushes field and at Smithfield, but very little tin was produced. The total recorded production was 36.99 tons, valued at £12,985.

Talc.

Mining in the Mount Monger area produced 72 tons of talc valued at £732.

Tantalite.

Tantalite amounting to 8,470 lb. was obtained by magnetic separation from tin ores at Greenbushes. Prospecting work obtained 1,181 lb. at Pilgangoora. The total production of 9,651 lb. was valued at £1,139.

Tungsten.

Operations at Higginsville and retreatment of the Westonia tailings dumps produced 16,275 lb. valued at £3,913.

Vermiculite.

The total production was 151 tons valued at £876. The Young River deposits yielded 91 tons and 60 tons was obtained at Bulong.

E. E. BRISBANE,
Assistant State Mining Engineer.

APPENDIX NO. 1.

Coal Mines Regulation Act, 1947.

ANNUAL REPORT OF THE BOARD OF EXAMINERS FOR MINE MANAGERS, UNDER MANAGERS AND DEPUTIES.

Office of the State Mining Engineer,
Mines Department, Perth
1st March, 1949.

The Under Secretary for Mines.

We submit herewith, for the information of the Hon. Minister for Mines, the Annual Report of the Board of Examiners for the year 1948.

This was the first occasion on which examinations were held under the provisions of the Coal Mines Regulations Act, 1946, and Regulations.

The only difference between this and previous examinations was the inclusion of an examination for Deputies who, under the old Act, were not required to be certificated.

April Examination.—No candidates presented themselves for this examination.

October Examination.—There were four candidates who presented themselves for First Class Certificates of Competency as Mine Managers. Only one of these satisfied the Board as to his competency and a certificate was issued accordingly.

Two candidates sat for the examination for Second Class Certificates as Under Managers, both of whom passed and were issued with certificates.

There were nine candidates for Third Class Certificates as Deputies, and all of these passed and were issued with certificates accordingly.

Third Class Certificates of Service as Deputy were issued to 23 applicants, under the provisions of Section 41 (3) (a) of the Act.

First Class Reciprocal Certificates of Competency were granted to two applicants, the holders of First Class Certificates of Competency granted in Great Britain.

A Second Class Reciprocal Certificate of Competency was granted to an applicant who is the holder of a Second Class Certificate of Competency under the New South Wales Act.

JOHN S. FOXALL,
State Mining Engineer,
Chairman.

H. A. ELLIS,
Government Geologist,
Member.

JAMES GILLESPIE,
Senior Inspector of Mines, Collie,
Member.

APPENDIX NO. 2.

Mines Department,
Kalgoorlie 12th April, 1949.

Report on activities of Board of Examiners for Underground Supervision for 1948.

The Chairman,
Board of Examiners for Underground Supervisors,
Perth.

I hereby submit the annual report on the activities of the Board of Examiners for Underground Supervisors, during the year 1948.

The only examination during the year was held in October, there being 24 candidates, 20 of whom sat for the examination at Kalgoorlie. Three were attended to by Mr. Lloyd and Mr. Adams during their inspection of the Northern District. The fourth from this district, unable to be present at Cue, was examined in Perth.

Of those candidates who sat, 13 were successful in obtaining Certificates.

One Duplicate Certificate of Service was issued to J. H. Wood on the 1st April.

Reciprocal Certificate for Underground Supervisors was granted to Mr. P. C. Thomas who is the holder of a N.S.W. Mine Manager's Certificate.

One Certificate of Service was issued to C. A. Morrow, of Eradu.

The Board of Examiners consisted of Mr. J. S. Foxall, Mr. H. Verran and Mr. R. A. Hobson of the School of Mines, Kalgoorlie.

Following are the names of persons to whom Certificates were granted during the year:—

Brodie-Hall, L.
Ryle, Richard Daniel.
Kuhlmann, Herman Karl.
Robb, Donald.
Kirkwood, Alexander.
Phillippe, Bertrand Philip.
Muncaster, Nicholas.
Pringle, William Sydney.
Collard, F. W.
Powell, Leo Edmund.
Wilson, John Alexander.
Ellerton, Ronald Keith.
Hammond, Stephen James.
Thomas, P. C., Reciprocal Certificate of Competency.
Wood, John H., Dup. Certificate of Service.
Morrow, Chester A., Certificate of Service.

(Sgd.) M. V. MORRIS,
Secretary to Board of Examiners.

Index to State Mining Engineer's Annual Report, 1948.

Division III.

Report of the Superintendent of State Batteries.

THE UNDER SECRETARY FOR MINES:

For the information of the Hon. Minister I submit herewith my report on the operations at State Batteries for the year ending December 31st, 1948.

Sixteen batteries crushed 40,634 tons of ore for an estimated yield of £332,495 as against 49,168.25 tons and £411,080 for the previous year.

The lower tonnage is a reflection of the gradual decline in the industry generally.

The grade of ore crushed still remained high at 16 dwts. 3.7 grs. per ton a slight falling off from the 1947 figure of 17 dwts. 18.3 grs.

Particulars of the grade of ore at all batteries is shown on schedule 2 attached to the report and it will be noted that the ore crushed at Sandstone and Cue was mainly responsible for the high average, with values at 46 dwts. 15 grs. and 40 dwts. 12 grs. per ton respectively.

Peak Hill reduced the average grade with 2,879 tons worth 6 dwts. 21 grs. per ton.

The estimated value of the bullion recovered was £332,495 bringing the value of production since inception to £13,601,799.

The estimated extraction obtained was still very high at 94.56 per cent. as against 94.89 per cent. in 1947 and signifies an average residue of 21 grs. per ton, which can be considered exceptionally good for this grade of ore.

The tonnage of tailing treated was 39,958 approximating that milled and resulted in a working profit of £6,641 3s. 4d. The loss on milling was £27,671 7s. 5d. and that on all operations £21,030 4s. 1d., as against a loss of £17,897 15s. 5d. in 1947.

A glance at the administration cost segregation further on in this report show the incidence of the 40-hour week, 22s. per week industry allowance and basic wage increases during the period.

Capital expenditure was low, £1,724 4s. 5d. being spent from loan and £969 1s. 1d. from revenue.

The supply position became more difficult especially such items as firewood, galvanised iron, steel plate and piping.

Maintenance of buildings has been a problem which has been only partly solved on account of the difficulty in getting materials, anything like skilled labour and to the fact that most of them are of considerable age and, on account of the fall in tonnage, unoccupied for long periods.

Schedules attached give the following information:—

Schedule 1.—Tonnage crushed and value per ton.

Schedule 2.—Yield and gross value.

Schedule 3.—Segregation of tailing.

Schedule 4 and 6.—Details of tailing treatment.

Schedule 5.—Purchase of tailing.

Schedule 7.—Details of milling costs.

Schedule 8.—Details of tailing treatment costs.

Schedule 9.—Balance sheet.

A comparison of the tonnage crushed and cyanided for the last three years is as follows:—

	1946.	1947.	1948.
Tons crushed ..	45,476	49,168	40,634
	22,390	41,401	39,958

Estimated Value of Production since Inception excluding Value of Gold Tax paid to Commonwealth.

	£
Production at Par:	
By Amalgamation	7,815,190.530
By Tailing Treatment	1,911,093.518
Gold Premium:	
By Amalgamation	2,914,038.761
By Tailing	867,022.023
	£13,807,344.832
Tin Production:	
Ore	93,883.160
Residues	572.000
Total Value ..	£13,601,799.992

DETAILS OF PRODUCTION.

Six hundred and eighty-six parcels were milled averaging 59.23 tons as against 865 parcels and an average of 56.84 tons in 1947.

The value of the yield with 1947 figures in parenthesis was as follows:—

Bullion by amalgamation, 28,851 grs. (39,134.8), worth £263,165.

Fine gold by tailing treatment, 6,440.6 grs. (7,450.46), worth £69,330.

Total, £332,495.

GRADE OF ORE TREATED.

Forty thousand, six hundred and thirty-four tons crushed yielded 24,451 fine ounces by amalgamation, equal to 12 dwts. 0.8 grs. per ton. The average value of tailing produced was 4 dwts. 2.9 grs., bringing the overall value to 16 dwts. 18.7 grs. per ton.

The average value for 1947 was 17 dwts. 18.7 grs.

ESTIMATED PERCENTAGE RECOVERY.

The whole of the tailing produced was not treated during the year and approximately eight per cent. of the total was cuperferous and untreatable, but applying the average extraction obtained at our tailing plants, viz., 78.65 to the average tailing value of 4 dwts. 2.9 grs., the estimated percentage extraction works out as follows:—

Head Value = 16 dwts. 3.7 grs.

	dwts.	grs.	%
Recovered by Amalgamation ..	12	0.8	= 74.49
Recovered by Tailing 78.68% of 4 dwts. 2.9 grs.	3	5.8	= 20.07
Total Extraction	15	6.61	= 94.56

RECEIPTS AND EXPENDITURE.

Receipts from all sources were £57,526 18s. 5d. as against £59,568 8s 2d. in 1947.

Expenditure amounted to £78,557 2s. 6d., the previous year's figure being £77,461 3s. 7d.

A comparative synopsis of receipts and expenditure under the different headings for 1948 and 1947 appears later in this report.

MILLING.

One 15-stamp, seven 10-stamp, and eight 5-stamp mills treated ore for the public. No ore was crushed atWarriedar or Yalgoo. This last named plant has been partly dismantled and the material used elsewhere.

Lake Darlot and Linden operated under lease and the remnants of Sir Samuel battery, which had been leased for many years, were sold by tender.

The Weerianna battery was run as a State plant during the year and two small rounds aggregating 276½ tons were crushed. This plant is now under lease.

The State-operated plants milled 686 parcels totalling 40,634 tons as against 865 parcels and 49,168.5 tons in 1947.

The average tonnage per parcel increased from 57.97 to 59.23 tons.

COST OF CRUSHING.

The gross working cost includes administration increased from 19/1.7s. in the previous year to 23/3.5s. per ton.

Shorter working hours, decreased tonnage and increased cost of wages and stores were responsible for this increase of 4s. 2d. per ton and managers did well to hold the cost within this margin.

A glance at Schedule 7 shows that Kalgoorlie with approximately 25 per cent. of the total tonnage crushed had the best cost at 14s. 10.1d. for 10,971 tons treated. Ora Banda and Laverton were the only other batteries whose costs were below 20s. with 16/1.3d. and 18s. 0.1d. respectively.

MILLING REVENUE.

Receipts for milling amounted to £19,655 or 9s. 8.1d. as against £23,530 and 9s. 7.2d. per ton respectively on the previous year.

TAILING TREATMENT.

Twelve plants handled 39,958 tons, Kalgoorlie heading the list with 12,300, and despite the continued difficulty in obtaining labour some headway was made in overtaking accumulations.

The average value of the tailing treated was 4 dwts. 2.85 grs. and the estimated residue 22.35 grs. giving an actual extraction of 78.68 per cent. The figures for the previous year were 4.579 dwts. and an extraction of 77.55 per cent.

COST OF TREATMENT.

The cost per ton rose from 14/8.2d. in 1947 to 15/7.5d. an all time high. Kalgoorlie had the best cost figures of 12/7.9d.

Repairs and renewals were heavy and included an almost complete new plant at Wiluna and the purchase of a new rotary hoe for Kalgoorlie at an approximate cost of £400.

Repairs and renewals and sundries including administration amounted to £6,428 9s. 9d. or 3/3.2d. per ton.

RECEIPTS.

Revenue amounted to £38,867 7s. 5d. or 19/5.5d. per ton and 3/1d. per ton above the 1947 figure. This is also an all time high and more than offset the rise in the cost of treatment.

The increased revenue was due to a smaller percentage of very low grade tailing and the remission of the gold tax over the full 12 months as against four months of the previous year.

Schedule 3 gives details of the tailing produced at each battery and its segregation according to value based on 90 per cent. of the tonnage crushed. The combined results are as follows:—

	Tons.		%
Over 2 dwts. 8 grs. per ton	20,495	=	56.2
Between 1 dwts. 18 grs. and 2 dwts. 8 grs	5,359	=	14.7
1 dwt. 18 grs. and under	7,484	=	20.5
Refractory	3,097	=	8.6
			100.0

The percentage of payable tailing or that over 2 dwts. 8 grs. was approximately 3 per cent. below the 1947 figure but the tonnage of all tailing over 1 dwt. 18 grs. increased by approximately 12 per cent.

Three thousand and ninety-seven tons or 8.6 per cent. of the total contained too much copper for successful treatment. Four hundred and fourteen and three-quarter tons from Gabanintha crushings put through at Meekatharra assayed 15.4 dwts. and was, I understand, purchased by a manure firm for top dressing purposes. The balance of 2,682 tons was low grade and assayed 2.37 dwts.

Comparative Synopsis of Results at State Batteries for Twelve Months Ended 31st December, 1947 and 1948.

——	1947.			1948.		
	Tonnage.	Expenditure per Ton.	Revenue per ton.	Tonnage.	Expenditure per ton.	Revenue per ton.
		s. d.	s. d.		s. d.	s. d.
Milling	49,168·25	19 1·7	9 7.2	40,634	23 3.5	9 8·1
Cyaniding	41,401·00	14 8·2	17 4.9	39,958	15 7.5	19 5·5

RECEIPTS AND EXPENDITURE.

	Tonnage.	Expenditure.	Revenue.	Profit or Loss.
		£ s. d.	£ s. d.	£ s. d.
Milling	40,634	47,329 13 6	19,658 6 1	27,671 7 5*
Cyaniding	39,958	31,227 9 0	37,868 12 4	6,641 3 4†
	....	78,557 2 6	57,526 18 5	21,030 4 1*

* Loss. † Profit.

CARTAGE SUBSIDIES.

State Plants.

Subsidies were paid on 16,367 tons and amounted to £7,756 6s. 7d. a reduction in both tonnage and expenditure, a reflection of the decreased tonnage crushed.

Private Plants.

Cartage subsidies including 2s. per ton feeding subsidy paid to customers of Lawrence's battery at Marvel Loch amounted to £1,393 8s. 2d. for 3,114 tons crushed, a slight increase in expenditure but a considerable decline in tonnage from the previous year's figure.

Comparative figures for the last three years are as follows:—

Year.	Tons. Crushed.	State Batteries.			Private Batteries.		Total.
		Tons Claiming Subsidy.	Percentage of ore Crushed.	Amount Paid.	Tons Claiming Subsidy.	Amount Paid.	
				£ s. d.		£ s. d.	£ s. d.
1946	45,476.50	6,890.75	15.1	3,169 9 4	1,406.5	514 8 9	3,683 18 1
1947	49,168.25	18,204.25	37.0	8,154 5 2	5,416.5	1,257 5 10	9,411 11 0
1948	40,634.00	16,367.00	40.2	7,756 6 7	3,114.0	1,393 8 2	9,149 14 9

CAPITAL EXPENDITURE.

Expenditure under this heading was reduced to a minimum, the total amounting to £2,693 5s. 6d. of which £1,724 4s. 5d. was charged to General Loan Fund and £969 1s. 1d. to C.R.F. which amount is included in our working loss for the year.

The details are as follows:—

General Loan Fund—

	£	s.	d.
Three residue conveyors	1,291	2	0
Meekatharra additions, rock breakers etc.	272	2	5
Report on sulphide plant	161	0	0
	1,724	4	5

C.R.F.—

	£	s.	d.
Purchase of horses	339	11	0
Transfer of St. Ives buildings ..	285	16	9
Scheelite plant dismantling	283	13	4
Sundries	60	0	0
	969	1	1

REPAIRS AND RENEWALS.

	£	s.	d.
Milling	7,723	5	10
Tailing plants	2,186	19	8
	9,910	5	6

The expenditure under the heading for the respective batteries is shown on Schedule 7 and 8. Included in the expenditure is the cost of extensive repairs to our manager's quarters at Marble Bar, the erection of an office and very extensive men's quarters from buildings purchased from Corunna Drome.

The manager's ancient residence at Norseman, unoccupied for some time has been put in reasonable order and the residence at Yarri also unoccupied for most of the time has been extensively altered and repaired.

This plant also had to be put in order after a long spell of idleness and the cost for new tanks, pipes, etc. has been heavy.

The whole of the vats and tanks at our Wiluna tailing plant were renewed and the cost being charged under the heading Repairs and Renewals as was the cost of a No. 2 Rotary Hoe for Coolgardie which replaced a worn-out No. 1.

STAFF.

Owing to the intermittent running, through shortage of ore, of all our plants except Kalgoorlie and Meekatharra, frequent temporary transfers were made, the only permanent alterations being the transfer of Manager Sturman's headquarters from Norseman to Ora Banda and Manager P. Hogg's appointment to Coolgardie in place of Manager A. Hepworth who retired early in the year after 41 years' service with State Batteries.

Acting Manager Clemesha completed a three years' term at our North-West Circuit and is at present on long service leave.

ADMINISTRATION.

The expenditure under this heading was £6,076 4s. 6d. as against £6,053 17s. 3d. in 1947 and equalled an amount of 1/6.09d. for each ton crushed and cyanided.

Comparative details under the different headings for the two years are as follows:—

	1948. £	s.	d.	1947. £	s.	d.
Salaries	3,549	10	9	3,818	3	3
Pay Roll Tax	1,121	15	10	1,069	3	10
Workers' Compensation ..	1,087	5	4	849	17	5
Postage	—			27	17	6
Travelling Expenses Inspection	297	14	11	270	3	3
Sundries	19	17	8	18	12	0
	6,076	4	6	6,053	17	3

Despite the increase due to basic wage adjustments salaries were lower than that for the preceding year; due to reduction in head office staff by the non-appointment of a junior clerk.

A reflection of the increases in employees' wages despite the lower tonnage handled is seen in the increased amount paid as Pay Roll Tax and Workers' Compensation.

LEASED PLANTS.

The tailing plant at Lake Darlot was completed and the Lessee had been able to satisfy practically all payments for accumulated tailing at time of writing.

Linden has had a reduced tonnage to handle and the plant has evidently run well. Difficulties over tailing payments have arisen but matters are in adjustment at the moment.

The remnants of the old Sir Samuel battery were sold and the little public crushing has been done by Mr. White's Vanguard battery.

Two small rounds were put through the Government's Weerianna battery by our north-west staff before the plant was handed over to a lessee.

Good returns were obtained from crushings put through the Government leased plant at 20-mile, though the tonnage was small and disappointing. Subsidies were paid the lessee for the year to enable customers to crush at State battery rates.

Quarters including sample and store were completed.

GENERAL REMARKS.

A glance at the figures in the attached schedules show that despite the shorter hours and increased wages our larger 10-stamp mills could be expected to run at little loss if continuously employed on ore which produced a reasonable percentage of payable tailing.

Laverton with a small tonnage and comparatively high grade tailing showed a profit of £410 and Kalgoorlie with approximately 25 per cent. of the total tonnage handled and 31 per cent. of the tailing treated showed a small loss of £443 with very low grade tailing and a heavy water bill. All these larger mills have been built since 1930 and Laverton is our latest one. The results from them combined with the annual working loss of £21,030 emphasise the costliness of the hand-fed 5-stamp plants under present working conditions.

I have stressed this point before but the diminishing tonnage and the ever increasing cost of the necessary additions to alter them to up-to-date 10-stamp plants make it difficult to recommend a general change over at the moment.

Early in the year it was decided to install a rock breaker, elevator and bins at Meekatharra which has been a busy centre showing a very heavy loss on milling. Difficulty in getting material has delayed the commencement of the work which is only now nearing completion.

The original estimate will be slightly exceeded but will be under £2,000 and there should be a saving of £1,000 per annum on a fully occupied mill.

The rock breaker, elevator and bins are so erected as to be able to supply a further 5 Stamp unit should occasion arise.

The treatment of the Mountain View ore has been successful and the decision by the directors to use our Cue plant instead of erecting their own suggests that our treatment charges are satisfactory.

Our relations with the Management have been most happy and naturally I am pleased that the Company has recognised that our State Battery method of treatment is the most suitable for small tonnages whether used by the State or small private companies.

The question of increased charges may have to be considered and I think the outback people would be prepared for some increase. In coming to this conclusion I have been influenced by the apparent willingness of the Leonora people to accept the local private battery's charges which are considerably higher than the Departments.

I also think the time crushing charge might be abolished and possibly the old regulation revived which provided for the payment of feeders wages when a specified minimum tonnage for a round was not reached.

At practically all the privately run plants the owners have to feed their ore and the Department subsidise prospectors in the Yilgarn 2s. per ton towards the cost.

On next year's Loan Estimates provision has been made for the installation of rock breakers, elevators and bins, as provided at Meekatharra, for at least two 5-head batteries at a cost of £2,000 each.

If the present state of the industry shows no signs of improvement it might be considered bad policy to carry on with this policy of mechanisation.

Personally I cannot conceive the industry being allowed to languish indefinitely and I consider the Government justified in making the additions mentioned, in the next financial year.

In concluding this report I take the opportunity of congratulating Goldfields officers on the high extraction obtained, viz 94.6 per cent. on ore treated, and to thank them and the Head Office Staff for their assistance and loyal co-operation during the year.

D. F. BROWNE,
Superintendent of State Batteries.

SCHEDULE 1.

Return showing Tons Crushed, Gold Yield by Amalgamation, Average per Ton in Shillings and Total Value without Premium for Year ended 31st December, 1948.

Battery.	Tons Crushed.	Gold Yield Bullion.	Value per Ton in Shillings and Pence.	Total Value without Premium.
		ozs.	s. d.	£ s. d.
Bamboo Creek	954	527.8	39 10	1,900 1 7
Boogardie	1,467¾	1,093.9	53 7.9	3,938 0 9
Coolgardie	3,193¾	1,851.3	41 8.7	6,664 13 3
Cue	3,898½	8,213.55	151 8.3	29,568 14 8
Kalgoorlie	10,971	3,464.95	22 8.8	12,473 15 10
Laverton	1,774¾	2,247.7	91 2.3	8,091 14 0
Marble Bar	883½	192.4	15 8.1	692 12 6
Meekatharra	4,557¼	2,054.2	32 5.5	7,395 2 3
Norseman	1,028¾	357.3	25 0.1	1,286 5 5
Ora Banda	3,476½	2,732.6	56 7.4	9,840 18 8
Paynes Find	1,594½	1,318.2	59 6.3	4,745 10 1
Peak Hill	2,879	700.3	17 6.2	2,521 1 7
Sandstone	1,006½	2,526.15	180 8.5	9,094 2 7
Wiluna	851¾	320.9	27 1.4	1,155 4 8
Yarri	1,790	1,136.8	45 8.7	4,092 9 4
Weerianna	276½	112.65	29 4	405 10 6
	40,634	28,851.69	51 1.4	103,865 17 8

SCHEDULE 2.

Number of Parcels Treated, Tons Crushed and Head Value for the Year ended 31st December, 1948.

No. of Parcels Treated.	Battery.	Tons Crushed.	Yield by Amalgamation. (Bullion.)	Yield by Amalgamation. (Fine Gold.)	Gross Contents of Tailings on 100% (including refractory).	Total Contents of Ore. (Fine Gold.)	Average per Ton (Fine Gold.)	Gross Value per Ton at £4 4s. 11½d. per Ounce.
			ozs. dwt.	ozs. dwt.	ozs. dwt.	ozs. dwt.	dwt. grs.	£ s. d.
20	Bamboo Creek	954	527 16	447 6	148 13	595 19	12 12	2 13 1
38	Boogardie	1,467¾	1,093 18	927 1	443 12	1,370 13	18 16	3 19 4
91	Coolgardie	3,193¾	1,851 6	1,568 18	636 1	2,204 19	13 19	2 18 7
97	Cue	3,898½	8,213 11	6,960 16	931 6	7,892 2	40 12	8 12 0
151	Kalgoorlie	10,971	3,464 19	2,936 9	1,668 13	4,605 2	8 9	1 15 7
27	Laverton	1,774¾	2,247 14	1,904 17	559 1	2,463 18	27 18	5 17 11
19	Marble Bar	883½	192 8	163 1	200 1	363 2	8 5	1 14 10
47	Meekatharra	4,557¼	2,054 4	1,740 17	1,039 5	2,780 2	12 5	2 11 10
28	Norseman	1,028¾	357 6	302 16	195 7	498 3	9 16	2 1 1
75	Ora Banda	3,476½	2,733 12	2,316 13	1,133 19	3,450 12	19 20	4 4 3
10	Paynes Find	1,594½	1,318 4	1,117 3	130 2	1,247 5	15 16	3 6 7
21	Peak Hill	2,879	700 6	593 10	397 0	990 10	6 21	1 9 3
14	Sandstone	1,006½	2,526 3	2,140 17	273 12	2,414 9	46 15	9 18 1
14	Wiluna	851¾	320 18	271 19	310 10	582 9	13 16	2 18 1
24	Yarri	1,790	1,136 16	963 8	245 8	1,208 16	13 12	2 17 4
10	Weerianna	276½	112 13	95 9	60 13	156 2	11 7	2 7 11
686		40,634	28,851 14	24,451 0	8,373 3	32,824 3	16 3	3 8 6

Average tons per parcel	59·23
Average yield by Amalgamation per ton (fine gold)	12 dwts. 0·8 grs.
Average value by Amalgamation per ton	£2 11s. 1d. Australian £6 9s. 5d.
Average head value of tailing (fine gold)	4 dwts. 2·9 grs.
Average value of tailing per ton	17s. 6d. Australian £2 4s. 4d.

SCHEDULE 3.

Segregation of Tailings Produced According to Value, Year ended 31st December, 1948.

Battery.	Payable.			2 dwts. 8 grns. to 1 dwt. 18 grns.			1 dwt. 18 grns. and under.			Refractory.			Total.		
	tons.	ozs.	dwts.	tons.	ozs.	dwts.	tons.	ozs.	dwts.	tons.	ozs.	dwts.	tons.	ozs.	dwts.
Bamboo Creek....	651¼	127	....	172	19	17	34¾	1	16	....	....	....	858	148	13
Boogardie	690	387	4	174½	20	12	510½	35	16	....	....	....	1,375	443	12
Coolgardie	1,484¾	500	7	692½	82	3	730¾	53	11	....	....	....	2,908	636	1
Cue	2,404	836	9	511¾	55	17	591¾	39	....	....	....	....	3,507½	931	6
Kalgoorlie	5,017¼	1,278	13	1,683¾	192	9	3,280¾	197	11	....	....	....	9,981¾	1,668	13
Laverton	1,540½	555	9	9	1	....	47	2	12	....	....	....	1,596¼	559	1
Marble Bar	335¼	178	13	39	4	1	76¼	3	19	346¼	13	8	796¾	200	1
Meekatharra	2,528½	624	8	539¾	67	....	347½	27	9	414¾	320	8	3,830½	1,039	5
Norseman	384	168	10	85½	9	1	454¾	17	16	....	....	....	924	195	7
Ora Banda	2,426½	1,077	1	334¼	39	15	360¼	17	3	....	....	....	3,121	1,333	19
Paynes Find	10½	2	4	524¾	60	1	449	32	12	342	35	5	1,326	130	2
Peak Hill	651¾	127	16	....	....	....	....	....	....	1,994¼	269	4	2,646	397	....
Sandstone	561¾	245	5	....	....	....	370¾	28	7	....	....	....	932½	273	12
Wiluna	694½	302	3	63¾	7	14	8½	....	13	....	....	....	766¾	310	10
Weerianna	206½	56	17	42	3	16	....	....	....	....	....	....	248¾	60	13
Yarri	908¾	173	13	487¼	54	13	222	17	12	....	....	....	1,618	245	8
	20,405¼	6,641	12	5,359½	617	18	7,484½	475	8	3,097¼	638	5	36,436½	8,373	3

SCHEDULE 4.

Details of Extraction Tailing Treatment, 1948.

Battery.	Tons Treated.	Head Value.	Contents.	Tail Value.	Contents.	Recovery.	Call.	Recovery.	Shortage.	Surplus.
		dwts. gns.	dwts.	dwts. gns.	dwts.	%	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Bamboo Creek	940	3 16	3,451	 15	583	82·95	608 14 10	628 11 8	....	19 16 10
Boogardie	2,248	4 8	9,755	 22	2,078	78·84	1,630 13 8	1,678 12 7	....	47 18 11
Coolgardie	5,942	3 19	22,599	 18	4,348	79·44	3,878 19 8	3,791 1 3	87 18 5	....
Cue	2,804	5 17	16,038	1 4	3,281	79·54	2,707 8 6	2,774 13 10	....	67 5 4
Kalgoorlie....	12,300	3 5·49	39,716	.... 17·33	8,884	77·63	6,548 14 9	6,557 8 8	....	8 13 11
Laverton	1,792	6 12	11,600	1 8	2,360	79·49	1,960 11 8	2,092 18 2	....	132 6 6
Marble Bar	844	7 15	6,439	1 9	1,570	81·97	1,033 1 8	1,135 2 0	....	102 0 4
Meekatharra	3,261	4 23	16,186	1 4	3,814	76·44	2,628 2 10	2,687 4 10	....	59 2 0
Ora Banda	1,812	6 10	11,641	1 19	3,228	72·08	1,787 15 2	1,839 7 7	....	51 12 5
Peak Hill	2,536	2 11	6,293	 14	1,497	76·27	1,018 10 11	1,074 8 6	....	55 17 7
Wiluna	2,986	4 3·7	12,413	1 3·2	3,391	72·26	1,916 4 2	1,876 0 6	40 3 8	....
Yarri	2,493	3 9·4	8,463	 21	2,185	74·2	1,333 7 5	1,246 15 8	86 11 9	....
	39,958	4 2·85	164,594	.... 22·35	37,219	77·55	27,052 5 3	27,382 5 3	....	300 0 0

Head Value	4 dwts. 2·85 grains
Tail Value	22·35 grains
Theoretical Recovery	77·55%
Actual Recovery	78·68%

SCHEDULE 5.

Direct Purchase of Tailings, Year ended 31st December, 1948.

Battery.	Tons of Tailings Purchased.	Amount Paid at £4 4s. 11½d.	Amount Paid A*c. Premium.
		£ s. d.	£ s. d.
Bamboo Creek	751½	123 6 8	251 7 3
Boogardie	721½	916 0 11	1,478 13 4
Coolgardie	2,150	1,608 16 8	2,175 12 9
Cue	1,708¼	1,064 7 11	1,524 18 6
Kalgoorlie	4,735¼	1,707 10 9	3,287 6 6
Laverton	1,781½	1,100 0 7	1,352 12 1
Marble Bar	485½	472 1 6	1,533 9 9
Meekatharra	2,130	685 14 1	1,669 3 8
Mt. Ida	18	19 2 4	12 7 8
Norseman	393	341 12 3	221 6 3
Ora Banda	1,962¼	1,967 0 8	2,003 1 8
Peak Hill	882¼	148 12 6	394 0 3
Sandstone	539¾	497 2 11	322 1 9
Wiluna	694½	617 5 3	1,098 1 0
Yarri	793½	154 5 6	99 18 9
20 Mile	363½	144 6 8	189 12 2
	20,110¼	£11,027 7 2	£17,613 13 4

SCHEDULE 6.

Tailing Treatment, 1948.

Battery.	Tonnage.	Yield.	Value.	Premium.	Total.
		Fine ounces.	£	£	£
Bamboo Creek	940	147.62	628.583	961.767	1,590.350
Boogardie	2,248	395.18	1,678.629	2,574.487	4,253.116
Coolgardie	5,942	892.56	3,787.005	5,814.779	9,601.784
Cue	2,804	652.93	2,774.692	4,253.649	7,028.341
Kalgoorlie	12,300	1,541.86	6,551.111	10,044.638	16,595.749
Laverton	1,792	489.96	2,092.907	3,191.987	5,284.894
Marble Bar	844	267.05	1,135.100	1,739.740	2,874.840
Meekatharra	3,261	632.64	2,687.239	4,121.398	6,808.637
Ora Banda	1,812	432.93	1,839.376	2,820.402	4,659.778
Peak Hill	2,536	252.95	1,074.424	1,647.827	2,722.251
Wiluna	2,986	441.65	1,876.024	877.265	4,753.289
Yarri	2,493	293.28	1,246.783	1,910.690	3,157.473
	39,958	6,440.61	27,371.873	41,958.629	69,330.502

SCHEDULE 7.

Statement of Receipts and Expenditure for Year ended 31st December, 1948.

MILLING.

Batteries.	Tonnage. Crushed.	EXPENDITURE.								RECEIPTS.		Profit.	Loss.
		Management.	Wages.	Stores.	Total Working Expenditure.	Cost per Ton.	Repairs and Renewals.	Sundries.	Gross Expenditure.	Cost per Ton.	Receipts.	Receipts per Ton		
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.
Bamboo Creek	954	139 3 0	697 0 5	243 16 5	1,079 19 10	22 7·7	66 7 9	120 3 1	1,266 10 8	26 6·6	552 11 6	11 7	....	713 19 2
Boogardie	1,467¾	170 4 6	702 0 0	403 17 2	1,276 1 8	17 4·6	362 12 1	287 5 2	1,925 18 11	26 2	752 17 0	10 3·1	....	1,173 1 11
Coolgardie	3,193¾	450 14 3	1,299 8 10	984 3 9	2,734 6 10	17 1·4	522 0 5	475 15 7	3,732 2 10	23 4·4	1,425 9 8	9 11·2	....	2,306 13 2
Cue	3,898½	459 10 7	1,690 0 8	916 1 0	3,065 12 3	15 8·1	814 0 3	522 15 3	4,402 7 9	22 7	2,220 1 8	11 4·3	....	2,182 6 1
Kalgoorlie	10,971	819 1 1	2,380 17 10	1,789 11 4	4,989 10 3	9 1·1	819 12 11	2,336 5 1	8,145 8 3	14 10·1	4,707 3 1	8 7	....	3,438 5 2
Lake Darlot	....	....	....	0 8 0	0 8 0	....	172 0 0	224 14 4	397 2 4	....	....	....	....	397 2 4
Laverton	1,774¾	199 14 5	686 5 5	264 8 1	1,150 7 11	12 11·6	186 10 9	261 4 4	1,598 3 0	18 0·1	851 5 0	9 7·1	....	746 18 0
Linden	....	....	....	....	....	....	....	....	....	....	94 14 6	....	94 14 6	....
Marble Bar	883½	247 10 11	356 14 1	257 10 11	861 15 11	19 6·2	996 9 4	155 13 6	2,013 18 9	45 7·2	449 0 6	10 2	....	1,564 18 3
Meekatharra	4,557¼	410 7 5	2,513 0 8	1,066 10 2	3,989 18 3	17 6·1	530 11 4	753 16 11	5,274 6 6	23 2·2	2,206 8 2	9 8·2	....	3,067 18 4
Mt. Ida	....	....	42 6 5	10 10 3	52 16 8	....	21 18 3	11 11 11	86 6 10	....	2 9 3	....	....	83 17 7
Mt. Sir Samuel	....	....	....	....	....	....	2 14 6	....	2 14 6	....	....	....	....	2 14 6
Norseman	1,028¾	229 12 8	828 3 0	450 8 1	1,508 3 9	29 3·8	621 4 4	237 17 0	2,367 5 1	46 0·2	489 5 9	9 6·1	....	1,877 19 4
Ora Banda	3,476½	262 10 10	1,094 18 9	625 11 9	1,983 1 4	11 4·9	328 9 4	474 9 4	2,786 0 0	16 1·3	1,408 19 11	8 1·1	....	1,377 0 1
Paynes Find	1,594½	254 3 8	987 1 11	340 18 5	1,582 4 0	19 10·2	159 16 11	516 17 11	2,258 18 10	28 4·1	1,001 14 0	12 6·7	....	1,257 4 10
Peak Hill	2,879	384 11 2	1,583 12 4	575 13 8	2,543 17 2	17 8·1	694 12 11	488 14 9	3,727 4 10	25 10·4	1,353 10 7	9 4·9	....	2,373 14 3
Sandstone	1,036½	241 18 4	725 10 3	341 9 2	1,308 17 9	25 3·1	199 7 11	335 16 10	1,844 2 6	35 7	574 12 11	11 1·1	....	1,269 9 7
St. Ives	....	....	....	....	....	....	....	5 15 0	5 15 0	....	....	....	....	5 15 0
Twenty Mile Sandy	....	....	....	4 15 3	4 15 3	....	....	....	4 15 3	....	....	....	....	4 15 3
Warriedar	....	....	....	10 11 3	10 11 3	....	8 14 10	1 14 0	21 0 1	....	0 19 6	....	....	20 0 7
Weerianna	276½	93 5 0	138 11 7	59 19 11	291 16 6	21 1·3	89 15 6	185 6 5	566 18 5	41 0·1	143 12 10	10 4·7	....	423 5 7
Wiluna	851¾	75 2 2	371 4 8	138 5 5	584 12 3	13 8·7	237 8 10	237 3 3	1,059 4 4	24 10·4	441 13 11	10 4·5	....	617 10 5
Yalgoo	....	....	....	100 0 0	100 0 0	....	....	5 16 0	105 16 0	....	....	....	....	105 16 0
Yarri	1,790	314 3 5	1,506 9 3	616 8 0	2,437 0 8	27 2·7	888 17 8	411 14 6	3,737 12 10	41 9·2	980 11 4	10 11·5	....	2,757 1 6
Head Office	....	....	....	....	....	....	....	....	....	....	0 5 0	....	0 5 0	....
Closed Batteries	....	....	....	....	....	....	....	....	....	....	1 0 0	....	1 0 0	....
	40,634	4,751 13 5	17,603 6 1	9,200 18 0	31,555 17 6	15 6·3	7,723 5 10	8,050 10 2	47,329 13 6	23 3·5	19,658 6 1	9 8·1	95 19 6	27,767 6 11
TOTAL LOSS	....	....	....	....	....	....	....	....	....	....	....	....	....	£27,671 7 5

SCHEDULE 8.

Statement of Receipts and Expenditure for Year ended 31st December, 1948.

TAILING TREATMENT.

Batteries.	Tons Treated.	EXPENDITURE.									RECEIPTS.		Profit.	Loss.
		Management.	Wages.	Stores.	Total Working Expenditure.	Cost per Ton.	Repairs and Renewals.	Sundries.	Gross Expenditure.	Cost per Ton.	Receipts	Receipts per Ton.		
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	s. d.	£ s. d.	£ s. d.
Bamboo Creek	940	80 3 8	218 11 5	129 19 5	428 14 6	9 1·5	78 4 1	113 8 7	620 7 2	13 2·4	1,090 4 6	23 2·4	469 17 4	....
Boogardie	2,248	197 16 10	852 2 3	367 19 7	1,417 18 8	12 7·4	147 10 8	244 1 6	1,809 10 10	16 1·2	2,175 7 3	19 4·3	365 16 5	....
Coolgardie	5,942	447 13 3	2,104 1 8	1,220 17 10	3,772 12 9	12 8·2	133 6 1	598 16 7	4,504 15 5	15 1·9	5,806 5 4	19 6·5	1,301 9 11	....
Cue	2,804	64 2 10	910 6 5	649 11 6	1,624 0 9	11 7	100 9 2	286 10 6	2,011 0 5	14 4·2	3,373 4 0	24 1·7	1,362 3 7	....
Kalgoorlie	12,300	391 6 4	3,893 19 7	2,081 6 9	6,366 12 8	10 4·3	363 18 1	1,056 15 5	7,787 6 2	12 7·9	10 782 12 9	17 6·4	2,995 6 7	....
Laverton	1,792	280 10 11	474 16 11	307 16 3	1,063 4 1	11 10·4	65 5 0	261 14 11	1,390 4 0	15 6·1	2,547 2 8	28 5·1	1,156 18 8	....
Marble Bar	844	161 2 2	311 10 1	218 1 10	690 14 1	16 4·4	214 2 6	174 6 3	1,079 2 10	25 7·8	1,306 5 5	30 11·6	227 2 7	....
Meekatharra	3,261	380 17 4	1,263 12 0	938 13 5	2,583 2 9	15 10·1	112 7 0	455 1 1	3,150 10 10	19 3·9	3,037 1 9	18 7·6	....	113 9 1
Norseman	....	5 0 0	3 15 0	40 3 0	48 18 0	....	87 4 7	11 7 8	147 10 3	....	....	....	....	147 10 3
Ora Banda	1,812	314 7 9	810 6 7	598 7 11	1,723 2 3	19 0·1	132 15 4	219 17 11	2,075 15 6	22 10·8	2,146 5 5	23 8·3	70 9 11	....
Paynes Find	....	....	....	....	....	....	....	13 16 10	13 16 10	....	....	....	....	13 16 10
Peak Hill	2,536	160 14 1	701 0 3	444 7 9	1,306 2 1	10 3·7	79 16 3	221 11 0	1,607 9 4	12 8·2	1,922 4 8	15 1·8	394 15 4	....
Sandstone	....	....	....	9 9 10	9 9 10	....	1 19 9	14 9 5	25 19 0	....	....	....	....	25 19 0
Warriedar	....	....	....	....	....	....	....	1 14 3	1 14 3	....	....	....	....	1 14 3
Wiluna	2,986	302 4 0	1,014 19 1	748 1 6	2,065 4 7	13 10	470 13 8	390 1 1	2,925 19 4	19 7·3	2,742 8 11	18 4·4	....	183 10 5
Yalgoo	....	....	....	....	....	....	....	0 11 0	0 11 0	....	....	....	....	0 11 0
Yarri	2,493	189 3 2	802 14 7	607 4 8	1,599 2 5	12 9·9	199 7 6	277 5 11	2,075 15 10	16 7·6	1,937 16 11	15 5·7	....	137 18 11
Twenty Mile	....	....	....	....	....	....	....	....	....	....	0 7 10	....	0 7 10	....
	39,958	2,975 2 4	13,361 15 10	8,362 1 3	24,698 19 5	12 4·3	2,186 19 8	4,341 9 11	31,227 9 0	15 7·5	38,867 7 5	19 5·5	8,264 8 2	£624 9 9
Interest Paid to Treasury	....	....	....	....	....	....	....	....	....	....	998 15 1	....	....	998 15 1
Net Receipts	....	....	....	....	....	....	....	....	....	....	37,868 12 4	....	....	1,623 4 10
		....	....	....	....	....	....	....	....	....	....	....	1,623 4 10	....
TOTAL PROFIT	....	....	....	....	....	....	....	....	....	....	....	....	6,641 3 4	....

GENERAL WORKING ACCOUNT FOR YEAR ENDED 31ST DECEMBER, 1948, COMPARED WITH 1947.

	1947. Milling.	Cyaniding.	Total.		1947. Milling.	Cyaniding.	Total.
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
To Wages	22,280 6 1	14,793 10 3	37,073 16 4	By Revenue	23,530 12 7	36,032 15 7	59,563 8 2
,, Stores	7,611 18 2	6,013 7 8	13,625 5 10	,, Loss Carried Down	20,256 4 0	....	20,256 4 0
,, Repairs and Renewals	6,938 1 2	3,053 8 1	9,991 9 3				
,, Battery Spares	1,130 7 2	....	1,130 7 2				
,, Water	3,442 18 8	2,184 9 7	5,627 8 3				
,, General Expenses	2,383 5 4	1,575 14 2	3,958 19 6				
,, Profit Carried Down	....	8,412 5 10	8,412 5 10				
	£43,786 16 7	£36,032 15 7	£79,819 12 2		£43,786 16 7	£36,032 15 7	£79,819 12 2

	1948. Milling.	Cyaniding.	Total.		1948. Milling.	Cyaniding.	Total.
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
To Wages	22,354 19 6	16,336 18 2	38,691 17 8	By Revenue	19,658 6 1	37,868 12 4	57,526 18 5
,, Stores	9,200 18 0	8,362 1 3	17,562 19 3	,, Loss Carried Down	24,605 13 8	....	24,605 13 8
,, Repairs and Renewals	7,723 5 10	2,186 19 8	9,910 5 6				
,, Battery Spares	1,260 10 1	....	1,260 10 1				
,, Water	....	....	....				
,, General Expenses	3,724 6 4	1,330 19 2	5,055 5 6				
,, Profit Carried Down	....	9,651 14 1	9,651 14 1				
	£44,263 19 9	£37,868 12 4	£82,132 12 1		£44,263 19 9	£37,868 12 4	£82,132 12 1

Profit and Loss Account.

	1947. Milling.	Cyaniding.	Total.		1947. Milling.	Cyaniding.	Total.
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
To Loss Brought Forward	20,256 4 0	....	20,256 4 0	By Profit Brought Down	....	8,412 5 10	8,412 5 10
,, Administration	3,270 17 9	2,782 19 6	6,053 17 3	,, Gross Loss Brought Down	23,527 1 9	....	23,527 1 9
,, Gross Profit Carried Down	....	5,629 6 4	5,629 6 4				
	£23,527 1 9	£8,412 5 10	£31,939 7 7		£23,527 1 9	£8,412 5 10	£31,939 7 7

	1948. Milling.	Cyaniding.	Total.		1948. Milling.	Cyaniding.	Total.
	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	£ s. d.
To Loss Brought Forward	24,605 13 8	....	24,605 13 8	By Profit Brought Down	....	9,651 14 1	9,651 14 1
,, Administration	3,065 13 9	3,010 10 9	6,076 4 6	,, Gross Loss Brought Down	27,671 7 5	....	27,671 7 5
,, Gross Profit Carried Down	....	6,641 3 4	6,641 3 4				
	£27,671 7 5	£9,651 14 1	£37,323 1 6		£27,671 7 5	£9,651 14 1	£37,323 1 6

General Profit and Loss Account.

1947.	£ s. d.	£ s. d.	1947.	£ s. d.
To Gross Loss Milling	23,527 1 9		By Nett Loss Carried Down	39,071 10 4
,, *Less* Gross Profit Cyaniding	5,629 6 4			
		17,897 15 5		
,, Interest	....	18,495 6 3		
,, Sinking Fund	....	1,406 0 0		
,, Depreciation	....	426 15 0		
,, Superannuation	....	845 13 8		
		39,071 10 4		39,071 10 4
,, Balance Brought Forward	....	1,451,743 5 5	,, Balance Carried Down	1,490,814 15 9
,, Loss for Year	....	39,071 10 4		
		£1,490,814 15 9		£1,490,814 15 9

1948.	£ s. d.	£ s. d.	1948.	£ s. d.
To Gross Loss Milling	27,671 7 5		By Nett Loss Carried Down	46,632 14 5
,, *Less* Gross Profit Cyaniding	6,641 3 4			
		21,030 4 1		
,, Interest	....	18,540 3 5		
,, Sinking Fund	....	1,431 12 0		
,, Depreciation	....	4,299 8 4		
,, Superannuation	....	1,331 6 7		
		46,632 14 5		46,632 14 5
,, Balance Brought Forward	....	1,490,814 15 9	,, Balance Carried Down	1,537,447 10 2
,, Loss for Year	....	46,632 14 5		
		£1,537,447 10 2		£1,537,447 10 2

BALANCE SHEET AS AT 31st DECEMBER, 1948.
COMPARED WITH 1947.

(For the Year 1947.)

Liabilities—1947.	£ s. d.	£ s. d.
Capital provided from—		
General Loan Fund	411,322 2 4	
Consolidated Revenue Fund	96,755 15 5	
Assistance Gold Mining Industry	28,621 13 5	
Commonwealth Assistance Metalliferous Mining	13,786 8 0	
		550,485 19 2
Tailings—		
Advanced by Treasury	22,500 0 0	
Sundry Creditors—		
For Tailings	665 17 1	
For Premiums	418 19 11	
Estimated Balance of Premium Due	602 4 6	
		24,187 1 6
Due to State Treasury—		
Excess of Expenditure over Revenue	179,281 3 6	
Superannuation—Employer's Contribution	2,702 19 11	
Interest on General Loan Fund Capital	715,513 6 3	
Sinking Fund on General Loan Capital	138,861 8 4	
		1,036,358 18 0
Sundry Creditors—		
Ordinary Accounts	3,177 2 2	
Cash Orders unpaid	2,490 18 7	
		5,668 0 9
		£1,616,699 19 5

Assets—1947.	£ s. d.	£ s. d.
Plant and Buildings Less Depreciation	....	75,713 14 1
Motors and Horses	2,185 3 9	
Less Depreciation	406 15 0	
		1,778 8 9
Stores—		
Outstations	17,700 2 4	
Head Office	136 5 10	
		17,836 8 2
Sundry Debtors	....	5,500 2 9
Battery Spares	....	869 8 5
Tailings—		
Tailings (not treated)	21,588 14 10	
Estimated Gold Premium	602 4 6	
Cash Balance of Advance	1,996 2 2	
		24,187 1 6
Profit and Loss Account	....	1,490,814 15 9
		£1,616,699 19 5

(For the Year 1948.)

Liabilities—1948.	£ s. d.	£ s. d.
Capital provided from—		
General Loan Fund	412,846 6 9	
Consolidated Revenue Fund	97,724 16 6	
Assistance Gold Mining Industry	28,621 13 5	
Commonwealth Assistance Metalliferous Mining	13,786 8 0	
		552,979 4 8
Tailings—		
Advanced by Treasury	22,000 0 0	
Sundry Creditors—		
For Tailings	1,828 14 10	
For Premiums	2,135 12 7	
Estimated Balance of Premium Due	669 2 3	
		26,633 9 8
Due to State Treasury—		
Excess of Expenditure over Revenue	201,688 15 8	
Superannuation—Employer's Contribution	4,034 6 6	
Interest on General Loan Fund Capital	734,053 9 8	
Sinking Fund on General Loan Capital	140,293 0 4	
		1,080,069 12 2
Sundry Creditors—		
Ordinary Accounts	3,209 12 8	
Cash Orders unpaid	2,484 5 6	
		5,693 18 2
		£1,665,376 4 8

Assets—1948.	£ s. d.	£ s. d.
Plant and Buildings	77,880 0 10	
Less Depreciation	3,862 8 7	
		74,017 12 3
Motors and Horses	2,107 19 9	
Less Depreciation	436 19 9	
		1,671 0 0
Stores—		
Outstations	18,119 2 8	
Head Office	148 0 5	
		18,267 3 1
Sundry Debtors	....	6,507 7 2
Battery Spares	....	832 2 4
Tailings—		
Tailings (not treated)	22,728 1 2	
Estimated Gold Premium	669 2 3	
Cash Balance of Advance	3,236 6 3	
		26,633 9 8
Profit and Loss Account	...	1,537,447 10 2
		£1,665,376 4 8

ANNUAL PROGRESS REPORT OF THE GEOLOGICAL SURVEY BRANCH OF THE MINES DEPARTMENT FOR THE YEAR 1948.

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Plates.

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Division IV.

Annual Progress Report of the Geological Survey of Western Australia for the Year ended 31st December, 1948.

The 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, 1948.

STAFF.

The active strength at the end of the year was as follows:—

			Total
Professional.			
Ellis, H. A., B.Sc., A.O.S.M.	Government Geologist		
McMath, J. C., B.Sc. (Hons. London), F.G.S.	Senior Geologist		
Lord, J. H., B.Sc., F.G.S.	Geologist, 1st Class		
Johnson, W., B.Sc. (Hons.)	Geologist, 1st Class		
Gray, N. M., B.Sc.	Geologist, 2nd Class		8
Gleeson, J., B.Sc.	Geologist, 2nd Class		
de la Hunty, L. E., B.Sc.	Geologist, 2nd Class		
Sofoulis, J., B.Sc.	Geologist, 2nd Class		
Clerical.			
Outtrim, I. F.	Clerk		
MacDonald, Mrs. N.	Typist (Temporary)		3
Potts, N. M.	Trainee Junior Clerk		
Laboratory.			
Fimmell, L. H.	Laboratory Assistant		1

Promotions, Resignations, New Appointments.

Mr. W. Johnson, B.Sc. (Hons.) was promoted to Geologist 1st Class as from 3rd June, 1948, to fill the vacancy caused by the promotion last year of Mr. McMath to Senior Geologist.

Mr. H. J. Ward, B.Sc., resigned on October 8th to join the staff of the Commonwealth Bureau of Mineral Resources, Canberra.

Mr. N. M. Gray, B.Sc., joined the staff as Geologist 2nd Class on February 16th.

Mr. J. Gleeson, B.Sc., Mr. L. E. de la Hunty, B.Sc., and Mr. J. Sofoulis, B.Sc., appointed as Geologists 2nd Class on 30th November.

Messrs. Gleeson, de la Hunty and Sofoulis graduated at the University of Western Australia in November and are ex-servicemen from the Royal Australian Air Force.

During the year Miss E. Meredith resigned from the position of typist owing to ill-health, and I would like to here record my appreciation of the very efficient service given by Miss Meredith in a most pleasing manner. The extreme shortage of competent technical typists and stenographers is reflected in the fact that the position vacated by Miss Meredith has not yet been filled by a permanent employee, and our present typist is the fourth since Miss Meredith left the Survey on May 20th. The following ladies served as temporary typists since May 20th:—Mrs. Peirce, Mrs. Walsh, Mrs. Morrison, Mrs. MacDonald.

Increase in Staff.

For the first time in three years the authorised strength of the professional staff, namely, one Government Geologist, one Senior Geologist, two Geologists 1st Class, and four Geologists 2nd Class, was brought up to full strength by the appointment in November of young graduates from the University of Western Australia to fill vacant postings.

The demands on the services of the Geological Survey are far in excess of what can be met with the authorised strength of eight geologists, but the State must consider itself fortunate in having this relatively strong geological staff, when probably not in the history of Australia has the demand for geologists been so strong.

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

Period.	Number of Geologists available including Government Geologist.	Area of State.	Square Miles per Geologist.	Population.
		sq. miles.		
1948.				
Jan.-Sept.	6	975,920	162,650	....
Oct.-Nov.	5	....	195,180	521,000
Dec.	8	....	121,990	....

ACTIVITIES OF PROFESSIONAL OFFICERS.

H. A. Ellis, Government Geologist.

In addition to head-office duties the following field work was undertaken:—

Places Visited.	*Purpose of Visit.*	*Period.*
On Long Service Leave		Jan.-Mar. (incl.)
Collie	Field inspection diamond drilling, Collie Burn Leases	April
Day Dawn	Field work in connection with projected deep drilling of Great Fingal	do.
Norseman	Inspection development work "Iron King" mine	May
	Inspection field work Coolgardie Geological Survey	do.
Geraldton and Northampton Districts	Water supply investigations	June
Day Dawn	Inspection field work in connection with Great Fingal deep drilling project	do.
Coolgardie	Inspection field work Coolgardie Geological Survey	do.
Mt. Ida	Inspection Timoni Gold Mine	do.
Edward's Find	Inspection underground development	do.
Mt. Ida District	Field Inspection	July
Coolgardie	Inspection field work Geological Survey	do.
Norseman	Inspection Iron King Pyrite Mine	do.
Greenbushes	Inspection tin deposits	August
Mt. Barker	Spongolite deposits Inspection	do.
Kondinin District	Water Supply	September
Norseman	Inspection Iron King Pyrite Mine	October
Tenindewa	Inspection Manganese Deposit	do.
Yinnietharra	Inspection of Beryl field	November
Kondinin District	Location of bore sites—farm water supplies	do.
Norseman	Inspection Iron King Pyrite Mine	December

J. C. McMath, Senior Geologist.

Acting Government Geologist during absence of Government Geologist on long service leave. Office duties in connection with Coolgardie re-survey. Preparation of reports for Annual Progress Report and general preparations for 1948 field season.

May-November: In charge of Coolgardie re-survey. Miscellaneous inspections in Coolgardie Goldfield.

December: Preparation of reports for Annual Report.

J. H. Lord, Geologist 1st Class.

January-May: Provided geological supervision for drilling at Collie carried out on the Collie Burn leases by the Mines Department, on the Black Diamond leases by the State Electricity Commission and on Prospecting Area 53 by the Goldfields Coal Syndicate. Reports prepared on the two former drilling programmes as completed.

June-July: Supervised drilling on Prospecting Area 53 and visited the Yanmah Kyanite deposit.

August-September: Supervised drilling and prepared detailed geological report on Prospecting Area 53. Set out drilling programme for Prospecting Area 54. Visited Yanmah twice and prepared report on the kyanite deposit. Visited and reported on a gold find in the Upper Helena River Valley.

October-November: Geological survey made of the Cardup Area for brickmaking materials. Surveyed sites for deep drilling at Collie.

December: Geological reconnaissance made of the Nannup-Fly Brook area for coal possibilities. Inspected manganese deposit at Laverton.

W. Johnson, Geologist 1st Class.

Janaary-April: Compilation of reports on Murchison Reconnaissance Survey and Hill 50 G.M.

May: Examination beach sand deposits, Denmark.

June: Examination Calyerup Creek gold find.

July-August: Examination Timoni Gold Mine, Mt. Ida.

September: Mapping Iron King and Lady Miller Leases, Norseman.

October: Examination anthophyllite deposit, Bindi Bindi.

November: Examination beryl deposits, Yinnietharra.

December: Examination clay deposits, metropolitan area.

N. M. Gray, Geologist, 2nd Class.

Appointed in February.

February-April: Compilation of Geological Sketch Map of W.A., 1949, in conjunction with Mr. Lord.

April-June: Survey of portion of the leases at Day Dawn in connection with a proposed deep drilling programme of the Great Fingal ore body.

June-November: In the field on group mapping in connection with the re-survey of the Coolgardie District.

November-December: Office work, preparation of reports.

H. J. Ward, Geologist 2nd Class.

Engaged in compilation of reports on mining groups in connection with the Coolgardie re-survey until date of resignation, October 8th.

J. Glecson, Geologist 2nd Class.

Appointed November 30th.

December: Assisting Mr. Johnson in the Yinnietharra beryl examination and in the examination of metropolitan clay deposits. Preparation of data for projected survey of Irwin River coal basin.

L. E. de la Hunty, Geologist 2nd Class.

Appointed November 30th.

December: Assisting Mr. Lord in Collie coal field work. Nannup District coal reconnaissance and inspection of manganese deposits, Laverton.

J. Sofoulis, Geologist 2nd Class.

Appointed November 30th.

December: Preparation of data for use in connection with oil survey activities in Exmouth Gulf District. Commenced field work with American oil geologist, Craig, carrying out investigations for Australian Motorists Petrol Company Limited (A.M.P.O.L.), holders of the permit to explore for petroleum in this area.

FIELD WORK.

Field Work in Progress as at December 31.

(1) The re-survey of approximately 900 square miles surrounding Coolgardie was completed in November, and no major field work was in progress at the end of the year.

(2) Beach and river sand reconnaissance investigations on behalf of the Commonwealth Bureau of Mineral Resources, Canberra. One party only operating on river sands.

(3) One officer (Mr. Sofoulis) participating in an oil survey in the Exmouth Gulf area, North-West Division.

Field Work for 1949.

(1) Completion of item (2) above.

(2) Commencement of a geological survey of the Irwin and Greenough River basins for coal.

(3) Supervision of deep-drilling campaigns at Collie and Day Dawn for coal and gold respectively.

(4) Commencement of detailed surveys in either the Mt. Magnet or Linden areas for gold.

(5) Continuation of item (3) above.

TRANSPORT.

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

Vehicle.	Make and Type.	Load.	Mileage as at 31-12-48.	Mileage for 1948.	Date Vehicle Purchased.	Remarks.
WAG 534	Dodge Utility	15 cwt.	102,675	7,713	1935 (new)	Three months in P.E's. workshop.
1053	Ford Utility	18 cwt.	55,255	6,590	1945 (used)	Five months in P.E'S. workshop.
1060	International Utility	15 cwt.	48,324	*4,199	1945 (used)	Two months in P.E's. workshop.
1175	Ford Utility	15 cwt.	28,408	6,859	1946 (new)	
1194	Ford Utility	15 cwt.	26,020	11,718	1946 (new)	
1307	Chevrolet Utility	15 cwt.	72,948	10,154	1947 (used)	
1413	Chevrolet Utility	15 cwt.	19,886	17,383	1947 (new)	
1421	Chevrolet Utility	15 cwt.	13,786	12,046	1947 (new)	

*Includes estimated 700 miles travelled while speedometer in disrepair.

Seventy-six thousand, six hundred and sixty-two miles travelled during the year with eight vehicles = av. 9,582 miles per vehicle, compares with 65,619 miles for 1947 with an average of 7,291 miles per vehicle (9).

Time spent by vehicles Nos. 534, 1053 and 1060 in plant engineers' workshop represents the loss of one year's use of a vehicle.

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

There has been no diminution in the number of enquiries for geological information throughout the year, and the Geological Survey has continued to render much appreciated help to mining interests and other Government Departments.

ACTIVITIES OF THE COMMONWEALTH BUREAU OF MINERAL RESOURCES.

The Geological Survey continued the work on beach and river sands investigations undertaken on behalf of the Commonwealth Bureau of Mineral Resources under circumstances as outlined in my last annual report. Two parties were in the field throughout the year up to the end of October and since that month work has been continued by one party only. This work is nearing completion.

Three Commonwealth geologists were engaged during part of the year on the mapping of sedimentary rocks and structures in the Fitzroy River area in conjunction with private geologists working for Australian Mining and Smelting Company Limited, who hold permits to explore for petroleum in this part of the State.

Three Commonwealth geologists were also operating in the Middalya district, north-east of Carnarvon, for part of the year examining the sedimentary rock succession and structure with a view to gaining information pertaining to the possible occurrence of petroleum in what is known as the North-West Basin.

Two student cadet geologists employed by the Bureau of Mineral Resources were working with an American oil geologist on a potential oil bearing area held by Australian Motorists Petrol Company Ltd., Sydney, in the Exmouth Gulf district of the North-West Basin during December. The search for radio-active minerals in the Marble Bar district of the Pilbara Goldfield was carried out by two geologists from the Commonwealth Bureau of Mineral Resources during several months of the year.

A Commonwealth geologist resident in Perth has also been engaged on miscellaneous mineral investigations throughout the year.

A party of geophysicists from the Bureau of Mineral Resources has been conducting geophysical surveys on potential deep alluvial leads south-east of Kalgoorlie on ground held by Western Mining Corporation.

PUBLICATIONS.

Issued During 1948.

Annual Progress Report of the Geological Survey of Western Australia for 1945.

Mineral Resources of Western Australia, Bulletin No. 4: The Dandaragan Phosphate Deposits, by R. S. Matheson, B.Sc., Geological Survey of Western Australia.

In the Press.

Annual Progress Reports of the Geological Survey for 1946 and 1947.

Geological Survey of Western Australia, Bulletin No. 102: The Greenbushes Mineral Field, by R. A. Hobson, B.Sc. (Hons.), and R. S. Matheson, B.Sc., Geological Survey of Western Australia (nearing completion).

Compiled and Awaiting Authority to Print.

Geological Survey of Western Australia Bulletin on the Geology of Portion of the Mt. Margaret Goldfield, by R. A. Hobson, B.Sc. (Hons.), Geological Survey of Western Australia plus two atlases of maps.

Geological Survey of Western Australia Bulletin on Some Economic Aspects of the Principal Tantalum Bearing Deposits of the Pilbara Goldfield, North-West Division, by H. A. Ellis, B.Sc., A.O.S.M., Geological Survey of Western Australia.

Mineral Resources of Western Australia Bulletin, Moulding Sands, by K. R. Miles, D.Sc., F.G.S., Geological Survey of Western Australia and H. A. Stephens, B.Sc., Council for Scientific and Industrial Research.

Mineral Resources of Western Australia Bulletin, Silver Lead, and Zinc, by W. Johnson, B.Sc. (Hons.), Geological Survey of Western Australia.

Mineral Resources of Western Australia Bulletin, Vermiculite, Talc and Soapstone, Fullers Earth, Bentonite, and Diatomite, by W. Johnson, B.Sc. (Hons.), Geological Survey of Western Australia.

Atlas of Maps of Bulletin No. 101 ("The Mining Groups of the Yilgarn Goldfield, North of the Great Eastern Railway").

Geological Survey of Western Australia, Bulletin on a Geological Reconnaissance of Part of the Area included between the limits Lat. 24° 00′S., and Lat. 29° 00′S. and between Long. 115° 00′E. and Long. 118° 30′E., including parts of the Yalgoo, Murchison, Peak Hill and Gascoyne Goldfields, by W. Johnson, B.Sc. (Hons.), Geological Survey of Western Australia.

Attention is drawn to the serious lag in the printing of the various reports listed above. Unless some improvement can be expected in this matter, a basic revision of the publishing policy of the Survey will be necessary.

In Course of Preparation.

Reprint of Geological Survey Bulletin 95, "The Physiography of Western Australia," by J. T. Jutson.

A Geological Sketch Map of Western Australia (40 miles = 1-inch) brought up to date 1949.

A Geological Survey Bulletin on the Resurvey of the Coolgardie District by J. C. McMath and N. M. Gray, Geological Survey of Western Australia.

Only very small progress has been made in publishing our reports, and the Geological Survey is not responsible for this state of affairs.

The achievements of the Survey during the year have been made possible mainly by the excellent spirit of co-operation manifested by all members of the staff, to whom I offer my thanks.

H. A. ELLIS,
Government Geologist.

January 28th, 1949.

WATER SUPPLY—CHAPMAN ROAD AREA, GERALDTON DISTRICT.

Report by H. A. Ellis, Govt. Geologist.

General Statement of the Problem.

It appears that up to the time of inspection (May 25th, 1948), tomato growers in the Chapman Road area were short of water for irrigation purposes. The quality of the water obtained from comparatively shallow bores was not good enough for irrigating young tomato plants, but did not seriously affect mature plants. Many growers had their own shallow bores, but a considerable number were carting water from the Chapman Road tanks which were having great difficulty in meeting the demand. The water in the Chapman Road tanks was supplied from the Wicherina-Geraldton pipe line.

The pipe line to the Chapman Road tanks was in course of duplication, and was nearly completed on May 25th. It is thus presumed that the immediate demand for water would be met by an increased rate of supply to these tanks.

Suggestions had been made (B. S. Crimp, A. M. Hutchinson, P.W.W.S. file 316/43) that certain usable waters at Narra Tarra, some six miles by road to the East, might be utilised in a pumping scheme, and that exploratory boring in search of sub-artesian water might be undertaken in this vicinity with a long range view of subsequent utilisation in a greater Geraldton scheme in the future.

Water Possibilities of the Area.

(*a*) *Ground Water.*—Shallow bores into the ground water zone have shown that the water here is not suitable for the complete needs of tomato growing in all its stages. The fresh water area on Ruddaway's property (Loc. 24) looks attractive, but does not give the impression that it would be of sufficient capacity to stand up to a continuous draw which would be made on it if it were exploited as the sole source of supply for the area West of the Morseby Range.

On the western side of the Morseby Range no conditions similar to those on Loc. 24 were observed, and there is very little prospect of obtaining usable water requirements from shallow ground water sources here.

(*b*) *Sub-Artesian Water.*—Some of the bores on the Western side of the Morseby Range are reported to be up to 250 feet deep, and the water in some of them is said to have risen in the holes after being encountered. The quality is reported as being not good enough for the complete needs of tomato growing.

Elsewhere, there does not appear to be any information available about the quality or quantity of sub-artesian water.

The rocks of the area consist of shales and sandstones with shales unfortunately predominating. The dip in general is at a very low angle to the West and over a fairly large area of country surrounding the area under consideration, no obvious intake beds in favourable topographic circumstances could be found.

An attempt to locate sub-artesian water would be entirely exploratory, and in any such undertaking it should be remembered that no accurate prediction can be made as to quantity, quality, or depth at which a water horizon would be likely to be encountered.

Three sites as set out below, are suggested as being most suitable for dual-purpose holes should it be decided to engage in this exploratory work.

Site No. 1.—Map Reference. Military Survey Series, 1 mile = 1 inch, NANSON, Point 564407.

This point is two miles along the road from the railway crossing on the Chapman Road tanks—Yuna Road. A drainage channel crosses the road from the N.E., and a suggested site is on the road reserve just North of the road on the South side of the drainage channel. The local topography is such that any possible useful supplies of ground water would be tested in the course of drilling for sub-artesian water.

The altitude of the site is about 245 feet above sea level. An arbitrary depth could be 1,000 feet or prior granite basement—depending on finance available. Shales and sandstones would be the principal rock types encountered.

Site No. 2.—Map Reference. Military Survey Series, 1 mile = 1 inch, NANSON, Point 627392.

This point is on Ruddaway's Loc. 24 immediately on the North side of Ego Creek in the South-Eastern portion of the block approximately 20 chains upstream from the point where Ego Creek goes out of the location. On the military map NANSON 1 mile = 1 inch, it is where the 200 feet contour crosses Ego Creek.

This site is again a dual-purpose one, selected to test the ground water possibilities as well as to explore for sub-artesian water.

The owner of Loc. 24 indicated to the writer that he would have no objection to the bore being sunk here, provided he was given a free water point in the event of success.

The altitude of the site is approximately 200 feet above sea level. The same remarks about depth and rock types as applied to Site No. 1 apply here.

Site No. 3.—Map Reference. Military Survey Series, 1 mile = 1 inch, NANSON, Point 609453.

This point is on the Eastern side of the road, in the road reserve, at a distance of approximately ¾ of a mile South of the bridge over the Chapman River on the Chapman Road tanks—Yuna Road, some 6¾ miles by road from the Chapman Road tanks. It is on the North side of a pronounced creek channel which drains a large area of hilly country to the West.

This is a dual purpose hole selected to test ground water possibilities as well as to explore for sub-artesian water.

The same remarks about depth and rock types as applied to Site No. 1 apply here.

General Remarks.

The order of preference in water possibilities in the above sites is placed as follows:—

First—No. 2 Site.
Second—No. 3 Site.
Third—No. 1 Site.

No other sites as suitable as these at which to explore for usable quantities of ground water and sub-artesian water could be found after an extensive reconnaissance of the area.

H. A. ELLIS,
Government Geologist.

16/6/48.

A SPONGOLITE DEPOSIT ON LOCATIONS 3277 AND 3278.

7m. East of Mt. Barker, S.W. Division.

Approx. Lat. 34°-37′ S.

Approx. Long. 117°-50′ E.

By H. A. Ellis, B.Sc., A.O.S.M., Government Geologist.

Situation and Access.

Early in August, 1948, applications were lodged with the Mines Department, Perth, for six prospecting areas Nos. 878H to 883H inclusive, covering parts of the Southern portions of Plantagenet Locations Nos. 3277 and 3278. The material for which prospecting rights were required was spongolite, an extremely fine-grained rock of sedimentary origin consisting essentially of extremely fine grains of quartz and the siliceous remains of sponges—sponge spicules.

The areas applied for are situated approximately seven miles due East of Mt. Barker, a town on the Perth-Albany railway line situated 38 miles North of the port of Albany and 302 miles South-South-East of Perth by rail. A bitumen road connects Albany and Perth and passes through Mount Barker. The distance by good gravel surface road from Mount Barker to the deposits is approximately 9½ miles. Mount Barker is 832ft. above sea level and the deposits would have approximately the same altitude. The deposit was examined on August 26th, 1948.

Mode of Occurrence.

The light grey to yellowish coloured rock outcrops over an area at least ¾ mile square, and it may cover a greater area. No attempt was made to trace its full extent. The country is covered with a thick growth of stunted jarrah, banksia, blackboy and low wattle scrub and is flat to gently undulating. Numerous outcrops of what appears to be either flat or low North dipping spongolite occur in the area, distributed more or less over a very low East-West trending minor crest. The rock is not exposed in section, but from several low North dipping outcrops it has a thickness of at least 3ft. in one place. The full thickness and the succession of strata below the spongolite could only be obtained by sinking exploratory pits, which had not been done at the time of inspection (August, 1948).

The prevailing colour of the exposed rock is grey to off-white, but evidence exists which tends to lead one to think that the unweathered rock may be somewhat yellow, due to a natural iron oxide content (leached out from the outcrop rock).

The material is light in weight when not saturated with water, as much of it is in the lower lying portions of the area. It shows a tendency to become silicified at the surface due to deposition of secondary silica, when it assumes a white porcelain appearance.

The rock is fossiliferous and contains casts of some brachiopods and a large number of sponge spicules. It is similar in mode of occurrence to similar material known to occur at Ravensthorpe and Norseman and is thought to represent a marine deposit of Tertiary age. Beds of a similar age occur further to the East in the valley of the Kalgan River.

Possible Economic Uses.

The report on tests carried out by the Government Chemical Laboratories on samples from surface material obtained from one locality, and reproduced below, indicates that the material could be used as—

(a) high temperature insulation bricks;

(b) abrasive material.

The spongolite is somewhat friable and would need protection from abrasion if used in furnaces. The laboratory report states that in the sample submitted there was a small amount of coarse quartz, which would diminish the value as a fine abrasive.

No exploratory work had been done on the deposit at the time of inspection (August, 1948) but it is considered by the writer that there is very little doubt about the deposit being capable of producing large quantities of material suitable for cutting into shapes for use as a refractory, and that on further prospecting suitable fine and even grained material usable as an abrasive would be discovered.

The Government Chemical Laboratory Report on material submitted is as follows:—

REPORT ON ONE SAMPLE FOR:—THE GOVERNMENT GEOLOGIST, PERTH.

Lab. No. 5783/48.

Locality Loc. 3278, 7 miles East of Mt. Barker. Lands Department Litho 445/80.

Description.

Several pieces of spongolite consisting largely of opaline skeletal matter with numerous fragments of sponge spicules and a small amount of quartz. The largest sponge spicule detected was approximately 0.3 millimetre long.

The sample consisted of irregular lumps broken from the deposit and it was difficult to obtain test pieces free from cracks. The material is easily sawn though somewhat friable. Test pieces were heated to temperatures of 1050°C, 1150°C, 1250°C and 1350°C taking four, eight, twelve and sixteen hours respectively to reach these temperatures. Some extension of existing cracks was noted but no fresh cracks occurred. Test pieces sawn from a large block of material submitted from this locality in May were without flaws and developed no cracks on firing.

Temperature. °C.	Linear Shrinkage from air dry. %	Porosity. %	Apparent Specific Gravity.
1050	2.21	....	1.25
1150	3.56	....	....
1250	4.31	....	....
1350	4.94	49.10	1.05

Remarks.

This material would be suitable for high temperature insulation blocks if excavatable in fair size without cracks and protected from abrasion. Its small amount of fairly coarse quartz diminishes the value as a fine abrasive.

H. A. ELLIS,
Government Geologist.

22nd October, 1948.

REPORT ON THE AVAILABILITY OF BERYL IN WESTERN AUSTRALIA.

By H. A. Ellis, B.Sc., A.O.S.M., Government Geologist.

APPENDIX 1.

Report on the Beryl Resources of the Yinnietharra Area.

By W. Johnson, B.Sc., (Hons.) Geological Survey of W.A.

Report on the Availability of Beryl in Western Australia.

Introduction.

This report has been compiled at the request of representatives of the British Ministry of Supply, and originates as a result of the comparatively small tonnage of beryl shipped to the United Kingdom subsequent to the release in August, 1947, of the information that the British Ministry of Supply needed 500 tons of beryl at £A5 per unit f.o.b. Australian ports less ore-buyers' commission—minimum content 9.5% BeO. (Letter dated 22nd August from the Secretary, Department of Supply and Shipping to Under Secretary for Mines, W.A.)

Up to October, 1948, approximately 14 months after the price of beryl had appreciated considerably, only about 45 tons of beryl had been shipped from Western Australia.

It would appear that the British Ministry of Supply was under the impression that no difficulty would be experienced in securing this 500 tons in about 12 months, and that the bulk of it would come from Western Australia. The Geological Survey of Western Australia was not at any time approached on the question of availability of beryl, and if assurances of supply emanated from this State, then they certainly did not originate with the Geological Survey.

General Background of Prices and Production.

In 1939 one buyer of beryl offered £A11 per ton for 13% BeO, f.o.b. Fremantle, and no improvement in this price took place until late in 1942, when representatives of the United States of America's Foreign Economic Administration entered the market and raised the price to a maximum of approximately £A38 per ton f.o.b. Fremantle for 13% BeO content, which price prevailed until the termination of a contract for supply at the end of 1944.

Beryl was not in demand after the end of 1944, but in December of that year one Sydney ore-buyer quoted Beryl at £A25 16s. 8d. per long ton in sound bags fit for shipment overseas, f.o.b. Sydney, BeO content 13% —minimum lots of 10 tons.

In January, 1945, this price was increased to £A28 7s. 3d. for similar grade ore, but f.o.b. Fremantle, for shipment to New York. This was the best price on offer until August, 1947, when publicity was given to the new price of £A5 per unit f.o.b. Australian ports in bags—less ore-buyers' commission, minimum BeO content 9.5%.

From a perusal of the attached graphs the following observations are made drawing comparisons between prices and production:—

(a) Up to and including 1942, only 9.55 tons of beryl were produced, and this came from the South-West part of the State (Balingup), where transport costs were comparatively low. The beryl was obtained as eluvial material and as a by-product while mining felspar in a pegmatite dyke.

(b) The greatly increased price, commencing in 1943 and continuing in 1944, was responsible for the major production (902.45 tons) in the overall total to date (September, 1948) of 1033.78 tons.

Note: Most of this increased production came from the Wodgina pegmatites *before* the Commonwealth Government commenced mining the dykes for tantalite. In fact, 600 tons approximately was obtained from one mass known to exist for years before it was mined in 1943.

(c) A sharp decline in production followed during the years 1945 and 1946, due partly to the collapse in price and partly due to the scarcity of easily-won beryl.

(d) The rise in price during 1947 to £A5 per unit resulted in a slightly better production, but the relatively small production (44.89 tons) with beryl at a record high price does not suggest that beryl is plentiful.

(e) The small production to September, 1948 (27.79 tons) with the price still at a record high level also indicates that the mineral is scarce.

The Centres of Production.

The writer has a personal knowledge of all of the centres from which beryl has been produced. An attached diagram shows graphically the relative production from the various known production centres.

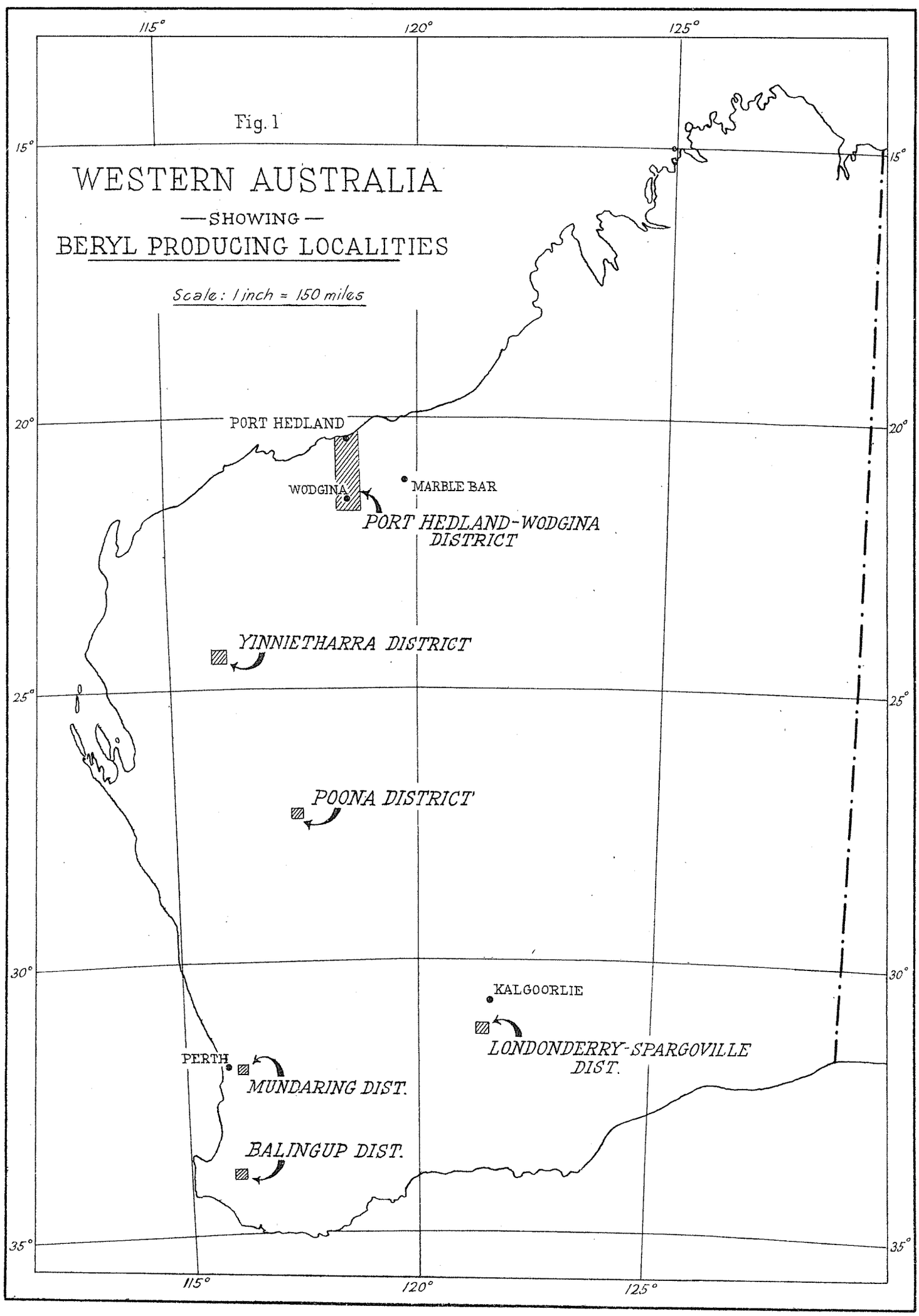


Fig. 1
WESTERN AUSTRALIA
—SHOWING—
BERYL PRODUCING LOCALITIES
Scale: 1 inch = 150 miles
115°
120°
125°
15°
20°
25°
30°
35°
PORT HEDLAND
WODGINA
MARBLE BAR
PORT HEDLAND-WODGINA DISTRICT
YINNIETHARRA DISTRICT
POONA DISTRICT
KALGOORLIE
LONDONDERRY-SPARGOVILLE DIST.
PERTH
MUNDARING DIST.
BALINGUP DIST.

By far the greater part of the total W.A. beryl production up to September, 1948 (1033.78 tons), was obtained from one locality, namely, Wodgina, whence approximately 600 tons was mined from one concentration which actually outcropped.

Of the balance of 433.78 tons, it is safe to assume that at least 75 per cent. came from eluvial sources, leaving only a comparatively small tonnage from the actual mining of pegmatite dykes.

It is not possible to deduce from statistics or from the inspection of workings the exact amount of beryl obtained in actual mining operations conducted in the production of felspar, mica and tantalite in the various pegmatites worked, because beryl from eluvial sources outside the holdings being worked is invariably included with any official return for any particular holding.

The following principal production centres will be briefly discussed:—Wodgina-Marble Bar District, Londonderry-Spargoville District, Yinnietharra District, Poona District, Balingup District, Mundaring District.

Wodgina-Marble Bar District.

The tantalite bearing pegmatite of the main workings at Wodgina has produced the bulk of the beryl from this district. A mass of beryl containing some 600 tons was mined here in situ in 1943. It contained approximately 11.5% BeO and 0.8% caesium oxide. Several other small concentrations of beryl were discovered in extensive underground mining operations on this pegmatite, but the proportion of beryl in the dyke away from the now mined-out concentration is obviously so small that mining for beryl in this pegmatite does not come within a justifiable mining risk. The dyke was mined primarily for tantalite, and the overall cost of mining operations in this dyke must have exceeded many times the value of tantalite won from the dykes (excluding eluvial tantalite).

No production of importance can be expected from this source.

The tantalite bearing pegmatites at Strelley and Tabba-Tabba and the cassiterite and columbite bearing pegmatites at Pilgangoora have never produced much beryl and are certainly not capable of being economically prospected for beryl alone.

The Kangan beryl deposits were small and gave no promise of further easily won supplies.

The Cooglegong beryl came mainly from eluvial sources, and there are no potential ore reserves there.

The Mt. Francisco beryl was of mixed origin, some coming from mining concentrations in pegmatite dykes, the balance from eluvial sources. All of the easily won beryl has been mined and collected, and the original finders do not relish the prospect of digging further in the dykes in the hope of finding more concentrations.

What may be termed the Port Hedland-Wodgina district covering a strip of country some 90 miles long North and South and 30 miles wide East and West, extending Southwards from Port Hedland to include Wodgina, Mt. Francisco, Pilgangoora, Tabba-Tabba and Strelley, could possibly contain some yet undiscovered beryl bearing pegmatites. During 1945, 1946 and 1948, prospector G. Lamont reported the sale of 39.04 long tons of beryl obtained from Crown Lands situated mainly in the vicinity of Wodgina and Mt. Francisco. This ore was not obtained from a registered mining tenement, and may or may not have come from the vicinities just mentioned. It could have come from anywhere within the above-mentioned Port Hedland Wodgina district, an area in which the writer knows that prospector Lamont operates.

As far as the Wodgina-Marble Bar District is concerned, it is the writer's opinion that any worth-while future production will come from similar sources to those from which Lamont produced his 39.04 tons during 1945, 1946 and 1948, namely, Crown Lands in the Port Hedland-Wodgina district.

Londonderry-Spargoville District.

The total recorded production to September, 1948, from this district is 80.66 long tons, of which 2.5 tons came from Spargoville, and the balance, 78.16 tons from the Londonderry Felspar Quarry and adjacent ground. The actual tonnage obtained from the felspar quarry is reported as 72.13 long tons, obtained as a by-product in mining microcline felspar in the main Londonderry Felspar Quarry. About $\frac{2}{3}$ of this 72.13 tons was obtained mainly from the Western or hanging wall side of the quarry, and approximately 64,612 long tons of pegmatite was mined in the process of recovering felspar and this quantity of beryl from this portion of the quarry. In this particular case approximately 1,346 tons of pegmatite was mined for every one ton of beryl produced. The largest individual mass of beryl encountered in the quarry weighed about 10 tons. The writer has followed closely the quarrying operations in the Londonderry Felspar Quarry since 1943, and is conversant with the manner of occurrence of the beryl there. He is convinced that any further selective mining of the pegmatite for beryl should take into consideration the fact that the ratio of beryl to pegmatite is likely to be in the order of one to 1,346, and that operations were suspended in the beryl-bearing portion of the pegmatite on account of the unpayability of the felspar content of the pegmatite in that particular part of the quarry. It is not anticipated, therefore, that any further production of beryl is likely to come from this source in the immediate future.

The writer would like to emphasise that he knows of no beryl occurrence in the State more worthy of prospecting than that mentioned above, since the quarry has been operated successfully for a considerable time on a payable basis as a producer of high grade microcline felspar. About 100 feet of shaft sinking and 2,000 feet of diamond drilling distributed radially as a series of short holes, would be required to decide whether the proportion of payable felspar and beryl was sufficient to warrant further mining operations in depth at the Western side of the main quarry. The proportion of payable felspar in a total tonnage of 129,225 tons of pegmatite mined from the Main (No. 1) Quarry is about one in four or about 29,475 tons.

An experienced beryl prospector has been operating in this district for the last two years and has located only small quantities of eluvial beryl.

Yinnietharra District.

This district is dealt with in detail by Mr. W. Johnson, a geologist of this Geological Survey, in a separate report attached hereto.

It is obvious from this report that future requirements will not be met by mining the pegmatites known to carry beryl, for the simple reason that this does not come within the realms of a reasonable mining risk.

The total production from all sources from this district was 76.37 tons as at September, 1948. Mr. Johnson indicates that this tonnage may be in the vicinity of 90 towards the end of December. He estimates that ore in sight and indicated ore, may amount to about 38 tons.

It is not economically possible to mine felspar in this district even if suitable deposits existed, on account of the low price of this mineral and the high transport costs. Attempts to mine mica from the pegmatite dykes in the past have not proved successful, chiefly on account of the scarcity of good grade mica.

It remains for new deposits of eluvial beryl to be found to form the basis on which future production is likely to depend, excluding the possible discovery of a large concentration in a pegmatite similar to that worked at Wodgina in 1943. By far the greater proportion of the total production of 90 tons has been derived from eluvial sources.

In the writer's opinion it is not likely that large quantities of eluvial beryl will be found on Yinnietharra Station in the near future.

Poona District.

The total production from this district to September, 1948, is 24.53 tons—all from eluvial sources. Many years ago some pegmatite dykes were worked here for emerald. This tonnage was produced in 1944 and 1945, and there has been none since—all the easily won eluvial beryl having been collected and the proportion of beryl in the pegmatite being for too small to encourage anyone to further mine the deposits.

No tonnage can be expected from this source in the near future.

Balingup District.

9.90 tons of beryl, largely from eluvial sources, is the total production from this source. Some of the tonnage represents beryl mined from some small pegmatite dykes during the course of working the dykes for microcline felspar and mica. The deposits are not potential suppliers of future beryl requirements.

Mundaring District.

A small quantity (.10 tons) of beryl was produced from a pegmatite dyke here, but the occurrence is more of mineralogical than economic interest. The deposit has no future possibilities.

Mining Pegmatite Dykes.

The principal workings in pegmatite dykes in Western Australia are as follows:—

Locality.	Mineral worked.	Accessory minerals of economic importance.
Wodgina	Tantalite	Beryl
Strelley	Tantalite	Beryl, cassiterite
Tabba-Tabba	Tantalite and Cassiterite	Beryl, cassiterite
Yinnietharra	Bismuth	Beryl
	Mica	Beryl
Londonderry	Microline Felspar	Beryl, columbite
Greenbushes	Cassiterite	Columbite and Tantalite

Numerous other pegmatite dykes have been opened up in centres not mentioned above, but the largest workings are as listed.

The quarry at Londonderry is the most extensive workings, about, 129,225 tons of pegmatite having been mined in a face in the search for microcline felspar. In the other principal workings listed above the dykes have been selectively mined for their respective principal valuable mineral. Not all of these operations have been economically successful, and none of them have been carried out in the search for beryl alone.

Prospecting for new shoots of columbite, bismuth or cassiterite by mining in the respective dykes has invariably proved very costly, and has not been very successful in this State. The writer's experience is that the likely positions of new concentrations of beryl are even more difficult to predict than are those of cassiterite, tantalite, and bismuth, since beryl is much more prone to occur in a dyke in single crystals widely separated from others of its kind. Finely disseminated beryl deposits are rare in Western Australia and none of economic value are known.

The consensus of opinion of *experienced* mining men and of economic geologists who have had experience in the examination of mineral bearing pegmatite dykes, is that once a concentration of any of the minerals sought, other than felspar, has been located on the surface and mined out in depth and length, then the further search by underground mining methods is extremely hazardous, and the writer has no hesitation in stating that this is particularly true of Beryl occurrences.

Future Source of Supply.

Beryl is likely to be produced in the future in W.A. from the sources from which it has already been produced; namely, from yet undiscovered eluvial material shed from pegmatite dykes, from the mining of crystals which outcrop in the solid pegmatite dyke, and as a by-product in mining for felspar, mica and tantalite.

At present (December 1948) active mining in pegmatite dykes is proceeding only on some beryl crystals at Yinnietharra and in the felspar rich parts of the Londonderry felspar quarry. No doubt prospectors are searching in the known beryl localities for more eluvial beryl, and occasional concentrations of beryl will be being mined whenever they are found.

It seems clear to the writer that even with beryl at the present price of £A75 per long ton, f.o.b. Australian ports, there is virtually no possibility of reaching the quota of 500 tons asked for in August 1947. Only about 45 tons had been produced in W.A. up to the end of September 1948, subsequent to August 1947. The reason for this comparatively small production is obviously the scarcity of beryl and the high cost of exploration in pegmatite dykes.

Even if the price of beryl were doubled, it is the writer's belief that exploration in depth in pegmatite dykes known to contain some beryl could not be profitably undertaken.

A big increase in price, say double the present price, together with a publicity campaign would be the most likely method to stimulate the search for and production of beryl in Western Australia.

Conclusions.

(1) The British Ministry of Supply was misinformed when it was under the impression that 500 tons of beryl could be obtained from Western Australia in a period of 12 months from August 1947. The actual quantity shipped during that period was about 45 tons, and a generous estimate of 20 tons produced but not shipped at the end of the period indicates the extent to which the conception was faulty.

(2) A survey of the various producing centres throughout the State indicates that increased production is not probable from sources which depend upon the mining of known beryl-bearing pegmatite dykes. Only the discovery of an unusually large outcropping concentration of beryl similar to that mined in the main dyke at Wodgina could render the preceding statement invalid.

(3) Future production will come from sources similar to those of past production, and unless new sources are found, and this is possible, no marked increase in the rate of production can be anticipated.

(4) An increase in price to £A10 per long ton unit, and a publicity campaign are suggested as being practical means of intensifying the search for and production of beryl.

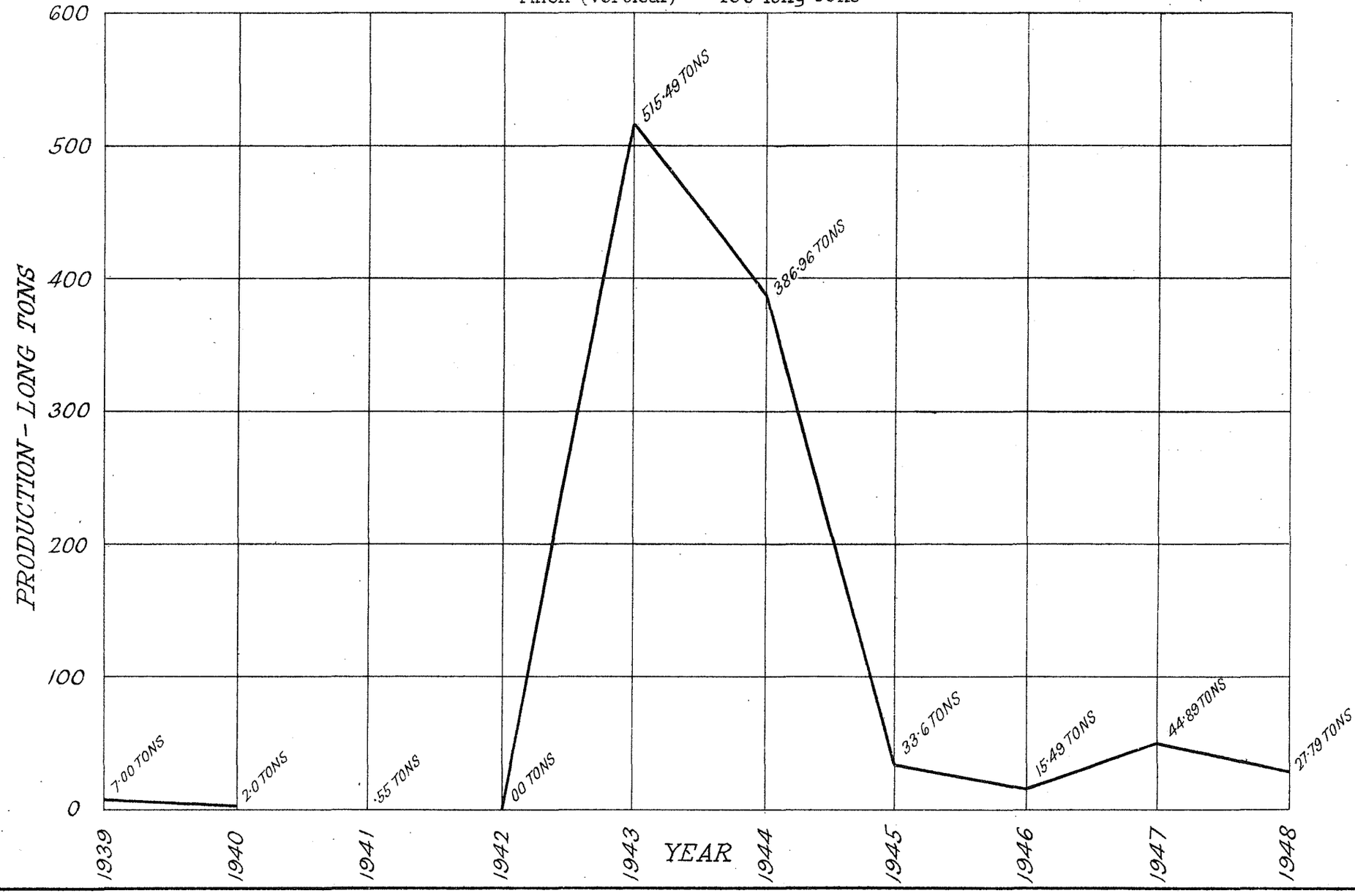
(5) The increase in price to £A5 per unit in August 1947, did not result in a very marked increase in production, although it did obviously stimulate the search for beryl.

Fig. 2

WESTERN AUSTRALIA
— BERYL —

Annual Production to Sept. 1948 - First Recorded Production, 1939

1 inch (vertical) = 100 long tons



BERYL ORE PRODUCTION—WESTERN AUSTRALIA.

(Reported to September, 1948.)

Year.	Ore	Metallic Contents Units BeO.	Value.	Producer.	No. of Holding.	Centre and Goldfield.
	Tons.		£A.			
1939	7.00	Unknown	60.00	Oma, V. C.	MC111H	Balingup—O.P.G.*
1940	2.00	do.	16.00	do.	MC111H	do. do.
1941	.55	do.	6.60	do.	MC111H	do. do.
1944	.10	do.	2.00	do.	MC111H	do. do.
1945	.25	do.	5.50	do.	MC111H	do. do.
1943	.10	do.	2.00	Norrish & Selkirk	PA793H	Mundaring—O.P.G.
....	10.00	....	£92.10			
1943	7.06	83.48	119.35	Burt, G. H.	PA815H	Yinnietharra—O.P.G.
	13.43	158.77	378.60	Burt & Thompson	PA816H	do. do.
	8.78	103.77	243.72	Middleton, L. W.	C/Lands	do. do.
	9.37	110.81	260.29	Thompson, A. B.	MC291H	do. do.
1944	2.50	29.44	74.89	Def. Project 58	....	do. do.
	11.51	152.64	447.65	Thompson, A. B.	MC291H	do. do.
	8.81	123.56	341.20	Moss, F. A.	MC291H	do. do.
	14.91	200.09	586.50	Burt, G. H.	PA815H	do. do.
	76.37	962.56	£2,452.20			
1943	476.75	5,618.24	13,559.81	Def. Project 83	MC107,etc.	Wodgina—Pilbara
1944	244.60	2,664.14	7,301.44	do. do.	do.	do. do.
	46.68	563.66	1,784.90	Lamont, G.	PA2104	do. do.
	3.32	43.79	128.30	Rogers, A. E.	PA2096	do. do.
	4.29	56.59	165.85	Hooley, G.	PA2116	do. do.
1945	11.13	131.57	324.00	Lamont, G.	C/Lands	do. do.
1946	15.49	197.29	580.60	do.	do.	do. do.
1948	8.55	90.82	482.51	do.	do.	Cooglegong—Pilbara
1947	16.04	208.05	513.19	Hooley, G. J.	ML365	Mt. Francisco—Pilbara
1948	11.50	139.75	742.42	do.	do.	do. do. (sold by Lamont)
	3.87	48.45	242.27	Lamont, G.	C/Lands	do. do. do.
	842.22	9,762.35	£25,825.29			
1944	28.71	322.65	945.58	Aust. Glass Manufacturers Pty.	ML80	Londonderry—Coolgardie
1945	19.23	238.07	519.42	do. do. do.	do.	do. do.
1947	24.19	273.82	832.86	do. do. do.	do.	do. do.
	2.26	25.75	93.35	Duplex, S. A.	PA6080	do. do.
1948	3.87	46.89	220.37	Scahill, E.	ML101	do. do. (sold by Giles)
1947	2.50	30.00	86.00	Giles, A.	PA5990	Spargoville—Coolgardie
	80.66	937.18	£2,697.58			
1944	15.50	210.78	617.81	Giles, A. S.	PA3071	Poona—Murchison
	6.03	70.28	205.94	Rule, G.	PA3073	do. do.
1945	2.00	Unknown	70.00	Giles, A. S.	PA3071	do. do.
	1.00	do.	34.00	Rule, G.	PA3073	do. do.
	24.53	281.06	£927.75			

SUMMARY.

9.90	....	90.10	....	....	Balingup—O.P.G.
.10	....	2.00	....	....	Mundaring—O.P.G.
76.37	962.56	2,452.20	....	....	Yinnietharra—O.P.G.
802.26	9,275.28	23,844.90	....	....	Wodgina—Pilbara
8.55	90.82	482.51	....	....	Cooglegong—Pilbara
31.41	396.25	1,497.88	....	....	Mt. Francisco—Coolgardie
78.16	907.18	2,611.58	....	....	Londonderry—Coolgardie
2.50	30.00	86.00	....	....	Spargoville—Coolgardie
24.53	281.06	927.75	....	....	Poona—Murchison
1,033.78	11,943.15	£31,994.92	TOTAL		

* O.P.G.—Outside a Proclaimed Goldfield.

REPORT ON THE BERYL RESOURCES OF THE YINNIETHARRA AREA, LYONS DISTRICT, NORTH-WEST LAND DIVISION OF WESTERN AUSTRALIA.

(Lands Department Litho 78/300 S. W. Quadrant.)

W. Johnson, (B.Sc. Hons.)

INTRODUCTION.

This report embodies the results of an examination of the above area in November, 1948. The examination was instigated by the British Ministry of Supply through the Commonwealth Bureau of Mineral Resources and the Department of Mines, Western Australia.

The primary object of the examination was to enable an estimate to be made of the amount of beryl likely to be available from the Yinnietharra area—

(i) immediately, i.e., beryl in sight in the known deposits and eluvial beryl located but not yet gathered by "fossickers";

(ii) in the future (within two to three years), i.e., beryl likely to be disclosed by development operations on known deposits and by the discovery of new beryl bearing pegmatites with their accompaniment of eluvial beryl.

During the examination information as to the physiography and geology of the pegmatite dykes and country rock, the geological and mineralogical occurrence of the beryl, the volume percentage of beryl in the pegmatite dykes and the zonal distribution of beryl in the pegmatites was gathered. This information is included in this report so as to make it available for public use.

LOCALITY AND ACCESS.

The area from which beryl has been collected and shipped by prospectors is almost confined to Yinnietharra Station. This station is a pastoral property of 500,000 acres leased from the Crown. It is situated at the top of the large north-pointing triangular bend in the Gascoyne River at approximate latitude 24° 30′ S. and approximate longitude 116° 10′ E. The beryl deposits are mainly in the northern portion of the property.

Yinnietharra Homestead can be reached by road from Carnarvon, the nearest seaport, or Mullewa, the nearest railhead. The road distances are respectively 220 miles and 330 miles. The sea distance, Carnarvon-Fremantle is 650 miles and the rail distance, Mullewa-Perth, is 330 miles. Road distance, Yinnietharra Homestead-Perth via Mullewa is 620 miles. A motor mail, which also carries freight, runs weekly from Carnarvon, through Yinnietharra and a separate one runs fortnightly from Mullewa to Dairy Creek Homestead, a distance of 60 miles south of Yinnietharra Homestead. Other transport agencies in both towns carry freight at special rates.

An air service lands an aeroplane twice weekly at Yinnietharra carrying mail to and from Perth on each occasion and conveying passengers to Perth on one trip and from Perth on the other.

Access to the various beryl deposits from Yinnietharra Homestead is by station tracks, most of which are very rough as are portions of the main roads leading to the station.

PREVIOUS WORK.

Various technical men have visited and examined mineral deposits in the area. Their geological publications on the area are listed below:—

1922, Wilson, R. C.: Report on the "Mica King" and "Mica Queen" Mineral Claims Nos. 19H and 20H. *Ann. Report Dept of Mines, Western Aust.* 1922, p. 54 + two plates.

1926, Wilson, R. C.: Gascoyne Mica Field. *Ann. Report Dept. of Mines, Western Aust.* 1926, pp. 82-84 + two plates.

1939, Ellis, H. A.: Report on a Bismuth Carbonate Deposit in a Pegmatite Dyke, M.C. 173H, Yinnietharra Station (Gascoyne River). *Ann. Prog. Rep. G.S.W.A.* 1939, pp. 12-15, Plate 1.

1940, Ellis, H. A.: Mica Mining on Mineral Claim 159H, Morrissey Hill, Yinnietharra Station, Gascoyne River. *Ann. Prog. Rep. G.S.W.A.* 1940, pp. 7-8.

1940, Ellis, H. A.: Report on Bismuth Carbonate Deposits in Pegmatite Dykes on M.C. 195H, and P.A. 744H, near Morrissey Hill, Yinnietharra Station, Gascoyne River. *Ann. Prog. Rep. G.S.W.A.* 1940, pp. 8-9.

1940, Ellis, H. A.: Progress of Work on Mineral Claim 173H, Yinnietharra Station. *Ann. Prog. Rep. G.S.W.A.* 1940, p. 10.

1940, Ellis, H. A.: Notes on Bismuth Deposits on Mineral Claim 191H, Nardoo Creek, Yinnietharra Station. *Ann. Prog. Rep. G.S.W.A.* 1940, p. 10.

1942, Matheson, R. S.: Report on the Mica Deposits in the Yinnietharra, Ajana, Northampton and Mullalyup Districts. *Unpublished Report G.S.W.A.*

1944, Matheson, R. S.: Report on Yinnietharra Mica Project, Lyons District, North-West Division. *Ann. Prog. Rep. G.S.W.A.* 1944, pp. 39-42.

1944, Matheson, R. S.: Report on M.C. 291H for Beryl, Yinnietharra, North-West Division. *Ann. Prog. Rep. G.S.W.A.* 1944, p. 42.

1944, Matheson, R. S.: Beryl Deposit, Bidgemia Station, Lyons District, North-West Division. *Ann. Prog. Report G.S.W.A.* 1944, p. 42.

1944, Owen, H. B., Report on the Commonwealth Mica Mine at Yinnietharra, Gascoyne River, North-West Division, Western Australia. *Commonwealth Dept. of Supp. and Shipping, Mineral Sources Surv., Report No.* 1944/34.

1944, Owen, H. B.: Second Report on Beryl Deposits near Yinnietharra, Western Australia. *Commonwealth Dept. of Supp. and Shipping, Mineral Resources Surv., Report No.* 1944/35.

Few of these publications deal directly with beryl deposits but all contain some geological information.

PHYSIOGRAPHY AND GEOLOGY.

The country described lies on the watershed of the Gascoyne River at the apex of the large north-pointing triangular-bend in that river. At the apex the Gascoyne receives numerous large tributaries (Morrissey Creek, Nardoo Creek, 31 Creek and 33 Creek, etc.) These tributaries flow in broad maturely dissected valleys eroded out of a plateau whose surface is probably represented by the tops of the low rounded hills of gneiss composing the divides between the creeks. The height of the plateau above sea level varies from 1,400 to 1,700 feet.

The hills owe their existence solely to erosion. A feature of them is that they are frequently capped by a pegmatite dyke. The course of some of the drainage channels is controlled by the strike of the foliation of the gneiss over which they flow.

The rocks of the area consist predominantly of tourmaline-bearing granitic gneiss containing lenses of mica and hornblende schists, plagioclase amphibolites, and anthophyllite-actinolite rocks. Most of the gneiss is thought to have originated by the granitisation of pre-existing metamorphosed sediments and igneous rocks. The lenses of mica and hornblende schists, and plagioclase amphibolites in this type of gneiss may represent ungranitised basic sediments, lavas or intrusives. Some of the gneiss may be highly metamorphosed quartzose sediments or acid to intermediate igneous rocks. As the purpose of this investigation did not include a detailed geological investigation of the rock types in the area only brief notes could be made as to their nature and origin.

The regional strike of the foliation of the gneiss varies from N. 30° W to N. 65° W. and the dip from 50° S.W. to 80° N.E. The strike of schistosity in the basic lenses is parallel to the strike of foliation in the nearby gneiss but the boundary between gneiss and basic rock is in some places transgressive to the foliation and numerous dragfolds suggest that the gneiss or the rock from which it was formed has been subjected to intense folding.

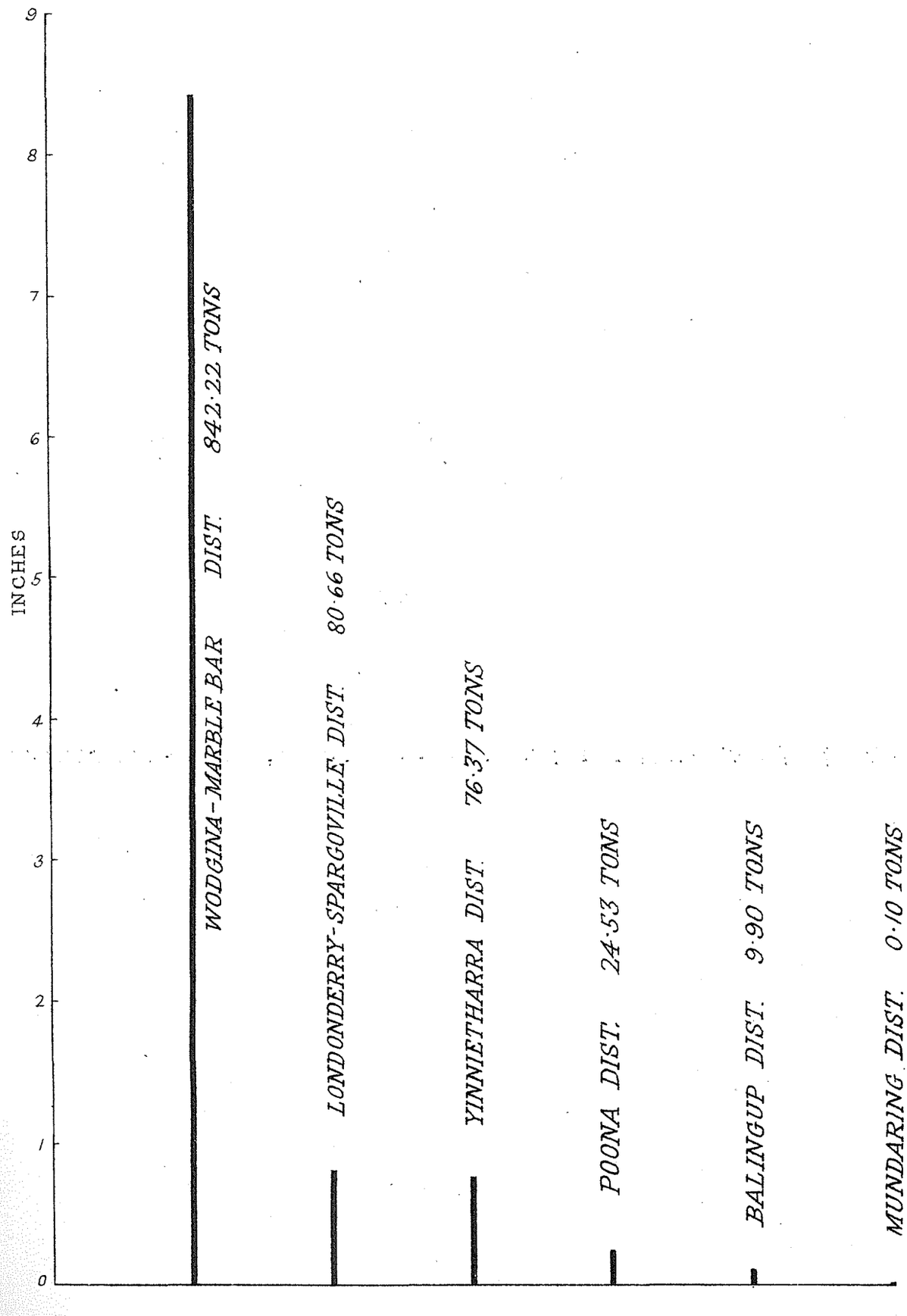
Fig. 3

WESTERN AUSTRALIA

—— BERYL ——

Total Production by Districts (to Sept. 1948) Shown Graphically

1 inch (vertical) = 100 long tons



All the fore mentioned rock types have been intruded by pegmatite dykes, aplite dykes, quartz veins and dyke-like masses of granite and augen gneiss. These acid intrusives are both parallel and transgressive to the foliation of the gneiss. Their dimensions range from one-eighth inch wide and 12 inches long to quarter mile wide and one mile long. The payable mineral concentrations occur in the pegmatite dykes. Features of the dykes are the large masses of quartz often forming a central core with "normal" pegmatitic material on either side. These quartz "cores" are more resistant to erosion than the rest of the pegmatite and form the "backbone" of such ridges as Morrissey Hill and "Bismuth Hill" (a local name for the pegmatitic ridge three-quarter miles east of the Commonwealth Mica Mine). Not all the pegmatite dykes have quartz cores and some outcrop in low ridges on flat country on the floodplains of the creeks.

THE BERYL DEPOSITS.

Introduction.

The locality map Plate I shows that a considerable number of mineral claims and prospecting areas have been pegged in the Yinnietharra area. The majority have been pegged for mica, some for beryl, some for tantalite and some for bismuth while some have been pegged for a combination of three of the above minerals.

As many of these mineral claims and prospecting areas as could be located were inspected by the writer in November, together with several beryl bearing pegmatites on unclaimed land. Only those pegmatites containing observable beryl will be described.

An attempt has been made to estimate the quantity of beryl available in each deposit to a depth of five feet below the present surface of the working faces. This arbitrary depth was selected because several crystals exposed in the workings are of sufficient cross sectional area to be expected to extend to that depth below the surface. Owing to the meagre data available the estimates are approximate, but if anything err on the generous side. They are most likely to be falsified by the chance discovery of a "super" crystal containing several tons of beryl. One such weighing 600 tons was mined at Wodgina in the Pilbara goldfield.

Most of the beryl in the Yinnietharra area occurs in the wall zones or adjacent to pods of coarse grained milky quartz, and very little in the other forms of mineralogical occurrence in pegmatites as enumerated by Cameron* and others.

A point which must be emphasised here is the low percentage of quantity of beryl in pegmatitic material. By measuring the total surface area of pegmatite exposed and of beryl crystals exposed, an estimate of the volume percentage of beryl in the pegmatite was obtained. This varied for individual pegmatites between .0001 per cent. and .04 per cent. Again, the quantity of beryl produced from the Commonwealth Mica Mine is 2.50 tons, while the tonnage of pegmatite excavated was 9,500 tons. These figures indicate that once beryl concentrations in sight have been removed prospecting for further beryl concentrations by sinking, driving and crosscutting would be an extremely risky business, and unless aided by luck, doomed to cause a financial loss to whoever undertook the operation.

Prospecting Area.

This prospecting area, two miles south of the Commonwealth Mica Mine, was originally pegged and is being worked for mica. Incidentally, approximately 5 cwt. of beryl crystals, mostly eluvial, have been collected by the owners.

The pegmatite dyke being worked for mica strikes N. 5° W., the dip being unobtainable. Its dimensions are length 700 feet, average width 100 feet. The country rock in the vicinity of the pegmatite is obscured by soil.

Workings have been opened up on lenses of mica in both wall zones of the pegmatite. The total volume of the workings is approximately 2,400 cubic feet. The site of collection of the eluvial beryl is close to an open cut on the west side of the south end of the dyke. Beryl crystals occur in this open cut in the east face. The dimensions of the cut are, length 60 feet, average width five feet, average depth six feet.

A future production of quarter to half a ton of beryl might be anticipated from this deposit. Access to the deposit is to be had by a rough track from the Commonwealth Mica Mine. Total distance from the homestead is 24 miles.

Mineral Claim 43H.

This claim was originally pegged for mica and an open cut has been dug on a small pegmatite covered by it. Some mica is said to have been produced from this pegmatite. Beryl crystals occur in the foot wall zone of the pegmatite and in the dump of waste material from a small shaft at the south end of the open cut.

The country rock of the pegmatite is the prevailing granitic gneiss striking N. 40° W. and dipping 70° N.E. The beryl bearing pegmatite is transgressively intrusive into the gneiss, its strike being N. 15° E. and dip 70° N.W. (as determined on the hanging wall). Mica appears to occur in both hanging and foot wall zones.*

The beryl crystals occur in a cluster in the hanging wall near the shaft. It is estimated that 5 cwt. of beryl could be obtained by picking out the crystals in the surface layer of pegmatite. Some beryl crystals of 3 to 4 lbs. weight were picked up on the surface of the dump of the shaft. It is thought that another 5 cwt. of beryl could be obtained by shovelling over the material of the dump. The estimated quantity of beryl available to a depth of 5 feet below the present surface of the workings is 2 tons and by all future operations 6 tons The largest crystal noted had a basal section of about 50 square inches area. Many crystals would be too small to sort out by hand picking.

No beryl is recorded as having been produced from this claim, but some of that attributed to other claims nearby was probably collected from M.C. 43H.

Access to the claim is by a rough track one mile in length westwards from the dump of the Commonwealth Mica Mine. The track from Yinnietharra Homestead to the mica mine is quite a good one. Road distance from the homestead to M.C. 43H is approximately 22 miles.

Defence Project 58, Commonwealth Mica Mine.

At the time of examination this deposit was still under reservation with respect to mica.

The geology, dimensions of the pegmatite dyke and other aspects of the project have been fully described by Matheson† and Owen‡. The pegmatite was mined primarily for mica and incidentally 2.5 tons of beryl were collected from the 9,500 tons of pegmatite material mined. Portion of this 2.50 tons was probably picked up as eluvial beryl on the surface before mining was commenced.

Owen states that some beryl was probably discarded with the waste material owing to non-recognition by the mica sorters. However, this discarded beryl would not amount to one ton.

Beryl crystals were observed in a border zone on the footwall side of the pegmatite in the West Open Cut together with green muscovite and fine grained quartz and felspar. The largest of the beryl crystals was ¼ inch by ⅛ inch so the beryl bearing zone could not possibly be mined for its beryl content. It is improbable that any more beryl will be obtained from this pegmatite.

Access to the Commonwealth Mica Mine is to be had by a fair track and the distance is 21 miles from Yinnietharra Homestead.

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*1947, Cameron, E. N., and Shainin, V. E., The Beryl Resources of Connecticut. Econ. Geol. Vol. XLII, No. 4, pp. 353-367.

* 1945, Cameron, E. N., and others, Structural and Economic Characteristics of New England Mica Deposits. Ec. Geol. Vol. XL, No. 6, pp. 369-393.

†1944, Matheson, R. S., op. cit. A.R., 1944, pp. 39-42.

‡1944, Owen, H. B., op. cit. Report No. 1944-34.

Mineral Claims 392H, 393H.

These claims cover a pegmatitic ridge one mile east of the Commonwealth Mica Mine. Their long direction is east and west and they have a common long boundary. 392H and 393H are identical with Mineral Claims 175H and 176H respectively. Old Mineral Claims 191H and 291H occupied part of the ground covered by Mineral Claim 392H and Prospecting Area 816H appears to have covered the identical ground covered by Mineral Claim 291H.

Mineral Claims 392H and 393H are recorded as being pegged for bismuth. The south-east corner of 392H takes in the west end of a bismuth carbonate-bearing pegmatite. All the bismuth carbonate has been removed from this deposit, and the main part of 392H is occupied by a beryl-bearing pegmatite geographically distinct from the bismuth carbonate-bearing pegmatite.

The beryl-bearing pegmatite on M.Cs. 392H and 393H has a quartz core forming the crest of a low ridge parallel to the strike of the dyke. It is intruded into the usual tourmaline-bearing hornblende granitic gneiss, striking in this localitity N. 50° W. and dipping 50° to 60° S.W. The strike of the pegmatite is N. 60° W. and its dip is not obtainable. The pegmatite varies widely in mineral and textural composition. Apart from the large quartz core forming the crest of the ridge there are several smaller "pods" composed wholly of quartz. Adjacent to these pods the feldspar is perthite in extremely large crystals. In other parts of the mass the pegmatite is more normal in mineral composition but is almost fine grained enough to be an acid granite. Very little muscovite occurs in this dyke.

The approximate measured dimensions of the pegmatite dyke are, length 2,500 feet, width 600 feet. The dyke may have extensions under soil cover at both ends and may be somewhat wider than the stated figure.

A large amount of eluvial beryl is reported to have been picked up on this ridge, none can be found now. Some large beryl crystals are showing in shallow workings at the N.E. side of the quartz pod forming the crest of the ridge. Three shallow potholes have been dug along the northern margin of the quartz pod. In one of these a beryl crystal with a surface area of about 860 square inches was showing. The attitude of this crystal could not be determined and the surface showing is probably not a basal section and thus any estimate of the amount of beryl to be obtained from it is approximate only. The total volume of the workings is 150 cubic feet. The reported production from the ground covered by M.C. 392H is 43.12 tons. Of this quantity some is eluvial beryl gathered from the slopes of the ridge on 392H and some is beryl dug from the workings mentioned above. The exact proportion of the 43.12 tons to be assigned to these sources is not known. Quite a large part of that quantity probably represents eluvial beryl gathered from the whole Yinnietharra Area and attributed to this claim for recording purposes. (This is very likely indeed. H. A Ellis, Government Geologist.)

It is estimated that three tons of beryl will be obtained by digging out the crystals showing in the shallow working and that possible future production may yield nine tons.

Access to this deposit is identical with that to the Commonwealth Mica Mine.

Prospecting Area 876H.

This P.A. has been recently pegged for tantalite. Its position on the Mines Department special map of the area shows it to be one mile west of P.A. 815H (= P.A. 744H) and two miles north-west of Morrissey Hill. The position on the Mines Department map was plotted from directions handed in by the prospector who pegged the area. From bearings and distances measured by the writer in November it would appear that P.A. 876H covers identical ground with P.As. 815H and 744H.

P.A. 744H was visited by H. A. Ellis* in 1940, while inspecting bismuth carbonate deposits in the locality. He mentions "some particularly large beryl crystals lying about on the surface." These beryl crystals must have been collected, as 21.97 tons are recorded as having been produced from P.A. 815H and the only working is the shallow pothole mentioned by Ellis.

* 1940, Ellis, H. A., op. cit., p. 9.

The strike of the country gneiss in this locality is N. 70° W. and the dip 60° S. As the strike of the beryl-bearing pegmatite is N. 85° E., the pegmatite is transgressively intrusive into the gneiss.

The dimensions of the pegmatite are; length 800 feet, width 40 feet. The pegmatite is coarse grained but in places has a fine grained edge and patches of greisenised gneiss occur in the dyke. Associated pegmatites are separated in this locality by narrow strips of country rock much of which is greisen.

Beryl crystals occur sporadically in the border zone on the south edge of the dyke. About 12 crystals were observed, the largest of which had a basal section 1½ inches by 1½ inches.

At the east end of this dyke another pegmatite striking N. 15° E. outcrops. It forms the top of a north-south ridge. On the west slope of the ridge a dozen small fragments of eluvial beryl were observed by the writer.

The production from P.A. 815H is recorded at 21.97 tons all of which must have been eluvial beryl and some of which must have come from ridges outside the P.A. Future production from this deposit will be nil.

Mineral Claim 403H.

Although this claim covers 300 acres the productive pegmatite is small and is in the south-eastern corner of the claim.

The country rock is the prevailing hornblende granitic gneiss striking N. 55° W. and dipping 60° S.W. The beryl producing pegmatite is in two parts. One part is parallel to the strike of the gneiss, its dimensions are: length 435 feet, average width 10 feet. This part contains five beryl crystals in the hanging wall zone. The total area of crystals exposed is 144 square inches.

The transgressive part of the pegmatite strikes N. 40° E. and joins the parallel part at its N.W. end. Its dimensions are, length 120 feet, width 40 feet. From the surface of this part of the pegmatite 5 cwt. of beryl has been gathered and from a pothole a further 5 cwt. has been dug. The volume of the pothole is 100 cubic feet. The associated minerals are quartz, perthite, green muscovite, orange garnet and some tantalite.

It is not anticipated that more beryl will be produced from this deposit.

One quarter mile north from this pegmatite, beryl crystals occur in the wall zone of a small pegmatite. Upwards of 100 crystals outcrop in a length of 100 feet. Owing to their size these crystals are not mineable with profit.

M.C. 403 is two miles north of Morrissey Hill. Its eastern boundary is on the west bank of Morrissey Creek. Access is by a short rough track along the creek branching off the main track to the Commonwealth Mica Mine at Morrissey Hill. Distance from the homestead is 13 miles.

Mineral Claim 413H.

This mineral claim covers the same ground as P.A. 874H and is situated a quarter mile S.E. from Morrissey Hill. It covers a pegmatite dyke forming a small island between a billabong and Morrissey Creek on the north-west side of the creek.

The pegmatite dyke strikes N. 50° W. and dips 70° S.W. parallel to the strike and dip of the country rock, which is tourmaline-bearing hornblende granitic gneiss. Dimensions of the pegmatite are; length 500 feet, average width 150 feet.

Several shallow prospect holes have been dug in the pegmatite and in all of these beryl crystals of various sizes are showing. The associated minerals are clear muscovite, green muscovite, albite, perthite, and clear quartz. At the north-west end the beryl occurs in the footwall zone and in the other workings at the margin of quartz pods.

The total volume of the workings is approximately 700 cubic feet. H. B. Owen* reported that in 1942, five tons of eluvial beryl were lying on the outcrop and that prospectors subsequently collected that amount (before the end of 1944.)

*op. cit., 1914.

PLATE 1

Mt YARAGNER

LOCKIER RANGE

SUGARLOAF HILL

DINNER TABLE HILL

BIDGEMIA STATION

YINNIETHARRA STATION

Gascoyne Boundary

Gascoyne River

Thomas River

Nardoo Ck

Morrissey Creek

33 Creek

31 Creek

Cork Tree Well

Well

PYRAMID HILL

YINNIE THARRA HOMESTEAD

Granite Outcrop

C'wealth Mica Mine.

MC. 43"

MC 46"
MC 45"

MC 44"

MC 392½" MC 175"

MC 393" - MC 176"
ML 373" - MC 173"
PA 717 (Bi, Mi)

MC 291" - PA 816"

MC 4(" - MC 142"

PA 755"
PA 756"
PA 754"

MC 141" - MC 40" Pb. MC 19" (Incl. ML 210")

PA 895"

PA 876" PA 815" - PA 744"
(Incl. Be. Bi. Ta).

MC 403"

MC 180" - MC 159"
Morrissey Well

MC 140" - MC 39" Pb. MC 19" (Incl. ML 195" & ML 210")

MORRISSEY HILL Rough Cairn Lat 24°32' 20"·90 cm

MC 413" (PA 874")
(Be. Bi. Mi)

MC 195"

MC. 412"

PA. 886."

MC 52"
MC 53"
MC 54"
MC 55"
MC 49"
MC 58"
MC 59"
MC 42"
MC 48"
MC 56"
MC 57"

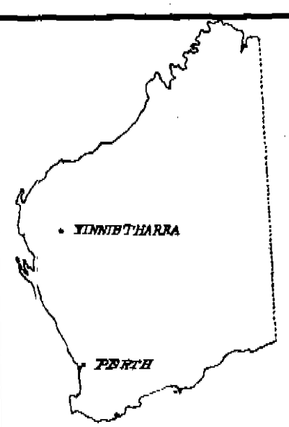
Locality from which ½ ton Beryl was collected unpegged

Minnie Pitchie Well

Codra Well

MINERAL SYMBOLS

Mi	Mica
Be.	Beryl
Bi	Bismuth
Ta	Tantalite.



— LOCALITY MAP —
— OF —
MINERAL CLAIMS AND PROSPECTING AREAS
— ON —
YINNIETHARRA AND BIDGEMIA STATIONS

Scale: 2 miles to an inch

No production is recorded from P. A. 874 or earlier claims covering approximately the same ground, so that this five tons must have been included when reporting in production from other claims.

The present owner of the claim states that in 1948 he has dug six tons of beryl from the workings (probably included in 13¾ tons of unknown origin shipped from Carnarvon, see section on "Production.").

The writer estimates that the crystals showing should produce two tons of beryl and that future operations may produce 10 to 15 tons of beryl. A few fragments of fractured aquamarine were picked up on the surface of this pegmatite.

M.C. 413H straddles the main track to the Commonwealth Mica Mine and is 11 miles from Yinnietharra Homestead along that track.

Mineral Claim 412H.

This mineral claim has been recently pegged over a pegmatite dyke in the bed of Morrissey Creek on its south-east side about a half mile downstream from M.C. 413H.

The pegmatite outcrops in alluvium so that its relation to the country rock is obscured. The strike of the dyke is N. 47° W., its dimensions, length 200 feet, average width 70 feet. At the south-east end of the dyke close to the margin of a pod of quartz two beryl crystals outcrop in two small workings. The basal section of both crystals are showing and the area of each is approximately 350 square inches. It is reported by the owner of the claim that 3 cwt. of beryl has already been chipped from one crystal. The volume of each working is about 70 cubic feet. In the middle section of the dyke on the south-west side another small pothole shows a few pounds of smaller beryl crystals (none exceeding 5lb. in weight).

If the two big crystals of beryl have a depth proportional to the diameter of their basal section between them they should yield one to two tons of beryl. The small pothole in the middle of the pegmatite may yield 1 cwt. The present owner states that some alluvial beryl was collected from the bed of Morrissey Creek at the south-east end of the outcrop by other prospectors prior to his pegging the dyke. This beryl must have been attributed to Crown Lands, P.A. 815, P.A. 816 or M.C. 291H.

Access to M.C. 412H is the same as that to M.C 413H except that instead of crossing Morrissey Creek the track turns S.W. and goes a half mile down the S.E. bank of the creek.

Prospecting Area 886H.

The position of this P.A. as plotted from bearings and distances sent in by the prospector, was on Mt. Phillips Station, about 6½ miles north-west from Morrissey Hill. Its true position is 13 miles 10° north of east from Yinnietharra Homestead.

The country rock on the P.A. is the usual tourmaline-bearing granitic gneiss striking N. 25° W. and dipping 80° N.E. The beryl pegmatite strikes parallel to the foliation of the gneiss and outcrops on the north slope of a low ridge. The contact of the pegmatite and gneiss is obscured by soil on all sides.

The observed dimensions are; length 1,000 feet, average width 300 feet, but the dyke may extend under cover at both ends.

Approximately 1 cwt. of beryl crystals was observed in small potholes at the N.W. end of a pod of quartz in the central part of the pegmatite. The minerals associated with the beryl are muscovite, clear quartz, bismuth carbonate and perthite. Shattered fragments of eluvial beryl can still be picked up on the slope of the ridge both above and below the pegmatite.

It is stated by the present owner that nine tons of eluvial beryl were collected from this area. As this amount was reported to the owner by a native it is no doubt exaggerated by several tons. However, there is little doubt that several tons of eluvial beryl were collected from the area (before it was pegged by the present owner) and attributed to some mineral claim or prospecting area for the purpose of reporting to the Mines Department.

Future production will probably be less than one ton of beryl.

Access to P.A. 886 is to be had by following the main road north from Yinnietharra to the south bank of "33" Creek and following a station track two miles south then generally east and north-east for 12 miles.

Prospecting Area.

This area, recently pegged, is one mile east of P.A. 886H. It covers several pegmatite dykes parallel to the strike of the country rock. Only two of these dykes are beryl-bearing.

The country rock on this area is the usual tourmaline-bearing granitic gneiss which quite close to the pegmatites contains lenses of amphibolitic rocks which may be metamorphosed basic tuffs or sediments. The strike of the gneiss is N. 30° W. and the dip 70° N.E. The beryl-bearing pegmatites are on the south-west slope of a ridge capped by a pegmatite with a quartz core heavily tourmaline-bearing. The dimensions of the beryl-bearing pegmatite are: length 1,200 feet, average width 80 feet. Only 30 or 40 small crystals (1in. by 2in. maximum size) of beryl were observed outcropping in the dykes. These crystals are disseminated throughout the dykes. Down the slope from these two dykes the ground is liberally besprinkled with small fragments, some showing crystal faces, of eluvial beryl.

It is estimated that between 10 cwt. and 1 ton of beryl could be obtained by collecting these fragments. No production is anticipated from the two pegmatite dykes.

Access to this deposit is the same as to P.A. 886 plus a rough track one mile east.

Area six miles S. 17° E. from P.A. 886.

From this area 10 cwt. of eluvial beryl has been collected and is awaiting shipment. The native who collected the beryl states that all has been collected and that none is left in the ground.

The actual hill slope from which the beryl was collected was not located by the writer. However, one square mile of country within one mile of the eluvial beryl occurrence was examined. The pegmatite dykes in this area were no different in their occurrence and mineral association from any others in the Yinnietharra Area except that one occupies the nose of a fold in the gneiss. In this locality the strike of foliation of gneiss swings from N. 50° E. to due North, the dip being 70° S.E. on one limb and 70° E. on the other. This would appear to be a local fold as the strike of the gneiss at points several miles east and west of that locality is N. 40° W., about the average regional strike for the Yinnietharra Area.

No beryl crystals were observed in any of the pegmatites examined so it is probable that the pegmatite from which the eluvial beryl, collected by the native, was shed was not seen by the writer. It is unlikely that its occurrence would be any different from those described.

No more beryl is likely to be produced from this locality.

PRODUCTION FIGURES.

The production figures given below are those reported to the Mines Department.

Area.	Name of Holder.	Ore ton. 2,240 lb.	BeO Content Units ton. 2,240 lb.	Year of Production.	Value. £A.
P.A. 815H	G. H. Burt	7·06 14·91	83·48 200·09	1943 1944	119·35 586·50
P.A. 816	Burt & Thomson	13·43	158·77	1943	378·60
M.C. 291	A. B. Thomson	9·37	110·81	1943	260·29
M.C. 91	A. B. Thomson	11·51	152·64	1944	447·65
M.C. 291	F. A. Moss	8·81	123·56	1944	341·20
Crown Lands	L. W. Middleton	8·78	103·77	1943	243·72
Defence Project 58	Commonwealth Government	2·50	29·44	1944	74·89
TOTALS	....	76·37	962·56	....	2452·2

Of the total of 21.97 tons from P.A. 815H probably only one-third came from the area covered by the P.A. and similarly with the other totals. The exact production locality of at least three-quarters of the beryl from Yinnietharra will never be determined.

No production figures are given for 1948. It is known that 13¾ tons of beryl have been shipped from Carnarvon up to October of this year; of this quantity, six tons produced by C. Spicer definitely came from Yinnietharra and probably the rest did too. Spicer's six tons was gathered over a wide area but some of it probably came from M.Cs. 403, 412, 413, as did portion of the other seven and three-quarter tons not yet attributed to any specific producer or area.

This 13¾ tons would raise the total production of the Yinnietharra area to 90 tons. The average grade of the beryl whose BeO content has been determined is 12½ per cent.

ECONOMICS OF PRODUCTION.

The price offering (November, 1948) for beryl is £A5 per unit of BeO, equivalent to £A60 per ton f.o.b. Fremantle for Yinnietharra beryl (average 12 per cent. BeO)

Known fixed charges against this price are as follows:—

Freight Yinnietharra Carnarvon	£A7 10 0	per ton
Freight Carnarvon Fremantle (sea freight)	18 0	per ton
Containers for ore (light petrol drums at 15s. each, six to the ton filled with beryl) ..	4 10 0	per ton
Handling and wharfage charges, agent's fees, assay charges, storage charges	2 0 0	
	£14 18 0	

Deducting this amount from £60 leaves £A45 as the approximate value of beryl (containing 12 per cent. BeO) per ton at grass, Yinnietharra. This gives a basis for calculating the economics of beryl production.

For example take a company employing four men in the field and with a capital investment of £3,000 in equipment. This small amount of capital would be the minimum necessary to provide a small compressor, jackhammer, spares, tools and necessary transport. The weekly expenditure of such a company on wages, depreciation, stores consumed, etc., would not be less than £30 per week so that the miners would have to produce a ton of beryl per week to cover that expenditure alone.

A generous estimate of beryl reserves at Yinnietharra is 40 tons. These reserves would not support a production as low as one ton per week for a whole year let alone pay wages, dividends, managerial fees, etc. Even if the four miners were the shareholders in the company the venture could be reasonably expected to return only £A2,000, i.e., their capital expenditure.

It can be seen from the new figures quoted above and without going into details, that production of beryl at Yinnietharra is uneconomical for even a small company, the obstacles being lack of ore reserves and the impossibility of economically establishing ore reserves by the usual undergorund development methods.

The quantity of beryl in sight at Yinnietharra is so small that it will only be extracted economically by prospectors working singly or in pairs with the minimum equipment, as it has been done in the past. When the prospectors have extracted all the beryl in sight even they will not be able to prospect economically for more by underground methods.

CONCLUSION.

A summary of the information on the various beryl deposits of the Yinnietharra area is presented in tabular form on page 63. The estimate of the total future production from Yinnietharra is liable to gross error owing to the possibility of the chance discovery of extra large beryl crystals (weighing several tons) during extraction of known concentrations of beryl or while prospecting as yet unexamined pegmatites.

The examination of the area by the writer has brought out the following main points:—

(i) The total production of beryl from the area from January 1943, to December, 1948, is 90 tons (allowing that the whole of the 13¾ tons shipped from Carnarvon to November, 1948, was from Yinnietharra).

(ii) The estimated future production from known deposits should not exceed 40 tons unless a super crystal (similar to that found at Wodgina, Pilbara G.F., and weighing 600 tons) is fortuitously discovered.

(iii) The beryl at Yinnietharra occurs most sporadically throughout the pegmatites and in any individual beryl bearing pegmatite. In the pegmatites the beryl tends to occur in definite zones chiefly near the walls or at the margin of uni-mineral masses of quartz. The volume percentage of beryl in the whole pegmatite varies from .04 per cent. to .0001 per cent for those deposits examined.

(iv) The beryl produced from the Yinnietharra area has been obtained from the following sources:—

(a) By gathering fragments of eluvial beryl from the ground overlying the source in pegmatites (probably accounts for 90 per cent. of the production).

(b) By "barring" out large easily removable beryl crystals from the pegmatitte matrix.

(c) By shallow mining, and deep open-cut mining (Commonwealth Mica Mine only).

(v) Future production of beryl from Yinnietharra depends chiefly on the efforts of prospectors by—

(a) selectively mining beryl in sight;

(b) gathering eluvial beryl already located;

(c) locating new concentrations of eluvial beryl;

(d) locating and extracting new concentrations of beryl crystals in situ in the pegmatites.

The yield from (a) and (b) is estimated at less than 40 tons (see ii above). That from (c) and (d) is impossible to estimate but will probably be less than 40 tons.

Even if both amounts are doubled the quantity would be far less than the initial requirements of the British Ministry of Supply, namely 500 tons, let alone the additional requirement of 500 tons per annum after the initial requirement has been satisfied.

(vi) More beryl could be obtained by prospecting the favourable zones in the beryl-bearing pegmatites by underground methods. The cost of such prospecting would far outweigh the reward expected from any anticipated yield of beryl.

W. JOHNSON,
Geologist.

7th December, 1948.

SUMMARY OF INFORMATION ON BERYL DEPOSITS AT YINNIETHARRA.

Locality of Beryl Deposit.	Pegmatite.					Beryl.					
	Dimensions.		Workings.		Mode of Occurrence.	Estimated Weight of Beryl Crystals in sight.	Reported Production.	Weight of Beryl Produced from Workings.	Percentage of Beryl in Pegmatite Material excavated from Workings.	Estimated Weight of Beryl to a depth of 5 feet below present exposed surfaces.	Possible future Production (includes Est. given in adjacent column).
	Length.	Average Width.	Estimated Volume.	Weight of Pegmatite Material excavated from Workings.							
Woodmans P.A.	feet. 700	feet. 100	cubic ft. 2,400	tons (2,240 lb.) 250	Wall Zone	tons (2,240 lb.) 10 lb.	tons (2,240 lb.) ¼†	tons (2,240 lb.) 1/20	·02%	tons (2,240 lb.) *Nil*	tons (2,240 lb.) ¼ to ½
Mineral Claim 43H	250	20	5,400	500	Footwall Zone	½	*Nil*	¼*	·05%	2	6
Defence Project 58 (Commonwealth Mica Mine)	600	30	180,000	9,500	Border Zone, Footwall	10 lb.	2·50	2·50	·03%	*Nil*	*Nil*
Mineral Claims 392H, 393H (=175, 176H) (M. Cutlack)	2,500	600	150	10	Marginal to pod of quartz	1½ tons	43·12	2–3‡?	20% ?	3	9
Prospecting Area 876H (C. Spicer) (=P.A. 815H = P.A. 744H)	800	40	10	1	Border Zone	10 lb.	21·97	*Nil* ?	not known	10 lb.	*Nil*
Mineral Claim 403H (H. H. Symonds)	550	12	80	6	Disseminated	10 lb.	*Nil*	¼	4%	1/20	*Nil*
Mineral Claim 413H	500	150	700	65	Footwall Zone and marginal to pod of quartz	1 to 2	11¶ ?	6† ?	10%	3	10 to 15
Mineral Claim 412H	200	70	140	12	Wall Zone and marginal to pod of quartz	1½	¼†	¼†	3%	2	4
Prospecting Area 886 (M. Spicer)	1,000	300	40	4	Marginal to pod of quartz	1/20	4 to 5§	not known	not known	1/4	1
Prospecting Area	2 in number 1,200	80	....	....	disseminated	1 to 2 (eluvial only)	....	....	....	*Nil*	2 to 3
Totals	....	....	....	10,348	....	5½ to 7½	....	10¼	0·1	10 1/10	32¼ to 38½

Footnotes :

* This amount is the estimated quantity of beryl crystals in waste dump.

† Quantity produced by present owner of claim not included in production figures reported to the Mines Department.

‡ Quantity estimated by the writer.

§ This quantity eluvial beryl collected before ground was pegged and attributed to one of the following claims, P.A's. 815H, 816H, M.C. 291H, Defence Project 58, Crown Lands.

¶ Five tons of this quantity (eluvial beryl) collected by prospectors other than present owner and attributed to one of the claims listed in footnote 4.

REPORT ON A MANGANESE DEPOSIT ON P.A. 330 p.p. AT TENINDEWA, APPROXIMATELY 12 MILES S.W. OF MULLEWA.

Approx. Latitude 28° 35′ S.
Approx. Long. 115° 22′ E.

By H. A. Ellis, B.Sc., A.O.S.M., Government Geologist.

Locality and Access.

P.A. 330 p.p. takes in part of locations 5466, 3757, 3571 and 5622, Lands Department Litho 156/80, situated approximately one and a half miles N.W. of Tenindewa Railway Siding. Tenindewa Siding is 56 miles by rail from the port of Geraldton and 11 miles from Mullewa. The shortest rail distance to Perth is 342 miles. The actual deposit is situated on the edge of some higher ground about 250 yards north of a road which runs along the southern boundary of Location 5466 at a point on this road 64 chains south-west by west from the corner of the road in Government Reserve No. 945. The distance by road from the deposit to the railway siding is approximately one and three quarter miles by an all weather gravel surfaced road, except for about 300 yeards of soft sandy surface across a cleared field and up a gentle rise to the edge of the scrub, in which is located the gravel pit from which the manganese ore has been obtained.

The deposit was examined on October 27th, 1948.

Geology and Mode of Occurrence.

The country in the vicinity of Tenindewa is gently undulating with a brown sandy soil overlying sedimentary rocks consisting of sandstones, ferruginous and felspathic, of Mesozoic age (probably Jurassic) interbedded with white and grey shales. There are also some recent deposits along the drainage channels.

The Manganese ore occurs in a highly ferruginous laterite exposed in a small gravel pit some 30 feet wide by 30 feet long by about five feet deep, opened up approximately in the centre of about 150 feet of outcropping laterite facing south at the south edge of a gentley rising elevation, covered with brown sandy soil and thick scrub and mallee (up to 10 feet high.) The laterite edge would be about 30 feet above the general level of the cleared farming lands to the east and south.

The rocks underlying the ferruginous laterite are not exposed anywhere in the near vicinity, a thick mantle of sandy soil effectively obscuring the local geology. About five chains north of the quarry a small piece of white felspathic sandstone was found on the surface, and this may be the rock type underlying the laterite. Local topography suggests that the laterite could be overlying ferruginous grits much younger in age than the Mesozoic sandstones and shales. The grits could have been formed and deposited in association with a Recent or near-Recent cycle of erosion.

An occurrence of lateritic manganese about one mile nearer Tenindewa siding situated on the north side of a creek and on the east side of the road, some 25 chains N. 20° W. from the Railway Siding is of interest. A blue tinged colouring on the surface of some ferruginous sandstones outcropping in this relatively low lying locality is due to manganese, and the concentration of manganese oxide right at the surface, due to solution and capilliary action, is very well demonstrated. A sample of the more strongly tinged sandstone was analysed at the Government Chemical Laboratories and contained 0.04 per cent. metallic Manganese.

Samples from ferruginous sandstone not showing visible manganese colouring were also examied chemically, and were found to contain traces of managanese. Special efforts were made in the Government Chemical Laboratory to ascertain whether any manganese bearing minerals such as rhodonite or spessartite were present in the sandstones, but no such minerals were found. The manganese was present in the sandstone samples as manganese oxide only. It may be a chemical precipitant in the original rocks.

This occurrence of manganese near the creek demonstrates very clearly and convincingly the mode of occurrence of lateritic Manganese in Western Australia, and shows the necessity for the exercise of extreme caution when estimating quantities of manganese ore in a surface deposit based on outcrop dimensions only. The necessity for vertical sampling is obvious.

Reverting to the quarry deposit on P.A. 330 p.p the tendency for the manganese oxide to be concentrated at or near the surface is obvious, and the concentrations are located mainly in the first two feet below the surface. Whatever the source of origin of the manganese is, and the writer is not able to definitely establish this for this deposit, it is obvious that the manganese oxide occurs in a very shallow zone, and that in that zone it is concentrated in local patches.

The proportion of Manganese-rich patches to iron-rich patches in the quarry is very small, but the overall distribution of Manganese-rich patches in the total extent of the laterite is not known. Loose brown sandy soil covers the probable laterite extension to the north, but it must extend wholly or in part for at least 20 chains north along the eastern side of the scrub-covered sandy rise running northwards from the quarry.

A sample collected by the writer from occasional outcrops and "floaters" over a length of eight chains, from 12 to 20 chains north of the quarry and on the eastern margin of the elevated area, contained 27.74 per cent. metallic manganese.

It is possible that there is either a continuous sheet of laterite under the sand covered elevation north of the quarry, or that a fringe of laterite extends round the low rise at about the same level as the quarry laterite. Should it ever become desirable to search for further manganese ore in this locality, the possibilities mentioned in the last paragraph should be remembered. It is also possible that manganese concentrations might be confined to the edges of laterite spurs, as is sometimes the case with bauxite concentrations in ferruginous laterite in Western Australia.

Grade and Quantity.

Samples were taken as set out in the Deputy Government Mineralogist's report below. The 30ft. wide 5ft. deep quarry face contains an average of 8.34 per cent. metallic manganese, a manganese content far too low for commercial requirements. A parcel of six tons broken from the quarry face in about August 1948, and sent to the Wundowie Charcoal Iron works analysed six per cent. metallic manganese.

The grade of the deposit is far too low to warrant any quantity surveys being made, since the work involved in pit-sinking necessary to provide the necessary data is not considered justified.

The deposit is not considered of sufficient grade or size on present indications to classify it as of economic importance.

Analytical Report.

Lab. Nos. 7249-7254 (incl.)

Locality.

P.A. 330 p.p. one and a half miles north west of Tenindewa Railway Siding approx. Gravel pit.

Marks.

No. 1 Vertical sample over 5ft., east side of pitface.
No. 2 Vertical sample over 5ft., centre of pitface.
No. 3 Vertical sample over 5ft., west side of pitface.
No. 4 Grab sample of floaters and occasional small outcrops over a distance of 8 chains from 12-20 chains N. of quarry along eastern margin of rise.

Lab. No.	7249	7250	7251	7252
Marks	No. 1.	No. 2.	No. 3.	No. 4.
Metallic manganese, Mn	6·69	12·50	5·85	27·74
Metallic iron, Fe	31·40	28·01	33·57	17·04
Metallic titanium, Ti	0·11	0·08	0·09	0·04
Silica, SiO_2	30·44	27·55	29·92	21·66

Note.—Manganese occurs as psilomelane.

Locality.—North side of creek and east side of road 25 chains N. 20° W. from Tenindewa Railway Siding.

Lab. No. 7253.

Marks three pieces of ferruginous sandstone.

Ferruginous sandstone containing approximately 0.04 per cent. manganese.

Lab. No. 7254.

Marks one piece felspathic sandstone.

Felspathic sandstone containing a trace of manganese.

Note.—The manganese in these two samples is present as oxide. No rhodonite or spessartite was detected.

H. A. ELLIS,
Government Geologist.

December 22nd, 1948.

CONSOLIDATED REPORT ON THE RE-SURVEY OF COOLGARDIE DISTRICT, COOLGARDIE GOLDFIELD, COVERING FIELD SEASONS 1946-48 INCLUSIVE.

By J. C. McMath. B.Sc. (Hons. Lond.); F.G.S., Geological Survey of Western Australia.

Contents

MAP.

Plate No.		Scale.
11	Provisional Structural Geological Map of Coolgardie District, Coolgardie Gold Field.	1/63,360

INTRODUCTION.

Centred about Coolgardie township the area re-surveyed comprises approximately 900 square miles. Reference to the attached map will give a succinct appreciation of the boundaries.

Greater geological detail was sought than had hitherto proven possible. The amplified data so obtained has been reviewed in the light of current geological knowledge and thought; a re-interpretation has been made of the mode of ore occurrence and its relations to geological structures. The work should prove of assistance to mining and prospecting interests in the district. A brief bibliography is appended for the convenience of parties interested.

The re-survey was initiated in 1946* by Mr. R. S. Matheson and subsequently carried on by the author† from 1947 until the conclusion in November, 1948.

GENERAL INFORMATION.

(a) *Reference Map*—L.O. 25/300.

(b) *Historical*—Mining history in the district dates from the discovery of "Bayley's" Reef by Messrs. Bayley and Forde on 18th September, 1893.

(c) *Production*—Official records to 31st December, 1948, ascribe a production of 1,278,109 fine ounces from 2,450,102 long tons of ore, while 32,630 fine ounces of alluvial and specimen gold have also been recovered.

(d) *Communications*—The area is well served by roads and tracks, the principal roads being the Eastern Highway and those to Norseman, Londonderry, Kunanalling, Grosmont and Jaurdi Hills. The least accessible area lies north-west of Coolgardie between the Jaurdi Hills Road and Bullabulling. This inaccessible sector has no economic significance.

(e) Water Supplies—The area is served by the Goldfields Water Supply through the Kalgoorlie and Norseman pipelines. Private branches of these pipelines run to the Surprise and Barbara Leases, Burbanks, and Gibraltar. Other water supplies are sporadic and consist of soaks, gnamma holes, dams, etc. They are dealt with elsewhere in this report.

(f) *State Government Facilities*—A Mining Registrar has offices in the town. A 10-head State battery together with cyanidation plant are available for treatment of public ore.

(g) *Mining Timber and Fuel*—The area has been cut over in past years by the Goldfields Firewood and Timber Company. Fuel and mining timber, in any but small quantities, is fairly scarce and becoming more so.

ACKNOWLEDGMENTS.

Ready assistance to the survey party has at all times been afforded by all approached.

The work of the party has been much facilitated by the information and help so obtained and the party tender their thanks to all State officials, mining company officials, and local residents concerned. To detail individuals would be a difficult—and invidious—task.

MINING ACTIVITY.

Post war mining activity has been affected adversely by the ever lessening margin between rising operating costs and the fixed price of gold The current (1948) situation in the Coolgardie District is briefly as follows:—

(a) *Major Mining Concerns.*

(i) *Phoenix Mine,* Coolgardie—Went out of production in September, 1948. The plant has been sold.

(ii) *Tindal's Mine*—Has not yet resumed production and shows no signs of so doing.

(iii) *Western Mining Corporation* interests—Steady development of the Barbara and Surprise Leases continues and early production is anticipated. The Burbanks group of leases are being explored in depth.

(iv) *Hansel Mundy G.M. Co. Ltd.*—Local interests are Three Mile Hill, Bonnie Vale, Zadows, where work is continuing. A battery is being erected on Three Mile Hill which will also treat public ore.

(v) *Hampton Gold Areas, Ltd.*—Continue to explore the Hampton Plains Estate holdings (Block 59 in the Coolgardie district).

(b) *Minor Mining.*

Prospecting continues in the district by individuals and small syndicates. New finds have become sparse since 1946.‡ The chief activity is centred about sporadic production from old shows.

(c) *Miscellaneous Allied Activities.*

(i) *Coolgardie Brickworks*—Based upon local actinolite schists and derived clays (ample reserves of which are held), the Company came into production in August, 1948. Weekly production of pressed bricks is approximately 35,000. No physical data on the product are yet to hand.

(ii) *Magnesite*—300 tons of magnesite were railed from the district during 1948. It was of good grade and was produced from E. Scahill's leases in the S.W. corner of the Camel Paddock.

(iii) *Londonderry Felspar Quarry*—Continues a steady production of felspar for ceramics. Approximately 100 tons a month are shipped, together with an occasional parcel of beryl.

FIELDWORK.

(a) *Initiation and Completion.*—The re-survey of the Coolgardie District was started in April, 1946, and finished in November, 1948.

(b) *Personal.*—Over the period of the re-survey the personnel engaged have changed owing to the exigencies of the service, and two resignations from the Geological Survey of Western Australia. Those employed were as follows:—

Geologist.	Period.	Function.
R. S. Matheson	1946	in charge
J. C. McMath	1947-1948	in charge
J. Lord	early part 1946	Assistant
H. J. Ward	1946, 1947	Assistant
N. Gray	1948	Assistant

* Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.

†Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.

‡ Ann. Prog. Rept. G.S.W.A., 1946, R. S. Matheson.

(c) *Scope of Fieldwork.*—The fieldwork comprised two aspects:—

(i) *General Regional Geological Investigations* which involved the re-mapping of the district to a scale of 20 chains to the inch. Survey methods varied according to conditions and comprised tacheometer, car, compass, and chain traverses.

(ii) *Mining Group Investigations* involved surface and underground mapping together with the preparation of cross sections. This work was to a scale of 5 chains to the inch and plane table methods were used.

Regional investigations were carried out by the geologists in charge whilst group investigations were carried out by the assistant geologists. The work of both aspects were facilitated by aerial photographs of the district (courtesy of Western Mining Corporation).

(d) *Mining Group Maps and Reports*—The following reports and maps have resulted from the re-survey of the district:—

Title.	Author.	Year.
Hampton Group	H. J. Ward	1946
Bayley's Group	H. J. Ward	1946
Burbanks Group	H. J. Ward	1946
Baker's Find Group	J. H. Ward	1946
Three Mile Hill Group	H. J. Ward	1947
Bonnie Vale Group	H. J. Ward	1947
Lord Bobs Group	H. J. Ward	1947
Londonderry Group	H. J. Ward	1947
Londonderry Felspar	H. J. Ward	1947
Sydenham Leases Group	H. J. Ward	1947
S. W. Bonnie Vale Group	N. Gray	1948
Nepean Group	N. Gray	1948
Lloyd George Group	N. Gray	1948
Reform Group	N. Gray	1948
Grosmont Group	N. Gray	1948

Arising from geological commitments in the area, but not immediately germane to the re-survey of the Coolgardie District, were the following reports:—

Title.	Author.	Year.
Report on Block 59, Hampton Plains, Coolgardie Goldfield	J. McMath	1948
Notes on the Porphyry-Porphyrite Series of Coolgardie, Coolgardie Goldfield	H. J. Ward	1948

(e) *Prospecting Recommendations.*—Arising as the re-survey progressed were areas showing promise of repaying further intensive prospecting. These areas were announced in the Press and through the Mining Registrar. Details follow later in the report.

For the information of the public it must be understood that neither the terms of reference of the re-survey nor the scope of the investigations permitted active engagement in prospecting but confined the party to defining areas likely to repay prospecting.

(f) *Assistance to the Public.*—Apart from the general recommendations referred to in sub-paragraph (e) above, prospecting activity in the area was assisted by:—

(i) Making preliminary investigations of holdings.

(ii) Giving verbal advice and assistance.

(iii) Making available at the Mining Registrar's office a progressive structural geological map.

(iv) Making available for study by those interested (in the Registrar's office) an annotated suite of local rock types.

(g) *Analyses, etc.*—The re-survey, both in its regional and group phases, entailed the collection of rock and mineral specimens for analysis and mineralogical and petrological determination. These results will be published, when available, in due course.

(h) *Miscellaneous Operations*—During the course of re-survey the following investigations germane to increased knowledge of the district took place:—

(*i*) *Geophysical Survey*—was carried out in 1946 by the Commonwealth Bureau of Mineral Resources with a view to further elucidating the geological features of economic importance in the Hampton Plains region of the Tindal's axis.

(*ii*) *Radioactive Minerals*—in August, 1948, Mr. J. N. A. Grace of the Government Chemical Laboratories, in company with the author, tested selected areas with a portable Geiger-Muller Counter. The results were of academic interest but of no economic significance. They are published elsewhere.

GEOLOGICAL NOTES.

(*a*) *Introduction.*—These notes are tendered in the full knowledge that they can be neither exhaustive nor treat in detail many vital matters of economic significance whether or not controversial. They are governed by the following duties of the Geological Survey:—

(i) Placing on record the progress and completion of the operation undertaken.

(ii) The desirability of making available to the interested public the salient geological facts at the earliest possible moment.
Time and space preclude any but the treatment adopted.

(*b*) *Recapitulation.*—Fieldwork during 1946 and 1947 yielded the following results:—

(i) Delineation of the major tectonic and geological record of the area.

(ii) Differentiation of the Coolgardie Greenstones into alternating, and most probably diachronous, belts of Basic and Ultra-basic Lavas. The doubts experienced in 1947 with regard to the stratigraphic position and relations of the Meta-gabbio (Amphibolite) have been further strengthened.*

(iii) Recognition of favourable auriferous horizons within which ore localisation has been largely by cross folding.†

Work during the past field season has confirmed the above findings in large measure and extended the area of their application. The country covered this season coupletes the re-survey of the area.‡

(*c*) *Geomorphology.*—Any but general notes are precluded, at this stage, by lack of adequately contoured maps. It is remarked that Jutson§ includes the region in his Salt Lake Division of Western Australia. The main topographic elements are:—

(i) A median belt of hills, comprised of Basic and Ultrabasic Lavas of the Older Greenstones of Kalgoorlie Series. These together with the Mt. Burgess monadnoch, represent traces of the "Old Plateaux" of Western Australia. Traces are also found westwards in the more isolated hills of Ultra-basic Lavas which extend from Mercer's Find southwards to Gibraltar.

(ii) The sand plain areas of the south-west, south-east and south-west quadrants (regarding Coolgardie as the centre). These are underlaid by granite, granite-gneiss, or granitised meta-sediments. Laterites occur as a Fossil B horizon in an old soil profile.

(iii) The soil covered, alluvium and eluvium, areas of the north-east, south-east, and south-west quadrants. The underlying rocks are obscure, but meta-sediments, granite gneiss, and granite outcrop in the neighbourhood. It is these areas that fringe the foci of the intermittent and seasonal drainage. On the peripheries of these areas, together with the north-western shore of Brown Lake, occur the "Breakaways" associated with the "New Plateau." These features are dealt with adequate by Jutson (cited above) and Cotton.‖

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* Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.
† Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.
‡ Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.
§ Bull. 95, G.S.W.A., Physiography of W.A., J. T. Jutson.
‖ Geomorphology—C. A. Cotton—Whitcombe & Tombs, Ltd., 1945.

Drainage is sluggish and intermittent except during heavy rains and, except in the vicinity of the hills, the channels are infilled with alluvium. These channels trend toward the drainage foci—Brown Lake, Kurrawang Lakes, the Mercer's Find, Jaurdi Hills depression and an unnamed lake six miles south south-west of Bullabulling—which are themselves infilled with deposits of alluvial origin. The abnormal cyclonic rain in February, 1948, filled these lakes and an appreciation of the characteristics was gained.

Renewed erosion of the alluvial deposits of these old channels can be seen in many deep creeks, particularly on Block 59, and is ascribable to increased run-off consequent upon the cutting out of timber over a period of 50 years.

In areas of contrasting relief, the drainage is largely controlled by the geological structure, but at the present day loses itself on the flats. The present drainage pattern is considered to be the disintegrated residuals of a past cycle of erosion which reached stagnation in comparatively recent times In this connection the alluvial section of 400′ exposed in Rollo's Shaft, Coolgardie, is suggestive and has economic implications with regard to the presence of "deep leads" in the district.

Erosion in the present cycle is mechanical (wind, sheet, flooding, isolation, the order of importance of which has not yet been evaluated) and chemical weathering by solution and oxidation is in progress.

SEQUENCE OF ROCK TYPES.

Resulting from the work of the past two field seasons, some amendments must be made to the classification of rock types previously published.*

These amendments affect:—

(i) The nature and stratigraphic position of the meta-gabbro (amphibolite).

(ii) The relations of the ? black flag series to the ? older greenstones.

(iii) The provisional place of the Bullabulling meta-sediments.

It is remarked that although the re-survey of the area is concluded, more stratigraphic evidence is required before this classification can be regarded as final or be intruded into the domains of dogma.

* Ann. Prog. Rept. G.S.W.A., 1946, R. S. Matheson.
* Ann. Prog. Rept. G.S.W.A., 1947, J. C. McMath.

Age.	Series.	Description.	Remarks.
Recent	....	Soils	Various types.
Tertiary to Recent	....	Alluvial and Lake Deposits	These may be younger or older than the laterites; possibly deposits of both ages occur.
Tertiary	....	Ferruginous Laterite—"Cement" deposits	Laterites of W.A. are generally accepted as being of Tertiary age.
		Post-Alaskite Movements.	
Pre-Cambrian	....	Quartz veins, alskite dykes and probably the mineral bearing pegmatites of Londonderry and elsewhere	This may represent either a second period of granitic intrusion or a regeneration of the granitic magma responsible for auriferous ore deposition.
		Post-Gold Faulting.	
Pre-Cambrian	....	Intrusive biotitic granite and gneiss, associated with which are quartz veins and pegmatoid dykes. Auriferous ore deposition is associated with this period of intrusion	Ore deposition is controlled by the regional folding and is also known to occur in places of post-porphyry shears. Hence it must be younger than both.
		Regional Folding, Shearing and Jointing.	
Pre-Cambrian	....	The Porphyry-Porphyrite series of acid minor intrusives	The rocks are folded sheared and jointed. They are older than the regional folding. Source magma unknown but presumably granitic.
		Pre-Porphyry Movements.	
Pre-Cambrian	? Younger Greenstones of Kalgoorlie	Meta-Gabbro (amphibolite)	Latest petrological and field evidence show that it is an intrusive—intrudes the Older Greenstones and the Sedimentary Series. Therefore is younger.
Pre-Cambrian	(a) Eastern Sedimen- Series ? Black Flag Series	Interbedded meta-sediments consisting of slates, phyllites, mica schists, grits, quartzites with some greenstone bands, together with paragneissic developments	Series is cut by the Porphyry-Porphyrite Series and by granitic rocks. Relations to underlying Older Greenstones may be one of disconformity rather than unconformity.
	(b) Western Sedimentary (Bullabulling) Series	Interbedded meta-sediments consisting of slates, grits, mica and horneblend schists with some greenstone bands and sillimanite gneiss	Series is cut by granitic rocks. Relations to Gibraltar facies of the Older Greenstones are obscure but may be of unconformity. Such field evidence as could be seen suggested that it might possibly be a sedimentary facies of the Gibraltar Greenstones. The question remains open.
Pre-Cambrian	Greenstone Series ? Kalgoorlie Series of Older Greenstones	Metamorphosed, alternating, conformable belts of basic lavas, allied rocks, and ultrabasic lavas. Interformational or inter flow horizons of thin slates, graphitic schists and mica schists	(i) The Meta-gabbro (amphibolite) has been removed from this series. (ii) The Bullabulling Sedimentary Series may belong here as a marginal sedimentary phase of the Gibraltar Greenstones. The question is open.

THE GREENSTONE SERIES.

Centred upon Coolgardie, this series occupies two main areas. Both areas are structurally and lithologically allied but possess certain characteristics permitting differentiation. These areas are:—

(a) A median belt extending from the northern boundary of the district, through Coolgardie to Londonderry and terminating in the Nepean outlier.

(b) A western extension occupying the Gibraltar, Gnarlbine-Mercer's Find triangle.

For present convenience these will be referred to as the Coolgardie and Gibraltar sub-areas respectively.

The series comprises:—

(a) *Coolgardie Sub-area.*—Alternating belts of basic and ultrabasic lavas. Thin, impersistent bands of sediments (slates, graphitic schists, mica schists and quartzites) occur at formation junctions and, occasionally, between flows. Their field value lies in structural delineation. The series has undergone low grade regional metamorphism, though very localised "highs" do occur—usually in the cores of minor structures. Folding, jointing and shearing have taken place. The series is intruded by:—

(i) The meta-gabbro (amphibolite) now tentatively regarded as of Younger Greenstones of Kalgoorlie in age. At least younger than either the Coolgardie greenstones or putative Black Flag series.

(ii) Members of the Porphyry-Porphyrite series.

(iii) Granites and allied rocks.

(b) *The Gibraltar Sub-area.*—Largely a development of ultra-basic lavas and metamorphosed pelitic sediments giving rise to rocks of ultra-basic aspect.

No indubitable basic lavas have been recorded. The remarks made with regard to folding, shearing, jointing, metamorphism, and subsequent intrusives in the Coolgardie sub-district apply here also. There is, however, stronger evidence of close isoclinal folding (with overfolding) than is to be had in the Coolgardie sub-area. The deformation of the regional schist trends to sub-parallelism with the eastern granite contact is noticeable, as is also the tendency of subsequent minor intrusives.

The rock types in the two sub-areas are now commented upon in the light of past fieldwork:—

(a) *Basic Lavas and Allied Rocks.*

Four main belts together with outlying occurrences east of Mt. Burgess and in the south-west of Block 59 have been mapped in the Coolgardie sub-area. No indubitable basic lavas have been recorded from the Gibraltar sub-area. The lavas and allied rocks consist of fine to medium grained types, amygdaloidal, pillow, and porphyritic lavas, together with volcanic breccias, agglomerates and possible tuffs. This sedimentary bands may be present and are indicative of successive flows. They are hard, dark green rocks, showing usually only a rude schistosity. They usually yield a dark red soil together with occasional travertinous patches. Considerable variations of character occur within each belt. Relatively resistant to erosion, these rocks generally form the dominant ridges and hills in the area, though exceptions do occur as to the south-west of Grosmont where ultra-basic rocks form the features.

A most noticeable basic porphyritic lava is recorded in the Londonderry-Burbanks area and elsewhere to the west. Noticeable by reason of fine, dark, groundmass, large white porphyritic felspars, and mode of weathering, it is usually to be found within a hundred yards of the basic-lava-ultra basic lava junction. No transgressive criteria have been noted to date. It may prove of value in detailed structural mapping. It was regarded by Blatchford* as an intrusive of later age but was determined on field and petrological evidence by K. R. Miles† as possibly a basic extrusive penecontemporaneous and co-magnatic with the other basic lavas. In this finding the author‡ concurs.

(b) *Ultra-basic Lavas and Allied Rocks.*

The ultra-basic rocks in both sub-areas reveal the following types:—Actinolite, actinolite-tremolite, anthophyllitic rocks and schists. They are fine to medium in grain. In addition fuchsite, garnet and chloritoid schists are recorded together with hornblendites and serpentines. In the vicinity of tight dragfolds and shears, talc, chloritoid, and hydro-bitite schists are seen.

Their genesis must remain uncertain for the moment, but it is believed that they originated from the regional metamorphism of peridotic and pyroxenitic flows and sills together with sediments of appropriate composition.* On weathering they tend to yield grey to light brown soils. Their decomposition products—jaspery, ironstone, cellular and opaline silica, magnesite—are very characteristic in the field, more especially in regard to the serpentines. Relatively soft rocks, they tend to occupy the low country. There are, however, exceptions.

Hydrothermal alteration closely following intrusion, or long subsequent, of some of the serpentines has produced a serpentine type carrying fine grains of vermiculite. It weathers with a characteristic pitting. It is with these serpentine types that magnesite of economic importance is associated. The margins of these bodies may carry economic bodies of vermiculite. Prospecting is required.

Of interest is the development previously remarked† of two types of actinolite rock.

These features have persisted in areas of ultrabasic rocks and are a useful guide to the proximity of minor acid intrusives.

To the ultrabasic belts of the Coolgardie sub-district already mapped‡ must be added that to the north-east of (and including) Mt. Burgess and that in the south-west of Block 59.

As previously stated, the Gibraltar sub-area is composed of ultra-basic rocks—but the development of types thought to originate from sediments of appropriate composition is considerably more pronounced.

(c) *Meta Gabbro (Amphibolite).*

The salient features have been recorded in the progress reports for 1946 and 1947. The following further notes are made:—

(i) In addition to the major occurrence in the Coolgardie sub-area, it outcrops in the form of minor intrusives in the Gibraltar sub-area and also to the north of Coolgardie in the meta-sediments ascribed to the Black Flag series.

(ii) In all cases its intrusive nature can be proven by contact features.

No chemical analyses are as yet available—but on the evidence it is younger than either the basic and ultra basic lavas or the meta-sediments. The author provisionally regards it as being of Younger Greenstones of Kalgoorlie in age.

METAMORPHISM.

With the exception of the younger granites intrusive in the district surveyed, the Pre-Cambrian rocks have suffered, in great or small measure, metamorphism. Any one metamorphic process may be dominant in a particular area. The major processes evident in the area are:—

(i) Regional metamorphism.

(ii) Thermal metamorphism.

This is their chronological order and that in which they will be noted.

(a) *Regional Metamorphism.*

This, generally speaking, is of low grade—but local "highs" are to be found in tightly dragfolded structures. It has resulted in the production of schistose

* Bull. 53, G.S.W.A., 1913, T. Blatchford.
†Ann. Prog. Report, G.S.W.A., 1946, K. R. Miles.
‡Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.

*Harker, A., "Metamorphism," Methuen, 1932.
†Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.
‡Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.
‡Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.

structures in the rocks together with some measure of re-crystallisation. Markedly consistent is the regional schist strike of North 20° West throughout the area. It varies little from the figure cited except in the neighbourhood of crossfold nodes and along the edges of major granite intrusions such as at the southern end of the Mungari granite and the Bullabulling granite. The regional metamorphism antedates the crossfolding.

(b) *Thermal Metamorphism.*

Only the salient features can be remarked. For the purpose of brevity the term is taken to include the following proceses:—

(i) Normal contact phenomena.

(ii) Deep seated or plutonic metamorphism.

(iii) All processes leading to granitisation.

(iv) Minor phenomena—silicification, hydrothermal alteration, etc.

These have been superimposed upon rocks already regionally metamorphosed.

(i) Normal contact metamorphism—is best illustrated with regard to the Mungari granite aureole. These effects have been previously recorded.*

(ii) Deep seated or plutonic metaporphism—two types have been noted:—

(a) In the aureole of the Bullabulling granite (a porphyritic biotite type) which is intrusive into meta-sediments (mica and hornblende schists together with more sandy types). This has resulted in the production of sillimanite gneisses and schists (best seen in the quarries one mile west of Bullabulling railway station). They pass outwards to normal meta-sedimentary types.

(b) Of very local occurrence—as remarked in Burbanks and Nepean dumps—are garnet amphibolite gneisses which are considered to have resulted from deeper seated thermal processes. Blatchford† in this connection shows some excellent photographs of ptygmatic folding of quartz reefs at Burbanks.

(iii) Granitisation—That rocks, previously very different in physical and chemical composition, have been granitised is most evident in the field. The geochemical processes involved must await future research.

The para-gneisses and migmatic rocks associated with the Mungari granite have been remarked in a previous report.‡ Granitisation of basic lavas and ultrabasic rocks is a common feature in the Coolgardie and Gibraltar sub-areas in the vicinity of the major granite masses.

At Yellari Rocks, south-east of Coolgardie, granitised meta-sediments are seen in association with the Yellari granite gneiss. In most cases any line of demarcation between gneiss and meta-sediment is arbitary.

It may be of significance that pegmatites associated with these granitised rocks have so far proven barren of economic mineral content, they being mainly composed of quartz, felspar, and, usually, a white mica. The question arises as to whether they are later intrusives or represent a phase in the process of granitisation. The author favours the latter view.

(iv) Minor phenomena—largely metasomatic in their nature, have been noted with regard to silicification of adjacent country rock by porphyry intrusives.§ Hydrothermal alteration of serpentines has already received mention.

Pegmatite intrusives carrying minerals of economic interest, e.g., Londonderry and Grosmont may have a late hydrothermal phase with the production of albite felspar.

The presence of fluorine and boron bearing minerals (quantatively negligible apart from any concentrations in pegmatites) in a widespread distribution in the country rocks, together with kaolinised granite margins, indicate some degrees of pneumatolytic activity. The Gibraltar and Londonderry districts furnish examples.

ACID IGNEOUS AND ALLIED ROCKS.

Major and minor acid intrusives occur in the area re-surveyed. They are grouped as follows:—

(a) *Porphyry-Porphyrite Series.*—Consisting of sills and dykes.

Their age, general distribution and features have been previously recorded.* A brief summary of their features will not be out of place and is as follows:—

(i.) The normal type is of grantitic composition, being composed essentially of albite felspar, quartz and minor amounts of biotite and muscovite.

(ii.) The majority of occurrences take the form of single sills or groups of sills.

(iii.) The intrusions favour zones of structural weakness and are most commonly intruded along formation or lava flow junctions.

(vi.) They have undergone regional folding and are thus older than the folding.

(v.) They have sometimes assimilated their wall rocks during intrusion and produced a wide range of hybrid rock types. Such effects can be traced along the strike of many of these bodies. A clear example is furnished on the North Burgess Leases where a member of the series shows all stages of assimilation of wall rock. The stages range from large, relatively unaltered fragments of wall rock suspended in the porphyry to the completed hybrid which resmbles a diorite in appearance.

vi.) The association of gold mineralisation with these rocks is considered accidental and not genetic. In this connection the recent notes on the Porphyry-Porphyrite Series by Mr. H. J. Ward are of interest.†

(b) *Major Granite Intrusions.*

Lack of critical exposures makes precise definition of the boundaries of specific intrusions either difficult or impossible.

These granites are intrusive into both the Greenstone Series and the Meta-Sedimentary Series.

A tentative grouping of the granite masses can be made as follows:—

(i.) Granites of the Gibraltar-Calooli-Mercer's Find areas are usually non-porphyritic biotite types which show some marginal gneissosity. Pegmatites associated with the granites may carry minerals of economic importance such as the beryl, lepidolite and biotite pegmatites at Grosmot, Gibraltar, and Mercer's Find.

(ii.) Granites of the Nepean-Quairnie Rocks area are, again biotite granites with porphyritic phases. They may be, as at Nepean, strongly gneissic, with bands of the normal granite alternating with dark bands consisting of biotite and hornblende. These latter bands vary in width from inches to a few feet. The strike of the banding is generally about N. 20° W.—the regional strike. Any pegmatites are barren.

(iii.) Bullabulling and Gnarlbine Granites show some features in common in mineral content but the latter is porphyritic. The pegmatites closely associated with these granites have so far proven barren.

(iv.) Cairnyie Rocks (10 miles north-north-west of Bullabulling) and the granitic rocks in the area show faint relics of a gneissosity similar to that observed at Nepean. The regional strike of North 20° West is maintained. The pegmatite phases are barren.

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* Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.
†Bull. 53, G.S.W.A., 1913, T. Blatchford.
‡Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.
§Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.

* Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.
* Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.
†Ann. Prog. Report, G.S.W.A., 1948, H. J. Ward.

The Mungari and South Grosmont Granites have been noticed last year.* However, very small traces of lithia mica have been found in the pegmatites of the latter body.

The reference of the Tantalite Hill and Londonderry pegmatites with any degree of surety to a possible parent granite has not been possible. It would seem that the South Grosmont granite may be a possible source.

In view of further field evidence—the author considers the Tantalite Hill and Londonderry pegmatites to be co-magmatic and probably facies of the same body. Evidence of the shape of the body is scanty. H. J. Ward† regards them as dykes. The author considers these pegmatites are more probably sheets with a south-south-east dip. Drill information is required to settle the point and to furnish information as to reserves and distribution of economic mineral content of the Londonderry pegmatite.

SEDIMENTARY ROCKS.

Two main categories of sediments are found in the area:—

(i.) Sandy and clayey types resulting from normal rock weathering.

(ii) Laterites and "Cements" arising from chemical weathering of rocks. Included in this category are opaline and cellular silica resulting from the decomposition of ultra-basic igneous rocks.

Occurring as schists and grits, the first category are seen in the Pre-Cambrian of the area and also as clays and sands in the Tertiary to Recent deposits. The latter category are entirely Tertiary to Recent in age.

Pre-Cambrian Sediments.

The following horizons have been noted:—

(1.) *The Older Greenstones Series.*

Graphitic and mica schists, also thin quartzites, occur at formation junctions and sometimes between flows in the Basic and Ultra-basic Lava belts. They are impersistent but of value in structual mapping.

2. *Sedimentary Series (? Black Flag Series.)*

The development of metamorphosed sediments to the east of Coolgardie was commented upon in the Progress Report for 1947. They retain their characteristics in north Camel Farm and Mt. Robinson areas.

Two further developments of metamorphosed sediments have been noted:—

(a) Those in the west which have been intruded (with the formation of sillimanite schists and gneisses) by the Bullabulling Granite.

Outside the aureole of the granite, these rocks consist of mica and hornblende schists together with occasional grits. The outcrops are extensively and deeply weathered. In this they present some aspects in common with the weathered greenstones of the Gibraltar area, suggesting that they may represent a sedimentary facies of these greenstones. Soil cover precludes an accurate idea of this relationship and the question of their correlation remains open.

(b) In the Nepean area a small outcrop of graphitic and mica schists, with thin quartzites, occurs. In the south east it is in contact with granite. In the west it shows a contact with Metagabbro (Amphibolite) which intrudes both the sediments and Ultra basic Lavas of the Older Greenstones. These sediments appear equivalent to those of the Mungari area and are tentatively correlated with the Black Flag Series.

Tertiary to Recent Sediments.

The extensive soil cover in the Coolgardie District may be classified:—

(a) *Alluvium and Lake Deposits.*

The observations‡ made in 1947 persist throughout the area re-surveyed. The large scale development of sheet flooding, the cause of the widespread distribution of quartz fragments, in the marginal areas of the drainage basins was particularly noticeable consequent upon the heavy rains of February.

(b) *Residual Soils.*

These mantle the hill slopes and gradually merge with the alluvium of the drainage channels. The line of demarcation is often arbitary. The soil types shown are:—

(i.) Red and brown clayey soils.

(ii.) Pink and grey sandy soils.

These soil types are often diagnostic of the underlying rocks, though on the plain areas they can only be classed as indeterminate. The first class are derived generally from the greenstones whilst the second class arise from the weathering of the granites, gneisses, and metamorphic sediments.

(c) *Laterites.*

Two types are distinguished:—

(i.) A ferruginous type developed on the greenstones. This largely occurs capping erosion residuals of Jusston's "Old Plateau"* but may occur at lower levels.

(ii.) An aluminous type which characterises the granites, gneisses, and metamorphosed sediments. It is typically developed on the "New Plateau" of Juston.†

Laterites occur associated with the sand plain areas. They are regarded as fossil B horizons of an old soil profile.

The distinction made in 1947‡ of two ribid types of laterite—high level and low level—is no longer considered valid.

(d) *Sand Plains.*

Sand plain areas are seen in the west, south-west, and north-west of the district re-surveyed. Derived from underlying granites, gneisses and metamorphosed sedimentary rocks they are regarded as an old soil profile.§

Of interest is the occurrence eight miles north of Bullabulling of a high level sand plain carrying a flora abnormal to the district. The alien elements are Blackboy and Prickly Banksia.

STRUCTURAL NOTES.

The Pre-Cambrian greenstones and sediments of the Coolgardie district have undergone folding on a regional scale. Two major axes of folding are seen:—

(i.) Trending in approximately a north-south direction. The regional schist strike has this direction.

(ii) Trending approximately east-north-east. The schist strikes swing in conformity with these axes which are termed "Cross-fold Axes."‖

Evidence of the relative ages of these two-fold axes is lacking. It is thought that the cross-folding closely followed the other period of regional folding.

The general structure resulting from this regional folding takes the form of an elongated dome which extends from the north of the district to Nepean in the south where it ends as a long and compressed fold. The following features have been observed:—

(a) The structure has a steep pitch at the north end.

(b) A southerly pitch is noted at the Nepean end.

(c) The limbs of the dome dip steeply.

(d) The eastern limb is well preserved whilst the western limb has been invaded and partially absorbed by granite.

(e) The core of the elongated dome is occupied by granite and allied rocks.

(f) The ultra-basic belts have been the incompetent members of the formations involved in regional folding, having a more highly developed schistosity than in the other formations and having developed internal folding (drag-folding) often passing into shears.

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* Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.

†Ann. Prog. Report, G.S.W.A., 1947, H. J. Ward.

‡Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.

* Bull. 95, G.S.W., "The Physiography of Western Australia," 1934, J. T. Jutson.

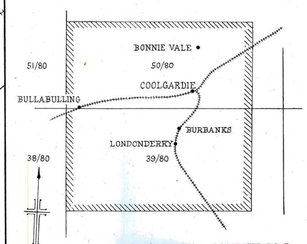
†Op. Cit.

‡Ann. Prog. Report, G.S.W.A., 1947, J. C. McMath.

§Bull. 97, G.S.W.A., 1939, Appendix by D. Carroll on Sand Plain Soils.

‖Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.

PLATE II



LEGEND

- Ferruginous Laterite
- Soil-covered areas — The nature of the underlying rocks cannot be inferred with any degree of certainty
- PRE-CAMBRIAN
- SEDIMENTARY SERIES — Probably corresponds with Black Flag Series
  - Metamorphosed sediments — Consisting of slates, phyllites, mica schists, quartzites, and thin bands of greenstone apparently overlying the greenstone series
- GREENSTONE SERIES — Probably corresponds with Kalgoorlie Series
  - Metamorphosed ultrabasic rocks — Fine to coarse-grained actinolite schists, actinolite tremolite schists and anthophyllite and serpentine rocks, with local variations to talc chloritic and biotite schists. Decomposition products in the form of magnesite and jasperoid in stone boulders and cellular opaline quartz rubble are scattered over these belts.
  - Metamorphosed basic lavas and allied rocks — Fine to medium-grained basic lavas, amygdaloidal and pillow lavas, volcanic breccias and agglomerates and probably tuffs
  - Amphibolite (metagabbro) — Medium to coarse-grained hornblende and hornblende-felspar rocks. At present their origin is doubtful.
- Granite, Gneiss and allied rocks
- Pegmatite

REFERENCE

- Boundaries assumed
- Boundaries approximate
- Fault
- Strike and dip of schistosity
- Strike of vertical schistosity
- Strike of schistosity with no observed dip

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

STRUCTURAL GEOLOGICAL MAP OF THE COOLGARDIE DISTRICT

COOLGARDIE GOLDFIELD

Scale: 80 chains = 1 inch

80 60 40 20 0 80 160 240

Geology by R.S. Mathieson, April to December 1946 and J.C. McMath, April to December 1947 and April to November 1948.

Cross-folding is of economic interest in the district—distribution of gold mineralisation shows:—

(a) That is is largely confined to the ultra-basic belts whose incompetency under regional folding has made these rocks the most favourable for gold deposition.

(b) That localisation of gold deposition appears to be concentrated on the flanks of cross-fold axes.

One major cross-fold has been established in detail—the Tindal's Cross-fold. It is an anticlinal with a pitch east-north-eastwards.*

Cross-folds, synclinal in nature, of the same order pass through Bonnie Vale and Londonderry. They are not so well established as that of Tindals.

* Ann. Prog. Report, G.S.W.A., 1946, R. S. Matheson.

* Ann. Prog. Rept., G.S.W.A., 1946, The Hampton Group, H. J. Ward.

Of a minor order is the folding on the flanks of the major crossfolds. This minor folding results in the bending of the formations between the major cross-folds. There is a suggestion of such a fold in the Nepean area.*

A further suggested minor cross-fold axes is that upon which the Three Mile Hill Group lies.†

* Ann. Prog. Rept., G.S.W.A., 1948, "The Nepean Group," N. M. Gray.

†Ann. Prog. Rept., G.S.W.A., 1947, "The Three-Mile Hill Group," H. J. Ward.

It is of interest to project these axes, confirmed or only suggested, westwards and to note their association with major gold-producing groups. The results are tabulated as follows:—

Axis.	Association West.	Association East.	Remarks.
Bonnie Vale	Mercers Find	Passes under soil	Major axis—both Bonnie Vale and Mercer's Find are in Ultrabasic rock belts.
Three Mile Hill	Gibraltar (Reform, Lloyd George Groups)	Through Mungari Leases	Minor axis—Gibraltar Groups in Ultrabasic Rocks. Three Mile Hill on Basic Lava—Meta-gabbro Contact.
Tindals	Grosmont Leases	Barbara Surprise Leases	Major axis—Groups are in Ultrabasic Rocks.
Londonderry	Reids Find, Gnarlbine....	Soil covered	Minor axis—Groups in Ultrabasic Rocks.

It is repeated that only the Tindal's Axis is well established, and attention is called to the fact that the validity of all projections of this nature is open to question. Any demonsration of the passage of these axes through Gibraltar, Gnarlbine, and Mercer's Find is rendered uncertain at present by reason of lack of critical exposures.

A further complication arises in the Gibraltar area where there is slight evidence of closely packed isoclinal folding which, together with subsequent intrusives, appears to trend sub-parallel with the contact of the granite on the east.

MINERALISATION.

(a) *Gold Mineralisation.*

1. Genesis.—The ultimate parentage of the ore deposits of the Coolgardie District is speculative. It is of interest, however, to note that:—

(i) Past and present gold producing leases of any consequence are never very far removed from a contact between the greenstones and a major granite intrusive body. Bonnie Vale, Gibraltar, Bayley's Group, Gnarlbine, and Lord Bobs are examples. An exception is found in the Barbara and Surprise Leases (Hampton Plains.)

(ii) Gold bearing quartz reefs occur in the Bonnie Vale granite*, and in the contaminated and gneiss ose granite which underlies the Lord Bobs greenstone area at shallow depth.

2. *Classification.*—The ore deposits as a whole are tentatively referred to the mesothermal category of Lindgren* by reason of their mineral association of pyrites, scheelite, arsenopyrite, etc. These mineral assemblages do not necessarily occur together or in the same mine.

3. *Types of deposit.*—The following types of gold deposit are recorded in the area:—

(i) Quartz reefs, with or without lode material, in greenstone country.

(ii) Quartz reefs, with or without lode material, in sedimentary bands in Greenstone Series.

(iii) Quartz reefs, with or without lode material, in porphyry dykes (e.g. at Phonix Gold Mine, Coolgardie.)

(iv) Stockwork types consisting of lode material and narrow quartz veins with varying attitudes. These are confined to the Meta-gabbro (Amphibolite) usually near the contact with Basic Lavas as the Three Mile Hill and Sydenham Leases occurrences.

(v) Schistose lode material with hard albitised and silicified bands (e.g. at the Barbara G.M. Hampton Group.)

(vi) Silicified lodes occurring in special structural positions near porphyry dykes (e.g. Bellbird G.M. south of Burbanks.)

(vii) Porphyry lode material with quartz veinlets (e.g. Tindals G.M.).

(viii) Hybrid silicified porphyry (e.g. the "Brown Lode" at the Surprise G.M., Hampton Group.)

(ix) Alluvial and or eluvial gold deposits.

4. *Host Rocks.*—Study of the gold producing leases of past or present importance shows a concentration in the Ultra-Basic Belts. Under regional folding these rocks have proven the incompetent member of the Greenstone Series; they show much internal folding (drag-folding) and a higher degree of schistosity than the other members of the series. It is probable that these factors favoured the passage of gold bearing solutions.

5. *Favourable Horizons.*—In addition to favourable host rocks, favourable horizons consisting of formation junctions, junctions between successive flows in the lava belts and the scattered groups of porphyry sills in the ultra-basic belts, occur. Auriferous deposits occur at scattered intervals along these favourable horizons in which shearing has taken place during the regional folding.

6. *Structural Controls.*—The relation of auriferous deposits to cross-folding has already been remarked. In detail, localisation of deposits is almost invariably associated with secondary consequences of the cross-folding such as shear zones, dragfolds, etc. It is with these features that the development of payable ore shoots takes place. Reference may be made to the Group Reports for details.

7. *Secondary Enrichment.*—That secondary enrichment processes have been active in the Coolgardie District is evidenced by:—

(i) In general the deposits are richer at the surface than in depth.

* W. Lindgren, "Mineral Deposits," McGrow-Hill, 4th Ed., 1933.

(ii) Enrichments occur at water level.

(iii) "Paint" and crystalline gold are found in ore bodies in the oxidised zone.

(b) *Minerals other than gold.*

Only those of economic importance can be noticed. A convenient classification is as follows:—

(i) Minerals associated with gold deposition.

(ii) Pegmatite minerals.

(iii) Minerals arising from metamorphic processes.

The first class are limited in their occurrence and consist of one of economic importance, namely scheelite. Other members of the mesothermal assemblage occur, such as pyrite (of importance only if auriferous), and bismuthinite (rare). During the war scheelite crushings were obtained from the Bayley's Group but it is not now mined. A fresh find of scheelite was made early in 1948 in the south-west corner of Block 59. It occurred with gold quartz veins in the Basic Lavas. A small crushing was put through. The second class are of increasing importance, especially with regard to beryllium, tantalum and the possibility of radio-active minerals. It is considered that the parent pegmatites are related to the granite intrusives of South Grosmont, Grosmont, Gibraltar, Calooli and Mercer's Find. These granites may well be portions of a batholith. It is significant that the eastern granites of the district—and those of Nepean and the south-west—have so far shown only barren pegmatites.

A tabulation of the main known economic pegmatites is of interest:—

Pegmatite.	Main Mineral Assemblage.	Remarks.
Londonderry	Felspar — lepidolite — petalite — beryl — columbite—biotite	Now only producing Felspar. Occasional parcels of Beryl, Columbite and Petalite have been obtained. ....
Grosmont	Felspar—biotite—lepidolite—beryl	Abandoned—Formerly worked for lepidolite.
Tantalite Hill	Felspar — tantalite — columbite — lepidolite — beryl	Only detrital tantalite and columbite worked—abandoned.
Mercer's Find	Felspar—amblygonite—lepidolite	Abandoned—one small parcel of amblygonite shipped in 1912.

Cassiterite has been recorded from Londonderry whilst detrital cassiterite is known from Mercer's Find. No evidence of esonomic cassiterite has so far been obtained, but the possibility exists.

The last category of economic mineral contains magnesite which is found as hydrothermal alteration product of the serpentines of the Ultra-basic Belts. It is in places of good grade and of increasing importance.

Amphibole asbestos, mainly actinolitic. is found in the ultra-basic Belts, especially in drag-folded areas. It is of poor quality and has, if at present any, only a limited use.

Vermiculite in economic bodies has not yet been recorded but, to judge from the widespread distribution of the mineral in the serpentine of the ultra-basic belts, economic concentrations may occur on the margins of these serpentines or in shear zones in the serpentine. These serpentines weather to a dull brown rock characteristically dimpled with small pits.

The sillimanite gneisses and schists in the aureole of the Bullabulling granite, together with their derived soils, may prove of ultimate interest in the refractory industries.

WATER SUPPLIES.

The water supplies of the Coolgardie District consist of dams, wells, soaks, gnamma holes and the pipelines of the Goldfields Water Supply. Their distribution, regarding Coolgardie Town as a centre, is here summarised for the convenience of those interested:—

(a) *North-east Quadrant.*

(i) Main Water Supply pipeline to Kalgoorlie.

(ii) Soaks around the Mungari Granite. Supplies small at best and very uncertain in summer.

(iii) Dams at 9 and 12 miles on the old Kundana-Black Flag road from Coolgardie. These were dry in 1947 but have been full since February, 1948.

(iv) Dam at the 10-mile on the Coolgardie-Kintore road. It was dry in 1947, but full since February, 1948.

Note—The dams were originally put in by the Goldfields Firewood and Timber Co.

(b) *South-east Quadrant.*

(i) Main water supply pipeline to Kalgoorlie and branch pipeline to Norseman.

(ii) Private pipeline to Tindals Mine.

(iii) Soaks around Yellari Rocks—not reliable, especially in summer.

(c) *North-West Quadrant.*

(i) Main Goldfields Water Supply pipeline to Kalgoorlie

(ii) Dams on Mt. Burgess Station—unreliable, they have mostly been breached.

(iii) Well and dam in granite rocks at 15-mile on the Coolgardie-Jaurdri Hills Road. Permanent water.

(iv) 7-Mile Rock Hole on the old Coolgardie-Wealth of Nations Road. Uncertain.

(v) Soaks and dam in granite of Delmenico Rocks —fairly certain.

(vi) Caenyie Rocks—soaks only.

Apart from the Mercer's Find area, the quadrant is of little interest from the economic point of view.

(d) *South-West Quadrant.*

(i) Main Goldfields Water Supply pipeline to Kalgoorlie and branch pipeline to Gibraltar.

(ii) Lady Miriam shaft, two miles south-west of Burbanks, gives a certain supply.

(iii) Nepean Rocks—gnamma holes and soaks—reliable for small quantities.

(iv) Bullabulling Rocks—well and soaks—permanent.

(v) Gnarlbine Rock—well and soaks—permanent.

(iv) Londonderry Dam—reasonably certain.

(v) Government Well on Coolgardie-Grosmont Road approximately at 10-mile peg. Requires cleaning and retimbering.

RECOMMENDATIONS.

(a) *Gold.*

An economic outcome of the re-survey of the Coolgardie District is the recognition of:—

(a) Favourable host rocks for ore deposition. These largely comprise the Rocks of the Ultra-basic Belts.

(b) Favourable horizons for ore deposition. These are formation junctions within the greenstones and in the vicinity of porphyry intrusives in the Ultra-basic Belts.

(c) A general control and localisation of ore deposition by the crossfold axes, such as that of Tindals. Localisation and control of ore deposition in detail by the shearing and drag-folding attendant upon the crossfolding.

General prospecting recommendations are based upon these factors and have resulted in the specific recommendations already made.*

To these may be added the following:—

(i) A zone striking west-south-west from the Lloyd George Mine. This line forms the projection of the hypothetical Three Mile Hill sub-axis. The known strike of Gibraltar ore bodies is suggestive. The area is largely covered with residual soils which are thought to be of no great depth. Normal loaming methods should be applicable.

(ii) A zone striking east-north-east from Gnarlbine Mine. This zone covers the projection of the Londonderry minor crossfold axis.

(iii) A zone west-south-west from Grosmont covering the projection of Tindal's axis. It is of interest to note that Nyborg earlier in the year made a small find in this zone. The zone is largely covered by residual soils.

(iv) An area located approximately two miles south of Grosmont and one and a half miles west of Tantalite Hill. This area lies on the projected Londonderry crossfold. It was announced in the press in August.

(v) Of special interest is the area surrounding the well-known Londonderry Gold Mine. This mine lies on the compressed eastern limb of the Coolgardie elongated dome. There is some slight evidence that it lies close to the axis of a minor crossfold. The ore body is recorded as having a southerly pitch.† Recent regional and detailed mapping‡ emphasises southerly pitching features and it is thought to be suggestive of possible repetitions of this type of ore-body in depth and to the south of the Golden Hole.

(b) *Pegmatites Bearing Economic Minerals.*

These minerals are becoming of ever increasing importance and comprise chiefly columbite, tantalite, beryl, lithia bearing minerals, felspar, together with possible radio-active materials.

Known distribution of pegmatites of this nature suggest that they have a genetic relation to the granites to the west of Coolgardie town and in particular to the South Grosmont, Eastern Gibraltar, Mercer's Find granites.

Accordingly the greenstones adjoining these granite masses should be further prospected.

PROBLEMS AWAITING INVESTIGATION.

Many points of general and economic interest have had, perforce, to be left or only glanced at in a cursory fashion. The majority of these matters are outside the present scope of the Geological Survey because either—

(a) they are precluded by the already large and pressing commitments of the small organisation, or

(b) they belong more properly in the sphere of activities of mining interests engaged in exploration and of the research student.

Accordingly these fields of future research have been grouped as to whether economic or academic implications are dominant. Some degree of overlap is unavoidable. These fields are, then:—

(a) *Economic.*

(i) The geomorphological history of the area with reference to past drainage patterns and the location of potential "deep lead" systems. Systematic work of this nature demands adequately contoured maps.

(ii) The extrapolation by geophysical methods of structures, economically significant, under heavy soil cover. Possible eastern extensions of the Tindals and Bonnie Vale structures illustrate the point.

(iii) The geophysical investigation of the basic lava-metagabbro (amphibolite) contacts in the Coolgardie greenstones with a view to the location of sizeable auriferous sulphide ore bodies. The Three Mile Hill and Sydenham Lease areas provide examples.

(iv) The investigation by deep drilling of the Londonderry-Burbanks structures in the Coolgardie greenstones with a view to establishing local ore controls and the proving of further auriferous bodies.

(v) The correlation of horizontal and vertical distribution of economic minerals with a view to the establishment of broad foci of mineralisation. This applies especially with regard to the pegmatite minerals of economic value. Londonderry Felspar Quarry, Tantalite Hill and Grosmont furnish possible starting points for such a systematisation.

(b) *Academic.*

(i) The relation of granitisation to the known major granite bodies and thus, ultimately, to the general history of mineralisation in the district.

(ii) The occurrence, nature, and metamorphic grade of local "highs" in the general low grade regional metamorphism of the Coolgardie greenstones. This should further the structural knowledge of the district, apart from economic implications.

(iv) Research into the stratigraphic relations of the putative Black Flag series of meta-sediments in the eastern portion of the district together with those of Bullabulling whose affiliations are as yet obscure. General stratigraphic clarification would be of service in the more precise formulation of the geological history of the State.

SUMMARY.

The re-survey of the Coolgardie District was started in the field season of 1946 and completed in that of 1948. Approximately 900 square miles, centred about Coolgardie town, were mapped.

Experience in the South Yilgarn Goldfield had demonstrated the relationship of ore deposition to certain stratigraphic horizons and geological structures.* The present work was approached with these principles in mind.

The principal results of the re-survey are:—

(a) The differentiation of the greenstones into a suite of basic and ultrabasic lavas with thin metamorphosed sedimentary bands, together with a further appreciation of the later metamorphosed Sedimentary Series.

(b) The recognition of the general geological structure of the district.

(c) A more complete picture, though yet far from complete, of the geological history of Coolgardie District.

* Ann. Prog. Rept., G.S.W.A., 1946, R. S. Matheson.

* Ann. Prog. Rept., G.S.W.A., 1947, J. McMath.

† Bull. 53, G.S.W.A., 1913, T. Blatchford.

‡ Ann. Prog. Rept., G.S.W.A., 1947, "The Londonderry Group," H J Ward.

* Bull. 97, G.S.W.A., 1939, H. A. Ellis.

Particular results, foreshadowed in the terms of reference of the re-survey, were:—

(a) The recognition of favourable host rocks and stratigraphic horizons for ore deposition.

(b) That a system of crossfold axes in large measure controlled ore deposition and that localisation of ore deposition in detail was controlled by minor structures and features (such as drag-folding and shearing) attendant upon the crossfolding.

Regional and mining group-mapping carried out has made possible:—

(a) Prospecting recommendations.

(a) Assistance to all interested in their exploration and development work.

(c) The discovery of several new finds.

(d) Renewed activity about old mining groups

(e) A better understanding of the mode of ore occurrence at many of the older mines.

Certain problems of economic as well as academic interest have, perforce, been left. They are listed for the notice of interested parties.

BRIEF BIBLIOGRAPHY.

Note.—This selected bibliography has been compiled from the point of view of ready availability of the works mentioned to the public. It is not intended as final or exhaustive. Only more recent works are listed.

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J. McMATH.

29/12/48.

REPORT ON BLOCK 59, HAMPTON PLAINS, COOLGARDIE DISTRICT.

By J. C. McMath, B.Sc. (Hons.) F.G.S. Geological Survey of Western Australia.

1. *Maps.*—Reference may be made to the following maps:—

(a) L.O. 50/80 and L.O. 39/80.

(b) Geological Map of Hampton Group—G.S.W.A. 1946. Plate III.

(c) Geological Map of Block 59—1in. = 1 mile—provisional for the purposes of this report.

1. *References.*—The most recent references only are given:—

(a) Annual Progress Report G.S.W.A., 1946 R. S. Matheson.

(b) Annual Progress Report G.S.W.A., 1947, J. C. McMath.

(c) Geophysical Report on Hampton Plains Area, Coolgardie—Bureau of Mineral Resources, 1947.

3. *Location.*—Block 59 (Hampton Plains) lies some 5 miles south-east of Coolgardie. Access to the relevant portions may be had as follows:—

(a) Via the Norseman road from Coolgardie.

(b) Via cleared and surveyed property boundary lines in the south and east.

(c) Tracks taking off from (a) and (b).

4. *Area.*—Hampton Plains comprises 50,830 acres or approximately 80 square miles.

5. *Nature of Lease.*—Block 59 is an old grant in which surface and mineral rights are vested in the grant holders, Hampton Land Co., together with the recent subsidiary Hampton Gold Areas. The provisions of the Western Australian Mining Act, 1904, apply only in so far as Safety Regulations in mining are concerned.

6. *Topography.*—Lacking contoured maps, the general topography is best appreciated by reference to the geological map of Block 59 cited above. The following features are apparent:—

(a) The Basic Lavas, Ultra-basic Igneous Rocks, and Meta-gabbro intrusive comprise the hilly areas in north and north-west of the Block.

(b) The same lithological unit forms a small knot of hills in the south-west corner of the Block.

(c) The low lying median area, trending north-east to Brown Lake, is occupied by residual soils and alluvium.

(d) Drainage, which in general seems to reflect some measure of structural control, trends north-east to Brown Lake. The drainage is sluggish and seasonal.

7. *Geology.*

(a) *Lithology and Stratigraphy.*—Reference paragraph 6 (a) and (b), these rocks have been correlated provisionally with the Kalgoorlie Older Greenstones. They comprise apparently conformable belts of:—

(*i*) *Basic Lavas*—which range in type from amygdaloidal lavas, through basalts, to dolerites.

(*ii*) *Ultra-basic Igneous Rocks*—ranging from actinolite schists to massive serpentines. Previous work in the Coolgardie District has differentiated five such belts, two of which enter the block. These are the Hampton Belt and Bonnie Vale belts respectively.

(*iii*) *Meta-gabbro (Amphibolite) Intrusive*—apparently conformable with the Basic-lava belts, there is some doubt as to its stratigraphic position.

These rocks have been intruded by later acid porphyries, many of which are thought to be metamorphosed sedimentary horizons in the Basic Lava and Ultra-basic belts.

In the north and south-east of Block 59 occur a metamorphosed sedimentary series which is provisionally correlated with the Black Flag Series. They comprise a conglomerate together with quartzites, phyllites, mica schists which, where in the aureole of granite intrusions, show transitions to para-gneiss.

A later phase of igneous intrusions is largely comprised of pegmatites consisting of quartz, microcline, biotite. Work may show these to have an economic importance.

The pegmatoidal features occurring in the Black Flag Series are ascribable to granitisation and are associated with the Yellari gneiss. They are of no potential economic importance.

(b) *Structure.*—The broad structural features of the Coolgardie District have been described by R. S. Matheson and J. C. McMath (Annual Progress Report G.S.W.A. 1946, 1947.) That affecting the area is the Tindal's Crossfold (anticlinal) which trends slightly north of east and is reflected in the Hampton Town area. Eastwards it passes under heavy soil cover.

Sub-parallel minor folding is associated with the major crossfolding and is reflected by the incompetent behaviour of the ultra-basic rocks under stress. This gives rise to major and minor drag folding together with echeloned shear zones in the Hampton and Bonnie Vale Ultra basic Belts.

(c) *Gold Mineralisation.*—The older Greenstones of Kalgoorlie have undergone gold mineralisation. Previous work (ref. G.S.W.A. Annual Progress Report 1946, 1947) has shown that:—

(i) Mineralisation has in large measure been controlled by structure.

BONNIE VALE BELT

N40°W

MT ROBINSON BELT

MT ROBINSON

70°

Three Mile Hill

N40°W

Brown Lake

70°

HAMPTON BELT

Barbara Gold Mine

Surprise Gold Mine

70°

HAMPTON

Banham Gold Mine

5M

Lady Loch Gold Mine

Track

Moore's Find

Zadow's Gold Mine

May's Find

Frank's Find

HAMPTON
LOC. 59

NORSEMAN

LOC. 53

10M

ROAD

MT ROBINSON BELT ?

Track

55°

Track

N50°E

70°

N40°E

Granitised

— REFERENCE —

- Soil covered areas (alluvium etc.)
- Metamorphosed sediments
- Metamorphosed ultrabasic rocks
- Metamorphosed basic lavas
- Amphibolite (metagabbro)
- Pegmatite
- Granite and/or gneiss
- Geological boundaries assumed ---?---
- Geological boundaries approximate ------

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PLAN OF PROVISIONAL GEOLOGY OF HAMPTON LOCATION 59

Scale : 1 mile to an inch

Base Maps, Lands Dept Lithos 39/80 & 50/80. J.C.McMath. May 1948

(ii) Mineralisation of economic importance is largely confined to the Ultra-basic Rock Belts. Some replacement sulphide bodies together with a quartz filled fracture system carrying low values are found on the Basic Lava—Meta-gabbro contact. In this case it is the Meta-gabbro which is the host rock.

(iii) Mineralisation takes the form of quartz reefs and lodes associated with shear zones and drag-folds in the Ultra-basic rocks. The association with acid porphyries is considered fortuitous.

Block 59 exemplifies these broad prinicples and work has shown:—

(i) General localisation of mineralisation is along the flanks of the Tindal's Crossfold.

(ii) Is confined to the Hampton Ultra-basic Belt with the exceptions of Zadow's and the Queenslander which are associated with the Basic Lava-Meta-gabbro contact.

No work has been done on the Older Greenstones forming the hill features of the south-west corner of Block 59, but the same broad principles are expected to apply. Available evidence suggests that mineralisation here will prove of no major economic value but may be of sufficient interest to small parties.

Major mines, small in themselves, are the Barbara and Surprise operated by New Coolgardie Consolidated G.M.N.L. (recently floated.) The remainder of prospects to date have shown no promise of being other than small syndicate propositions.

Much sporadic prospecting has been carried out on the Tindal's Axis but, apart from that of the Western Mining Corporation (centred about the Barbara and Surprise Leases) little in the way of logical and geologically controlled prospecting programmes appear to have been carried out.

(d) *Minerals other than Gold.*

1. *Magnesite.*—This appears confined to the Bonnie Vale Ultra-basic belt where it enters Block 59. The evidence is confined to nodules on the surface of the massive serpentines. It is of interest to note that E. Scahill has proven magnesite in this belt to the north of the railway. No work on this mineral has, so far as is known, been done in Block 59.

2. *Asbestos.*—Anthophyllitic asbestos has been noted at various horizons in the Ultra-basic belts but prospecting in detail is required to evaluate the economic possibilities.

3. *Bauxite.*—Bauxitic horizons have been noted in the metamorphosed sediments and in the granitised areas. They may have a future economic value on closer investigation.

4. *Scheelite.*—Occurs in the south-west corner of Block 59 associated with a quartz reef which itself is associated with a pegmatite area further east. Baker Bros., in the course of opening up the reef for gold, collected and crushed 10 tons (average grade said to be 70 per cent.). Gold values were said to be low and of the order of 2dwts. More work remains to be done to assess scheelite potentialities. It is of interest to remark that apparently this recent work is the only prospecting that appears to have been done in this corner.

5. *Felspar.*—Pegmatites in the south-west corner are felspar rich and merit some work to estimate possibilities of production. No lithium minerals were noted in them.

8. *The Hampton Land Company.*—As previously remarked surface and mineral rights are vested in the Hampton Land Company which has a mining subsidiary, Hampton Gold Areas. Of interest are the following:—

(a) The prospecting activities of the Company.

(b) Relations of the Company to outside prospectors.

(c) Company policy with regard to granting of gold mining and mineral leases.

(a) As far as can be ascertained the company did little or no prospecting on their own behalf prior to the discovery of the Barbara and Surprise Mines. Information on this point is vague. At present a prospecting programme is being carried out by Hampton Gold Areas in the Burbanks—Tindals area. The plan and details are vague. Some work was carried out on the Tindals Crossfold, again details are lacking but it appeared to consist of loaming of uncertain quality. The Hampton Town area and the soil covered extension of the Tindals Axis cannot yet be considered adequately and systematically closely prospected apart from the activities of the Western Mining Corporation on the Surprise and Barbara holdings.

(b) The relation of the company to outside prospectors is as follows:—

1. A prospecting right is gratis—but some selection is exercised in granting the right.

2. The selected prospecting area is given complete protection for one month. This is renewable monthly at no charge to the prospector.

3. On the basis of ore (and tenor) found, the prospecting area is convertable to a lease of which the rent is £1 per annum per acre together with a survey fee of £8.

4. Services of tool sharpening and water are afforded prospectors.

5. The company has no settled policy with regard to granting of mineral leases. Possibly a royalty basis might be operated.

(c) Reference paragraph 8b (3) above—the Company on the conversion of a prospecting area to a lease may exercise the right to peg alternate blocks. Reference. G.S.W.A. Map—Hampton Group Geological Map, 1946—the following instances of this policy in operation are tabulated:—

Original lease pegger.	Company pegging.	Remarks.
316—Baker Bros.	318, 320	316—Original Surprise
319—Baker Bros.	325, 326	
324—E. Scahill	333	
330—E. Scahill	344, 334	330—Original Barbara
337—E. Scahill	340, 349	
335—Franks	394	
345—Pentony	395, 348	

The implications of this policy in relation to the encouragement of independent prospecting are clear.

9. *Recommendations*—Arising from the foregoing are the following recommendations:—

(a) That the Tindal's Axis and its soil covered projection be logically and closely prospected.

(b) That the north-west corner of the area be systematically and closely prospected for gold, magnesite and asbestos.

(c) That the south-western hills be closely prospected for gold, scheelite, felspar.

(d) That the eastern part of the area, apart from the zone of the Tindals Axis, be considered unlikely to produce mineral of economic importance.

(e) That the foregoing operations be carried out on a company basis under direct geological supervision—alternatively, that a leasing system be formulated designed to tangibly encourage outside prospectors to work in the area.

10. *Summary and Conclusions.*—The following matters have been dealt with in the body of the report and occasion no further comment:—

Location and Access.
Area and Nature of Holding.
Topography.
General Geology.
Structure.
Mineralisation.
The Hampton Land Company.

Recommendations regarding the exploration and development of Block 59 were made based upon the foregoing matters.

With regard to the Hampton Plains Block, the following conclusions are drawn:—

(1) The proven gold bearing area is comprised in the Tindals structure.

(2) Only small mines of the calibre of the Surprise and Barbara may be anticipated to result from close prospecting if at all.

(3) That whilst insufficient data exist for a true appreciation of the economic mineral potentialities of the block, the impression has been gained that nothing startling may be expected.

DREDGING CLAIMS 11H and 19H, MINNINUP BEACH, W.A.

J. C. McMath, B.Sc. (Hons., Lond.) F.G.S.

Contents—

DREDGING CLAIMS 11H AND 19H—MINNINUP BEACH, WA.

Location and Access.—Minninup Beach lies in Geographe Bay, eleven miles south of Bunbury. Access may be had by track (said to be in good condition) from the 128-Mile Peg on the Bunbury-Busselton Road.

Maps.—Reference may be made to—

(a) L.O. 413/80;

(b) appendix 1. Plate IV.

The Claims.—D.C. 19H takes in the area to seaward whilst D.C. 11H comprises the beach to high water mark together with approximately 10 acres of coastal dunes. The dunes are backed by marshy land which is used for pastoral purposes. This land is alienated from the Crown (App. 1). The claims are for ilmenite, rutile, and zircon as principal economic minerals.

Title.—It is understood that the claims were held originally by Mr. F. Morgan. The title has since been transferred to a nominee of British Titan Products, of Burnie, Tasmania.

Previous Work.—A sample of 50lb. of sand from Minninup Beach had been submitted to the C.S.I.R. by Mr. F. Morgan. Recommendation 5 of the report* is of interest. It states, "the percentage of quartz present in the sample supplied was unusually low and it is recommended that if the commercial treatment of these sands is contemplated, a careful survey be first made to verify whether such a low quartz content is typical of the deposit." In this connection see Appendix 2.

Sampling.—This beach sampling formed part of a larger programme being conducted by the Geological Survey of W.A. on behalf of the Commonwealth Bureau of Mineral Resources. The detailed work was carried out in December, 1947, by Mr. J. Hepden upon the instructions of the Government Geologist. The following observations are made:—

(i) Sampling was by post hole auger.

(ii) Detailed sampling was confined to the beach between tide marks (App. 1).

(iii) Holes were taken to bedrock or water-level.

(iv) 148 samples were taken on the beach—two only in the dunes (Apps. 1 and 2).

(v) Sample analysis was carried out by the Government Chemical Laboratory (App. 2).

(vi) D.C. 11H was sub-divided into seven sub-areas for preparing bulked representative samples. These areas are A, B, C, D, E, F, G (Appendices 1 and 3).

(vii) D.C. 19H, a sea claim, was not sampled.

Distribution of Economic Minerals.

(i) Ilmenite, zircon, rutile concentrates occur as surface layers and small lenses in the sands (maximum thickness noted was four inches).

(ii) These minerals do not persist below water-level.

(iii) The highest concentration of mineral occurs in sub-areas D and E (App. 3).

(iv) The distribution of economic mineral content of the dunes is unknown. Based on two analyses (App. 2), a guess can only be hazarded as to the general tenor.

(v) There is the possibility of a "fossil" beach existing and extending landwards beneath the marshy ground.

Estimates of Order of Magnitude of Available Economic Minerals (App. 3.).

(i) The claim has been subdivided into areas A-G inclusive and estimates are based on bulked representative samples.

(ii) Both grade and quantity of the sands are liable to seasonal fluctuation. Whilst it is not expected that the order of magnitude of the deposits will vary greatly, the estimates are only strictly applicable to the period of sampling.

(iii) D.C. 11H, then consists of:—

(a) The area between tide marks to which the estimates apply.

(b) An unsampled area above high-water mark whose value is speculative and requires investigation. It may amount to a third of the value of the sampled area.

(c) The dune area whose tenor is entirely speculative and requires investigation.

(iv) Accordingly from (iii) (a) above, approximately 88,000 cubic yards of concentrates containing 20 per cent. of economic mineral can be seen. Ilmenite comprises 18 per cent. whilst the remaining 2 per cent. consists chiefly of rutile and zircon.

Ilmenite.—The ilmenite is particularly noteworthy by reason of the low chromic oxide content (Cr_2O_3 being 0.06 per cent.—App. 2).

Summary and Conclusions.—The detail of analyses and estimates may be seen in Appendices 2 and 3. Some 88,000 cubic yards of concentrates averaging 1,033 pounds of ilmenite per cubic yard are available. These known reserves may be supplemented by investigation of the speculative areas of the claim.

It would appear that preparation of an ilmenite concentrate on the spot offers the best prospects of commercial success, but careful costing of beneficiation, transport, and administrative factors together with the creation of more reserves is required before exploitation is contemplated.

J. McMATH,
Senior Geologist.

24/1/49.

*Investigation 320—Joint Investigations of C.S.I.R., 1948.

PLATE IV

INDIAN OCEAN

Joins Sheet 2

Loc. 637

Loc. 394

Loc 179

Loc 154

AREA D

AREA C

AREA B

AREA A

5720' Black Sand — Between L.W.M. & H.W.M. — 3½ ac.

7320' — About 3" Black Sand on surface between H.W.M. and edge of sand dunes — 6½ ac.

5500' White Sand — Between L.W.M. & H.W.M. — 9½ ac.

16650' White Sand — Between H.W.M. and edge of sand dunes — 51½ ac.

16050' Black Sand — Between L.W.M. & H.W.M. — 71½ ac.

8060' White Sand — Between L.W.M. & H.W.M. — 9½ ac.

2" of Black Sand on area between H.W.M. & edge of sand dunes — 12015 — 75 ac.

660'

D.C. 19"

D.C. 11"

MARK

BAND

DUNES

LOCALITY PLAN
10m. = 1 inch

INDIAN OCEAN

BUNBURY

Minninup Beach

Cape Naturaliste

Geog. Bay

BUSSELTON

REFERENCE

Low Water Mark ————————

High Water Mark - - - - - - - - - -

Edge of Sand Dunes —·—·—·—

Sample Number ○ 290

Note:-
For drafting purposes, number only is shown for each sample in place of usual method. e.g. GS/AM 290/M.J.H is shown simply as 290

The boundary between D.C. 11" and D.C. 19" taken as High Water Mark

SHEET 1

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

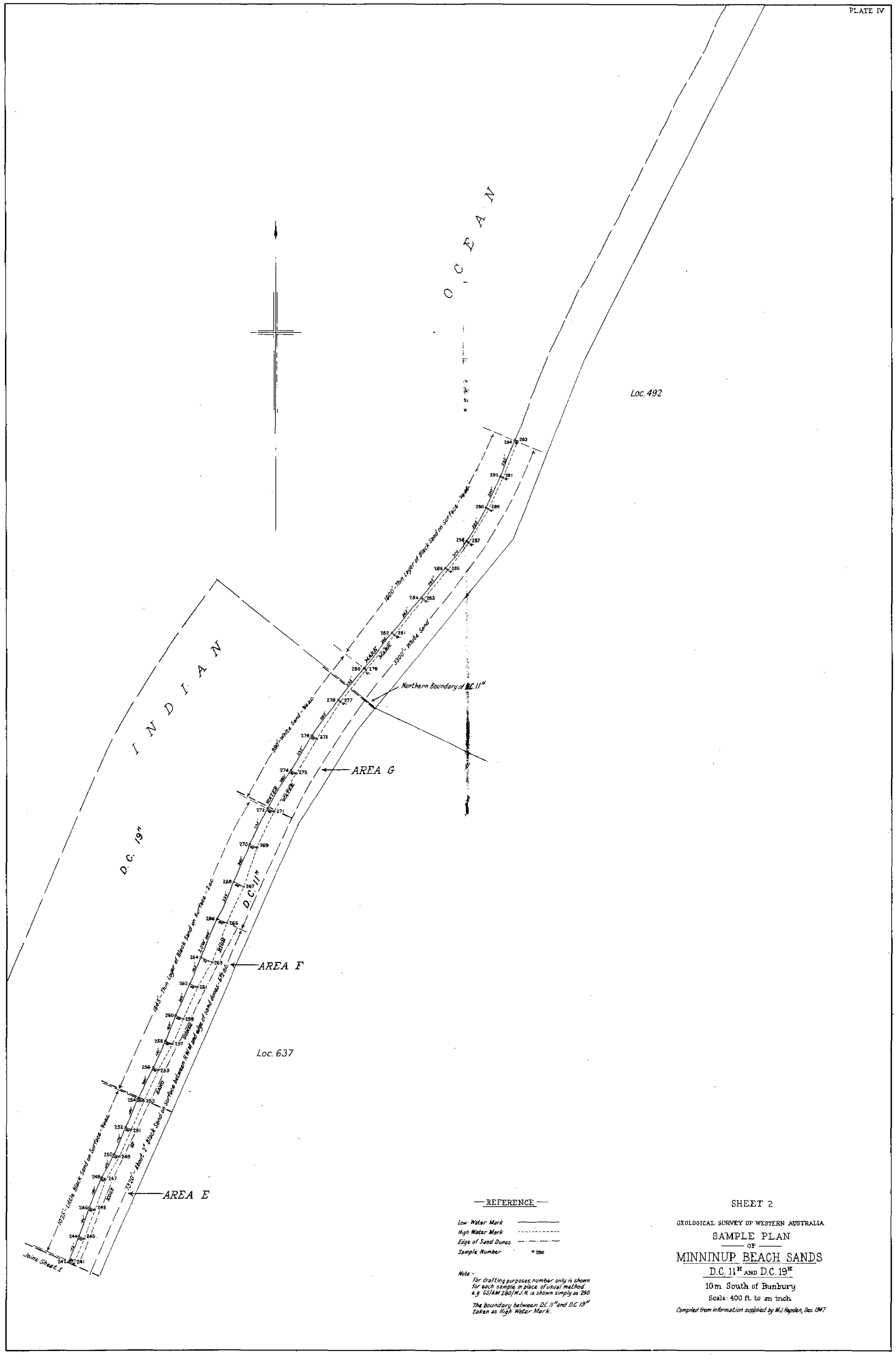
SAMPLE PLAN OF MINNINUP BEACH SANDS

D.C. 11" AND D.C. 19"

10m. South of Bunbury

Scale: 400 ft to an inch

Compiled from information supplied by M.J. Hepden, Dec. 1947



REFERENCE

Low Water Mark ————————

High Water Mark - - - - - - - - - -

Edge of Sand Dunes — · — · — · —

Sample Number ° 290

Note -

For drafting purposes number only is shown for each sample in place of usual method. e.g GS/AM 280/M.J.H. is shown simply as 290

The boundary between D.C. 11H and D.C. 19H taken as High Water Mark.

SHEET 2

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SAMPLE PLAN
OF
MINNINUP BEACH SANDS
D.C. 11H AND D.C. 19H

10m. South of Bunbury

Scale: 400 ft. to an inch.

Compiled from information supplied by M.J. Hayden, Dec. 1947

APPENDIX II.

Location.—Dredging Claims 11H and 19H at Minninup Beach, approximately 11 miles south of Bunbury.

Note.—These samples are representative of 148 samples taken between L.W.M. and H.W.M., grouped as follows:—

Lab. No.	Representative of
8471	GS/AM147/MJH—GS/AM154/MJH
8472	GS/AM155/MJH—GS/AM174/MJH
8473	GS/AM173/MJH—GS/AM180/MJH
8474	GS/AM179/MJH—GS/AM242/MJH
8475	GS/AM241/MJH—GS/AM254/MJH
8476	GS/AM253/MJH—GS/AM272/MJH
8477	GS/AM271/MJH—GS/AM280/MJH
8478	GS/AM279/MJH—GS/AM294/MJH

Lab. No.	Approximate Percentages 8471	8472	8473	8484
Mineral Composition—				
Quartz*	69	60	70	36
Shell Grit	29	27	29	18
Total heavy (+ 2.85) mineral fraction	2.1	12.7	1.3	45.8
Consisting of—				
Ilmenite	2	11	0.8	38
Magnetite	†	†	†	†
Garnet	0.1	0.7	0.1	5
Hornblende	†	†	†	1
Zircon	0.1	0.8	0.1	2
Leucoxene	†	†	†	†
Kyanite	†	†	†	†
Spinel	†	†	†	†
Nigrine	†	....	†	†
Epidote	†	†	†	†
Tourmaline	†	†	....	....
Staurolite	†	....	....	†
Rutile	0.1	0.1	0.1	0.2
Hypersthene	†	....	....	....
Limonite	†	....	....	....
Actinolite	....	....	†	....
Zoisite	....	†	†	....
Monazite	0.1	0.1	....	....
Radio-activity	*Nil*	*Nil*	*Nil*	*Nil*

* Including a little felspar. †Present in amounts less than 0.5 per cent.

Lab. No.	Approximate Percentages 8475	8476	8477	8478
Mineral Composition—				
Quartz*	51	61	70	61
Shell Grit	24	27	29	31
Total heavy (+ 2.85)	25.1	12.2	0.9	7.5
Consisting of —				
Ilmenite	18	9	0.5	4
Magnetite	†	†	†	†
Garnet	3	1	0.1	0.9
Hornblende	†	†	†	1
Zircon	0.6	0.5	0.1	0.1
Leucoxene	†	0.5	†	†
Kyanite	†	†	†	†
Spinel	†	†	....	†
Nigrine	0.5	†	†	†
Epidote	†	†	....	†
Tourmaline	†	†	†	†
Staurolite	†	†	†	†
Rutile	0.2	0.2	0.1	0.1
Limonite	....	....	†	....
Monazite	....	....	0.1	0.1
Radio-activity	*Nil*	*Nil*	*Nil*	*Nil*

* Including a little felspar. † Present in amounts less than 0.5 per cent.

Analysis of composite sample representative of ilmenite content of beach sand samples GS/AM147/MJH—GS/AM294/MJH.

On Sample dried at 105°C.

TiO_2 57.0 per cent.

Cr_2O_3 0.06 per cent.

C. R. LE MESURIER,
Deputy Government Mineralogist.

APPENDIX III.

ESTIMATES OF ECONOMIC MINERAL CONTENT OF DC11H MINNINUP BEACH, BUNBURY, W.A.

Area.	Approx. Volume in cub. yds.	Mean Depth to Water or Level Bedrock.	lb. per cubic yard (Approx.) Ilmenite.	Zircon.	Rutile.	Nigrine.*	Monazite.	Estimated available long tons. Ilmenite.	Zircon.	Rutile.	Nigrine.*	Monazite.	Remarks.†
A	1,146	ft. in. 1 11	128	less than 3	less than 3	*Nil*	less than 3	65	less than 1	less than 1	*Nil*	less than 1	Black sand on surface only.
B	2,377	2 1	645	47	less than 6	*Nil*	less than 6	680	50	less than 6	*Nil*	less than 6	Small lenses Black sand 3 in. thick to water level.
C	733	1 9	49	less than 6	less than 6	*Nil*	*Nil*	16	less than 2	less than 2	*Nil*	*Nil*	Black sand on surface only.
D	13,241	2 3	1,600	120	120	*Nil*	*Nil*	9,011	714	714	*Nil*	*Nil*	Thin lenses Black sand 1 in. thick to water level.
E	60,740	2 1	1,065	35	12	20	*Nil*	28,870	949	325	813	*Nil*	do. do.
F	8,473	2 1	538	230	120	*Nil*	*Nil*	2,035	870	454	*Nil*	*Nil*	do. do.
G	1,553	1 6	30	less than 6	less than 6	*Nil*	less than 6	20	less than 4	less than 4	*Nil*	*Nil*	Black sand on surface only.
			Average lb. per cubic yard over DC11H.										
TOTAL	88,263	....	1,033	63	38	14	2	40,097	2,590	1,506	813	7	

* Nigrine = Ferruginous Rutile.

† At date of sampling (Dec., 1947).

Estimated Available Long Tons Ilmenite 40,097 = 16,883 tons TiO_2
Estimated Available Long Tons Rutile 1,506 = 1,506 tons TiO_2
18,389 tons Total TiO_2 content

} TiO_2 content of Nigrine is ignored.

MISCELLANEOUS REPORTS.

J. L. McMath, B.Sc. (Hons. Lond.), F.G.S.,
Geological Survey of W.A.

CONTENTS.

1. *Alleged Meteor Crater at Dulyalbin, South Yilgarn.*

Reference Map—L.O. 19/300 of 30/11/28.

Location.—Dulyabin lies 20 miles south of Moorine Rock from which it can be reached by gravel road.

In February, 1948, Mr. E. Page, of Dulyalbin, drew the attention of the Geological Survey to a depression on Lot 487 which, by reason of its symmetry, he thought might be a meteor crater. The depression was examined in April by the author whilst en route for Coolgardie.

The depression is situated in a dominantly granite-gneiss terrain with typical residual soils. Almost circular in plan, the depression has a diameter of approximately 80 chains and its larger axis has a north-south trend. The symmetry is extremely noticeable.

The centre of the depression is occupied by clay pans, timbered by boree and ti-tree, and lies approximately 50 feet below the surrounding country.

The edges of the depression are steep, slightly gullied, timbered with gimlet and morrel, and made up up of sandy soils, together with travertine and calcrete nodules.

No meteor fragments or australites were found, though search was made. The depression is a member of the dry lakes characteristic of the Salt Lake physiographic division of Western Australia but differs from the usual occurrence by reason of a higher degree of symmetry.

2. *Magnesite—Mineral Leases* 87, 91, 92 (*E. Scahill*) Coolgardie District. Coolgardie Goldfield.

Reference Map—L.O. 50/80 of 6/11/18.

Location.—The leases lie in the south-west corner of the Camel Paddock some six miles east-north-east of Coolgardie town. They are accessible either via the Goldfield's Water Supply pipeline track to Kalgoorlie, or from the 3-mile on the Bonnie Vale road. The latter is the best approach.

The leases adjoin each other and are largely soil covered. Two low ridges run through the leases and trend approximately east-north-east. It is on these ridges that magnesite rubble is concentrated and sheds on to the flats. The leases are in Bonnie Vale Ultrabasic belt* which in this vicinity consists of serpentine rocks from which the magnesite has been derived most probably by later hydrothermal alteration of the serpentines.

Such work as has been done suggests that the magnesite forms flat lenses; there is a possibility of further lenses in depth; exploration work is required.

Two grades of magnesite were noted and analyses made by the Government Chemical Laboratory. The grade improves in depth. They are:—

(a) Surface material—in the form of hard nodules.

(b) Material from 3ft. depth—soft but coherent.

The analyses are:—

Constituent.	Sample (a) 6564/48. %	Sample (b) 6565/48. %
Silica—SiO_2	0.57	0.04
Iron Oxide—Fe_2O_3	0.15	0.04
Lime—CaO	5.07	0.03
Magnesia—MgO	42.19	47.25
Carbon dioxide—CO_2 equal to	50.22	51.78
Calcium Carbonate—$CaCO_3$	9.05	0.05
Magnesium Carbonate—$MgCO_3$	88.24	98.82

Production has been spasmodic, the method of recovery being by using a bull-dozer, but 291 tons are recorded prior to 1943 whilst approximately 250 tons were shipped in the current year.

Available information can only afford a figure indicative of the probable order of magnitude of the deposit. It is estimated that:—

(a) Magnesite in sight (M.L. 87 alone) is of the order of 300-400 tons.

(b) Possible magnesite (M.L's. 87, 91, 92) is of the order of 1,500 tons.

Location 48 (Hampton Plains) East Coolgardie Goldfield.

Reference Map L.O. 25/300 of 2/2/07.

Location.—The occurrence, which consists of a surface show of large boulders offering a small but quick tonnage, is situated approximately 12 miles south-east of Wolluba Dam and is best approached by the Red Hill road from White Hope to Reeves Find.

The occurrence was sampled and analysis shows a good grade magnesite. The analysis, by Government Chemical Laboratory, is:—

Sample 6566/48.

Silica—SiO_2—0.10%

Iron Oxide Fe_2O_3—0.06%

Lime CaO—0.16%

Magnesia MgO—47.20%

Carbon dioxide—CO_2—51.75%
equal to

Calcium Carbonate $CaCO_3$—0.29%

Magnesium Carbonate $MgCO_3$—98.72%

M.C. 7 Higginsville (E. Scahill) Coolgardie District, Coolgardie Goldfield.

Reference Map L.O. 10/80.

Location.—The deposits are immediately on the Esperance railway one and a half miles north of Higginsville Siding. It is also readily accessible from the Norseman road.

The deposits occur in serpentine rocks which have been extensively altered with the production of jasperoid silica and cellular quartz. They form two parallel ridges extending on either side of the railway. The trend averages N. 10° E. approximately. There is evidence of a schist dip of 30° at E. 10° S.

The deposits are lenticular and result from hydrothermal alteration of the serpentines and should persist to water level. No work has been done upon which to base an accurate conception of available tonnage. Two main exposures suggest that some 2,000 tons may be immediately available and that a like tonnage in depth may be looked for on development.

* Ann. Prog. Rept., G.S.W.A., 1946, R. S. Matheson.
* Ann. Prog. Rept., G.S.W.A., 1947, J. McMath.

The grade of magnesite is indicated from the following analyses of samples by the Government Chemical Laboratory:—

Constituent.	Sample.		
	7455/48	7456/48	7457/48
	%	%	%
Silica—SiO_2	0.82	0.24	2.14
Iron Oxide—Fe_2O_3	0.33	0.19	0.92
Lime—CaO	0.93	1.59	1.09
Magnesia—MgO	46.43	46.45	45.64
Carbon Dioxide—CO_2	51.12	51.62	49.55
equal to			
Calcium Carbonate $CaCO_3$	1.66	2.84	1.94
Magnesium Carbonate $MgCO_3$	96.55	96.52	93.30

3. *Note on Monazite in Cape Riche Pegmatites.*

In view of the present economic importance of monazite a further sampling of the Cape Riche* pegmatites was carried out. Analyses of samples by the Government Chemical Laboratories show that—

(a) the previous recording of monazite was not a single instance;

(2) that its distribution in the pegmatites is limited;

(c) that its quantitative importance is negligible.

The results of the Cheyne Beach Sand† investigation are in accord. The sand concentration of monazite is too low to be of economic importance. The provenance of these beach sands is confirmed. A report on the recent samples is appended.

REPORT ON SEVEN SAMPLES FOR THE GOVERNMENT GEOLOGIST, PERTH.

Lab.	Marks. Cape Riche Injection Gneiss	Result of Examination.
1621	C.R. 1	Thin section: microcline-microperthite, quartz, oligoclase, myrmekitic quartz-albite intergrowths, biotite, chlorite, apatite. Examination of the rock specimen showed, in addition, the presence of a small amount of diallage and much smaller amounts of magnetite, pyrite and ilmenite.
1622	C.R. 2	Thin section: microcline-microperthite, quartz, chlorite, biotite, oligoclase (saussuritised in patches), myrmekitic quartz-albite intergrowths, apatite, magnetite and ilmenite. In addition, very small amounts of zircon and diallage were found in the rock specimen.
1623	C.R. 3	Thin section: oligoclase-andesine, hornblende diopside, a little biotite and odd crystals of apatite. Limonitic stains in cracks. A strong tendency for the hornblende to be oriented in one direction and the diopside occurs in bands lying in the same direction. In addition, magnetite and ilmenite were found in traces only.
1624	C.R. 4	Thin section: microcline-microperthite, quartz oligoclase-andesine, myrmekitic quartz-albite intergrowths and sericite. In addition, examination of the rock specimen showed the presence of very small amounts of biotite, chlorite and hornblende with much smaller amounts of magnetite, magnetiferous hematite, ilmenite, apatite and zircon.
1625	C.R. 5	Thin section: oliogclase-andesine, microcline-microperthite, quartz, biotite, chlorite and myrmekitic quartz-albite intergrowths. In addition, hypersthene, magnetite, apatite and ilmenite are present in small amounts.
1626	C.R. 6	Thin section: microcline-microperthite and quartz. In addition, magnetite, biotite, chlorite, magnetiferous hematite, zircon, apatite and ilmenite are present in small amounts.
1627	C.R. 7	Thin section: oligoclase-andesine (some acting as host to microcline), quartz, biotite, chlorite and zircon. In addition, very small amounts of magnetite and apatite and odd grains of *monazite* and ilmenite are present.

Remarks.—The iron ore present is almost entirely magnetite: only a very small amount of ilmenite is present in any sample.

Monazite was detected in the only specimen which contained a notable amount of biotite, namely Lab. No. 1627 (C.R. 7), and there is a trace only.

Lab. No. 1623/48.

Marks: C.R. 3.

Specific Gravity: 2.92.

Chemical Analysis.

	Per cent.	Mols.
SiO_2	49.99	832^3
Al_2O_3	18.35	180^9
Fe_2O_3	2.15	13^5
FeO	5.97	83^1
MnO	0.14	2^0
MgO	6.19	153^5
CaO	10.39	185^3
Na_2O	3.79	61^1
K_2O	0.91	9^7
H_2O-	0.28	—
H_2O+	0.92	51^1
TiO_2	0.87	10^9
CO_2	Nil	Nil
P_2O_5	0.30	2^1
FeS_2	0.09	0^8
Cl	0.12	3^4
F	Nil	Nil
Cr_2O_3	0.05	0^3
V_2O_3	trace	trace
	100.51	
Less O = Cl	0.03	
	100.48	

Analyst: V. N. Young.

4. *Location 48 (Hampton Plains)*—East Coolgardie Goldfield.

Reference Map—L.O. 25/300.

Upon instructions from the Government Geologist a rapid reconnaissance was made of a small area (about two square miles) lying some five miles south-south-east of Mt. Goddard.

The reconnaissance found:—

(a) A suite of basic lavas and ultrabasic rocks together with thin and impersistent bands of metamorphosed sediments. These rocks were reminiscent of the Coolgardie equivalents of the older greenstones of Kalgoorlie.

(b) A suite of acid porphyry intrusives together with major granite intrusives. The porphyries were intrusive into the greenstones.

(c) A suggestion that gold deposition in the area was genetically related to the major granite intrusives.

(d) Certain structural features reminiscent of the Coolgardie District.

5. In view of the above findings, more detailed work was considered desirable and Mr. N. M. Gray mapped the area on a five chain to the inch scale. The area covers certain leases of Hampton Gold Areas, Ltd. Reference may be made to the detailed report.*

* Ann. Prog. Rept., G.S.W.A., 1947, J. McMath.
†Ann. Prog. Rept., G.S.W.A., Cheyne Bay Beach Sands—J. McMath.

* Ann. Prog. Rept., G.S.W.A., 1948, "White Hope Group," N. M. Gray.

VERMICULITE AT BULONG—NORTH-EAST COOLGARDIE GOLDFIELD.

J. C. McMath, B.Sc. (Hons. Lond.), F.G.S.
N. M. Gray, B.Sc.

Geological Survey of Western Australia.

Maps.

Reference may be made to the following:—

(a) L.O. 84/20 Bulong.

(b) Plate 1, Bulletin 82, G.S.W.A., 1919.

(c) Sketch Plan of Vermiculite Workings, Plate V.

Location.

Bulong lies some 20 miles east of Kalgoorlie to which it is connected by a gravel road. The lease worked for vermiculite (3Y) is situated on the western shore of Lake Yindarlgooda approximately three miles east-south-east of Bulong. Access is by track from Bulong.

Water Supplies.

Water is obtained from the Government Dam at Bulong.

General Geology.

The country in the vicinity of Mineral Lease 3Y is a greenstone complex, the dominant types being serpentines and actinolitic rocks. Thin horizons of slates and phyllites occur in these greenstones. Later intrusives of epidiorite and acid porphyry sills or dykes were noted. The epidiorites were reminiscent of the Younger Greenstones of Kalgoorlie. The complex has been regionally metamorphosed and the general strike of the country is a few degrees east of north. In detail, though, the schist strikes swing rapidly, indicative of drag-folding of some intensity which is further evidenced by metamorphic highs in the meta-sedimentary bands (garnetiferous slates having been noted).

The serpentines, which weather to a dull brown blocky rubble, dimpled with small pits after vermiculite, and the actinolitic rocks yield decomposition products of opaline silica and cellular quartz. Actinolitic asbestos was noted as rubble.

Magnesite is much in evidence in the serpentine rocks where it occurs in sheets and lenses which appear to be controlled by the local structures. It is most probably derived from the serpentines by carbonation in the zone of weathering and is unlikely to persist below ground water level.

Mineral Lease 3Y.

The lease (40 acres) takes in an isolated ridge which forms a promontory into Lake Yindarlgooda. The ridge trends N. 15° E. and is comprised of serpentine of the type previously noted. A horizon of phyllites was noted at the base of the ridge on its western side whilst the soil on the adjacent flat glittered with particles of vermiculite. A small epidiorite intrusive is found on the north-west flank of the ridge. Such schist dips as were recorded were high and westerly. The remarks made previously with regard to rapid swinging of schist strikes apply.

The vermiculite body being worked appears to have been formed in a shear zone (of strike approximately S. 60° W.) in the serpentine which afforded access to later hydrothermal fluids. The transition from the vermiculite body of the sheer zone to the vermiculitic serpentine can be seen across the strike.

The body is strongly dragfolded in places. The two main dragfolds in the two workings are in the same line (strike about N. 20° W.). This may be a fault line. The folds pitch southwards at about 45°, the westerly limbs dip at approximately 15°, whilst the easterly limbs are overturned and dip at about 80°. Together with evidence from other local dragfolds, there is a suggestion that the vermiculite bodies are situated on the left limb of a southerly pitching anticline.

The Workings.

Exploitation of the vermiculite has taken place from two shafts which are termed for convenience the "Old" and "New" shafts respectively (ref. Appendix 1). These shafts, both bottoming on the water table, are situated on the south-west flank of the ridge.

The "Old" shaft has a depth of 27 feet, the last eight feet of which are inaccessible. There are two drives off this shaft, the easterly one (60 feet long) only being accessible. It is unsafe owing to the heavy nature of the ground. The vermiculite body is strongly dragfolded half-way along this drive.

The "New" shaft was sunk recently to, it is understood, develop new vermiculite and for ventilation. Of two compartment dimensions, this shaft is distant 60 feet horizontally from the "Old" shaft and is taken to a depth of 50 feet. The difference in height between the collars of the shafts is about 20 feet. The bottom of the "New" shaft lies 20 feet south of the ore body which was reached by a crosscut. This crosscut was extended a further six feet in an attempt to reach the old workings. It failed of its purpose by 18 or 20 feet. This crosscut extension is considered unnecessary; any vermiculite won could have been taken more economically from the "Old" shaft.

Where the above crosscut intersects the drive, the drive extends 45 feet E.N.E. and about 35 feet in the opposite direction where it turns south for 10 feet in a dragfold. From this point the drive turns west for 30 feet but not in vermiculite (though this was present in the back). The drive ends a few feet south of the "Old" shaft.

Adequate geological information was available from the "Old" workings to secure the siting of the "New" shaft to cut the vermiculite body (which outcrops in a shallow costean to the north). Such siting would have effected a saving in footage in shaft sinking.

It is understood that a State loan of £1,500 was advanced for the following purposes:—

(a) The sinking of the "New" shaft.

(b) The provision of plant for future working of the vermiculite.

From the topography and known geology it is apparent that more economic exploitation of the vermiculite could have undertaken by adit or open-cut mining than by the methods actually adopted.

Production and Reserves.

The vermiculite has been worked from time to time over the past 12 years or so. It is understood that a total production of the order of 100 tons has been obtained, the most recent parcel being of 50 tons.

Estimation of reserves is speculative, no exploration work or adequate development work having been done. Based upon the nature of the occurrence, vermiculite exposed in backs and faces, together with past production, a possible 400 tons of vermiculite immediately obtainable may exist. Of this estimate only about a third may be of commercial grade as these bodies contain a considerable quantity of vermiculitic clay of no economic value. These estimates err on the side of leniency. This gangue has to be removed on the surface, selective mining being impracticable. The commercial characteristics of the vermiculite is indicated in Appendix I. Some 30 tons of vermiculite lie on the dump deteriorating in quality rapidly under the weather.

Conclusions.

From the foregoing the following conclusions are drawn:—

(a) The method of exploitation of the deposit has not been to the best economic advantage.

(b) Without adequate exploration and development further exploitation is economically unsound.

(c) Present workings and transport costs (railhead Kalgoorlie) further detract from this vermiculite as an economic proposition.

(d) The product is inferior to other deposits at present being worked in the State, e.g., Young River.

(e) Should it be considered desirable to produce at any future time, careful exploration northwards over a strike of approximately 1,500 feet may disclose vermiculite bodies of the same characteristics.

APPENDIX I.

Report on Two Samples of Vermiculite for the Government Geologist, Perth.

Lab. No.—17-18/49.

Marks.—B1 and B2.

Locality.—Bulong.

The mineral occurs in folded green sheets interleaved with pale green saponite.

Each sample of vermiculite was graded as follows:—100 grammes were crushed through 1in. mesh and screened into the following grades:—

Grade.	Screen Sizes.
A	—½in. +¼in.
B	—¼in. +⅛in.
C	—⅛in. +1/16in.
D	—1/16in. +30 mesh.
E	—30 mesh +60 mesh.
F	—60 mesh +90 mesh.
G	—90 mesh.

As the vermiculite was associated with an appreciable amount of saponite, for testing purposes a portion of B1 and B2 samples were steeped in water and elutriated.

The results of the examinations, and that of Young River for comparative purposes, are tabulated as follows:—

Grade.	Per cent.	Mineral before exfoliation. Weight lb. per cubic ft. Gross.	Exfoliated Mineral. Weight lb. per cubic ft. Gross.	Exfoliated Mineral. Volume increase Gross.	Remarks.
Lab. No. 17/49, B1.—					
A	28.4	39.3	7.0	6	Brittle in parts due to the saponite.
B	31.6	35.5	5.2	7½	The exfoliated flakes were a mixture of silver flakes and discoloured flakes of the vermiculite with the dark and almost black flakes of the saponite.
C	23.2	40.0	8.2	5	
D	11.1	50.1	13.4	3½	
E	3.3	49.4	20.6	2¼	A reasonably good product was the B grade, although partly discoloured by the saponite present.
F	1.5	90.6	impure		
G	0.9	76.2	impure		
Lab. No. 17/49, B1, Elutriated.—					
A	14.8	30.9	7.6	3½	The steeping in water and elutriation free the laminae from the saponite giving a cleaner product, the laminae being softer and more regular in shape.
B	29.6	31.2	5.3	5½	
C	28.9	32.4	6.3	4½	
D	16.8	31.6	8.9	3¾	The exfoliation product showed less discolouration which was mostly brown except in A grade size that would probably be less dark by longer steeping of the mineral.
E (1)	2.9	39.6	21.7	1¼	
F	....	....	....	....	
G (2)	4.4	30.5	12.2	2	The exfoliated product appeared to be more friable.
Lab. No. 18/49, B2.—					
A	34.3	35.7	8.7	4	A greater amount of saponite is present in the sample 2 than in No. 1.
B	31.6	39.4	9.4	3¾	
C	20.8	41.1	12.6	3	All the exfoliated products showed a high percentage of saponite which was evidenced by the black flakes and discolouration of the vermiculite.
D	9.2	50.6	11.4	3¾	
E	2.3	45.4	22.6	2	
F	1.0	60.9	impure		
G	0.8	51.0	impure		
Lab. No. 18/49, B2, Elutriated.—					
A	26.8	36.6	13.8	2½	After steeping in water and elutriating the A grades carried the highest percentage of saponite which after exfoliation was lighter in colour than in the untreated mineral and particularly apparent in the finer products.
B	25.9	34.8	10.0	3	
C	30.4	33.3	8.9	3¼	
D	11.5	39.8	10.5	2¾	
E	2.2	36.6	12.2	2¾	
F (1)	1.4	41.1	22.3	1½	
G (2)	1.8	32.0	12.2	2¼	
Lab. No. 6525/48, Young River Sample.—					
A	24.4	45.3	2.5	15½	Mostly curved exfoliation. Light coloured silver white on face, light brown on edge. Very springy when compressed on face.
B	34.7	49.3	3.8	10½	
C	20.1	48.8	4.6	9	
D	13.5	50.0	5.7	7½	A and B grades tend to crumble on edges.
E	4.3	51.8	6.1	7	
F	1.4	46.4	10.4	3½	
G	1.6	....	impure		

(1) From screening. (2) Sediment settlement.

The exfoliated volume of the elutriated product was less than that of the untreated sample as it was more compact and regular in size apparently due to the freeing of the laminae by the steeping in water.

Remarks.—This material compares unfavourably with previous samples of Bulong vermiculite and with the Young River vermiculite of marketable quality.

(Sgd.) C. R. LE MESURIER,
Deputy Government Mineralogist.

THE AVAILABILITY OF COAL ON THE COLLIE BURN LEASES, COLLIE COALFIELD.

By J. H. Lord, B.Sc., F.G.S.

The Collie Burn leases, recently (1947) withdrawn from Amalgamated Collieries of W.A. Ltd., are leases with the original numbers 47-50, 81-84, 124-130 all inclusive, and 233, as shown on the accompanying map (Plate VI.) They are a block of leases situated to the south-west of Collie extending from Collie Burn almost to the Cardiff Colliery, and from the Griffin leases in the west to Temporary Reserve 1119H in the east.

The Collie to Cardiff railroad passes across approximately the centre of the block of leases.

MINING HISTORY.

The only mining attempted on the leases is in the vicinity of Collie Burn. The No. 1 or main seam was opened up in January, 1903, by the Collie Boulder Coal Co. Ltd., by a tunnel onto the seam near the Collie Burn Siding. This company also opened the No. 2 seam a few weeks later by a tunnel on Lease 281, but no extensive mining was done and the tunnel was abandoned due to the soft nature of the roof.

In 1904, the Scottish Co-operative Collieries Co. Ltd., took over the colliery on the main seam, known as the Collie Burn. In 1915 the pumps were unable to cope with the water entering the mine, due probably to the close proximity of the workings to the river, and, in consequence, the mine was closed. A later attempt to reopen the mine was unsuccessful and the mine is now (1948) full of water and the tunnel has collapsed.

GENERAL GEOLOGY.

The middle or Collie Burn horizon of coal seams occurs near the surface on this block of leases. This horizon extends from the Griffin-Wyvern area in the west through Collie Burn and eastwards across the southern portion of Lease 82. All seams dip southwards.

Similar to many localities on the Collie Coalfield the boring results to date, due to lack of geological control, show such variability that it is impossible to establish definitely the number of seams existing on this horizon. It appears that there are three seams and possibly four, of a thickness of over five feet.

The top, main, or No 1 seam of this horizon was worked in the Collie Burn Colliery where the thickness averaged about 9 feet. There is a stone band varying from one to four inches in thickness near the centre of the seam and the dip in the workings is 7 degrees (1 in 8) in the direction of S. 5° W. It is overlain by a dark shale, which is usually very hard, up to 3ft. thick. Above this is coarse-grained sandstone. Below the seam is a thin layer of shale, below which is sandstone.

This No. 1 seam, considered to be the eastern extension of the Wyvern seam, can be traced in shallow bores across Lease 50 and again across the southern portion of Leases 83 and 82. The seam probably extends further into Temporary Reserve 1119H with its strike becoming progressively more southerly. This area, however, has not been investigated even by shallow bores.

The seam called the Collie Burn No. 2 on which mining was attempted, is some 300 feet below the Collie Burn No. 1 Unless faulting has taken place there is another seam (approximately 6ft. thick) between these two seams. This No. 2 seam, so called, is nearly 6ft. thick with a southerly dip of 7 degrees (1 in 8). The roof is coarse-grained sandstone, while 1 foot of hard shale forms the floor. The coal contains much more iron sulphide (''brass'') than No. 2 seam.

North of this Collie Burn No. 2 seam there appears to be another seam with a thickness of about 6ft., which may be the eastern extension of the Griffin seam.

None of these seams, except the No. 1 seam, has been followed eastwards with shallow boring. However, they should behave in a similar manner to No. 1 seam, but drilling is required to verify this point.

Near the southern boundary of Leases 126 and 127, the No. 2 seam of the Cardiff horizon may be encountered, but it would be of insufficient extent, on these leases under consideration, to be of any use.

Below the Collie Burn horizon and over the whole of the leases, the Collie horizon (i.e. seams mined by the Proprietary, Co-operative and Stockton Collieries) should exist at an unknown depth, probably at least 1,500 feet below the Collie Burn No. 1 seam. No guarantee of the quality of the coal at that depth can be given. To investigate the Collie horizon in this area, it would be necessary to implement the deep drilling programme already recommended (see Mines Department File 893/46.)

COAL AVAILABLE.

Open-cut Coal.

It is only possible to indicate suitable open-cut areas where sufficient shallow boring has been carried out. In consequence, much of this block of leases is unknown; however, it is doubtful if the six-foot seams will offer any open-cut possibilities.

The No. 1 seam, due to its thickness, offers a possible site to the east of the Collie River, at Collie Burn, in Leases 49 and 50, but further east limited boring has shown that the thickness of overburden is too great for open-cut working.

This site was reported on in detail by the writer in September, 1946, (see Mines Department File 893/46.) It was considered in that report that 12 shallow holes would be necessary to prove the area. From the limited data available, and assuming it to be correct, an open-cut 1,200 feet by 400 feet would recover an average of 8ft. 5 in. of coal with the removal of an average of 33ft. overburden, producing 135,000 tons of coal. Drainage problems may be encountered in working this open-cut site.

Shallow Colliery Coal.

The availability of coal, which can be recovered using the inclined tunnel method of mining, is considered under this heading.

It should be possible to recover coal from all the seams by this method, but as with the open-cut prospects, more shallow boring is required to test the seams. Again, the No. 1 seam would have preference due to its greater thickness, which allows more economical mining.

A site on No. 1 seam suitable for investigation may be found on the east side of the Collie River, where this seam has been tested eastwards to Lease 82 and probably it extends further. This site would provide a colliery which could be extended along the strike of the seam for at least two miles; however, it could not be extended more than half a mile down the dip unless it were found possible to work under or close to the river. To work such a colliery it would be necessary to build a spur railroad, which may necessitate the bridging of the Collie River.

To discover the suitability of other seams for shallow collieries would entail extensive shallow boring and examination of the material above and below the seam, in order to determine the possibility of extracting the seam economically, since the other seams are much thinner than No. 1 seam.

Deep Colliery Coal.

Before the selection of the best site for a deep colliery on this block of leases, it is desirable that the deep boring programme as recommended by the recent Commonwealth Geophysical Survey and the Geological Survey of Western Australia should be carried out (see Mines Dept. File 893/46.)

For deep collieries it is necessary to have a number of seams. In consequence, it is desirable not only to determine the sequence of the seams of the Collie Burn horizon, but also of the Collie horizon below, from which the best Collie coal has been obtained.

In the deep drilling programme, bores 6, 8, and 10 were sited with the object of testing the Collie Burn area for a deep colliery with the shaft on Lease 126 between the road and railway. The bores would be taken to the basement rock, thus giving the exact geological situation.

Since it has now been requested that the area be investigated without this complete drilling, but instead with holes to about 1,000 feet, it is suggested that three scout holes (shown on the attached plan) should be put down to pierce the Collie Burn horizon at the same sites as it is proposed to use in the deep drilling programme. If the results are favourable, it will be necessary to drill several more holes to confirm the area.

For the drilling the following recommendations are made:—

(a) That three scout bores as described below be drilled.

(b) That the bores should be put down on the sites shown on the accompanying map. (Plate VI.)

(c) That the minimum core diameter be two inches at the bottom of each hole.

(d) That adequate steps be taken to preserve such cores for future reference, which would entail provision of suitable core boxes and core sheds.

(e) That the drilling programme be carried out under geological supervision.

(f) That the drilling contract price be for core recovered, or, alternatively, a penalty clause be inserted for loss of core.

Site No. 1.	M.L. 48.
Location	1,610 feet on true bearing 344½° from S.E. corner peg of Lease 48.
R.L.	692 feet.
Minimum anticipated depth to bottom of Collie Burn Horizon	850 feet.
Accessibility	On laterite, close to main Collie-Cardiff road. Access should be easy in all weather—no special surfacing required from road to site.

Site No. 2.	M.L. 83.
Location	525 feet on true bearing 334½° from S.E. corner peg of Lease 83.
R.L.	742 feet.
Minimum anticipated depth to bottom of Collie Burn Horizon	750 feet.
Accessibility	On laterite. Adjacent power-line track. River crossing should present few difficulties except in winter. Some work may be necessary on crossing.

Site No. 3.	M.L. 127.
Location	945 feet on true bearing 95½° from S.W. corner peg of Lease 127.
R.L.	661 feet.
Minimum anticipated depth to bottom of Collie Burn Horizon	1,300 feet.
Accessibility	On laterite—adjacent to Cardiff-Lyall's Mill track. Access easy all weathers. No special road-works should be necessary.

DRILLING.

The following information has been gathered hastily regarding the possibility of letting a contract for the above drilling:

(1) Boyle Brothers (parent company of Mineral Drillers) stated several months ago that they were not interested in contract drilling at Collie.

(2) Davis Hankinson, due to staff shortages, would not consider contracting for such a job for at least six months.

(3) The West Australian Diamond Drilling Co., with no experience of boring under such conditions at at Collie, quotes the following:

	£ s. d. per foot.
Drilling to 1,000 feet	2 0 0
Extra over for each succeeding run of 500 feet	8 6
Drilling out cement	10 0
Reaming for Casing when necessary	7 6
Providing inserting and withdrawing casing when necessary ..	5 6
Providing and carting water ..	1 0

We undertake to provide all the necessary equipment and labour for the completion of the work.

The above quotation is for using standard "N" Drilling Equipment recovering a 2-inch core.

From this quote it is seen that the average cost of drilling would be well above 50s. per foot, because it is probable that the holes will have to be cased throughout: With a deep drilling programme pending, which will give optimum results for the logical development not only of this small area but of the whole coalfield, the drilling of these three is not considered, from a geological point of view, to be economically sound for the limited results that will be obtained.

DIAMOND DRILLING ON THE COLLIE BURN LEASES, COLLIE COALFIELD, 1948.

By J. H. Lord, B.Sc., F.G.S.

Subsequent to the report on "The Availability of Coal on the Collie Burn Leases, Collie Coalfield" (page 82) a contract was let to the Westralian Diamond Drillers, to drill the three scout holes considered necessary for testing these leases for deep colliery coal.

Drilling History.

Drilling was commenced at Site 2 on Lease 83, as shown on the plan accompanying the report mentioned above, on 3rd March, 1948. This hole (No. 1) was drilled to 145 feet through poorly consolidated sedimentary strata, for the recovery of five feet nine inches of core only At this depth the casing jammed and while being freed a casing bit was lost in the hole. All efforts to "fish out" or to by-pass this bit failed and this No. 1 hole was abandoned.

Hole No. 2 was commenced on 15th March, 1948, five feet of the west of hole No. 1 at Site 2. This hole was drilled to a depth of 567 feet, where, on 14th April, the rods and casing were jammed. The rods were eventually freed but the casing was not freed. The contractor then requested permission to continue the hole with AX equipment instead of the NX previously used, thus reducing the diameter of the core from 2⅛ to 1⅝ inches. This request was granted.

The hole was continued with AX equipment on 25th April and reached a depth of 725 feet on 5th May, 1948. At this depth the rods became jammed while drilling out cement, and the hole was lost.

Core Recovery.

The core recovery during the drilling was unsatisfactory. The best core was recovered from dark grey to black shales and coal. Table I shows the percentage of core recovered for each hundred foot drilled.

TABLE I.

Depth (feet).	Percentage Core Recovered.
0–100	6
100–200	14
200–300	9
300–400	19
400–500	40
500–600	38
600–700	26
700–725	12
Average 0–725	20

As a result of this poor core recovery, the contract, which contained no penalty clause for loss of core, was terminated. The cost of drilling the hole had been £2 19s. 2d. per foot.

Geological Results.

The object of the bore was to test the four seams of the Collie Burn horizon. It is considered that three of the four seams were penetrated, while the hole was lost before reaching the No. 4 seam (the equivalent of the Griffin seam in western portion of the coalfield).

The No. 1 seam, equivalent to the seam worked in the Wyvern Colliery, was intersected by the drill at 165 feet 6 inches. The thickness of the seam was 13 feet 3 inches, which was better than expected, while it analysed satisfactorily throughout as shown in the Table 11.

The No. 2 seam was intersected at 282 feet 5 inches, but was not up to expectations because of the presence of 1 foot of shale 1 foot 3 inches from the top of this 6 foot 6 inch seam; however it analysed satisfactorily below the shale.

The No. 3 seam was intersected at 440 feet, but although 6 feet 6 inches thick it was disappointing, because it carried thin shale bands over 3 feet and analysed poorly.

The No. 4 seam was expected between 700 and 800 feet; unfortunately the hole was lost at 725 feet. A seam, 3 feet 1 inch thick, was intersected at 701 feet 4 inches, which may correspond to a similar seam found to the west about 80 feet above the Griffin seam.

Numerous smaller seams of no economic importance were encountered as shown in the log of the bore.

Near this bore site the coal measures are dipping at 5 degrees to S. 38° W. Results of this bore also suggest that the thickness of sediments between each seam of this Collie Burn horizon is increasing from west to east, that is, from the Griffin area in the west to this bore site.

Table II sets out the seams intersected together with the proximate analysis and calorific value of each. For a detailed log of the bore see Geological Survey File 10/48, while a summarised log is set out below.

TABLE II.

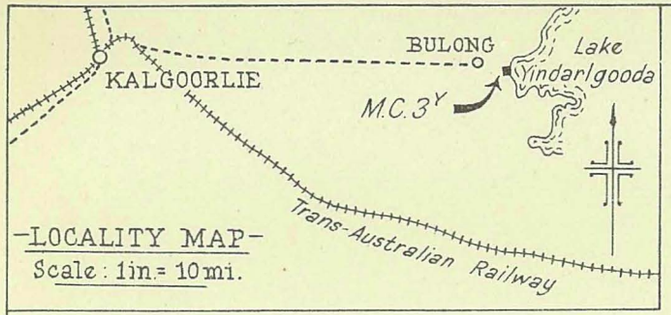
Collie Burn Seam No.	Depth Intersected. From.	Depth Intersected. To.	Thickness of Coal.	Proximate Analysis. Moisture.	Ash.	Volatile Matter.	Fixed Carbon.	B.Th.U.'s per lb.	Remarks.
	ft. in.	ft. in.	ft. in.						
1	165 6	168 0	2 6	15.52	9.07	27.64	47.77	9,274	B.Th.U's./lb. over full thickness is 9,492 with 5.52% ash.
	168 0	171 0	3 0	18.41	3.95	30.96	46.68	9,565	
	171 0	175 0	4 0	18.30	4.59	28.21	48.90	9,642	B.Th.U's./lb. for the lower 10 feet is 9,544 with 4.72% ash.
	175 0	178 9	3 9	18.97	5.42	28.35	47.26	9,423	
			13 3 Total						
2	282 5	283 8	1 3	....	....	....	....	....	Separated by 1 foot of shale.
	284 8	288 11	4 3	19.72	5.07	31.46	43.75	9,644	
3	440 0	445 0	5 0	16.65	16.80	28.18	38.37	8,350	18 inches of coal and black shale at 442 ft.
	445 0	446 6	1 6	....	....	....	....	....	Coal with black shale bands.
	701 4	704 5	3 1	20.04	6.17	28.85	44.94	9,470	

Analyst: W.A. Government Chemical Laboratories.

Summarised Log of Government Collie Burn Bore No. 2 (R.L. 742 feet).

Although a diamond drill was used, only 20 per cent. core was recovered, so most of the details below have been derived from sludge samples which were taken every five feet when not coring.

Depth (feet). From	To	Description.
0	64	Sandstone.
64	66	White clay.
66	69¾	Dark grey shale.
69¾	165¼	Sandstone.
165¼	165½	Sandy clay.
165½	178¾	COAL (13ft, 3in.).
178¾	179	Black shale.
179	281	Sandstone (shale band near 220ft.)
281	282½	Shale.
282½	283¾	COAL (1ft. 3in.).
283¾	284¾	Shale.
284¾	289	COAL (4ft. 3in.).
289	290½	Black shale with thin bands of coal.
290½	360¼	Sandstone (18in. of shale and coal bands between 300 and 310 feet).
360¼	360⅜	Black shale with bands of coal.
360⅜	383	Shale (sandy in places).
383	384⅛	COAL (1ft. 1½in.).
384⅛	414⅜	Mainly shale.
414⅜	415¾	Coal and black shale (1ft. 5in.).
415¾	431	Shale.
431	432¼	COAL (1ft. 3in.).
432¼	440	Shale.
440	442	COAL (2ft.).
442	443½	COAL and black shale (1ft. 6in.).
443½	445	COAL (1ft. 6in.)
445	446½	COAL and black shale (1ft. 6in.).
446½	456	Shale and sandy shale.
456	457⅜	COAL and black shale (1ft. 8in.)
457⅜	526	Mainly shale. A few bands of porous coarse-grained sandstone and grit. (8in. and 2in. of coal somewhere between 465 and 485 feet.)
526	560	Shale, sandy in places.
560	565	Coarse sandstone and grit.
565	566⅛	Shale.
566⅛	567⅛	COAL (11in.).
567⅛	590	Shale, sandy in places.
590	640	Coarse sandstone and grit.
640	646	Shale.
646	664½	Sandstone, shaley in places (½in. of coal at approx. 656ft.).
664½	667½	Shale.
667½	668⅛	COAL (10in.).
668⅛	679	Sandstone (shaley in places).
679	695	Coarse sandstone, grit and conglomerate.
695	701⅛	Sandstone with bands of shale.
701⅛	704 5/12	COAL (3ft. 1in.).
704 5/12	720	Sandstone.
720	725	Sandstone and shale.



—LOCALITY MAP—
Scale: 1in.= 10mi.

—LEGEND—

PRE-CAMBRIAN

Vermiculite and vermiculitic clay

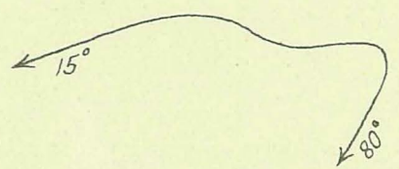
Undifferentiated serpentines and actinolitic rocks.

REFERENCE

Shaft

Probable fault

Strike and dip of vermiculite N63°E 60°



SECTION SHOWING DRAGFOLDING AT "A"
Pitch approx 40° S., Strike 340°
Section about 1ft. square
Not to scale

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

APPENDIX I

To Accompany Report on Vermiculite at Bulong

GEOLOGICAL SKETCH MAP OF UNDERGROUND WORKINGS M.C. 3Y – N.E. COOLGARDIE G.F.

Scale: 10 feet to an inch

Geology, compass and tape survey by N.M.Gray, B.Sc., Nov. 1948.

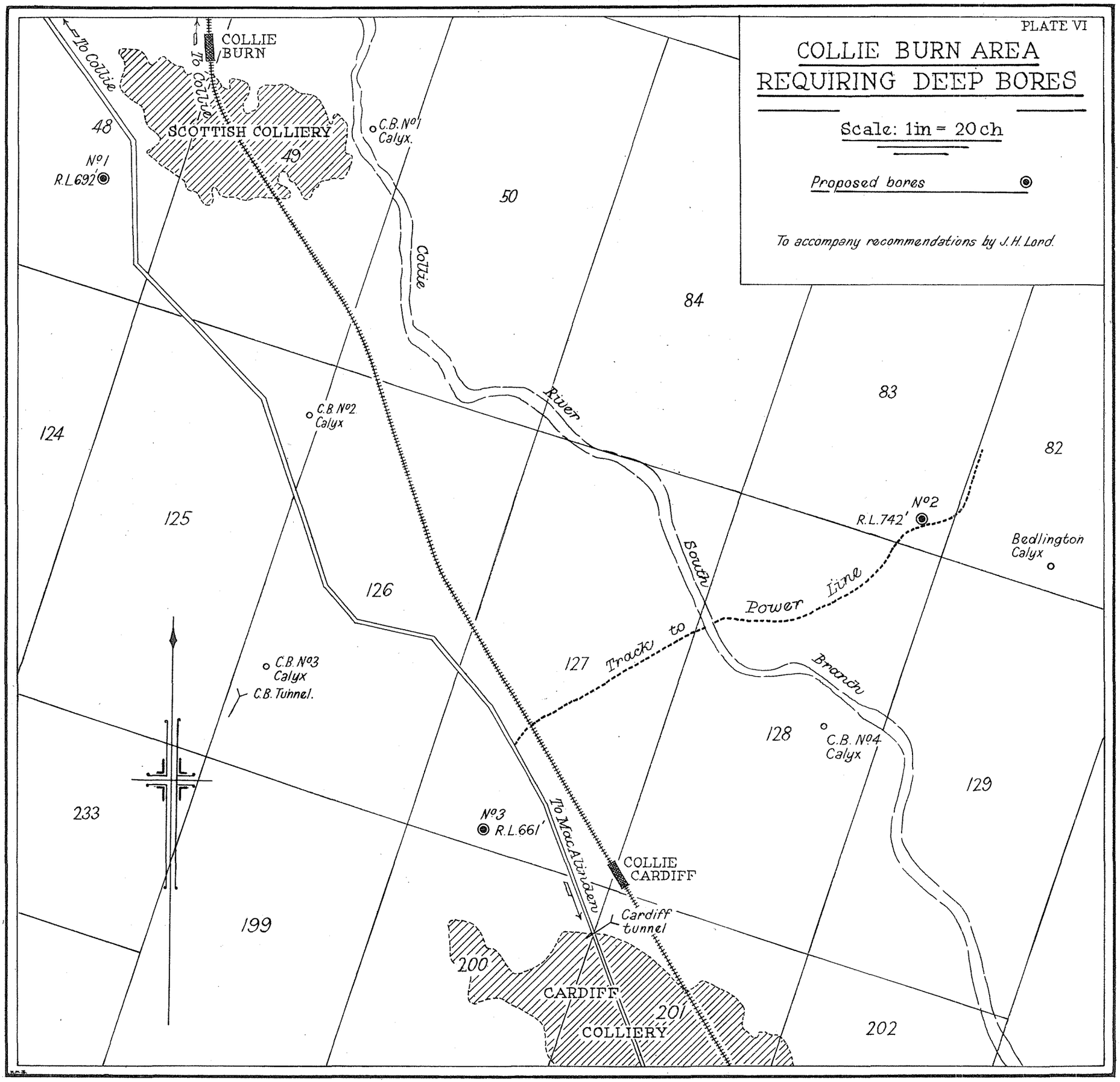


PLATE VI
COLLIE BURN AREA
REQUIRING DEEP BORES
Scale: 1in = 20ch
Proposed bores
To accompany recommendations by J.H. Land.
To Collie
COLLIE BURN
To Collie
SCOTTISH COLLIERY
48
49
50
84
83
82
124
125
126
127
128
129
233
199
200
201
202
No1 R.L.692'
C.B. No1 Calyx.
C.B. No2 Calyx
C.B. No3 Calyx
C.B. Tunnel.
C.B. No4 Calyx
No2 R.L.742'
No3 R.L.661'
Bedlington Calyx
Collie River
South Branch
Track to Power Line
To MacAlpine
COLLIE CARDIFF
Cardiff tunnel
CARDIFF COLLIERY

REPORT ON THE BLACK DIAMOND AND ADJOINING LEASES (M.L's. 304, 256 and 254) AT COLLIE, WESTERN AUSTRALIA.

By J H. Lord, B.Sc., F.G.S.

The Black Diamond leases include Mineral Leases 304 and 256 at the extreme north-western end of the main Collie coal basin, adjoining the old Westralia Colliery. The portion, which has open-cut possibilties, extends from a site on the south side of the main Collie-Roelands Road about ½-mile west of the Allanson turn-off east-north-eastwards to the old Westralia Colliery tunnel.

Historical.

The first discovery of coal at Collie was made on the river's edge near Survey Station T.17 in Lease 256, in 1893. In 1889, a little prospecting was done near this point by means of small shafts. The first recorded drilling on these leases was carried out by the East Collie Coal Mining Company under the supervision of Mr. John Ewing, L.S., in 1920, when fourteen bores and three shafts were put down.

The leases became the property of the Amalgamated Collieries of W.A. Ltd., on 19th June, 1925. Except for sampling an old shaft, this Company did no work on the area until boring was commenced in 1947, the first hole to 34 feet being completed on 14th March, 1947, the date on which the leases were resumed by the State Electricity Commission. The Amalgamated Collieries continued boring on these leases for seven months after this resumption.

In June, 1946, as the State Electricity Commission had requested the aid of the Geological Survey, the writer set out a boring programme of 17 holes (bores A to Q), and as requested the first 14 holes were to test the area on Lease 304 near the old bores for coal with overburden not exceeding 30 feet in thickness. Sixteen of these holes, which had been recommended, and a further 32 holes on sites selected by the State Electricity Commission were drilled. At this stage the assistance of the Geological Survey was requested to interpret the results, and to set out further holes to prospect Lease 256 and eastwards for open-cut coal.

The writer set out holes Nos. S.E.C. 3 to 10 and 16 to 21 and further holes would have been set out and drilled had the leases not been returned to Amalgamated Collieries of W.A. Ltd. in April, 1948. This Company immediately commenced open-cut operations on Lease 304.

Holes No. S.E.C. 11-15 were drilled contrary to the advice of the writer.

Communications.

As stated the main road from Collie to Roelands, which is sealed, passes over the southern portion of this area. Allanson railway siding is to the north-east in the adjoining Lease 256. The furthest open-cut from the siding would be about one mile. The siding could be prepared to receive the coal as it originally serviced the Westralia Colliery.

Mining Methods and Production.

No coal has been produced from the leases by direct mining operations, but the lower workings of the Westralia Colliery extended into Lease 256 at depth.

Due to the short distance between the north and south boundary of the coal basin in this area, there is no possibility of developing a large mine economically. It is considered that after the removal of all coal possible by open-cut methods, the remaining coal will not be removed for a long time as production costs would be too high.

Geology.

The coal in this area is the western continuation of the lower or Collie horizon. The three main seams are present, the lower or No. 3 being the seam which was worked in the old Westralia Colliery. This seam dips at about 5 degrees to the south near the old colliery; moving westwards the dip gradually increases to 18 degrees to S. 20° E. in the far west, as shown on the plan (Plate VII) and in the sections (Plate VIII). The No. 2 or "dirty" seam and No. 1 or Moira seam both behave in a similar manner.

With the steepening of the dip to the west, the bands of shale in the seams appear to increase in thickness, the coal is more disturbed and washouts occur.

It is difficult to determine the presence of washouts at Collie because the lake beds overlie the coal measures, and they were not evident on these leases until close boring was carried out. There is no evidence of washouts in Bores Nos. 1 to 39, but with the other bores the existence of washouts is shown, the most noticeable instance occurring in Bore No. S.E.C. 9 approximately midway between Bore No. S.E.C. 3 and Bore No. S.E.C. 36, both of which intersected Nos. 2 and 3 seams. However, S.E.C. 9 was put down 70 feet without encountering coal. Section No. 6 (Plate VIII) shows this example. In other places, where washouts were encountered, pieces of coal were found in the slurry encountered. All holes in washouts were characterised by larger quantities of water than is met with normally.

It is difficult to trace the washouts accurately, but the approximate position has been shown on the plan (Plate VII), although the position to the far west is rather indefinite. In places the coal appears to have been affected badly by water and, although it was not removed, it may have been in the course of the washout channel.

The main washout channel may have been the old course of a creek, which now flows south on the west side of Allanson and enters the Collie to the south of Survey Station T.17.

There are two other seams between 5½ and 6½ feet in thickness, one approximately 100 feet below the No. 3 seam and the other about 50 feet above No. 1 seam. There is little evidence of either seam occurring to any extent on Lease 304.

Quality of the Coal Seams.

The No. 1 or Moira seam has not been mined on the coalfield except in the old Moira Colliery, which extracted 19,415 tons between 1900 and 1901. The seam, from bore information, appears to be free from any definite stone bands, although near the top there is frequently a little shale and/or splint. Westwards from Bore No. 22, the quality of the coal seems to deteriorate and small shale bands occur more frequently.

No. 1 (OR MOIRA) SEAM.

Locality of Sample.	Total Moisture	Ash.	Volatile Matter.	Fixed Carbon.	Calorific Value B.Th.U./lb.	Calorific Value (Moisture Free) B.Th.U./lb.
	%	%	%	%		
Bore A 1	11.70	5.54	35.12	47.64	10,940	....
Bore B 1	11.62	4.82	27.00	56.52	10,660	....
Bore D.	10.05	23.35	24.90	41.70	8,670	....
Bore E.	5.00	18.57	26.00	49.43	9,595	12,520
Bore H.	4.28	14.30	26.42	55.00	10,630	12,980
Shaft No. 3	22.29	3.40	25.00	49.33	9,883	....
Shaft No. 3 Drive	18.47	6.51	21.70	53.32	9,357	....
Shaft No. 3	17.88	4.50	15.69	51.92	10,783	....
Shaft No. 3	14.27	6.00	25.73	53.92	10,932	....
Moira Seam near Co-operative Colliery	18.14	7.80	24.98	49.08	9,596	....

Analyst: W.A. Government Chemical Laboratory.

All the shaft samples are from the same shaft, the first being a channel sample taken by the writer over a vertical thickness of six feet as exposed in the shaft. The remaining samples were probably taken in a drive off the shaft, which has now caved in (May, 1948).

No. 2 seam or "dirty" seam, as it is generally known, has not been mined, as the coal from it has been rejected by the W.A. railways, due to the high ash content. It seems that the only possibilityof using this seam would be in conjunction with No. 3 seam. Instead of discarding it with the overburden, the coal from No. 2 seam should be blended with the coal from No 3 seam and used as a pulverised fuel for power plants. This seam will be wasted unless this can be done when No. 3 seam is worked.

There are no reliable analyses available for this seam.

No. 3 seam, which was mined in the old Westralia Colliery, has a shale band varying from one to two feet in thickness about four feet from the bottom. This seam is high grade Collie coal, but the shale band would hamper open-cut mining for railway purposes. It would not interfere, however, with the plan suggested for working it in conjunction with No 2 seam.

The following proximate analyses of the coal from this seam have been reported:—

No. 3 SEAM.

Locality of Sample.	Total Moisture.	Ash.	Volatile Matter.	Fixed Carbon.	Calorific Value (Air Dried) B.Th.U./lb.	Calorific Value (Moisture Free) B.Th.U./lb.
	%	%	%	%		
*Bore N.	4.20	10.97	28.20	56.63	11,165	13,170
*Shaft No. 1	19.51	8.62	21.68	50.19	9,864	12,223
*Shaft No. 1 Drive	16.95	4.81	25.67	52.57	10,625	....
†Westralia Colliery	19.30	8.12	26.90	45.68	9,779	13,486
‡Westralia Run-of-Mine (Average for 9 years)	17.50	9.75	....	....	9,660	13,280

Analysts: * = W.A. Govt. Chemical Laboratories. † = I. H. Boas. ‡ = W.A. Govt. Railways.

Future Development.

Due to the increasing dip, the presence of washouts and the close proximity of the granite boundary to the south, there is little prospect of mining the coal in this area economically by the underground methods at present (1948). Hence, the open-cut method must be exploited if the coal is required.

The present methods of open-cut mining at Collie extracts to a ratio of four of overburden to one of coal, but with the installation of a large dragline it should be possible to increase this ratio to at least six to one. This would nearly double the amount of coal available, as can be seen from the estimate of coal reserves.

The No. 2 seam is the next problem as it is unsuitable for railway purposes. A method of blending and pulverising the coal from this seam with the coal from No. 3 seam for power production purposes should be devised. This would increase the tonnage available up to a possible six-fold.

Coal Reserves.

Previously there has been no classification given to coal reserves at Collie. It has been considered sufficient to put a line of bore holes along the strike of the seam, and to deduce a huge coal reserve from the results. It is intended here to use the classification for mineral reserves as adopted by the United States of America Bureau of Mines, The Australian Commonwealth Bureau of Mineral Resources, and the Geological Survey of Western Australia, namely:—

"Measured ore" is ore for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurements are so closely spaced and the geologic character is defined so well that the size, shape, and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to differ from the computed tonnage or grade by more than 20 per cent.

"Indicated ore" is ore for which tonnage and grade are computed partly from specific measurements samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to outline the ore completely or to establish its grade throughout.

"Inferred ore" is ore for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any samples or measurements. The estimates are based on an assumed continuity or repetition for which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred ore should include a statement of the special limits within which the inferred ore may lie.

Due to the decrease in dip moving eastwards across these leases, and the decrease of the thickness of strata between No. 1 and No. 2 seams, the area available for open-cutting increases eastwards as shown on the plan (Plate VII). The western portion of the Lease 304 has been discarded as an open-cut project because of the steep dip, the high percentage of ash in the coal and the presence of washouts. However, when the indicated open-cuts have been developed it may be possible to win some of this coal by working westwards.

The possible open-cut sites have been named:—

(a) The Black Diamond No. 1, which is on the No. 1 seam and extends eastwards from bore No. E.

(b) The Black Diamond No. 2, which is on No. 2 and 3 seams and extends eastwards from bores No. L2 and C.

(c) The Westralia, which begins on Lease 256 to the west of the old Westralia workings and extends southwards to join the Black Diamond No. 1.

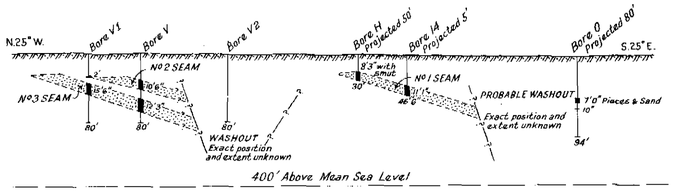
Work has already commenced on the Black Diamond No. 1 open-cut. It will be a narrow open-cut at first, but will widen out going eastwards. It will be necessary to move a considerable length of the main bitumen road later. The western extension of this open-cut can be classified only as inferred coal as there are insufficient bores. A fault may be encountered between bores 19 and 20 and also between bores No. 33 and 35, but it should not interfere with operations.

The Black Diamond No. 2 site would not be of any great extent, unless it is possible to work both seams. Even so, it is limited because of the washout to the south. Further exploration of this washout may improve the position.

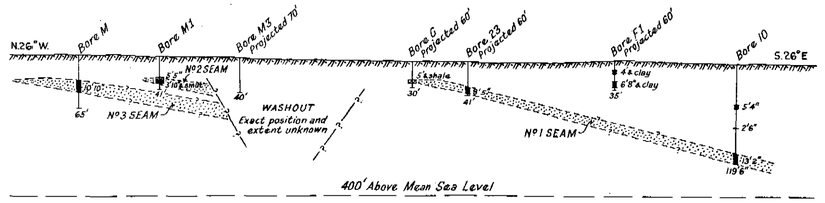
PLATE VII

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
PLAN OF
BLACK DIAMOND & ADJOINING LEASES
(M.L.s 304, 256 & 254)
COLLIE MINERAL FIELD
Showing Bore Holes, Coal Intersected and Possible Open Cut Areas
SCALE: 4 CHAINS TO AN INCH
Based on surveys by State Electricity Commission, Amalgamated Collieries of W.A. Ltd and G.S.W.A. All levels adjusted to Amalgamated Collieries datum.
Interpretation by J.H. Lord, BSc., F.G.S., May 1948.
-REFERENCE-
Approximate boundary of coal measures
Approximate boundary of colliery workings
Approximate boundary of washouts
Boundary of possible open cuts
Lease boundary
Line of section
Fault
Shaft, inaccessible
Underground survey station and reduced level
U/G S.S. R.L. 480'
Bore hole showing indentification (38), reduced level (R.L. 602') significant coal seams intersected (3'0" at 62'0") and depth of bore hole (80')
38 R.L. 602' 3'0" at 62'0" (80')
Strike and dip of coal seam deduced from borehole data
Number of seam to which coal intersected is correlated or to which dip refers
Measured coal reserves
Indicated coal reserves
Inferred coal reserves
LOCALITY MAP
M.L.304
M.L.256
M.L.254
Loc 1128
Loc 1363
A L L A N S O N
Old Westralia Workings of No 3 Seam
No 3 SEAM RATIO 4 TO 1
No 2 & 3 SEAMS RATIO 4 TO 1
No 2 & 3 SEAMS RATIO 6 TO 1
No 1 SEAM RATIO 4 TO 1
No 1 SEAM RATIO 6 TO 1
RATIO 6 TO 1 No 1, 2 & 3 SEAMS
WASHOUT
Approximate Boundary of Coal Measures
COLLIE RIVER
To Collie
GOVT. D.D. No 8

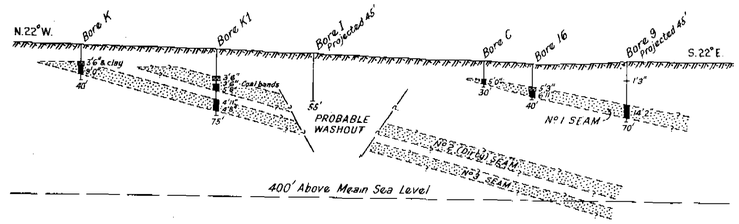
SECTION Nº 1
Along Line Through Bore V1 and Bore V2



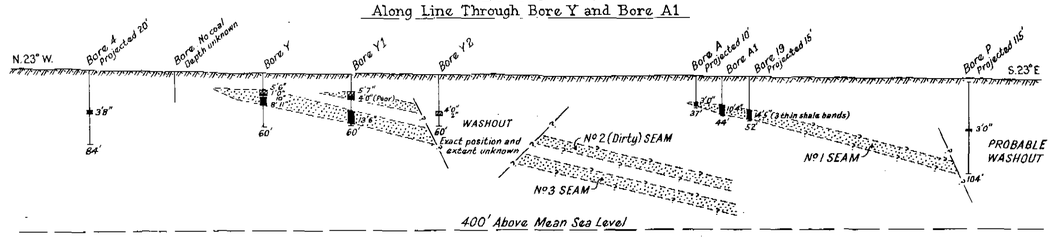
SECTION Nº 2
Along Line Through Bore M and Bore 10



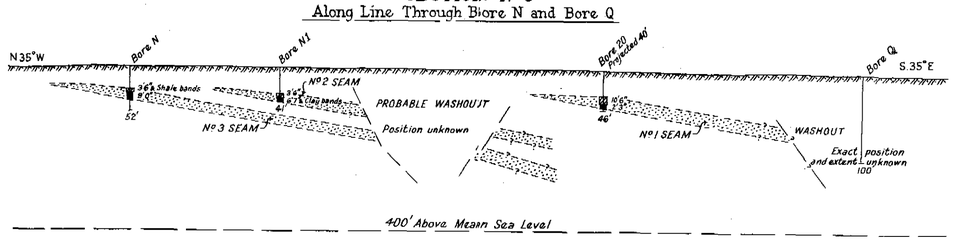
SECTION Nº 3
Along Line Through Bore K and Bore 16



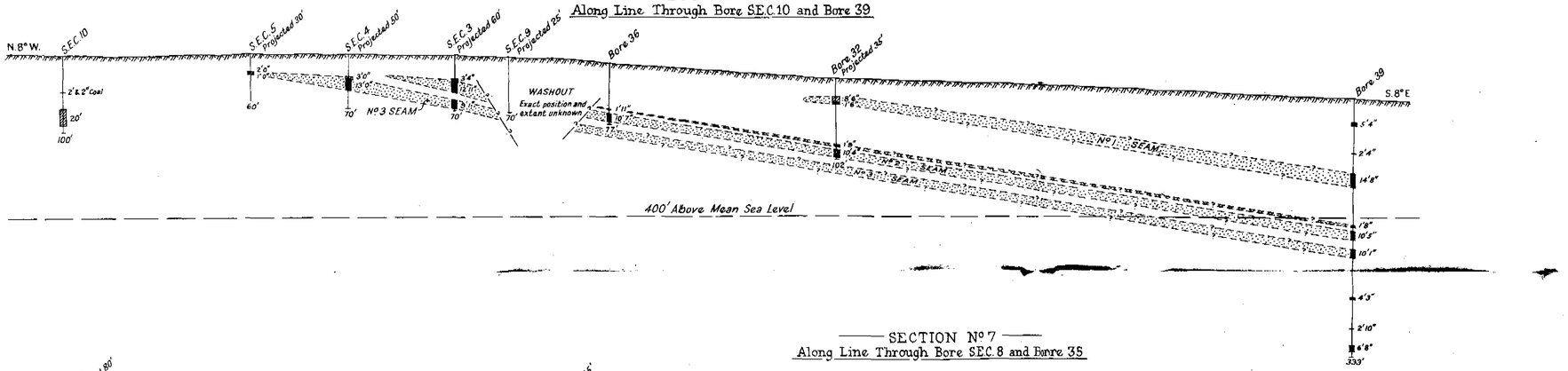
SECTION Nº 4
Along Line Through Bore Y and Bore A1



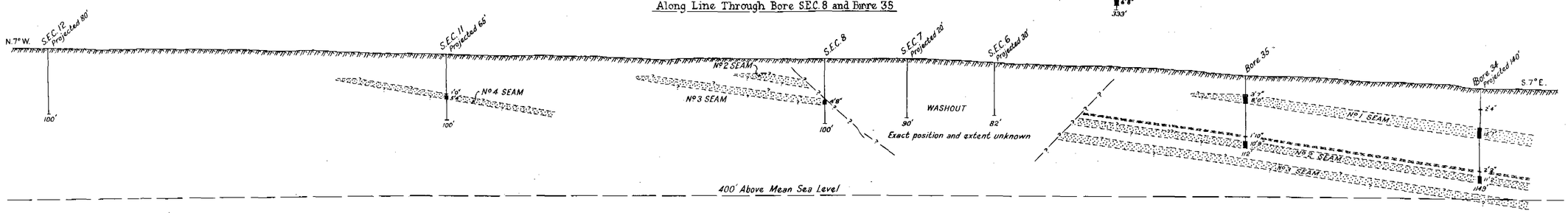
SECTION Nº 5
Along Line Through Biore N and Bore Q



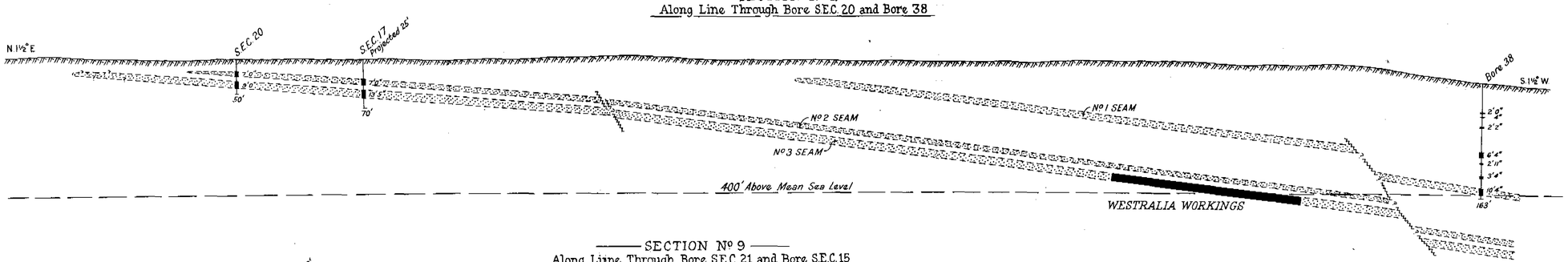
SECTION Nº 6
Along Line Through Bore SEC.10 and Bore 39



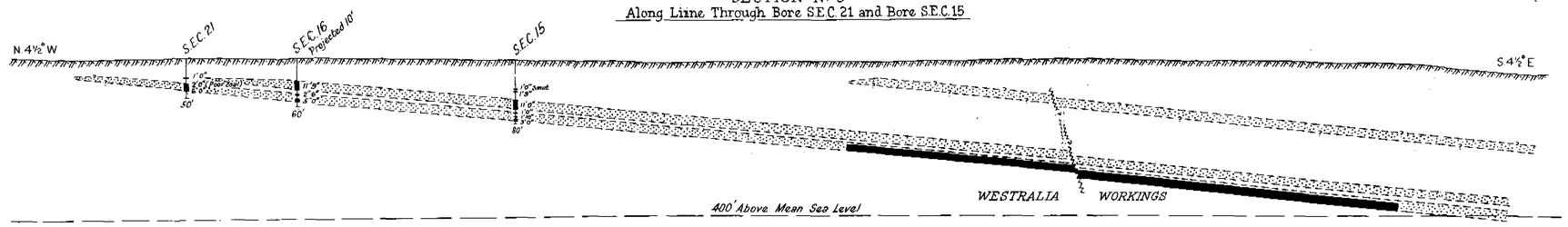
SECTION Nº 7
Along Line Through Bore S.E.C. 8 and Barre 35



SECTION Nº 8
Along Line Through Bore S.E.C. 20 and Bore 38



SECTION Nº 9
Along Liine Through Bore S.E.C. 21 and Bore S.E.C. 15



REFERENCE

- Geological boundary approximate
- Geological boundary assumed
- Unworked coal seams
- Worked coal seams
- Fault
- Probable fault, or fault with unknown dip
- Approximate surface
- Coal
- Smut
- Bore hole with depth and coal seams intersected

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL SECTIONS
OF
BLACK DIAMOND & ADJOINING LEASES
(M.Lˢ 304, 256 & 254)
COLLIE MINERAL FIELD

Scale: 100 feet to an inch

100 50 0 100 200 300

Compiled and interpreted by J.H. Lord, B.Sc., F.G.S., 1948, on assumption that bore logs and surveys are correct.

The Westralia site has the brightest prospects, if the coal from No. 2 seam can be used, because the dip here has decreased, and in the course of open-cutting No. 2 and No. 3 seams to a ratio of six to one, No. 1 seam should be encountered. This would enable the open-cut to be worked much further down the dip. There is a good possibility of extending the open-cut eastwards, if the necessary exploration is carried out.

Further drilling is required under geological supervision to raise the classification of the large tonnage of inferred coal.

In calculating the following coal reserves, it has been assumed that all the bore logs are correct, that the surveyed positions of the bore holes with the reduced levels are correct, and that one ton of coal occupies 30 cubic feet.

BLACK DIAMOND No. 1.

Seams to be worked.	Assumed Thickness.	Ratio of overburden to Coal.	Coal Reserves.			
			Measured	Indicated.	Inferred.	Total.
	feet.		tons.	tons.	tons.	tons.
No. 1.	10	4–1	25,000	....	....	....
No. 1	11	4–1	....	....	192,000	217,000
No. 1	11	6–1	25,000	....	365,000	390,000

BLACK DIAMOND No. 2.

Seams to be worked.	Assumed Thickness.	Ratio of overburden to Coal.	Coal Reserves.			
			Measured	Indicated.	Inferred.	Total.
	feet.		tons.	tons.	tons.	tons.
No. 3	9	4–1	24,000	26,000	....	50,000
No. 3	9	6–1	40,000	54,000	....	94,000
No. 2 and No. 3	17	4–1 or to washout	60,000	....	....	....
No. 2 and No. 3	19	....	....	130,000	....	190,000
	....	6–1	Probably washed out		....	....

WESTRALIA.

Seams to be worked.	Assumed Thickness.	Ratio of overburden to Coal.	Coal Reserves.			
			Measured	Indicated.	Inferred.	Total.
	feet.		tons.	tons.	tons.	tons.
No. 3	8	4–1	....	24,000	38,000	62,000
	....	6–1	49,000	24,000	70,000	143,000
Nos. 2 and 3	17	4–1	245,000	88,000	105,000	438,000
	....	6–1	245,000	88,000	423,000	756,000
Nos. 2 and 3	27	6–1	245,000	88,000	701,000	1,034,000

GRAND TOTAL OF OPEN-CUT COAL IN THIS AREA.

(Subject to No. 2 Seam being worked.)

	tons.
Measured Coal	330,000
Indicated Coal	218,000
Inferred Coal	1,066,000
	1,614,000

REPORT ON PROSPECTING AREA 53 AT COLLIE, WESTERN AUSTRALIA.

By J. H. Lord B.Sc., F.G.S.

Prospecting Area 53 (referred to as the "P.A.") consists of 2,845 acres of ground commencing to the north-west of the old Premier Colliery at Shotts (8 miles east of Collie), and extending southwards and then westwards around this Colliery as shown on Plate IX. The P.A. includes all of abandoned leases 262, 263, 265, 266 and 322, portions of abandoned leases 102, 135, 293, 294, 295, 296 and 297, together with some previously unpegged ground to the north-east of Shotts. It was taken out in the name of Messrs. F. Walsh and S. Simpson for the Goldfields Coal Syndicate.

The Syndicate approached the Geological Survey of Western Australia for technical assistance in exploring the P.A.; in consequence, the writer was instructed to lay out a drilling programme and supervise it geologically, the results of which are given in this report.

COMMUNICATIONS.

The north-eastern portion of the P.A., which is the most important, is well served with communications (see Plate IX). The Collie to Wagin road, which is sealed, and the Collie to Wagin and Narrogin railway line cross this portion of the P.A.

The following rail distances from the siding at Shotts, which adjoins the P.A., are of interest:—

Shotts to Collie—8 miles.

Shotts to the port of Bunbury—50 miles.

Shotts to Perth—133 miles.

Shotts to Kalgoorlie, via Collie and Perth—513 miles.

Shotts to Kalgoorlie, via Narrogin and Northam—504 miles.

Shotts to Kalgoorlie, via Narrogin, Wickepin and Merredin—429 miles.

The portion of the P.A., south of the railway, is served only by bush tracks, many of which are impassable during winter (June to October).

MINING METHODS AND PRODUCTION.

No coal has been produced within this P.A. However, the closed Premier Colliery on adjoining Leases 260 and 261 produced coal by the bord and pillar method from the year 1911 to the year 1927, when the colliery was purchased and closed by Amalgamated Collieries of W.A. Ltd. The first or "old" tunnel on Lease 261 was abandoned due to faults, creep and fire. Operations in the second or "new" tunnel on Lease 260 were hampered by faults, water and lack of capital.

OLD TUNNEL—LEASE 261—SEAM NO. 4.

Year.	Tonnage.	Value (£A).
1911	6,612	3,115
1912	37,522	17,075
1913	33,189	15,573
1914	2,640	1,180
Total	79,963	36,943

NEW TUNNEL—LEASE 260—SEAM No. 6.

Year.	Tonnage.	Value (£A).
1916	10,002	4,532
1917	12,860	7,170
1918	21,418	12,971
1919	30,282	20,397
1920	38,829	29,617
1921	42,894	37,124
1922	44,312	38,158
1923	46,503	40,511
1924	47,519	40,711
1925	45,083	38,221
1926	38,850	32,889
1927	9,571	7,911
Total	388,123	310,212
Combined Total, from Both Tunnels	468,086	347,155

GEOLOGY.

General.

In the detailed investigation of the Collie Coalfield during the years 1946 and 1947 by the Geological Survey of Western Australia and the Commonwealth Bureau of Mineral Resources, the boundary of the coal measures was defined as accurately as possible. This resulted in the recognition of two basins of sedimentation in the area known previously as the Collie Coal Basin, with several "islands" of granite rocks. The two basins are separated by a ridge of pre-cambrian rocks, composed mainly of granite. One of these basins, which lies to the south-west of the ridge is known as the Main or Collie Basin, and the other, situated to the north-east of this ridge, has been called the North-Eastern Basin. As can be seen on the locality map (Plate IX) the ridge is exposed for the greater part, but is covered by coal measures to the north-west.

Sedimentation and coalification took place simultaneously in these two basins, which in earlier times may have covered a larger area. When the Collie (or lower) horizon of coal seams was formed in the Collie Basin, an horizon of coal seams was deposited in the North-Eastern Basin.

Similarly, when the Collie Burn (or middle) horizon of coal seams was being formed, an horizon was deposited contemporaneously in the North-Eastern Basin. This horizon was worked in the Premier Colliery and has been disclosed in more detail by the recent boring programme, carried out by the Goldfields Coal Syndicate.

There is no available evidence, nor is it considered likely that a third horizon of coal seams exist in this North-Eastern Basin, as in the main Collie Basin.

The coal measures, which are of Permian Age are overlain uncomformably by pliocene lake beds of variable thickness, usually between 20 and 35 feet. The strata of the coal measures near the grantitic ridge are usually affected by faulting and slumping.

Geology of P.A. 53.

The syndicate did not have the above information when this P.A. was pegged, with the result that, although the major part of the P.A. is in the North-Eastern Basin, it also takes in a portion of the granitic ridge and extends a short distance on to the Collie Basin. The granitic ridge divides the P.A. into two distinct portions geologically, which will be discussed separately.

(a) *The South-Western Portion of P.A. 53 on the Collie Basin.*

Since the seams of the Collie Basin dip southwards, one would expect to find the continuation of the Collie horizon of coal seams, as worked in the Stockton Colliery, in this portion of the P.A. However, due to the proximity of the granitic ridge, they may be affected by faulting and slumping.

This area was drilled by the East Collie Coal Mining Co. in the year 1920, and in bore E.C. No. 3 (Plate IX) a seam 9ft. 2in. thick was reported at 134 feet, but for some unknown reason, drilling was not continued down the dip of the seam; instead it was carried on to the north-east, closer to the granitic ridge. In consequence, a bore D5 was commenced by the syndicate to the south-west of E.C. 3. At 106½ feet, when 4ft. 9in. into a seam of coal, the bore could not be continued due to caving ground. Another bore, D6, was drilled about 25 chains to the south-south-east of bore D5 but was discontinued at a depth of 300 feet, the thickest coal intersected being three feet at 209 feet. This seams is the best quality coal encountered in the Collie Coalfield. Faulting could account for the absence of the thicker seams in this hole.

As only a small area of these coal measures was held in the P.A., no further drilling was carried out on this portion. However, with the granting of P.A. 54 to the syndicate, further and more detailed prospecting can be carried out for these seams. There is a definite possibility of both the Collie and Collie Burn horizons of coal seams occurring within PA. 54.

(b) *Portion of P.A. 53 on the North-Eastern Basin.*

The horizon of coal seams discussed here is that which was deposited contemporaneously with the Collie Burn horizon in the main Collie Basin. Deep boring may prove the existence of a lower horizon equivalent to the Collie horizon, as found by Hard Coals Ltd. to the north of Ewington.

The deepest bore on or in the vicinity of the P.A. is the calyx bore, which was drilled south of the "old" tunnel on Lease 261 (Plate IX). There is some variation in the existing logs of this bore, but the log produced in the prospectus of the original company appears to be an average of all results. Following information is taken from the Company's prospectus. Seams less than three feet have been omitted.

Seam.	Thickness.	Depth.
No. 1	3ft. 0in.	82ft.
No. 2	6ft. 0in.	199ft.
No. 3	5ft. 4in.	253ft.
No. 4	6ft. 4in.	268ft.
No. 5	4ft. 0in.	439ft.
No. 6	5ft. 0in.	451ft.
*No. 7	5ft. 4in.	520ft. (?)

*This No. 7 seam is said to exist but was not reached by the Calyx Bore.

The system of numbering the seams, as introduced by the Premier Coal Mining Co. Ltd., is maintained here for conformity. An endeavour has been made to number and correlate the seams intersected on the P.A. with those intersected in the calyx bore.

The "old" Premier tunnel worked on No. 4 seam while the "new" Premier tunnel worked No. 6 seam. The method of working the seams was affected by faulting, and in particular by a large upthrow fault on the north-east side. It would appear that the strata near the granitic ridge have slumped, forming a large fault or a series of minor faults to the north-east of the Premier Colliery. On P.A. 53 a repetition of the strata found in the Premier Colliery is encountered, due to this faulting. There is no detailed information obtainable regarding this fault or faults, except that the Premier workings encountered this upthrow fault on the north-east side. Drilling carried out on P.A. 53 suggests such a break in the strata, with a total vertical displacement probably of 200 feet.

TABLE I.

CORRELATION OF COAL SEAMS ENCOUNTERED IN BORES ON P.A. 53.

Bores.			No. 1 Seam.		No. 2 Seam.		No. 3 Seam.		No. 4 Seam.		No. 5 Seam.		No. 6 Seam.	
No.	Reduced Level.	Depth.	Thickness.	Depth.	Thickness.	Depth.	Thickness.	Depth.	Thickness.	Depth.	Thickness.	Depth.	Thickness.	Depth.
	Feet.	Feet.	ft. ins.	Feet.	ft. ins.	Feet.	ft. ins.	Feet.	ft. ins.	Feet.	ft. ins.	Feet.	ft. ins.	Feet.
A1	786	260	(a)	(a)	(a)	(a)	(a)	(a)	4 6	77	3 6	247	(b)	(b)
A2	766	300	(a)	(a)	(a)	(a)	(a)	(a)	Missing		4 6	258	5 0	267
A4	762	216	3 0	30	5 0	147	5 6	189	6 9	204	(b)	(b)	(b)	(b)
A6	754	230	4 0	48	6 6	173	6 0	203	6 0	219				....
A8	744	145	(a)	(a)	6 6	110	3 0	142	(b)	(b)	(b)	(b)	(b)	(b)
1	778	142	(a)	(a)	4 0	123	6 9	164	Missing		(b)	(b)	(b)	(b)
Z1	818	250	3 0	73	6 0	180	5 9	218	7 0	232	(b)	(b)	(b)	(b)
B3	727	217	Two thin seams, neither can be correlated.											
B6	773	184	(a)	(a)	5 6	122	5 9	155	6 6	174	(b)	(b)	(b)	(b)
B8	787	250	(a)	(a)	6 3	122	6 0	166	7 0	185	(b)	(b)	(b)	(b)
B10	787	214	(a)	(a)	6 6	144	6 9	176	6 0	200	(b)	(b)	(b)	(b)
B12	....	100	No seams intersected.				....	....	....	....	....	....	....	....
Z2	794	160	(a)	(a)	6 0	102	5 6	132	7 6	149	(b)	(b)	(b)	(b)
E1	744	130	(a)	(a)	6 2	35	5 9	73	Missing.		(b)	(b)	(b)	(b)
E2	722	150	(a)	(a)	(a)	(a)	5 6	60	5 6	83	(b)	(b)	(b)	(b)
C1	805	150	No seams intersected.				....	....	....	....	....	....	....	....
C3	824	200	(a)	(a)	(a)	(a)	5 6	54	6 0	82	(b)	(b)	(b)	(b)

(a) = Bore commenced below this seam. (b) = Bore stopped before reaching this seam.

PLATE IX

Granite

Loc. 2315

Loc. 2980

Loc. 2447

N39°W SECTION No. 5

273

A.8. R.L. 744'
② 6'6" at 110'0"
③ 3'0" - 142'0"
(145') Hole lost in Coal.

N.E.

A.6. R.L. 754'
① 4'0" at 48'6"
② 6'6" - 173'0"
③ 6'0" - 203'0"
④ 6'0" - 219'0"
(230')

A.4. R.L. 762'
① 3'0" at 30'0"
② 5'0" - 147'6"
③ 5'6" - 189'6"
④ 6'9" - 204'0"
(216')

B.12. No Coal (100')

293

To Collie

SHOTTS TOWNSITE

291

Station

PREMIER COLLIERY (CLOSED)

A.2. R.L. 766'
⑤ 4'6" at 258'0"
⑥ 5'0" - 266'0"

A.1. R.L. 786' (300')
④ 4'6" at 76'9"
⑤ 3'6" - 246'6"

Z.1. R.L. 817'
① 3'0" at 72'6"
② 6'0" - 179'6"
③ 5'9" - 218'0"
④ 7'0" - 231'9"
(250')

B.10. R.L. 787'
② 6'6" at 144'0"
③ 6'9" - 176'0"
④ 6'0" - 200'0"
(214')

Loc. 1715

I.A. R.L. 778'
4'0" at 122'6"
6'9" - 163'6"
(206')

B.8. R.L. 787'
② 6'3" at 122'0"
③ 6'0" - 165'6"
④ 7'0" - 184'6"
(250')

263

Z.2. R.L. 794'
② 6'0" at 102'0"
③ 5'6" - 132'0"
④ 7'6" - 149'0"
(157')

E.1. R.L. 744'
② 6'0" at 35'3"
③ 5'9" - 73'0"
1'0" - 82'0"
(130')

271

260

261

S.W. SECTION No. 1

B.6. R.L. 773'
② 5'6" at 121'6"
③ 5'9" - 156'6"
④ 6'6" - 174'0"
(184')

262

S.W. SECTION No. 2

E.2. R.L. 722'
③ 5'6" at 60'0"
④ 5'6" - 83'0"
(150')

339°E

Loc. 1416

STOCKTON COLLIERY

Calyx Bore
① 3'0" at 82'0"
2'6" - 155'0"
② 6'0" - 199'0"
③ 5'4" - 250'0"
④ 6'4" - 268'0"
1'6" - 355'0"
⑤ 4'0" - 430'0"
⑥ 5'0" - 445'0"
(500')

264

B.3. R.L. 729'
2'6" at 37'0"
2'0" - 48'0"
(217')

P.A. 53.

Granite

Greenstone

Loc. 2133

265

266

Loc. 1619

301

E.C.8. No Coal (135')

E.C.2. Granite at 74'

E.C.5. No Coal (95')

E.C.6. 4'0" at 99'0" 4'6" - 135'6" (156')

E.C.4.

322

360

E.C.7. 4'6" at 85'0" 3'6" - 119'4" (132')

E.C.3. 3'0" at 55'2" 5'0" - 98'3" 9'2" - 134'0" (144')

E.C.9. 4'6" at 38'8" 2'0" - 105'6" (178')

E.C.10. No Coal (146')

D.5. R.L. 683' 0'6" at 71'6" 4'9" - 106'6" (Hole lost in Coal)

E.C.11. 1'0" at 155'2" (170')

E.C.12. Granite at 76'

E.C.13. Granite at 57'

294

D.6. 1'6" at 199'0" 3'0" - 209'0" (300')

102

N12°W SECTION No. 4

C.3. R.L. 824'
③ 5'6" at 54'0"
④ 6'0" - 82'6"
1'3" - 90'0"
(200')

C.1. R.L. 805' No Coal (150')

E.C.22. 4'5" at 83'5" 5'8" - 108'4" (116')

N75°E

E.C.20. 5'0" at 110'2" 1'5" - 116'9" (134')

E.C.21. 4'4" at 126'10" 6'2" - 138'10" (147')

E.C.24. 6'3" at 80'0" 1'6" - 88'0" (150')

E.C.17. ③ 5'5½" at 31'0" ④ 6'2" - 66'0"

E.C.16. 4'2" at 33'3" 6'0" - 74'0" (124')

E.C.15.

E.C.14. 1'6" at 62'11" 2'6" - 92'3" (124')

③ 6'7" - 114'3" 1'0" - 122'5" (142')

E.C.18. 1'6" at 74'6" ② 6'5" - 107'10" (134')

S12°E

S75°W SECTION No. 5

E.C.19. 4'6" at 97'8" 1'4" - 104'0" (122')

E.C.23. 1'2" at 128'10" (133')

135

295

296

297

298

299

—LEGEND—

Coal Measures

Pre-Cambrian Rocks (Granite, Greenstone etc.)

— REFERENCE TO SIGNS —

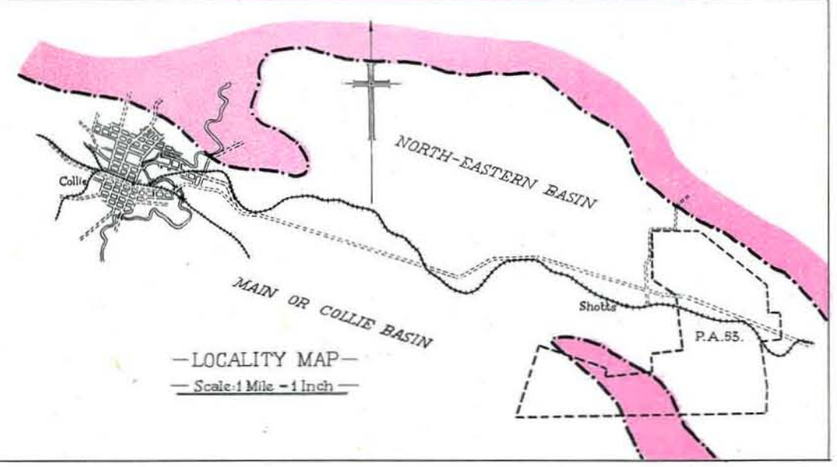
- Approximate Boundary of Coal Measures
- Approximate Boundary of Colliery Workings
- Boundary of P.A. 53.
- Lease and Location Boundary
- Line of Section
- Fault (U = upthrow side, D = downthrow side.)
- Borehole, drilled by Goldfields Coal Syndicate, showing identification (B.6) reduced level (R.L. 773') significant coal seams intersected (5'6" at 121'6") and depth of borehole (184')
- Borehole, drilled by previous Companies, showing similar detail where available
- Strike and Dip of Coal Seam from borehole data
- Number of Seam to which coal intersected is correlated, or to which dip + strike refers
- Outcrop of Pre-Cambrian Rocks

B.6. R.L. 773'
5'6" at 121'6"
(184')

5°

④

—LOCALITY MAP—
— Scale: 1 Mile = 1 Inch —



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PLAN OF

PROSPECTING AREA 53

COLLIE MINERAL FIELD

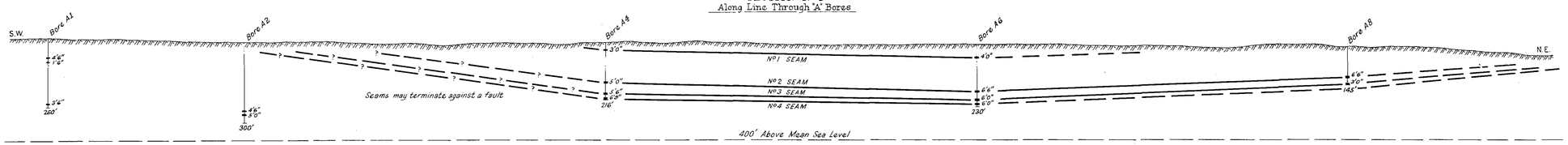
Showing Geology and Boreholes with Coal Intersected

SCALE: 20 CHAINS TO AN INCH

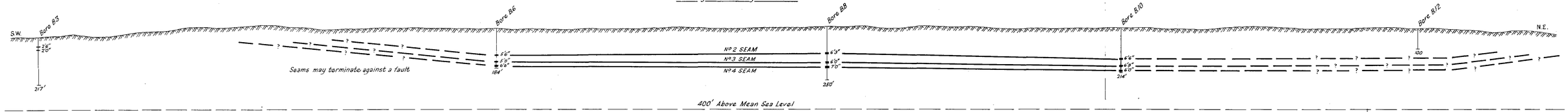
20 10 0 20 40

Based on bore logs and their positions as supplied by GoldFields Coal Syndicate, together with information in the possession of Geological Survey of W.A.
Collated and Interpreted by J.H. Lord, B.Sc., F.G.S., August 1948.

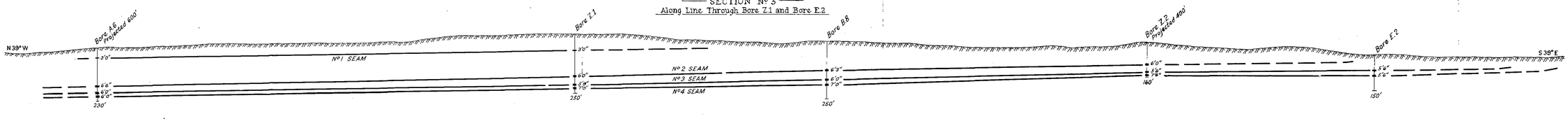
SECTION No 1
Along Line Through 'A' Bores



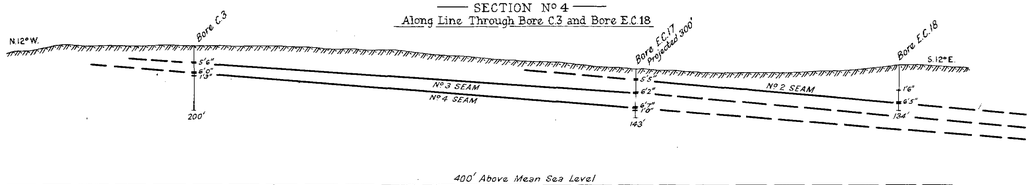
SECTION No 2
Along Line Through 'B' Bores



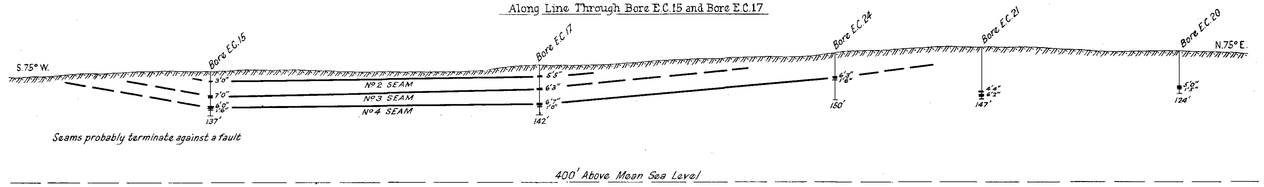
SECTION No 3
Along Line Through Bore Z1 and Bore E2



SECTION No 4
Along Line Through Bore C3 and Bore EC18



SECTION No 5
Along Line Through Bore EC15 and Bore EC17



REFERENCE

Approximate surface	
Coal seams measured	
Coal seams indicated	
Coal seams inferred	? — ? — ?
Bore hole with depth and coal seams intersected	4'6" 125'

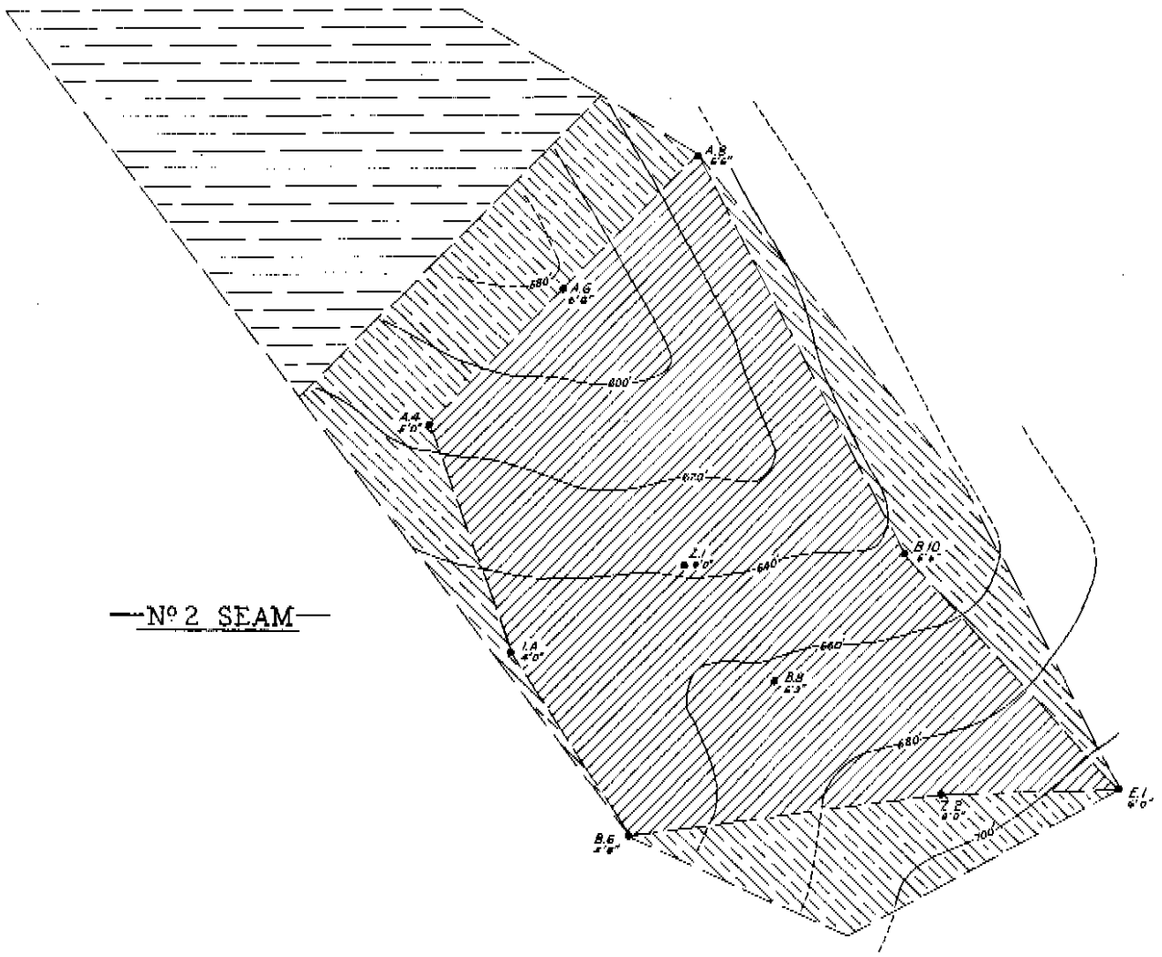
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL SECTIONS OF PROSPECTING AREA 53 COLLIE MINERAL FIELD

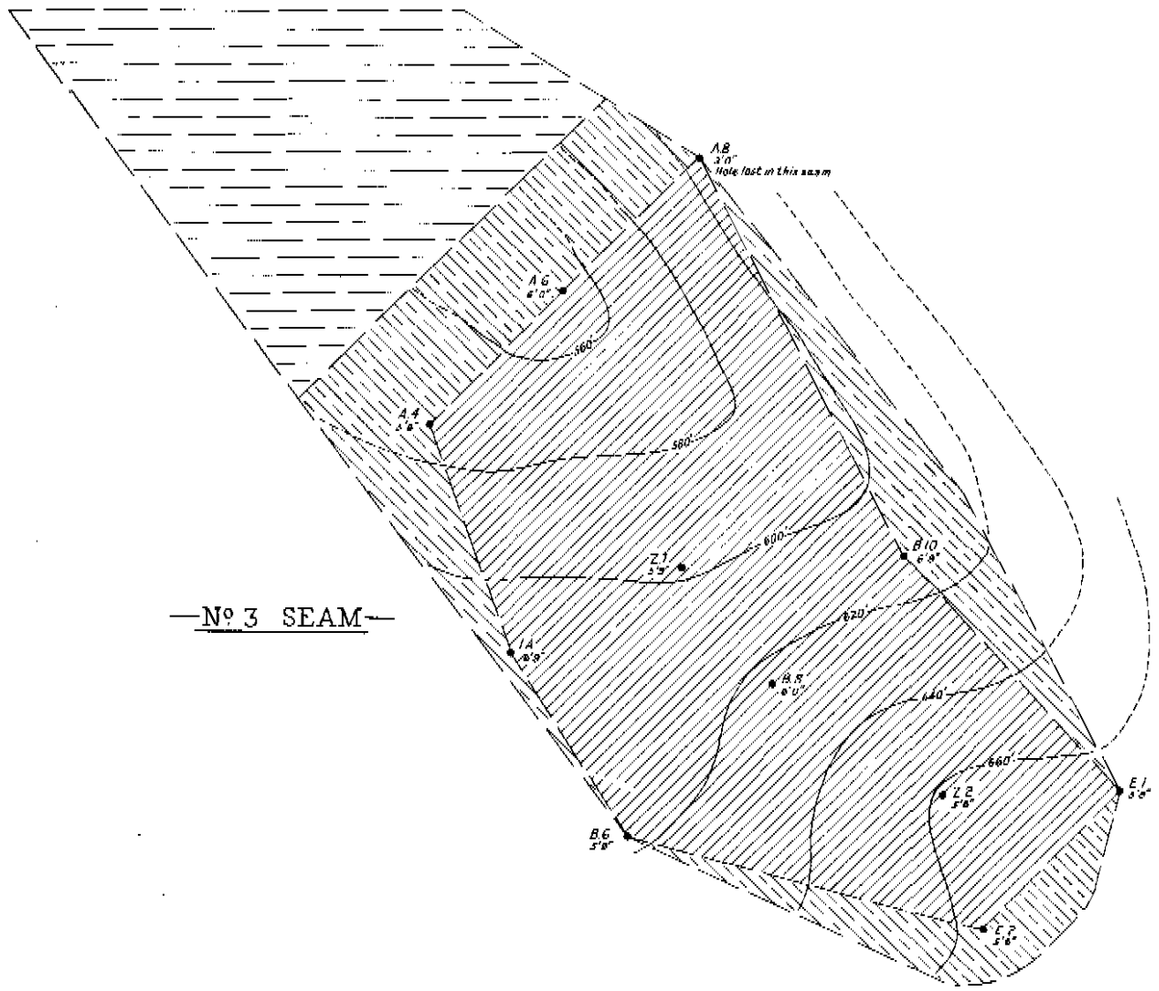
Scale : 200 feet to an inch

200 100 0 200 400 600

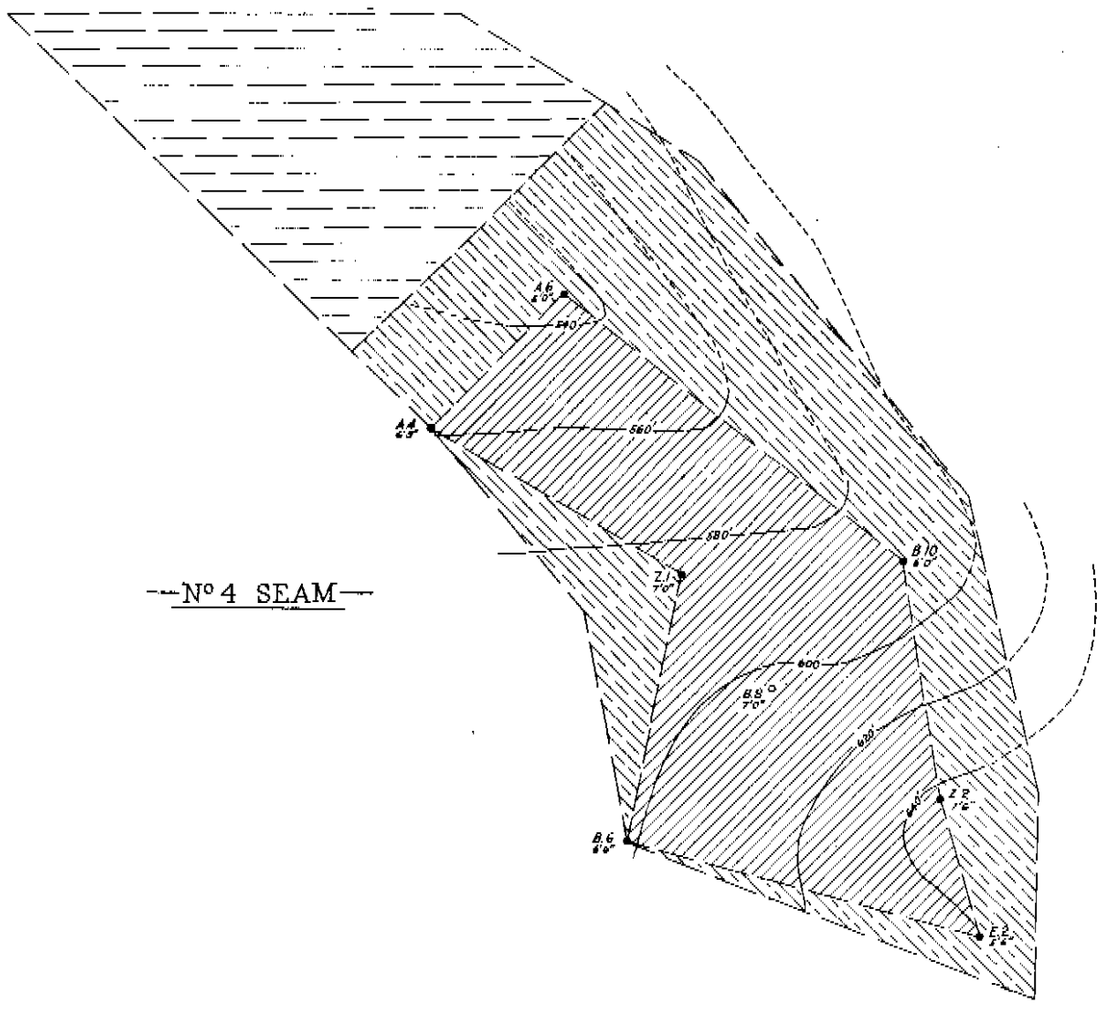
Compiled and interpreted by J.H. Lord, B.Sc, F.G.S., 1948, on assumption that bore logs and surveys are correct.



—Nº 2 SEAM—



—Nº 3 SEAM—



—Nº 4 SEAM—

—REFERENCE—

Coal Reserves
- Measured
- Indicated
- Inferred

Structure Contours (Height above Main Seal Level on top of coal seam)
- Observed ---600'---
- Assumed . . . .

Bore hole intersecting the coal seam, with number of bore and thickness of seam. ◆ B.10 6'0"

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PLAN OF PORTIONS

OF

PROSPECTING AREA 53

COLLIE MINERAL FIELD

Showing Coal Reserves and Structure Contours of the Workable Coal Seams

Scale 20 chains to an inch

20 10 0 20 40

Compiled by J.H. Lord, B.Sc., F.G.S., 1948

The "new" Premier tunnel encountered No. 6 seam dipping to the south-east. As work progressed the direction of dip gradually changed to north-east and north showing the existence of a dome structure—a feature that is encountered in the Stockton Colliery on the opposite side of the ridge. The dome was probably produced as a result of slumping.

The object of the exploratory drilling on P.A. 53, after establishing the general structure of the strata, has been to locate Nos. 2, 3 and 4 seams which are the three thickest seams in the horizon. The only previous drilling carried out on this portion of the P.A. was by the East Collie Coal Mining Co. in the south-eastern corner, but, although this Premier horizon of coal seams was encountered, the seams could not be correlated satisfactorily.

It was anticipated that the seams may not be continuous over the full north-south length of this portion of the P.A., so bore sites were set out on two lines "A" and "B" to the north, and line "C" to the south. This proved to be so with the seams near the "C" line dipping to the south and out of the P.A., while the seams in the vicinity of lines "A" and "B" dip to the north-west.

The blind outcrop* of the northern seams is in the vicinity of bores E1 and E2; from here they have a regional dip of 1 to 1½ degrees to the north-west. The angle of the dip is so small that the calculated strike is variable. This can be seen on the Plate IX where the dip and strike of the seams is shown and also on Plate XI, where the structural contours of the coal seams are shown. From these dips it appears that the seams in this area are little affected by faulting and form a trough-shaped basin. The basin has been proved to extend from the vicinity of "E" bores north-westwards to the line of "A" bores, a distance of 85 chains, and it probably extends for a further 45 chains to the boundary of the P.A. The exact width of this trough-shaped basin has not been ascertained.

On the "E" line of bores, the seams have been proved over 22 chains, on "B" line over 45 chains and on "A" line over 45 chains. It is reasonable to assume that there will be up to a 20 chain increase in these widths with closer boring.

Typical of the coal measures elsewhere at Collie, the larger coal seams are consistent in thickness, while the smaller seams (under three feet) vary greatly. The sediments between the seams are so variable in type that they are of no use for correlation purposes. In Table I is shown the suggested correlation for the seams encountered during the drilling on this portion of the P.A.

No. 2 seam is consistent over the possible mining area (see Plate XI, Fig. 1). It decreases in thickness on the south-west and south side, where bores A4, 1a and B6 disclosed 5ft., 4ft., and 5ft. 6in. respectively. However, seven bores to the north-west all disclosed a thickness of between 6ft. and 6ft. 6in. The average thickness of this seam in all bore intersections is 5ft. 10in. There is always a black shale roof on this seam, while it rests on a black or grey shale floor. The No. 3 seam is at an average of 30 feet below No. 2 seam.

No. 3 seam is also consistent over the possible mining area (see Plate XI, Fig. 2). This seam shows no general trend in variation of thickness, which is from 5ft. 6in. to 6ft. 9in., and the average is 5ft. 11in. (omitting bore A8 which was lost when three feet into this seam). It usually has a black shale roof, but three bores Z1, B8 and E1 disclosed a sandstone roof. Shale is found below the seam except in bore A4. The No. 4 seam is found at an average of 12 feet below this seam.

The No. 4 seam is not as consistent as the seams mentioned above. Assuming the correlation propounded earlier to be correct, then this seam deteriorates into black shale in bores E1 and 1a. This seam has an average thickness of 6ft. 6in. and has a shale roof and floor throughout.

Since the dip of the seams is small (see Plate IX, Plate X, sections 1 to 3 and Plate XI structure contours) there will be no mining problems because of steep dips. However, mining engineers must consider carefully the practicability of extracting seams Nos. 3 and 4, since they are separated only by 12 feet of sediment. Because of the soft nature of sediments and the abundant supply of water therein, the problem of support must be considered carefully.

*"Blind Outcrop" is the term applied to the former outcrop of a coal seam which has since been covered by later deposits, in this instance lake beds.

QUALITY OF COAL SEAMS.

The quality of coal produced from the Premier Colliery, now closed, was comparable with the coal produced from the Collie Burn or middle horizon (namely, Wyvern, Griffin and the old Collie Burn Collieries) in the main Collie Basin. The low ash content was a characteristic feature of the coal from the Premier Colliery. The West Australian Government Railways supplies the following analyses for the last five years of the colliery's operation:—

Large Coal (over 1½in. screen)—Moisture, 23 per cent.; Ash, 2.35 per cent.; Calorific Value, 9,655 b.t.u.

Run-of-Mine Coal (70 per cent. large and 30 per cent. smalls)—Moisture, 23 per cent.; Ash, 3.75 per cent.; Calorific Value, 9,425 b.t.u.

The results of analyses of seams encountered on P.A. 53 during drilling are shown on Table II. They show that the coal conforms with the usual definition of Collie coal, namely, it is hydrous, non-caking, subbituminous coal deficient in volatile materials, but possessing good steaming properties. The moisture content in each analysis has been adjusted to 20 per cent., which is approximately the average moisture content of Collie coals. This was necessary because the samples were taken from percussion drillings by the following method: After intersecting the seam, all sludge taken from the hole while drilling through the seam was deposited in a drum, from which a washed sample of coal was taken.

The disadvantage of this method is that small, dirty bands (if any) in the seam are discarded and the resulting analysis will probably be better than the true analysis of the seam; in fact it can serve only as a guide.

Only analyses of workable seams, namely Nos. 2, 3 and 4, have been shown in Table II. Of these three seams the No. 3 seam has the highest average calorific value 9,676 b.t.u. and the lowest average ash content 3.59 per cent; however, No. 2 and 4 are nearly as good with an average calorific value of 9,616 and 9,612 and an average ash content of 3.96 and 4.04 per cent. respectively.

TABLE 2.

PROXIMATE ANALYSES OF COAL SEAMS ENCOUNTERED IN BORES ON P.A. 53.

Seam Number.	Bore Number.	Proximate Analysis.				Calorific Value B.t.u's.
		Moisture.	Ash.	Volatile Matter.	Fixed Carbon.	
		%	%	%	%	
*2	A6	20·00	3·95	....	....	9,719
2	1a	20·00	2·00	39·78	38·22	9,592
2	Z1	20·00	4·72	32·00	43·26	9,640
*2	B6	20·00	4·30	....	....	9,533
2	B8	20·00	3·79	34·02	42·21	9,520
2	B10	20·00	5·33	....	....	9,420
2	E1	20·00	3·63	29·37	47·00	9,890
Average for No. 2 Seam		20·00	3·96	33·79	42·67	9,616
*3	A6	20·00	3·69	....	....	9,741
3	1a	20·00	3·49	37·23	39·27	9,610
3	Z1	20·00	3·00	31·06	45·94	9,810
*3	B6	20·00	2·96	....	....	9,720
3	B8	20·00	4·17	34·00	41·84	9,390
3	B10	20·00	3·59	....	....	9,640
3	E1	20·00	4·80	29·12	46·08	9,560
3	E2	20·00	3·07	29·97	46·96	9,935
Average for No. 3 Seam		20·00	3·59	32·27	44·02	9,676
*4	A6	20·00	3·90	....	....	9,647
4	Z1	20·00	3·62	30·72	45·66	9,730
*4	B6	20·00	3·90	....	....	9,496
4	B8	20·00	4·97	33·66	47·35	9,390
4	B10	20·00	4·17	....	....	9,560
4	E2	20·00	3·68	29·28	47·04	9,850
Average for No. 4 Seam		20·00	4·04	31·22	47·02	9,612
3	C3	20·00	2·07	30·02	47·91	9,880

* Analysis by W.A. Government Railway Laboratory. All other analyses by the W.A. Chemical Laboratories.

The drilling in the south-west portion of the P.A., on the main Collie Basin, disclosed in Bore D6 the highest quality coal seam encountered at Collie. Unfortunately the seam was only three feet thick. The Government Chemical Laboratories' following report is of great interest:—

Proximate Analysis.		*Ultimate Analysis.*	
Percentage moisture	20·0	Carbon	76·1
Ash	7·26	Hydrogen	7·04
V.M.	39·22	Oxygen + Nitrogen	16·31
Fixed Carbon	33·52	Sulphur	0·50
	100·00		
Calorific Value	10,260	B.Th.U./lb.	
Dry Ash Free	14,110		

It is to be noted that the volatile matter content of the coal, its dry ash free calorific value and the per cent. hydrogen in the coal are higher than is normal for Collie coals. The W.A.G.R. Laboratories confirm the high figure for calorific value in an independent sample.

To elucidate the nature of the coal further, carbonisation assays were performed at 600° and 900°C which show tar and gas yields equal to that of good New South Wales gas-making coals with, however, absence of coking in the solid residue and a high CO_2 content in the gases which distinguish this coal as a high rank sub-bituminous coal similar to some found in New Zealand.

GRAY KING CARBONISATION ASSAY TESTS AT 600°C AND 900°C ON DRY COAL.

	At 600°C.		At 900°C.	
	Per 100 gms.	Per ton.	Per 100 gms.	Per ton.
Solid Residue	55·48	11·17 cwt.	51·68 g.	10·34 cwt.
Liquor	13·78	30·8 gal.	14·70 g.	32·9 gals.
Tar	25·0 g.	56·0 gal.	10·80 g.	24·2 gals.
Gas. Volume	11,480 ml.	4,110 c. ft.	33,470 mls.	12,150 c. ft.
C.V.B.Th.U/C.ft.	674		759	
Therms/ton	27·7		92·4	
Per cent. CO_2+ H_2S	18·5		8·8	

One other sample was obtained from bore D6: 1ft. 6in. of coal at 199ft. It was a normal Collie coal.

Proximate Analysis.

	Per cent.
Moisture (arbitrary)	20.0
Ash	6.24
V.M.	20.07
Fixed Carbon	44.69
	100.00
Calorific Value B.Th.U./lb. =	9,480
Dry Ash Free =	12,890

At present there is insufficient data with which to correlate this interesting seam, but the proposed drilling P.A. 54 may intersect this seam and make correlation possible. It probably belongs to the lower or Collie horizon of coal seams.

COAL RESERVES.

The coal reserves have been classified according to the system adopted for ore reserves by the United States Geological Survey, the Commonwealth Bureau of Mineral Resources and the Geological Survey of Western Australia, namely:—

Measured ore—is ore for which tonnage is computed from dimensions revealed in outcrops, trenches, workings and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling and measurements are so closely spaced and the geological character is defined so well that the size, shape and mineral content are well established. The computed tonnage and grade are judged to be accurate within limit which are stated, and no such limit is judged to differ from the computed tonnage or grade by more than 20 per cent.

Indicated ore—is one for which tonnage and grade are computed partly from specific measurements, samples, or production date and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to outline the ore completely or to establish its grade throughout.

Inferred ore—is ore for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition for which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence.

The coal seams have been blocked out in accordance with the above classification, the details of which are shown in Figs. 1, 2 and 3 of Plate XI. for seams Nos. 2, 3 and 4 respectively. It should be noted that the estimates given represent the total coal in the seams, based on the assumption that 30 cubic feet of coal weighs one ton. If it is possible to work the three seams successfully, 50 per cent. of the estimated tonnage available could be won by bord and pillar mining and 90 per cent if the pillars are extracted.

TABLE III.

COAL RESERVES ON P.A. 53.

Seam No.	Average Thickness.	Measured Tonnage.	Indicated Tonnage.	Inferred Tonnage.	Total
	ft. ins.				
2	5 10	2,460,000	1,380,000	1,320,000	5,160,000
3	5 11	2,880,000	1,290,000	1,340,000	5,510,000
4	6 6	1,775,000	1,980,000	1,275,000	5,030,000
2, 3 and 4	....	7,115,000	4,650,000	3,935,000	15,700,000

FUTURE DEVELOPMENT.

The results of the drilling programme which has been carried out on P.A. 53 suggests the following lines of future development:—

1. Planning the extraction of the coal to the north-east of Shotts, possibly preceded by some closer boring to determine the exact edges of the mineable area.

2. Shallow grid boring of the area in the vicinity of "E" bores, to determine the possibility of open-cut coal, and to obtain information of the exact position of the blind outcrop for future mining operations.

3. Scout drilling southwards from the line of "C" bores to determine if mineable coal seams occur.

4. Scout drilling to the south of the line of "D" bores on the main Collie Basin on P.A. 54 to test the continuity of the Collie and the Collie Burn horizons of coal seams.

REPORT OF A REPORTED GOLD FIND IN THE UPPER HELENA RIVER VALLEY, FOURTEEN MILES SOUTH OF BAKER'S HILL, WESTERN AUSTRALIA.

By J. H. Lord, B.Sc., F.G.S.

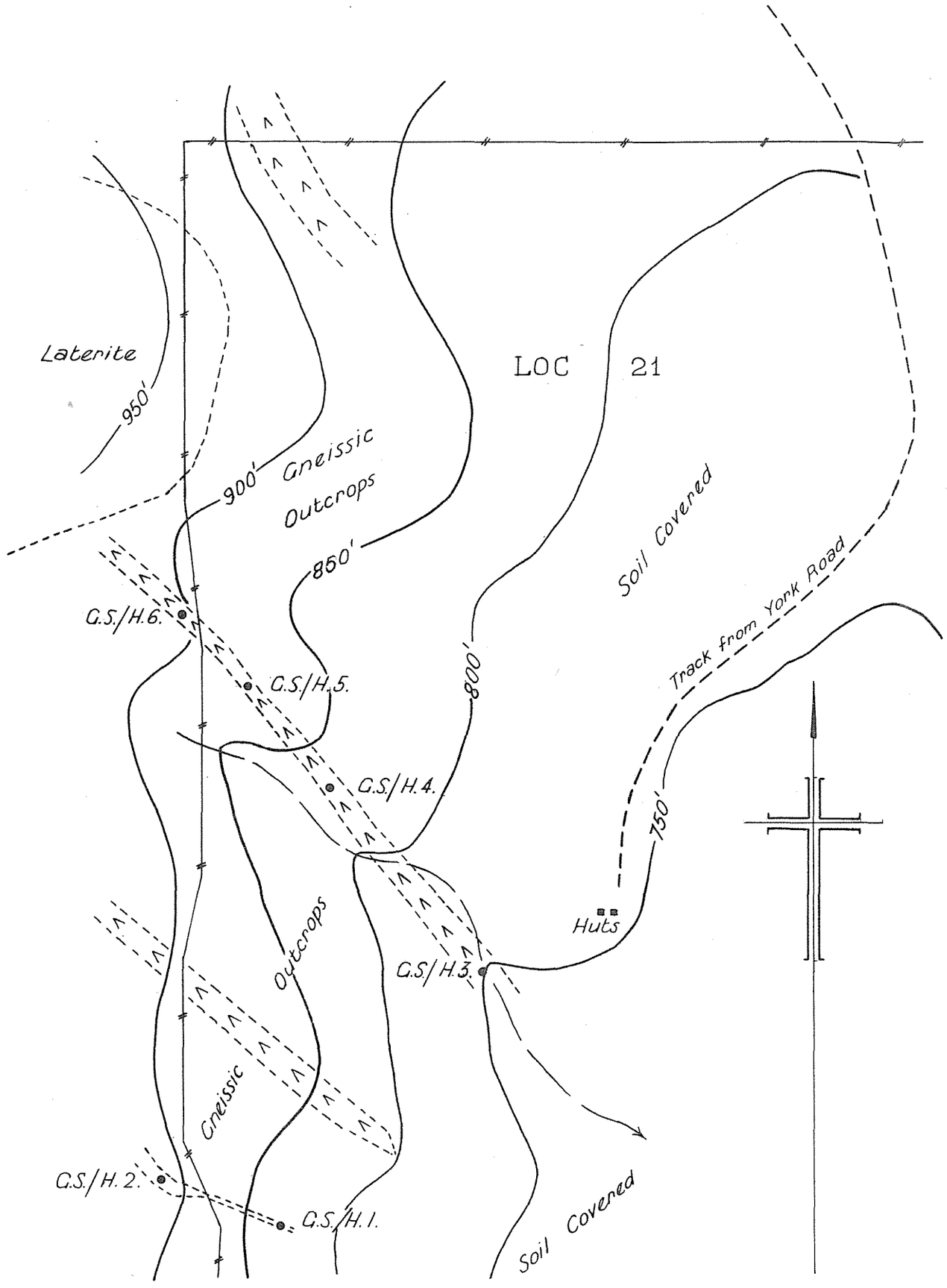
Locality.

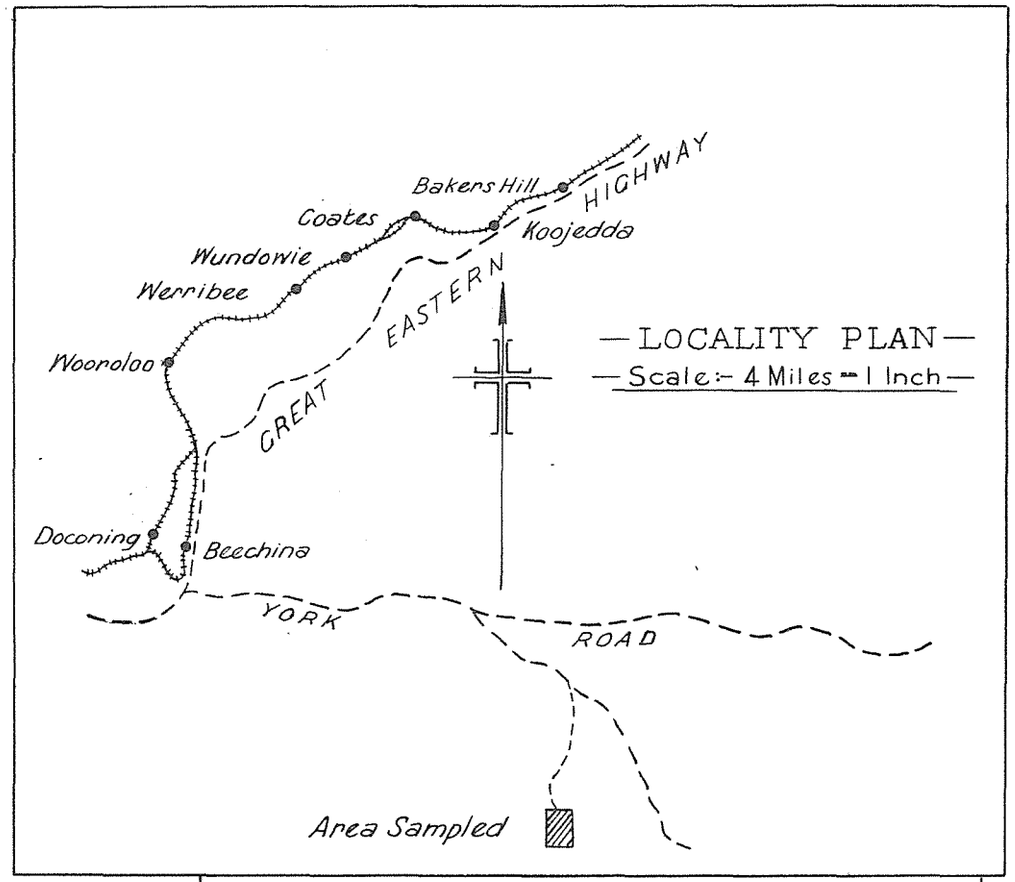
This gold find is situated on Lat. 31° 27′ S. and Long. 116° 27′ E. approximately. By leaving the Perth-York Road east of the 38 mile peg, and following a track in a general south-south-easterly direction for about 5½ miles on to Location 21, on the north side of Helena River, the area is reached (see Plate XII.—locality map).

General Information.

Dr. J. D. Dunn (dentist) was the first to prospect this area for gold early in 1948.

At the time of inspection (31st August, 1948), 15 prospecting areas had been pegged mainly along the eastern slope of a large north-south spur. However, no work, such as shafts, costeans, etc., had been done, and apparently all sampling carried out had been merely "grab samples" from surface rocks.





—LOCALITY PLAN—
—Scale:- 4 Miles = 1 Inch—

—LEGEND—

Approximate Geological Boundaries	- - - - - - -
" Contours(based on Army 1"-1mile)	—900'—
" Position of Samples	• G.S./H.1.
Fences	———
Tracks	- - - - -
Streams	~~~→
Greenstone Dykes	^ ^

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SKETCH PLAN

— Showing Position of Samples taken on —
— LOCATION 21. Upper HELENA RIVER —
Lat. 31° 37' S. Long. 116° 27' E.
— With some Geology shown —
— Scale :— 5 Chains = 1 Inch —

Compass and Pacing Survey by J. H. Lord. B.Sc, F.G.S.
August 1948.

A sketch plan (Plate XII) of the area was made by compass and pacing; the approximate position of samples was fixed.

Geology.

The general geology of this area is typical of the Darling Range, consisting of large granitic and gneissic outcrops cut by dolerite dykes.

In the locality where the alleged gold-bearing samples were taken, are large outcrops of gneiss, which was probably formed by the granitisation of old sediments. The gneiss is cut by several dolerite dykes which are nearly parallel with a general north-west strike. In the dykes, the dolerite varies from unaltered dolerite through various stages to uralitised dolerite, and in places there is some mineralisation in the form of pyrite. In these dykes the gold values are alleged to have been found.

Sampling.

As there are no shafts, costeans or workings of any description, the samples were taken across the dykes by taking chips off the outcropping dolerite where mineralisation was showing.

Six samples were taken at the positions shown on the plan. A seventh sample was taken from a prospecting area to the north-east of the plan.

All these samples were assayed for gold and silver by the W.A. Government Chemical Laboratories. The results in all cases were nil.

Conclusion.

Mineralisation exists in places in the dolerite dykes as pyrite, which suggests that an occasional trace of gold may be found. However, there are no indications, nor are there any future prospects, of payable quantities of gold being found in the area examined.

REPORT ON KYANITE DEPOSITS TO THE NORTH OF YANMAH, NELSON DISTRICT, SOUTH-WEST DIVISION.

By J. H. Lord, B.S.c., F.G.S.

GENERAL INFORMATION.

This investigation was carried out in September, 1948, as a result of a request by the Midland Mining Co. Ltd, for financial and technical assistance in their search for kyanite on mineral claims situated to the north of Yanmah, in the Nelson District, South-West Division of Western Australia (approximate Latitude 34° 07′ S., Longitude 116° 00′ E.).

The mineral claims are in three groups:—

(a) Those on the Manjimup Brook including M.C's. 287H, 367H, 373H, 382H, 384H, 385H, 386H, and 387H covering 796 acres. The first three are held by J. H. Smith, while the Midland Mining Co. Ltd. holds the remainder.

(b) Those approximately three miles north-north-east of Group A on the Donnelly River, including M.C's. 383H, 388H, 389H and 390H, covering 586 acres, all held by the Midland Mining Co. Ltd., while prospecting area 864H is in this group and held by F A. Skeet.

(c) Those approximately two miles north of Group B on the east and north-east side of Ross's Swamp (sometimes referred to as Smithfield), of which the Midland Mining Co. Ltd. holds M.C. 381H of 300 acres and H. D. Payne holds M.C's. 368H and 369H of 97½ acres.

LITERATURE.

The following reports have been published in the Annual Reports of Geological Survey of Western Australia.

1939. Ellis H. A.: Report on a Kyanite Deposit, 10 miles S.W. of Bridgetown (actually Ross's Swamp).

1944, Forman, F. G.: A Kyanite Deposit near Yanmah, Nelson District, South-west Division.

1947, Ellis, H. A.: The Yanmah Kyanite Deposit, Mineral Claim 287H.

A report entitled "Report on Yanmah Kyanite Deposit" by R. S. Matheson, which was compiled for a private company, is also in existence.

Constant reference will be made to the above reports and it is taken for granted that they have been consulted.

PRODUCTION.

Apparently some of the kyanite produced in early years was not reported to the Mines Department; however, the tonnage involved would be small.

Ellis (1939) reports that approximately 50 tons had recently been sold from Ross's Swamp, presumably from M.C. 369H. However, the only kyanite production reported to the Mines Department prior to 1946, was in 1938, when 19.19 tons valued at £100 were extracted.

The following tables show the production reported to the Mines Department:—

ROSS'S SWAMP GROUP.

Year.	Mineral Claim.	Tonnage.	Value (£A).
1938	369H?	19·19	100
1947	368H	35·00	185
TOTAL	....	64·19	285

MANJIMUP BROOK GROUP.

Year.	Mineral Claim.	Tonnage.	Value (£A).
1946	287H, 267H,	139·74	568
1947	373H, 386H	2,896·00	14,412
1948 (to end of September)	do.	1,125·00	6,516
TOTAL	....	4,160·74	31,496

There are no production returns from the Donnelly River group of Mineral Claims. Small quantities of Kyanite are alleged to have been produced from this group and other scattered localities.

GEOLOGY.

The mode of occurrence of the kyanite on the Manjimup Brook Group of Mineral Claims is described by Ellis (1947) and Matheson (1947), while the occurrence at Ross's Swamp is fully described by Ellis (1939). Other reported deposits of kyanite in this locality have a similar mode of occurrence.

Interest has now moved from the eluvial kyanite to the "in situ" deposits, and a few remarks regarding the mode of origin of such deposits will be of assistance.

Dr. J. A. Dunn (until recently Director of the Geological Survey of India, but now with the Commonwealth Bureau of Mineral Resources) sets out two main modes of origin for the type of kyanite considered considered here "(a) as segregations or nodules of massive kyanite in mica-schists (generally aluminous); and (b) parts of kyanite-quartz-rocks in which there has been a concentration of kyanite during metamorphism, or veins of course-bladed kyanite in kyanite-quartz-rock."

The Yanmah deposits have probably the former origin. On weathering, these segregations or nodules harden considerably and take on a smooth rounded appearance easily, which suggests much water erosion, but actually the kyanite boulders are usually found in the vicinity of their site of origin. This appears to be so at Yanmah because of the lack of sorting of the boulders.

MINING OPERATIONS

Eluvial Kyanite.—The production and prospecting for eluvial boulders of kyanite have been abandoned as uneconomical at the existing price of kyanite. Originally, boulders were located and mined by hand methods but later a bulldozer was used.

This eluvial material was the source of nearly all kyanite produced. The main area worked was on M.C.287H, as shown on Plate XII. fig. 1, while other boulders were produced from M.C.386H, where the open-cut and shaft is now situated, and from the south side of the Manjimup Brook in M.C.367H. These bulldozed areas have been so turned over and uprooted that it is now impossible to ascertain if there were any particular lines of boulders; nor is it possible to fix where the main concentration of boulders was found.

Some bulldozing was attempted on the Ross's Swamp group of Mineral Claims, but the laterite encountered proved too difficult to remove for the amount of kyanite recovered. At other scattered localities, attempts have been made to find the boulders by bulldozing, but all have been abandoned, apparently due to the scarcity of the kyanite.

"In Situ" Kyanite.—With eluvial boulders of kyanite becoming scarce and a resultant rise in production costs, the attention of the Midland Mining Co. Ltd., has turned entirely to the possible production of "in situ" kyanite.

The first attempt to mine "in situ" kyanite was made on M.C.287H (see Ellis, 1947, and Plate XIII., fig. 1 of this report). This site is now partially filled with overburden, which has been bulldozed into the small open-cut previously made; but it is reasonable to assume that the kyanite has cut out. A shaft, which was sunk nearby, failed to find any continuation at depth of this kyanite by cross-cutting.

More recently, rock which was considered to be "in situ" kyanite was encountered on M.C.386H, when it was being bulldozed for eluvial boulders. Work has been carried out on this suspected outcrop and now a shaft and a cross-cut have intersected a kyanite lode approximately 9 feet wide, as shown in Plate XIII., fig. 2. At present the cross-cut is being extended to another smaller shaft, in order that the water, which is hampering mining operations, can be pumped out more readily. This lode was sampled where exposed in the cross-cut, at positions indicated on Plate XIII., fig. 2, the results, as obtained by the W.A. Government Chemical Laboratories, being:—

Lab. No.	Mark.	Result of Examination.
	From M.C. 386H at Yanmah.	
6544	GS/Y1	Kyanite 92 per cent. approx.
6545	GS/Y2	Kyanite 95 per cent. approx.
5646	GS/Y3	Kyanite 96 per cent. approx.
6547	GS/Y4	Kyanite 96 per cent. approx.
6548	GS/Y5	Kyanite 94 per cent. approx.
6549	GS/Y6	Kyanite *Nil*
6550	GS/Y7	Kyanite *Nil*
6551	GS/Y8	Kyanite 1 per cent. approx.

Analysis of composite sample representing Lab. Nos. 6544-6548/48.

	On sample dried at 105°C per cent.
SiO_2	35.33
Al_2O_3	62.66
Fe_2O_3	1.59
TiO_2	.40
MgO	.17
CaO	.12
Na_2O	.07
K_2O	trace.
	100.34

It is considered that this lode warrants further prospecting, but caution must be exercised in suggesting any optimistic results, because of the known lenticular mode of occurrence of kyanite.

The following information regarding quality and costs has been supplied by the Midland Mining Co. Ltd.

The kyanite, for which this Company has a ready market, should conform to the following standard analysis:—

Al_2O_3—minimum 55 per cent.
TiO_2—maximum 3.5 per cent.
Fe_2O_3—maximum 1.5 per cent.

The value of such kyanite is £A8 per ton F.O.B., Fremantle with an additional 4s. per ton for each 1 per cent. Al_2O_3 above 55 per cent., while kyanite not up to the above analysis can be quitted at a lower price.

Estimated cost per ton F.O.B. Fremantle is—

	£	s.	d.
Mining cost	2	0	0
Road transport to Manjimup		9	0
Railage to Fremantle		19	0
Shipping, wharfage, etc.		17	6
Miscellaneous extras		4	6
	4	10	0

Without allowing for the sale of any kyanite produced the cost of prospecting is estimated as follows:—

	per foot. £	s.	d.
Shaft sinking	5	0	0
Winzing	4	0	0
Driving and cross-cutting	2	0	0

Except for the kyanite, the ground so far encountered is decomposed schist, which requires close timbering.

MINING EQUIPMENT.

The equipment, listed below, which has been installed at the site by the Midland Mining Co. Ltd., is in good condition and is being well maintenanced by a capable manager. It is considered suitable and sufficient for carrying out any prospecting programme.

1 Compressor—Broome and Wade—60 cu. ft/min. driven by 20 H.P. Lister Diesel engine.
1 Compressor—Broome and Wade—160 cu. ft/min. driven by 38 H.P. Lister Diesel engine.
2 Air Receivers—(i) 6 feet by 2 feet diameter; (ii) 5 feet by 1 foot diameter.
4 Cooling tanks—sufficient for continuous operation.
5 Pumps—Ingersoll-Rand Sump Pump, nominal capacity 7,500 gallons per hour.
1 Consolidated Pneumatic Sump Pump, nominal capacity 7,500 gallons per hour.
2 Centrifugal Pumps, nominal capacity 5,000 gallons per hour.
1 Double action pump, capacity 500 gallons per hour.
2 Holman air winches 5 p.p.
3 Rock drills (Sinkers).
6 End tipping trucks.
600 feet Rails 14 lb.
2 McDonald Diesel Engines 12 H.P.
1 Chev. truck 30 cwt.
Small blacksmith's shop with a supply of steel and minor spares.
Ample supply of timber and water.

RECOMMENDATIONS.

Under existing conditions, it is not considered advisable to prospect for further eluvial deposits, as production from this source is uneconomical as a company proposition.

The lode disclosed on M.C. 368H warrants further prospecting, but until this lode is proven to be of a mineable size, prospecting for further lodes cannot be recommended.

Financial assistance for the following prospecting programme is recommended:—To sink the existing shaft 30 feet and to cross-cut to the lode. (This is necessary because at present the lode is too close to the shaft to permit work on it); to winze on the lode for 50 feet and then to drive in both directions on the lode.

Estimate of the cost of this programme based on costs supplied by Midland Mining Co. Ltd., is:—

		£
Shaft sinking—	30 feet at £5 per foot	150
Cross-cutting—	25 feet at £2 per foot	50
Winzing—	50 feet at £4 per foot	200
Driving—	200 feet at £2 per foot	400
		800

If the above programme proves the kyanite lode to be continuous throughout, the quantity of kyanite proven should place the Company in a position to be able to carry out further development themselves, in conjunction with the extraction of this proven kyanite.

If the prospecting programme proves that the kyanite is only a small lens, further assisted development could not be recommended.

REPORT ON THE EXAMINATION FOR BRICK-MAKING MATERIALS OF THE CARDUP AREA—COCKBURN SOUND, SOUTH-WEST DIVISION.

By J. H. Lord, B.Sc., F.G.S.

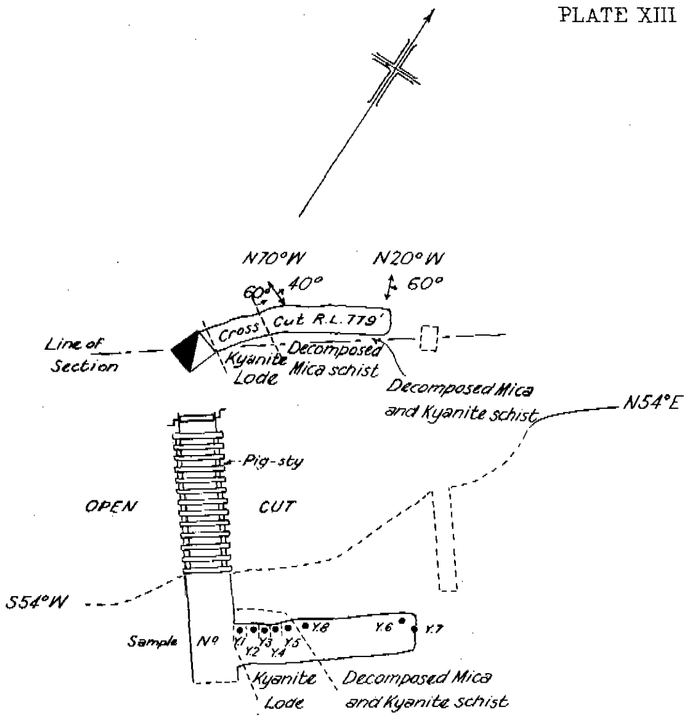
GENERAL INFORMATION.

This investigation was carried out to ascertain the extent of the brick-making material on the property owned by Millars' Timber and Trading Company Limited at Cardup, 25 miles south-south-east of Perth. This property includes the whole of Cockburn Sound Location 345 and portion of Cockburn Sound Locations 22, 24 521 and 721, South-West Division, as shown on Plate XIV. The total area is 184 acres.

PLATE XIII

Sample Results

Sample No	Percentage Pure Kyanite	
Y. 1.	92	Composite Sample
Y. 2.	95	$Si\ O_2$ 35·33%
Y. 3	96	$Al_2 O_3$ 62·66%
Y. 4.	96	$Fe_2 O_3$ 1·59%
Y. 5.	94	$Ti\ O_2$ 0·04%
Y. 6.	Nil	
Y. 7.	Nil	
Y. 8.	1	



SKETCH PLAN
— and —
SECTION
— of —
Workings on M.C. 386 H.
Scale 20 feet = 1 inch

LOC. 9624

850'
840'
830'
820'
810'
800'
790'
860'
870'

794' R.L. of Shaft collar
Height of Pigsty to Bridge 23'
792'
795'
Collar R.L. 806'
Bridge to Shaft
Engine Room
811'
Dump of Overburden
811'
810'
Assumed datum Road peg 800'

MANJIMUP BROOK

M.C. 386 H
M.C. 384 H
M.C. 373 H
M.C. 367 H
M.C. 287 H

N25°E
Max. depth 12'
Cutting Max. depth 4'
Line of shallow cutting
N20°E
Collar R.L. 858'
Area Bulldozed
Position of open-cut on an "in situ" deposit now filled
For
Elluvial
Kyanite

REFERENCE TO SIGNS

- Mineral Claim Boundaries
- Strike and dip of schistosity — N60°W 50°
- Strike of vertical schistosity — N60°W
- Dumps
- Open cuts
- Costeans
- Approximate boundary of area worked by bulldozers for elluvial Kyanite
- Tracks
- Creeks (non-perennial)
- Contours — 800'
- Assumed contours — 800'
- Shafts (Accessible)
- " (Inaccessible)

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PLANS
— OF —

YANMAH KYANITE WORKINGS

10 MILES W.N.W. OF PALGARUP SIDING

NELSON DISTRICT—SOUTH WEST DIVISION

Scale: 200 feet to an inch

200 100 0 200 400

Assumed datum 800 feet, at road peg on N.W. boundary of M.C. 386 H.
Surface Survey with plane table, and telescopic alidade.
Underground Survey with compass and chain, by J. H. Lord. B, Sc, F.G.S.

This property and some of the adjoining area was mapped, using a plane-table and telescopic alidade, during the latter portion of October and early November, 1948. The result of this mapping is the contoured geological plan as shown on Plate XIV., on a scale of 200 feet to an inch, and contours at 20-feet intervals. For east-west transverse sections have been drawn on a natural scale, at positions indicated on the plan. Due to the scale used, no attempt has been made to show the thickness of surface soil.

Although it is said that the main quarry has been in operation for over 50 years, the present company has owned it only since 1927, and has produced 72,901,000 bricks to November, 1948. The works were closed from 1942 to 1945, and since re-opening have not been working at full capacity, due to labour shortage.

GENERAL GEOLOGY.

The most important brick-making material in this area is shale, which occurs as a portion of the Cardup Series. As this Series and associated rocks have been described in detail by several writers (see Bibliography), only the description of their mode of occurrence in this Cardup area will be stated here. The Cardup Series has been correlated with both the Mosquito Creek Series (Archaeozoic) and the Nullagine Series (late Proterozoic), by various writers. It is considered, however, that eventually the Cardup Series will be proven to be a series deposited after the Mosquito Creek Series, but prior to the Nullagine Series.

This area is a portion of the foothills of the Darling Scarp, which consists of Archaeozoic granitic rocks. The Cardup Series rests, apparently uncomformably, against these granitic rocks on the Scarp, both being intruded by greenstone dykes and quartz reefs and veins. The lowest formation in this Cardup Series, which dips steeply to the west, is the furthest to the east, namely the Cardup sandstone, which is actually quartzite and quartz veins.

The actual contact between the Cardup sandstone and the older granitic rocks is difficult to locate exactly although it can be narrowed to a zone about 100 to 200 feet wide. In places it appears as if a greenstone sill may be intruded along this contact.

Above the Cardup sandstone lies the formation, termed the lower Cardup shale. This shale, which has been quarried at Armadale and Byford (State Brickworks), occurs in this area where mapping was extended eastwards, particularly as a pronounced north-south ridge on Lot 5 of Location 22. This shale is hard and more siliceous than the shale found further to the west. In many localities it could be termed a slate, while near the southern boundary of the Lot there is an outcrop of hard cherty shale (or slate), which has been tested several times for use as a honestone, but apparently it has not met the required specifications.

This lower shale formation is separated from the upper shale formation found further to the west, by a large greenstone sill. It extends northwards passing the State Brickworks on the west side, and is probably continuous to the Armadale quarry, where it is found again on the west side. Also intruding the granitic rocks and Cardup Series are dolerite dykes; however, in mapping no differentiation was made between the greenstone in the sill and the dykes, for it did not affect the object of the examination, nor was it of any economic importance, as both produce a good type of clay for brick-making.

The smaller dykes are difficult to follow, and it is found that the surface soil contains large boulders which are not "in situ". For example, the soil overlying the shale disclosed in the small quarry in the north-east portion of Location 24, contains greenstone boulders up to 18 inches in diameter. In consequence, soil-covered areas with greenstone boulders have to be considered with caution when suggesting the type of rock underlying them.

The upper Cardup shale formation is found to the west of the large greenstone sill. This shale formation was examined, drilled and described in 1947 by the writer on a portion of Location 521. It has now been mapped southwards through Millar's Cardup quarry for a distance of over 1¼ miles. To the north of Location 521 this formation has not been recognised, and its existence on the surface is due to the presence of a quartzose reef, which commences near the northern end of Lot 4 in Location 24, and outcrops almost continuously southwards through Millars' Cardup quarry on to Location 721. In places the reef stands 20 feet above the surface as a vertical wall 8 to 14 feet thick; as it has been resistant to erosion it has protected the shale. To the east the shale slopes away to the greenstone sill; in the west it slopes away and is covered by more recent sandstone deposits. On the south side of the Cardup Brook, the reef is displaced approximately 220 feet to the west, and along this displacement there may be a greenstone dyke extending westwards from the large sill, already described, to an intrusive sill which occurs in the upper shale on the west side of Millars' Cardup quarry. The exact north-south extent of this sill is rather obscure, but it does not extend northwards on to Location 521, and southwards it can only be traced definitely to the Cardup Brook.

The surface of the shale which slopes away to the west rather rapidly, as was shown in boring results on Location 521, is covered by beds which outcrop on the surface as ferruginous sandstone. In places this is lateritised to form "low-level" laterite, while below and where streams have cut a deep channel it occurs as a white clayey sandstone. This sandstone has in places, presumably near the base, large well rounded boulders and pebbles of quartz and quartzite and an occasional piece of shale. As it resembles other deposits occurring at Ridge Hill, as described by Prider (1946), and also the Lake Beds which cover the Collie coal measures, it is probably of Pliocene age. The boundary of the eastern extent of this sandstone is variable. Towards the southern end of the area examined, it extends eastwards covering all the upper shales to the greenstone sill, while to the far south the boundary retreats to the west again, leaving the upper shales exposed at the surface.

RESERVES OF BRICKMAKING MATERIALS.

Shale.

The existing quarry at Cardup can be worked northwards, on the same level, at least to the northern boundary of Location 345. This will provide 1¼ million cubic yards of shale, which, on the assumption that the present plant has a capacity of five million bricks per annum, would be sufficient shale for 125 years. The floor of the quarry would still be shale.

To the west of the greenstone, in Location 345, there is more shale, which would be worked northwards from Cardup Brook by removing (easily by sluicing) an overburden of clayey sandstone.

Further shale, without overburden, occurs on Lot 1 and 3 of Location 24 and extends southwards into Lot 2 of Location 22; but to work further southwards into Lot 8 of Location 22 would necessitate the removal of clayey sandstone overburden, the thickness of which would require testing before attempting to work it.

The harder shale of the State Brickworks type occurs extensively as the lower shales on Lot 5 of Location 22, and, providing it is suitable for brick-making, a quarry worked southwards from the 360-foot contour (see Plate XIV) should produce three million cubic yards of shale (i.e., 300 years supply for the existing plant).

Clay.

Lot 9 of Location 24 can be worked throughout for clay; good clay occurs also in a gully to the north-east of the north-east corner of Location 345. The clay pit to the west of the Cardup quarry can be worked further northwards. These three localities, assuming an average depth of five feet of clay, should produce at least 50,000 cubic yards of suitable clay.

A similar amount could probably be obtained from Lot 1 and 3 of Location 24 and Lots 4 and 6 of Location 22.

In all, this would provide approximately 30 years' supply of clay at the capacity of the existing plant.

Elsewhere on Millars' property small amounts of clay can be found, but there is no clay to the west where the ferruginous sandstone occurs.

Red Sand.

Small quantities of red sand are used in brick-making and can be obtained at the southern end of Lot 8 of Location 22.

CONCLUSIONS.

On the property of Millars' Timber and Trading Company at Cardup, there is an ample supply of shale, while the clay supply, although not scarce, is limited. As a result there is no necessity for any drilling to be done at present.

Large deposits of clay occur on portions of Locations 24 and 22, which are not owned by Millars.

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GEOLOGICAL RECONNAISSANCE OF THE FLY BROOK AND NANNUP COAL DEPOSITS—SOUTH-WEST DIVISION.

Approximate Latitude 34° 20′ S.

Approximate Longitude 115° 50′ E.

By J. H. Lord, B.Sc., F.G.S. and L. E. de la Hunty, B.Sc.

GENERAL INFORMATION.

Fly Brook is the southern-most tributary of the Donnelly River and enters the latter about five miles from its mouth. The Donnelly flows into the Southern Ocean about 30 miles east of Cape Leeuwin and, although perennial, it is not navigable—due to a sand bar across its mouth.

Access to the coal outcrop at Fly Brook was gained by travelling about seven miles from Pemberton along the Nannup road then about one mile south-west along a fire break then three miles in a more westerly direction.

The Nannup coal deposits occur four miles north of Nannup near the old Bibilup Siding. Bibilup and Fly Brook are approximately 40 miles apart.

The purpose of the investigation, which was made early in December, was to assess the economic importance of the Fly Brook and Nannup coal deposits.

PREVIOUS WORK.

The first geological work done in the area, on coal, was by H. P. Woodward—as described in his Annual General Report for 1888-9. A later account by the same geologist, appears in Geological Survey of Western Australia, Bulletin No. 65, 1915, "The Reputed Petroliferous Area of the Warren River District."

In his Annual Report for 1929, the Government Geologist, T. Blatchford, gave a little information on Fly Brook and mentioned results of boring at Bibilup.

Woodward's first report states that coal mining leases were first taken up at Fly Brook in 1888, although the existence of coal seams was known to local inhabitants for some time previous to this. A series of hand bores were put down but water continually caused the holes to cave. However, one of the bores passed through 20 feet of coal in sinking to a depth of 128 feet. This 20 feet was made up of 17 seams—the largest being 5ft. 4in. with a 6in. clay parting. Two smaller ones, 2ft. 4in. with a 3in. clay parting and 2ft. 3in. with a 2in. parting were encountered, while others up to 1ft. in thickness and separated from each other by thin shaly partings were also logged.

Woodward described the coal as "lignite of a highly lustrous variety, having almost the appearance of jet, but lacking its hardness, while the woody structure is clearly visible in some pieces." The average of three samples assayed in Melbourne and Adelaide, soon after drilling commenced, showed:

	%
Water	16.40
Volatile Matter	38.23
Fixed Carbon	43.52
Ash	1.85

Blatchford (1929) reports the following analyses:—

	Fly Brook.	Bibilup.	Collieburn
	%	%	%
Water	14·51	12·87	13·81
Volatile Matter	37·89	37·75	36·16
Fixed Carbon	44·89	43·84	45·19
Ash	2·71	5·54	4·84

The Government mineralogist and analyst stated that the Bibilup sample was "a valuable coal if there is any quantity available." This sample was submitted by J. Elias. He put down five handbores in the area and reported a 7ft. 6in. seam at 165 feet depth in one of them. However a Calyx bore put down to 531 feet in that area, at a later date, failed to locate any coal. This is significant.

GEOLOGY.

The area lies in the sunkland which is bordered to the east by the Darling Fault and to the west by the Dunsborough Fault. It is close to the Darling Scarp and is an area of numerous ridges rising 50 to 150 feet above the flats. The area is heavily timbered and has dense undergrowth.

Grits and clay beds (the latter often micaceous) overlaid by a bed of ferruginous conglomerate form the coal-bearing series. The conglomerate bed contains large water worn pebbles of quartz and quartzite and forms the junction between this series and more recent clays and sands on the surface.

The age of the coal measures is probably the same as that of the Donnybrook sandstone which is considered to be Triassic.

A bore put down at Warren River (1915, Woodward) went to 1,700 feet and the first 500 feet of strata corresponded to those at Fly Brook. A number of very thin coal seams, of no economic importance, were intersected in this bore.

Little can be seen of coal in the outcrop of the Fly Brook strata. Very thin bands of coal occur in a soft grey shale—these being above a thicker seam which gives rise to pieces of coal six inches thick being washed into the stream bed. Some of these pieces were collected and analysed. This analysis will thus be of a weathered sample.

At Bibilup the whole area is covered with a sandy soil.

Other outcrops of coal or lignite have been reported in the Blackwood River but none of these appears to be of sufficient thickness or quality to be considered of economic importance.

ANALYSIS.

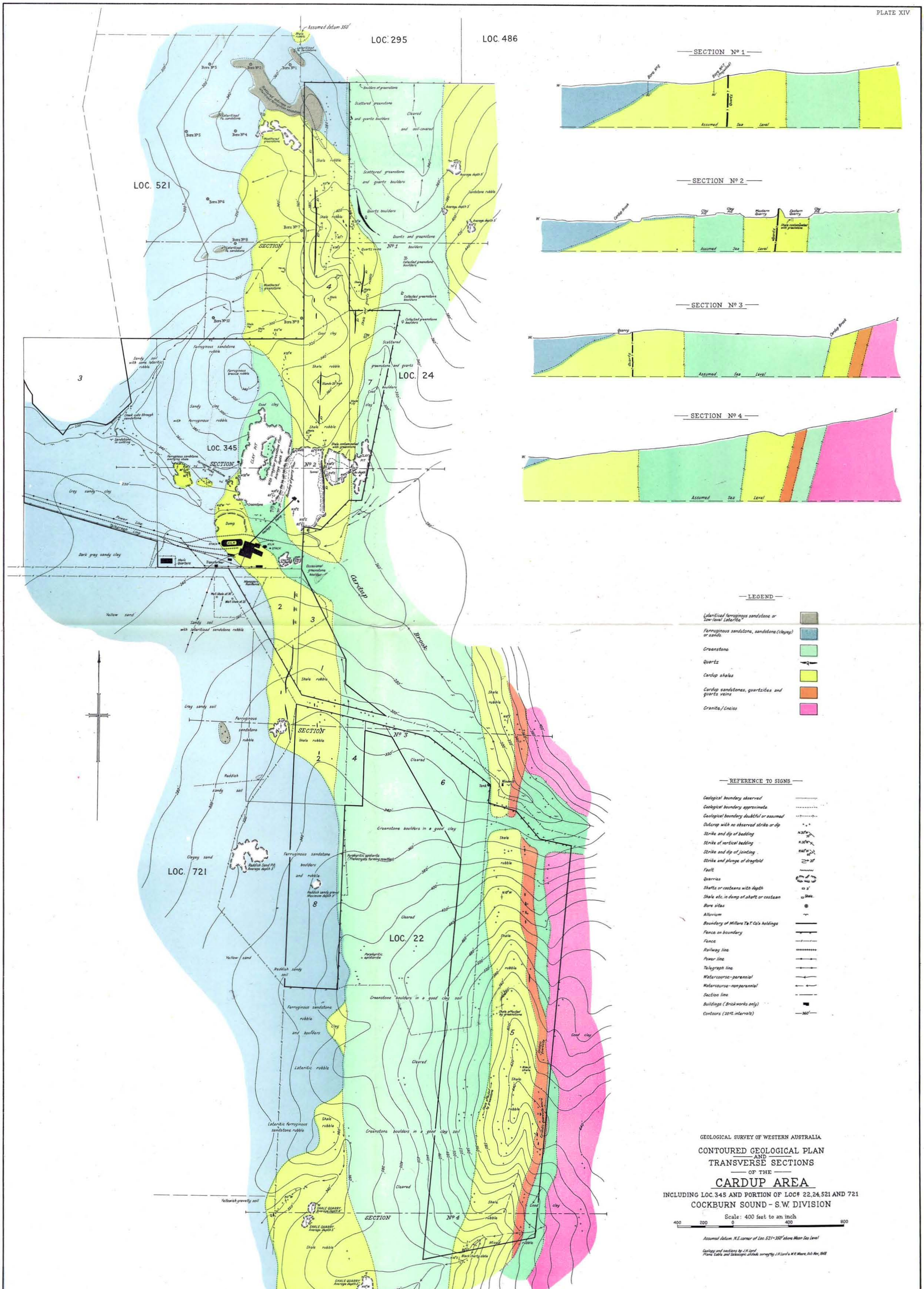
A sample of the coal outcropping in Fly Brook was taken, and a portion (about 25lbs.) was forwarded to the Government Chemical Laboratories for analysis, with the following result:—

Lab. No. 8397.—Has appearance of a true lignite. On natural plane of fission shows a woody grain.

Proximate Analysis—

	Per cent. as received.	Per cent. D.A.F.
Moisture	44.40	
Ash	3.80	
Volatile Matter ..	23.10	44.59
Fixed Carbon	28.70	
Calorific Value—		
B.Th.U./lb.	6,140	11,850
Sulphur, per cent. ..	0.53	
Ash (dry basis) ..	6.85	

Colour of ash—Mixture of white and brown particles.


SECTION Nº 1
SECTION Nº 2
SECTION Nº 3
SECTION Nº 4
LOC. 295
LOC. 486
LOC. 521
LOC. 24
LOC. 345
LOC. 721
LOC. 22
Cardup Brook
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
CONTOURED GEOLOGICAL PLAN
AND
TRANSVERSE SECTIONS
OF THE
CARDUP AREA
INCLUDING LOC. 345 AND PORTION OF LOCS 22, 24, 521 AND 721
COCKBURN SOUND - S.W. DIVISION
Scale: 400 feet to an inch
400 200 0 400 800
Assumed datum. N.E. corner of Loc. 521 = 350' above Mean Sea Level
Geology and sections by J.H. Lord
Plane table and telescopic alidade survey by J.H. Lord & W.R. Moore, Oct-Nov, 1948
LEGEND
Lateritised ferruginous sandstone or "Low-level Laterite"
Ferruginous sandstone, sandstone (clayey) or sands.
Greenstone
Quartz
Cardup shales
Cardup sandstones, quartzites and quartz veins
Granite / Gneiss
REFERENCE TO SIGNS
Geological boundary observed
Geological boundary approximate
Geological boundary doubtful or assumed
Outcrop with no observed strike or dip
Strike and dip of bedding
Strike of vertical bedding
Strike and dip of jointing
Strike and plunge of dragfold
Fault
Quarries
Shafts or costeans with depth
Shale etc. in dump of shaft or costean
Bore sites
Alluvium
Boundary of Millars T & T Co's holdings
Fence on boundary
Fence
Railway line
Power line
Telegraph line
Watercourse-perennial
Watercourse-non perennial
Section line
Buildings (Brickworks only)
Contours (20ft. intervals)

Gray King Low Temperature Carbonisation.

	As received. 100 gs.	Assay. Dry Basis (110°C.) Per ton.	100 gs.	Per ton.
Solid Residue	35·5 gs.	7·2 cwt.	63·7 gs.	13·0 cwt.
Liquor	51·8 gs.	116·0 gals.	13·3 gs.	30·0 gals.
Tar (S.G. = 1)	2·97 gs.	6·7 gals.	5·34 gs.	12·0 gals.
Gas	8,020 mls. at S.T.P.	2,860 c. ft. at S.T.P.	14,420 mls. at S.T.P.	5,140 c. ft. at S.T.P.
Therms	....	9·3	....	16·8

Examination of Gas—

CO_2 % 27.8

O_2 5.0

Calorific Value, B.Th.U./lb, 326.

Density, 9.06 x 10^{-4} gs/cc.

S.G., 0.77.

From this analysis it can be seen that the sample is only a poor lignite. The tar content is too low for briquetting purposes. The gas yield is low and of a poor quality, while it does not form a usable coke.

CONCLUSION.

With all the evidence considered there appears to be no justification for any detailed geological or geophysical work to be carried out in this area. If any such work were done, it would only prove an area of poor quality coal in thin seams. Since a deposit of this nature would be economically useless at present, detailed work would be simply a waste of money.

The most promising prospect would be the seven foot six inch seam reported at Bibilup, but since the calyx bore failed to locate it the existence of such a seam is still in doubt.

REPORT ON THE MANGANESE DEPOSIT ON TEMPORARY RESERVE 1225H NEAR LAVERTON, W.A.

Approximate Latitude 28° 47′ S.

Approximate Longitude 122° 30′ E.

By J. H. Lord, B.Sc., F.G.S. and L. E. de la Hunty, B.Sc.

GENERAL INFORMATION.

The north-west corner peg of the 300 acre Temporary Reserve 1225H for Manganese is approximately 22 chains south-east of the 8-Mile peg on the Euro-Jerusalem Road. The Reserve is 12 miles south-south-east of Laverton on a direct line, but is 14 miles by track. The track crosses three streams and a number of ironstone ridges, so is rather rough.

The purpose of the investigation, which was carried out on December 16th to 18th, 1948, inclusive, was to determine the extent of the deposit and to assess its economic importance.

A sketch plan was made of the locality of the deposit (see Plate XV) showing the geology and position of samples taken.

GEOLOGY.

The manganese deposit occurs on a low ridge striking slightly east of north. This ridge rises approximately 35 feet above the general level of the surrounding soil-covered country and is composed of a highly ferruginous variety of jaspilite with occasional bands of a more quartzose variety outcropping particularly along the south-east base of the ridge. The strike of the jaspilite varies from N. 10° E. to N. 20° E.

The manganese occurs as patches in the jaspilite and can be distinguished easily by its lustre. While the jaspilite shows a vitreous lustre, the manganese has a peculiar dull "bluish bloom." The manganese crops out as hard, massive boulders 18 inches in diameter ranging down to pebbles which, when broken, show a bright silvery lustre and some small vughs containing quartz. These boulders and pebbles constitute only 35 per cent of each patch—the remainder being a red clay soil. There are no workings on the Reserve but in two small holes, dug to a depth of 1½ft., the manganese shows a pisolitic structure and deteriorates to a soft, crumbly, brownish-black mineral.

There is one large patch of manganese covering approximately $\frac{3}{5}$ of an acre. Two other small patches mapped cover approximately 500 square yards, while elsewhere, occasional small patches can be found which are of no economic significance.

The majority of the world's manganese deposits occur as secondary enrichments at the surface and this deposit appears to be no exception.

SAMPLING RESULTS.

Due to absence of any workings on the deposit, most of the samples were taken on the surface. This method of sampling is not entirely satisfactory in a secondary deposit of this nature, since the manganese content will be higher at the surface. Two samples, LM1 and LM3 were taken about 1½ft. below the surface at positions as shown on the plan. The analyses of these two samples are highly significant. They show that the manganese content decreases rapidly with depth while the iron and silica percentages increase markedly.

All other samples were taken on the surface as shown. Samples LM7, LM8 and LM10 were taken to determine whether the jaspilite contained any manganese.

The following are the results of analyses carried out by the Government Chemical Laboratories on the samples collected.

Sample.	Metallic Manganese Mn.	Metallic Iron Fe.	Metallic Titanium Ti.	Silica SiO_2.
LM1	17·34	30·71	0·10	9·10
LM2	17·27	31·30	0·16	11·14
LM3	42·75	15·29	0·02	1·49
LM4	46·48	10·98	0·02	1·80
LM5	37·80	20·70	0·02	1·82
LM6	37·13	19·92	0·02	2·51
LM9	52·90	3·45	trace	0·88
LM11	36·16	22·44	0·02	1·64
LM8	Trace only of manganese present.			
LM7	Manganese is present in too small amounts to identify the mineral form in which it occurs.			
LM10				

The main manganese minerals present are the oxides polianite and psilomelane.

CONCLUSIONS.

The total area of manganese is approximately 3,700 square yards and it is of interest to note (see plan) that half of this is outside the Reserve.

The average manganese content of the surface samples is 42.2 per cent. while the depth sample with 17.3 per cent. lowers this average to 29.8 per cent. for only an 18in. depth of working. The average iron content in the same way increases to 23.5 per cent.

The Broken Hill Proprietary Coy. Ltd., are buyers of manganese ore in Australia. Their current procedure is "to investigate offers as received, and arrange orders to mutual satisfaction, having due regard to grade and location of the deposit."

Quotations are usually made for 48 per cent, Mn with a bonus or penalty of 2s. per unit above or below 48 per cent., a penalty of 3s. per unit from 45 per cent. to 40 per cent. Mn and subject to the following deductions for impurities:

For each 1 per cent. Silica above 8 per cent.—1s. 6d. per ton.

For each 1 per cent. Iron above 8.5 per cent.—3s. 6d. per ton.

For each 0.01 per cent. Phosphorous above 0.18 per cent.—9d. per ton.

An average of the analyses made on the surface samples is: Manganese 42.2 per cent., Iron 15.5 per cent., Silica 6.1 per cent. Assuming these values persist for 6in. below the surface, some 650 tons of ore would be available (9 cu. ft./ton). The penalty rating would be 14s. 6d. per ton for Mn, £1 4s. 6d. per ton for Iron; that is a total of £1 18s. 6d. per ton.

From the values of the two samples at 18 inches depth it can be seen that even 6in. at the above values is probably an over-estimate. The remainder of the deposit is definitely unsaleable.

REPORT ON DEPOSITS CONTAINING CONCENTRATIONS OF HEAVY MINERALS ON D.C. 20H, NEAR DENMARK, WESTERN AUSTRALIA.

Approximate latitude 35° 1′ S.

Approximate longitude 117° 11′ E.

By W. Johnson, B.Sc. (Hons.), Geological Survey of W.A.

Locality.—Dredging Claim 20_H has its datum peg approximately 750 yards on a bearing 284° from the south-west corner peg of Plantagenet Location 2238, and is approximately 6½ miles on a bearing of 240° form the town of Denmark. The examination was made on April 28, 1948.

Access.—The Claim is reached by a rough track which leaves the main Denmark-Nornalup road five miles west of Denmark and one quarter mile east of Mt. Hallowell Siding on the Denmark-Nornalup railway. The distance from main road to Claim is three miles. Denmark is reached by rail or excellent road via Albany.

Geology and Topography.—The basement rock underlying the surrounding country is a coarse-grained porphyritic gneiss with augen structure. The phenocrysts are crystals of felspar, ranging up to 5 cms. long and 2 cms. wide. The gneiss has been intruded by dolerite dykes transverse to the strike of gneissosity.

The gneiss and dolerite in the vicinity of the Claim are overlain by ancient beach deposits, lignite, soft ferruginous sandstone, black and brown clays and dune sands.

On the coast in the vicinity of the Claim, the gneiss outcrops in low, rounded masses, reaching to 30 or 40 feet above sea level but on the average 10 feet above sea level. The gneiss has been eroded in basins, and in these basins the sandstones, lignites, and beach sands have been deposited. This series has been covered in turn by sand dunes, which, on the coast line, reach to 50 feet above sea level.

About one half mile north-west of the datum peg of D.C. 20_H there is a line of fixed sand dunes parallel to the coast and 100 to 150 feet high. This line ends to the east against some granite tors about 200 feet above sea level. Further north, about one and a half miles from the coast, a line of hills, composed of gneiss and running east and west, reaches a height of 500 feet to 600 feet. North of the fixed inland dunes the sand is piled up against this ridge of gneiss. Between the inland and coastal dunes there is a small sand plain containing several small lakes and marshes, in which peat is forming.

The area is drained by small creeks, originating in springs at the base of the inland dunes and hills of gneiss. Only one (see sketch map) contains potable water. The others contain too much peaty matter, and the water is brown in colour.

The Black Sand Deposits.—These are of two types:—

1. Fossil beaches.
2. Existing beaches.

Type 1.—The 'fossil' beaches are two in number, and outcrop in low cliffs on the edge of existing beaches. The two beaches are each overlain by at least 20 feet of sand and peat. They are in two basins separated by a 'bar' of gneiss, as shown in the accompanying sketch map. The lateral extent of the fossil beaches could not be determined, owing to the depth of the overburden and the saturation of it by water. Both beaches lie on decomposed gneiss. The source of the heavy minerals is probably the country gneiss with a contribution of ilmenite from the dolerite dyke.

Some dimensions are given below. The volumes and weights are given to show how much tonnage would be available if the deposit continued under the overburden with the measured length and average thickness. The conversion factor used is 14 cubic feet to one long ton, derived from an average specific gravity determination of 4.07, and a porosity determination by a method by Milner.*

Beach.	Length.	Average thickness.	Volume at depth, 100 ft.	Weight.	Volume at depth, 500 ft.	Weight.	Volume at depth, 1,000 ft.	Weight.
	Feet.	Feet.	cub. ft.	Long tons.	cub. ft.	Tons.	cub. ft.	Tons.
A	76	2	15,200	1,085.7	76,000	5,428	152,000	10,857
B, west part	60	25	15,000	1,071.5	75,000	5,357	150,000	10,715
B, east part	90	1	9,000	642.8	45,000	3,214	90,000	6,428
Total	....	....	39,200	2,799.9	196,000	13,999	392,000	27,999

Type 2.—The existing beaches, at the date of examination, had only a shallow depth of sand covering a wave cut platform in decomposed gneiss. The concentrations of heavy minerals of economic importance were confined to three beaches. Two of these fronted fossil beaches A and B, and the third was farther east. All were measured by pacing and were roughly sampled. The geographical limits of concentration of black mineral sand along the coast are—to the west, a point 32 chains on a bearing 255° from datum peg D.C. 20_H, to the east, a point 8 chains on a bearing 255° from datum peg D.C. 20_H. The concentration of black sand continues below water level, and it is considered that considerable replacement of any material removed from the beaches would take place. The source of the black sands on the existing beaches is the gneiss, sand dunes (known to contain some heavy minerals), fossil beaches, and the dolerite dyke.

Rough estimates of volume and tonnage available on April 28, 1948, are given below.

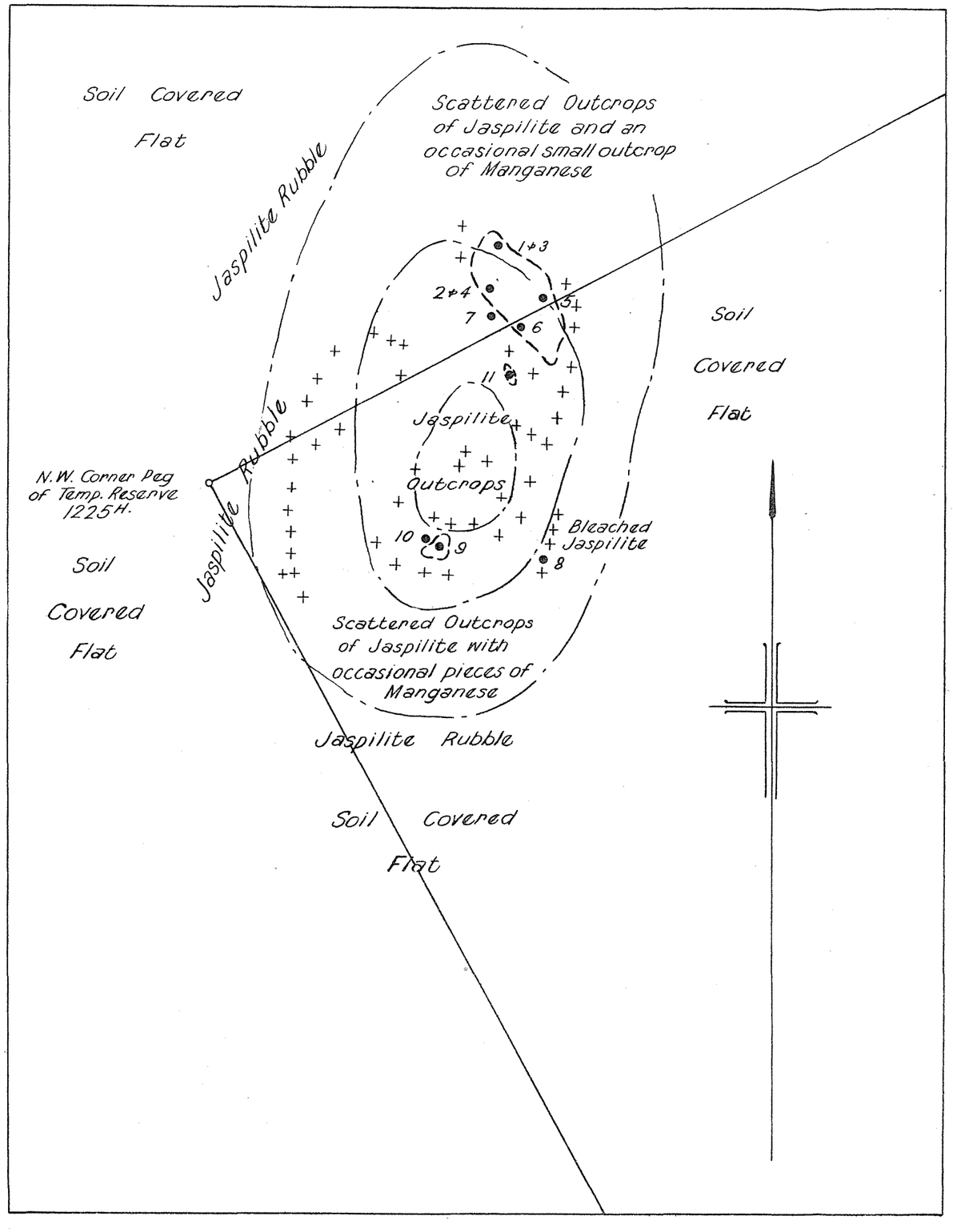
Beach.	Length. Feet.	Average width. Feet.	Average depth. Feet.	Volume. Cub. ft.	Tonnage. Long Tons
AB	170	40	1	6,800	425·00
BB	140	30	1	4,200	262·5
CB	250	30	1	7,500	468·75
Totals	....	....	....	18,500	1,156·2

Conversion factor, 16 cubic feet to the long ton.

Samples.

Rough average samples were taken of all deposits. The samples were analysed by the Government Chemical Laboratories. Results are given in a separate table.

* Milner, H. B., Sedimentary Petrography, 3rd Edition, p. 209.



REFERENCE TO SIGNS

Position and number of sample — 3

Outcrops — + +

Boundary of Manganese outcrops

Form lines

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL SKETCH PLAN

OF A PORTION OF

TEMPORARY RESERVE 1225H

FOR MANGANESE

12 MILES S.S.E. OF LAVERTON

MT. MARGARET GOLDFIELD W.A.

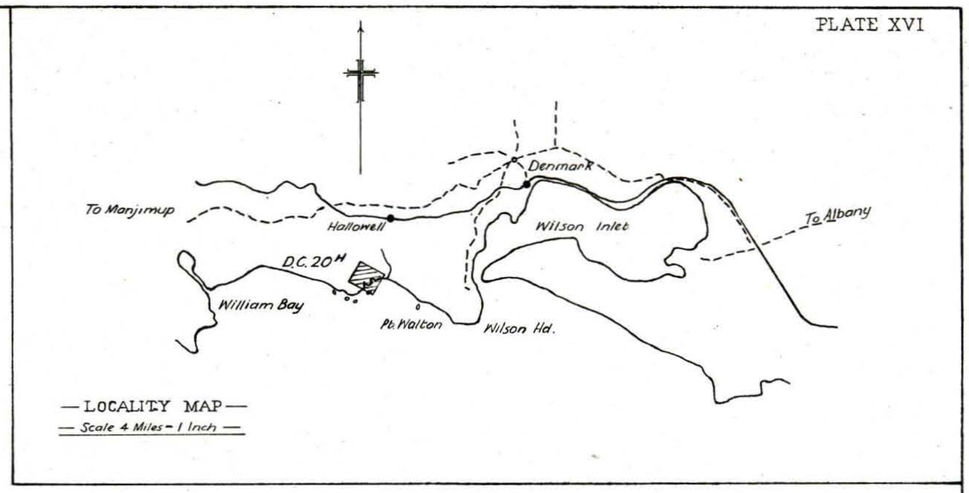
SHOWING POSITION OF SAMPLES

Scale: 4 chains to an inch

4 3 2 1 0 5 10

Geology, sampling and surveying by J.H. Lord. B.Sc., F.G.S. and L.E. de la Hunty B.Sc. December 1948.

PLATE XVI



—LOCALITY MAP—
— Scale 4 Miles = 1 Inch —

Tors of Gneiss with sand piled against them. Sand slopes fixed by vegetation

Marsh and Sand Plain
covered by Thick Scrub
18 inches to 2 Feet high

30°
5000

Line of Fixed Dunes
100' to 150' high

120°
6000

Main Road from Track

Springs

Landslip

Ilmenite Garnet in Auger hole

Creek Bed contains small concentrations of Black Mineral Sands

D.C. 20H

Clear water creek flowing 15000 gals. an hour 28/4/48

FIXED COASTAL DUNES UP TO 50' HIGH

Fossil Beach B West Part } Overlain by Peat and Sand

Horizontal Beds of Peat and Soft Brown Sandstone

Cliff 10' High

Cliff 15' High

N 40° W

Fossil Beach B East Part

Beach CB

Morgans Camp

Cn

Beach BB

Dolerite Dyke

East Limit of Black Mineral Sand Concentration

Datum Peg DC 20H
750 yds. on bearing 284° from S.W. corner of Plantagenet Loc. 2238

Fossil Beach A N17°E

Waterfall over Cliff 10' high

Beach AB

West Limit of Black Mineral Sand Concentration

N25°E

6000
300°

5000
210°

—REFERENCE TO SIGNS—

- Sand dunes, peat, lignite, soft ferruginous substances etc.
- Beaches with commercial concentrations black mineral sands
- Beaches with small concentrations black mineral sands
- Gneiss
- Dolerite
- Fossil Beaches
- Strike of Vertical Schistosity — N40°W
- Strike of Vertical Foliation in Gneissosity — N45°W
- Geological boundary observed .....
- " " doubtful or assumed ---?---
- " " approximate -----
- Tracks ----
- Creeks
- Breakaway
- Approximate Waveline 29-4-48

—GEOLOGICAL SURVEY OF WESTERN AUSTRALIA—

—GEOLOGICAL SKETCH MAP—

— OF —

D. C. 20H

COMMON RESERVE ↑12264
PLANTAGENET DIST.
APPROX. 7 MILES S.W. OF DENMARK

— Scale: 4 Chains to an inch —

— Based on pace and compass traverse by M. Johnson 29-4-1948. —

B.E.D.

Conclusion.

1. The amount of black sand available on the existing beaches at April 28, 1948, was too small to warrant exploitation on a large scale.
2. This amount may increase seasonally.
3. The amount available in the "fossil" beaches is not calculable from available knowledge. Drilling with casing would be necessary to determine the amount in these deposits. The amount would have to be large to warrant removal of the thick overburden. Since all beach deposits are lenticular, it is probable that the fossil beaches on D.C. 20H are too small to warrant large scale exploitation.

SAMPLING RESULTS—ANALYSES BY THE GOVERNMENT CHEMICAL LABORATORIES.

BEACHES.

	Fossil Beach, A.	Existing Beach, AB.		Fossil Beach, B.		Existing Beach, BB.	Existing Beach, CB.	
		West Half.	East Half.	West Half.	East Half.		West Half.	East Half.
Sample No.	D1	D2	D3	D4	D5	D6	D7	D8
Chemical Laboratory No.	3158	3159	3160	3161	3162	3163	3164	3165
	APPROXIMATE PERCENTAGES BY WEIGHT.							
Minerals—								
Ilmenite	41	34	33	34	15	33	34	32
Quartz	15	25	16	5	57	11	8	35
Zircon	30	19	30	49	14	32	48	18
Garnet	10	14	13	6	9	19	7	9
Magnetite	1	*	*	1	*	*	*	*
Leucoxene	*	*	*	*	*	1	*	*
Staurolite	*	1	*	*	*	*	*	*
Green Spinel	*	*	*	*	*	*	*	*
Tourmaline	*	*	*	*	*	*	*	*
Monazite	*	*	*	*	*	*	*	*
Kyanite	1	3	1	1	1	2	1	1
Rutile	*	*	*	*	*	....	....	....
Nigrine	*	*	*	*	*	*	*	*
Shell Grit†	*	4	4	*	*	2	2	5
Epidote	*	*	*	*	*	*	*	*
Limonite	2	*	*	3	4	*	*	*

NOTES.— 1. * = present in amounts of, or less than, 0.5 per cent.
2. † = includes limonite.
3. Chromic oxide in composite sample of ilmenite from above samples = chromic oxide Cr_2O_3 = 0.04 per cent.
4. Percentages of minerals in existing beaches are valid only as at 28th April, 1948, owing to seasonal changes in the mineral composition of the beach.

REPORT ON A GEOLOGICAL EXAMINATION OF A NEW GOLD FIND ON CALYERUP CREEK IN THE SOUTH-WEST LAND DIVISION OF WESTERN AUSTRALIA.

Approximate Latitude 33° 58′ S.
Approximate Longitude 119° 6′ E.

By W. Johnson, B.Sc. (Hons.).

LOCALITY.

The find is approximately 33 miles due east of Ongerup Railway Station and about three miles south-west of the gate in No. 2 rabbit proof fence on the Ongerup-Ravensthorpe Road. Ongerup is on a spur line branching out east from the Great Southern Railway at Tambellup. The find is outside a proclaimed goldfield, being about 50 miles west of the western boundary of the Phillips River Goldfield.

ACCESS.

Access to the Calyerup Creek area is by road. The find is 288 miles from Perth by road and 36 miles from Ongerup, the nearest railhead. Ongerup is 311 miles from Perth by rail. The Ongerup-Ravensthorpe Road is capable of supporting heavy traffic except in the wettest weather. The route to the gold find turns off the Ravensthorpe Road, three miles east of Jarramongup Station homestead, along the road to Quailup and Bremer Bay. This road too is traversed by heavy trucks throughout the winter. Five miles south of the turn-off from the Ravensthorpe road a rough bush track branches off east and goes in two miles to the site of the gold find. This last two miles of track is the only part which would be absolutely impassable in wet weather.

The nearest battery for the treatment of gold ore is in the vicinity of Ravensthorpe, 75 miles away.

HISTORY OF THE FIND.

In December, 1947, the Government Geologist received from a Mr. Amos Moore some specimens of rock containing arsenopyrite. These specimens were collected by Mr. Moore from the Calyerup Creek area. They were sent to the Government Chemical Laboratory for assay and one was found to contain gold in small quantity (3 dwts. 5 grains per ton). In March, 1948, Mr. Moore sent in three specimens for assay. All were found to contain gold and silver in small quantities.

This find of auriferous rock is outside any proclaimed goldfield and in geologically little known country. To gain some knowledge of the geology of the area and to estimate its economic potentialities, the writer made an examination of the find in June, 1948. The results of the examination form the subject matter of this report.

WATER SUPPLY.

At the time of the writer's visit there were sufficient pools of brackish and fresh water in the creek flowing through Moore's prospecting area 647H for small scale prospecting operations (loaming, etc.). As the visit was at the end of one of the longest dry spells known in the district, such pools may be regarded as permanent. Small supplies of domestic water could be obtained by digging small soakage wells at the base of the larger masses of granite abounding within two to three miles of P.A. 647H.

The location of larger supplies of water would be a problem. Owing to shallow cover of soil in the vicinity of the find adequate supplies of ground water would probably be unobtainable. As the find is in the 15-inch to 20-inch rainfall belt, large supplies of water could be provided by constructing earthen dams across the creeks.

TIMBER.

Enough yate timber for prospecting operations is growing on the alluvial flats of the Gairdner River and its tributaries. Within a radius of two miles from P.A. 647H, there are moderate stands of yate. Around Ongerup there are plentiful stands of yate, salmon gum and gimlet.

PHYSIOGRAPHY.

The gold find is situated in the valley of Calyerup Creek, a tributary of the Gairdner River. The Gairdner and its tributaries have incised themselves quite deeply in the uplifted Old Plateau, creating a relief of 150 feet from valley floor to general Old Plateau level. While Calyerup Creek flows transverse to the strike of the metamorphosed sediments, its tributaries in the vicinity of P.A. 647H flow parallel to the strike of the metamorphosed sediments.

The topography in the area extending from Jarramongup west boundary gate to two miles east of the find is at the stage of early maturity or late youth. This topography is only a local phenomenon caused by the Gairdner River, as the surrounding country exhibits typical uplifted Old Plateau topography.

The nearest visible hills are the Stirling Range to the west and Mts. Barren and Maxwell to the south. The "hills" surrounding the find are only dissected remnants of the Old Plateau and nowhere project above the level of this plateau.

GEOLOGY.

The main rock types observed by the writer in the area of the find are as follows: Hornblende granulite gneiss, garnetiferous mica schist, metamorphosed conglomerate, garnetiferous graphic granite, biotite granite, hornblende epidote granite, pegmatite, coarse and fine grained amphibolite, coarse and medium grained dolerite.

The country rocks of the gold bearing ore bodies are vertically dipping hornblende granulite gneiss and coarse and fine grained amphibolite. The amphibolite probably represents a thin concordant intrusion of basic igneous rock. The gneiss is interbedded with much contorted and dragfolded conglomerate and mica schist bands. The conglomerate is an ill-sorted type, the constitutent pebbles ranging in size from ½ inch by 1 inch to 9 inches by 12 inches.

The metamorphosed sedimentary rocks have been intruded concordantly and discordantly by a series of rocks of acid composition, the "normal" type of which is thought to be a medium grained biotite granite. Though the contact between the acid intrusives and the metamorphosed sediments is usually sharp, small stringers of quartzose and feldspathic material, occurring in the metamorphosed sediments, parallel to the bedding planes, can be traced into the massive intrusives. These stringers in places have converted the dark looking hornblende granulite gneiss to a granite gneiss, in appearance and mineralogical constitution.

Some of the granitic intrusives have clearly forced their walls aside in the process of intrusion. The beds of gneiss curve around and follow the boundary of the intrusion. Others appear to have been intruded by some form of magmatic stoping and assimilation. The writer observed at least three sides of several rectangular (in outcrop section) intrusives. Individual beds of gneiss (ungranitised) ended abruptly against the granite-gneiss contact with no suggestion of curving around the corners of the intrusive.

The numerous examples of undoubted injection gneiss are indistinguishable lithologically from those observed by the writer in the Gascoyne District.*

The latest intrusive rocks are some fine to coarse grained epidioritic dolerite dykes. These dykes cut both granite and metamorphosed sediments and appear to be of post-gold age.

It is probably that the movements causing the folding of the sedimentary rocks accompanied the intrusion of the granite and its associated rocks. The granite was probably responsible for the metamorphism of the sediments as these rocks are little schistose.

The lenses of metamorphosed sediments extend about three miles north-east from P.A. 647H. Plate XVII takes in only those lenses proved to be auriferous. It is likely too that other lenses are hidden under the soil-covered areas of the surrounding Old Plateau.

It was observed that there was some correspondence between type of vegetation and type of underlying rock. Areas covered predominantly by mallet (mainly *eucalyptus annulata* and *E. oleosa var. glauca*) were underlain by acid rocks, and areas covered predominantly by one species of broom (*Melaleuca uncianata*) were underlain by the more basic rocks. This is, of course, a generalisation and applies only to the Calyerup Creek area.

ORE BODIES.

Up to the time of the author's visit, little systematic prospecting had been done. Traces of gold had been obtained in samples of soil from all over the spur leading down to the main creek on P.A. 647H. Several quartz veins outcrop on the spur but none of these had been discovered to be the source of the eluvial gold. The original finder, Mr. A. Moore, had dug several pits and a costean on his P.A. 647H. From these he had collected the gold bearing samples referred to earlier in this report. The costean was dug across the strike of a band of granulite gneiss and revealed two possible ore bodies; a quartz vein one foot wide and a heavily mineralised band of coarse grained greenstone. The granulite gneiss itself, however, contained sulphides. This costean and other pits dug by Mr. Moore were systematically sampled by the writer and the samples sent to the Government Chemical Laboratory for assay. The results are shown in the table below.

* 1947 Johnson, W., Progress Report on the Geology of Portion of the North West Division between latitudes 24° S. and 29° S. and between longitudes 115° 30′ E. and 118° 30′ E. *Annual Progress Report Geological Survey of Western Australia*, 1947, *pp.* 102–105.

SAMPLING OF ORE BODIES ON P.A. 647H.

Sample Locality.	Description of Sample Locality.	No.	Position and Description of Sample.	Assay Results.
AMA*	Costean 28 feet long, 2 feet to 3 feet deep at right angles to the strike of hornblende granulite gneiss. Sampling started from north end of costean.	1	0 feet to 3 feet gneiss	0 dwts. 5 grains
		2	3 feet to 6 feet gneiss	Trace
		3	6 feet to 11 feet gneiss including 1 foot wide quartz vein	0 dwts. 22 grains
		4	11 feet to 16 feet greenstone	2 dwts. 5 grains
		5	16 feet to 21 feet greenstone	0 dwts. 23 grains
		6	21 feet to 24 feet greenstone	0 dwts. 23 grains
		7	24 feet to 28 feet greenstone and gneiss	0 dwts. 19 grains
		8	Quartz vein 1 foot wide at 10 feet from north end	0 dwts. 5 grains
		9	Lode ? heavily mineralised 1 foot 3 inches wide at 22 feet from north end	0 dwts 14 grains
AMB*	Pit 5 feet long, 4 feet deep, 3 feet wide exposing 2 feet wide quartz vein in north end	....	Across true width of quartz vein	0 dwts. 5 grains
AMC*	Pit 4 feet 6 inches long, 5 feet deep, 2 feet wide. In metamorphosed conglomerate	....	Across east face (4 ft. 6 in.) of pit	0 dwts. 18 grains
AMD*	Pit 7 feet long, 3 feet deep, 2 feet wide exposing metamorphosed conglomerate.	....	Across east face over 5 feet from north end.	0 dwts. 4 grains
AMF*	Pit 5 feet long, 2 feet 6 inches deep, 2 feet wide in weathered hornblende schist	....	Across east face over 2 feet from south end	0 dwts. 18 grains

* Sample localities shown on Plate.

Massive granite
With lenses of metamorphosed sediments

Yate confined to alluvium

Yate vegetation

Soil-covered
Underlain by granite with lenses of metamorphosed sediments

P.A.648H

P.A.649H

P.A.650H

Metamorphosed sediments extend at least 40 chains east of J17 & J18.

P.A.653H

P.A.647H

P.A.654H

Mallet and Broom Vegetation

Soil-covered
Fragmentary outcrops of granite, pegmatite dykes and quartz veins

Sparse yate

Soil-covered
Probably overlain by granite with lenses of metamorphosed sediments

Vegetation, mallet with patches of broom

Soil-covered

Sparse yate

Soil-covered

Hornblende granulite gneiss

Massive biotite granite

Some smaller lenses of metamorphosed sediments in massive granite

Soil-covered
Probably underlain by granite

Dolerite extends at least ½ mile northeast.

Dolerite dyke, probably extends discontinously over 2 miles west southwest.

Coarse grained dolerite with fine grained selvedge

Dolerite dyke at each contact

Small pothole

Track

Pit

Costean

Datum Peg P.A.647H

Magnetic North

3°

REFERENCE TO SIGNS

LEGEND

Alluvium	~
Soil-covered areas, probably underlain mainly by granite with some patches of metamorphosed sediments	
Coarse, medium and fine-grained dolerite, practically unmetamorphosed.	
Biotite granite, hornblende epidote granite, garnetiferous graphic granite, pegmatite, vein quartz	Gr
Metamorphosed sediments-hornblende granulite gneiss, garnetiferous mica schist, conglomerate quartzite, with interbedded coarse-grained greenstone	S

Prospecting areas	P.A.647H
Costeans	
Track	
Intermittently flowing watercourse	
Form lines	
Geological boundaries observed	
Geological boundaries approximate	
Geological boundaries assumed	
Outcrops with no observed strike and dip	+ + +
Strike and dip of banding in gneiss	N30°W 80°W
Strike of vertical banding in gneiss	N20°W.
Strike and dip of bedding	N80°W 70°
Strike and plunge of dragfold	40°
Dip of axial plane of dragfold	40° 80°
Locality and number of specimen	×
Locality of samples	• AMA

ASSAY OF SAMPLES COLLECTED ON P.A.647H

LOCALITY	POSITION AND LENGTH OVER WHICH SAMPLE TAKEN	ASSAY RESULT GOLD PER TON
AMA Costean	0'-3'	0 dwts 5 grains
	3'-6'	Trace
	6'-11'	0 dwts 22 grains
	11'-16' (Measuring from N end of costean)	2 - 5 "
	16'-21'	0 - 23 "
	21'-24'	0 - 23 "
	24'-28'	0 - 19 "
AMB Pit 5' long	2' width of quartz vein	0 - 5 "

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP
OF
CALYERUP CREEK GOLD FIND

APPROX., LAT. 33° 58' S., LONG. 119° 6' E.
LANDS DEPT. LITHO. 434/80

Scale: 5 chains to an inch
5 4 3 2 1 0 5 10

Based on compass and chain survey by W. Johnson, June 1948.
Geology by W. Johnson, June 1948.

The assay results show that the main ore body is probably the coarse-grained greenstone although traces of gold occur in the gneiss and the quartz vein.

CONCLUSION.

The assay results show that the most probably favourable horizon for gold deposition at Calyerup Creek was the coarse-grained greenstone band in the granulite gneiss, the most favourable part of the greenstone being close to the contact of the greenstone and a quartz vein. In this part of the band the assay result was 2 dwts. 5 grains of gold per ton over 5ft. Such a value is too small to encourage hopes for the economic prospects of the find; however, other and richer ore bodies may be discovered. Eluvial gold occurs uphill from costean AMA (see plan) on P.A. 647H and in the soil on other P.A.'s. so that there must be other sources of gold than the greenstone band in costean AMA. Unless these other sources are discovered and prove to be richer, it is unlikely that the Calyerup Creek find will ever become a producer of gold.

Some prospecting recommendations are:—

1. Systematic loaming throughout the area to discover the source of eluvial especially uphill from costean AMA.

2. Proper sampling of any ore bodies so discovered.

3. Search the area for bands of mineralised rock similar to the greenstone exposed in costean AMA. Sample properly any bands so discovered.

Note.—The mineralised greenstone must not be confused with the dolerite dyke outcropping on the P.A. east of P.A. 674H. The rocks are similar but the dolerite does not contain the silvery looking mineral arsenopyrite.

4. Trace the greenstone band exposed in costean A.M.A. along the strike and sample it at 50 feet intervals, by costeaning at right angles to the strike and cutting sample channels across the greenstone in the manner practised by the writer in costean AMA.

REPORT ON THE TIMONI WORKINGS OF MT. IDA GOLD MINES LTD., COPPERFIELD, MENZIES DISTRICT, NORTH COOLGARDIE GOLDFIELD.

Approximate Latitude 29° 12′ S.

Approximate Longitude 120° 29′ E.

By W. Johnson, B.Sc. (Hons.), Geological Survey of W.A.

INTRODUCTION.

This report embodies the result of an underground and surface examination of the Timoni Workings of Mt. Ida Gold Mines Ltd. The examination was carried out as a result of a request to the Geological Survey for assistance by the owners, Goldfields Australian Development Ltd. The examination consisted of geologically mapping an area surrounding "Timoni" G.M.L. 5537z by plane table and chain and compass on a scale of 1 inch = 100 feet, and geologically mapping the underground workings on G.M.L. 5537 on a scale of 1 inch = 40 feet. The examination was completed in July, 1948.

The object of the examination was to ascertain:—

(i) What structural influence, if any, was responsible for the gold deposition in the Timoni ore body.

(ii) How the ore body had been affected by the extensive faulting occurring in the area and how this faulting would influence the Company's future development work.

(iii) The conditions of ground water occurrence, so that sites could be suggested for water bores to obtain water for an expansion of treatment tonnage.

A summary of findings and the writer's recommendations will be found at the end of this report.

The writer wishes to acknowledge gratefully here the helpful and willing assistance given by Mr. E. B. Mundle, general manager for Goldfields Australian Development in Western Australia and Messrs. L. Lee and W. Hincheliffe, manager and underground manager respectively, of the Timoni Mine.

LOCALITY.

The Timoni workings are situated on G.M.L. 5537z, Copperfield, as indicated in the title. Copperfield is approximately 50 miles north-west of Menzies and five miles south-west of Mt. Ida State battery.

ACCESS.

Copperfield is reached by a "bush" road running generally north-west from Menzies, the nearest railhead, the road distance being 61 miles from Menzies Post Office. The road is capable of supporting heavy motor vehicles except in wet weather. A mail service runs once a week to Copperfield from Menzies. The distance from Perth to Menzies by rail is 477 miles and by road 470 miles. A triangular airstrip capable of accommodating light aircraft has been constructed one mile north of the Timoni Mine, and the mine office is in wireless communication with the Kalgoorlie base of the Aerial Medical Service.

HISTORY.

The ore body being developed by Mt. Ida Gold Mines lies wholly within the boundaries of Timoni G.M.L. 5537z. The same ore body was probably discovered in 1896 and was extensively worked between 1899 and 1906.

From 1896 to 1907 the Timoni ore body was covered by Timoni G.M.L. 4583z and "Ballance" G.M.L. 4549z, from 1908 to 1921 by "Timoni" G.M.L's. 5321, 5449 (=5321), and 5469 (=5449) and by "South Timoni" G.M.L. 5384 (1912/1913) and Timoni South G.M.L. 5470 (1919-1921). The existing lease has been held since 1932, and from 1943 by Goldfields Australian Development.

By 1906 the Timoni ore body had been worked from a depth of 100 feet to the surface along a length of 1,200 feet.*

The amount of gold produced from the ore body is not known, as the production has been bulked with that from other mines operated in the vicinity by the various holding companies.

GENERAL GEOLOGY.

The map, Plate XVIII, shows that the Timoni ore body lies in a belt of sheared metamorphosed sediments 1,800 feet west of the margin of a belt of gneiss formed by granitisation of the sediments.

The sediments in which the ore body occurs are basic and slightly schistose, possibly originally basic tuffs. A band of coarse-grained amphibolite outcrops in the sediments 1,000 feet west of the mine. This amphibolite is finer-grained towards its contacts with the sediments, and may be a metamorphosed concordant basic intrusive. Other rock types within the area mapped are talc schist, acid sediments and a peculiar coarse-grained hornblende feldspar rock. This last type was not observed outcropping, but occurred in the dump of the main shaft of the Copperfield G.M.L. 5701z and the dumps of two prospecting shafts 1,000 feet south-east of the Copperfield main shaft. The rock consists of large crystals of mauve tinted feldspar (size varying from ⅛-inch by ¼-inch to ½-inch by 1-inch with occasional larger crystals) and intergranular large, bladed crystals of hornblende. Some specimens on the dump represented a mylonitised version of the rock, produced by extreme dynamic metamorphism.

Unfortunately, the Copperfield workings were inaccessible, so that the exact stratigraphic position of the rock cannot be ascertained. However, it must have been close to the ore body (not the Timoni ore body) as very little crosscutting is said to have been done on the Copperfield.†

The contact of the belt of gneiss and the basic metasediments is quite sharp across the strike, and the line of contact is parallel to the strike of the bedding of the metasediments and the foliation of the gneiss. Within the gneiss, small patches of ungranitised metasediment occur, and the gneiss grades eastwards over a distance of two or three miles into a coarse-grained granite.

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* 1906, Gibson, C. G.—The Geology and Mineral Resources of Lawlers, Sir Samuel and Darlot (East Murchison Goldfield) Mount Ida (North Coolgardie Goldfield) and a portion of the Mt. Margaret Goldfield. *G.S.W.A. Bull. No.* 28, pp. 31–41.

† 1906, Gibson. — *op. cit. p.* 33.

According to Woodward* and Gibson†, the Copperfield ore deposit occurs in the western one of two belts of "greenstone" outcropping to the east and west of a mass of intrusive granite. This accords with the writer's brief examination of the regional geology.

There are two sets of prominent quartz veins in the area. One set is parallel to the strike and dip of the metasediments, and includes most, if not all of the ore bodies within one mile of the Timoni workings. The other set is generally transverse to the strike and dip of the metasediments, is non-auriferous, and occupies fault surfaces of large or small scale faults which have displaced metasediments, gneiss, and the auriferous quartz veins.

STRUCTURAL GEOLOGY.

Folding.

Within the area mapped no local folding was observed and the few minute dragfolds discovered had most conflicting pitches. These dragfolds are probably associated with movement along fault surfaces. The pitch of regional folding may have influenced ore deposition at Copperfield. The area mapped was too small to indicate this.

Faulting.

As can be seen from Plate XVIII the area surrounding G.M.L. 5537z has been faulted in complicated fashion by a series of major faults striking generally N. 70° E., accompanied by lesser faults whose strikes vary from N. 30° E. to S. 80° E. but which are concentrated about one or other of those two bearings. The dip of the major faults is not obtainable on the surface, and so far none has been encountered in the underground workings (July, 1948). Several minor faults have been encountered in the workings, and their dips vary from 75° N. to vertical, so that it is probable that the dips of the major faults vary in like manner.

It is the writer's opinion that the faulting is post gold in age. Two almost conclusive pieces of evidence support this opinion.

(i) The auriferous quartz veins have been displaced by the faults, examples on a minor scale are numerous in the Timoni workings; on a large scale the shift of the Copperfield ore body (associated with a distinctive rock type) is an example.

(ii) The fault surfaces are occupied by quartz veins invariably barren. If the faulting had been prior to gold deposition some at least of the transverse quartz veins should have been auriferous.

The complete components of movement along the steeply dipping fault surfaces cannot be determined owing to the impossibility of finding two identical points on opposite sides of the fault. The horizontal separation varies from 500 feet along the fault near the north boundary of G.M.L. 5537, to a few inches in some minor faults. The faults are parallel to the dip of steeply dipping sediments, and a horizontal separation of 500 feet may mean a vertical slip of many thousands of feet. This fact has an important bearing on the economy of the area as will be seen below.

The section of the auriferous quartz vein being worked on G.M.L. 5537 is in a fault block which has moved to the east relative to the country north and south; the horizontal separation being approximately 400 feet. If the movement along the fault surfaces was purely horizontal then an ore shoot in the fault block would continue at the same level in the faulted continuation of the ore body (as the ore body is parallel to the strike and dip of the sediments). If the movement was purely vertical a horizontal separation of 400 feet would mean a vertical separation of 1,200 feet, and the ore shoot would not continue in the faulted portion of the ore body at the same level. In the latter instance a horizontal drill hole put out, at say 400 feet V.D., in the right direction might find the ore body without finding the same ore shoot as that cut off by the fault. (See diagram, fig. 4.)

* 1901, Woodward, H. P. Mt. Ida. *Ann. Prog. Rep. G.S.W.A.* 1901, *pp.* 12, 13.
† 1906, Gibson. *op. cit. p.* 33.

In addition to the steeply dipping faults, a series of fractures striking N. 60° E. and dipping from 10° S. to 20° S. were mapped in the Timoni underground workings. There is no evidence of these faults on the surface. The apparent maximum movement along the faults is 18 inches. Some of the flat dipping fault surfaces are marked by vugs ½-inch to six inches wide and several feet long. These vugs are lined with crystals of calcite, secondary silica and pyrite, and pseudomorphs of brown limonite after pyrite. According to Mr. Hinchcliffe, the flat dipping fault zones were often water bearing when encountered. One was struck in a winze at the south end of No. 3 level drive. This ore delivered over 25,000 gallons a day for some time. This same fault was driven through on the level and delivered little water. The inference is that the water channels in the fault zones must pursue an irregular course.

The economic significance of these flat dipping faults lies in their water bearing properties, and in the facilities they have offered for the operation of the processes of secondary enrichment and impoverishment. The assay data available is incomplete, especially for the earlier workings, stopes and drives, but there is an indication that in the zones around the flat dipping faults, there are lower or higher values in the ore body. This is more noticeable in the south end of the mine.

Jointing.

The metamorphosed basic sediment forming the country rock of the Timoni ore body is heavily and closely jointed, especially in the vicinity of the various fault surfaces. The joints are concentrated in four major sets whose strikes and dips are (i) strike N. 2° W., dip 80° W.; (ii) strike N. 30° W., dip 85° S.W.; (iii) strike N. 50° E., dip 85° N.W.; (iv) strike N. 75° E., dip 18° S.

These directions correspond approximately to the strikes and dips of the various faults and to the schistosity of the metamorphosed sediments. The joints are regarded as being associated with the movements causing the faults. Many joint planes are filled with quartz and/or calcite.

ORE BODIES.

Timoni Workings.

Only one ore body is being developed in the Timoni workings. This is a quartz vein striking N. 20° W. and dipping 70° W. parallel to the strike and dip of the regional schistosity of the country rock, which is a metamorphosed basic sediment. The quartz vein occupies a sheer with well defined walls, and the vein varies in thickness from ⅛-inch to 36 inches. The vein has been traced to a depth of 550 feet, and has been driven on for a maximum length of 550 feet north and 850 feet south from the main shaft. The quartz carries gold throughout, but the higher values seem to be concentrated in the south end. It will be noticed from Plate XVIII that at the time of examination (July, 1948) no drive either north or south had reached either of the large bounding faults.

The ore body being developed now is the same that was worked from 1899 to 1906. By 1906, as Gibson states*, "the reef has been taken out from the 100 feet level to the surface for a length of 1,200 feet."

The mine plans show that the ore body has been partially stoped over an indeterminate distance between Nos. 1 and 2 levels, and over a distance of 830 feet between Nos. 2 and 3 levels. Between Nos. 2 and 3 levels, the stope length is longer south of the main shaft. Leading stopes only have been taken out on No. 4 level, and two winzes have been sunk to the proposed No. 5 level which will be approximately 125 feet below No. 4 level.

The assay plans of stopes are not complete enough to show by comparison of assay values in the ore body any definite pitching shoot of ore, but indications are that a shoot of ore pitches to the south at a moderate angle. It is interesting to note that Gibson† observed south pitching shoots in the ore body of the Federation Mine G.M.L. 5035 (now 5668z).

* 1906, Gibson. *op. cit. p.* 36.
† Gibson, C. G. *op. cit. p.* 35.

C.M.L. 5701²
(5692² on posts)

"Copperfield"

Tailings & dump — Main shaft (inaccessible) Three compartments

Stoped and open cut to 15'

Patch of gneiss

Heaps of oxidised tailings

Copper stained quartz in dumps.

Fallen in

Shafts fallen in

Basic meta-sediment or volcanic tuff

Patches of ungranitised meta-sediments in gneiss

Well 40'76' to water
Meta-sediments in dump

Basic meta-sediment

Vein quartz in dump

Shallow open cuts partially fallen in.

Filled

Pit with copper stained quartz in dump

Quartz in dumps

Coarse grained hornblende felspar rock similar to that in dump of main shaft "Copperhead" G.M.L.5701

Basic meta-sediment or tuff

T.A.4²
(47² on posts)
Tailings from "Timoni" Treatment Plant

Filled shaft

DD.3

DD.2

DD.1

Line of workings bearing N.20°W
Probably faulted continuation of Timoni Ore Body

Quartz vein 2' wide

500' N. Coordinate

NORTH SHAFT

30° from N.

00 Grid Line

No 1 Level

No 2 Level

No 3 Level

No 4 Level

100' E. Coordinate

MAIN SHAFT

G.M.L. 5537²

00 Grid Line

500' W. Coordinate

DD⁵ 5 & 6
(On No 4 Level)

200' S. Coordinate

SOUTH SHAFT

"Timoni"

Talc schist in dump

Filled shaft, talc schist in dump

DD.4

No outcrops

Impregnated with limonite

Possible strike of quartz vein

Direction of this fault and amount of horizontal separation, as shown here, may be incorrect, owing to difficulty of tracing formation boundaries.

Laterite and weathered gneiss
Probably containing lenses of ungranitised metamorphosed sediments

Soil

Some vein quartz in dumps

Covered by quartz rubble

Twin bands of gneiss

G.M.L. 5610²

Possible weathered meta-sediment in dump

Vein quartz and weathered meta-sediment in dump

Meta-sediments in dumps

"Duke"

Meta-sediment in dump

Quartz veins

Pothole
Weathered meta-sediment in ends

Meta-sediment in shaft

Shallow shafts
Quartz in dumps

12'V.D.
Sloped drive, W from bottom
Quartz in dump.

"Timoni Extd."

G.M.L. 5553²

G.M.L. 5702²

"Federation North"

Bedding planes

30'V.D.
Crosscuts from bottom
Basic meta-sediment in dump.

Basic meta-sediments

T.11
(Stn 2, Chain & compass survey)

40'V.D.
Quartzose meta-sediment in dump.

30'V.D.

15'V.D.
Underlay S.W. Crosscut N.E. at 10'V.D.

Basic meta-sediments

Open Cut
6'x 5'

Large shaft, three compartments
Inaccessible. V.D. 200'
Considerable workings and large dump. All basic meta-sediments.

G.M.L. 5668²

20'V.D. in basic meta-sediments.

20'V.D.

Basic meta-sediments

T.9

T.10

"Federation"

6'V.D.

1000' S. Coordinate

—LEGEND—

Alluvium, shallow cover only	~
Gneiss, probably formed by granitisation of metamorphosed sediments	Gn
Amphibolite, metamorphosed basic igneous rock, probably intrusive.	A
Metamorphosed sediments, mainly basic, some acid, possibly of tuffaceous origin. Includes a band of coarse grained hornblende, felspar rock of doubtful origin.	S
Quartz veins	—Q—

—NOTE—

Except for alluvium, geological bounderies are sub-surface, as a large percentage of the area is soil covered.

—REFERENCE TO SIGNS—

Existing mining holdings	
Void mining holdings	
Observed geological boundaries	
Approximate geological boundaries	
Assumed geological boundaries	
Strike and dip of foliation in gneiss	N20°W 70°E
Strike of vertical foliation in gneiss	N40°W
Strike and dip of bedding	N10°W 80°E
Strike of vertical bedding	N30°W
Strike and dip of schistosity	N25°W 70°E
Strike of vertical schistosity	N25°W
Strike and dip of jointing	N35°E 25°
Strike and plunge of drag fold	20° 80°
Probable fault	
Intermittant streams or drainage channels	
Form lines	
Accessible shafts	
Inaccessible shafts	
Costeans	
Open cuts	
Tailings	
Diamond drill borehole sites	DD.2

—LOCALITY MAP—
Scale: 30 miles = 1 inch

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP
OF
"TIMONI," G.M.L. 5537 & VICINITY
COPPERFIELD - 4 M. SW. OF Mt IDA
NORTH COOLGARDIE GOLDFIELD

Scale: 200 feet to an inch
200 100 0 200 400

Based on survey information supplied by Mines Dept.
Mine levels obtained from plans of Mt Ida Gold Mines
Geology, plane table and compass and chain traverses by W. Johnson, July 1948

DIAGRAMMATIC REPRESENTATION BY MODIFIED ISOMETRIC PROJECTION

OF

FAULTING AT COPPERFIELD

4 Miles S.W. of Mt. Ida

NORTH COOLGARDIE GOLDFIELD

SCALES

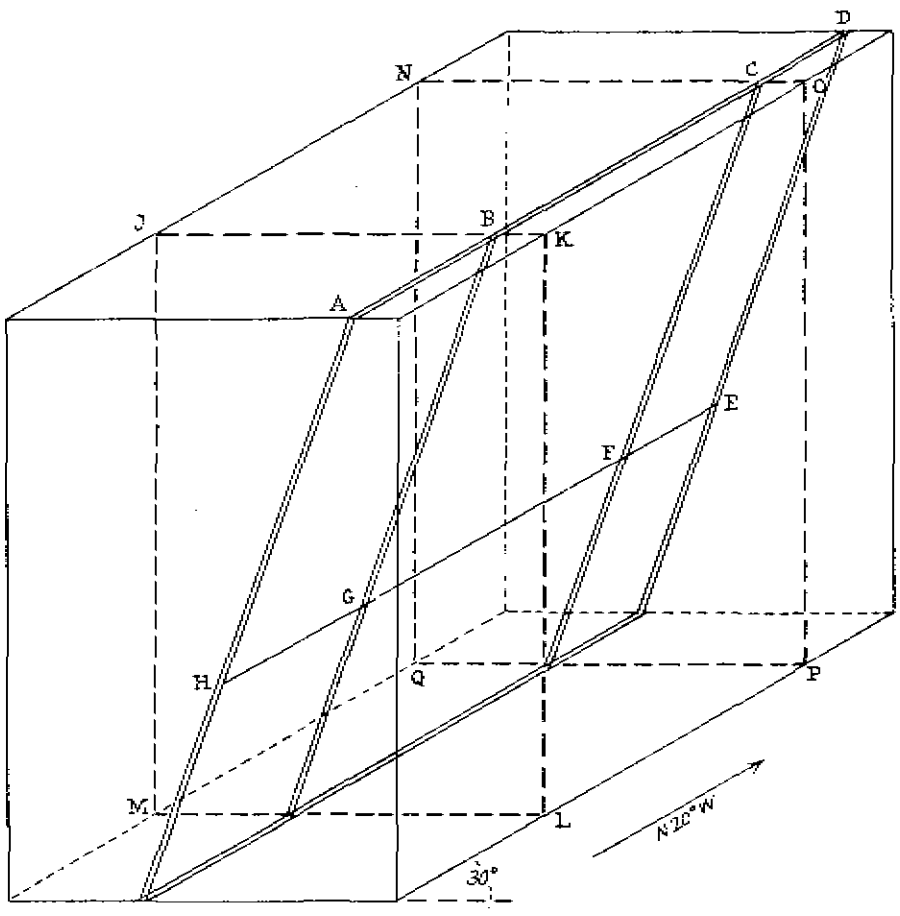
VERTICAL & HORIZONTAL

FEET 1000 0 500 1000 1500 FEET

2000 0 1000 2000 3000

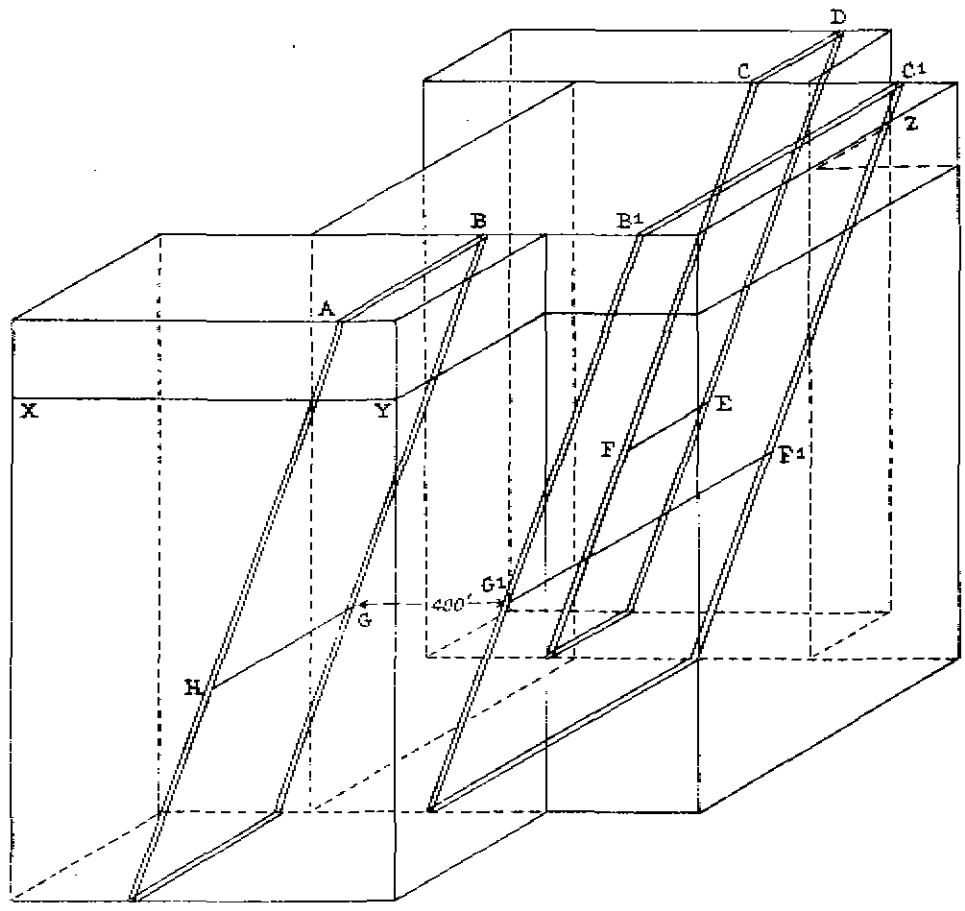
DIAGONAL

Note:- *The diagrams do not represent accurately the actual existing fault conditions, as the strike of south fault, dip and direction of movement of both faults and length, pitch and depth of ore shoot are not known.*



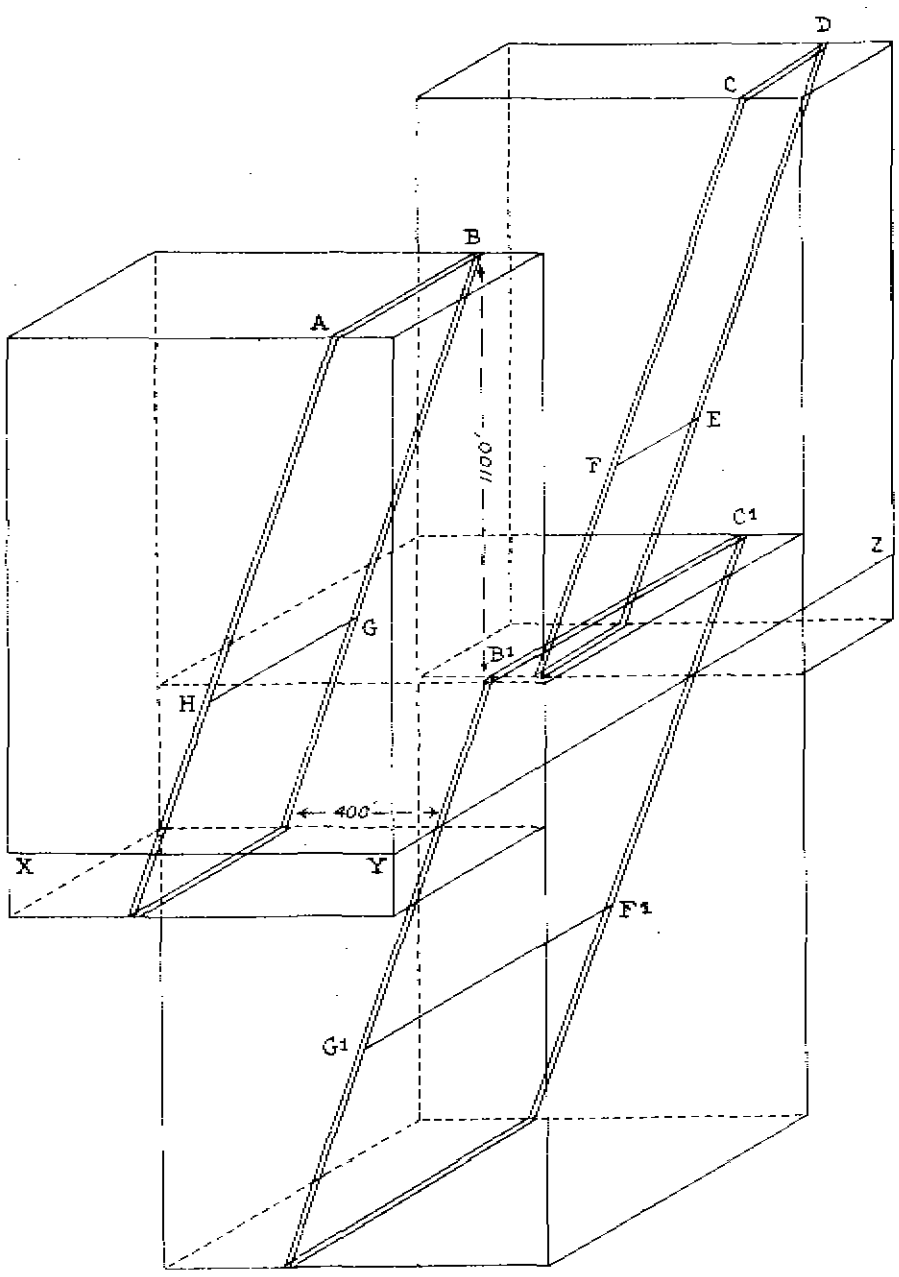
1

Original block before faulting. ADEH, assumed shoot in ore body. JKLM and NOPQ are fault planes.



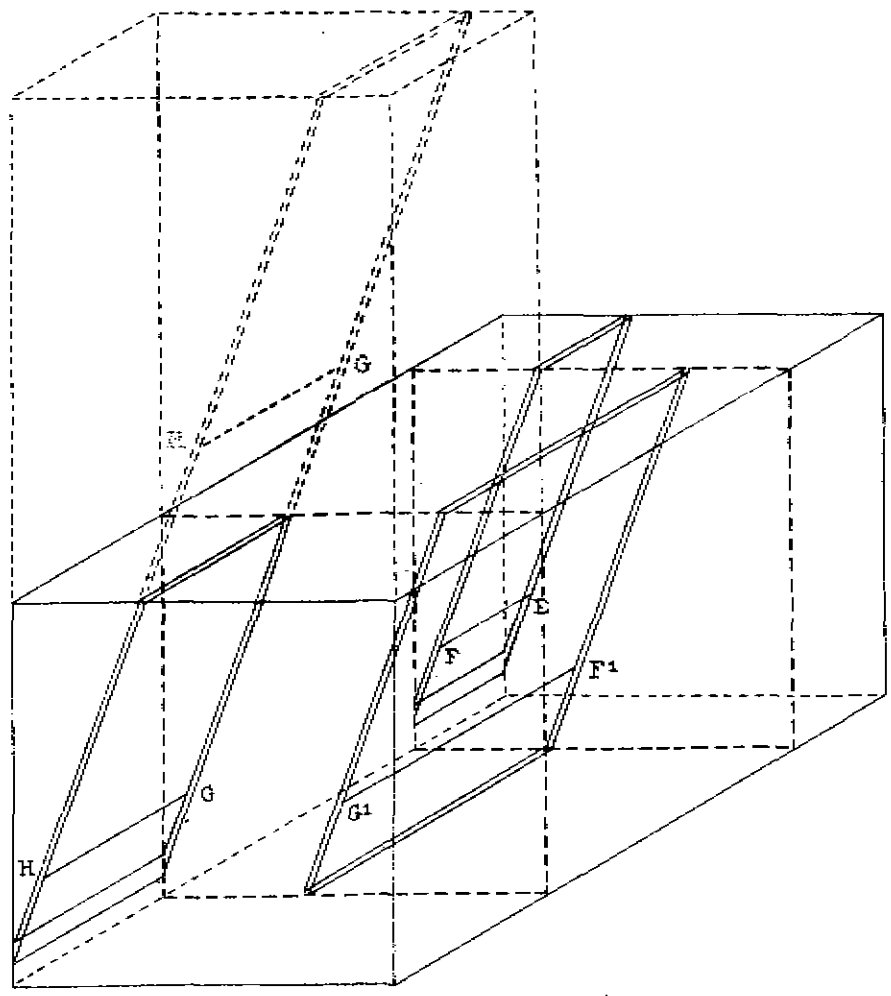
2

Position after faulting with movement purely horizontal. B1, C1, F1, G1, positions of B, C, F, G, faulted portion of ore shoot



3

Position after faulting with movement purely vertical



4

Appearance of a block, after erosion has removed country above level of plane XYZ.
Country presents same appearance, whether fault movement has been vertical or horizontal but note the relative positions of bottom of ore shoots in non-faulted portion. Dotted line HG represents bottom of ore shoot, after vertical movement and firm line HG represents the bottom of ore shoot, after horizontal movement.

W. Johnson, Aug. 1948

Along No. 4 level south drive, the ore body from co-ordinate 350 S. consistently assayed high values, while in the north drive most of the ore body assayed low values. The assay results from No. 4 level No. 9 winze at co-ordinate 610 S., sunk to a depth of 118 feet below the level, are appended in the table below. In addition to showing the continuance of the ore shoot below No. 4 level, they show that there is no apparent correlation between gold values and thickness of quartz.

TABLE 1.

ASSAY DATA FROM No. 9 WINZE, TIMONI GOLD MINE, No. 4 LEVEL AT CO-ORDINATE 610 S.

Figures supplied by courtesy the Management, Goldfields Australian Development.

Depth from Brace.	Position of Sample.	Quartz Width.	Lode Width Samples.	Assay Value.	Reported.	
					Value.	Width.
Feet.		Ins.	Ins.	dwt.	dwt.	Ins.
4–20	In hanging wall country.	....	....	....	....	....
20	North Wall	30	36	9.4	8.0	42
22½	South Wall	17	30	32.1	16.0	42
25	North Wall	20	30	21.5	15.0	42
27½	South Wall	24	36	41.4	20.0	42
30	North Wall	24	30	45.4	20.0	42
32½	South Wall	24	32	38.1	17.5	42
35	North Wall	25	33	27.3	15.0	42
37½	South Wall	24	30	22.8	15.0	42
40	North Wall	22	30	37.7	20.0	42
42½	South Wall	18	36	16.5	14.2	42
45	North Wall	17	32	4.2	3.2	42
47½	South Wall	20	36	2.6	2.2	42
50	North Wall	18	34	5.4	4.4	42
52½	South Wall	18	36	5.4	4.6	42
55	North Wall	15	32	10.8	8.1	42
57½	South Wall	12	30	5.7	4.0	42
60	North Wall	10	30	5.2	3.7	42
62½	South Wall	8	24	42.4	15.0	42
65	North Wall	6	24	6.1	3.5	42
67½	South Wall	14	30	10.4	7.4	42
70	North Wall	6	24	233.0	20.0	42
72½	South Wall	12	30	16.0	9.1	42
75	North Wall	8	30	10.4	7.4	42
77½	South Wall	8	22	23.1	12.1	42
80	North Wall	6	22	13.2	6.7	42
82½	South Wall	6	20	80.0	20.0	42
85	North Wall	5	18	61.6	15.0	42
87½	South Wall	4	18	28.0	10.0	42
90	North Wall	4	18	36.0	12.5	42
92½	South Wall	6	24	43.5	17.5	42
95	North Wall	2	24	11.3	6.1	42
97½	South Wall	4	22	49.9	17.5	42
100	North Wall	4	28	47.0	17.0	42
102½	South Wall	5	18	40.2	12.5	42
105	North Wall	2	18	45.4	12.5	42
107½	South Wall	4	20	25.7	10.0	42
110	North Wall	3	24	39.5	15.0	42
112½	South Wall	6	30	32.3	15.0	42
115	North Wall	2	18	40.5	12.0	42
117½	South Wall	7	26	28.3	12.5	42

The ore body has been faulted by numerous minor faults whose horizontal separations vary from six inches to five feet. At no stage has the development work lost the ore body. When driving, either north or south, reaches the faults which terminate the Timoni fault block, considerable deadwork will have to be done to find the continuation of the ore body. To the south the continuation of the ore body should be found between 200 and 400 feet west of its termination in the Timoni fault block. For reasons explained in the section on "Faulting," the ore body when found need not necessarily contain payable values.

Parallel quartz veins to the ore body have been discovered in the Timoni workings, but none has contained more than a trace of gold.

Other ore bodies.

The workings outside G.M.L. 5537 are all inaccessible. All those with ore paddocks were on quartz veins parallel to the strike and dip of the bedding or schistosity of the country rock. Gibson* shows several veins parallel to the ore body of the Copperfield, but these were obscured by tailings in July, 1948. The line of workings, 600 feet north-west of the North shaft of the Timoni, on G.M.L. 5347, is thought to be on the faulted continuation north of the Timoni ore body. The faulted south continuation of the Timoni ore body does not outcrop. The Federation, G.M.L. 5668, and the Copperfield, G.M.L. 5701, both produced considerable amounts of gold, but their faulted continuations north and south have not been discovered or worked. Considerable scope exists for prospecting with a diamond drill and a scheme will be outlined later.

* 1906, Gibson. *op. cit. p.* 36, *Plate A.*

WATER SUPPLY.

The average daily "make" of water in the mine according to the owners is 15,000 gallons. The company intends to increase its treatment capacity and estimates its water needs at 30,000 gallons a day.

Adequate supplies of groundwater from a "general" water table are not obtainable within economical distance of the mine. A well in alluvium one mile north of the mine supplies "about 2,000 gallons a day," and around the mine itself no water occurs in the shallow alluvium.

The water encountered in the mine comes from the shatter zones surrounding the faults, both shallow and steep dipping. The best chance of finding sufficient water for the proposed treatment plant is to prospect

from the surface or underground in the vicinity of the quartz veins filling the transverse faults. These quartz veins act as underground dams to the water-bearing, flat dipping faults, and in addition the major faults (steep, north-dipping) will be surrounded by zones of shattered, sheared and jointed rock which will act as water storages. If the transverse faults are all vertical or steeply north-dipping as is probable, underground water conditions will approximate those depicted in the diagram, Fig. 5.

Large numbers of quartz filled transverse faults are known within one mile of the Timoni mine, and all may have to be tested to obtain an adequate supply. The first one to be tested should be the fault terminating the Timoni fault block to the north. This could be tested most cheaply and effectively by a diamond drill hole from the north end of the drive on No. 4 level. The hole would be horizontal, bearing N.30°W. magnetic, and the length necessary would be approximately 200 feet (from the face as at July 29, 1948). Further testing could be done by horizontal drill holes from the same station fanned out to pierce the fault at distances from the original hole of 300 feet east and west. A site for testing this fault from the surface has been laid out on the map Plate XVIII. This hole would not be necessary if the diamond drill holes indicated a negative result. The site may have to be shifted if the dip of the fault as determined in the original underground diamond drill hole differs from that assumed (80°N.) when laying out the site.

The possibilities of the southern major fault will be tested during routine development by driving south.

The other transverse faults will best be tested from the surface using a 6in. percussion drill. The holes should be sited north of the fault to enter the crushed zone at a depth between 300 and 400 feet. To do this accurately, the dip of the fault should be known. These holes should not go down till after the northern fault has been tested, and an assumed dip equal to that of the northern fault can be taken for the other transverse faults. Care should be taken not to pierce the quartz veins as this might have the effect of draining the underground dams.

These latter, like all other sources of water, are not inexhaustible, and to ensure continuance of adequate supplies several holes would be needed. The best plan would be to have at least four holes and, even if each is apparently capable of supplying the total amount required, to use each in rotation for a short period of not more than four weeks. The rest period gives time for the slow moving underground water to refill the "dam" just as surface dams have to be replenished each year.

CONCLUSION.

The general objects of the examination, stated in the introduction, have been attained.

(i) No local structural influence was found responsible for the gold deposition in the Timoni ore body.

(ii) The ore body being worked is in a fault block 1,500 feet long terminated north and south by faults having horizontal separations of approximately 400 feet. The relative movement of the block is to the east with respect to the country north and south. Within the fault block the ore body has been displaced only by minor faults and has not been lost in the workings.

(iii) The shoot of ore probably pitches south, but the angle of pitch and the length of the shoot are not definable with the present assay data.

(iv) The irregularly placed zones of low values and extremely high values are due to the operation of the processes of secondary impoverishment and enrichment controlled by the systems of faults and joints.

(v) The conditions of ground water occurrence are favourable to the finding of water only in the vicinity of the quartz filled transverse faults.

RECOMMENDATIONS.

The necessary work for the finding of water supplies is outlined in the section on water supply and will not be repeated here.

A. Development.

Much of this work would no doubt be carried out by the company in the course of its normal development programme.

No. 3 Level—

(1) Crosscut 20 feet west at co-ordinate 500 S. This will test whether the drive is off the ore body in the poor zone between co-ordinate 440 S. and 620 S. or whether this zone is due to secondary impoverishment.

(2) Continue drive south to at least co-ordinate 740 S. Drive has been stopped near the south edge of a poor zone probably due to secondary impoverishment. If values improve rise on them at least 40 feet.

No. 4 Level—

(1) Sink winze 125 feet at 180 N.

(2) Rise at least 40 feet at 150 N. The drive between No. 5 winze (which averaged poor values) and the main shaft may be in a zone of secondary impoverishment.

(3) Crosscut 20 feet west at 255 S. to test whether drive is off ore body between co-ordinates 185 S. and 330 S.

(4) Sink winze 125 feet at 255 S. This winze will test block between Nos. 7 and 9 winzes and also test the poor zone between co-ordinates 185 S. and 330 S. in depth.

B. Necessary Exploratory Work.

The south drive on No. 4 level when continued should cut the large south fault terminating the Timoni block approximately 250 feet south of the present face at co-ordinate 760 S., i.e., about co-ordinate 1010 S. Owing to the poor outcrops the course of this fault could not be traced directly across the critical area on the surface, and the fault may be reached anywhere between co-ordinates 900 S. and 1100 S.

When the fault is reached the following exploratory work will be necessary:—

(1) Drive through the fault zone which may or may not be marked by a massive quartz vein and continue at least 10 feet on the south side of the fault.

(2) Crosscut 20 feet east and west along the south side of the fault surface to ensure that the fault is one of large dimensions. This crosscutting should also expose portions of the fault surface. On the fault surface there may be features such as grooves and slickensides which will enable the direction of movement along the surface to be determined.

As future exploration on the south side of the fault is contingent upon direction of movement along the fault surface, it would be wise for the company to obtain further geological advice before proceeding with recommendation No. 3

(3) From the end of the drive (10 feet south of the fault) put out a horizontal diamond drill hole on a bearing generally south-west but parallel to the strike of the fault as determined in the crosscuts. This hole would have to be approximately 500 feet long. If the movement along the fault surface were purely horizontal and the drive terminated on the north side of the fault in good values, then the drill hole should intersect the ore body and ore shoot. If the movement along the fault surface were vertical then the borehole may not even intersect the ore body,* and if it does, may not intersect values. If this happens then it is doubtful whether further exploration would be warranted from this site.

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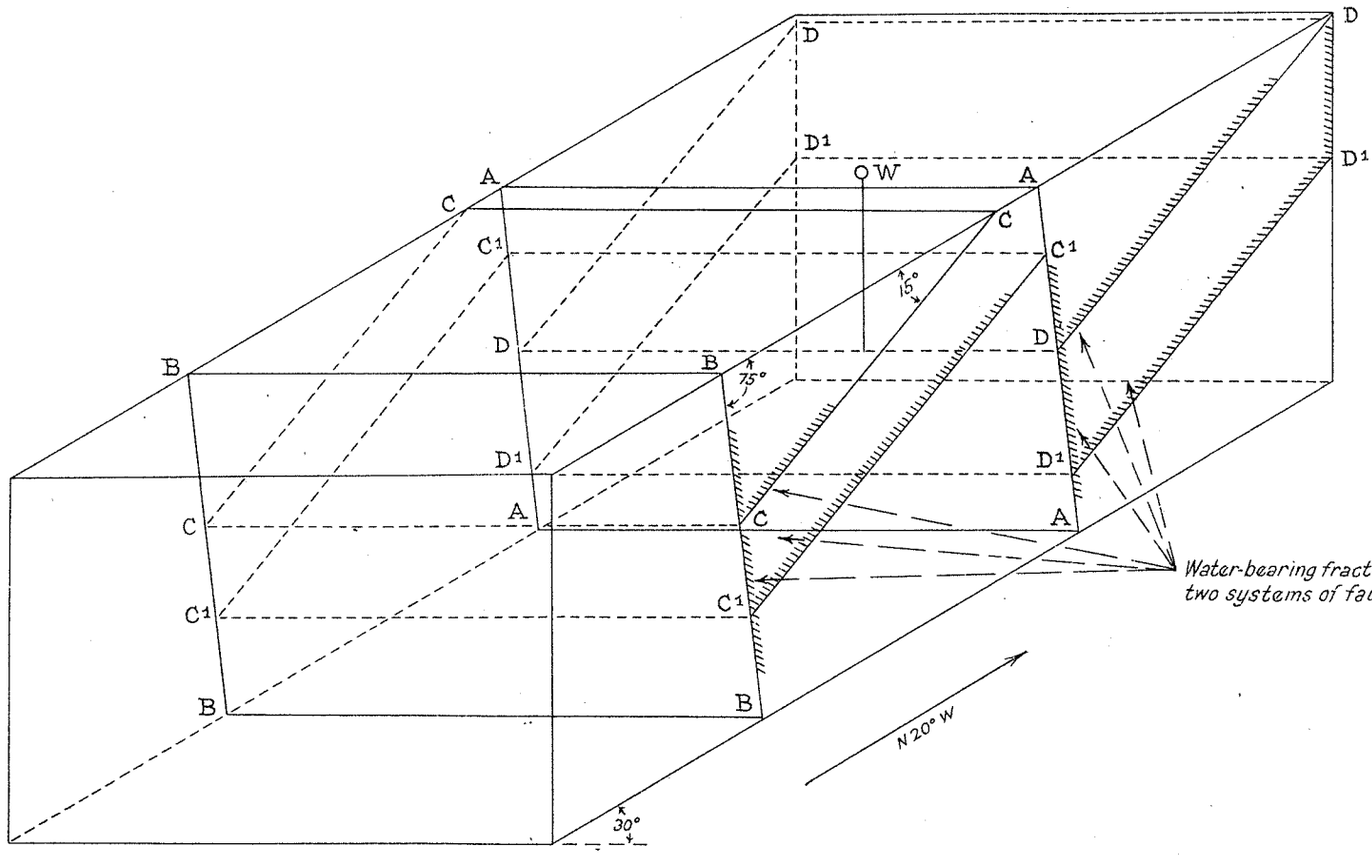
* *See* diagram fig. 4.

DIAGRAMMATIC REPRESENTATION BY MODIFIED ISOMETRIC PROJECTION OF

UNDERGROUND WATER CONDITIONS AT COPPERFIELD

4 Miles S.W. of Mt Ida.
NORTH COOLGARDIE GOLDFIELD

SCALES
VERTICAL & HORIZONTAL
FEET 100 0 500 1000 1500 FEET
200 0 1000 2000 3000
DIAGONAL



A A A A and B B B B represent the existing steep North-dipping fault planes.
C C C C and $C^1C^1C^1C^1$ represent the existing shallow South-dipping fault planes.
D D D D and $D^1D^1D^1D^1$ represent the assumed shallow South-dipping fault planes, north of the steep North-dipping fault planes.
W represents the site of bore to enter fracture zone at 400 feet vertical depth.
Note :-
The depth to which water-bearing fracture zones exist is not known.

J.McL

W. Johnson Aug. 1948

Prospecting.

The company is at present confining its activities in the area to development of the single ore body on the Timoni lease G.M.L. 5537z. If at some future date they intend prospecting within the reserve held by them, there are several attractive ventures in sight which could be prospected with a diamond drill at reasonably shallow depth.

Sites have been marked on the map and a programme is laid out below to explore, between 300 feet and 400 feet vertical depth the faulted continuations of known gold producing ore bodies. Also included in this programme are two holes to be bored from the No. 4 level Timoni mine, as there is no geological reason why there should not be parallel ore bories to that being worked in the mine.

TABLE 2.

SUGGESTED PROGRAMME FOR PROSPECTING BY DIAMOND DRILL IN THE VICINITY OF G.M.L. 5537z COPPERFIELD.

No. of Hole.	Location of Hole.	Bearing of Hole.	Angle of of Depression.	Maximum Length of Hole.	Purpose.
				Feet.	
DD_1	Surface, 760 feet on a bearing 271° from N.W. cr. peg G.M.L. 5537z	70°	53°	600	To cut the faulted continuation north of the Timoni ore body at vertical depth 400 feet.
DD_2	Surface, 1070 feet on a bearing 307½° from N.W. cr. peg G.M.L. 5537z	70°	53°	600	Ditto DD_1, but 400 feet north of DD_1.
DD_3	Surface, 828 feet on a bearing 4° from S.E. cr. peg G.M.L. 5537z	66°	57°	550	*To cut the faulted continuation south of the Copperfield ore body at vertical depth 400 feet.
DD_4	Surface, 446 feet on a bearing 30° from S.E. cr. peg G.M.L. 5537z	66°	57°	550	*Ditto DD_3, but 460 feet south of DD_3.
DD_5	No. 4 Level Timoni workings south drive Co-ordinate 530 S.	60°	Horizontal	500	To explore country to east of the Timoni ore body for parallel ore bodies.
DD_6	No. 4 Level Timoni workings south drive Co-ordinate 530 S.	240°	Horizontal	500	To explore country to the west of the Timoni ore body for parallel ore bodies.

Note.—* This ore body may be easily identified by its association with the distinctive coarse grained hornblende-feldspar rock, examples of which occur on the " Copperfield " main shaft dump.

A GEOLOGICAL AND TOPOGRAPHICAL MAP, WITH SECTIONS, OF AN AREA SURROUNDING THE IRON KING AND LADY MILLER MINES, NORSEMAN, DUNDAS GOLDFIELD.

Approximate Latitude: 32° 14′ South.

Approximate Longitude: 120° 48′ East.

By W. Johnson, (B.Sc. Hons.)

The geological and topographical map (Plate XIX) of about half a square mile of country surrounding the Iron King and Lady Miller Mines was completed by the writer in September, 1948, with the assistance of Mr. J Morton, surveyor for Norseman Gold Mines N.L. owners of the Iron King Mine. The assistance of Mr. Morton was obtained through the courtesy of Mr. T. O'Brien, Underground Superintendent of Norseman Gold Mines, N.L.

The primary object of the mapping was to determine the relationship between two jaspilite beds in the Area, one 450 feet east of the main shaft, Iron King Mine, and one 30 feet west of the main shaft, Lady Miller Mine.

The ore body in the Lady Miller Mine is the foot-wall section of the jaspilite. In this ore body the ore shoot pitches 25° north. The secondary object of the survey was to obtain sufficient data to enable the laying out of one or more diamond drill boreholes—to cut, within the Norseman Gold Mines leases, any extension of the Lady Miller ore shoot.

Sufficient factual data being unobtainable it was necessary to make certain assumptions regarding the subsurface structure of the rocks in the Area.

These assumptions are:—

1. The Lady Miller jaspilite horizon has an average dip of 45° west and that it maintains this average without major changes to a reduced level of 1,450 feet on the Norseman Gold Mines datum.

2. That the known pitch (25° north) of the ore shoot in the Lady Miller jaspilite remains constant to the same reduced level.

3. That the ore shoot is centred about the existing No. 5 level drive on the Lady Miller Mine.

4. That the ore shoot actually extends into the boundary of the Iron King leases.

If these assumptions are correct then the boreholes laid out on the outline map and sections should cut the ore shoot.

The estimated thickness of rock between the Iron King and Lady Miller jaspilite beds shown in the table below should provide some check on the accuracy of the above assumptions. Information obtained on boreholes will no doubt modify the assumptions.

BOREHOLE DATA.

No.	Position of Site.	True Bearing of Hole.	Angle of Depression.	Length.	True thickness of rock between foot wall Iron King Jaspilite Bed and Hanging Wall Lady Miller Jaspilite Bed.	Inclined thickness along borehole between F/W Iron King Jaspilite and H/W Lady Miller Jaspilite.
GS_1	No. 5. Level Iron King Mine, East Lode Drive. Mine Co-ordinates 844 East, 2546 North	93° 12′	47°	900 ft.	500 ft. approximately	500 ft. approximately
GS_2	No. 5. Level Iron King Mine, East Lode Drive. Mine Co-ordinates 960 East, 3156 North	95° 30′	70½°	900 ft.	470 ft. approximately	550 ft. approximately

REPORT ON A DEPOSIT OF ANTHOPHYLLITE ASBESTOS TWO MILES NORTH OF BINDI BINDI SIDING ON THE PERTH-MILING RAILWAY.

Approx. Lat. 30° 34′ S
Approx. Long. 116° 20′ E

By W. Johnson, B.Sc. Hons.

INTRODUCTION.

The deposit described in this report is situated on Location 932 of the Midland Railway Company's property. A surveyed area of 53 acres, known as Lot 1 encompasses the deposit and has been transferred to the Midland Mining Company who are at the time of writing (October, 1948) exploiting the deposit. Lot 1 is approximately 40 chains on a bearing S. 25° E. from the north-west corner peg of Loc. 932 and 10 chains west of the 116 mile peg on the Great Northern Highway.

Access can be had to the deposit by rail or road, the distances from Perth being respectively 140 miles and 116 miles. The compay rails its crude anthophyllite from Bindi Bindi Siding to its works at Bassendean —a Perth suburb.

The date of examination was October 18th-20th, 1948.

GENERAL INFORMATION.

Anthophyllite is one of a series of minerals known collectively in their fibrous form as "asbestos." It is the least valuable of the asbestos series because of its limited range of uses. The physical cause of its limitations is the brittleness of its fibres compared with chrysotile and crocidolite asbestos.

Its specific gravity varies from 2.85 to 3.2 equal to a range of 12.5 cubic feet to the ton to 11.2 cubic feet to the ton in the solid. As the anthophyllite at Bindi Bindi breaks out in solid lumps ½ ton and 1 ton metalliferous ore trucks will have approximately their same capacity for anthophyllite.

Western Australian anthophyllite is used locally for boiler lagging, acid resistant filters and oil filters. Only small quantities are used locally. The major part of the Western Australian production is sent overseas. Its usage there is not known.

Publications giving detailed information on anthophyllite and asbestos are—

1925 Ladoo, R. B., Non-Metallic Minerals.

1930 Hall, A. L., Asbestos in the Union of South Africa. *Dept. of Mines and Industries, Geol. Surv., Memoir No.* 12.

1937 Bowles, Oliver, Asbestos. *U.S. Bureau of Mines, Bull.* 403.

GEOLOGY.

The country surrounding the deposit is part of the Great Plateau of Western Australia 15 to 20 miles east of its western edge. The stream pattern is adjusted, in the vicinity of the lease to the structure of the underlying rocks which are predominantly gneisses whose foliation has a regional strike of N.85°W. The stream valleys are at the mature stage of physiographic history, the depth of dissection being about 70 feet.

The rocks in which the anthophyllite veins occur are practically obscured by soil and little of their geology could be observed. The immediate country rock of the veins is extremely weathered and was not observed in its fresh condition. It appears to be a weathered metamorphosed basic or ultrabasic rock and probably a micaceous amphibolite. In the soil overlying the rock and in weathered remnants of the rock, seams and fragments of opaline silica were observed. Elsewhere in Western Australia opaline silica has been observed to be a weathering product of basic and ultrabasic rocks.

Whatever the unweathered rock may be it is replaced in patches by a rock consisting almost entirely of unoriented, non-fibrous anthophyllite.

The other major rock type in the area is a granite gneiss with well defined foliation. The foliation is considered to represent the original bedding planes of an erosion or volcanic sediment converted to granite gneiss by the process of granitisation. The foliation may have been intensified by folding during the granitisation process. The gneiss grades in places into small outcrops of coarse-grained granite.

Geological relations between gneiss and amphibolite may be—

(a) gneiss intrusive into amphibolite;
(b) gneiss faulted against amphibolite;
(c) gneiss represents selective granitisation of favourable horizon in a conformable rock series of which the amphibolite is another member;
(d) the amphibolite represents an original intrusive in the now granitised bedded rocks represented by the gneiss.

Little evidence was observed to support any specific one of the above relations and all may be present. However, the following relations were noted in the field. At one place the contact between gneiss and amphibolite was vertical and nearly normal to the axis of a shallow pitching fold. At another place the contact was parallel to the foliation of the gneiss and a seam of anthophyllite separated the two rock types.

All rocks in the vicinity of the deposit (except the laterite and other superficial deposits) have been folded along axes striking east and west. The dip of foliation in the gneiss varies from 10° north. It is probable that the deposit lies on the limbs of several small, rather open, folds on the limb of a major structure. Several minor folds observed pitched 30° to 40° to the east. It is possible that the folding was accompanied by thrust faulting.

OCCURENCE OF THE ANTHOPHYLLITE VEINS.

Veins of anthophyllite outcrop in irregular fashion over an area 700 feet square. The majority seem to have random strikes and dips uncontrolled by any structural features. One vein, mentioned previously, occurs at a vertical depth of 12 feet in shaft No. 2 at the contact of the amphibolite and flatly dipping gneiss, and other observed flatly dipping veins may be controlled by unobserved flatly dipping fold limbs in the amphibolite. Many veins ramify from a centre and join again at a distance from the centre.

It is suggested here that the anthophyllite veins were formed in the basic rocks during the granitisation of the original associated sediment to form granite gneiss and that the veins represent the iron and magnesia removed from the sediment during granitisation. In other words the anthophyllite veins represent a "basic front."*

Owing to insufficient field evidence this hypothesis remains unproven for the present.

The anthophyllite in the veins consists of cross fibres, slip fibres and mass fibres with slip fibre veins predominating. Slip fibre veins are those in which the fibres are aligned parallel to the longitudinal direction of the vein. The other terms are self-explanatory. The width of the veins varies from 2in. to 3ft., the average width being about 10in. The length of individual fibres is controlled by jointing in the veins at right angles to the fibre but this is not particularly important as anthophyllite is not a textile asbestos.

The deepest vein in the area is 16ft. below the surface and no seam has been followed below the zone of weathering. In this connection an opinion by Hall† is of interest.

"In the prevalent granite gneiss formation of the surrounding area are certain massive igneous rocks rich in magnesia, which have locally developed a fibrous structure under the influence of changes in the zone of weathering; . . . . the formation of asbestic would seem to depend largely on proximity to the present surface. It is possible to collect a series of transitional stages starting with an almost massive magnesian rock, and passing through progressive degrees of fibrous structure to rock rich in, or composed wholly of, asbestic. Persistence of anthophyllite to any great depth is, therefore, doubtful."

* 1947, Reynolds, D. L. The association of basic fronts with granitisation. *Sci. Prog., Vol.* 35, *pp.* 205–219.
† 1930, Hall A. L. *op., cit. pp.* 225–226.

PLATE XIX

G.M.L. 1580

"Iron King East"

Ferruginous quartz vein

NORTH AIR SHAFT

G.M.L. 1641

Saw Pit Gully

"Iron King Extd. East"

G.M.L. 1638

G.M.L. 1502

No 5 LEVEL

Alluvial Workings

Gully

G.M.L. 1639

"Iron King Nth. West"

"Iron King Nth."

MINES

GOLD

Salvado's

"Iron King Nth. East"

N.G.M. Datum

G.M.L. 1481

MAIN CUT

"Iron King"

R.L. No 5 Level at plat 359·29'

CAMPBELL SHAFT R.L. Collar 5·68'

QUEEN CUT

RED WHITE & BLUE CUT

NORSEMAN

CENTRAL

CORPORATION

G.M.L. 1640

"Iron King East"

Morelli's Gully

Shaft with acid lava in dump

G.M.L. 1460

"Red White & Blue"

SOUTH CUT

Ferruginous quartz vein

G.M.L. 1535

"Red White & Blue Sth."

G.M.L. 1406

"Lady Miller West"

Salvado's

Gully

Alluvial Workings

G.M.L. 1353

Possibly some metamorphosed lavas in this band of meta-sediments

"Vini"

No 5 LEVEL R.L. -228·72

LADY MILLER MAIN SHAFT R.L. Collar 39·98' (On N.G.M. datum)

Coarse-grained amphibolite in dump

Old adit

G.M.L. 1347

OLD MAIN SHAFT LADY MILLER

"Old Miller"

—LEGEND—

Coarse-grained amphibolite, metamorphosed basic intrusive.	G
Metamorphosed quartzose sediments, basic sediments, basic lavas and possibly some intrusive rocks.	S
Jaspilite	J
Ferruginous quartz veins, may be oxidised portions of pyritiferous quartz veins.	

REFERENCE TO SIGNS

Observed geological boundaries	.....
Approximate geological boundaries	-------
Assumed geological boundaries	--?---?--
Dip of bedding of sediments	/ 40°
Strike and plunge of dragfold with dip of axial plane.	50° / 70°
Shaft	□
Open cut	
Intermittent stream	

REDUCED LEVELS ON N.G.M. DATUM

—IRON KING—

Campbell Shaft Collar	5·68 feet
No 5 Level Plat	-359·29 "
No 4 Level Plat	-262·12 "
No 3 Level Plat	-187·98 "

—LADY MILLER—

Main Shaft Collar	39·98 feet
No 2 Level	-91·56 "
No 5 Level	-228·72 "

Average dip of East Lode at North Air Shaft 50°W.
Average pitch of Lady Miller Ore Body 25°N.

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL SUBSURFACE MAP

OF

LADY MILLER GROUP

3½ MILES S.E. OF NORSEMAN

DUNDAS GOLDFIELD

Scale: 200 feet to an inch

200 100 0 200 400

Based on survey data obtained from lease plans supplied by Norseman Gold Mines N.L.
Contours on N.G.M. leases transferred from an N.G.M. plan.
Contours on C.N.G.C. leases drawn from plane table traverse.
N.G.M. datum adopted.
Plane table traverse by J. Morton & W. Johnson, Sept., 1948
Geology by W. Johnson, Sept., 1948.
Plan of Levels as at 1st Sept., 1948

PLATE XX

C.M.L. 1580

C.M.L. 1641

Bearing 95°30'
Angle of Dep. 70°30'
Length 900' approx.

North Air Shaft

D.D. Site
G.S. 2.

B.

B.

"Iron King Mine"
No 5 Level
R.L. – 359·29'
on N.G.M. Datum

D.D. Site
G.S.1.

Bearing 93°12'
Angle of Dep. 47°
Length 900' approx.

HORIZON

A.

A.

C.M.L. 1502

NORSEMAN

C.M.L. 1639

CENTRAL

JASPILITE

CORPORATION

NORSEMAN

C.M.L. 1481

GOLD

C.M.L. 1640

MILLER

Campbell Shaft
"Iron King Mine"
R.L. 5·68' N.G.M. datum

GOLD

LADY

C.M.L. 1460

MINES

C.M.L. 1353

"Lady Milleer Mine"
No 5 Levvel
R.L. – 2288·72'
on N.G.M. datum

Main Shaft
"Lady Millen"
G.M. Collar
R.L. 39·98'
N.G.M. Datum

C.M.L.. 1406

C.M.L. 1535

Assumed ore shoot
at surface

West A.

A.

45°

N.G.M. Datum 00'

N°5 Level
Drive

N°5 Level
East Lode
Drive

47°

"Iron King Mine"

D.D. G.S.1.
Bearing 93°12'
Length 900 Feet

C.M.L. 1502

LADY MILLER JASPILITE HORIZON

C.M.L. 1641
and
C.M.L. 1639

ORE SHOOT

– 1150'

— DIAGRAMMATIC SECTION ALONG LINE A.A. ON OUTLINE MAP —
Vertical and Horizontal Scale: 1 Inch = 200 Feet

West B.

B.

N.G.M. Datum 00'

North Air Shaft

45°

N°5 Level
East Lode
Drive
"Iron King Mine"

70°30'

D.D. G.S.2.
Bearing 95°30'
Length 900 Feet

C.M.L. 1580

LADY MILLER JASPILITE HORIZON

C.M.L. 1641

ORE SHOOT

– 1150'

— DIAGRAMMATIC SECTION ALONG LINE B.B. ON OUTLINE MAP —
Vertical and Horizontal Scale: 1 Inch = 200 Feet

— REFERENCE TO SIGNS —

Boundary of "Lady Miller" jaspilite horizon at the surface ------
Boundary of the horizon at R.L. – 1150 Feet —·—·—
Boundary of the "Lady Miller" ore shoot in plan from surface to a depth of 1400 Feet --x---

— LEGEND —

Information Shown

1. The LADY MILLER jaspilite horizon at the surface.
2. The same horizon at an R.L. of – 1150 feet on the NORSEMAN GOLD MINES datum (IRON KING MINE).
3. Plan of the projected extension of the ore shoot in the LADY MILLER jaspilite horizon to an R.L. – 1400 Feet.
4. Two sites for diamond drill boreholes, to cut the assumed extension of the ore shoot in the LADY MILLER jaspilite horizon. Bearing, angle of depression, and length of hole are given.

Data Assumed.

a. Average dip of LADY MILLER jaspilite = 45° West, and that no major changes in dip occur.
b. Pitch of LADY MILLER ore shoot = 25° North, and that this pitch remains constant.
c. Length of ore shoot = 700 feet approx.
d. That the ore shoot extends to a sufficient depth, to pass into G.M.L. 1641 (NORSEMAN GOLD MINES).

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

OUTLINE MAP and SECTIONS OF LADY MILLER GROUP

3½ MILES S.E. OF NORSEMAN

DUNDAS GOLDFIELD

Scale 200 feet to an inch

200 100 0 200 400

Map based on a Geological Map of the Area by W. Johnson, Sept., 1948.

However, Hall is writing of deposits of mass fibre anthophyllite, not concentrated in veins, so that his conclusions may not apply to Bindi Bindi. The general resemblance between the Bindi Bindi and South African occurrences is noticeable. Until more evidence is available no prediction can be made on the physical form at depth of the anthoplyllite at Bindi Bindi.

WORKINGS AND MINING METHODS.

The workings in existence at Bindi Bindi in October, 1948, consisted of; No. 1 open cut, the main open cut approximately 180 feet by 70 feet; three smaller open cuts; four shafts; an indeterminate working (working A) and numerous small potholes, pits and costeans (shown on the map Plate). In all of these workings, except No. 4 open cut, veins and masses of slip fibre anthophyllite are showing. In addition numerous other untouched veins and irregular masses of anthophyllite outcrop in the area.

Only those workings of special interest will be described. The main open cut was excavated by a bulldozer to an average depth of 12 feet below the general surface level. The excavated soil was pushed up into a dump at the west end of the open cut. The amount of anthophyllite obtained from this open cut is not known. Anthophyllite veins are exposed in two pits 5½ feet deep in the floor of the open cuts. Anthophyllite was being dug from these seams with a pick by two men at the time of examination. This anthophyllite was shovelled into half-ton trucks which were hauled out of the open cut up a tramway by a friction winch driven by a 5 h.p. petrol engine.

The only other vein being worked was that in working A. None of the veins outcropping has been investigated methodically by proper development, laterally and in depth. The reason for abandonment of any one working is not apparent as the anthophyllite showing appears identical with that awaiting treatment at the company's plant in Bassendean, except for a slight variation in the amount of iron-staining. Use of a bulldozer in mining thin veins of irregular strike and dip is puzzling, and the whole workings give the impression that little method was used in seeking minable anthophyllite.

The approximate average dimensions of the other open cuts are:—

	ft. Width.	ft. Length.	ft. Depth.
No. 2	20	40	7½
No. 3	12	25	7
No. 4	20	20	9½

TREATMENT.

No gangue in the accepted sense of the word is railed from Bindi Bindi as the ore is selectively mined there by pick and shovel. On arrival at Bassendean the crude lumps of anthophyllite are reduced in size by a Sturtevant inch jaw crusher with a capacity of 8 tons a day. The reduced lumps are then conveyed to a Christie and Norris 30-inch rotary hammer mill (maximum capacity 8 tons a day) which beats the anthophyllite into fibres.

The fibres are then conveyed by air suction to a simple type of vertical cylindrical air separator. The separator has an open bottom and the fibre enters about 24 inches above the bottom. Unfiberized anthophyllite and quartz grains drop out of the separator and the fibre is sucked up the cylinder and delivered to a revolving trommel screen. In the trommel most of the dust and fine impurities are removed. The fibre delivered from the end of the trommel is ready for shipment. Most of the fibre is of one grade only, Standard Bulk Grade, and production is 85 per cent. to 90 per cent. of the crude anthophyllite delivered to the plant. The remaining 10 per cent. to 15 per cent. is oversize from the air separator and dust from the trommel screen. Some small parcels of unstained fiberized anthophyllite have been produced by separate milling of specially selected crude anthophyllite.

ECONOMIC ASPECTS.

The Standard Bulk Grade is worth £22 per ton f.o.b. Fremantle. The buyers state no specification for this grade and from observation of samples awaiting shipment it seems that fairly wide variation in fibre length and iron staining is allowable. The waste or oversize is also saleable at £10 a ton in Australia, so that practically 99 per cent. of the crude anthophyllite landed at Bassendean is saleable.

Under present arrangements costs of production are as follows:—

	Per Ton. £ s. d.
Cost of ore at grass Bindi Bindi ..	3 0 0
Freight to Bindi Bindi Siding (to be reduced to 2s. 6d. per ton if company runs its own truck)	10 0
Rail freight Bindi Bindi to Bassendean	16 9
Estimated treatment costs, assuming mill is kept running continuously at maximum capacity of 8 tons per day ..	1 10 0
Freight Bassendean Fremantle—wharfage etc.	7 0
Total	6 3 9
Administrative and other overhead charges	Not calculable

The economical exploitation of the anthophyllite deposit at Bindi Bindi depends on the following requirements:—

1. Primarily on an adequate supply of anthophyllite from the mine to keep the plant running at full capacity and to meet any future expansion of buyers' requirements. This adequate supply of course depends on proper development of ore reserves at Bindi Bindi.

2. Sufficient contracts from buyers to keep the mill working near full capacity.

3. Reduction of treatment and administrative costs to a minimum.

4. Economical methods of small scale mining. The present gouging by two men with pick and shovel is incapable of supplying sufficient anthophyllite to keep the plant working anywhere near its full capacity.

Unless these requirements are observed the anthophyllite cannot be exploited successfully by a company.

PRODUCTION.

Figures given in the table below represent the amount of treated anthophyllite sold by the company. As noted previously this amount is almost identical with the amount of crude anthophyllite produced from Bindi Bindi. The yearly amounts may be in error as there is likely to be a carry-over of treated anthophyllite from year to year. The total amount is approximately correct.

Period.	Name of Producer.	Tons. (2,000 lb.)	Value. £
1944	Associated Engineers Corp.	23.00	225.65
1945	Midland Mining Co, Ltd.	81.00	870.00
1946	Midland Mining Co., Ltd.	5.00	100.00
1947	Midland Mining Co, Ltd.	75.00	988.00
1948 (Jan./Aug.)	Midland Mining Co., Ltd.	93.00	1,550.00
Totals		277.00	3,733.65

It will be noticed that no yearly production is anywhere near the stated capacity of the treatment plant (2,000 tons a year).

CONCLUSION.

Examination of the Bindi Bindi anthophyllite deposit has disclosed the following facts:—

1. Numerous irregular seams of anthophyllite outcrop on the Midland Mining Company's property.

2. Owing to insufficient exposures and the irregular strike and dip of the seams no estimate of the amount of anthophyllite likely to be available to a given depth can be made.

3. Future prospects of mining at Bindi Bindi cannot be properly assessed until some methodical development has been done on one or more of the veins of anthophyllite.

EQUIPMENT.

The following is a summary of part of the equipment available on the lease. With the possible addition of a medium size water pump this equipment would be adequate to carry out the recommended prospecting programme.

1 Compressor (Centinal series 23); 75 cubic feet per minute, driven by a diesel engine approximately 35 h.p.

1 Air receiver.

2 Water cooling tanks.

1 Diesel engine, Imperial 12½ h.p. and friction winch.

1 New Way petrol engine 5 h.p. and friction winch.

2 Heavy kibbles.

1 Light kibble.

300ft. light steel rails.

4 steel ½-ton mining trucks.

2 Rock drills, Consolidated pneumatic jack hammers.

1 Air hose, filter coupling and line oiler plus valves and fittings.

Quantity drill steel plus 50 jackbits and two shafts for jackbits.

Quantity 1½in. and 1in. air pipe. } Total 1,500 feet.
Quantity 2in., 1½in. and ½in. water pipe. }

2 4ft. x 4ft. plat sheets, steel.

Small blacksmith's shop, equipped.

Small set carpenters tools.

PROSPECTING RECOMMENDATIONS.

Numerous anthophyllite veins outcrop on the surface but little is known of their behaviour in depth. If sufficient demand for anthophyllite asbestos exists to warrant expansion of the amount produced from Bindi Bindi the following preliminary programme of prospecting and development could be carried out with the plant already in existence on the lease.

1. Sink an underlay shaft 5 feet by 3 feet to an inclined depth of 50 feet on the vein of anthophyllite dipping 55° to 65° north in the pit at the west end of the main open-cut. (No. 1 open-cut.)

2. If the vein persists to this depth drive at least 50 feet each way along it at the shaft bottom.

3. A flatly dipping vein exists at the bottom of Shaft No. 2 (see Plate XXI). This vein should be investigated with drives 50 feet long in directions N.50°E. (magnetic) and S.50°W. (magnetic).

4. Sink a trial shaft 10 feet to 20 feet deep at the point marked S6 on Plate XXI. This shaft would test the possibilities of the mass fibre anthophyllite below the surface.

If these operations, which should be conducted in the order outlined above, reveal extensions of anthophyllite then of course more work would be necessary to develop the extensions.

If no extensions are revealed then it is difficult to see that the deposit will be a successful company proposition.

NOTES ON EMU GOLD MINE, AGNEW, EAST MURCHISON GOLDFIELD.

By H. J. Ward, B.Sc., Geological Survey of Western Australia.

CONTENTS.

FIGURE.

GENERAL INFORMATION.

The Emu Gold Mine, the property of Emu Gold Mines Ltd., is managed by Australian Mines Management and Secretariat Ltd., Perth. The mine is situated about three-quarters of a mile west of Agnew townsite (approx. lat. 28° 10′ S., long. 120° 20′ E.).

A graded road gives access to the mine from Agnew. The nearest railhead is at Leonora some 80 miles to the south. All goods are transported from Leonora by motor transport. At the time of inspection (February, 1948), Airlines (W.A.) Ltd., operated an air service between Perth and Agnew.

Postal facilities are available at Agnew and the nearest mining registrar is at Leonora.

Water, for mining and domestic purposes, is available from wells and shafts, as the underground water is fresh. The Emu Mine draws its drinking water from the "Cinderalla Shaft," which is situated approximately 125 chains on a bearing of 344 degrees from the main shaft on the "Waroonga" G.M.L. 1236.

The ground water level is approximately 90 feet. To keep the mine dry two Pomona pumps are in use. One pump is situated on No. 9 level (V.D. 933 feet), the other on No. 8 level (V.D. 799 feet). The water is pumped from No. 8 level to the surface where it is used for milling purposes. The estimated amount of water pumped is 70,000 gallons per day.

At 80 feet below the No. 9 level (V.D. 933 feet) water was struck in a winze (No. 23). The winze is now sealed off by a valve fitted in cement. The pressure on the valve is estimated to be 350 pounds per square inch.

There is a battery with 20-head of stamps of which only 10 were in use. The ore is treated by amalgamation and cyanidation. At the time of inspection approximately 100 tons of ore were treated per day.

There is no suitable timber for mining purposes in the area. Timber for lagging is obtained from Collie at a cost of 1s. 4d. per stick and heavier timber is obtained from Southern Cross at a cost of 27s. for logs 10 feet long and 7 inches in diameter.

The area held by Emu Gold Mines Ltd. embraces some 364 acres. There are 20 gold mining leases which extend over a length of more than two miles. The leases are:

G.M.Ls. 1295, 1249, 1334, 1269, 1310, 1326, 1270, 1311, 1327, 1287, 1236, 1240, 1271, 1312, 1328, 1313, 1304, 1329, 1303, 1302.

Active mining operations are at present solely confined to G.M.Ls. 1311, 1236 (Feb., 1948).

The purpose of the mine inspection, which took place from the 9th to the 18th February, 1948, was to record the geology of the accessible underground workings and to sample where possible the main working faces.

The writer's underground examination was facilitated by the use of up-to-date survey plans and sections provided by the management, for whose ready co-operation and provision of an assistant he is much indebted.

UNDERGROUND WORKINGS.

The main shaft, which is vertical, is situated on the "Waroonga" G.M.L. 1236 and is 216 feet on a bearing of 14 degrees from the south-eastern corner peg of the lease. The main shaft was sunk to intersect the ore-body at an approximate vertical depth of 200 feet. The ore-body has a dip of 60° W., consequently the distance of the ore-body from the main shaft increases with depth below No. 3 level. The main shaft, from which

Magnetic North

GREAT NORTHERN HIGHWAY

RAILWAY LINE

Gneiss

Shaft with headframe
Workings in gneiss

SHAFT 1
R.L. Collar 622'
V.D. 23'

Vein quartz

Slip fibre anthophyllite

Gneiss, strongly folded

No 3 OPEN CUT
V.D. 7'

V.D. 12'

60'

Boulders of gneiss
Slightly foliated

Slight ridge of fibrous anthophyllite

Seams of anthophyllite

WORKINGS A

N50°E
70°

Pothole

Gneiss

R.L. 55·15'

Gneiss boulders
Rudely foliated

Dolerite boulders
(Younger Dolerite)

Soil-covered slope

Boulders of fibrous anthophyllite
scattered throughout

Weathered outcrop of massive and schistose micaceous anthophyllite rock with fragmentary seams of fibrous anthophyllite

R.L. 51·35'

Gneiss

V.D. 8'

Ill defined open cuts
some cross fibre anthophyllite in dump.

R.L. 42·5'

40'

No 4 OPEN CUT
Massive weathered amphibolite in walls of open cut.

V.D. 12'

Seam of anthophyllite in shallow pit

SHAFT A. V.D. 16'
Weathered micaceous greenstone? in dump

LOT I

50'

Soil-covered slope
Strewn with many boulders

SHAFT 3
V.D. 16'

Seam of anthophyllite in shallow pit

Boulders of fibrous anthophyllite

Outcrop of anthophyllite rock

of gneiss

Bottom of pit in open cut, R.L. 258'
showing seam of anthophyllite
12" true width

Open Cut
V.D. 8'

Mullock
Dump from bulldozing of open cut

No 1
MAIN OPEN CUT

R.L. 30'

R.L. 43·6'

SHAFT 2
R.L. 43·2'
V.D. 16'

Shaft sunk through gneiss. Almost horizontal seam of anthophyllite at V.D. 12'.

Weathered massive greenstone?

Engine & friction winch

Old Loading Ramp

Engine & winch

Gneiss

SHAFT S
V.D. 8'

Boulders of fibrous anthophyllite

N70°E

Slip fibre anthophyllite

Tramway

No 2 OPEN CUT

Weathered micaceous amphibolite?

Seam of slip fibre anthophyllite, 10" true width, at base of west face of open cut. 4'6" vertically above bottom seam a cross fibre seam outcrops, the two meet at the north end.

Shallow pits

Workshop & Engine shed

R.L. 49·04'

Gneiss

Outcrop of anthophyllite rock

Dolerite Dyke

Gneiss

30'

40'

Soil-covered slope

Fragments of gneiss in soil

Track

Boulders of gneiss in soil

Outcrop of gneiss

Assumed Datum +20'

20'

Lot 1 situated approximately 40 chains S.20°E. from N.W. corner peg of Loc. 932.

Based on lease survey by H.W.B. Talbot, July 1943 with additional plane table traverse and geology by W. Johnson, Oct. 1948.

Contours based on arbitary datum +20 feet, S.W. corner peg of Lot 1.

LEGEND

- Soil-covered areas. May contain patches of gneiss and anthophyllite rock.
- Younger dolerite (intrusive into gneiss)
- Granite/gneiss intrusive? into anthophyllite rock
- Anthophyllite bearing metamorphosed basic rock. Possibly originally a basic or ultrabasic intrusive

REFERENCE TO SIGNS

- Observed geological boundary
- Approximate geological boundary
- Strike and dip of schistosity — N70°E, 70°
- Strike of vertical schistosity — N70°E
- Strike and dip of foliation in gneiss — 10°
- Strike and dip of anthophyllite vein — 70°
- Outcrop with no observed strike and dip
- Open cuts
- Accessible shaft
- Inaccessible shaft
- Costean
- Track
- Intermittent streams
- Area from which 1ft. to 2ft. of soil has been removed by bulldozer.

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP OF ANTHOPHYLLITE ASBESTOS DEPOSIT

LOT 1, MELBOURNE LOC. 932, MIDLAND RAILWAY COMPANY

2 Miles N. of Bindi Bindi Siding, Perth-Miling Railway

Scale: 1 inch = 100 feet

100 50 0 100 200 300

nine levels have been opened up, has been sunk for a vertical depth of over 930 feet. The reduced levels and vertical depths of the levels are as follows:—

Level.	Reduced Level.	Vertical Depth.
Collar (Main Shaft)	1,300.00 ft.	0.00 ft.
	ft.	ft.
No. 1 Level	1,211.27	88.73
No. 2 Level	1,100.05	199.95
No. 3 Level	1,036.18	263.82
No. 4 Level	936.93	363.07
No. 5 Level	837.31	462.69
No. 6 Level	737.20	562.80
No. 7 Level	633.66	666.34
No. 8 Level	500.95	799.05
No. 9 Level	370.95	929.05
990 Level	317.45	982.55

Accessibility.—Of the workings from the main shaft, none are complete accessible. Those drives and crosscuts which are accessible are either partly stoped overhead or timbered along the walls. The following table will give some idea of accessibility.*

Level.	Total Length of Drives.	Total Length of Corsscuts.	Accessibility (ft.). Drives.	Crosscuts.
	feet.	feet.	feet.	feet.
No. 1	....	.....	Completely Inaccessible	
No. 2	....	....	Completely Inaccessible	
No. 3	1,640	250	270	40
No. 4	1,150	300	180	90
No. 5	....	....	Completely Inaccessible	
No. 6	2,100	550	....	150
No. 7	1,840	300	....	170
No. 8	2,000	830	800	560
No. 9	1,900	655	Accessible	
990	670	210	540	170

The inaccessibility of the workings is generally due to the weakness of the footwall country which is highly sheared adjacent to the lode. With the removal of the ore the footwall has collapsed into the stopes; for example, between April and May, 1947, the ground between No. 6 and 7 level collapsed at 150 feet and 170 feet respectively from the main shaft, and fell into the stopes above No. 8 level. On the 990 level there are more recent examples of the weakness and movement of the footwall country. The main shaft is not truly vertical between No. 3 and No. 4 levels. This is due to movement of the country after the shaft was sunk, through the lode between these levels.

On all levels below No. 3 level, the ore-body has been developed by crosscutting westwards along the main shaft and driving to the north and south along the hanging wall of the lode. The crosscut from the main shaft to the ore-body is termed the main west crosscut. On each level below No. 3 level the ore-body increases in width to the north of the main west crosscut. The increment in width pitches between 70°-80° N. It has been found that the highest gold values occur in shoots adjacent to the hanging wall and footwall of the lode. Hence north of the main west crosscut to the lode, where the lode increases in width from about 10 feet to 120 feet, driving along the footwall of the lode as well as the hanging wall has taken place. The footwall drives are not continuous. They are generally opened up by crosscuts from the north hanging wall drive.

MINE GEOLOGY.

There was no surface geological mapping performed but the following observations can be made.

The mine is in an area of metamorphosed ultrabasic rocks and sediments, which have been intruded by porphry dykes, all of which are of pre-cambrian age.

The series has a general north strike and a dip of approximately 60° W. In the vicinity of the main shaft on the "Waroonga" G.M.L. 1236 there is a change in strike due to folding. The strike changes from the north to N. 40° E.

In underground mapping the rocks were mapped as metamorphosed ultrabasic rocks, metamorphosed sediments (gneiss), and lode. No porphyry dykes were seen underground, but they have been located by diamond drilling.†

Metamorphosed Ultrabasics.

These rocks form the footwall to the lode. They vary from talcose, chlorite-carbonate schists to fine-medium to coarse grained actinolite rocks. The coarse grained variety of actinolite rock does not occur very often in the footwall country. A banded coarse grained actinolite rock was observed in the main west crosscut on No. 3 level, approximately 30 feet from the main shaft.

Metamorphosed Sediments.

These rocks form the hanging wall of the lode from which they can be easily differentiated. The sediments have been metamorphosed to biotite, actinolite gneiss. Locally they have been termed "slates," on account of the manner in which they fracture. Adjacent to the lode the gneiss has been silicified and mineralised.

The Lode.

The lode consists of medium to coarse grained actinolite rock, partly biotitic, which has been silicified and mineralised. Quartz occurs as reefs, veins, and veinlets within the lode. Montgomery‡ states, "In Nos. 5 and 6 levels there has been a very favourable change, large lenses of quartz of typical reef character replacing the "formation" material of the higher levels, and carrying better values. . . . . At the time of my visit the faces of quartz that were being driven upon were six to eight or more feet wide. . . . ."

The coarse grained actinolite rock has been formed by a higher degree of metamorphism of the ultrabasic rocks. The lode is distinguishable from the ultrabasic rocks of the footwall country by a diminution in gold values and the occurrence of talcose, carbonated, biotite schist along the footwall of the lode.

The lode has been proved over a length of 2,000 feet and a depth of 960 feet. The width of the lode varies from approximately six feet to 120 feet. About 600 feet of the lodge has an average width of 15 feet, whilst the remainder has an average width of 100 feet.

Structure.

From underground observations it appears that the mine is situated on the nose of a synclinal fold which has a westerly pitch of approximately 60 degrees. The main south drives along the contact of the lode with the gneiss (namely, the hanging wall) are on the southern limb of the fold and those drives north of the main west crosscuts are situated on the nose of the fold. The northern limb of the fold has not yet been exposed.

Minor faulting has occurred but the effect on mining methods are negligible. The fault, which is situated 35 feet south of 7N winze in the hanging wall drive on No. 8 level, displaces the contact of the lode with the gneiss approximately eight feet to the east on the northern side of the fault. The fault has an approximate east strike and a dip of 70° N. on this level. On No. 9 level the fault dips 55° N. It is thought to be a post gold fault.

Ore Deposition and Mineralisation.

The ore-bearing solutions were introduced after folding had occurred. The coarse grained actinolite rock, which resulted from the metamorphism of the ultrabasic rocks, was silicified and mineralised to form the lode.

* Information from plans supplied by Emu Gold Mines, Limited.
† *See* Diamond Drill logs, Mines Department.
‡ Montgomery, A. Department of Mines Report, Progress of Mining in Districts of Leonora and Wiluna 1909, p. 55.

It is thought that the quartz has replaced folds in the coarse grained actinolite rock. This statement is hard to substantiate but the arrangement of lenses of quartz in No. 2 east crosscut on No. 9 level suggested replacement. Throughout the accessible workings the quartz generally occurs as lenses of varying size in the coarse grained actinolite rock. Around the quartz the actinolite is generally light coloured, becoming dark green further away from the quartz.

Sulphides, occurring in the mine, are arsenopyrite and chalcopyrite, the former predominating.

The hanging wall country (metamorphosed sediments) has been mineralised up to 20 feet away from the lode but there is little or no gold occurring therein.

Mineralisation has not extended strongly into the footwall country, small amounts of chalcopyrite having been observed.

The gold occurs in shoots which are approximately vertical or else pitch steeply to the north. These shoots are confined to the hanging wall and footwall of the lode.

At the northern extremities of the workings an ore shoot occurs between Nos. 7 and 9 levels. This shoot has a dip of 60°W, a pitch which is almost vertical and a strike of approximately N.20°W. The strike of the shoot is not parallel to the footwall or the hanging wall of the lode. The shoot branches off the footwall of the lode but does not continue to the hanging wall. It is called the *Cross Lode.*

Further investigations should determine the manner in which folding controlled the formation of ore shoots within the lode.

REMARKS.

At the time of inspection (February, 1948) there were no ore reserves and no development work was in progress. In short, the mine was on the point of closing down*. The lack of development work prior to December, 1947, has been attributed to the war (1939-1945) and its aftermath.

The ore has to be transported, by manual labour in half ton trucks for distances greater than 1,000 feet to the main shaft.

Future development of the orebody necessitates a new main shaft, the site of which will have to be further north and east of the present main shaft.

A thorough geological examination of the mine is recommended, especially as it is thought that the lode will decrease in thickness as driving is continued northwards. The location of orebodies on the noses of folds to the south of the mine should not be overlooked.

PRODUCTION.

The following table, compiled by the Mines Department Statistician shows the production of gold from the ground held by Emu Gold Mines Ltd.

A graph (Fig. 6) has been prepared from these figures. It illustrates the peak periods of production and the average grade of the ore treated.

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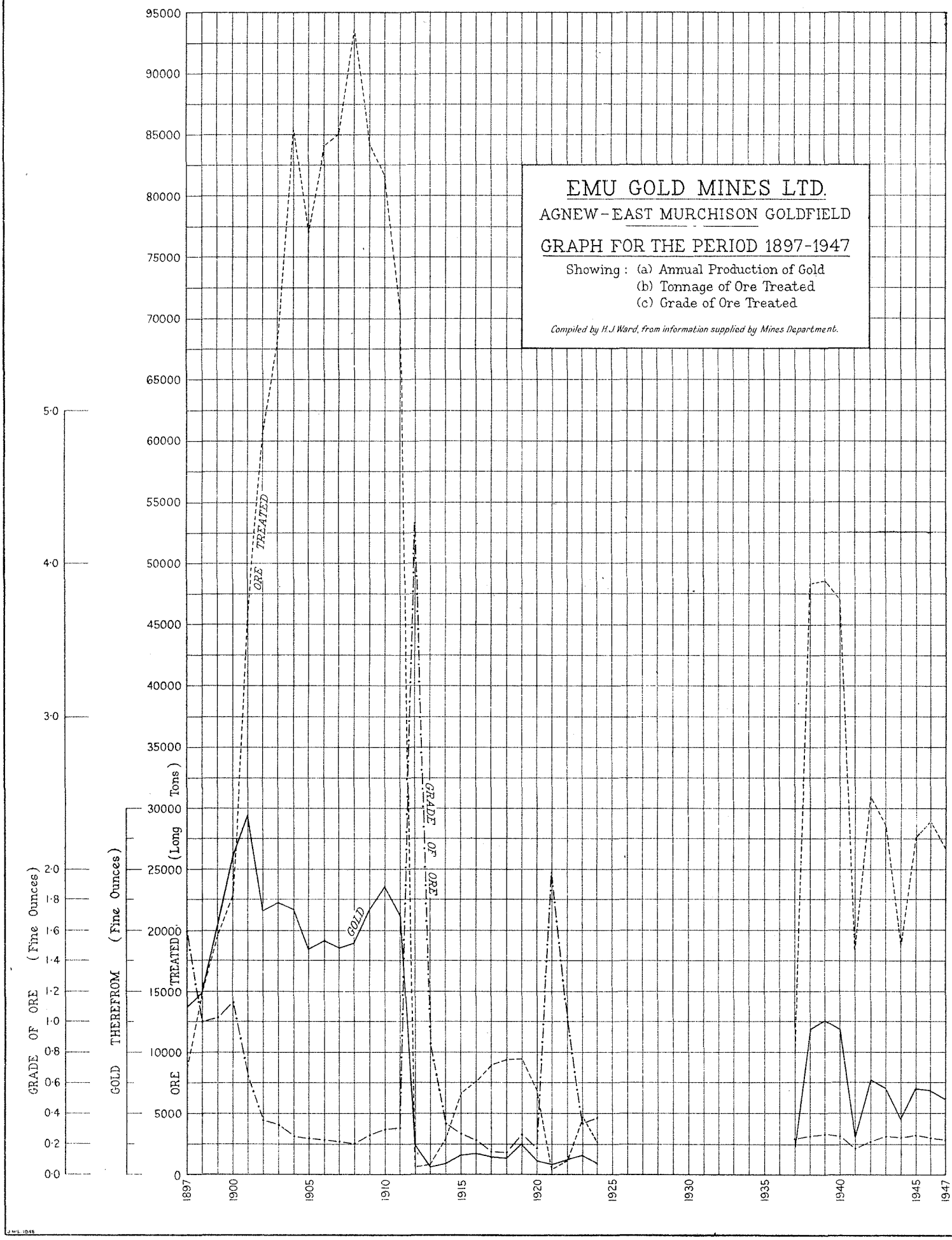
* Since this report was compiled (May, 1948) underground equipment has been brought to the surface and the water allowed to rise.


EMU GOLD MINES LTD.
AGNEW-EAST MURCHISON GOLDFIELD
GRAPH FOR THE PERIOD 1897-1947
Showing : (a) Annual Production of Gold
(b) Tonnage of Ore Treated
(c) Grade of Ore Treated
Compiled by H.J Ward, from information supplied by Mines Department.
GRADE OF ORE (Fine Ounces)
GOLD THEREFROM (Fine Ounces)
ORE TREATED (Long Tons)
ORE TREATED
GRADE OF ORE
GOLD
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
3.0
4.0
5.0
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
55000
60000
65000
70000
75000
80000
85000
90000
95000
1897
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1947

RECORD OF PRODUCTION FROM GROUND HELD BY EMU GOLD MINES LTD.

Name of Lease or Company.	Lease Numbers.	Period of Production.	Alluvial.	Dollied.	Ore Treated.	Gold Therefrom.	Total Gold.	Grade dwts. Gold per Ton.	Silver.	Remarks.
			Fine oz.	Fine oz.	Tons.	Fine ozs.	Fine ozs.		Fine ozs.	
Talcarini	1295	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Wait-a-Bit	393	1899	....	....	128·20	32·63	32·63	....	....	
Esmeralda	599	1902–03	....	....	303·00	119·38	119·38	....	....	
Rajah	889	1905	....	....	867·00	229·59	229·59	....	....	
Rajah Leases	889, 895	1906–11	....	....	2,998·00	916·01	916·01	....	....	
Rajah	1178	....	....	....	....	....	....	....	....	*See* Waroonga G.M. Co., Ltd.
Waroonga	1249	1935–36	13·02	....	168·50	77·29	90·31	....	....	*See* also Emu G.Ms., Ltd.
Waroonga Extended Deeps	1334	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga North East	1269	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Commonwealth	482	1900–01	....	....	189·00	113·01	113·01	....	....	
Waroonga North	603	1902–05	....	....	690·00	273·03	273·03	....	....	
Waroonga North	918	....	....	....	....	....	....	....	....	*See* London and Western Australian Exploration Co., Ltd. *See* Northern Mines, Ltd. *See* Waroonga G.M. Co., Ltd.
Waroonga Extended South	1310	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga Extended South Deeps Joker	1326, 948	1907	....	....	28·00	21·11	21·11	....	....	*See* Emu G.Ms., Ltd.
Waroonga East	1270	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga	58	1898–99	....	....	2,438·50	2,755·45	2,755·45	....	....	*See* also East Murchison United, Ltd. *See* also London and Western Australian Exploration Co., Ltd. *See* also Northern Mines, Ltd. *See* also Waroonga G.M. Co., Ltd.
Waroonga North	1311	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga Deeps No. 1	811	....	....	....	....	....	....	....	....	*See* East Murchison United, Ltd. *See* London and Western Australian Exploration Co., Ltd. *See* Northern Mines, Ltd.
Waroonga Deeps	1327	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga No. 1	1287	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga G.M. Co., Ltd.	1236	1928–32	....	Sands Treatment Only		1,103·80	1,103·80	....	....	
Waroonga	1236	....	....	....	....	....	....	....	....	*See* also Emu G.Ms., Ltd.
Waroonga West	1240	1931–32	....	Sands Treatment Only		35·84	35·84	....	....	*See* also Emu G.Ms., Ltd.
Waroonga South East	1271	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga South Leases	62, 562, 563	1899–1903	....	....	42,150·00	14,329·48	14,329·48	....	....	*See* also East Murchison United, Ltd. *See* also London and Western Australian Exploration Co., Ltd. *See* also Northern Mines, Ltd. *See* also Waroonga G.M. Co., Ltd.
Emu	1312	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga South Deeps	562	....	....	....	....	....	....	....	....	*See* Waroonga South Leases. *See* also East Murchison United, Ltd. *See* also London and Western Australian Exploration Co., Ltd. *See* also Northern Mines, Ltd.

RECORD OF PRODUCTION FROM GROUND HELD BY EMU GOLD MINES LTD.—*continued.*

Name of Lease or Company.	Lease Numbers.	Period of Production.	Alluvial.	Dollied.	Ore Treated.	Gold Therefrom.	Total Gold.	Grade dwts. Gold per Ton.	Silver.	Remarks.
			Fine oz.	Fine oz.	Tons.	Fine ozs.	Fine ozs.		Fine ozs.	
Emu Deeps	1328	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga South Extended	563	....	....	....	....	....	....	....	....	*See* Waroonga South Leases. *See* also East Murchison United, Ltd. *See* also London and Western Australian Exploration Co., Ltd. *See* also Northern Mines, Ltd.
Emu Extended	1313	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga South Extended No. 1	218	1899	....	....	209·00	193·40	193·40	....	....	
Waroonga South No. 1	1304	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
New Woman North	1329	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
New Woman Leases	78, 320	1899–1903	....	....	896·30	944·05	944·05	....	....	
New Woman	858	1904–07	....	....	402·50	390·48	390·48	....	....	
Tarwong	1106	....	....	....	....	....	....	....	....	*See* Northern Mines, Ltd.
Waroonga South No. 3	1302	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Waroonga South No. 2	1303	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Eastern United Extended	377	1899–1900	....	....	106·00	69·72	69·72	....	....	*See* also East Murchison United, Ltd. *See* also London and Western Australian Exploration Co., Ltd. *See* also Northern Mines, Ltd.
Great Eastern	1171	1914–15	....	....	927·00	337·72	337·72	....	....	
Great Eastern Leases	1171, 1186	1915–19	....	....	1,601·74	1,352·43	1,352·43	....	....	
Great Eastern	1171	1921–24	....	....	217·00	168·80	168·80	....	....	
Great Eastern	1319	....	....	....	....	....	....	....	....	*See* Emu G.Ms., Ltd.
Great Eastern	155	....	....	....	....	....	....	....	....	*See* East Murchison United, Ltd. *See* London and Western Australian Exploration Co., Ltd. *See* Northern Mines, Ltd.
True Blue South	158	....	....	....	....	....	....	....	....	*See* East Murchison United, Ltd. *See* London and Western Australian Exploration Co., Ltd. *See* Northern Mines, Ltd.
Great Eastern West	1318	....	....	....	....	....	....	....	....	*See* Emu G.M.s, Ltd.
East Murchison United, Ltd.	22, 58, 62, 37, 70, 155, 156, 157, 158, 385, 426, 427, 376, 377, 459, 474, 500, 508, 509, 510, 511, 512, 552, 562, 563, 573, 811, 840, T.L. 8	Previous to 1897–1905	....	....	291,797·00	155,594·26	155,594·26	....	900·48	
London and Western Australian Exploration Co., Ltd.	37, 58, 62, 70, 155, 156, 157, 158, 376, 377, 381, 385, 399, 426, 427, 459, 474, 500, 508, 509, 510, 511, 512, 552, 562, 563, 573, 811, 840, 916, 918, T.Ls. 6, 7, 8, 10	1905–07	....	....	179,563·00	40,438·14	40,438·14	....	2,560·31	

Northern Mines, Ltd.	22, 37, 58, 62, 70, 155, 156, 157, 158, 376, 377, 381, 385, 399, 426, 427, 459, 474, 500, 508, 509, 510, 511, 512, 552, 562, 563, 573, 811, 840, 916, 918, 929, 947, 1053, 1106, 1109, 1110, 1123, 1160	1907–15	....	....	398,856·50	102,005·52	102,005·52	....	8,356·89
Waroonga G.M. Co., Ltd.	58, 62, 918, 1178	1915–26	....	3·27	55,416·00	13,455·56	13,458·83	....	....
Emu G.Ms., Ltd.	1240, 1236, 1249, 1269, 1270, 1271, 1287, 1925, 1302, 1303, 1304, 1310, 1311, 1312, 1313, 1318, 1319, 1326, 1327, 1328, 1329, 1334	1937–47	....	....	333,557·68	81,558·04	81,558·04	....	452·00

EXAMINATION OF BORE CORES FROM PHOENIX GOLD MINES LTD., COOLGARDIE DISTRICT.

BY H. J. Ward, B.Sc., Geological Survey of Western Australia.

In 1947, the cores from Borehole Nos. 44, 45, 46, 47, and 50, were kindly made available by the Management. The results of examination are contained in the following tables.

Reference should be made to underground mine plans held by the Mines Department, Perth, and also a report on Bayleys Group, Coolgardie District.*

No core specimens were retained by the Geological Survey.

TABLE 1.

PHOENIX GOLD MINES, LTD., COOLGARDIE.

BOREHOLE No. 44.
LEVEL: No. 10 Level Price's Shaft.
CO-ORDINATES OF COLLAR 1007.89 S. BEARING—
1298.06 W. Assumed : 131° 39′
True : 68° 19′
Inclination: Horizontal.
Petrology by: H. J. Ward.

Core.				Remarks.
ft.	ins.	ft.	ins.	
0	0 to	31	0	Fine grained ultrabasics. Mineralised with pyrite, pyrrhotite 15 ft. to 20ft
31	0 ,,	41	0	Minerlised porphyry.
41	0 ,,	53	0	Talcose ultrabasics.
53	0 ,,	80	0	Silicified schistose ultrabasics.
80	0 ,,	99	0	Mineralised ultrabasics.
99	0 ,,	111	6	Milky quartz mineralised with pyrite at 105½. Mineralisation more intense, pyrite and pyrrhotite.
111	6 ,,	112	6	Mineralised porphyry.
112	6 ,,	114	6	Mineralised graphitic schists.
114	6 ,,	137	6	Coarse grained, mineralised ultrabasics.
137	6 ,,	138	0	Porphyry
138	0 ,,	146	0	Partly mineralised dense ultrabasics.
146	0 ,,	209	5	Porphyry. Mineralised and silicified 180 ft. 0 ins. to 181 ft. to 0 ins., Silicified 205 ft. 0 ins. to 207 ft. 0 ins.
209	5 ,,	250	0	Ultrabasics— At 209 ft. 5 ins. to 227 ft. 0 ins. Coarse grained radiating actinolite rock. Shears at 237 ft. 0 ins., 241 ft. 0ins. and 237 ft. 0 ins. to 250 ft. 0 ins.
250	0 ,,	260	0	Sheared fine to medium grained ultrabasics with veinlets of quartz.
260	0 ,,	264	0	Fine grained ultrabasics—(? shear zone).
264	0 ,,	279	0	Fine grained ultrabasics.
279	0 ,,	400	0	Fine to medium grained ultrabasics. Shears at 280 ft., 299 ft., 304 ft. 331 ft. to 333 ft. Silicified. 337 ft. 0 ins. to 337 ft. 1 in. quartz. 339 ft. shear 335 ft. 6 ins. of quartz. This is in the faulted horizon of Price's Lode. No gold values on assay. 359 ft. 0 ins. 1½ ins. of quartz. End of hole at 400 ft. in fine to medium grained ultrabasics.

TABLE 2.

PHOENIX GOLD MINES, LTD., COOLGARDIE.

BOREHOLE No. 45.
LEVEL: No. 10 Level Price's Shaft.
CO-ORDINATES OF COLLAR 1283.58 S. BEARING—
1393.45 W. Assumed 139° 37′
True 67° 35′
INCLINATION: 6° 30′ (Depression).
PETROLOGY BY: H. J. Ward.

Core.				Remarks.
ft.	ins.	ft.	ins.	
0	0 to	55	0	Fine to medium grained ultrabasics with pyrrhotite and quartz veinlets.
55	0 ,,	57	6	Mineralized graphitic schists.
57	6 ,,	77	0	Ultrabasics.
77	0 ,,	96	0	Mineralised (pyrite) ultrabasics.
96	0 ,,	100	0	Silicified and mineralised ultrabasics.
100	0 ,,	110	0	Quartz mineralised with pyrite.
110	0 ,,	119	0	Mineralised and silicified porphyry.
119	0 ,,	126	6	Fine to medium grained ultrabasics.
126	6 ,,	188	0	Mineralised and hybridised porphyry.
188	0 ,,	190	0	Slightly mineralised ultrabasics.
190	0 ,,	200	0	Porphyry.
200	0 ,,	296	6	Fine grained ultrabasics. Shears at 281 ft., 283 ft., 293 ft.
296	6 ,,	297	0	Quartz.
297	0 ,,	396	0	Fine to medium grained ultrabasics with quartz veinlets. Shears at 329 ft., 363 ft., 294 ft. Hole ends at 396 ft.

* Ward, H. J. Geological Survey of Western Australia. Annual Report 1946, pp. 8–20.

TABLE 3.

PHOENIX GOLD MINES, LTD., COOLGARDIE.

BOREHOLE No. 46.

LEVEL: No. 13 Level Price's Shaft.

CO-ORDINATES OF COLLAR 612 S. 317W. BEARING— Assumed 239° True 166°

INCLINATION: 72° Depression.

PETROLOGY BY: H. J. Ward.

Core.				Remarks.
ft.	ins.	ft.	ins.	
0	0 to	12	6	Porphyry.
12	6 ,,	110	0	Mineralised ultrabasics with pyrite and pyrrhotite. 3 ins. of quartz at 102 ft. Shear at 107 ft.
110	0 ,,	130	6	Mineralised porphyry.
130	6 ,,	131	0	Mineralised and silicified graphitic schists.
131	0 ,,	152	3	Porphyry, with quartz veinlets. Both mineralised.
152	3 ,,	153	0	Mineralised graphitic schists.
153	0 ,,	200	0	Dense fine-grained greenstone (? Basic lava). End of hole at 200 ft.

TABLE 4.

PHOENIX GOLD MINES, LTD., COOLGARDIE.

BOREHOLE No. 47.

LEVEL: No. 13 Level, Price's Shaft.

CO-ORDINATES OF COLLAR 612 S. 317 W. BEARING— Assumed 239° True 166°

INCLINATION: 65° Depression.

PETROLOGY BY: H. J. Ward.

Core.				Remarks.
ft.	ins.	ft.	ins.	
0	0 to	13	0	Porphyry.
13	0 ,,	25	6	Fine grained ultrabasics.
25	6 ,,	27	6	Ultrabasics, mineralised with pyrite and pyrrhotite.
27	6 ,,	109	0	Fine to medium grained ultrabasics, with pyrite and pyrrhotite.
109	0 ,,	138	0	Porphyry.
138	0 ,,	138	6	Mineralised graphitic schist.
138	6 ,,	140	0	Quartz, slightly mineralised.
140	0 ,,	142	0	Mineralised porphyry with some graphitic schist.
141	0 ,,	142	0	Quartz, mineralised.
142	0 ,,	162	0	Mineralised porphyry. 4 ins. of quartz at 153 ft.
162	0 ,,	165	0	Mineralised and silicified graphitic schist.
162	0 ,,	201	0	Dense fine grained greenstone (? Basic lavas). End of hole at 201 ft.

TABLE 5.

PHOENIX GOLD MINES, LTD., COOLGARDIE.

BOREHOLE No. 50.
LEVEL: No. 5 Level, Bayley's South Shaft.
CO-ORDINATES OF COLLAR 1454 S. BEARING—
1525 W. Assumed 258°
962 ft. R.L. True 185°
INCLINATION: Horizontal.
PETROLOGY BY: H. J. Ward.

Core. ft.	ins.		ft.	ins.	Remarks.
0	0	to	1	10	Ultrabasics, fine to medium grained.
1	10	,,	2	4	Quartz (not mineralised).
2	4	,,	25	0	Ultrabasics.
35	0	,,	37	8	Mineralised graphitic schists.
37	8	,,	38	6	Quartz.
38	6	,,	39	0	Mineralised graphitic schist.
39	0	,,	47	6	Coarse grained ultrabasics (actinolite rock).
47	6	,,	53	0	Mineralised graphitic schist.
53	0	,,	63	0	Porphyry.
63	0	,,	70	6	Mineralised graphitic schist.
70	6	,,	71	0	Mineralised ultrabasics.
71	0	,,	79	0	Fine to medium grained ultrabasics.
79	0	,,	79	6	Mineralised greenstone (? Basic lavas).
79	6	,,	81	0	Quartz.
81	0	,,	82	0	Mineralised fine grained greenstone (? Basic lavas.)
82	0	,,	84	0	Fine grained greenstone (? Basic lavas).
84	0	,,	94	0	Mineralised fine grained greenstone (Basic lavas).

NOTES ON THE PORPHYRY-PORPHYRITE SERIES OF COOLGARDIE, COOLGARDIE GOLDFIELD.

By H. J. Ward B.Sc., Geological Survey of Western Australia.

CONTENTS.

INTRODUCTION.

Throughout the Central Goldfields of Western Australia the relationship of porphyries to ore deposition has created interest. In this respect the porphyries of Coolgardie are not unique, as the majority of all large ore bodies in the vicinity of Coolgardie have been found adjacent to members of the porphyry-porphyrite series. Matheson* discussed the general features of this series as determined in the 1946 Field season. Further work has confirmed these general relationships.

OCCURRENCE.

Members of this series (hereafter referred to as porphyries) are intrusives into members of the Older Greenstone Formation. They occur as concordant and discordant intrusives, the concordant type predominating.

Porphyries are found more frequently in the Ultrabasic belts, as delineated by Matheson† and continued by McMath†, and as concordant intrusives in metamorphosed erosion sediments, represented by grey, graphitic schists and slates. The porphyries have been observed to follow the strike of these metamorphosed erosion sediments for several miles without showing any discordant intrusive arms. Probably the best illustration of this feature is that porphyry which is found at the eastern formation junction of the metagabbro (amphibolite) with basic lavas‡. In some places partial assimilation of these metamorphosed erosion sediments by the porphyries has resulted in a bluish grey colour of the porphyries. These characteristics have been reported from Kalgoorlie § (viz. Boulder Dyke), Golden Ridge§ and Binduli§.

The intersection of two porphyries is suspected but not proved in the Burbanks Group*. Both porphyries are similar in composition and are presumed to be comagmatic.

In both the Basic Lava and Ultrabasic belts the porphyries exhibit changes in strike which have been interpreted as due to folding. Examples of this are to be found at the Hampton Group, Bakers' Find and the late "Bellbird" Gold Mine, south of Burbanks. The aplitic intrusions† of the Tindals Mine are thought to be sharply folded intrusives.

PETROLOGY.

Generally speaking, the porphyries are hard, light coloured rocks and are well jointed. In underground workings their hardness and jointing readily distinguish them from the surrounding greenstones, when the walls of drives and crosscuts are obscured by dirt and dust. Any variation in the colour of the porphyries is due, as a rule, to the partial assimilation of graphitic schists and slates or the invaded greenstones. In both instances a darker coloured rock is produced along the walls of the porphyry intrusion. Included in the series are rocks which range in texture from a fine textured aplite to a rock with medium sized phenocrysts in a granulitic groundmass.

The porphyry, exposed in the cutting 3½ miles east of Coolgardie, on the Coolgardie-Kalgoorlie railway line, has a texture which ranges from granulitic to porphyritic. It consists predominantly of *albite* and *quartz*—the *albite* occurring as phenocrysts and in the groundmass. *Muscovite, biotite* and *limonite* are found in the rock.

The aplitic intrusions of Tindals mine have been discussed by Miles‡ who observed changes in texture in individual intrusives. The textural changes were from aplitic to granitic.

When there is a distinct porphyritic texture in these rocks the phenocrysts usually consist of *albite* felspar and *quartz*. *Oligoclase* felspar has been observed infrequently. It has been noted that with a granular groundmass the *quartz* phenocryysts are not so common as when the groundmass is fine grained. In some specimens *quartz* phenocrysts only, occur, and a sedimentary origin has been suggested.§

The groundmass may be fine grained or coarse and granular. It generally is found to consist of *albite* felspar, and *quartz* with some *actinolite* and *biotite*. Common accessory minerals are *ilmenite, apatite* and sometimes *sphene*.

Hybridisation of the porphyries by the greenstones has been mentioned. An excellent example of the hybridisation of a quartz albite porphyry by the already consolidated ultrabasic rocks was obtained from the No. 4 diamond drill hole, G.M.L. 316. Hampton Block 59 at 272 feet from the collar. Sections cut (G.S. W.A. Reg Nos. 7161, 7162, 7163) show a gradual change from a radiating coarse grained actionolite rock with interstitial felspar, to a quartz albite porphyry with abundant biotite in a rather coarse grained groundmass. The unaltered rock, a quartz albite porphyry with a fine grained groundmass without biotite, is found at the centre of the intrusive (approximately at 280 feet from the collar of the drillhole).

RELATION TO ORE DEPOSITION.

This series, in many places intimately associated with ore bodies, is regarded as being connected with ore deposition from a structural aspect only. In this they are similar to the albite prophyries of Kalgoorlie‖ and the quartz porphyry of Golden Ridge‖. Honman, working in the Golden Ridge area, concluded that prior to ore deposition there was a "formation of fractures or spaces. . . . . in the porphyry, and a subsequent filling with quartz." He also proved that there was post ore faulting.

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* Matheson, R. S. Geol. Surv. of W.A. Ann. Rep. 1946.
† *Vide* Geol. Surv. of W.A. Ann. Rep. 1946, 1947.
‡ Ward, H. J. Geol. Surv. of W.A. Ann. Rep. 1947. "Three Mile Hill Group."
§ Gustafson and Miller, Proc. Aust. Inst. Min. & Met. New Series X906.
§ Honman, C. S. Geol. Survey of W.A. Bull. 66.
§ Honman, C. S. Geol. Survey of W.A. Bull. 56, p. 28.

* Ward, H. J. Geol. Surv. of W.A. Ann. Rep. 1946. "Burbanks Group."
† Miles, K. P. Geol. Surv. of W.A. Ann. Rep. 1945. "Tindals Group."
‡ Miles, K. R. Report of the Dept. of Mines of W.A. 1945, p. 98.
§ Ward, H. J. Geol. Surv. of W.A. Ann. Rep. 1947. Londonderry Felspar Group.
‖ Gustafson and Miller. Proc. Aust. Inst. Mining & Metallurgy, June, 1937, Vol. No. 106 New Series.
‖ Honman, C. S. Geol. Surv. of West Aust. Bull. 66, p. 45.

At Coolgardie, the same general structural history has been attributed to the porphyries*

Investigation of a number of ore deposits has shown that the porphyries, on account of being more competent rocks, were less susceptible to shearing. Folding of the porphyries produced extensive fracturing at the noses of folds. The less competent greenstones (particularly those in the ultrabasic belts) sheared as well as folded. Shearing movement was greatest in the vicinity of porphyry intrusive contacts as they would provide easy relief under folding stresses. It is along these planes of shearing, so produced, that ore has been deposited.

Ore deposition related to porphyries may be discussed in two divisions:—

1. Ore deposition in porphyries.
2. Ore deposition adjacent to porphyries.

1. *Ore Deposition in Porphyries.*

The aplitic lodes of Tindals and the "Brown Lode" G.M.L. 316, Hampton Block 59, are the two principal occurrences of ore deposition in porphyries.

The writer has not seen the relationship of the aplitic and "silicified" lodes of Tindals as described by Miles†. Working under unfavourable mapping conditions and in a restricted area Miles gained the impression that the aplite was "injected into the cooling, though in places "silicified" lode material in the main lode." Further, he regarded mineralisation as being introduced at a late stage in "the intrusion of the aplite and as an end product of the aplitic magma." Also, he concluded that the aplites are post folding intrusives.

The aplite intrusives at Tindals Mine are included in the porphyry-porphyrite series of intrusives, hence the above conclusions have to be reviewed if they are to agree with the present concept of the geological history of Coolgardie.

It is more likely that the manner of mineralisation at Tindals is comparable to that of the "Brown Lode" G.M.L. 316 Hampton Block 59.

The "Brown Lode" G.M.L. 316 *Hampton Block* 59.

The ore body on this lease is situated in a porphyry intrusive which has been hybridised, mineralised and jointed. It is thought that the mineralising solutions penetrated the most extensively shattered portions of the porphyry. This mineralisation has resulted in the formation of the hard "silicified" bands which are exposed at the 68ft. level‡. Microscopic examination of specimens (G.S. W.A. Reg. Nos. 7159, 7157, 7156) from these bands showed that they consist principally of *albite* and *quartz* together with *biotite muscovite* and some *microcline*. Sulphide minerals present are *pyrite* and *pyrrhotite*. These are also minute needles of *rutile* and scattered grains of *ilmenite*. All minerals have a roughly parallel orientation.

The "silicified" bands can be easily delineated from the porphyry footwall and the hybridised porphyry hanging wall.

The footwall rock is a quartz-albite porphyry (G.S.W.A. Reg. No. 7158) in which the phenocrysts are idiomorphic crystals of *albite* and *quartz*. These are set in groundmass of fettered laths of *albite*, scattered *actinolite, biotite* and a little *quartz*, together with small crystals of *apatite* and *ilmenite* partially altered to *leucoxene*.

The hanging wall rocks are not quartz porphyries, but are regarded as hybridised porphyries. Microscopic examination§ shows that these rocks consist of radiating aggregates of *actinolite* and crystals of brown *biotite* in a microcrystalline groundmass of *albite, oligoclase* and *quartz*. Accessory minerals are *ilmenite, apatite* and *sphene*. Weathering has yielded *leucoxene, limonite* and some *kaolin*. These rocks are presumed to be the result of hybridisation of the porphyry by coarse grained carbonated actinolite rock, some of which occurs in a lens on the 105 feet level.

Thus the "silicified" lode is regarded as being produced by the mineralisation of a shattered, hybridised quartz albite porphyry.

2. *Ore Deposition adjacent to Porphyries.*

More ore bodies have been discovered adjacent *to* than *in* porphyry intrusives. The most important mines whose ore bodies are so situated are Phoenix Mine*, "Barbara" G.M.L. 330*, Hampton Block 59, "Yellow Lode" G.M.L. 319*, Hampton Block 59, and Bakers Find*. Generally the porphyry has been mineralised (the sulphides being *pyrite* and *pyrrhotite* and sometimes *arsenopyrite*) but in no instance has gold been found in them in economic quantities. Accompanying sketches† show the structural relationship of the lodes to the porphyrites at the above localities.

The "New Lode" of the Phoenix Mine is confined to the footwall of a porphyry which has concordantly intruded a band of metamorphosed sediments. Ore deposition has occurred in this horizon for at least two miles on either side of the Phoenix Mine but in no place have ore bodies been developed to such a magnitude as at the Phoenix Mine. A broad structural control by folding has been suggested by regional work.

CONCLUSION.

The porphyry intrusives of the Coolgardie District are principally albite porphyries which are prefolding in age. On account of their greater competency than the surrounding rocks they have, under rotational stress, provided the most favourable loci for ore deposition. Their origin and associations are similar to those of Kalgoorlie and Golden Ridge, with which they are probably consanguinous.

REPORT ON THE PROPOSED DIAMOND DRILLING OF THE GREAT FINGAL ORE BODY, DAY DAWN, MURCHISON GOLDFIELD.

By N. M. Gray, B.Sc.

1. *Introduction.*

Early this year the Mines Department agreed to participate in the proposed deep drilling of Great Fingal Ore Body for the purpose of proving the reef and its values at depth. The drilling has not, as yet (December 1948), commenced. Mining operations may be started to exploit the reef at greater depths than the old workings if satisfactory results are obtained from the drilling.

2. *Surveying.*

Owing to the poor state of preservation of some of the old lease pegs and the absence of others, it was first necessary to survey these in using the theodolite and chain. The new pegs were numbered, arbitrarily, G1, G2, up to G26 and not with the lease numbers. Other pegs were placed at certain points, some within various leases and others to the S.W. of the leases. Following this, reduced levels of these and some lease pegs with reference to an arbitrary peg were calculated.

The geology was mapped on a scale of 100 feet to an inch using the plane table and telescopic alidade.

3. *Geology.*

(a) *Physiography.*—The higher ground lies to the west but the difference in elevation within the area mapped is only about 50 feet. This higher portion more or less follows the general strike of the country which here is roughly N.E.-S.W. The low ground is mostly covered by soil. The country slopes gently from north to south.

The main stream, non-perennial, is a subsequent one following the eastern contact between the basic lavas and the quartz dolerite. There are numerous tributaries which cross the strike of the rocks.

The high ground probably forms part of the Old Plateau or may be even a monadnock in the Old Plateau.‡ These residuals are not capped by laterite as are some in the precincts of Cue.

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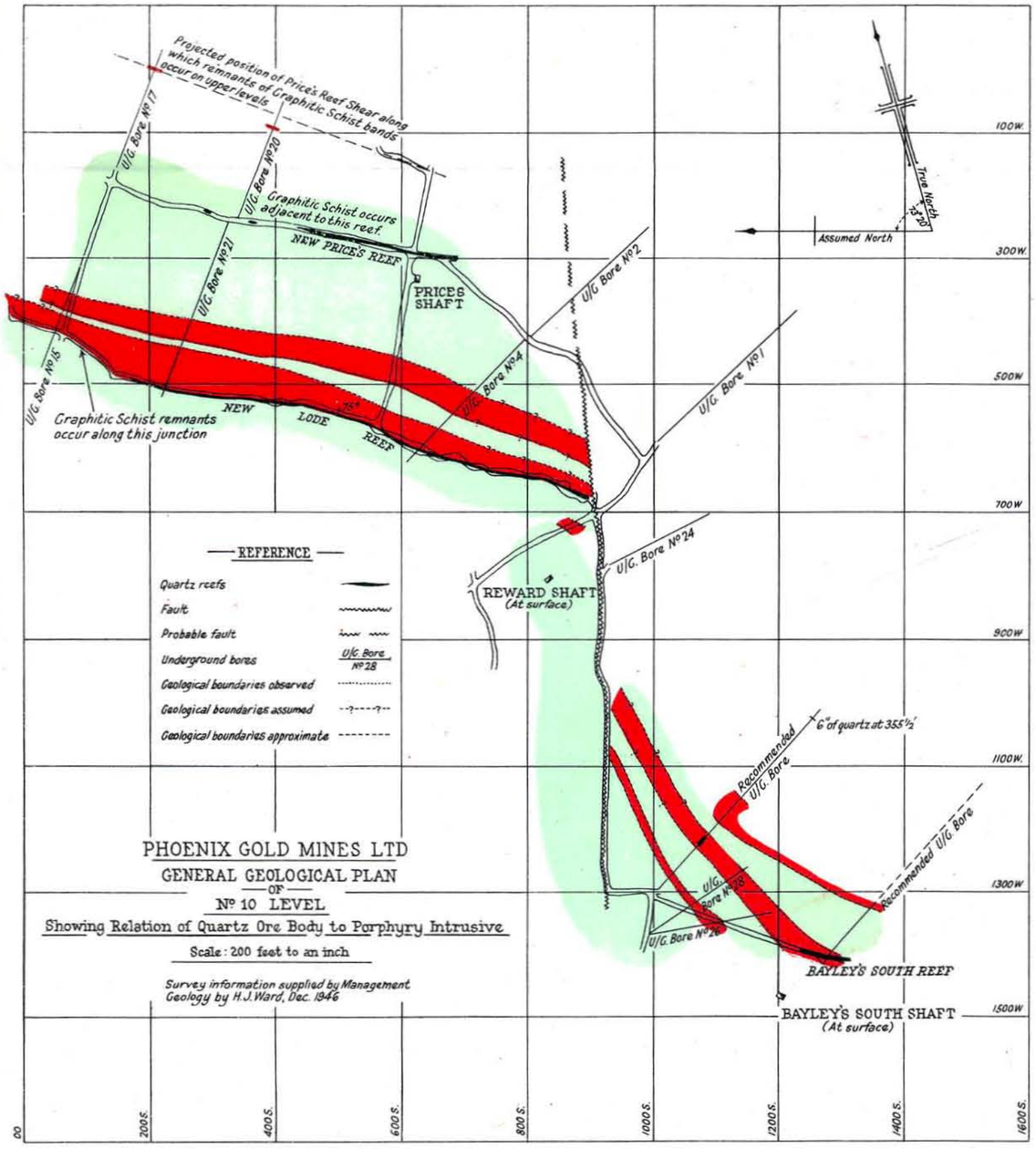
* Matheson R. S. Geol. Surv. of West. Aust. Ann. Rep. 1946.
† Miles K. R. Rep. of Dep. of Mines of West. Aust. 1945 p. 97.
‡ See Plate III.
§ Sections G.S.W.A. Reg. Nos. 7155 7153 7154.

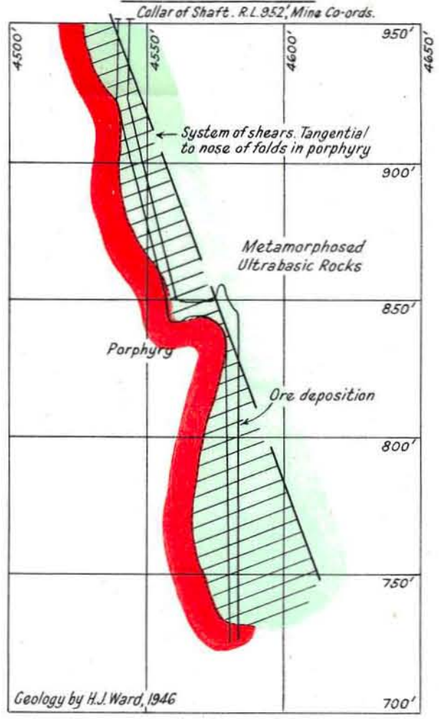
* Ward H. J. Geol. Surv. of West. Aust. Ann. Rep. 1946.
† See Plate XXII.
‡ The Physiography of W.A., G.S.W.A. Bull. 95 Jutson J. T.



PHOENIX GOLD MINES LTD
GENERAL GEOLOGICAL PLAN
OF
Nº 10 LEVEL
Showing Relation of Quartz Ore Body to Porphyry Intrusive
Scale: 200 feet to an inch
Survey information supplied by Management
Geology by H.J. Ward, Dec. 1946

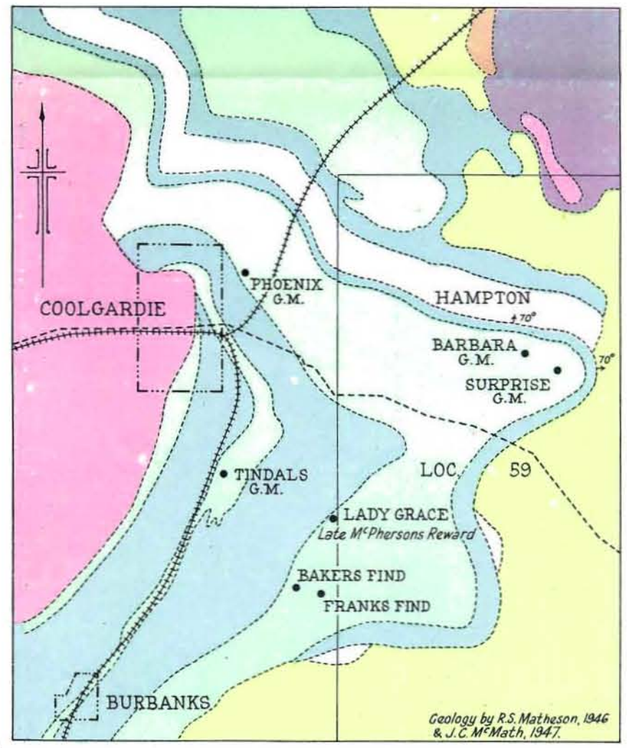
SKETCH OF THEORY OF STRUCTURAL CONTROL OF ORE DEPOSITION OF "YELLOW" LODE LADY MARY, G.M.L 319, HAMPTON LOC. 59

Scale: 1 inch = 50 feet



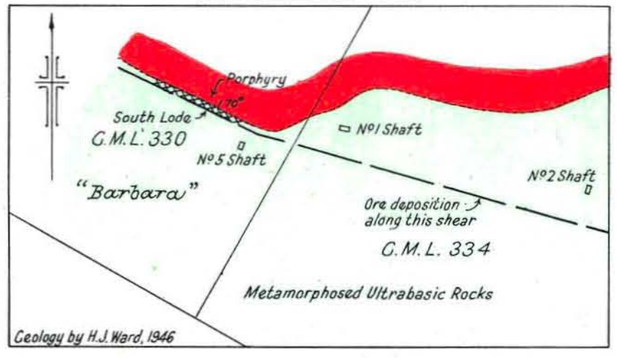
LOCALITY MAP

Scale: 1 inch = 2 miles



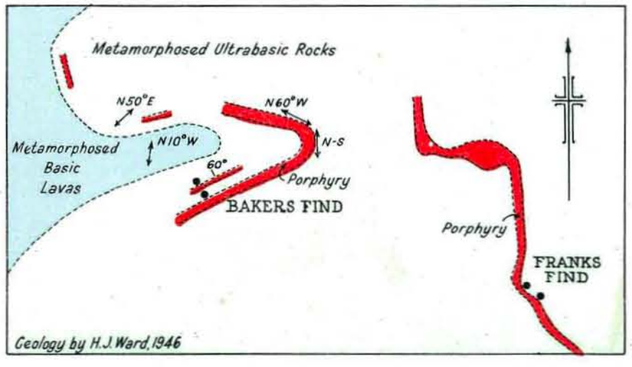
ORE DEPOSITION ADJACENT TO PORPHYRY AND ALONG SHEAR TANGENTIAL TO CHANGE IN STRIKE OF PORPHYRY G.M.Ls 330 & 334, HAMPTON GROUP, COOLGARDIE G.F.

Scale: 1 inch = 100 feet

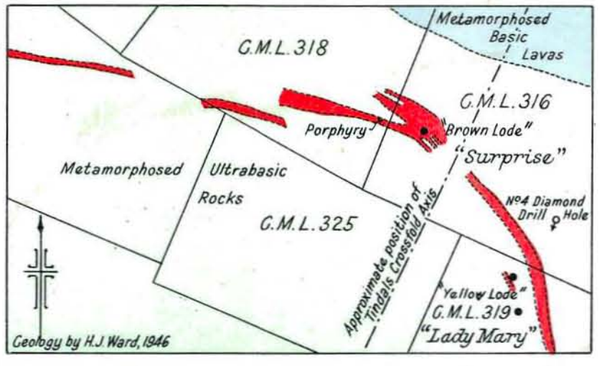


LEGEND

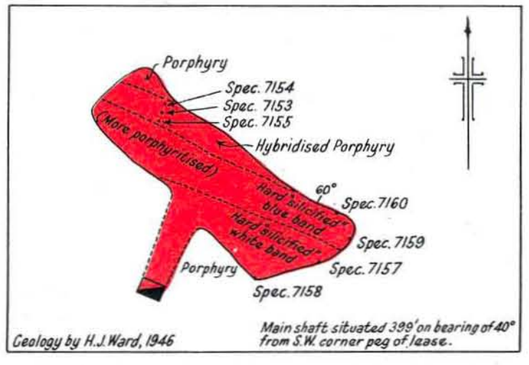
- Soil covered areas
- Metamorphosed erosion sediments
- Metamorphosed basic lavas and allied rocks
- Metamorphosed ultrabasic rocks
- Amphibolite
- Granite, gneiss and allied rocks
- Porphyry-Porphyrite series



BAKERS FIND & FRANKS FIND
COOLGARDIE GOLDFIELD
Scale: 1 inch = 10 chains



"BROWN" & YELLOW" LODES - HAMPTON GROUP
COOLGARDIE GOLDFIELD
Scale: 1 inch = 10 chains



BROWN LODE, G.M.L. 316 - HAMPTON GROUP
68' LEVEL - POSITIONS OF SPECIMENS OBTAINED
Scale: 1 inch = 40 feet

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PRINCIPAL ORE DEPOSITS
ASSOCIATED WITH MEMBERS
OF
PORPHYRY-PORPHYRITE SERIES
COOLGARDIE GOLDFIELD

J.McL

(b) *Stratigraphy and General Geology.*—The stratigraphy within the area mapped is as follows:—

Recent.—Soil (residual and alluvial) ....

Pre-Cambrian.—Younger Greenstones (?)—quartz dolerite. Older Greensones—slate—fine grained basic lavas.

The slate is both intra-formational and interformational between successive lava flows and between the lava and the dolerite.

The quartz dolerite is a sill intrusion flanked by lavas. The strike of the sill is approximately N.E.—S.W. and dips N.W. at about 70°. The westerly contact was mapped with fair accuracy but the easterly counterpart is obscured by soil and the only place where it could be determined within about 40 feet was the extension of the "Crown" reef, and then only by structure and not by outcrop.

The sill outcrops over a width of about 1600 feet.

In the southern end of this area, there is a split in the sill which is filled by basic lavas. Only in a few places was evidence of this found. Its shape is a dubious question owing to the soil cover.

To the west of this sill, there is evidence, both petrological and structural, of further sills of smaller size, the strikes of which appear to be parallel to the one mapped. One may be about 400 feet wide across the outcrop, and two other possibilities appear to be about 100 feet wide.

5. *Structure.*—The quartz reefs of the Great Fingal and other adjacent mines have formed in tension cracks due to rotational shearing forces. Owing to the different textural and mineralogical compositions of the two main rock types, the tension cracks change their strike when passing from the lava to the dolerite and again from the dolerite to the lava, through the strike is constant—except for minor variations—within the one type of rock.

It was from this change of strike that the possibility of further sills being found was first surmised. Subsequently, change in rock type was seen which substantiated their presence.

6. *Drilling.*—With an accurate large scale map showing the western sill-lava contact, and the reduced levels of various points together with the underground plans, it will be possible to site bore holes for the proposed drilling.

7. *Acknowledgments.*—The writer wishes to acknowledge the help willingly given during the survey by the Mining Registrar, the Inspector of Mines and others at Cue.

REPORT ON THE BONNIE VALE STRUCTURE GROUP, COOLGARDIE GOLDFIELD.

By N. M. Gray. B.Sc.

1. *Summary.*

The ore bodies are low grade sulphide lode formations in fault zones, mostly striking approximately E.—W., in a coarse grained epidiorite (amphibolite) of the Younger Greenstone Series.

2. *Introduction.*

This group, approximately one square mile in area, was surveyed in June, 1948. Only one lease is held at present (Dec., 1948), i.e., G.M.L. 5679, the "Ada," and that is not being actively worked.

The object of the survey was to map in detail the rock types and associated structures, and with the interpretation of them determine, if possible, the cause of the ore deposition and mineralisation.

3. *General Information.*

The area is about five miles north of Coolgardie by road. This track is fair and leads direct from Coolgardie to the group. A turn-off about seven miles out along the Kununalling Road leads also to this area via other leases. This track is in bad condition. Access may also be obtained from Bonnie Vale using part of the route mentioned in the second method.

Water for drinking purposes has to be carted from the stand-pipe in Coolgardie, but water for other purposes can be obtained from a water shaft on G.M. 5679, the "Ada."

The nearest battery is the State battery at Coolgardie.

Blackbutt and Jam are by far the commonest timbers in the area. Only a few Gimlet were seen. However, there are plenty of the former available for mining purposes.

4. *Geology.*

(a) *Physiography.*

(i) *Topography.*

In comparison with most of the Coolgardie Gold Field, this area has quite a rugged relief. Water Reserve 6629, in the northern part of the group, takes in the highest feature, and the top of this hill is some 280 feet above the lowest ground within the area mapped. The shape of these hills or ridges follows the strike of the country which, here, is a back-to-front "S" in shape.

The hills overlook a big area around Coolgardie, and are the highest hills, with the exception of Mt. Burgess a few miles to the north-west.

(ii) *Streams.*

The streams, non-perennial, are all subsequent, their courses having been determined by the folding of the country. The two largest water courses are parallel to the contact of the basic lavas and the epidiorite. However, one of them cuts across the lavas and follows nose of the fold to the east of the Water Reserve 6629. The other flows roughly W.—E. parallel to the contact in the south of the area. A S.W. flowing stream follows the other nose of the folds where the contact changes its strike from S.W. to E.S.E. in G.M.L. 3194. This flows out into soil. Similarly, the northern part of the area, a stream, passing into soil, flows westward along the nose of the first mentioned fold. The first three are young while the latter is more mature.

(iii) *Other Physiographic Notes.*

Just north of Coolgardie are remnants of some mesas or buttes. These appear to have been once part of the Old Plateau.* The Bonnie Vale area is considerably higher than these remnants and, though no accurate topographical information is available, these hills may be considered as monadnocks or residuals of a previous cycle of erosion.

Mt. Burgess may be a monadnock of this same cycle, or even of a previous one.

(b) *Rock Types.*

The two main rock types are fine grained basic lavas (Older Greenstones) and coarse grained amphibolite (probably of the Younger Greenstones).

A suite of the latter type were kindly examined by Prof. R. T. Prider of the University of W.A. He states that they "consist of well crystallized prismatic hornblende and plagioclase felspar together with iron ore the size of which being indicative of the original grain size of the rocks. Recrystallisation may be a deuteric effect. They are medium to coarse grained epidorites."†

The acid intrusions are porphyry and quartz veins. The former, except in one case, is associated with the epidiorite. The excepted case is a weathered outcrop very close to the contact of the Older and Younger Greenstones, but owing to the considerable rubble and poor outcrops it could well be in the epidiorite. Some of the porphyries may be traced for nearly a quarter of a mile.

Most of the quartz veins outcrop only over a short distance, though one "blow" can be followed discontinuously for over four hundred yards.

The only other distinct rock type is slate. This is very low grade with little bedding generally.

(c) *Stratigraphy.*

The stratigraphical succession is as follows:—

Recent.

Soil (residual and alluvial.)

Tertiary (?)

Laterite.

Pre-Cambrian.

Quartz reefs	
Porphyry Intrusions.	
Younger Greenstones	Epidorite (amphibolite.)
Older Greenstones	Slate (interbedded) fine grained basic lavas.

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* Physiography of Western Australia G.S.W.A. Bull. 95, Jutson, J. T.

† Personal communication.

The slate appears to be interformational between the two greenstones series, but the possibility that it may be intraformational between successive lava flows, though not far from the contact of the epidiorite, must not be overlooked. Owing to the large amount of rubble and few outcrops, it is not possible to be definite in this matter. The former view is supported by what appear to be chilled margins of the epidiorite. These were seen in only two or three places and of those in only one case was it associated with slate.

The writer considers the epidiorite to be a concordant intrusion (a sill) for it is flanked by both sides by lava, but within the area concerned only the easterly flank was mapped, and there is the interformational slate. This intrusion was probably of the order of 1,200 feet thick, assuming that it has been isoclinally folded.

Quartz reefs and porphyries probably formed in shear zones caused by the folding, but no shear zones were found associated with them. The possibility that they are pre-folding must be considered. but the former view seems more probable. The intrusion of the quartz and porphyries may or may not have been contemporaneous with each other or with the folding.

Laterite occupies only a small area in the S.W. part of the group.

(d) *Structure.*

Nowhere in the area does the lava outcrop to give any information as to structure.

The epidiorite is strongly jointed. The best example is in G.M.L. 5679, the ''Ada'', in a face of an open cut. Here, the face is cut by a fault or shear zone. On each side of this fault the joint system is very pronounced but the strikes and dips of these two parts do not correspond. The fault strikes approximately E.—W. and dips north at about 80°-85°, and, in one place, vertically. This fault can be traced continuously for about 2,000 feet and from then on spasmodically. These latter parts may belong to other faults. Another fault just out of the open cut strikes about S. 75° E. an some short distance westward this changes to N.W. The dip varies with the strike from about 75° to 50° respectively. This fault is only traceable for about 600 feet.

Some 10 chains west of the northern part of G.M.L. 2187, the ''Armidale Extd,'' there are similar shear zones or faults, but these cannot be traced for more than a few yards.

Associated with the joints is what may be fracture cleavage, as can be seen in the open cut, but it is not nearly so well defined as the joints. There is some doubt, therefore, whether this structure is fracture cleavage.

There appears to have been the usual two phases of folding. Firstly, the major folding gave the regional N.N.E.-S.S.W. trend and, secondly, on this was superimposed the crossfolding of the E.-W. trend.

The former may have been of sufficient intensity to have caused isoclinal folding as is suggested by the regional picture of the epidiorite being flanked by lavas to both the east and west. However, there is no structural information to support or deny this, so the question must be left open, but in other areas there is definite evidence of isoclinal folding. Similarly, there is no information available to indicate the nature of the crossfolding, assuming this to have taken place. The superposition of crossfolds could well have caused this rude back-to-front ''S'' shape of this locality.

(e) *Ore Bodies, Mineralization.*

The ore bodies are low grade sulphide lode formations with a few quartz stringers which have formed in the fault zones. In G.M.L. 5679, the lode varies in width from about one foot to 12 feet and has been worked to an inclined depth of about 50 feet. Numerous specimens from this lease were dollied and gave very small values; the stringers only gave a few colours. The lode is post-folding.

Granite does not outcrop in the area, but outcrops of a large boss or possibly a batholith occur less than a mile away to the south-west.

5. *Mining.*

Most of the work done in this group was carried out many years ago, but there has been some recent activity in 1935 in G.M.L. 5462, ''Ballarat Hill,'' and from 1943 onwards in G.M.L. 5679, ''Ada,'' the latter lease is now the only one not void. The ''Ballarat Hill'' produced 34.96 ozs. of gold from 31 tons of ore in that year and in the period 1943/45, the ''Ada'' produced 80.33 ozs. from 800.25 tons of ore. The only other record available is for the ''Ada'' as G.M.L. 4044 in the years 1903/04 when 44.44 ozs. of gold was won from 278 tons of ore.

The old workings show that there was considerable activity once as old foundations for machinery can still be seen.

Most of the leases in the areas have only occasional costeans or shafts and have never been producers.

There are no dry blown areas.

6. *Prospecting Recommendations.*

Unless a close handy battery that can treat sulphide ores becomes available, there is little chance of this area becoming a producer. The amount of free gold in this ore appears to be too low to be mined economically even by prospectors.

However, there are indications of cross faults which, where they intersect, may give increased values. If these are found small lenses or shoots may be available for selective mining. One was seen in the workings of the ''Ada.''

7. *Acknowledgments.*

The writer wishes to acknowledge the help willingly given by Professor R. T. Prider in examining rock sections of this and other groups, and by the Mining Registrar, Coolgardie, and those officers who were relieving him at various times.

REPORT ON THE NEPEAN GROUP, COOLGARDIE GOLDFIELD.

By N. M. Gray, B.Sc.

1. *Summary.*

The rocks are mainly ultra-basic types (Older Greenstones) with some sheared amphibolite (Younger Greenstones?) and lesser amounts of acid intrusions. The area has been isoclinally folded and shear zones have developed parallel to the strike, along which have come quartz veins, stringers, ore solutions and acid intrusions. The area is thought to be a fairly shallow one. There is the possibility of a cross-fold. Nepean seems to be a roof-pendant at the southern end of the major Coolgardie structure.

2. *Introduction.*

The area mapped was about one square mile and the survey was carried out during July-August, 1948. There are no active workings but the place was being prospected at the time of the inspection.

The survey was made with the object of determining, if possible, the cause of the ore deposition and its relation to the structure.

This group was the most southern one surveyed and is the southerly limit of the main Coolgardie structure. To the south, the greenstone belt passes into soil and granite.

3. *General Information.*

Nepean is about 16 miles south of Coolgardie (Lands Department Litho 39/80, just east of point B3 on map) and access is obtained via the Burbanks Road, Londonderry Siding, Londonderry Dam and thence by bush track. The road as far as the turn-off to the siding is good but from then on is only fair.

At Nepean itself, there is no water. The nearest drinkable water is at Londonderry Dam. Nepean Rocks are about three miles to the west and Quairnie and Victoria Rocks are about 10 miles away to the south and south-west. Numerous gnamma holes in these rocks hold water for some time after rain. The possibilities of

sub-surface gnamma holes and soaks around the margins of these granite rocks must not be overlooked*. The nearest standpipe of the Goldfields Water Supply is at Coolgardie.

The nearest facilities for public crushings are at the State Battery, Coolgardie.

There is a plentiful supply of Gimlet, Salmon Gum and Jam available for mining purposes. Blackbutt is scarce.

4. *Geology.*

(a) *Rock Types.*

Greenstones.

The Older Greenstone Series are represented by ultra-basic rocks. These consist of hornblende schist, fine and medium grained quartz-hornblende schist, talc-hornblende schist and plagioclase-hornblende granulite the latter probably being a highly metamorphosed basic igneous rock. The talc-hornblende schist was the only one that could be mapped as a separate entity. There is considerable quantity of cellular and opaline silica which has formed superficially on the ultra-basic rocks, largely serpentines. Its presence, in lieu of outcrops or rubble, was taken as indicative of underlying ultra-basic rocks.

The Younger Greenstones (?) are represented by sheared amphibolite. The hand specimen of this rock appears similar to the "epidiorite" of the Bonnie Vale area. (This applies equally well to the Younger Greenstones' amphibolite of the other groups.) The orientation of the amphibole in the epidiorite is due to shearing. The epidiorite did not outcrop well enough for any detail to be found.

Acid Intrusions.

The acid intrusions consist of gneiss, porphyry, pegmatite and quartz veins.

The gneiss has probably been formed from the granite as granite is found in some of the dumps. The gneissosity is the same as the country rock. Granite outcrops about half a mile to the east.

The pegmatite is a mixture of graphic granite and felspar. No other minerals were seen.

Other Rocks.

A fine-grained biotite-quartz-felspar gneiss, probably a metamorphosed arkose, occurs in dumps which have a general alignment along the centre of the area.

Apart from soil (residual and alluvial), laterite of Tertiary (?) age outcrops over small areas of a few hundred square yards in the southern part of the area.

(b) *Stratigraphy.*

The stratigraphical succession is not clear. It may be summarized as follows:—

Recent.

Soil (residual, alluvial.)

Tertiary (?)

Laterite, cellular and opaline silica.

Pre-Cambrian.

Quartz veins.
Porphyry (dykes or sills.)
Pegmatite (dyke or sill.)
Gneiss (probably ortho-gneiss.)
Biotite-quartz-felspar gneiss.
(para-gneiss, metamorphosed arkose.)

Younger Greenstones		Epidiorite (amphibolite.)
Older Greenstones.	Meta-morphosed Ultra-basic Rocks.	Hornblende schist.
		Quartz - hornblende schist (fine and medium grained.)
		Anthophyllitic rock.
		Plagioclase-hornblende granulite.
		Talc-hornblende schist.

The position of the biotite-quartz-felspar gneiss is unknown. It does not outcrop and is only found in dumps.

From the field evidence, the talc-hornblende schist appears to be the oldest member of the ultra-basic series. The order of the other four members is purely arbitrary.

(c) *Structure.*

The talc-hornblende schist, in the northern part of the area, gives most of the information available as to the structure. Here, the rock is overturned, isoclinally folded, striking about N. 5° W., the west limb dipping about 70° W. and the east limb about 80° W. The dragfolding indicates that the structure is a south pitching anticline. The amount of pitch could not be determined but it is thought to be small.

About half a mile south of this dragfolded schist, several outcrops of ultra-basic rocks were seen which showed dragfolding. Accordingly, the structure of this part seems to be a possible north pitching anticline. However, information is not nearly so definite as the other to the north.

If this is correct, there may be a synclinal cross-fold in G.M.L. 1383 and this has had no effect on the regional strike.

There is repetition of the talc-hornblende schist in one line along the strike. This may be due to (i) cross-folding (ii) several horizons of the schist. It is not possible to say how many horizons there would be as no information is available as to the pitch, so the horizons cannot be correlated with the topography.

Whether the epidiorite is a concordant intrusion or not cannot be stated from the available evidence. Its structure is not allied to the ultra-basic rocks and appears to be folded (and sheared) along a rough E.-W. axis. This is in accordance with the cross-fold hypothesis.

Cross-folding is supported by quartz reefs which probably occupy shear zones, the strike of which trend towards E.-W. However, most of the quartz reefs are in shears parallel to the regional strike.

The acid rocks may have been intruded along these N.-S. shears.

Owing to the presence of the gneiss, outcropping and in dumps, the area does not appear to be a deep one. In G.M.L. 1383, in the supposed cross-fold, there is a shaft 600 feet deep. Granite is found in the dump of this shaft. The area may well be basin-shaped.

(d) *Ore Bodies, and Mineralisation.*

As no ore body is known to outcrop, the following discussion is, therefore, largely theoretical.

From the structure and the rock types of the area, it appears that the ore bodies would probably be both lode and reef formations. The ultra-basic rocks along the centre are quite silicified and this, coupled with the quartz reefs and the inferred shears, seems to indicate the ore solutions came along these shears.

No information is available as to whether there has been any sulphide mineralisation or not.

The granite nearby may be the parent rock of the ore solutions.

A representative sample of the talc-hornblende schist, when dollied, gave no colours of gold. This rock is, apparently, not associated with gold in any way.

5. *Mining.*

The area has not been actively mined for fifty years. All leases, but one, were taken out before 1900. This lease, G.M.L. 5575, took in parts of old ones and some work has been done there, mostly dry-blowing. Though considerable work has been done in the past, mainly shaft sinking, gold production has been extremely small as is shown in the table below (information supplied by the Statistical Branch, Mines Department).

Lease.	Company or Lease.	Ore Treated.	Gold Therefrom.	Total Gold.	Period.
		(Tons, 2,240 lbs.)	Fine ozs.	Fine ozs.	
Late G.M.L. 1383	Sam's Wealth of Nations Gold and Exploration, Ltd.	73·00	18·12	18·12	1897/1898
Late G.M.L. 3552	Lady Bell	50·00	19·43	19·43	1898
Late G.M.L. 5575	Iron Ridge	18·00	15·97	15·97	1938

* " Water Supplies in the Kalgoorlie and Wheat Belt Regions of W.A." R.S.W.A. Vol. XXII, p. xli, 1935-36. Clarke, E. de C.

6. *Prospecting Recommendations.*

The writer does not recommend Nepean as an area for prospecting or mining though, no doubt, small amounts of gold can still be won from there (e.g. G.M.L. 5575, see "Mining" above). Nowhere within the area were undoubted structures found that would cause or control ore-deposition or mineralisation to any extent.

The only possibility for prospecting that can be put forward is the suggested cross-fold in G.M.L. 1383.

REPORT ON WHITE HOPE GROUP, BLOCK 48 HAMPTON PLAINS, EAST COOLGARDIE GOLDFIELD.

By N. M. Gray, B.Sc., Geological Survey of W.A.

1. *Summary.*—The rocks of this area represent an extension of the Coolgardie Series, the main members being basic lavas and ultra-basic rocks. A fault striking approximately N.-S. cuts the regional N.N.W.-S.S.E. strike. Most of the gold won has been from alluvial workings.

2. *Introduction.*—The survey was undertaken for two reasons; firstly, from the economic aspect and, secondly for the possible extension of the Coolgardie Series. It was carried out in the latter part of September and early October, the area mapped being nearly one and a half square miles.

3. *General Information.*—The area concerned is about three miles south of the White Hope Mine in Block (or Location) 48. The group is on the main Red Hill Road, which is in fair condition with some good stretches. It is about 30 miles south from Kalgoorlie and about 35 miles south-east from Coolgardie by road. The writer did not traverse the latter track and understands it is in bad condition.

Water for drinking purposes is carted from Kalgoorlie or Boulder. The nearest dam is Woolabah Dam, about five miles north, but the water is unfit for human consumption and the dam has been largely washed out by the heavy rains of February this year (1948). There are several gnamma holes—not examined by the writer—and a well in the granite in the south-west part of the group. These contain variable amounts of good water. The gnamma holes retain their water for a long time; the well is permanent. These supplies are kept as a reserve. Good water can be obtained from a Government well near Red Hill—about five miles south—but this is little used except by occasional prospectors around Red Hill.

The nearest facilities for public crushings are at the State Battery, Kalgoorlie.

There is considerable quantity of Jam, Blackbutt and Salmon Gum available for mining purposes. Gimlet is very scarce.

The following leases are within the area mapped:—G.M.Ls. 37, 38, 45, 76, 130, 150, 196, 197, 198, 199, 216, 240, 272, 273, 292 and 371.

4. *Geology.*

(a) *Physiography.*—Only those aspects that have an economic bearing will be dealt with here. Their significance will be discussed under the sections "Mining" and "Prospecting Recommendations."

The topographic features mainly follow the regional strike particularly the basic lavas in the north-west part of the group. One other ridge runs transverse to this, approximately north to N. 20° E. due to the harder silicified fault zone rock. The granite boss has no general alignment.

The stream pattern is, broadly, radial and most streams flow from the centre ridge and all cut across the strike of the rocks.

(b) *Rock Types.*—Generalised, the rock types are Older Greenstones and granitic intrusions. The Older Greenstones can be sub-divided into basic lavas—fine grained, amygdaloidal and amphibolite types, the latter possibly by shearing of the lavas—and ultra-basic rocks which consist of fine to medium serpentine rocks, talc-hornblende schist, talcose rock and anthophyllitic rock. The acid intrusions are granite porphyry, fine-grained granite porphyry, fine-grained acid porphyry and quartz veins.

The other rocks are slate and silicified fault zone rock.

Some of the above require description. The difference between the talcose rock and the talc-hornblende schist is one of degree, the former not having been altered as much as the latter. The anthophyllitic rock has a very marked radiating or spherulitic structure and fracture. The silicified fault zone rock is similar to jasper (NOT JASPILITE) but, for sake of clarity, the name given will be used throughout this report. It is also formed in tension cracks.

Micro-petrological examinations may necessitate changes in the nomenclature of some of the rocks.

(c) *Stratigraphy.*—The stratigraphical succession, suggested by the available evidence is as follows:—

Recent.

Soil (residual, eluvial, alluvial).

Pre-Cambrian.

Quartz veins.

Granite porphyry (boss and dykes or sills).

Fine-grained granite porphyry (dykes or sills).

Fine-grained acid porphyry (costean and outcrop).

Slate (stratigraphical relation obscure).

Silicified fault zone rock.

Older Greenstone Series.	A	Anthophyllitic rock
	Metamorphosed Ultra-basic Rocks	Talcose rock
		Talc-hornblende schist
		Serpentine rocks (fine and medium grained)
	B	Amphibolite (?sheared basic lavas)
	Metamorphosed Basic Lavas	Fine-grained and amygdaloidal lavas

The stratigraphical relations of A and B above are obscure and the order stated is purely arbitrary. Similarly, the order within the ultra-basic rocks is debatable.

The acid intrusions are post-faulting and, except the boss, occupy what appear to be tension cracks. Their formation may be contemporaneous with the faulting or the formation of the silicified fault zone rock. These intrusions may be dykes or sills.

(d) *Structure.*—The regional trend of the country is approximately N. 25° W., and across this trend is a fault which strikes N.-S. in its southern part and about N. 20° E. in the northern portion. There are no surface indications as to its dip. It could be followed for over three-quarters of a mile in the area and the writer was informed that, to the south on the other side of the granite, it can be picked up again and also to the north after being under soil cover for some distance.

What may be shear zones or tension cracks, in which have formed the various porphyries and the silicified fault zone rock, are of two systems nearly at right angles to each other and at about 45° to the fault.

(e) *Ore bodies and Mineralisation.*

In the north-west sector of the group is an ore body of talc-hornblende schist. It has a maximum width of about 14 feet and its existence has been proved for a distance of 12 chains by costeaning. Near the centre of the area is a now inaccessible shaft but the rock type can still be examined and appears to be a more weathered version than that already mentioned. Where the proved lode has been mined (G.M.L. 371) it dips about 70°-80° S. It varies in thickness along the strike and dip and is dragfolded which are probably the reasons why the values vary. This schist is in the midst of undifferentiated serpentine rocks and basic lavas. Granite is about half a mile distant to the south of G.M.L. 371, and about 200 yards away from the south end of the lode.

There is a layer of magnesite near the surface cutting the lode. The writer was informed by the prospectors that samples taken from above the magnesite, when dollied, gave only a trace of gold, but samples from below the layer gave results, which were to be expected, knowing the values obtained from assays and crushings. It appears that there has been some secondary enrichment and this has taken place at the same time as the formation of the magnesite.

It is considered that this lode has been largely responsible for the alluvial and eluvial gold of Barrie's Gully.

In G.M.L. 196, there is a shaft, some 40 feet deep, in which the country rock—serpentine rock—is well fissured and these fissues are filled with clay. According to Mr. J. Terrell of Hampton Plains Gold Mining Areas, Ltd., this clay contains payable gold and the gold is somewhat rounded. This suggests alluvial origin.

In G.M.L. 38, at the head of Campbell's Gully, there are some old workings. The lode is thought to be the talcose rock. No information is available. These workings are within a few yards of the granite.

As has been mentioned above, the silicified fault zone rock has formed in the fault and shear zones. In the shears, the rock is much mineralized, mainly pyrite, and has a colour or two of gold. The rock of the fault is NOT mineralized and carries NO gold. The origin of the rock indicates that gold of any value is unlikely to be found in these rocks.

5. MINING.

The gold won has mostly come from alluvial workings. The dry blown area of Barrie's Gully has largely followed an old stream course which is above the present one. The present one, in parts, is quite outside the dry blown area. All the other streams have been dry blown.

There are about 35 shafts in the area and nearly half of them are inaccessible, and most of the remainder are in bad condition. Considerable costeaning has been carried out and many of the old ones have been cleaned out in recent years. Most of them have been in connection with the silicified fault zone rock, but two or three of the other major ones cut across the strike of the greenstones, in the eastern part of the area, for a distance of nearly 15 chains. This is apart from the proving of the talc-hornblende schist lode in the north-west of the group, the most recent workings.

Two underlay shafts were sunk to a depth of about 100 feet inclined, in G.M.L. 371, on this lode. During the heavy summer rains of this year, a considerable quantity of water entered the workings and they are now not being worked. To the south westward of this lease, but on the lode, three shafts, each about 50 feet deep, have been sunk. No information is available as to the production of these workings.

At the time of the inspection (Sept.-Oct., 1948), the work being carried out by the three prospectors of Hampton Plains Gold Mining Areas, consisted of following, by costeaning, and sampling the silicified fault zone rock in the shears about five chains west of the N. W. end of G.M.L. 130 in Henry's Gully.

6. *Prospecting Recommendations.*

The following recommendations are put forward:—

(a) The present prospecting of the silified fault zone rocks be discontinued as it is both geologically and economically unsound.

(b) The ultra-basic rocks of the south-eastern portion be prospected. It is suggested that a systematic loaming programme on a grid system be instituted. There is the possibility that a new lode or lodes may be discovered or even the extension of the talc-hornblende schist lode on the eastern side of the fault. No indications, on the available evidence, can be given as to where it might be found, if it is present.

(c) The physiography of the area indicates the possibilities of both alluvial and eluvial gold being found to the north-east of the talc-hornblende schist lode. In this area of soil, only one creek bed has been dry blown and that for a distance of about five chains. Old creek beds, similar to the dry blown Barrie's Gully, may be found. With the lode along the slope of this north-west trending hill, the conditions are suitable for the shedding of gold.

(d) Mining operations in the shaft, in G.M.L. 196, mentioned in "Ore Bodies and Mineralization" be commenced, owing to the reported payable ore.

(e) The talc-hornblende schist lode be mined.

7. *Acknowledgments.*

The writer wishes to acknowledge the help given by Mr. J. Terrell and his staff of Hampton Plains Gold Mining Areas, Ltd., and by Mr. Beavis, a prospector on Block 48.

REPORT ON THE GROSMONT GROUP, COOLGARDIE GOLDFIELD.

By N. M. Gray, B.Sc.

1. *Summary.*

The area examined forms a supposed easterly pitching anticline made up of ultra-basic rocks, basic lavas and amphibolite, the latter possibly having been formed by shearing of the lavas (this amphibolite is not the amphibolite of the Younger Greenstone Series). The main acid intrusions are pegmatites with lesser amounts or porphyry and quartz porphyry. The main workings are in the ultra-basic rocks but about half of the workings are associated with the amphibolite. Ore deposition may be connected with the intrusion of the pegmatites or to a lesser extent the porphyry.

2. *Introduction.*

The area, roughly half a square mile, was surveyed during October, 1948. There are no active mines but there was one prospector working around an old show.

The leases wholly within the area mapped are G.M.Ls. 4475, 5261, 5320, 5473, 5524 and M.C.3, and those in part or adjoin the south-east edge are 5264, 5265, 5266 and 5267.

Structural information and the possible relation to ore deposition were the objects of the survey.

Only a small portion of the Grosmont Mining Centre was mapped. This portion covered the nose of the fold and it was hoped that this part would give the information required.

Certain remarks, particularly as to ore deposition, are not necessarily applicable to the remainder of the mining centre outside the area mapped.

3. *General Information.*

Grosmont is about eight miles S.W. of Coolgardie on the old Gnarlbine Rocks-Coolgardie Road. This road to Grosmont is the best and most used and is in fair to good condition as far as the group itself. Access can be obtained by other routes but the above is the most practicable.

Water for domestic purposes has to be carted. The nearest standpipe is at Gibraltar (a pipeline runs from Ubini on the G.W.S. main to Gibraltar) but, owing to the poor track between these two centres, water is usually obtained from the standpipe in Coolgardie. Water for loaming, etc., might be obtainable from some of the disused shafts and the Government well at the eight mile peg.

The nearest facilities for public crushings are at the State Battery, Coolgardie.

Timber for mining purposes is not very plentiful within the area mapped as the growth is mainly secondary, but to the east and south, particularly, sufficient timber would be obtainable. Jam, Blackbutt and Salmon Gums predominate with lesser amounts of Gimlet.

4. *Geology.*

(a) *Rock Types.*

The Older Greenstones are represented by the Ultra-basic Rock Series and the Basic Lava Series.

The rocks of the ultra-basic series are quite varied. A carbonated-serpentine rock and quartz-albite-hornblendite were the types mappable as separate entities. The others of this series, not differentiated, were hornblendite, tremolite rock, anthophyllite-amphibole rocks and mica-hornblende schist. It is thought that the last mentioned probably forms the bulk of the area. Some slate was also found amongst the ultra-basic rocks.

The basic lavas were divisible into three rock types, fine grained basic lavas, talc-tremolite schist and amphibolite. Field evidence implies that the latter two were formed from the lavas. (This amphibolite is *not* the amphibolite-epidiorite of the Younger Greenstones, which has been mapped as a separate entity on the regional scale.)

Acid intrusions are porphyry, quartz porphyry, pegmatite and quartz reefs.

Apart from soil, cellular and opaline silica, there are no rocks younger than the acid intrusions.

(b) *Stratigraphy.*

The stratigraphical succession is as follows:—

Recent.

Soil (residual, eluvial, alluvial).

Pre-Cambrian.

Acid Intrusions.	Quartz veins. Pegmatite (dykes or sills). Quartz porphyry (dykes or sills). Porphyry (dykes or sills).
	Older Greenstones.
Metamorphosed Basic Lavas.	Amphibolite (? sheared basic lava). Talc-tremolite schist. Fine grained basic lavas. Carbonated-serpentine rock.
Metamorphosed Ultra-basic Rocks	Quartz-albite hornblendite. Slate. Other ultra-basic rocks; quartz-hornblende-plagioclase granulite, tremolite rock, hornblende schist, hornblendite, anthophyllitic-amphibole rock, mica-hornblende schist.

The stratigraphical order within the various groups is obscure. Similarly, though the basic lava group is placed younger than the ultra-basic group in the above table, this order is purely arbitary. However, if the structure of the area is proved to be an easterly pitching anticline, then the order of the basic lava and the ultra-basic groups would be correct.

(c) *Structure.*

The structural information obtained from the survey will be discussed under the following sub-headings; folding, dips, shears, and drag-folding.

FOLDING.

The south-eastern portion of the area has a general N.E.-S.W. strike with local variations where it bays out to the south. At the east end, the strike changes to N.-S. thence to E.-W. and finally swings away to the N.W. The writer considers that this change of strike is, in effect, the regional strike of the locality that has been altered from the usual N.N.W.-S.S.E. trend by cross-folding. The intrusion of the granite to the north-west and north-east may also have had some effect.

DIPS.

The only dips obtained were in the south-east part where there have been numerous workings and these are all schistosity dips. These average between 45° and 60° S.E., though occasionally larger dips of 75°-80° were found, but these were where there has been local alteration of the strike from the usual N. 60° E. to S. 45° E.

Shears.

There are two sets of shear zones, one set parallel to the strike of the country and the other is nearly at right angles to the former. In the ultra-basic rocks, quartz reefs and pegmatite dykes have been intruded into both sets of shears while the quartz porphyry has occupied only those shears which parallel the strike. In one place porphyry outcrops but its strike is unknown.

In the basic lava group, only those shears parallel to the strike were found. Porphyries, quartz reefs, and one long dyke (or sill) of quartz porphyry were observed occupying these shears. No pegmatites were found in this rock group within the area mapped.

Drag Folding.

Only one set of drag folds (a few square feet in area) were found in the talc-tremolite schist about 300 feet N.E. of the south peg of G.M.L. 4475.

An interpretation based on such meagre evidence, as this one small area of drag folds, may well be wide of the mark as the following interpretation at first appears. Even so, this interpretation can be correlated with the regional structure..

This drag indicates a left limb of an easterly pitching anticline. In reality, it is on the right limb of the structure as is indicated by the regional viewpoint. The writer considers that this is a drag within a drag and, therefore, this interpretation does not disagree with the regional structure.

Summarising, the area is an easterly pitching anticline, the southern portion of which has an average dip of 50°S.W. Associated with the folding are two sets of shear zones into which the acid rocks have been intruded.

McMath* suggests that the continuation westwards of the Tindal's major cross-fold may go through this area.

(d) *Ore Bodies, and Mineralization.*

About half the shafts that have been sunk are in the ultra-basic rocks, and most of the remainder are in the amphibolite. The writer knows of one low grade lode formation and considers that, generally, the ore bodies may be both lode and reef formations. It appears that mineralisation is associated with the shears parallel to the strike and not the transverse shears, although no definite information was obtained as to the nature of the ore bodies apart from the case cited above.

Granite outcrops about 400 yards N.W. of G.M.L. 5524.

Ultra-basic workings.

Mica-hornblende schist is thought to form the bulk of the ultra-basic rocks. It is considered, though there are no surface indications except in the one case, that this rock forms the lode and the rock has been silicified and may have quartz stringers (C.f. the lodes of Gibraltar†).

There are no surface indications as to whether the ore bodies contain sulphide minerals or not.

Basic Lava Workings.

No workings were seen in the unaltered basic lavas.

(i) *Amphibolite.*—Ore deposition has probably taken place along and been controlled by the shear zones. Porphyries are plentiful in this belt though they are only seen in scattered outcrops. There are also several quartz reefs in the shears parallel to the strike.

(ii) *Talc-Tremolite Schist.*—Remarks reference the amphibolite above apply here in regards the porphyries and the quartz reefs but the porphyries are not so prevalent.

There may be some genetic relationship between the pegmatites and the gold deposition. There is a possibility that the gold deposition may be related to the porphyries.

Pegmatites.

The pegmatites of the area are mineralized and contain such minerals as lepidolite, beryl and topaz.‡

Mining.

At the time of the inspection (October, 1948) there were no leases actually held. At the same time, there was only one prospector in the area and he won a small amount of gold from his P.A. during the year.

The area, not a deep one, appears to be largely worked out. Prospecting being carried out now is around old shows and are low grade propositions.

Gold production from the leases within the area mapped is set out in the following table:—

No. of Lease.	Reg. Name of Co. or Lease.	Dollied Specimens.	Ore Treated.	Gold therefrom.	Period.
		Fine ozs.	Tons (2,240 lb.)	Fine ozs.	
5473	Grosmont	....	1,482·00	379·43	1935–39
4475	Vice Regal	....	129·00	552·02	1914–16
5320	Golden Arch....	10·15	516·35	159·73	1934–38
5524	Coronation	...	140·00	23·73	1936–37

Prospecting Recommendations

The writer does not recommend Grosmont as an area for prospecting, though, no doubt, there is still gold to be won by the small prospector.

* " Consolidated Report of the Re-Survey of the Coolgardie District." Ann. Prog. Reports, G.S.W.A. 1948. McMath, J. C.

† " Report on the Gibraltar Groups." Ann. Prog. Reports G.S.W.A. 1948. Gray, N. M.

‡ Department of Mines, Mineral Resources of Western Australia. " Census of Western Australian Minerals," Bull. No. 1. Carroll, D., Ph.D., D.I.C.

REPORT ON THE GIBRALTAR GROUPS, THE "LLOYD GEORGE" AND THE "REFORM," COOLGARDIE GOLDFIELD.

By N. M. Gray, B.Sc.

1. SUMMARY.

The rocks are mainly ultra-basic types with some amphibolites; the acid intrusions are mostly granite and pegmatite. The folding is isoclinal with a regional E.-W. strike. The area is cut by at least one fault. The cause and control of the ore deposition and mineralisation was not determined. Petrologically and structurally, the area lends itself into two parts corresponding with the two groups.

2. INTRODUCTION.

Though the general structure of the area has been deduced, it was not possible to carry out the fundamental object of the survey, viz., to determine the genesis and control of the ore deposition and mineralisation.

The area surveyed was nearly three square miles and the survey was carried out during August-September, 1948.

The only active workings, at the time of the inspection, were at the "Lloyd George" where overburden was being removed preparatory to mining by the open-cut method.

Structurally and petrologically, the area appears to be in two parts, the junction being under soil between the "Lloyd George" and the granite about a quarter of a mile to the west.

The "Lloyd George Group" and the "Reform Group" will be dealt with separately in the sections "Geology" (except "Stratigraphy") and "Mining."

3. GENERAL INFORMATION.

Gibraltar is about 12 miles S.W. of Coolgardie and about four miles south of the main road and the railway line. The area may be reached by the following routes:—

(a) Asphalt road to Bali and good track to the groups. This is the best track and the most used.

(b) Asphalt road to Ubini then fair track (follows G.W.S. pipeline to Gibraltar).

(c) Good road to Grosmont and fair track from then on.

(d) Bush track from Bulla Bulling (now impracticable).

Water can be obtained from a standpipe just west of the "Lloyd George." This standpipe is on a pipeline which runs from Ubini, on the Goldfields Water Supply main, to the battery of the "Lloyd George."

There is a five-head battery at the "Lloyd George" which, at the time of the inspection, was being prepared for operation. The nearest facilities for public crushings are at the State Battery, Coolgardie.

The "Lloyd George Group" has more timber available for mining purposes than the "Reform Group." Trees available are Gimlet, Blackbutt, Salmon Gum and Jam. In the "Reform Group" these types are mainly found in the northern part, the southern part being largely covered by Jam growing on laterite.

The "Reform" lease is no longer in existence. Part of the old lease is now incorporated in the "Winston Churchill." Though the name has been changed, this lease is still referred to, locally, as the "Reform."

4. GEOLOGY AND MINING.

Stratigraphy (Both Groups).

The stratigraphical succession of the Gibraltar Groups is as follows:—

Recent.

Soil (residual, alluvial).

Tertiary (?).

Laterite, cellular and opaline silica.

Pre-Cambrian.

Quartz veins.
Porphyry (dykes or sills).
Quartz-felspar-mica schist (possibly metamorphosed arkose).
Aplite (dyke or sill).
Pegmatite (dykes or sills).
Granite (dykes or sills, and boss).

Younger Greenstones. Epidiorite (amphibolite, dykes or sills).

Older Greenstones. Metamorphosed Ultra-basic Rocks.
- Anthophyllitic rock (dykes or sills).
- Fine grained anthophyllitic rock (dyke or sill).
- Anthophyllitic-amphibole rock (dyke or sill).
- Other ultra-basic rocks:—
  - Hornblendite, quartz-hornblende schist, quartz-mica-hornblende schist, anthophyllitic-amphibole schist, asbestos (anthophyllitic type), felspar-? kyanite-cummingtonite - actinolite schist.

(The identification of the felspar-(?)kyanite-cummington-actinolite schist and certain other rocks is due to Professor R. T. Prider of the University of W.A., to whom the writer wishes to express his thanks.)

The stratigraphical relation of the quartz-felspar-mica schist is obscure. It may be part of the Older Greenstones Series. It has not been intruded by the epidiorite, as far as could be determined in the field. The critical part, however, is covered by laterite so this intrusive position cannot be stated with certainty. The rock is certainly pre-gold deposition.

There may be two ages of porphyry intrusions, one pre- and the other post-faulting. (Faulting is post-granite, i.e., in the "Lord George Group.") The writer considers that one age of porphyry is more probable and that post-faulting.

The basic lava series is not represented.

(a) *Lloyd George Group.*

The following are the rock types noted in this group:—

Ultra-basic rocks; anthophyllitic rock, fine-grained anthophyllitic rock, anthophyllitic-amphibole rock, quartz-hornblende schist, quartz-mica-hornblende schist, anthophyllitic-amphibole schist, asbestos.

Younger Greenstones; epidiorite.

Intrusions; quartz veins, porphyry, pegmatite, granite.

Other Rocks; laterite, cellular and opaline silica.

STRUCTURE.

About a quarter of a mile south of the "Lloyd George" mine, the schistosity strikes approximately N. 20° E. This may be only part of a dragfold but, when considered in relation to the structure of the area, it may be a portion of a N.-S. shear zone.

The regional strike is approximately E.-W.

A large dragfold in the anthophyllitic rocks in G.M.L. 4502 and a smaller similar one in the epidiorite nearby were seen. This may indicate that these beds are on the righ limb of an easterly pitching syncline. Further to the north is a large dragfold pegmatite dyke (or sill) which appears to be on the left limb of the same structure. Between the two an outcrop, in a costean, gives its position by dragfolding as in the syncline which here is overturned to the north.

Poor quality anthophyllite asbestos outcrops in a costean in the south of the group. Its position is on the crest of an anticline. Rubble on the surface shows dragfolding but this could not be observed in the costean.

What dips that are available are in northern part of the area and here the mica-hornblende schist and the epidiorite dip together at about 30° to the south. This suggests that the epidiorite may be a sill intrusion.

The general picture, therefore, is isoclinal folding, overturned to the north, pitching eastwards, with a possible N.-S. shear zone on the west end.

Superimposed on this is a N.-S. fault which is post-granite and pegmatite. This fault cuts across all rocks except the porphyry, which, in one place, has come up along the fault. Near this "fault-porphyry" is a quartz vein which strikes parallel to the porphyry and dips 20° W. This may be the same dip as the fault. The displacement of the intrusives, particularly the pegmatite, is clearly discernible in the field.

ORE BODIES, AND MINERALISATION.

The outcrops and rubble gave no indication as to the nature of the ore bodies.

According to Feldtmann,* the ore body may be one or two lodes. He considers the latter more probable with barren reefs between the lodes. Both strike about N.N.E., and the easterly one dips about 20° E. while the other is nearly vertical. The ore bodies themselves are "impregnated schists," presumably silicified hornblende or mica-hornblende schist with quartz stringers. The lodes are low-grade with some rich lenses. By the structure, Feldtmann considers that the schists forming the ore body have been folded into "sharp synclines" (? isoclinal folding) with axes practically vertical and the folding is pre-pegmatite, the intrusion of which further sheared the ore-body. This intrusion was pre-ore deposition. He considers that there is probably some genetic relationship between the pegmatite and the mineralisation.

Unoxidised ore contains some pyrite but "on the whole the ore bodies appear to be fairly free from refractory minerals."†

MINING.

The present activity is confined to G.M.L. 5723, the "Lloyd George." At the time of the survey (September, 1948), an open-cut was being prepared for mining. Considerable overburden had been removed from one of these "caved-in" areas, preparatory to working the lode.

The only other recent workings have been in G.M.L. 4504 where some costeans showed dragfolding, in anthophyllitic rock, referred to in "Structures" above.

(b) *Reform Group.*

ROCK TYPES.

The following are the rock types noted in this group:—

Ultra-basic rocks; mica-hornblende schist (with and without silicification and quartz stringers), hornblende, felspar-(?) kyanite-cummington-actinolite schist.

Younger greenstones; epidiorite.

Intrusions; granite (fine and medium grained), aplite, pegmatite.

Other rocks; laterite, quartz-felspar-mica schist.

STRUCTURE.

The regional strike is still approximately E.-W., and the average dip is about 25° S. In the "Reform," the dip takes a "screw-motion" being about 65° S. in the east edge, lessening westwards to about 25° S. only 200 yards away. This may be due to the granite boss about 200 yards to the north or to a shear (? fault) running N.N.E.-S.S.W. between the two groups, or a combination of both.

Dips of about 40° S. were noticed in the "Quartette Group," about a mile south of the "Reform."

Only one north dip was seen, in G.M.L. 2790, and was only of the order of 15°. This is probably not far off the crest of an anticline or may be just a local change.

In the "Quartette Group" (G.M.Ls. 4516, 4517, 4257, 4535), there is dragfolding of granite and epidiorite dykes (or sills) similar to the "Lloyd George Group" and is part of the left limb of an easterly pitching anticline.

ORE BODIES, AND MINERALISATION.

The ore body of the "Reform" itself is a silicified mica-hornblende schist with numerous quartz stringers. Feldtmann‡ considers that the lode may be a series of bands 70-100 feet wide. Surface indications do not give any real idea of the width. He considers that aplite dykes, which are fairly persistent but of varying widths, are associated with the lode. These dykes did not outcrop. A short distance to the north of the lode is a fine-grained granite dyke (or sill) but it is not associated with the lode as far as could be determined.

The ore body of the "Quartette Group" appears similar to that of the "Reform" but rubble and laterite largely obscure the issue. What appears to be a lode is a hard hornblende schist striking roughly E.-W., and dipping 40° S. There are numerous parallel quartz reefs in the vicinity.

From the general appearance of rocks of the group, other workings all seem to be on the same type of rock though, no doubt, different lodes.

MINING.

The most recent workings have been in the "Reform" (i.e. "Winston Churchill" G.M.L. 5684) (February, 1941, to February, 1943). The lease was taken out again in August, 1944 and is still held. No work was being carried out at the time of the inspection (September, 1948). The writer understands that, during the period referred to above, some of the old dump was re-treated and that there was a certain amount of work carried out underground.

5. OTHER ACTIVITY (Both Groups).

Most of the many pegmatites have been worked at some time. Apart from felspars the only other minerals noticed were members of the mica group which were not of economic quantity or quality.

Manganocolumbite is mentioned by Feldtmann in regard to some of these pegmatites. Tourmaline, corundum are also referred to by Simpson and others*

PROSPECTING RECOMMENDATIONS.

Apart from the work carried out on the "Reform," "Lloyd George" and the J. G. Ward Group (the latter about half a mile S.W. of the Reform Group), the only recent activity has been some costeaning in G.M.L. 4504. Owing to the easterly pitching synclinal structure here, further work along the strike to the east may bring some reward. However, there is considerable soil cover in this direction but loaming may give some results.

In the "Reform Group," the extent of the present known worked lodes has not been delineated. Some good lenses may be discovered as has been in the "Lloyd George." Further lodes may be found but no specific locations can be indicated.

No stream courses have been dry-blown. Alluvial (and eluvial) gold may be found, particularly from that course flowing south through the "Lloyd George." Some parts are a quarter of a mile wide and the wash is at least nine feet deep.†

REPORT ON SUPPOSED TANTALITE AT PARKESTON, P.A. 4744E, EAST COOLGARDIE GOLDFIELD.

By N. M. Gray, B.Sc.

1. INTRODUCTION.

P.A. 4744E (24 acres) was taken out during September, 1948, for prospecting a supposed occurrence of tantalite. The P.A. is located about a quarter of a mile west of where the Kanowna Road crosses the Trans-Australian Railway Line and is on the north side of the line. The writer was informed (December, 1948) that the P.A. has probably been moved 8-10 chains west adjoining G.M.L. 6101E.

At the time of the inspection (November, 1948) the Acting Mining Registrar, Kalgoorlie, informed the writer that the prospector was working an old shaft, about 15-20 feet deep, on top of which was an old rickety windlass. From this description, the shaft was easily found.

The P.A. was not being worked at the time of the examination.

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* " The Auriferous Lodes of the Gibraltar District, Coolgardie Goldfield," Feldtmann, F. R. G.S.W.A. Bull. No. 91, pp. 16–21.
† Feldtmann, *op. cit.* p. 17.
‡ *op. cit.* p. 17.

* Department of Mines, Mineral Resources of Western Australia. " Census of Western Australian Minerals," Bull. No. 1, Carroll, D., Ph.D., D.I.C.
† Feldtmann, *op. cit.* p. 8.

2. TOPOGRAPHY.

The P.A. is situated on a dome-shaped hill which rises about 20 feet above the surrounding country.

3. GEOLOGY.

Owing to the almost complete lack of outcrops due to laterite and soil, practically no information was obtained from the surface reconnaissance; examination of the shaft gave meagre information only.

Within the P.A. there are several old, mostly inaccessible, shafts, some of which are probably quite deep.

The dome-shaped feature is covered with laterite and lateritic soil. The few quartz reefs seen only outcrop over a few yards. No pegmatites or pegmatitic rubble were found.

The country rock which surrounds the shaft that was examined showed no evidence of having been formed from a pegmatite. Three representative samples were taken. They are as follows:—

Departmental No.	Sample.
C820	White clay.
C821	Yellow clay.
C822	Lumps of clayey material.

These were submitted to the Government Chemical Laboratories for determination of the presence of tantalite. No traces of tantalite were found.

4. SUMMARY.

Chemical determinations support the field evidence that the area being prospected is non-tantaliferous.

Index to Geological Survey Annual Progress Report for 1948.

Division V.

School of Mines, Western Australia.

The Under Secretary for Mines.

I submit, for the information of the Hon. Minister for Mines, my Annual Report for 1948.

1. KALGOORLIE SCHOOL OF MINES.

Enrolments.

The total number of students enrolled during 1948 was 420. This is a decrease on the number enrolled during the previous year. Individual enrolments and class enrolments for the three terms of 1946, 1947 and 1948 are given below.

ENROLMENTS.

Year.	1st Term.		2nd Term.		3rd Term.	
	Individual.	Class.	Individual.	Class.	Individual.	Class.
1946	489	1,328	476	1,211	483	901
1947	546	1,807	533	1,551	513	1,374
1948	397	1,491	358	1,365	310	1,253

The number of students enrolled in the various subjects is given in Table 1.

The total enrolment of 420 students was made up as follows:—

(A) Students who are not returned servicemen, and who are—				
(1) Paying class fees or laboratory fees	Full-time	11		
	Part-time	52		
			—	63
(2) Paying only a registration fee (5s. per year) or who are exempt from fees ..	Full-time	10		
	Part-time	109		
			—	119
(B) Students who are returned servicemen, and who are exempt from fees (General Regulation 5). Not enrolled under Commonwealth Reconstruction Training Scheme ..	Full-time	1		
	Part-time	59		
			—	60
(C) Commonwealth Reconstruction Training Scheme students ..	Full-time	117		
	Part-time	61		
			—	178
				420

TABLE 1.

CLASS ENROLMENTS.

1948.

Subject.	1st Term.	2nd Term.	3rd Term.
Preparatory Chemistry	59	43	32
Chemistry IA.	58	48	42
Chemistry IB.	3	1	1
Analytical Chemistry I.	20	20	18
Analytical Chemistry II.	15	15	15
Applied Chemistry	12	11	11
Metallurgy I.	13	10	9
Metallurgy II.	6	4	4
Assaying	30	28	26
Mineral Dressing	22	21	19
Metallography	4	4	3
Preparatory Mathematics	58	49	41
Trade Mathematics I.	40	20	16
Trade Mathematics II.	6	5	5
Mathematics IA.	119	114	110
Mathematics IB.	15	11	8
Mathematics IIA.	46	44	43
Mathematics IIB.	13	12	11
Applied Mathematics	62	57	51
Preparatory Physics	42	31	22
Physics IA.	58	53	49
Physics IB.	54	51	48
Preparatory Drawing	57	53	45
Engineering Drawing I.	54	57	48
Engineering Drawing II.	27	28	29
Mechanical Drawing I.	47	43	40
Mechanical Engineering II.	10	10	10
Practical Electricity	10	7	6
Electrical Engineering I.	40	39	36
Electrical Engineering II.	7	7	7
Internal Combustion Engines	39	32	30
Workshop Practice I.	23	22	19
Workshop Practice II.	16	14	13
Welding	20	24	24
Engine Driving	19	21	21
Structural Engineering I.	44	41	41
Structural Engineering II.	9	8	6
Hydraulics	27	25	23
Machine Design	11	11	10
Materials of Construction	23	21	21
Preparatory Geology	23	30	26
Geology IA.	30	30	30
Geology IB.	25	24	23
Geology II.	14	13	13
Geology III.	2	2	2
Mining I.	32	25	25
Mining II.	23	15	13
Mining III.	12	12	12
Surveying I.	34	33	31
Surveying II.	21	20	19
Technical English	23	22	22
Leaving English	17	17	17
Petrology	4	4	4
Mining and Economic Geology	3	3	3
Total Class Enrolments	1,491	1,365	1,253

The revenue for the year was received from students enrolled under groups A 1, A 2 (small amount only), C and from fees received for diplomas and certificates.

The number of correspondence class students was the same as in 1947, i.e., 32. In 1947 the correspondence classes were suspended and no further enrolments were accepted after February, 1948. The position was slightly modified during 1948 to allow enrolments to be accepted from Commonwealth Reconstruction Training Scheme trainees, who desired additional training. Such trainees would, however, not be eligible to sit for School of Mines examinations.

Enrolments during 1948 were not as high as during 1947, but, there was still an appreciable number of full-time Commonwealth Reconstruction Training Scheme trainees. Extra laboratory classes were held, mainly during the afternoons, to accommodate these students.

Revenue.

The total revenue from fees, including fees from Commonwealth Reconstruction Training Scheme students, was £2,529 9s. 0d. Fees received for work done in the Metallurgical Laboratory are not included in the above amount.

Staff.

Miss R. Armstrong ceased duties as assistant in the Chemistry, Metallurgy and Assaying Department at the end of the 1947 academic year. The vacant position was advertised, but no suitable applicant could be obtained. Mr. F. T. Lynn was appointed as a part-time instructor.

Mr. F. G. Watson resigned from the position of assistant in the Mathematics and Physics Department on 2/7/48, and Mr. R. R. H. Doran was appointed to same position as from 5/7/48.

Mr. M. A. Moore resigned from the position of Assistant Research Metallurgist on 8/10/48.

A new position of Laboratory Assistant was created in the Chemistry, Metallurgy and Assaying Department, and Mr. S. R. H. Gibb appointed as from 7/4/48.

Mr. E. A. Edwards retired from the position of caretaker on 16/4/48. He had been associated with the school since 1933—from 1933 to 1939 as cleaner, and from 1939 to 1948 as caretaker. Mr. Edwards gave good service to the school, and retired with the good wishes of all members of the staff and all students.

To assist with the office work Miss Joan Stevens was appointed junior typist on 4/2/48, and Master G. Wholley as junior clerk on 1/3/48.

Mr. A. J. Murphy resigned from the position of cadet in the Geology Department on 16/4/48, and Mr. A. J. Reid was appointed to the same position on 17/5/48.

Mr. B. W. Long resigned from the position of cadet in the Mathematics and Physics Department on 31/12/48.

Mr. F. E. Gray ceased duties as cadet in the Metallurgical Laboratory on 13/1/49.

Advisory Committee.

During 1948 the Advisory Committee met on nine occasions. The members of the committee remained as for 1947. All members were re-appointed for a further period of 12 months from 8/5/48.

In February the Advisory Committee approved of the purchase of a milling machine and a grinding machine for the workshop from the "Apparatus and Equipment Trust Fund," which had been established by contributions of £1,000 each from the Chamber of Mines and the Mines Department. These two machines will greatly improve the school workshop, and enable instruction to be given in modern workshop practice.

The Registrar, Mr. Lumb, continued to act as secretary to the committee.

Courses of Study.

In the 1947 Annual Report it was pointed out that the revised courses first introduced in 1947 were further modified for 1948, and that the total number of hours of study for the Associate Courses was fixed at approximately 72, excluding the Preparatory Subjects. For the Certificate Courses the total number of hours of study was fixed at approximately 50, including the Preparatory Subjects. It was felt that these were the maximum number of hours, which were possible for the part-time student.

The Courses for 1948 are listed below—

Associateship Course in Metallurgy.

Associateship Course in Mining.

Associateship Course in Engineering.

Associateship Course in Mining Geology.

Assayer's Certificate Course.

Surveyor's Certificate Course.

Draftsman's Certificate Course.

Electrical Technician's Course.

Engine Operation and Maintenance Course.

As there were still a number of students completing their courses under the regulations in force to 1947 some subjects such as Mining and Economic Geology and also Petrology, which are not included in the new courses, were continued during 1948. For other subjects in the old courses appropriate substitute subjects from the new courses were given to students entitled to complete under the old regulations.

Diplomas and Certificates.

The following Diplomas and Certificates were issued during 1948:—

Associateship Courses—	
Metallurgy	—
Mining	2
Engineering	3
Mining Geology	—
Total	5
Certificate Courses—	
Assayer's	2
Surveyor's	1
Draftman's	1
Electrical Technician's	—
Industrial Chemist's	—
Geologist's	1
Electrician's	1
Total	6

Annual Examinations.

These were held from 1/11/48 to 12/11/48. Of the 1,097 entries for the examinations 75 per cent. passed, and of the 75 per cent. 24 per cent. obtained credit passes. These results are considered quite satisfactory. Examination results for individual subjects are given in Appendix III.

Scholarships and Prizes.

During 1948 the conditions for all scholarships and prizes were reviewed and amended. All scholarships and prizes are now awarded on the results of the annual examinations in one or more subjects. The conditions are given in Appendix I.

In the past the Chamber of Mines has provided two scholarships—one in Mining and one in Metallurgy. During 1948 the Chamber of Mines agreed to grant two additional scholarships—one in Engineering and one in Mining Geology. It also agreed to make the value of all scholarships £20. The new arrangement will become effective in 1949.

A list of scholarships and prizes awarded for 1948 is given in Appendix II.

Commonwealth Reconstruction Training Scheme.

Full-time and part-time trainees under this scheme continued to attend the school during 1948. The numbers decreased from 1947. Details are given below:—

	1947.	1948.
Full-time	142	117
Part-time	91	61

The results of the year's work by trainees were generally satisfactory. Details for full-time trainees are given below. These include decisions based on the supplementary examinations held in February, 1949.

	Number of trainees.	Approximate per cent.
Recommended for re-enrolment, 1949	66	74
Course completed	11	
Training period expired, course not completed	10	
Year's work not successful. Recommended for part-time training 1949, at own expense, with resumption of full-time training 1950, if successful 1949	11	9
Year's work not successful. Recommended for termination of Commonwealth Reconstruction Training Scheme privileges	6	14
Course abandoned during year	11	
Deceased	2	
Total	117	

Services to the Public.

In addition to its normal teaching activities the school provides a number of services to the public.

The work of the Metallurgical Research Laboratory will be referred to later in more detail. During the year 41 samples were submitted for investigation.

During the year 313 samples were submitted by prospectors for determination or assay. The total number of assays for gold was 163 and for other metals 6. The number of samples decreased by comparison with 1947.

The prospectors' course was again held. It followed similar lines to the 1947 course, but was extended to four days—from Tuesday, 7/12/48 to Friday, 10/12/48. Because of the interest at the present time in radioactive minerals arrangements were made for a talk to be given by Mr. Grace of the Government Chemical Laboratories, and for the Geiger-Muller Counter to be demonstrated About 50 prospectors were present at this talk and demonstration, but the attendance at other lectures was disappointing. A new feature introduced this year was a talk by Mr. S. C. Parker on "Diesel and other Engines." The course is an excellent opportunity for prospectors to learn something of the principles of geology, and to become acquainted with minerals other than gold.

The Director continued to act as local secretary for the University Annual Examinations and for the University Public Examinations. These examinations were held at the school and were supervised by members of the Staff. Supervision and accommodation were also provided for various other examinations, including those held by the State Electricity Commission, by various Technical Colleges, by the Australian Music Examinations Board, and by other examining bodies.

During the year lectures have been given by various visitors to Kalgoorlie, and these have been open to the public.

Monthly meetings of the Australian Institute of Mining and Metallurgy continue to be held at the school. From 26th May, 1948, to 1st June, 1948, the First Ordinary Meeting, 1948, of the institute was held in Kalgoorlie. The reading of papers and discussions thereon were held at the School of Mines.

Monthly meetings of the Institution of Engineers (Australia) are held at the school. Mr. Quartermaine, lecturer-in-charge, mining and mine surveying, is the local secretary.

Exhibition and Demonstration.

A very successful exhibition and demonstration was held on the night of Friday, 27th August, and the morning of Saturday, 28th August. This was organised mainly by the committee of the Students' Association, with the active co-operation and assistance of the members of the staff. An attractive booklet describing the exhibition and the work of the school was published.

Buildings.

Minor improvements have been made to the buildings during the year, and the buildings generally are in a satisfactory condition. Improvements considered necessary to the buildings are listed in a separate section of this report (refer "Principal Requirements of the School").

Buildings 48 and 51 were ready for occupation at the commencement of the school year. Building 48 was allotted to the Geology Department. The building includes a lecture room, two staff rooms and senior geological laboratories, and provides adequate accommodation for the senior geological subjects. Building 51, which was allotted to the engineering department, includes a lecture room, two staff rooms and an engineering library. It is a valuable addition to the engineering department.

Library.

During the year two students were employed part-time on work associated with the library. No central room is available as a library, and consequently libraries have been established in the various departments. Additional steel shelving was purchased during the year, and all periodicals have now been indexed and stored in suitable shelves. Some provision has been made for binding, but this work is very far behind and further attention will be given to this during 1949. Unbound periodicals go astray very readily, and every effort should be made to bind periodicals.

The school does not possess a central library, nor a full-time librarian. No space is available at present and the provision of a library would require a new building. It is realised that this is not practicable at the present time, but consideration should be given to this in the near future. Such a library would not only be of great benefit to the students, but could be available to those engaged in the mining industry. The services of a full-time librarian would be required.

Principal Requirements of the School.

Much of the new equipment ordered during 1946 and 1947 was received during 1948, and has been placed in use. There is still, however, much to be done. Further equipment has been ordered, and a satisfactory grant of money has been placed on the estimates for the 1948-49 financial year. For many items the supply position is difficult, and a long time elapses between the placing of the order and delivery of the items ordered.

Regarding the major requirements listed in the Annual Report for 1947 very little progress has been made. The present position regarding these is given below:—

(1) Electrical Installations—These were again inspected during July by an officer of the Public Works Department, and an amended scheme involving a transfer of portion of the school to A.C. was drawn up. Arrangements are being made by the Kalgoorlie Municipal Council to supply the school with A.C., and the policy is to transfer the whole of the school to A.C. within the next few years. It is hoped that the scheme referred to above will be implemented early in 1949.

(2) Transport—During the year a utility truck was made available to the school, and the old truck (W.A.G. 615) was sold.

(3) Additional Laboratories: Chemistry, Metallurgy and Assaying Department—During the year sketch plans for conversion of the Wiluna School of Mines building for use as a metallographic and metallurgical laboratory and for

a new mineral dressing laboratory were submitted for consideration. Approval has now been given (15/3/49) for transfer of the Wiluna building to Kalgoorlie, and for its conversions to laboratories as set out above. The building of the new mineral dressing laboratory has been deferred.

(4) Fume Cupboards—It is estimated that to rebuild some of these and to equip all fume cupboards with mechanical ventilation will cost £1,837. This work has been deferred, but it is hoped that further consideration will be given to this request. Present conditions are most unsatisfactory.

(5) Workshop—The milling machine referred to in last year's annual report was delivered late in 1948, but the grinding machine has not yet been received. Provision was made in the 1948-49 estimates for the purchase of additional equipment for the workshop.

(6) Electrical Engineering Laboratory—Some additional items of the equipment ordered in 1947 were received during 1948. Some are still outstanding. One 5 KVA generator has been installed, but all work on the switchboard has been held up because angle iron cannot be obtained.

The only major item which can be added to the above list is the provision of a library and full-time librarian. Reference to this has already been made in a previous section of this report.

Metallurgical Research Laboratory.

As in previous years the work done in the Metallurgical Research Laboratory consisted of routine investigations into samples of ore from various localities in Western Australia and elsewhere. The number of samples received was 41—an increase of eight samples by comparison with 1947. Three investigations were subsequently cancelled. Of the remaining 38 investigations 27 were in connection with gold ores, and the other 11 in connection with the ores of other minerals. Ores of the following minerals were investigated:—Lead, magnesite, asbestos, scheelite, vermiculite, copper, kyanite. Some work was also done on furnace bricks.

The work of the laboratory was handicapped by shortage of staff after Mr. Moore's resignation, and also by the absence of the senior research metallurgist because of sickness and association with other special work. As a result some work was outstanding at the end of the year. This will be completed early in 1949.

During 1948 the staff of the laboratory has been reclassified, and all members brought under the Public Service Commissioner. This will mean that the work of the laboratory will continue over the Christmas vacation, and that the members of the laboratory staff will work under the same conditions as other public servants. Adequate increases in salary have been granted to compensate members of the staff for the holiday periods lost. The classification allotted are given below:

Position.	Classification.	Salary Range.
Senior Research Metallurgist	P-I.-15	£809—£926 including a basic wage adjustment and marginal allowance of £100, plus district allowance, and an honorarium of £72 (C.S.I.R.)
Assistant Research	P-II.-2/3 with limit fixed at intermediate grade of class 2	£710—£788 including a basic wage of £346 and a marginal allowance of £19, plus district allowance and an honorarium of £50 (C.S.I.R.)
Assistant	P-II.-4/6	£574—£684 including a basic wage of £346 and a marginal allowance of £19, plus district allowance.

2.—SCHOOL OF MINES, NORSEMAN.

The total number of students enrolled was 102, which is an increase of 40 by comparison with 1947. Details regarding the enrolments are given below:—

ENROLMENTS.

Year.	1st Term.		2nd Term.		3rd Term.	
	Individual.	Class.	Individual.	Class.	Individual.	Class.
1946	70	118	67	104	58	87
1947	51	75	50	68	44	56
1948	96	165	84	122	89	139

The revenue received was £67 15s. 0d. As in previous years many of the students were under 21, and consequently did not pay class fees. Other students were returned soldiers, and were exempted from the payment of class fees.

Mr. Dowson continued to act full-time instructor and Master N. B. Creagh as cadet. Mr. Dowson very successfully maintained liaison between Kalgoorlie and Norseman, and also between the various part-time instructors at Norseman. Of a total of 380 questions set in the final examinations in all subjects only two had not been fully covered at Norseman. During the year approval was given for an additional full-time instructor at Norseman. The remainder of the staff at Norseman consisted of part-time instructors, and the success of the school is very largely dependent upon the work of the part-time instructors, all of whom give an appreciable amount of their leisure time to the school.

The subjects taught at Norseman last year were:—Preparatory Chemistry, Preparatory Drawing, Engineering Drawing I and II, Workshop Practice I and II, Internal Combustion Engines, Practical Electricity, Electrical Engineering I, Engine Driving, Preparatory Geology, Elementary Mathematics, Preparatory Mathematics, Mathematics IA, Trade Mathematics I, Preparatory Physics, Mining I, Welding. One student also sat for the final examination in Applied Mathematics.

For the annual examinations there were 109 entries in 19 subjects. The percentage of passes obtained was 81, of which 36 per cent. were credit passes. This is very satisfactory and reflects credit on the instructors at Norseman.

The building at Norseman was painted during the year, both externally and internally. Its condition is satisfactory. Minor improvements such as additional cupboards and new bench tops, were made during the year. Additional apparatus was provided for the laboratories, and these are now reasonably satisfactory for the subjects being taught. During the year also some provision was made for additional equipment for subjects to be introduced in 1949, particularly for Geology IA and Geology IB.

New subjects will be gradually introduced at Norseman as they are required, and the present policy is to aim at having all except some of the final year subjects of the certificate courses available at Norseman. Very little expansion is possible without additional buildings. At the present time very complete use is being made of the present building, and all available space is occupied. Accordingly during 1948 plans for an additional building and for improvements to the grounds were submitted for consideration. This building will enable the policy stated above to be implemented.

During the year the Board of Examiners for apprentices at Norseman drew up a syllabus of subjects available at Norseman and suitable for the various apprentices. Apprentices are now regularly attending the school, and arrangements have been made for some subjects to be available during the day time.

In October the Director and representatives of the Students' Association visited Norseman to discuss with the Norseman students the proposed formation of a branch of the Students' Association. After discussion the Norseman students decided to form a branch of the Students' Association at Norseman. An interim committee was elected, and the branch should become active during 1949.

As in past years classes in Workshop Practice I and II were held in the Central Norseman Gold Mines workshop. By courtesy of the same company the class in welding was also held there.

The Advisory Committee, under the chairmanship of Mr. Dutton, has continued to take a lively interest in the affairs of the school, and the thanks of the Department are due to all members of this committee.

During the year also the mining companies and the townspeople of Norseman have continued to take an interest in the affairs of the school and assistance has been forthcoming from time to time as required.

ACKNOWLEDGMENTS.

In conclusion the writer would like to acknowledge the assistance received from all members of the staff of the school, including the teaching staff both at Kalgoorlie and at Norseman, the office staff, the staff of the Metallurgical Laboratory and the cleaning staff. For all, the year has been a busy one, and all have responded well. The Advisory Committees both at Kalgoorlie and Norseman, have met from time to time, and the writer would like to record his appreciation of their work.

R. A. HOBSON,
Director, School of Mines.
23rd March, 1949.

APPENDIX I.

SCHOLARSHIPS AND PRIZES, 1948, CONDITIONS.

1. *Chamber of Mines Scholarships*:

   (i) In Metallurgy—Value £15.

   To be awarded for highest aggregate marks in Preparatory Mathematics and Preparatory Drawing.

   (ii) In Mining—Value £20.

   To be awarded for the highest aggregate marks in Chemistry IA plus Geology I, or Mathematics IA plus Physics IA.

2. *Students Association Scholarship*—Value £15.

To be awarded to the part-time student who obtains the highest aggregate marks in any three subjects of one of the diploma courses, and who complies with the conditions of the scholarship.

3. *Institute of Mine Surveyors*—Two prizes available:

   (i) Value £10. To be awarded to the part-time student enrolled in the Associateship Course in Mining or in the Surveyor's Certificate Course who gains the highest aggregate marks in Surveying I (compulsory) plus either Mining I or Geology I. To be eligible for this prize a student must obtain at least 60 per cent. in Surveying I.

   (ii) Value £5. To be awarded to the student, either full-time or part-time, who gains the highest marks in Surveying II.

4. *Associates' Association Scholarship*—Value £10.

To be awarded to the part-time student enrolled for a diploma course, who obtains the highest aggregate marks in any two of the following subjects:—

Associateship Course—Mining.—Mining I, Geology I, Surveying I.

Associateship Course—Engineering.—Mathematics IA, Physics IA, Applied Mathematics.

Associateship Course—Metallurgy.—Mathematics IA, Physics IA, Chemistry IA.

Associateship Course—Geology.—Geology I, Mathematics IA, Physics IA.

5. *C. A. Hendry Prize*—Value £2 2s.

To be awarded to the part-time student who obtains the highest marks in Mathematics IA.

6. *Mining Standard Prizes* (Critchley Parker Prizes).

Two prizes available. One to be awarded to the student who obtains the highest marks in Mining I, and the other to the student who obtains the highest marks in Metallurgy I.

APPENDIX II.

SCHOLARSHIPS AND PRIZES, 1948.

Junior Scholarship—£40 per annum:
R. Rasmussen.

Entrance Scholarship—£60 per annum:
L. I. Smith.

Chamber of Mines Scholarship—£15 per annum —Metallurgy:
S. J. Ritchie.

Chamber of Mines Scholarship—£20 per annum—Mining:
R. A. Flottman.

School of Mines Students' Association Scholarship—£15 per annum:
J. S. Quadrio.

Society of School of Mines Associates Scholarship—£10. per annum:
C. J. R. Kingsbury.

Institute of Mining Surveyors Prizes:
C. J. R. Kingsbury—£10 prize.
T. Wells—£5 prize.

C. A. Hendry Prize:
R. F. Turner.

Critchley Parker Mining Standard Prizes:
J. L. Clayton.
A. J. Gittos.

Wesley Ladies Guild Prize:
A. G. Selkirk.

APPENDIX III.

SCHOOL OF MINES OF W.A.

ANNUAL EXAMINATIONS, 1948.

PASS LIST.

Names are in order of merit.

(E) Denotes equal.

TRADE MATHEMATICS I.

Credit—
Rochester, A.
Tonkin, D.
Mason, E. E.

Pass—
Pantall, D. H.
Hunt, R. J.
Frank, B.
Stevens, B. E.
Denholm, J. V.
Bailey, W. J. } E
DeCampi, R. }
MacGregor, C. C.

TRADE MATHEMATICS II.

Credit—
Horn, H. L.
Masson, J. W
Yaksich, C.

Pass—
Moseley, J. H.
Irving, J L.

PREPARATORY MATHEMATICS.

Credit—
Thomas, A.
Ford, A. T.
Shenton, E. F.
Ritchie, S. J.
Smailes, J. P.
Jacobsen, P. J.

Pass—
Baker, M. L. } E
Heathcote, L. J. }
Jennings, R. E.
Siggins, A. M.
Hosie, A.
Chambers, S. R.
Coldwell, V. G.
Stevens, B. E.
Bawden, C. L. } E
Bower, J. K. }
Chamberlain, H. I.

Slade, L. K. } E
Yurisich, T. }
Regan, V. T.
Cedro, J. A.
Boughton, E. G.
Gibb, S. R. } E
Timoney, E. G. }
Griffiths, C. G.

PREPARATORY MATHEMATICS. Algebra Section.

Pass—
Gillieatt, K. P.

Geometry Section.

Credit—
Watson, N. J.

MATHEMATICS IA.

Credit—
Flottman, R. A.
Power, F. W. G.
Tanner, A. C.
Williams, G. D.
Turner, R. F.
Fariss, T. W. L.
Clark, A. M.

Pass—
Flanagan, J. C.
Jacobs, N.
Gillieatt, K. P.
Smith, L. I.
Walker, H. R. C.
McGlashan, G.
Metcher, I. S.
Jacobs, R. A.
Colgan, J. G.
Bell, B. W.
Moriarty, C. J.
Smith, C. T.
Saunders, N. L.
MacGregor, D. D.
Cant, R. G.
Brabazon, W. M.
Harper, D. G.
Wilson, A.
Eddy, J. G.
Rasmussen, G. P.
McMullan, W. R.
Braithwaite, A.
McDermott, C. J.
Duthie, W. H.
Brennan, Miss R. C.
Warburton, J. C.

MATHEMATICS IA.—continued.

Rich, H. J.
Harlond, B. C.
Edgar, K. R.
Morris, L. W.
Gilbert, W. B.
Munro, G. W.
McRae, R. K.
Hille, T. S.
Manners, M. D. L.
Quan, L. E.
Shaw, S. C.

MATHEMATICS IA. Algebra Section.

Credit—
Holtzman, V. R.
Holland, A. J.

Pass—
Crowley, P. J.
Skerry, T. F.
Bonner, M. H.
Horan, C. B.
Kelly, K. W.
Griffiths, I. N.

Geometry Section.

Credit—
Thomas, A. V.

Pass—
Gardner, J. A.
Pinnock, J. H.
Pegler, A. V.

Trigonometry Section.

Pass—
Lloyd, J. K. N.

MATHEMATICS IIA.

Credit—
Young, J. G. W.
Skerry, T. F.

Pass—
Casserly, F. A.
Dodd, K. C.
Reid, A. J.
Hogg, J. M.
Lloyd, J. K. N.
Kanther, H. I.
Wells, T.
Antulov, V.
Newton, R. J.
Darroch, I. N. D.
Crowley, P. J.
Thomas, A. V.
Long, B. W.
Edgar, G. S.
Airey, J A. }
Baster, L. R. }
Carter, K. J. } E
Manners, J. E. L. }
Zehnder, J. W. }
Gibson, A. A.

MATHEMATICS IIB.

Credit—
Smith, B. R.
Kanther, H. I.

Pass—
Oakley, D. J.
Darroch, I. N. D.
Skerry, T. F.
Newton, R. J.
Thomas, A. V.

APPLIED MATHEMATICS.

Credit—
MacGregor, D. D.

Pass—
Manners, J. E. L.
Smith, L. I.
Faichney, J. M.
Sublet, G. H.
Flottman, R. A.
Toms, H. E.
Metcher, I. S.
Harris, J. W.
Taylor, S. R.
Tanner, A. C.
Rich, H. J.
Williams, G. D.
Smith, A. M.
Miles, A. T.
McMullen, W. R.
Myers, E. O.

PREPARATORY PHYSICS.

Credit—
Thomas, A.
Ritchie, S. J. L.
Smailes, J. P.
Shenton, E. F.

PREPARATORY PHYSICS-contd.

Pass—
Coldwell, V. G.
Bower, J. K.
Chambers, S. R.
Hosie, A.
Pantall, D. H.
Boughton, E. G.
Olsen, O.
Cedro, J. A.
Stevens, B. E.
Gibb, S. R.
Griffiths, C. G.

Pass in Practical Only—
Miller, J. B.
Reibel, K.
Regan, J. T.
Chamberlain, H. I.
Deacon, M. N.
Neve M. G.

PHYSICS IA.

Credit—
Flottman, R. A.
Dunstan, H. E.
Reid, A. J
Smith, L. I. } E
Williams, G. D. }
Walker, H. R. C.
Turner, R. F.
Gillieatt, K. P. } E
Tanner, A. C. }

Pass—
Myers, E. O.
Miles, A. T. } E
Ritchie, H. G. }
McRae, R. K.
Colgan, J. G.
Rich, H. J. }
Wilson, A. } E
Flanagan, J. C. }
Hille, T. S. } E
Smith, C. T. }
Ford, A. T.
Nelli, W. M.
Manners, M. D. L. } E
Smith, A. J. }
Loukes, K. R. } E
Siggins, A. M. }
Sweet, R. B.
McLellan, G. K.
Thomas, R. P.
Yurisich, T.
Zuvich, M. } E
Watson, N. J. }
Low, W. H. } E
Munro, G. W. }

Pass in Practical only—
Rasmussen, G. P.
Gard, R. C.
Baker, M. L.
Smailes, M. G.
Milligan, R. J.
Boyle, A. M.
Cain, J. M.
Finucane, P. J.
Glenister, G. J.
Heathcote, L. J.
Jacobsen, P. J.
Jennings, R. E.
Harlond, B. C.
Berry, A. T.

PHYSICS IB.

Credit—
Young, J. G. W.
Dodd, K. C.
Skerry, T. F.
Quadrio, J. S.
Kanther, H. I.
Manners, J. E. L.
Hogg, J. Mc.
Lloyd, J. K. N.

Pass—
Doran, R. R. H.
Thomas, A. V.
Crawford, J. H.
Gittos, A. J.
Saunders, N. L.
Abotomey, J.
Huxtable, D. A.
Gilbert, W. B.
Long, B. W.
Newton, R. J.
Royle, P. G.
Inman, R. D.
Harvey, J. J.
Casserly, F. A.
Haddow, J. F.
Cranston, A. G.
Edgar, G. S.
Clarke, A. M.
Bonner, M. H.
Zehnder, J. W.
Compton, G. R.
Green, E. J.
Edgar, K. R.
Brabazon, W. M.
Baster, L. R.
Stodart, J. W.
Carew-Reid, D. M.
Bird, C. R.

PREPARATORY CHEMISTRY

Credit—
Thomas, A.
Chambers, S. R.
McRae, R. K.
Amm, R. A.
Beveridge, A. W.

Pass—
O'Neill, J.
Ritchie, S. J.
Bower, J. K.
Hosie, A.
Kirkwood, G. C.
Timoney, E.
Hug, F.
Smailes, J. P.
Low, W. H.
Warburton, J. C.
Jennings, R. E.
Regan, V. T.

CHEMISTRY IA.

Credit—
Watson, R. J.

Pass—
Flottman, R. A.
McCarthy, M. G.
Tanner, A. C.
Flanagan, J. C.
Rhodes, D. J.
Miles, A. T.
Smith, L. I.
Williams, G. D.
Sarell, R. G.
Metcher, I. S.
Huxtable, D. A.
Reid, A. J.
Whitton, W. R.
Royle, P. G.
Shaw, S. C.
Mathews, W. A. R.
Sublet, G. H.
Colgan, J. G.
Jacobs, R. A.
Smith, G. T.
Gillieatt, K. P.

Pass in Practical only—
Berry, A. T.
Smailes, M. G.
Callow, R. D.
Cant, R. G.
Loukes, K. R.
Milligan, R. J.
Rich, H. J.
Turrell, R. M.

APPLIED CHEMISTRY.

Pass—
Harvey, J. J.
Brabazon, W. M.
Horan, C. B.
Webb, H. J.
McGlashan, G.

APPLIED CHEMISTRY IA

Credit—
Griffin, A. F.

Pass—
Edgar, G. S.

ANALYTICAL CHEMISTRY I.

Pass—
Quadrio, J. S.
Gittos, A. J.
Green, E. J.
Webb, H. J.
Walker, H. R. C.
McGlashan, G.

Pass in Theory only—
Harvey, J. J.
Hicks, E. J.
Knight, L. B.

Pass in Practical only—
Spencer, W. J.

ANALYTICAL CHEMISTRY II.

Pass—
Casserly, F. A.
Edgar, G. S.
Green, E. J.
Griffin, A. F.
Reid, D. M.
Way, I. E.
Young, J. G. W.
Brennan, Miss R. C.
Gray, F. E.
Long, B. W.
Franklyn, R. P.

METALLURGY I.

Credit—
Gittos, A. J.
Quadrio, J. S.
Green, J. W.

Pass—
Bird, C. R.
Harvey, J. J.
Spencer, W. J.
Edwards, N. A.
Webb, H. J.

METALLURGY IA.

Pass—
Rhodes, D. J.
Faichney, J. M.

METALLURGY II.

Credit—
Edgar, G. S.

Pass—
Franklyn, R. P.

Thesis Accepted (1946 Syllabus.)
Griffin, A. F.

ANALYTICAL CHEMISTRY IIC.

Pass—
Bonner, M. H.
Gibson, A. A.

METALLOGRAPHY.

Credit—
Edgar, G. S.

Pass—
Green, E. J.

ASSAYING.

Credit—
Bonner, M. H.
Baster, L. R.

Pass—
Power, F. W. G.
Miles, A. T.
Huxtable, D. A.
Moriarty, C. J.
Flanagan, J. C.
Manners, M. D. L.
Turrell, R. M.
Spencer, W. J.
Boylen, R. S.
Smith, L. I.
Crawford, J. H.
Baker, M.
Rich, H. J.

MINERAL DRESSING.

Pass—
Green, J. W.
Bonner, M. H.
Lloyd, J. K. N.
Nicholls, L.
Hogg, J. M.
Burrows, H. L.
Considine, D. C.
Gibson, A. A.
Harvey, J. J.
Inman, R. D.
Franklyn, R. P.
Bird, C. R.
Faichney, J. M.
Myers, E. O.
Green, E. J.
Casserly, F. A.

PREPARATORY GEOLOGY.

Credit—
Thomas, A.
Compton, D. E. A.
Watson, R. J.
Chambers, S. R.
McRae, R. K.

Pass—
Boylen, R. S.
Crawford, J. H.
Gibb, S. R.
Amm, R. A.
Smailes, J. P.
Spencer, W. J.
Ritchie, S. J. L.
Bower, J. K.
Olsen, O.
Taggart, J.
Murphy, A. J.
Vukobratich, S.
Smith, A. J.

GEOLOGY I.

Pass—
Reid, J. A.
Baster, L. R.
Carter, K. J.
Kingsbury, C. J. R.
Holtzman, V. R.
Weedon, R. P. J.
Antulov, V.
Heathcote, L. J.
Forster, E. T.
Mathews, W. A. R.
Long, B. W.
Zehnder, J. W.
Gray, F. E.
Edlington, W. B.
Potts, E. M.
Smailes, M. G.
Abotomey, J.
Morris, L. W.
Quan, L. E.

Pass in Practical only—
Slade, L. K.
Milligan, R. J.
Griffiths, I. N.
Steel, W.
Stodart, J. W.

Pass in Practical only—*contd*
Callow, R. D.
Low, W. H.
Christey, R. B.
Harper, D. G.

GEOLOGY IB.

Pass—
Casserly, F. A.
Chambers, S. R.
Franklyn, R. P.
Gittos, A. J.
Webb, H. J.
Ion, C. E.
Walker, H. R. C.
Edwards, N. A.
Brabazon, W. M.
McGlashan, G.
Moriarty, C. J.
Sublet, G. H.
Tanner, A. C.

Pass in Practical only—
Bell, B. W.
Brennan, Miss R. C.
McCarthy, M. C.
Bird, C. R.
McMullan, W. R.
Loukes, K. R.
Jacobs, R. A.
Rich, H. J.
Whitton, W. R.

GEOLOGY II.

Pass—
Wells, T.
Hogg, J. M.
Manners, J. E. L.
Inman, R. D.
Sarell, R. G.
Lloyd, J. K. N.
Faichney, J. M.

Pass in Theory only—
Way, I. E.
Burrows, H. L.

GEOLOGY III.

Pass—
Bonner, M. H.
Gibson, A. A.

PETROLOGY.

Pass—
Considine, D. C.
Crowley, P. J.
Royle, P. G.
Compton, G. R.

MINING AND ECONOMIC GEOLOGY.

Pass—
Power, F. W. G.
Crowley, P. J.
Middleton-White, K. C.
Considine, D. C.

Theses Accepted (1946 Syllabus).
Matheson, W. R.
Bonner, M. H.

MINING I.

Credit—
Clayton, J. L.
Way, I. E.

Pass—
Wilson, A.
Quan, L. E.
Siggins, A. M.
Phillips, J. A. (Snr.)
Hicks, E. J.
Timoney, E. G.
Rhodes, D. J.
McLellan, G. K.
Boylen, R. S.
Zuvich, N.
Place, R. T.
Pegler, A. V. } E
Heathcote, L. J. }
Antulov, V.
Vukobratich, S.
McDermott, J. C

MINING II.

Credit—
Weedon, R. P. J.
Morris, L. W.
Baster, L. R.
Gibson, A. A.
Abotomey, J.

Pass—
Amm, R. A.
Edlington, W. B.
Clarke, L. D.
Crawford, J. H.
Cranston, A. G.

MINE SAMPLING AND VALUATION.

Credit—
Gibson, A. A.
Baster, L. R.
Mathews, W. A. R.

Pass—
Edlington, W. B.
Abotomey, J. } E
Weedon, R. P. J. }
Amm, R. A.
Ibbotson, A. W.
Forster, E. T.
Crawford, J. H. }
Morris, L. W. } E
Vukobratich, S. }
O'Connor, J. M. }
Antulov, V.
Low, W. H.
Carter, K. J.
Potts, E. M.
Zehnder, J. W.

MINING III.

Credit—
Sweet, F. B.
Hogg, J. M. } E
Wells, T. }
Power, F. W. G.

Pass—
Wreford, P. M.
Clarke, L. D.
Inman, R. D.
Lloyd, J. K. N.
Haddow, J. F.
Myers, E. O.

SURVEYING I.

Credit—
Hughes, E. E.
Way, I. E.
Kanther, H. I.
Manners, J. E. L.
Smith, B. R.

Pass—
Kingsbury, C. J. R.
Crawford, J. H.
Skerry, T. F.
Newton, R. J.
Holland, A. J.
Saunders, N. L.
Boylen, R. S.
Edgar, K. R.
Steel, W.
Siggins, A. M.
Hicks, E. J.
McDermott, J. C.
Doran, R. R.
Harper, D. G.
Thomas, A. V.
Quan, L.
Eddy, J. G.
Antulov, V.
Pegler, A. V.
Manners, M. D. L.
Rhodes, D. J.

SURVEYING II.

Examination only (1948).

Credit—
Wells, T.
Holtzman, V. R.

Pass—
Gibson, A. A.
Ibbotson, A. W.
Mathews, W. A. R.
Carter, K. J.
Zehnder, J. W.
Forster, E. T.
O'Dea, W. J.
Abotomey, J.
Amm, R. A.
Bonner, M. H.
Myers, E. O.

Theses Accepted.
Faichney, J. M. (1946 Syllabus).

PREPARATORY DRAWING.

Credit—
Eddy, J. G.
Hamilton, I.
Thomas, A.
Ritchie, J.
Isle, R.
Reibel, K.
Cedro, J.
Cliff, I. F.
Wilson, A.

Pass—
Beveridge, A.
Smailes, J. P.
McRae, R. K.
Morton, W.
Phillips, J. A.
Chamberlain, H.
Shenton, E. F.
Miller, J. B.
Reid, A. J.
Stevens, B. E.
Boylen, R. S.
Masson, J. W.
Hug, F.
Finucane, P. J.
Green, J. W.
Moseley, J. H.
Marshall, R.
Deacon, M.
Brennan, T.
Boughton, E.
Regan, J. T.

ENGINEERING DRAWING I.

Credit—
Selkirk, A.
Smailes, M. G.
Watson, R. J.
Quadrio, J. S.
Burrows, H. L.
Smith, L. I.
Smith, C. T.
Stronach, B. J.
Flanagan, J. C.
Crawford, J. H. } E
Ewing, D. A. }
Vukobratich, S.
Cranston, A. G.
Ford, A. T.
Munro, G. W.
Field, D.
Siggins, A. M.
Sweet, R.

Pass—
Miles, A. T.
Chambers, S. R.
Whitton, W. R.
Moriarty, C. J.
Harvey, J. J.
Newton, R. J.
McMullan, W.
Sublet, G.
Walker, H. R. C.
Loukes, K. R.
Smith, A. J.
Horan, C. B.
Nelli, W. M.
Stodart, J. W.
Colgan, J. G.
Hosie, A.
McCarthy, M. G.
McGlashan, G.

ENGINEERING DRAWING II.

Credit—
Gibson, A. A.
Wells, T.
Hogg, J. M.
Manners, M. D. L.
Zehnder, J. W.
Watson, R. J.
Manners, J. E. L.
Mathews, W. A. R.
Darroch, I. N. D.
Woods, J.
Antulov, V.
Metcher, I. S.
Abotomey, J.
Clayton, J. L.

Pass—
Holland, A. J.
Lloyd, J. K. N.
Carter, K. J.
Turrell, R. M.
Doran, R. R.
Yurisich, T.
Callow, R. D.
Amm, R. A.
Holtzman, V. R.
Kelly, K. W.
Christopher, L. F.

MECHANICAL ENGINEERING I.

Credit—
Kanther, H. I.
Lloyd, J. K. N.
Skerry, T. F.
Hogg, J. M.
Inman, R. D.
Clarke, L. D.
Compton, G. R.
Thomas, A. V.
Faichney, J. M.
Metcher, I. S.
Wells, T.
Flottman, R. A.
Crawford, J. H.
Saunders, N. L.
Edgar, K. R.
Shaw, S. C.
Burrows, H. L.

Pass—
Miles, H. G. K.
Cranston, A. G.
Ewing, D. A.
Hille, W. C.
Huxtable, D. A.
Franklyn, R. P.
Yurisich, T.
Ford, A. T.
Boylen, R. S.
Clark, A. M.
Carew-Reid, D. M.
Abotomey, J.
Haddow, J. F.
Cant, R. G.
Slade, L. K.
Munro, G. W.
Harper, D. G.

MECHANICAL ENGINEERING II.

Credit—
Dodd, K. C.
Darroch, I. N. D.
Smith, B. R.
Mead, G. F.
Oakley, D. J.

Pass—
Taylor, S. R.

MATERIALS OF CONSTRUCTION.

Credit—
Dodd, K. C.
Ewing, D. A.
Martin, D. J.

Pass—
Skerry, T. F.
Smith, B. R.
Kanther, H. I.
Doran, R. R.
Edgar, K. R.
Flottman, R. A.
Power, F. W. G.
Newton, R. J.
Cant, R. G.
Holland, A. J.
Thomas, A. V.
Toms, H. E.
Crowley, P. J.
Clark, A. M.
Harper, D. G.
Ford, A. T.
Harlond, B. C.
Munro, G. W.

MACHINE DESIGN.

Credit—
Darroch, I. N. D.
Airey, J. A.
Oakley, D. J.

Pass—
Duthie, W. H.
Saunders, N. L.
Doran, R. R.
Braithwaite, A.
Clark, A. M.
Fariss, T. W. L.
Cain, J. M.

Thesis Accepted (1946 Syllabus).
Morphet, J. P.
Rasmussen, L. A.

STRUCTURAL ENGINEERING I.

Credit—
Ewing, D. A.
Collister, J. D.
Manners, J. E. L.
Skerry, T. F.
Inman, R. D.
Doran, R. R. H.
Lloyd, J. K. N.
Haddow, J. F.
Huxtable, D. A.
Darroch, I. N. D.
Hogg, J. M.
Compton, G. R.
Dodd, K. C.
Considine, D. C.
Kanther, H. I.

Pass—
Wells, T.
Baster, L. R.
Oakley, D. J.
MacGregor, D. D.
Crawford, J. H.
Harper, D. G.
Saunders, N. L.
Newton, R. J.
Power, F. W. G.
Boylen, R. S.
Edgar, K. R.
Metcher, I. S.
Bonner, M. H.
Abotomey, J.
Flottman, R. A.
Toms, H. E.
Thomas, A. V.
Clark, A. M.
Cant, R. G.
Fariss, T. W. L.
Cranston, A. G.
Duthie, W. H.

STRUCTURAL ENGINEERING II.

Pass—
Smith, B. R.
Gilbert, W. B.
Martin, D. J.
Harris, S. L.
Braithwaite, A.

HYDRAULICS.

Credit—
Dodd, K. C.
Ewing, D. A.
Darroch, I. N. D.
Young, J. G. W.
Hastings, R. W.
Kanther, H. I.
Royle, P. G.

Pass—
Smith, B. R.
Newton, R. J.
Edgar, G. S.
Oakley, D. J.
Metcher, I. S.
Green, E. J.
Compton, G. R.
Saunders, N. L.
Braithwaite, A.
Brabazon, W. M.
Taylor, S. R.
Carew-Reid, D. M.

ELECTRICAL ENGINEERING

Credit—
Collister, J. D.
Dodd, K.
Young, J. G. W.
Martin, D. J.

Pass—
Inman, R. D.
Brabazon, W. M.
Baster, L. R.
Edgar, G. S.
Casserly, F. A.
Metcher, I. S.
Compton, G. R.
Toms, H. E.
Edgar, K. R.
Holland, A. J.
Cant, R. G.
Yurisich, T.
Harris, S. L.
Franklyn, R. P.
Way, I. E.
Gilbert, W. B.
Martin, J. D.
Ford, A. T.
Shaw, S. C.
Green, E. G.
Naumoff, G. S.
Abotomey, J.
Clark, A. M.
Taylor, S. R.
Warren, R. E.
Miles, H. G. K.

ELECTRICAL ENGINEERING II.

Credit—
Oakley, D. J.

Pass—
Hastings, R. W.
Smith, B. R.
Doran, R. R.
Gardner, J. A.

Theses Accepted—
Fisher, E. W. (1946 Syllabus)

WORKSHOP PRACTICE, I.

Credit—
Brabazon, W. M.
Darroch, I. N. D.
Edgar, G. S.

Pass—
Long, B. W.
Staker, T. R.
Franklyn, R. P.
Jones, A.
McGlashan, G.
Carew-Reid, D. M.
Boyle, A. M.
Hosie, A.
McIvor, J. R.

Pass in Theory Only.—
Jacobs, N.
Ferguson, D. J.
Webb, H. J.
Moseley, J. H.

Pass in Practical Only—
Morton, W. A.

WORKSHOP PRACTICE II.

Pass—
Gilbert, W. B.
Taylor, S. R.
Church, E. G.
Cant, R. G.
Rustand, J.
Hastings, R. W
Selkirk, L. A.
Hudson, H. R.
Holland, A. J.
Colgan, J.

Pass in Theory Only—
Jennings, R. E.
Gard, R. F.

INTERNAL COMBUSTION ENGINES.

Credit—
Hastings, R. W.
Rochester, A.
Young, J. G. W.
Oakley, D. J.
Darroch, I. N. D.
Smith, B. R.
Toms, H. E.
Power, F. W. G.
Mason, E. E.
Holland, A. J.
Newton, R. J.
Hosie, A.

Pass—
Williams, P. B.
Clayton, J. L.
Creed, H. E.
Mitchell, K. R.
Fariss, T. W. L.
Clark, A. M.
Doran, R. R.
Stewart, W.
Kelly, K. W.
Hingston, A. F.

PRACTICAL ELECTRICITY.

Credit—
Horn, H.
Hosie, A.
Sullivan, A. D.

Pass—
Pusey, J.

ENGINE DRIVING.

Pass—
Mason, E. E.
Paterson, J.
Harpwood, A.
LeCampi, R.
Annear, R. J.
Rucklidge, G. H.

WELDING.

Credit—
Simmonds, G.
Toms, H. E.

Pass—
Gilbert, W. B.
Edgar, K. R.
Dodd, K.
Harlond, B. C.
Smith, B. R.
Yurisich, T.
Doran, R.
Cant, R. G.
Clark, A. M.

Pass in Theory Only—
Braithwaite, A.

TECHNICAL ENGLISH.

Credit—
Young, J. G. W.
Burrows, H. L.

Pass—
Hogg, J. M.
Edgar, G. S. } E
Wells, T. }
Inman, R. D.
Faichney, J. M.
McCarthy, M. G.
Casserly, F. A.
Lloyd, J. K. N. } E
Lynn, F. T. }
Myers, E. O.
Naumoff, G. S.
Cant, R. G.
Bird, C. R.
Turrell, R. M.

CORRESPONDENCE COURSES.

Mining I.

Pass—
O'Sullivan, F.
Downey, R. H. J.

METALLURGY I.

Credit—
Tauss, W.

ORE DRESSING.

Credit—
Tauss, W.

Theses Accepted (1946 Syllabus).

Associateship Course in Mining—
Naumoff, G. S.—Mining Thesis in place of Geological Thesis.
Brodie-Hall, L. C.—Thesis in Mining.
Bonner, M. H.—Thesis in Mining and Economic Geology.

Mine Surveyor's Certificate Course—
Ion, C. E. } Surveying II.
Huxtable, D. A. } Thesis.
Weedon, R. P. J. }

SUPPLEMENTARY EXAMINATIONS, 1948.

PREPARATORY MATHEMATICS.

Trigonometry Section.
Gillicott, K. P.
Loukes, K. R.
Wark, A. R. J.
Watson, N. J.

PHYSICS IA.
Brennan, Miss R. C.
Callow, R. D.
Moriarty, C. J.

MATHEMATICS IIA.
Compton, G. R.

ELECTRICAL ENGINEERING I.
Harlond, B. C.

ELECTRICAL ENGINEERING II.
Saunders, N. L.

PETROLOGY.
Pass in Practical Only—
Smith, A. M.
Clarke, L. D.

APPLIED MATHEMATICS.
Edlington, W. B.
Kelly, K. W.
Saunders, N. L.

PREPARATORY CHEMISTRY.
Kelly, K. W.

WORKSHOP PRACTICE II.
Camilleri, O.

STRUCTURAL ENGINEERING I.
Crowley, P. J.

MINING IIA.
(Mine Sampling.)
Cranston, A. G.

SURVEYING I.
Poole, R. H.

SURVEYING II.
Crowley, P. J.

PREPARATORY GEOLOGY.
Abotomey, J.
Cedro, J.
Low, W. H.
McLennan, G. K.
Rich, H. J.

ANALYTICAL CHEMISTRY I.
Carew-Reid, D. M.

APPLIED CHEMISTRY IB.
Fennell, W.
Naumoff, G. S.

TECHNICAL ENGLISH.
Brabazon, W. M.
Christopher, L. F.
Edwards, N. A.
Henderson, D. C.
Kanther, H. I.
Moriarty, C. J.
Morris, L. W.

CHEMISTRY IA.
Knight, L. B.
Toms, H. E.

CHEMISTRY IA.
(Practical Section.)
McGlashan, G.

YEAR'S FEE SCHOLARSHIPS.

TRADE MATHEMATICS I.
Rochester, A.

TRADE MATHEMATICS II.
Horn, H. L.

PREPARATORY MATHEMATICS.
Thomas, A.

MATHEMATICS IA.
Flottman, R. A.

MATHEMATICS IIA.
Young, J. G. W.

MATHEMATICS IIB.
Smith, B. R.

APPLIED MATHEMATICS.
MacGregor, D. D.

PREPARATORY PHYSICS.
Thomas, A.

PHYSICS IA.
Flottman, R. A.

PHYSICS IB.
Young, J. G. W.

PREPARATORY CHEMISTRY.
Thomas, A.

CHEMISTRY IA
Watson, R. J.

YEAR'S FEE SCHOLARSHIPS—*continued.*

APPLIED CHEMISTRY IA
Griffin, A. F.

METALLURGY I.
Gittos, A. J.

METALLURGY II.
Edgar, G. S.

METALLOGRAPHY.
Edgar, G. S.

ASSAYING.
Bonner, M. H.

PREPARATORY GEOLOGY.
Thomas, A.

MINING I.
Clayton, J. L.

MINING II.
Weedon, R. P. J.

MINING III.
Sweet, F. B.

SURVEYING I.
Hughes, E. E.

SURVEYING II.
Wells, T.

PREPARATORY DRAWING.
Eddy, J. G.

MECHANICAL DRAWING I.
Selkirk, A.

MECHANICAL DRAWING II.
Gibson, A.

MECHANICAL ENGINEERING I.
Kanther, H. I.

MECHANICAL ENGINEERING II.
Dodd, K. C.

MATERIALS OF CONSTRUCTION.
Dodd, K. C.

MACHINE DESIGN.
Darroch, I. N. D.

STRUCTURAL ENGINEERING I.
Ewing, D. A.

HYDRAULICS.
Dodd, K. C.

ELECTRICAL ENGINEERING I.
Dodd, K. C.

ELECTRICAL ENGINEERING II.
Oakley, D. J.

WORKSHOP PRACTICE I.
Brabazon, W. M.

INTERNAL COMBUSTION ENGINES.
Hastings, R. W.

PRACTICAL ELECTRICITY.
Horn, H.

WELDING.
Simmonds, G.

TECHNICAL ENGLISH.
Young, J. G. W.

NORSEMAN SCHOOL OF MINES.

ELEMENTARY MATHEMATICS.
Credit—
Orton, J. E. R.
Silvester, S. W.

Pass—
Swaine, W. T.
Templeman, F. D.
Warne, R.

TRADE MATHEMATICS I.
Credit—
Clark, L.
Dodd, L. C.
Dillon, J.
Pugh, D.
Forgan, F. A.
Hanson, R. J.

Pass—
Kerr, R. N.
Winston, J. T.
Kerr, W. J.
Halse, E. J.
Parker, A. W.

PREPARATORY MATHEMATICS.
Credit—
Prince, A.
O'Connell, J. C.

Pass—
Hanson, R. J.
Dillon, J. D.

MATHEMATICS A.
Credit—
Creagh, N. B.

Pass—
Brett, R. L.

APPLIED MATHEMATICS.
Credit—
Creagh, N. B.

PREPARATORY PHYSICS.
Pass in Theory Only—
Turner, R. H.

PREPARATORY CHEMISTRY.
Credit—
Turner, R. H.

Pass—
Horsham, J. F.

PREPARATORY GEOLOGY.
Credit—
Creagh, N. B.

Pass—
Stubbs, J. R. M.
Morton, J. L.
Meacock, W.

MINING II.
Credit—
Brett, R. L.
Orton, J. E. R.
O'Connell, J. C.
Collin, A.
Redmond, G. J.

Pass—
Morton, J. L.
Prince, A.
Warne, R.
Silvester, S. W.

MINE SAMPLING.
Credit—
Redmond, G. J.
Collin, A.
Brett, R. L.

Pass—
Warne, R.
Morton, J.
Prince, A.
O'Connell, J. C. } E
Silvester, S. W. }

PREPARATORY DRAWING.
Credit—
Silvester, S. W.
Warne, R.

Pass—
Parker, A. D.
Parker, A. W.
Newman, M. F.
Dillon, J. D.

ENGINEERING DRAWING I.
Pass—
O'Connell, J. C.
Warne, R.
Kerr, P. H.
Turnor, J. S.
Winston, J. T.

ENGINEERING DRAWING II.
Credit—
Creagh, N. B.

WORKSHOP PRACTICE I.
Credit—
Creagh, N. B.
Brett, R. L.

Pass—
Kerr, P. H.
Wojvodich, F.
Young, J. R.

WORKSHOP PRACTICE II.
Pass—
Kerr, W.
Kerr, R.
Delamotte, H. C.

Pass in Practical Only—
Regolini, J. A.
Bird, R.

ENGINE DRIVING.
Pass—
Trotter, E. G.
Turnor, J. S.
Forgan, F. A.
Dodd, L.
Bird, R. J.

WELDING.
Credit—
Wilson, S. E.
Guest, C. A.
Guest, A. I.
O'Brien, T. N.
Dodd, L.
Pass—
Forgan, F. A.
Kerr, W. J.
Newman, F. A.
Bullen, E.
Guest, P. H.
Clark, L.
Turnor, J. S.
Bach, D.
Bunyan, W. L.
Halse, E. J.
Eyre, C. H.
Pugh, D. D.
Lamplugh, A.

Pass in Practical Only—
Mayberry, A. J.
Hills, H. P.
Baker, A. H.

PRACTICAL ELECTRICITY.
Credit—
Arthurell, E.

Pass—
Parker, A. W.
Kerr, R. N.
Pugh, D. D.

ELECTRICAL ENGINEERING I.
Credit—
Brett, R. L.

INTERNAL COMBUSTION ENGINES.
Pass—
Hills, H. P.
Lord, S. J.

SUPPLEMENTARY EXAMINATIONS, 1948.

MINING II.
Mine Sampling.
Pass—
Orton, J. E. R.

YEAR'S FEE SCHOLARSHIPS.

ELEMENTARY MATHEMATICS.
Orton, J. E.

TRADE MATHEMATICS I.
Clark, L.

PREPARATORY MATHEMATICS.
Prince, A.

MATHEMATICS IA.
Creagh, N. B.

APPLIED MATHEMATICS.
Creagh, N. B.

PREPARATORY CHEMISTRY.
Turner, R. H.

PREPARATORY GEOLOGY.
Creagh, N. B.

MINING II.
Brett, R. L.

MECHANICAL DRAWING II.
Creagh, N. B.

PREPARATORY MECHANICAL DRAWING.
Silvester, S. W.

WORKSHOP PRACTICE I.
Creagh, N. B.

WELDING.
Wilson, S. E.

PRACTICAL ELECTRICITY.
Arthurell, E.

ELECTRICAL ENGINEERING I.
Brett, R. L.

PERTH TECHNICAL COLLEGE.

ASSAYING I.
Credit—
Hickey, L.

Pass—
Fitzmaurice, K. A.
Kerrigan, G. C.
Murphy, J. F.

DIVISION VI.

Annual Report of the Inspection of Machinery Branch of the Mines Department for the Year 1948.

OPERATIONS UNDER THE INSPECTION OF MACHINERY ACT, 1921.

ANNUAL REPORT OF THE CHIEF INSPECTOR OF MACHINERY AND CHAIRMAN OF THE BOARD OF EXAMINERS FOR ENGINE-DRIVERS, FOR THE YEAR ENDED 31st DECEMBER 1948, WITH STATISTICS.

The Under Secretary for Mines.

For the information of the Hon. Minister for Mines, I submit the report of the Deputy Chief Inspector of Machinery on the administration of the Inspection of Machinery Act, 1921, for the year ended 31st December, 1948.

JOHN S. FOXALL,
Chief Inspector of Machinery.

SECTION 1.

Inspection of Boilers, Mantenance Etc.

See Returns Nos. 1, 2, and 3.

The term "Boiler" as defined in the Act includes any vessel in which steam is generated, above atmospheric pressure for working any kind of machinery, or for any manufacturing purposes, also unfired pressure vessels, such as steam jacketed pans, stills, sterilisers, digesters, vulcanisers, air or gas receivers, montejus, etc.

The type and the country of origin of the 222 boilers which were registered during the year 1948 are given in Return No. 1. The total number of boilers and pressure vessels of all types on the register at the end of 1948 was 5,892, but as only 2,625 certificates were issued during the year, the number of boilers actually in use or likely to be used again is probably only about 50 per cent. of the total number registered, the remainder were potentially useful when discarded, but owing to a variety of causes the majority of the discarded power boilers will never be used again to generate steam.

From Return No. 3 it will be seen that nine second-hand boilers from the Eastern States, 10 transferred from the jurisdiction of other departments in this State, and three reinstated were added to the register, while 23 permanently condemned or cut up, and four sent out of this State were deleted leaving a net increase of 217 registered boilers and pressure vessels.

Thorough inspections increased by 212 and working inspections for which separate reports were submitted decreased by 238, there were 209 more certificates issued, but 50 fewer repair notices.

NEW CONSTRUCTION.

Return No. 1 shows that 147 new boilers and pressure vessels were built in this State, but none was of unusual design, and the steam boilers were all of small size, this also applies to those built in the Eastern States.

MAINTENANCE.

On the average the maintenance of boilers is better than it was, but there is still room for a considerable amount of improvement. It is hard to persuade some boiler owners that the cost of feed water treatment will be more than saved by the reduction in fuel costs, and cost of maintenance.

Owing to the short supply of boiler quality steel plates, the construction of new boilers is made almost impossible, but by long term planning there is enough coming forward to allow the carrying out of extensive repairs.

There has been an improvement in the supply of coal, but it is still strictly rationed, and an acute shortage is liable to occur at any time. Firewood is still scarce and dear. A few owners of small boiler plants and some hospitals and institutions are using sawdust and chips as boiler fuel, but the supply is limited.

The engineer of a local hospital was troubled by steam pressure building up on the low pressure side of a reducing valve, which was required to reduce the steam pressure from 100 to 20lb., so he installed two one inch diameter reducing valves in series, with three feet length of four inch steam pipe between them. The first reducing valve reduced from 100 to 65lb. and the second from 65 to 20lb. This arrangement acted satisfactorily.

To prevent the usual water line corrosion which almost invariably occurs on the uptake of vertical boilers, a small boiler 4ft. x 1ft 6ins. had a stainless steel sleeve welded on over the 6in. uptake. When this boiler was last inspected the sleeve had been in position for about 12 months. It will be interesting to see how long this 1/16in. thick sleeve lasts. The uptake was 3/8in. thick and had only been in service about 12 months when the sleeve was fitted.

RETURN No. 1.—SHOWING THE NUMBER OF BOILERS OF EACH TYPE, AND COUNTRY OF ORIGIN OF NEW REGISTRATION FOR THE YEAR ENDED 31ST DECEMBER, 1948.

Type.	Country of Origin.					Total.
	United Kingdom.	U.S.A.	Eastern States.	Western Australia.	Unknown Sources.	
Cornish	....	....	....	19	....	19
Vertical Stationary	....	....	3	17	....	20
Vertical Multi-Stat.	....	....	2	....	....	2
Locomotive Rectangular Firebox Stat.	....	1	....	....	....	1
Return Multi-Stat. Underfired	....	....	3	5	....	8
Water Tube	....	....	1	11	....	12
Saddle Back	....	....	1	15	....	16
Digester	....	....	1	15	2	18
Vulcaniser	....	....	11	3	1	15
Steam Jacketed Vessel	....	....	3	7	3	13
Steriliser	....	....	1	14	2	17
Air Receiver	3	....	23	41	13	80
Waste Heat (Multi-Stat.)	1	....	....	....	....	1
	4	1	49	147	21	222

RETURN No. 2.—SHOWING CLASSIFICATION OF VARIOUS TYPES OF USEFUL BOILERS IN PROCLAIMED DISTRICTS ON 31ST DECEMBER, 1948.

Types of Boilers.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals. 1948.	Totals. 1947.
Lancashire	41	55	96	96
Cornish	144	470	614	596
Semi-Cornish	11	37	48	48
Vert. Stationary	388	351	739	720
Vert. Portable	72	15	87	86
Vert. Multi. Stat.	45	25	70	67
Vert. Multi. Port	18	3	21	19
Vert. Pat. Tubular	48	....	48	49
Loco. Rect. Firebox Stat.	90	66	156	152
Loco. Rect. Firebox Port.	256	64	320	322
Loco. Circ. Firebox Port.	139	8	147	146
Locomotive	82	36	118	119
Water Tube	308	116	424	410
Return Multi. Underfired Stat.	207	61	268	264
Return Multi. Underfired Port.	1	8	9	8
Return Multi. Int. Fired Stat.	46	12	58	56
Return Multi. Int. Fired Port.	2	....	2	2
Egg ended and other types not elsewhere specified	323	28	351	321
Digesters	200	9	209	191
Air Receivers	849	480	1,329	1,256
Gas Receivers	7	....	7	7
Vulcanisers	320	10	330	308
Steam Jacketed Vessels	429	12	441	432
Total Registrations Useful Boilers	4,026	1,866	5,892	5,675
Total Boilers Out of Use, 31st December, 1948	1,797	1,470	3,267	3,259

RETURN No. 3.—SHOWING OPERATIONS IN PROCLAIMED DISTRICTS DURING YEAR ENDED 31ST DECEMBER, 1948.

	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals. 1948.	Totals. 1947.
Total number of useful boilers registered	4,026	1,866	5,892	5,675
New boilers registered during year	217	5	222	215
Boilers reinstated	3	....	3	1
Boilers converted	....	....	....	....
Boilers inspected—				
Thorough	2,252	399	2,651	2,439
Working	159	2	161	399
Boilers condemned during year—				
Temporarily	23	1	24	12
Permanently	20	3	23	28
Boilers sent to other States during year	4	....	4	2
Boilers sent from other States during year	9	....	9	4
Transferred to other Departments	....	....	....	4
Transferred from other Departments	10	....	10	7
Number of Notices for Repairs issued during year	464	12	476	526
Number of Certificates issued including those issued under Section 30 during the year	2,229	396	2,625	2,416

SECTION 2.

EXPLOSIONS AND INTERESTING DEFECTS.

There were no reports of explosions of boilers or pressure vessels which were subject to the provisions of the Act, but two cases of the collapse of furnace tubes might easily have had more serious results.

The left hand furnace tube of the middle boiler of a nest of three Lancashire boilers 32 feet by 8 feet 6 inches became overheated during the night shift, but although the fourth and fifth sections of this furnace were obviously heated to a red heat, the fusible plug in the right furnace was not melted and still showed unburnt soot on the underside. There was a slight depression on the top of the fifth section of the left furnace, but the fourth section had two trough shaped depressions reaching for the full length of the parallel portion between the Adamson rings approximately 24 inches long by 3 inches deep at the centre, which were situated on either side of the top centre line at about 11 and one o'clock.

By careful measurement it was found that even at the deepest part of these depressions the plate had not been stretched circumferentially and only to a very slight extent longitudinally, so that it was decided to press this section back by hydraulic pressure. This was successfully carried out and the section was returned to true form. After repair the boiler was tested by hydraulic pressure to 210lb. per square inch or 40 per cent. in excess of the authorised working pressure of 150lb. There was no appreciable deformation of any section under test. After three months work the flue was again gauged and was found to be unaltered. This boiler was the only one of the three which was under steam at the time, and the card on the steam pressure recorder showed that the boiler had been working at over 10 pounds above the pressure at which the safety valves were set for nearly one and one half hours, and as the safety valves were in good order and correctly set, it is obvious that the boiler attendant must have been away from his boiler for at least that time. On the recommendation of the Board of Examiners his certificate was suspended for six months.

The other furnace which collapsed was that of a Cornish boiler 19 feet 7 inches long by 5 feet 6 inches diameter, the furnace tube was 2 feet 9 inches diameter of ½ inch plate. Before banking fires on the Saturday prior to the accident, the fireman blew down the boiler about one half glass, and then filled up with cold water to a full glass in order to reduce the pressure. Before leaving on Saturday the fireman closed the glass water gauge cocks, and on Monday morning when he opened the water way cock he says that the water level jumped to 3 inches in the glass, but he did not test the gauges, and apparently was not surprised at the drop in water level over the week end, because he lit the fire without making sure where the water level actually was. The fire which was lit about 7.15 a.m. consisted of a layer of coal overlaid with wood and was described by the fireman as intense, but it obviously was uneven because the fusible plug did not melt until 7.50 a.m. and at that time the right hand side of the second section from the front end was hot enough to bulge inwards just above the fire bar level, to a maximum of about 6 or 7 inches. The fireman says that this bulge formed while he was drawing the fire. As this boiler is 43 years old it will probably not be repaired.

SECTION 3.

Inspection of Machinery. See returns 4, 5, 6.

The number of groups of machinery registered increased by 1,385 and the number of groups inspected increased by 2,013. The corresponding figures for 1947 were 1,135 and 55 respectively. There were 2,149 more inspections made in districts worked from Perth Office but there were 136 fewer inspections made on the Goldfields.

The number of passenger lifts increased by four, goods lifts by three and service lifts by nine, the number of other types remained unchanged.

RETURN No. 4.—SHOWING CLASSIFICATION ACCORDING TO MOTIVE POWER OF GROUPS OF MACHINERY IN USE OR LIKELY TO BE USED IN PROCLAIMED DISTRICTS AND WHICH WERE ON THE REGISTER DURING THE YEAR ENDED 31ST DECEMBER, 1948.

Classification.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals. 1948.	Totals. 1947.
No. of Groups driven by steam engines	444	526	970	988
No. of Groups driven by oil engines	1,379	932	2,311	2,335
No. of Groups driven by gas engines	62	189	251	254
No. of Groups driven by Compressed air	....	62	62	63
No. of Groups driven by electric motors	15,146	3,792	18,938	17,507
No. of Groups driven by hydraulic pressure	5	....	5	5
	17,036	5,501	22,537	21,152

RETURN No. 5.—SHOWING OPERATIONS IN PROCLAIMED DISTRICTS DURING YEAR ENDED 31ST DECEMBER, 1948.
(*Machinery only.*)

Classification.	Districts Worked from PERTH.	Districts Worked from KALGOORLIE.	Totals.	
			1948.	1947.
Total registrations useful machinery	17,036	5,501	22,537	21,152
Total inspections made	11,256	2,562	13,818	11,805
Certificates (bearing fees)	3,371	464	3,835	3,324
Certificates (steam without fees)	29	2	31	35
No. of extension certificates issued under Section 42 of the Act	....	....	....	....
Notices issued (Machinery dangerous)	293	9	302	280

RETURN No. 6.—SHOWING CLASSIFICATION OF LIFTS ON 31ST DECEMBER, 1948.

Types.	How Driven.	Totals.	
		1948.	1947.
Passenger	Electrically driven	196	192
	Hydraulically driven	1	1
Goods	Electrically driven	99	96
	Hydraulically driven	3	3
	Belt driven	4	4
Service	Electrically driven	42	33
		345	329

ACCIDENTS TO MACHINERY.

Five accidents in connection with winding engines were reported, but luckily none were serious and no one was injured.

An overwind occurred on a double drum electric winding engine, and although the overwind device acted, the safety hook went into the thimble and detached the rope. There is only three feet over-run when the cage is at the top brace. Although the driver had considerable experience, he was new to this particular engine. No damage was done.

About eight months later on the same shaft, the bottom working level of which is 1,350 feet, the descending south cage caught in the shaft while a man was being raised to the surface in the north cage. The driver admitted that when the north cage was about 300 to 400 feet from the surface, he noticed that the south rope was slack, but owing to lack of experience he continued to raise the north cage to the surface, and afterwards proceeded to wind up the slack rope on the south side with the result that the rope was kinked in several places. This rope was three inches circumference of 6/7 construction 110/120 tons per square inch in breaking strain. This rope which had been in use for six years was replaced. No reason could be found for the south cage hanging up, possibly a wheelbarrow which was being lowered in it may have shifted and caught in the shaft.

On another shaft a skip became jammed by a loose piece of timber, some damage was done to the shaft timbers, cage and rope.

Two double drum electric winding engines installed on a mine, are fitted with parallel post brakes, the back and front brake blocks are connected at the top and bottom by tension rods which are attached to the bell crank levers by a pin passing through an eye on the rods, the other end of which is threaded and passes through a hole in either end of the other brake post, and is held by the adjusting nut, which is flat faced, the washer is also flat faced. If both top and bottom tension rods were originally correctly adjusted, and if both were equally tightened to take up wear, then the pull would be axial on both tension rods, but obviously if either tension rod is taken up more than the other, the load will be applied eccentrically, this must have occurred because one rod broke at the thread on each of these winders. All the washers have been removed and replaced by washers with a spherical face, in order to ensure that the load is always applied axially.

On an underlay shaft, the head wheel bearings which were originally of white metal were replaced by ball bearings, the spindle of one wheel broke after 6½ years use. When the spindle broke, the head wheel only canted over, and no further damage was done. The spare wheel was fitted and winding resumed. All the spindles have since been replaced by new ones made out of 45/60 ton steel, with ample fillets where there is a reduction in diameter.

The benefits of standardisation were well examplified in the case of a 100 horsepower four cylinder vertical National Diesel engine. This engine was having a trial run after overhaul when the connecting rod of the cylinder at the governor end of the engine broke just below the gudgeon pin. The engine was badly damaged, the cylinder jacket and liner were cracked, the engine casing badly broken, the connecting rod bottom end and bottom end bolts were also broken, the piston was thrown out on the floor and the governor completely smashed.

An unsuccessful attempt was made to repair the engine, when the owners heard of a 50 horsepower two cylinder engine by the same makers from which they were able to borrow a cylinder complete with accessories, which fitted exactly, allowing the engine to be put into commission again. This engine belonged to a butter and bacon factory, and they were extremely fortunate to be able to get their refrigerator plant in full commission before the electric power cuts started during the Christmas holidays, as their cold storage rooms were all full of perishables.

SECTION 4.

There were no prosecutions.

SECTION 5.

Accidents to Person.

Return No. 7 records only those accidents to persons in which the injuries were caused by working machinery which is subject to the provisions of the Act, and the injuries were of such a nature as to prevent the injured person from following his usual occupation for a period of two weeks or more. Accidents which occurred on timber mills that are subject to the provisions of the Timber Industry Reg. Act, 1926, are not included. Those which occurred on Mines are also included in the report of the State Mining Engineer.

There were only 42 accidents recorded and reported on, or twelve less than last year, four of these accidents caused the death of the person injured, being two more than last year.

It is absolutely marvellous what extraordinary risks inexperienced persons will take when using a circular saw. A circular saw bench with a wooden top had a strip of wood 31¼ inches long by 2¾ inches wide by ½ inch thick nailed parallel to the saw at a distance of 1¾ inches, at the leading end and one of the nails by which it was held was standing clear ¾ inch; this strip had evidently been used previously as a fence or guide for ripping 1¾ strips. The piece of wood which caused the accident was oregon free from knots or shakes and was 36 inches by 4⅜ by ¾ inch thick, and which the deceased was trying to rip down the centre, so that one side of it must have been resting on the strip nailed to the top of the bench. One of the Sisters of the Convent at which the deceased was employed as a gardener saw him fall, but no one saw him actually using the saw, so it will never be known how he managed to make a cut 24 inches long with one side of the piece he was cutting ½ inch above the table. Apparently the wood was picked up on the back of the saw, hitting him a violent blow in the abdominal region, rupturing the right illiac artery. He was operated on soon after the accident and appeared to be making good progress, but he died nine days later.

The result of another circular saw accident was almost identical, as the injured man died from the effects of general peritonitis and a perforation of the lower illeim. In this case the piece of wood which was being ripped was picked up by the back of the saw because the saw did not have sufficient set to prevent the cut binding on the saw. Neither of these groups of machinery had been registered.

A pendulum docking saw owned by a large gold mining company, caused the third death. The deceased who was cutting bush timber into short lengths for domestic firewood, was assisted by another man who was stacking the cut wood. The bench on which the wood to be cut rests is 18½ inches wide, and has a steel angle iron at the back which projects 4½ inches above the bench. When the saw which was being used, was hanging plumb the periphery would be about 5 to 6 inches radially behind the top back of angle iron, and at the horizontal centre line the saw would be about 2 inches vertically behind the angle iron. The bottom of the guard over the top of the saw would be about 6 to 8 inches above the top of the angle iron. The deceased placed a very crooked branch on the bench, which apparently slipped out of his hand and touched the saw or the saw might possibly have swung forward, at any rate the teeth of the saw gripped the wood pulling it over the back of the bench, unfortunately the other end swung up and hit the deceased a violent blow on the side of the head, causing a compound fracture of the left side of the skull and laceration of the brain. He died shortly after he was admitted to hospital. The teeth of the saw were not suitable for use in a pendulum docker as they had positive hook of at least eight degrees. The owners have been instructed to only use saws with straight teeth in future.

The fourth fatality was due to the deceased being caught by a belt and whirled round an overhead shaft. He received such severe injuries that he died in hospital the following day. There was no actual witness of the accident, but an Australian Aboriginal who was working on the premises, heard the noise caused by the deceased's legs hitting the roof beams, and immediately stopped the electric motor. His statement is the clearest I ever remember reading, all relevant details were mentioned in their proper sequence. His surname "Brilliant" is very appropriate.

Two more of the 16 accidents due to circular saws caused injuries which nearly proved fatal, and in each case the injuries were caused by a piece of wood being flung back on the sawyer by the saw. In one accident the injured man was assisted by his son who was tailing out. In passing the flitch across the back of the saw, the son carelessly let the end of it touch the saw which flung it on to his father fracturing his skull. The other accident was due to the man's own carelessness. He was cutting up firewood into 24in. lengths and in throwing the end length over the saw on to the heap he let it touch the saw, with the result it was flung back and hit him on the head fracturing his skull. The bench in this case was higher than is usual which may have been a contributory factor.

The remainder of the saw accidents were nearly all due to carelessness and resulted in lacerated or amputated fingers.

None of the other machinery accidents were of particular interest.

In addition to the accidents which were caused by machinery which was subject to the provisions of the Act, the cause of several other accidents was inquired into.

Two fatal accidents were caused in each case, by the deceased falling off a truck on private railways. In another case a man was killed in a quarry by a heavy wooden screen which fell on him, owing to the lifting lugs carrying away just as the screen was being landed after being moved by a crane. A fourth fatality was caused by a home-made makeshift pulley which was fitted to a four cylinder 1926 Dodge motor car engine, which burst and a piece hit the deceased on the head. This plant was used on a banana plantation at Carnarvon, which industry is exempt from the provisions of the Act.

The cage of a gravity lift which is used for lowering materials from three upper floors to the ground floor, was allowed to over run at the top owing to the hand brake not being properly applied when the empty cage was being raised by the balance weight, as a result the cage became jammed and when one of the staff tried to free the cage, the floor collapsed, and the injured man fell about 40 feet. He suffered fractured ankles, broken legs and concussion; he is extremely lucky not to have been killed. As this lift is not power driven, it is not subject to the provision of the Act.

RETURN No. 7.—SHOWING NUMBER OF SERIOUS ACCIDENTS BOTH FATAL AND NON-FATAL WHICH OCCURRED IN PROCLAIMED DISTRICTS DURING THE YEAR ENDED 31ST DECEMBER, 1948.

(F) denotes FATAL.

——	Wood Working Furniture.	Firewood Cutting.	Building.	Leather Goods.	Metal Working and Engineering.	Printing and Allied Industries	Lifts.	Flour Milling.	Laundry.	Fertilizer Manufacturing.	Architectural Modelling.	Butchering.	Food Processing.	Power House.	Refrigeration.	Wool Scouring.	Mining.	Other.	Total Machines.
Drain Tank Scalding	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Circular Saw	9 2(F)	2	1	....	1	....	....	....	....	....	....	....	....	....	1	....	....	....	14
Pendulum Docker Saw	1	1(F)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Buzzer	3	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Guillotine	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Swedging Machine	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Press	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Lathe	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Cardboard Box Machine	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Printing Press	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Fibre Teaser	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
Rolls	....	....	....	2	....	....	....	....	....	....	....	....	1	....	....	....	....	....	3
Belting and Shafting	1	....	....	....	1	....	....	....	....	....	....	....	2 1(F)	....	....	....	1	....	5
Nailing Machine	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Paper Bag Machine	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Paint Mixer	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Total	16	3	1	2	8	4	....	....	....	....	1	....	3	....	1	....	1	2	42 4(F)

SECTION 6.

Examination of Engine-Drivers.

Examinations were held as follows:—

Perth 4, Kalgoorlie 4, Bunbury 2, Mt. Magnet 1. Goldfields Water Supply Pumping Stations 8.

Fifteen days were occupied on examinations by the travelling Board.

Thirty days were occupied in Perth dealing with applications for competency certificates, examination papers and inquiries, etc.

Sixteen days were occupied in travelling and looking into matters connected with engine-drivers and boiler attendants.

Three hundred and ten applications were received and 293 certificates granted

Return No. 8 Showing Total of Engine Drivers and Boiler Attendants' Certificates (all classes) Granted in 1948 compared with 1947.

	Number Granted	
	1948.	1947.
Winding Competency, including certificates issued under Regulation 40 and Section 60 of the Act	13	9
First Class Competency, including certificates issued under Regulations 40 and 45 and Sections 60 and 63 of the Act	39	22
Second Class Competency, including certificates issued under Regulation 40 and Section 60 of the Act	21	33
Third Class Competency, including certificates issued under Regulations 40 and 45 and Sections 60 and 63 of the Act	26	41
Locomotive Competency, including certificates issued under Regulation 40 and Section 60 of the Act	5	19
Traction Competency, including certificates issued under Regulation 40 and Section 60 of the Act	....	2
Internal Combustion Competency including certificates issued under Regulation 40 and Section 60 of the Act	57	59
Crane and Hoist Competency including certificates issued under Regulation 40 and Section 60 of the Act	18	27
Boiler Attendant Competency including certificates issued under Regulation 40 and Section 60 of the Act	109	120
Interim	....	1
Copies	5	6
Transfer	....	....
	293	339

SECTION 7.

Staff, Revenue, Expenditure, Mileage, General.

Staff.—There was no change in the staff during the year.

Revenue and Expenditure.—Return No. 9. The financial result of the year's work was a deficit of £3,501 9s. 4d.

Mileage.—Return No. 10 gives the particulars of the miles travelled in making inspections.

General.—Contrary to my expectations this time last year, I am able to submit my 14th Annual Report, owing to the fact that I was not required to take accrued long service leave before reaching the age of sixty-five.

During the year a request was made for improvements to the lighting and braking on the locomotives used in the Timber Milling Industry. All the firms which own timber lines were approached and their replies were sympathetic, but they pointed out that under present conditions not much could be done. A number of locomotives are fitted with steam turbine generators supplying current to electric headlights, others have motor car type headlights operated by storage batteries, some still have the old fashioned oil lamps which give a poor light, and few locomotives have no lights at all because they are only used during daylight. The turbine generators are practically unprocurable at present, the motor car type lamps are satisfactory if properly looked after, but there have been complaints that the train crew neglected them in a few cases.

Owing to the type of rolling stock used, viz., small four-wheel trucks at irregular distances apart according to the length of the logs being carried, it would be impracticable to fit vacuum brakes to the train. Quite a fair percentage of the locomotives are fitted with vacuum brakes, but it is a moot point whether a vacuum brake on the locomotive and tender only, gives a greater margin of safety than good hand brakes. The usual practice is to slow up the top of the bank and apply the handbrakes on the trucks, which is a very old practice and quite safe if the train crew are properly trained. The driver can then regulate the speed by manipulating the brakes on the locomotive and tender. A few locomotives are fitted with steam brakes in addition to the usual hand operated brake.

I sincerely thank all those who have assisted in carrying out the work of this branch, and to record my appreciation of the co-operation of officers of the Commonwealth and other Departments of this State, more particularly the Police Department for reporting cases of injury caused by machinery. I wish especially to thank all the officers of this branch for the good work they have performed, and also all other officers of the Mines Department for their unfailing courtesy and assistance.

G. MOORE,
Deputy Chief Inspector of Machinery.

RETURN NO. 9 SHOWING REVENUE AND EXPENDITURE FOR YEAR ENDED 31ST DECEMBER, 1948.

Revenue.			Expenditure.		
	1948.	1947.		1948.	1947.
	£ s. d.	£ s. d.		£ s. d.	£ s. d.
Fees for Boiler Inspections	3,240 18 6	3,079 10 7	Salaries	10,720 8 1	9,342 8 4
Fees for Machinery Inspections	6,048 12 11	5,290 6 6	Incidentals	2,465 13 0	1,723 19 2
Engine Drivers' Fees	427 4 0	443 5 6	Engine Drivers	90 5 6	171 18 7
Incidentals	58 1 10	77 10 3			
Increase, £884 4s. 5d.	9,774 17 3	8,890 12 10	Increase £2,038 0s. 6d.	13,276 6 7	11,238 6 1

Loss = £3,501 9s. 4d.

RETURN No. 10 SHOWING DISTANCES TRAVELLED, NUMBER OF INSPECTIONS MADE AND AVERAGE MILES TRAVELLED PER INSPECTION FOR THE YEAR ENDED 31ST DECEMBER, 1948.

Areas Traversed.	Rail Miles.			Road Miles.			Water Miles.			Air Miles.			Total Miles.			Total number of Inspections.			Average miles per Inspection.		
	1948	As compared with 1947.		1948	As compared with 1947.		1948	As compared with 1947.		1948	As compared with 1947.		1948	As compared with 1947.		1948	As compared with 1947.		1948	As compared with 1947.	
		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.		Increase.	Decrease.
Districts worked from Perth	1,542	1,135	....	43,506	....	7,087	186	181	....	6,176	6,176	....	51,410	405	....	13,667	2,124	....	3·76	....	·65
Districts worked from Kalgoorlie	....	....	....	14,504	....	2,253	....	....	....	....	....	....	14,504	....	2,253	2,963	....	137	4·89	....	·51
Totals	1,542	1,135	....	58,010	....	9,340	186	181	....	6,176	6,176	....	65,914	405	2,253	16,630	2,124	137	3·96	= Average all Districts, 1948.	
																			4·62	= Average all Districts, 1947.	
Increases or Decreases	Increase 1,135			Decrease, 9,340.			Increase, 181.			Increase, 6,176.			Decrease, 1,848.			Increase, 1,987.			= Average ·66 decrease mile per inspection.		

Annual Report of the Government Chemical Laboratories for 1948.

Contents.

Division VII.

Annual Report of the Government Chemical Laboratories.

The Under Secretary for Mines:

I have the honour to present for the Hon. the Minister for Mines, my report on the operating of the Government Chemical Laboratories for the year ending 31st December, 1948.

STAFF.

The staff as at 31st December, 1948, numbered 42 and consisted of 31 professional, six clerical, and five general officers.

A number of staff changes took place during the year, due to resignations, retirements, promotions and new appointments. The following resignations were received: F. F. Allsop, J. C. Hayton, T. Hick, W. G. Inglis, N. K. Jones, P. N. Roberts, professional; and Miss C. Craig, clerical. Mr. J. S. Tait retired from the position of Laboratory Technician having reached the age limit. He was a most efficient officer and gave long and faithful service to the Laboratories. R. A. Broadbent and B. W. Stenhouse transferred from the Agricultural Division to the Fuel Technology and Mineral Division respectively.

The following officers commenced duty during the year: L. J. Brennan, S. C. Baseden, K. J. Carter, E. G. King, M. T. Dunstan, P. N. Roberts, P. J. Southern and A. J. Sims, professional; and Miss J. F. McColl, clerical.

Promotions during the year were as follows:—

E. C. Hodgson to Analyst and Research Officer, B. W. Stenhouse and D. Burns to Mineralogists and Research Officers, F. G. O'Halloran to Laboratory Technician. Long Service Leave was taken by A. J. Hoare, G. E. M. Dean, and N. R. Houghton.

ACCOMMODATION.

The volume of the work undertaken by these Laboratories continues to expand and consequently the question of increased accommodation must again be raised as the need for this is becoming urgent. These requirements, include increased accommodation for the Divisions—Mineral, Mineral Technology and Geochemistry; Food, Drugs, Toxicology and Industrial Hygiene; and Agriculture, Forestry and Water Supply; as well as an increase for the Refectory, Administration, Stores, etc.

The most pressing need, however, is for the erection of the Industrial Chemistry Laboratory and Pilot Plant, in order that this Division can properly function. The erection of this building should be proceeded with immediately as the lack of suitable housing will retard the experimental work necessary in laying the foundations of industrial development in connection with our natural resources. If these problems are not investigated now in the laboratory and pilot plant stages, the information may not be available in sufficient time to enable industry to be established under the favourable market conditions now operating. In the meantime the Chief Industrial Chemist cannot adequately undertake the duties that were originally intended for him.

ADMINISTRATION.

The first complete year under the reconstitution of these Laboratories has now been completed. This reorganisation has resulted in a considerable increase in the volume of work handled for other Departments, Industry and General Public and has increased the administrative duties considerably. The number of samples received during the year was 8,738, which was an increase of 2,491, or approximately 40 per cent. The source from whence they were derived is shown in the accompanying table.

The chief expansion has been in the direction of work in connection with Industrial Development, development of the State's natural resources particularly in regard to economic minerals, coal and its associated problems in regard to Fuel Technology, disposal of Trade Wastes, participation in a monthly survey in connection with the Swan River pollution and the number of water samples handled for farmers, etc. Following discussions at the 27th meeting of the Australian Agricultural Council the Commonwealth Government approved of an annual grant for a period of five years for experimental and demonstration work in connection with tobacco leaf production. Under this grant a chemist was appointed early in the year for chemical investigation on tobacco. It is expected to commence investigational work with the 1949 tobacco crop.

The suggestion in the report of the Fuel Technology Division that the function of a fuel efficiency committee of the various interests concerned with the use of Collie coal merits consideration.

EQUIPMENT.

Delivery of equipment ordered is still uncertain and is only coming to hand slowly. In order not to delay the work of the laboratory unduly it has been necessary to have certain equipment made locally by the Public Works Department, State Engineering Works and in some cases private firms. This has enabled the work particularly of the recently established Fuel Technology Division to proceed more quickly. This Division is now equipped to carry out all standard determinations required in the analysis of fuels and in aspects of the investigation of W.A. fuels which require advanced research.

Among the new apparatus received are a Sturtevant coal crusher, gas furnace, electric furnace, combustion furnace, coal tumber, coal washer, hydraulic press, Jones Miller calorimeter, Sigma recording gas calorimeter, Boys non-recording gas calorimeter and Stanton aperiodic balances.

GENERAL.

As in previous years a considerable amount of information and advice has been given to Government Departments and to the General Public. Close co-operation is being maintained with other departments and much consultative and specialistic work has been done by the Divisional Heads.

Mr. J. C. Hood, the Deputy Government Analyst is a member of the Drug Panel under the Department of Industrial Development and represents the laboratories on the Swan River Pollution Reference Committee. He continues to act as Convenor of the Fruit Technical Committee and Dairy Products Committee and is a member of the Insecticide and Fungicide Committee. He has acted at various meetings of Water Supply and Food and Drug Advisory Committee. His services have been engaged to report on health and fire hazards associated with dangerous cargoes. He also represents the laboratories on the Sectional Committee of the Standards Association of Australia on "Edible Gelatine."

Dr. L. W. Samuel, the Deputy Government Agricultural Chemist continued to be a member of the Soil Technical Committee and the Technical Committee of Investigation of Standards for Waters for Irrigation. During the year he was elected a fellow of ANZAAS and as such is a member of the Australian National Research Council. He was also elected a Fellow of the Australian Chemical Institute.

Mr. H. P. Rowledge is a member of the Coal Panel, Water Purity Committee and Food and Drugs Advisory Committee and is one of the Government representatives on the W.A. State Committee of the Council for Scientific and Industrial Research.

Mr. R. P. Donnelly was appointed a member of the "Fuel Research Advisory Committee" of the Council for Scientific and Industrial Research.

Evidence in Coroners and other Courts has been given by Mr. Southern, Mr. Sedgman and Mr. Houghton.

A number of visits and inspections were carried out during the year.

Dr. L. W. Samuel and Mr. P. J. Southern visited Manjimup in connection with the investigational work on Tobacco Leaf Production. The latter officer spent several weeks at the Research Station familiarising himself with the field operations. He also spent several weeks working in the Laboratories of the British Australasian Tobacco Co., by courtesy of that Company, gaining experience in the chemical analysis of the various grades of tobacco.

Dr. Samuel also accompanied officers of the Department of Agriculture in October on field inspections of the Experimental Agricultural Research Stations.

Mr. C. R. LeMesurier visited the Marble Bar area in connection with radio-active minerals. He contacted prospectors and examined mineral deposits in the district.

Mr. J. N. A. Grace spent several days with the Geological Survey party in the Coolgardie area and examined a number of mineral occurrences for radio-activity by means of a Geiger Muller Counter. He also gave a talk on this subject to a class for prospectors being held at the Kalgoorlie School of Mines.

Considerable help was given to the Wundowie Wood-Distillation Charcoal-Iron and Steel Industry by Mr. Donnelly, Mr. Reid and Mr. Greaves. The works were visited by these officers and myself. On several occasions, Mr. Greaves spent several weeks at Wundowie helping in the reorganisation of the laboratory.

Mr. Donnelly visited Collie in connection with gasification of Collie coal and inspection of the various seams. He visited Melbourne on two occasions, firstly in connection with gasification of Collie coal and secondly to attend a meeting of the Council for Scientific and Industrial Research Fuel Advisory Committee.

TABLE SHOWING SOURCE OF SAMPLES FOR 1948.

Source of Samples.	No.
Chemical Laboratories	77
Minister for Mines	2
State Mining Engineer	90
State Batteries	231
Government Geologist	330
Explosives Branch	56
Interdepartmental Fruit Committee	4
Interdepartmental Irrigation Committee	121
Interdepartmental Tobacco Investigation	99
State (W.A.) Alunite Industry	3
Wood-distillation, Charcoal-iron and Steel Industry	10
Bureau of Mineral Resources, Atomic Mineral Survey	827
Public Health Department	148
Hospitals	18
Agriculture Department	1483
War Service, Land Settlement Scheme	71
Police—	
Coroners	90
Criminal Investigation Branch	30
Liquor Inspection Branch	12
Government Stores and Tender Board	77
Metropolitan Water Supply, Sewerage and Drainage Department	2624

Table Showing Source of Samples for 1948—*continued.*

Source of Samples.	No.
Department of Works and Labour	343
Industrial Development Department	63
Chief Inspector of Factories	9
Fisheries Department	3
Lands and Surveys Department	3
Department of Native Affairs	2
Prisons Department	2
Department of Supply and Development	4
Council for Scientific and Industrial Research	4
Free	683
Pay Public	1101
„ State Housing Commission	6
„ State Brickworks	6
„ State Engineering Works	1
„ State Electricity Commission	1
„ State Hotels Department	1
„ Royal Australian Air Force	3
„ Aeronautical Inspection Directorate	5
„ Repatriation Commission	4
„ Forests Department	7
„ Perth Hospital Construction	15
„ West Australian Government Railways	38
„ West Australian University	3
„ Local Governing Bodies	16
„ Main Roads Department	3
„ Arbitration Court	6
„ Commonwealth Works and Housing Department	3
Total	8,738

H. P. ROWLEDGE,
Director.

24/5/49.

FOODS, DRUGS, TOXICOLOGY AND INDUSTRIAL HYGIENE DIVISION.

ANNUAL REPORT FOR THE YEAR ENDED 31st DECEMBER, 1948.

By J. C. Hood, B.E.M., A.A.C.I.,
Deputy Government Analyst.

FOOD.

The number of samples submitted during the year amounted to 125 of which food inspectional samples represented 64 with 61 from other sources, chiefly the Department of Agriculture and the Government Tender Board.

It is pleasing to record the re-institution of testing in connection with the allocation of contracts and supplies to Government institutions. It is frequently necessary to apply other tests besides the requirements of the Food and Drug Regulations to these samples and to make comparisons with standard products on the market. In the past many of the samples of foods offered to the Government for its use whilst complying with the minimum requirements of the Food and Drug Regulations, have been of poor quality. This frequently applies also to other materials offered for Government contracts.

Milk.

The number of milk samples from inspectional sources and those examined in the capacity of referee were very small, amounting to only 12 in number.

Four of these failed to comply with the Food and Drug Regulations and gave freezing points which indicated gross adulteration with water.

Lemon "Butters."

A continuation of the examination of food preparations designated lemon butter, cheese or spread supported the conclusions of last year that nearly all have little justification to the use of a label embracing the word "butter" or "cheese." Although the word "spread" is not covered by any regulation of the Food and Drug Regulations, such a label probably describes more correctly the contents of this class of preparation.

Dairy Products.

Twenty-seven samples of cheese and four samples of condensed milk were received from the Department of Agriculture for the purpose of checking the quality and grading of products from various factories within the State.

Fruit Squashes and Cordials.

The examination of natural fruit squashes and cordials again shows that whilst all comply substantially with the existing Food and Drug Regulations the ascorbic acid (vitamin C) contents are almost negligible. As the vitamin content of West Australian fruits generally are high, the loss undoubtedly occurs during the extraction of the juices and subsequent processing.

The need for exclusion of air during bulk expression of juice is indicated and, in juices susceptible to oxidation by enzymes, further processing by deaeration followed by pasteurisation may also be necessary.

Miscellaneous Food Samples.

A comprehensive range of samples of foodstuffs, many of which were not covered by the Food and Drug Regulations, were received from the Department of Public Health for the purpose of ascertaining their composition and expression of opinion as to whether they could be reasonably considered as true to label.

Liquors.

Only 13 samples of liquors were received from the Liquor Inspection Branch and State Hotels, 11 of which were wines examined for preservatives, saccharin and false trade description, the remainder being spirits examined for adulteration.

Investigational.

Fruit.—A further extension of the surveys of the composition of fruits grown in Western Australia was made by the analysis of grapefruits for the Interdepartmental Committee on Fruit Products. The results are shown in appendix I.

Fish.—For the purpose of investigating the possibilities of developing surface fisheries along the South Coast, the Fisheries Department forwarded pilchards caught in the vicinity of Albany. Analyses made of mature and immature fish showed the oil content to be 12 per cent. and 15.1 per cent. respectively, calculated on the moisture free basis.

DRUGS AND MEDICINES.

Anaesthetic Ether.

Anaesthetic ethers drawn from supplies to the Government Stores and Royal Perth Hospital amounting to 52 samples, were tested for the presence of peroxides and aldehydes as indicators of deterioration. These supplies are now exclusively anaesthetic quality ether preservatised by the addition of hydroquinone and none of the samples examined failed to comply with the British Pharmacopoeia tests for purity.

Experimental work with preservatised ether under conditions of storage and use which would normally be considered faulty practice showed that the preservative effectively prevented autoxidation. A further series of experiments using unpreservatised ether in Oxford vapourisers and C.I.G. machines over a period of time, standing in the machines undisturbed and also continuously "topped" up, showed that with ether which was pure at the outset no products of autoxidation developed.

Drugs.

A number of tubes of hypodermic tablets which were suspected of having been mixed, inadvertently or otherwise, were examined for the Department of Public Health. The analyses showed that in no case did the tablets agree with the stated contents although traces of powder adhering to the tubes gave reactions indicating that the original materials had been correctly manufactured and labelled.

The use of the substituted hypodermic tablets may have had serious consequences.

Miscellaneous samples examined under this heading included the investigation of the discolouration of sterile procaine hydrochloride solutions, suitability of bulk supplies of pure sodium chloride for intravenous injections, a supposed cough cure and a "medicine" for the relief of tuberculosis and catarrhal conditions reputedly prepared from mesembryanthemum (pig face).

INDUSTRIAL TOXICOLOGY.

Forty-two samples of urine were examined for lead or arsenic from workers exposed to these industrial poisons; also from private medical practitioners for the purpose of supporting diagnosis of "leaded" patients and also checking the progress of treatment.

A number of dusts collected as the result of a survey of working conditions in assay offices of mines in the Goldfields were examined for lead to ascertain the concentration and degree of hazard to industrial plumbism these workers would be exposed.

Twelve samples of air from mines were received, eight of which were from coal mines where air conditions were thought to be bad as the result of faulty ventilation and four from asbestos workings to determine the vitiation of the atmosphere by the products of combustion of diesel engines used underground.

Chemicals and materials used in the chemical and fertiliser industry were submitted for examination and assessment of active or potential hazards of the industry. Claims of the noxious nature and a reputed dust hazard during the manufacture of meatmeal and blood and bone type of fertiliser were discountenanced on inspection and confirmed by the analysis of samples taken at positions of maximum exposure.

The collapse of a junior coppersmith using a coke-fired soldering iron stove was alleged to be due to carbon monoxide generated in the stove. Variations in the experimental operation of the stove failed to produce at the bench more than traces of carbon monoxide. The amounts determined could be regarded as being without significance.

TOXICOLOGY.

Human Poisoning Cases.

The fatal human poisoning cases numbered 33 in connection with which a total of 74 exhibits were received. The common poisons found were:—barbiturates, 7; alcohol, 3; strychnine, 3; nicotine, 2; lysol, 2; aconite, 1; arsenic, 1; chloral, 1.

Attention is again drawn to the increasing number of deaths attributable to barbiturates which in one form or another are being widely prescribed. Without placing too many restrictions on the use of these drugs more rigid control on the sale of barbituric acid and its derivatives are clearly indicated.

The self administration of Blackleaf 40, an insecticide containing 45 per cent. nicotine sulphate, was responsible for the death of two people during the year. The extremely poisonous nature of this preparation is not generally appreciated and its indiscriminate sale as a horticultural supply is much to be deprecated. Although stated to be used exclusively for agricultural or horticultural purposes, the ease with which violently poisonous substances can be obtained at general stores constitutes a problem to authorities in checking their improper use which seems incapable of easy solution.

Criminal Investigation.

The number of specimens examined for the Criminal Investigation Branch amounted to 11, five of which were in connection with the death of an elderly man as the result of a hit-run accident. The impounded vehicle showed definite brushed marks from which specimens were taken and identified with stains on the clothing of the deceased.

Other specimens submitted were for the identification of pills obtained under circumstances suggestive of criminal administration, materials from a fire thought to have been maliciously started, petrols and oil suspected to have been sabotaged with abrasives.

Animal Poisoning.

In all, 23 specimens were received in connection with animal poisoning, eight of which were baits and viscera as the result of the malicious poisoning of dogs.

As the result of mortality following dipping operations with arsenical preparations samples of the dips are frequently submitted for analysis, and it is found almost invariably that the preparations are within the prescribed limits.

A high mortality occurred amongst sheep with symptons suggestive of European lupinosis as the result of grazing Western Australian Blue Lupins grown in a certain country district. It was suspected the occurrence may have been associated with a high percentage of the toxic principle. An examination of the seed from the crop, separated into groups according to maturity, showed that the alkaloidal content was highest in the immature seed and amounting to 0.95 per cent. calculated as lupanine. The presence of lupinotoxin was not established although there is some evidence that this poison is produced by metabolism.

As the result of suggested variations in the efficacy of strychnine poison baits distributed by aircraft in the campaign against dingoes and wild dogs, prepared strychnine tablets from different sources were checked for weight and composition. Analysis showed that there was nothing in the chemical composition or physical state of the poison to account for the suggested variations in toxicity.

The advice of the Division was sought on the disposal of cyanide effluents from a gold mine on to land carrying sheep and also on many points raised by the use of equipment normally used for the processing of crayfish offal being turned over in the off-season to the manufacture of fertiliser from rabbits poisoned by strychnine.

Insecticides.

A number of insecticide preparations, both proprietary brands and recognised mixtures were analysed as the result of complaints that they were ineffective for their particular function or showed some incompatibility in admixture. The analyses showed that the compositions generally conformed to the submitted formulas, but in some the suspending or emulsifying agents were incapable of effectively dispersing the active principles for a reasonable working period.

Work was also undertaken for the Plant Pathologist on various brands of sulphur used for the control of Oidium fungus. Claims by viticulturists of the superiority of Sicilian sulphur were not borne out in the investigation nor was there any marked difference in the particle size, fineness or specific gravity of any of the samples to suggest their more efficient distribution in the common method of dusting.

No significant results were obtained with regard to volatility when tested under conditions approximating closely to the optimum weather conditions for "sulphuring."

NATURAL PRODUCTS.

Linseed.

One hundred and seven (107) samples of linseed were received from yield trials and test rows at Avondale Research Station. Analysis showed that generally the linseed oil content was not as high as in previous years, the average oil content being 37.3 per cent. calculated on the moisture free basis.

Peanuts.

An endeavour has been made to grow peanuts at Wiluna, an inland area previously maintained by gold mining. Analysis of the first crop showed an oil content of 51.6 per cent. Two varieties of kernels obtained from Queensland for seed purposes showed 52.6 per cent. and 57.9 per cent. of oil respectively.

CHEMICAL SEWAGE CONTROL.

Weekly and Fortnightly Routine.

The routine chemical control work undertaken for the Metropolitan Water Supply, Sewerage and Drainage Department consisted as usual in weekly inspections of the two main treatment works at Subiaco and Swanbourne and the examination of samples for reaction (pH), solids in suspension and combustible matter in raw and digested sludge. The influents and effluents from each of the Subiaco, Swanbourne and Fremantle works were also examined fortnightly for biochemical oxygen demand (B.O.D.) suspended solids and reaction.

The total number of samples examined under this heading has been considerably augmented and amounted to 2,294 for the year.

Complete Analysis.

The complete analysis of influent and effluent from the three treatment works has been made half-yearly and in addition to the usual analysis the determination of grease was carried out in order to obtain figures which may be of use when effluents from wool scours are under consideration.

Generally the treatment plants may be considered to be working satisfactorily.

Investigational.

Experimental work was initiated during the year in connection with the reduction of sulphates to sulphide in sewers and to verify whether such reduction occurred only in slimes at the bottom of sewers.

The addition of sulphates to sewage and the effect on the formation of sulphides were also observed. The results confirmed the time factor in the generation of hydrogen sulphide and indicated no appreciable difference with increased sulphate concentration.

Observations were made from time to time on the hydrogen sulphide concentrations in the main sewer. The concentrations would appear to be less than has been experienced in the past.

Further work on the suppression of hydrogen sulphide by the addition of ferric chloride during pumping into a long rising main was carried out. The results showed a considerable reduction in the dissolved sulphide after passage through the main and demonstrated that the continuous treatment with ferric chloride at this location would be satisfactory.

Ocean Outfall and Beach Surveys.

One ocean outfall and four beach surveys were carried out during the year. The ocean survey samples are taken at surveyed positions seaward north and south of the sewage outfall. Reference samples were taken of the emerging effluent and also of ocean water remote from any source of pollution.

Observations showed that diffusion of the sewage stream with the ocean was complete about 500ft. on the lee of the outfall which was about the extent of the pollution as indicated by the chemical and bacteriological samples.

Both the ocean outfall survey and the quarterly beach surveys showed that no pollution of the beaches by sewage effluent occurred.

Trade Wastes.

The implementing of a systematic survey of existing wastes and the appointment of a special inspector by the Metropolitan Water Supply, Sewerage and Drainage Department to deal specifically with trade wastes has entailed a considerable increase in the samples examined and in the advice tendered where preliminary treatment is required before sewer disposal.

Some of these wastes have been discharged by way of storm water drains to the Swan River. It is therefore primarily to eliminate these avenues of pollution that the diversions to sewer disposal are being actively pursued.

River Pollution—139 Samples.

During the year much Press publicity was given to the pollution of the Swan River which some writers claimed had reached an unprecedented level and for which the disposal of trade wastes and man-made pollution was entirely responsible.

To ascertain the facts a preliminary survey was undertaken for the Swan River Reference Committee. The selected sampling points were at positions adjacent to bathing beaches and public utilities and the angle of investigation was that of health, towards which the chemical and bacteriological examinations were directed.

The survey was initiated in July but in the light of the valuable data obtained it was decided to continue in its present form for a year at monthly intervals.

The results to date clearly indicate that there is little tangible evidence of man-made pollution beyond Matilda Bay.

The popular conception of pollution as suggested by evidence of dead algae growth on beach may arise from a variety of naturally occurring causes associated with the changing estuarine character of the river, alternating periods or stratification of fresh and saline water, depletion of dissolved oxygen and temperature. Investigating this phase of "pollution" would require more extensive work and records being kept over a long period of conditions favourable to the growth of green algae and also conditions causing its death.

In both of these the influence of industrial wastes may be very localised and contribute very little to the causative factors.

TABLE I.

FOODS, DRUGS, TOXICOLOGY AND INDUSTRIAL HYGIENE DIVISION.

Source and Description of Samples received during 1948.

	Public Health Department.	Agriculture Department.	Metropolitan Water Supply.	Police and Coroner.	Police, C.I.B.	Police, L.I.B.	Chief Inspector of Explosives.	Departmental—The Director, Government Chemical Laboratories.	Department of Works and Labour.	Government Stores and Tender Board.	Chief Inspector of Factories.	Royal Perth Hospital.	Industrial Development Department.	State Mining Engineer.	Fisheries Department.	C.S.I.R.	Free.	Pay—Public.	Pay—State Housing Commission.	Pay—W.A.G.R.	Pay—Repatriation Commission.	Pay—A.I.D.	Pay—State Hotels Department.	Pay—Children's Hospital.	Pay—Forests Department.	Pay—P.W.D. Perth Hospital Construction.	Pay—Commonwealth Works and Housing.	Arbitration Court.	Interdepartmental Fruit Committee.	TOTAL.
	119	224	2,563	90	25	12	56	5	143	53	1	16	13	23	3	4	5	22	3	37	4	4	1	2	6	2	1	6	4	3,447
Foods—																														
Fish (smoked)	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Crayfish	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fish Paste	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7
Kraft Fish Supreme	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Kraft Wham	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Kraft Pastry Mix	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Lemon Butter	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Lemon Cheese	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Custard	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Bread and Flour	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Butter	1	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Pickles	1	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Brown Sugar	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Coffee Essence	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Icecream Powder	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Mayonnaise Salad Dressing	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Cheese Spread	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Sandwich Relish	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Vegemite	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Mockreme	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Nescafe	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Milo	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Cheese	....	27	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	27
Cowsmilk	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Salt	1	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	5
Cordials	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7
Butter Milk (Infant Food)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Condensed Milk	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	4
Tea	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	5
Dripping	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1
Pilchards	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Mixed Peel	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Jams and Marmalade	....	....	....	....	....	....	....	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Chutney	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Sauces	....	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Vinegar	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Peanuts	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Foods, etc. (susp. poison)—																														
Bananas (sprayed)	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
Water (arsenic)	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
Fruit Investigation—																														
Grapefruit	....	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Fruit Juices	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4	4

Liquors—																																
Wine						11																										1
Whisky						1																										1
Rum																									1							1
Water	7							3	1																							11
Brine (Refrign.)																												2				2
Human Toxicology—																																
Spec. Patient Susp. Poisoning	1																															1
Exhibits Death				74	13																											7
Anaesthetic—Detd.	9			10																												19
Hair and Nails	8																															
Industrial Toxicology—																																
Urine	4																		7		27	4										42
Paint Scrapings											1																					1
Coal Mine Air														8																		8
Mine Air (Diesel)														4																		4
Dust, Assay Office														11																		11
Super. and Chem. Works	6																															6
Air Workshops																				10												10
Oils (Polish Manuf.)													2																			2
Air and Dust—Abattoirs																														6		6
Animal Toxicology—																																
Bait from Dog																			1													1
Specimens	1	16		6																												23
Criminal Cases—																																
Pills					1																											1
Hit Run Case					5																											5
Fire—Bunnings					2																											2
Petrol (Identification)					2																											2
Oil Mixture					1																											1
Drugs, Medicines, etc.—																																
Drug Solutions																										2						2
Supposed Cough Cure																		1														1
Ether									36		16																					52
Tablets (Phenobarb)									1																							1
Sodii Chlor. BP.									1																							1
Sodium Silicate Soln.		1																														1
Pig Face Medicine	1																															1
Dangerous Drugs & Poisons—																																
Drugs	4																															4
Fluid (Cocaine)					1																											1
Strychnine Tablets		2																														2
Insecticides—																																
Spray Prepn. and Sprayed Apples		5																														5
Fruit Fly Bait		1																														1
Sulphur Preparation		5																														5
Fly Sprays	1																															1
D.D.T. Preparation	1																															1
Cattle Dip		21																														21
Human Milk	11																		1													12
Timber (Pres.)													4														3					7
Linseed		109																														109
Lupin Seed		1																														1
Oils, etc.—																																
Olvol Oil	1																															1
Neatsfoot Oil		1																														1
Tallow		5																														5
Turpentine																								3								3
Fuel Oil									2										4													6
Lub. Oil													1																			1
Putative Petroleum																		1														1
Paint																													1			1
Building Materials—																																
Permaglos Wall Sheets																					3											3
Sewage—																																
Weekly routine			2,294																													2,294
Half-yearly complete			12																													12
Investigational			29																													29
Special			14																													14
Trade Wastes			28																													28
Neutraliser Liquors			8																													8
Sludge (as fert.)			3																													3
Beach Survey			175																													175

TABLE I—*continued.*

	Public Health Department.	Agriculture Department.	Metropolitan Water Supply.	Police and Coroner.	Police, C.I.B.	Police, L.I.B.	Chief Inspector of Explosives.	Departmental—The Director, Government Chemical Laboratories.	Department of Works and Labour.	Government Stores and Tender Board.	Chief Inspector of Factories.	Royal Perth Hospital.	Industrial Development Department.	State Mining Engineer.	Fisheries Department.	C.S.I.R. Institute of Agriculture.	Free.	Pay—Public.	Pay—State Housing Commission.	Pay—W.A.G.R.	Pay—Repatriation Commission.	Pay—A.I.D.	Pay—State Hotels Department.	Pay—Children's Hospital.	Pay—Forests Department.	Pay—P.W.D. Perth Hospital Construction.	Pay—Commonwealth Works and Housing.	Arbitration Court.	Interdepartmental Fruit Committee.	TOTAL.
River Polution	....	....	....	....	....	....	....	....	139	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	139
Steel Hume Pipe	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Wood Distillation Products—																													
Tar	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Methanol	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Cleaning Materials—																													
Soap Powder	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Solvex Cleaner	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Wandoo and Mallet Bark	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	3	....	....	....	4
Paper Bark	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1
Explosives—																													
Fireworks	....	....	....	....	....	....	56	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	56
Glue	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Casein	....	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Whey Paste	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Soils—																													
Test for D.D.T.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	4
Copper Plating Solution	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Chromic Acid Solution	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Wheat (pickled)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Airmen's Boots	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1
Pseudo Bitumen	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fresh Bat Guano	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Miscellaneous—																													
Deposit from Pump Rod	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Fatty Substance	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Black Substance	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1
	119	224	2,563	90	25	12	56	5	143	53	1	16	13	23	3	4	5	22	3	37	4	4	1	2	6		1	6	4	3,447

AGRICULTURE, FORESTRY AND WATER SUPPLY DIVISION.

ANNUAL REPORT FOR THE YEAR ENDED 31st DECEMBER, 1948.

By L. W. Samuel, Ph.D. (Lond.) A.R.I.C., F.A.C.I.

Deputy Government Agricultural Chemist.

SOILS.

Only 46 samples of soil were examined during 1948 and of these particular interest attaches to 13 samples from the Carnarvon area submitted by the Department of Agriculture in connection with the poor growth of banana plants. The soluble salts content of these samples was low but the pH value of nine of them was relatively very high, being greater than 8.3. The most alkaline pH value of these soils was 9.0.

In the Annual Report for 1947, reference was made to the method of J. S. Burd and H. F. Murphy (Hilgardia Feb. 1939, Vol. 12, No. 5) for assessing the phosphate status of soils. This method requires the calculation of the adsorption index of the soil, being the ratio between the adsorption deficit and the total phosphate. The adsorption deficit is the difference between the adsorption capacity (for phosphate) of the soil and the actual phosphate present in the adsorbed condition. This value has been determined for the 37 soils examined but unfortunately the field response to phosphatic fertilisers is known for only a few of these soils. For some of the soils a high adsorption index parallels a known good response to phosphatic fertilisers but a number of soils known to respond do not show a high adsorption index and some soils with a relatively high adsorption index respond less than do other soils of lower adsorption index.

The data available indicate that the method of Burd and Murphy for assessing the response of soils to superphosphate is unsuitable for routine estimations because of the complexity of the chemical determinations and that the results are not applicable to West Australian soils.

WATERS.

The total of 1,368 samples of water examined for the year shows an increase of nearly 30 per cent. over the previous year. More than half of the samples were submitted by farmers, graziers and market gardeners etc., for examination for suitability for stock, irrigation and domestic purposes. The importance of water supplies in the Agricultural and Pastoral areas of this State needs no emphasis so that this phase of the Division's work is of great value.

(a) The routine examination of existing water supplies to towns and cities has been continued and involved the analysis of 36 samples from the Canning Dam; 77 samples from Mundaring Weir (including 65 daily samples during the period of overflow); 6 samples from Mt. Charlotte Reservoir and the Kalgoorlie reticulation system; 7 samples from the Wellington Dam. A further 18 samples of the water supplied to the Metropolitan area were examined from the Canning, Churchmans Brook and Victoria Reservoirs, the Wungong pipehead dam and the Mt. Eliza Reservoir.

Existing water supplies of country towns were examined for Boyup Brook and Katanning and 43 samples were tested for country centres from Derby in the North to Albany and Esperance in the South.

(b) The determinations of the quantity of silt carried by the Ord River were continued and 16 samples were examined, being two sets of eight samples taken at different periods of the year. This investigation is in connection with the proposed Ord River dam and irrigation project in the Kimberley district.

(c) The survey of the waters from rivers and streams in the south-west portion of the State was continued and 23 samples were analysed during the year. The volume of this work is now being reduced considerably as data is available for different periods of the year for the past 8 to 10 years for the major streams. The results conform to the general pattern for the Agricultural areas of this State in that approximately three quarters of the total soluble salts is sodium chloride (common salt.)

Apart from the great importance of the knowledge of the salinity of these rivers and streams and hence the use that can be made of them in any water supply scheme these analyses have shown that the hardness of the waters (calculated as calcium carbonate) approximates closely to one third of the sodium chloride content or one quarter of the total soluble salts. This relationship holds for values as high as 2,000 parts per million of total soluble salts (140 grains per gallon) for the data collated and examined to date.

(d) Interdepartmental Committee on Standards for Irrigation Waters.

Perhaps the most valuable and important activity of this Committee during 1948, was the compilation and publication in the Journal of the Department of Agriculture of a paper on the salinity standards for water for various agricultural purposes. A reprint of this paper is included with each report of water analysed for farmers, graziers, etc., and permits a much more detailed discussion of the uses of the water than would otherwise be possible in each of the more than 900 such reports issued during 1948.

The systematic monthly sampling of waters used for irrigation on a commercial scale was continued for two districts.

(i) Armadale-Cannington district.

Periodic sampling at four sites in this district (one well and three positions on the Canning River) ceased with the July, 1948 sample. The variation in total soluble salts for the samples from each of the four sites from November, 1946, to July, 1948, inclusive, are shown graphically in figure 1. As noted in the 1947 Annual Report the water from the well was relatively constant in soluble salts content but the samples from the Canning River showed considerable variation both between sites at the same time and for the same site at different times.

(ii) Geraldton district.

Monthly samples were taken from nine bores used for commercial irrigation of tomatoes in the Geraldton district and the variation in salinity is shown in figure 2 for 7 of the bores for which sampling has extended over a full year. These samples have confirmed that two of these bores exceed the safe upper limit of salinity used as a standard by these laboratories for the irrigation of tomatoes and that a third bore is practically the same as this safe upper limit (220 grains per gallon.) Information from the Department of Agriculture confirms the accuracy of this safe upper limit in that some of the waters tested are not suitable for seedlings, great care has to be used in irrigating, e.g. that the water be kept off the leaves of the plants, and that irrigation of the plants is only practised for a short period.

Fig. 2 shows that there is considerable variation during the year in the salinity of some of the bore waters. At the end of the year some of the waters had returned to substantially the original salinity but others had shown a decrease (bore II) or an increase (bores III and V.)

(iii) In addition to the 115 samples examined for the above surveys there were 10 miscellaneous samples analysed for the Committee, samples for which considerable information was available on the growth of various plants irrigated.

FERTILISERS.

(a) Analyses were made of 37 samples of fertilisers and two samples of lime. Further to the suggestion that commercial fertilisers may contribute significant amounts of "trace" elements, analyses were made of commercial sodium molybdate and of limestone. The quantities of trace elements (other than molybdenum in the sodium molybdate) were negligible. The copper, manganese, molybdenum and zinc content of the limestone were also negligible, even at the high rate at which lime is sometimes used.

A sample of flue dust from Ravensthorpe reputed to contain 6 to 10 per cent. of copper and therefore a proposed useful source of copper for fertiliser was found to contain less than 4 per cent. of copper. Other trace elements in this flue dust were zinc 0.5 per cent. manganese and molybdenum 182 and 35 parts per million respectively. Samples of copper ore for fertiliser use contained 3.6 per cent. and 13.4 per cent. of copper respectively.

ARMADALE-CANNINGTON DISTRICT

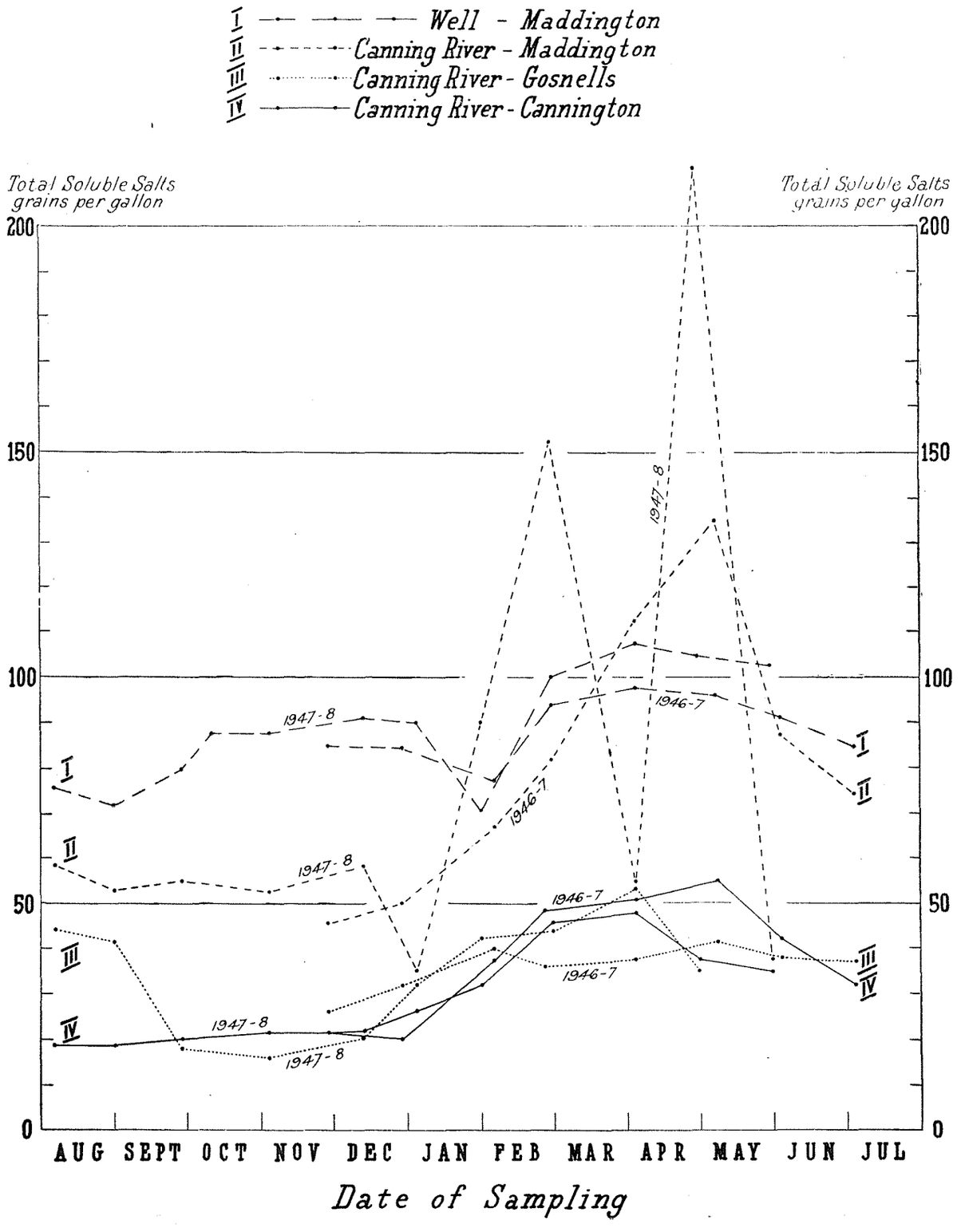
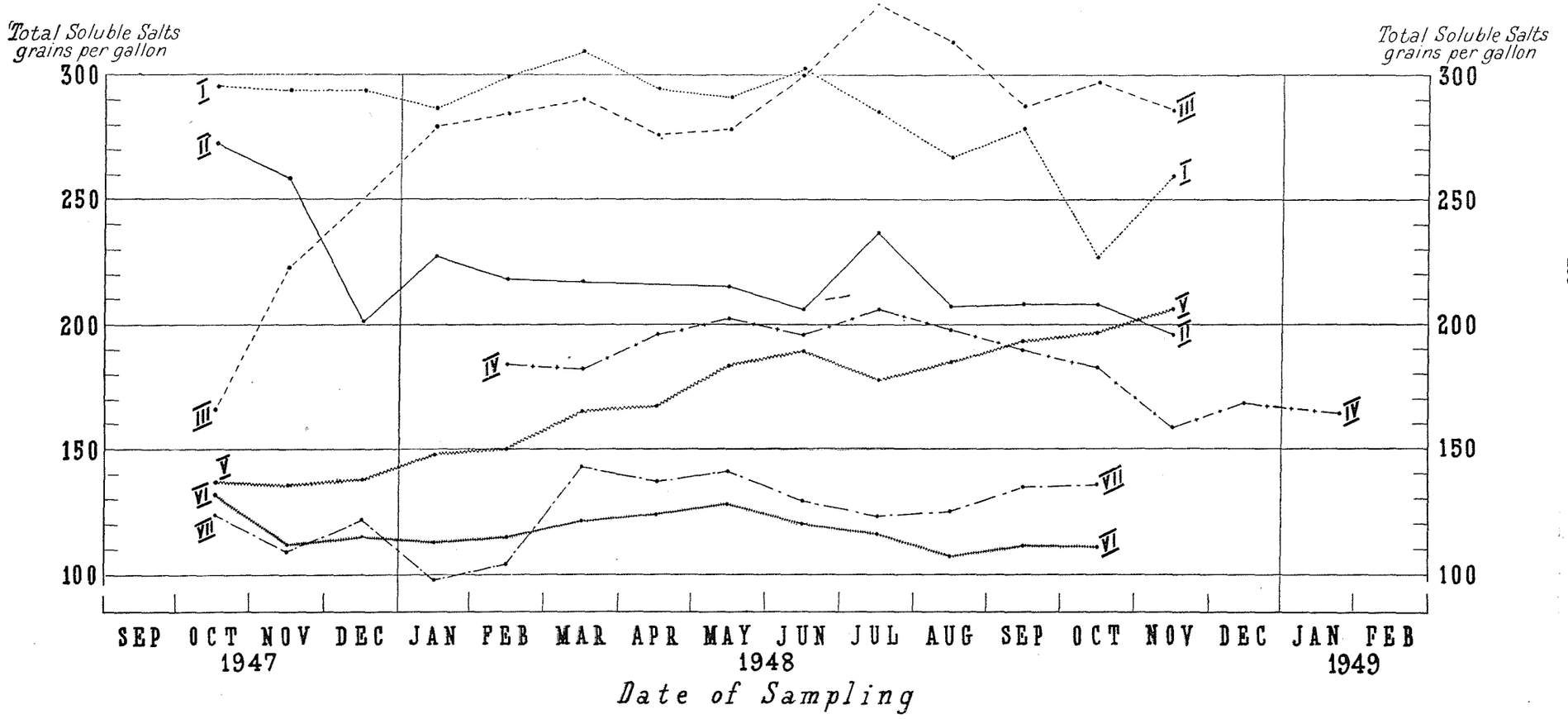


FIGURE 1

FIGURE 2

GERALDTON DISTRICT

7 Bores



The range in composition of 12 samples of guano is shown in the following table and some of these would be valuable sources of nitrogen and of phosphoric acid if they occur in commercial quantity. By contrast, a sample described as "bat guano" contained only 0.1 per cent. of nitrogen 0.04 per cent. of potash (K_2O) and 3.64 per cent. of total phosphoric acid (P_2O_5).

	Guano (12 samples) Range Per Cent.
Moisture	6.1 to 17.1
Lime, (CaO)	12.4 to 35.6
Nitrogen, (N)	0.08 to 16.1
Potash, (K_2O)	0.05 to 2.31
Phosphoric acid, (P_2O_5)	
Water soluble	trace to 0.44
Citrate soluble	6.5 to 19.9
Acid soluble	1.1 to 7.4
Total	10.0 to 23.6

(b) Fertiliser Act.

Of the 35 samples analysed for compliance with the Fertiliser At, 1928, only 11 samples complied with their registered analysis. The deficiencies were: in water soluble potash eight samples; in nitrogen five samples; in phosphoric acid, water soluble, four samples, citrate soluble seven samples, acid soluble nine samples, total phosphoric acid four samples. One sample of fertiliser was deficient in fine material.

PASTURES AND FEEDING STUFFS.

(a) The dry weight of 81 samples of pasture cuts from the rate and time of application of superphosphate on irrigated and non-irrigated land in the South-West dairy areas was determined and the samples analysed for calcium, nitrogen and phosphorus. Because there were field indications of a potash deficiency developing in these experiments which have been conducted over several years, a number of these samples were analysed for potassium also.

These pastures are mixed grasses and clover and a marked feature of this year's analyses was a great reduction in the calcium, nitrogen and phosphorus content (to one-half to one-third of previous values) due to a great reduction in the proportion of clover in the pastures; for one experimental plot clover was practically absent.

(b) Samples (8) of barrel medic plants inoculated with seven different bacterial strains and grown in sand culture at the Department of Agriculture were analysed for nitrogen. There was no marked difference in the nitrogen content of the inoculated samples (3.7 to 4.4 per cent. on dry basis) but the inoculated samples contained approximately three times as much nitrogen as the control (uninoculated) sample. (1.5 per cent. nitrogen on dry basis.)

A further 12 samples of barrel clover were analysed for nitrogen and phosphorus, the samples being from a barrel clover establishment experiment at the Wongan Hills Agricultural Research Station. The experimental treatments were superphosphate, with and without liming, and basic superphosphate. There was no marked variation in nitrogen content with treatment (range 3.6 to 4.4 per cent. on dry basis), but the phosphorus content varied widely, from 0.28 per cent. for a basic superphosphate plot to 0.66 per cent. for a limed-superphosphate plot.

(c) A series of 55 pasture cuts from the comprehensive rotation and grazing experiment, P.71, at the Wongan Hills Research Station were analysed for the usual feeding stuffs constituents

(d) Two series of subterranean clover samples cut at different stages of growth were analysed and the marked variation in composition of some constitutents and the relative constancy of others is shown in the accompanying diagram. There is a marked decrease in protein and phosphorus and an increase in crude fibre with age.

(e) In connection with the cereal grazing trials at the Agricultural Research Station analyses for feeding stuffs constitutents and calcium and phosphorus have been made of seven plant samples from the barley grazing trial and of 14 plant samples from the oat grazing trial, being two series of "cuts" at different periods of growth.

(f) A series of pasture samples from the Kimberley Research Station have been analysed to assess the feeding value of Birdwood and Rhodes grass when grown with different fertiliser treatments. Further samples of Buffel and Mitchell grass from the Kimberley district were also analysed.

(g) Tree lucerne (*Cytisus prolifix*) is palatable to stock and five samples of the edible leaves and small stems from various parts of the State and at different stages of growth both with and without fertiliser were examined for nutritional value, including calcium and phosphorus. For four of these samples the protein content ranged from 15 to 30 per cent. on the dry material.

(h) The analysis of the 230 samples of cereals for the proximate feeding stuffs analysis and for calcium and phosphorus was completed. These samples included wheat and oats, grain, straw, chaff and cocky chaff.

Samples of 10 fodders being used in the poultry feeding trial at the Muresk Agricultural College were analysed.

(i) Miscellaneous pastures and fodders analysed included: Two samples of vetch seed; baled meadow hay consisting mainly of capeweed; sunflower seed; lupin seed; two samples of pillow weed or kapok bush (*Aerua tomentosa*); choko; 13 samples of meadow hay and mixed pasture; a sample of oaten hay suspected as having caused nitrate poisoning of stock; bones and evaporated skim milk; five samples of Wimmera rye grass from the cultivation and fertiliser experiment at the Merredin Research Station; five samples of Kikuyu and two samples of subterranean clover grown on the same area.

(j) The Feeding Stuffs Act, 1928-1948, provides for the registration of—

the minimum crude protein content;

the minimum crude fat content for a feed not of animal origin;

the maximum crude fat content for a feed of animal origin;

the maximum crude fibre content.

In addition the manufacturer or agent may register the content of any substance of reputed nutritional value.

Except for some poultry mashes there are no "Government" standards to which a feed must conform, but any feed sold must conform to the registered composition. No difficulty is experienced in applying the results of analysis for protein, fat and fibre but when the sodium chloride, lime, or phosphoric acid are also registered as a definite value (neither a maximum nor a minimum) in some instances to the second decimal place it is obviously impossible commercially to maintain this value rigidly since for example "lime" and "phosphoric acid" in a mixed feed may be derived from a number of the components of the mixed feed. It is therefore preferable that the registration of all constituents be either for a maximum or a minimum value and in many instances both a maximum and minimum should be registered to safeguard both manufacturer and buyer.

Of the 112 samples of feeding stuffs analysed for compliance with the Feeding Stuffs Act, 1928-1948, less than half, namely 49 samples, complied with their registered analysis for crude protein, crude fat and crude fibre. The deficiencies were, in crude protein 38 samples, in crude fat 42 samples, and in crude fibre 14 samples.

Of 2 samples of stock licks analysed, one complied with the registration and the other was deficient in sulphur.

PLANT NUTRITION.

Prior to 1948 analyses in these Laboratories of plant materials for molybdenum have been very unreliable as none of the available methods yielded satisfactory results because of the very small quantities of molybdenum present in local plants (usually less than 1 part per million). During 1948 a new method of estimation became available and has proved very satisfactory.

Satisfactory results have also now been obtained for the estimation of boron in plant materials.

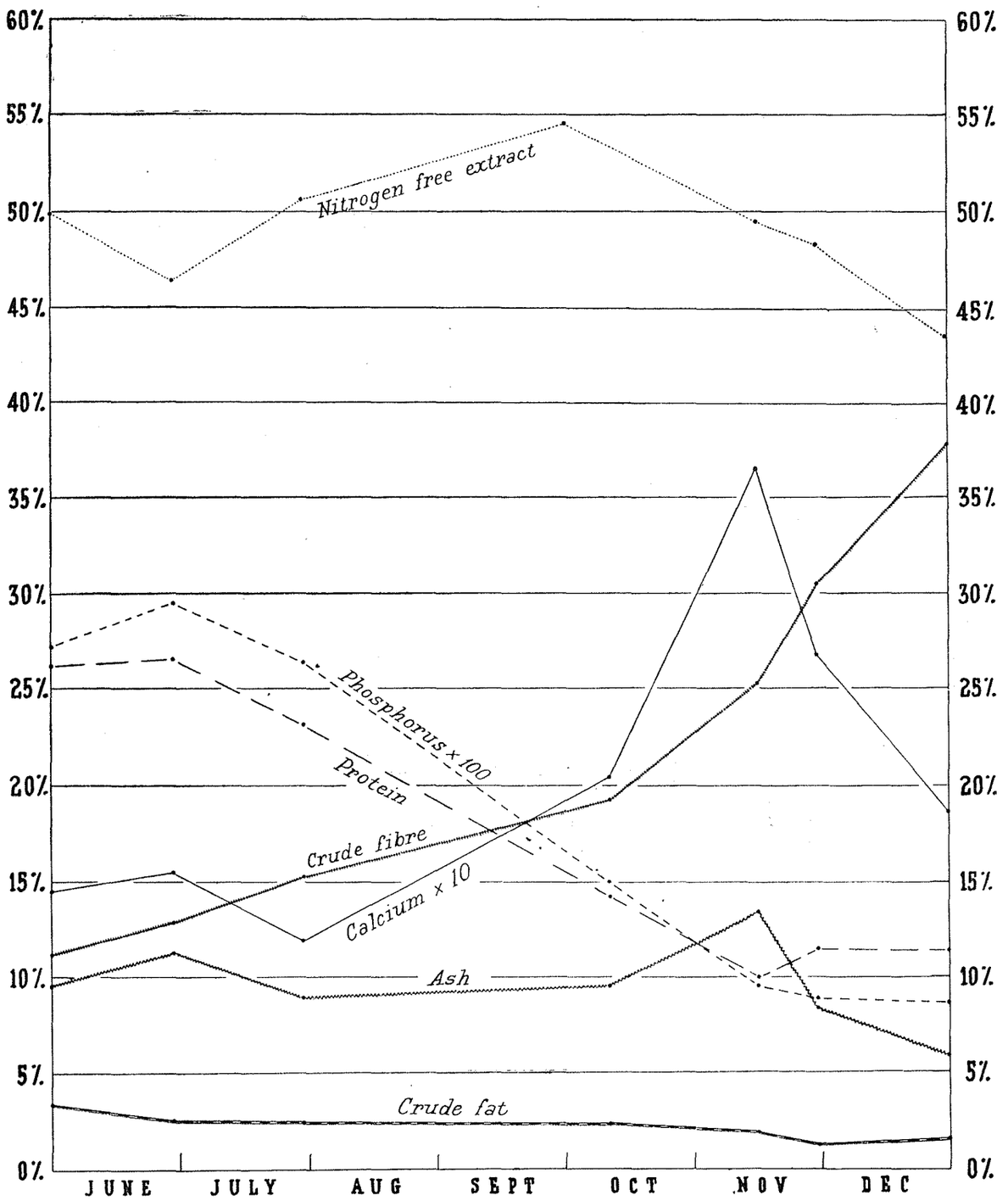
Apples.

The analyses of apple leaves have been almost entirely for the continuation of the study of the zone of absorption of elements by the roots of the apple tree.

COMPOSITION OF DWALGANUP SUBTERRANEAN CLOVER AT VARIOUS STAGES OF GROWTH

Analyses expressed on dry basis

1947



For magnesium absorption, 63 samples have been analysed for magnesium including groups of 12 sampled at 5 different periods of the year. The 6 fertiliser treatments were magnesium sulphate on the surface and at 15 in. in spring or autumn and magnesite on the surface and at 15 in. in the spring.

For the absorption of manganese, 2 series of samples were analysed for this element.

(i) A series of 39 samples, including groups of 12 sampled at 3 different periods of the year, the manganese fertiliser having been applied at different depths by different methods.

(ii) A series of 48 samples, including groups of 11 sampled at 4 different periods of the year, the fertiliser being manganese sulphate or manganese ore applied at different depths by different methods, with or without the application of sulphur.

In addition, phosphorus and potassium were determined on four groups each of six samples of apple leaves, from trees to which phosphorus and/or potassium fertilisers had been applied.

In connection with the investigation of magnesium deficiency a sample of Granny Smith apple fruits was divided into seeds and flesh and these were analysed for magnesium.

	Granny Smith apple fruits	
	Flesh	Seed
Weight, as received g.	1367	3.16
Moisture, per cent.	85.9	32.6
Magnesium, Mg, per cent. on dry basis	0.09	0.46

Thus of a total of 0.183 g. of magnesium in the fruit, 0.173 g., or nearly 95 per cent was in the flesh.

Cauliflower.

Cauliflower leaves analysed have been from two sources (a) general fertiliser experiments and mineral deficiency investigations and (b) the specific use of a molybdenum fertiliser for the control of "whiptail."

For the first group, 12 samples were analysed for nitrogen, phosphorus, potassium and sulphur and 4 were analysed for calcium, magnesium, nitrogen, phosphorus, potassium, copper, manganese, molybdenum and zinc. For the second group, 28 samples were analysed for molybdenum and 10 of these were also analysed for calcium, magnesium, nitrogen, phosphorus, potassium, copper, manganese and zinc.

The use of crude sodium molybdate as a fertiliser raised the molybdenum content of cauliflower leaves from the normal value of less than one part per million to as high as 34 parts per million.

Cereal leaves.

Most of the analyses, both chemical and spectrographic of cereal leaves were of samples from fertiliser experiments involving the 'trace' elements copper, manganese, molybdenum and zinc. For some samples, the major elements, nitrogen, phosphorus, potassium, calcium, magnesium were estimated and for others the sulphur content was determined.

A total of 23 wheat plant samples, 50 oat plant samples and five barley plant samples were analysed chemically and a further nine wheat plant samples, 10 oat plant samples and nine barley plant samples were examined spectrographically for direct comparison of the spectrograms.

Flax.

All of the analyses of flax samples were in connection with 'trace' element fertiliser trials by the Department of Agriculture. A series of 30 samples, being 10 each of straw, seed and of chaff from the seed heads were analysed for calcium, magnesium, nitrogen, phosphorus, potassium and the 'trace' elements copper, manganese, molybdenum and zinc. A further 22 samples of the flax plant were analysed for the trace elements only and two were compared directly spectrographically.

In general the inclusion of copper and/or zinc in the fertiliser did not materially increase the copper or zinc content of the plant but the inclusion of molybdenum in the fertiliser increased the molybdenum content of the plant from the normal of less than one part per million to as high as 12 parts per million.

Vines.

Samples (44) of pruning wood from vines treated with minor elements were analysed for calcium, magnesium, nitrogen, phosphorus, potassium and the trace elements, copper, manganese, molybdenum and zinc. Zinc was determined on five samples of leaves from the same experiments.

Miscellaneous.

Lettuce leaves (5) from a fertiliser experiment were analysed for nitrogen, phosphorus, potassium, calcium and magnesium. Quince leaves (2) were analysed for magnesium.

W.A. f.a.q. WHEAT.

As in past years samples of the current season's f.a.q. wheat sample for the State (1947-1948 season) and of the flour milled from it were received from the Department of Agriculture and analysed.

	Wheat.	Flour.
Moisture (1 hr. at 130°C) %	10.8	11.5
Protein, % (N x 5.83) ..	9.96	—
(N x 5.7) ..	—	8.78
Ash, %	1.32	0.50
Gluten, %		
Wet	—	28.3
Dry	—	9.0
Maltose figure (Kent Jones)	—	1.97

TABLE 2.

AGRICULTURE, FORESTRY AND WATER SUPPLY DIVISION—SOURCE AND DESCRIPTION OF SAMPLES RECEIVED DURING 1948.

	Department of Agriculture.	Metropolitan Water Supply, Sewerage and Drainage Department.	Department of Works and Labour.	War Service Land Settlement Scheme.	Interdepartmental Irrigation Committee.	Department of Public Health.	Department of Industrial Development.	State Mining Engineer.	Government Geologist.	Department of Native Affairs.	Prisons Department.	Police Department.	Wood Distillation, Charcoal Iron and Steel Industry.	Public Works Department—Perth Hospital Construction.	Departmental—Director, Government Chemical Laboratories.	Pay—Royal Australian Air Force.	Pay—Forests Department.	Pay—Public.	Pay—Local Governing Bodies.	Pay—Commonwealth Department of Works and Housing.	Pay—Main Roads Department.	Pay—State Electricity Commission.	Pay—Western Australian Government Railways.	Interdepartmental Tobacco Investigation.	Free.	TOTAL.
Water	32	57	176	67	121	10	1	3	5	2	2	1	4	5	5	3	1	843	15	2	3	1	1	....	8	1,368
Fodders—																										
Feeding Stuffs Act Samples	141	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	141
Feeding Stuffs	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Mixed Pastures	201	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	201
Kikuyu Grass	11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11
Sub-Clover	56	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	56
Meadow Hay	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Wheat Grain	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Mixed Fodders	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Vetch	9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9
Pillow Weed	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tree Lucerne	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Kapoc Weed	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Barrel Clover	69	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	69
Capeweed Hay	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Parakeelia	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Oaten Hay	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Wheat—Straw and Stubble	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Wimmera Rye Grass	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Grasses	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Wheat Leaves and Plants	18	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18
Lucerne Leaves	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Barley	37	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	37
Oats	44	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44
Meatmeal	21	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	....	....	....	....	....	....	....	28
Bonemeal	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	3
Rycena	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
Meatmeal Digester Liquid	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
Fishmeal	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6	....	....	....	....	....	....	....	6
Iron Oxide	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
Crayfish Residue	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1
Stock Food (Bones and Milk)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fertilisers—																										
Fertilisers Act Samples	35	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35
Guano	13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13
Limestone	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Compost (Straw)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Flue Dust	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fertiliser	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	8
Animal Fertiliser	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Sodium Molybdate	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Slaked Lime	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Copper	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	3
Blood and Bone	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12	....	....	....	....	....	....	....	12
Mixed Fertiliser	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Super	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1

TABLE 2—*continued.*

AGRICULTURE, FORESTRY AND WATER SUPPLY DIVISION—SOURCE AND DESCRIPTION OF SAMPLES RECEIVED DURING 1948—*continued.*

	Department of Agriculture.	Metropolitan Water Supply, Sewerage and Drainage Department.	Department of Works and Labour.	War Service Land Settlement Scheme.	Interdepartmental Irrigation Committee.	Department of Public Health.	Department of Industrial Development.	State Mining Engineer.	Government Geologist.	Department of Native Affairs.	Prisons Department.	Police Department.	Wood Distillation, Charcoal Iron and Steel Industry.	Public Works Department—Perth Hospital Construction.	Departmental—Director, Government Chemical Laboratories.	Pay—Royal Australian Air Force.	Pay—Forests Department.	Pay—Public.	Pay—Local Governing Bodies.	Pay—Commonwealth Department of Works and Housing.	Pay—Main Roads Department.	Pay—State Electricity Commission.	Pay—Western Australian Government Railways.	Interdepartmental Tobacco Investigation.	Free.	TOTAL.
Fruit Investigation—																										
Orange Leaves	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Vine Prunings	44	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44
Apple Leaves	146	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	146
Apple Flesh	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Apple Seeds	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Quince Leaves	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Vegetable Investigation—																										
Cauliflower Leaves, Curd and Sap	49	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	49
Lettuce Leaves	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Flax	36	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36
Soils—																										
Bowling Green	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	12
Farm	35	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	41
Tobacco Leaves	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	99	....	99
Material From Pipe	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Gold—																										
Tellurium (spectrographic)	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Cereals—																										
Wheat	82	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	82
Flour	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Barley	11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11
Oats	62	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	62
Marri (Red Gum) Leaves	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Total	1,257	58	176	71	121	10	1	3	5	2	2	4	4	5	7	3	1	879	15	2	3	1	1	99	8	2,738

MINERAL, MINERAL TECHNOLOGY AND GEOCHEMISTRY DIVISION.

ANNUAL REPORT FOR THE YEAR ENDED 31st DECEMBER, 1948.

By C. R. LeMesurier, A.W.A.S.M., A.A.C.I.
Deputy Government Mineralogist.

Two thousand, four hundred and twenty-nine, (2,429) samples were entered for examination during the year, an increase of 725 on the previous year's total. This increase is largely accounted for by the increasing number of samples submitted in connection with the Radio-active Mineral Survey.

The main sources of samples were:—free assays and determinations for the general public, 664; State Batteries, 231; Geological Survey, 163; and Bureau of Mineral Resources (Radio-active Mineral Survey), 977.

ALLOYS AND METALS.

Samples of copper tubing incorporating a tobin bronze weld and of brass from the pumps to be used for circulating brine in the refrigeration system of the Royal Perth Hospital were submitted for corrosion tests. Calcium chloride brine of specific gravity 1.22 (27°Be) was used for the tests, four sloutions being made up as follows:—

1. With distilled water.
2. As for (1) with the addition of sodium dichromate in the proportion of 100lb. to 1,000 cubic feet.
3. With tap water.
4. As for (3) with added dichromate.

All brine solutions were maintained at a pH of 7.5. Tests were carried out in still and circulating solutions and with the test pieces rotated and examination of the samples after 14 days showed—

1. Considerable corrosion of both copper and brass.
2. The dichromate had no apparent effect as an inhibitor.
3. Movement of the brine solution increased corrosion.

Complete analyses were made of three samples of discarded aeroplane blades to determine their suitability as a source of aluminium for use in local industry.

Other materials examined included pig-iron from Wundowie blast furnace, stainless steels, ferro-manganese locally smelted and lead sludge from scrap lead recovery.

CLAYS AND REFRACTORIES.

Clays.

Clay tests were carried out on six samples of clay from various localities. A quartzose fireclay from a well sunk on a grazing lease at Parkers Range, although containing too much salt to be used without previous washing, burnt to a well shaped though somewhat friable fire brick at 1350°C, the linear shrinkage from air dry being only 1.6 per cent. The washed kaolin from this sample burns to a good white at 1250°C and is suitable for the manufacture of white porcelain ware.

An extremely fine grained kaolin containing less than one per cent. of grit was received from the Aldersyde District, Beverley. After washing out 0.32 per cent. of contained salt this clay burnt to a good white but porous body at 1150°C. At higher temperatures a dense body results but shrinkage is excessive and colour is off-white. The extreme fineness of this clay, pure white colour in the raw state and absence of grit suggests its use as a dusting powder base or as a paper filler.

Burning tests were also carried out on a series of shales from the State Brickwork's quarry at Byford.

REFRACTORIES.

Kyanite.

Sixteen samples of kyanite-bearing rock were submitted by the Government Geologist and the company concerned in connection with development work on the Yanmah kyanite deposit. Determination of the Kyanite content was required, most samples contained fifty per cent. and over, the main impurity being quartz. An analysis of a composite sample of high grade material submitted by the Government Geologist gave the following results:—

	Per cent.
SiO_2	35.33
Al_2O_3	62.66
Fe_2O_3	1.59
TiO_2	0.40
MgO	0.17
CaO	0.12
Na_2O	0.07
K_2O	trace
	100.34

Except that the Fe_2O_3 is 0.09 per cent. in excess of that allowable, this material complies with the specifications for kyanite.

Nine mineral specimens submitted from various localities contained kyanite, but only two, one from the vicinity of Hopetoun and the other from south of Bridgetown showed promise of being a marketable product. Small amounts of kyanite have also been detected in many of the heavy sands from the beaches and river beds of the South-West.

Magnesite.

Fifteen samples of magnesite were received for analysis. Samples submitted by the Government Geologist from one and a half to two miles north-west of Higginsville indicate a deposit of fair grade material. Results are as follows:—

Lab. No.	5309/48 %	7455/48 %	7456/48 %	7457/48 %
Silica, SiO_2	0.69	0.82	0.24	2.14
Iron oxide, Fe_2O_3	0.22	0.33	0.19	0.92
Lime, CaO	0.02	0.93	1.59	1.09
Magnesia, MgO	46.96	46.43	46.45	45.64
Carbon dioxide, CO_2 equivalent to Calcium Carbonate, $CaCO_3$	51.15	51.12	51.62	49.55
	0.04	1.66	2.84	1.94
Magnesium carbonate, $MgCO_3$	97.98	96.55	96.52	93.30

A specimen submitted from a locality given as Erlistoun Creek, north of Laverton proved to be magnesite of high purity but no details of the size of the deposit are known, and it is unlikely that material at such a distance from a port would be marketable.

Spongolite.

A sample of spongolite (a sediment consisting mainly of siliceous sponge Spicules) in the form of a sawn block approximately 6in. x 4in. x 4in., was submitted from a locality described as being six miles east of Mt. Barker. The material was easy to saw but somewhat friable. Test blocks were subjected to firing tests with the following results:—

Temperature. °C.	Linear Skrinkage. %	Porosity. %	Apparent Specific Gravity.
950	0.98	—	—
1150	3.7	—	—
1350	5.2	50.6	1.1

The test pieces after firing to 1350° were moderately strong with sharp arrises. This material would make an excellent high temperature insulation if protected from abrasion.

NATURAL MINERAL PIGMENTS.

Twenty two samples were tested for value as pigments, most of these were classified as red ochres with a ferric oxide content ranging from 30 to 45 per cent., which, although yielding a bright and fairly dense paint when ground in oil have little market value owing to their low tinting power.

No samples of marketable yellow ochres, for which there is a ready market, were received during the year.

METALLIC ORES AND MINERALS.

Beryllium.

Few specimens of beryl were received during the year, but most of those received were from localities from which beryl has not previously been reported. Specimens of massive beryl were submitted from fifty miles North-East of Yinnietharra Station, from Warrambie Station via Roebourne, and from Napier Downs Station via Derby, and small green knots of beryl were identified in a biotite schist from Koolyanobbing Ranges, Central Division, all new localities for beryl. The Napier Downs occurrence is particularly interesting as beryl has not previously been reported from the Kimberley Division.

Copper.

Twenty-three samples of copper ore were received for assay; most of these were carbonate ores and while several were of high grade, it is unlikely that they would find a market except to a limited extent as soil dressing.

Gold.

Three hundred and eighty-three samples were assayed for gold. Of these, 163 were gold ores, 45 umpire tailings, and 169 battery tailing checks. Thirty samples were received from the Government Geologist, mostly from Moore's Find, which is about 30 miles east of Ongerup Siding. One hundred and fourteen samples were assayed free for prospectors.

Heavy Sands.

One thousand and forty-four samples of heavy sands were received during the year. Of this number, 827 were submitted by the Radio-active Mineral Survey, and 166, mainly from Minninup Beach, by the Geological Survey.

The mineral assemblage of the heavy fraction of the samples examined shows little variation, ilmenite being almost invariably the most abundant, with smaller amounts of zircon and garnet. Kyanite and monazite are almost invariably present but in very small amount.

Iron Ores.

Sixteen samples of iron ore were submitted for analysis, and a large number of specimens received from prospectors and others for identification proved to be iron ore, many of them high grade haematite.

Analysis of samples submitted by the Government Geologist from a deposit at Mt. Gould, east of Peak Hill, Murchison Division, showed it to be of uniformly high grade, with very low sulphur and phosphorus content. Results have already been published in the progress report of the Geological Survey, Mines Department Annual Report, 1947.

Lead.

Eighty samples of lead ore and concentrates were assayed for lead and silver during the year. In addition a large number of assays were carried out on specimens of lead ore received from prospectors for mineral identification and evaluation.

Manganese.

Analyses were carried out on 22 samples of manganese ore submitted during the year. A number of specimens from a wide range of localities were also shown to be manganese ores, several of them of high grade. It is doubtful, however, whether many, if any, of these finds are of economic importance as specimens almost invariably represent picked ore, much above the average grade as shown by systematic sampling.

RADIO-ACTIVE MINERALS.

During the year, two senior members of the staff have been engaged on the examination of beach and river sands as part of the programme of the Commonwealth Radio-active Mineral Survey. Besides the determination of uranium and thorium content of samples showing radio-activity, the examination included identification and estimation of approximate percentages of minerals present.

Tests for radio-activity were also made on numerous samples sent in by prospectors with, in nearly all cases, negative results. On the request of the Government Geologist, Mr. Grace visited Coolgardie and spent three days with members of the Coolgardie survey party testing the pegmatite formations in the vicinity with a portable Geiger counter. Several samples showing radio-activity were collected and are described in the appendix.

MINERALS FOR IDENTIFICATION.

Over 500 specimens of rocks, minerals and ores were submitted during the year for mineral identification and evaluation. Amongst those not already mentioned under their appropriate headings, the following are of interest.

Columbite.

From Moogoorie Station, near Carnarvon, and from a locality given as approximately 50 miles north of Yinnietharra, both new localities. Neither specimen conformed with the specification for marketable columbite which requires 60 per cent. Nb_2O_5.

Aragonite.

As typical pseudo-hexagonal twinned crystals encrusting quartz from the dump of main shaft, Copperfield G.M., Mt. Ida.

Damourite.

From a bore on Wongan Hills Research Station. This mineral, an altered muscovite which occurs as extremely finely divided scales, was encountered at a depth of 50 feet, where it impeded drilling operations by flowing freely into and blocking the bore hole.

Nickel-bearing Minerals.

Arseno pyrite and pyrrhotite occurring in a diorite from 30 miles east south east of Ongerup, contained approximately one per cent. of nickel. Copper and nickel were also detected in a specimen of psilomelane from Byro Station, via Mullewa.

Riebeckite.

An amphibole of deep blue colour was detected in a highly sheared ferruginous jasper from the Ophthalmia Range. A dense, fine grained variety of this rock is the parent rock of the crocidolite deposits of the Hamersley Range.

Meteoric Stone.

A small specimen from a locality given as 120 miles north-east of Loongana, on the trans-Australian railway, proved to be of meteoric origin. It consisted of a much weathered stoney matrix in which were dispersed small pellets of nickel iron with troilite.

Complete Analyses.

Complete analyses were made for the Government Geologist of four greenstones and a talcose ultra-basic rock in connection with the Coolgardie survey, and of an injection gneiss from Cape Riche. Analyses were also made of a garnet granulite and two dyke rocks intrusive into it from the Northampton Mining Field at Galena for Dr. Prider, of the University of Western Australia.

Other complete analyses carried out included an iron ore to be used as a standard and a blast furnace slag, both for Wundowie charcoal and iron industry.

CEMENT AND OTHER BUILDING MATERIALS.

Four samples of cement from the Mundaring Weir construction were submitted for chemical analysis and determination of specific surface area.

The latter determination was made by the air permeability method using K. R. Banks modification of the apparatus devised and described by P. C. Pecover.

Results showed little variation in the composition of the cement, all samples complying with B.S.S. requirements for chemical composition, but that specific surface area is somewhat less than that of cement manufactured in the Eastern States.

Three cements were analysed for the Metropolitan Water Supply Department; two of these failed to comply with B.S.S. requirements in that the insoluble residue was in excess of one per cent.

Fly Ash.

The use of fly ash (flue dust) from coal burning boilers to replace a proportion of cement in concrete has been advocated recently in America. Fly ash possesses weak hydraulic properties and acts in a similar manner to natural pozzolanas, combining with the free lime set free on gauging cement. At the request of the Director of Works, chemical and mechanical analyses were carried out on a series of samples of fly ash from the East Perth Power Station. Results of two analyses of fly ash are given below, with that of an an Italian natural pozzolana for comparison.

	Fly Ash 19/12/47	Fly Ash 17/2/48	Italian Pozzolana
SiO_2	59.34	56.38	46.5
Al_2O_3	20.37	21.87	18.7
Fe_2O_3	10.00	12.42	10.88
MnO	0.22	0.08	—
MgO	0.65	1.00	3.04
CaO	0.97	1.42	9.60
Na_2O	0.16	0.40	2.01
K_2O	0.26	0.40	2.30
SO_3	0.65	0.05	—
FeS_2	0.22	1.08	—
C	5.98	3.35	—
Ignition Loss ..	—	—	6.18

Mechanical Analysis of Fly Ash—

Screen Size Meshes per inch.	Fly Ash 19/12/47 Per cent.	Fly Ash 17/2/48 Per cent.
+80	8.4	1.6
—80 +115	4.4	1.9
—115 +200	9.4	5.6
—200 +250	2.5	2.0
—250	75.3	88.9
	100.0	100.0

Sand-cement Bricks.

Two sand-cement bricks were submitted for determination of the cement content. The bricks were friable with a rough, sandy surface, the cement ratio being only 1: 8 approximately.

Roofing Tile.

Permeability and absorption tests were carried out on a sample of roofing tile of Indian manufacture for the Public Works Department. Although possessing a smoother surface and finer texture than a sample of locally produced tile used for comparison, the permeability and porosity were appreciably greater as shown below.

	Indian Tile.	Local Tile.
Permeability (mls. per sq. cm.)—		
7 hours	1.64	0.55
24 hours	4.90	2.26
Porosity (% by weight) ..	20.0	14.0

MISCELLANEOUS.

Sand-lime Bricks.

Samples of quartz sand and limestone were examined for suitability for manufacture of lime-sand bricks. This process, which has been practised for many years in Europe and America, consists of moulding under high pressure a damp mixture of correctly graded quartz sand with 7 to 8% of slaked lime, and curing by autoclaving with steam at a pressure of about 150 lbs. per sq. inch for 4 to 8 hours. The slaked lime was prepared from the limestone sample, which contained about 15% SiO_2 and 5% MgO and briquettes moulded in a hand-mould and autoclaved. Compressive strength tests were not made but briquettes were firm and compact, showed no shrinkage on autoclaving and their porosity compared favourably with standard burnt bricks.

Moulding Sands.

A sample of Guildford loam was examined for suitability as a moulding sand.

Gypsum and Plaster.

Several samples of gypsum were examined for suitability for plaster making, and the water content of a number of samples of plaster determined for a firm developing plaster board manufacture.

Health Hazard.

Twenty-eight samples were submitted by the Health Department for examination and report on industrial hazard. Samples included moulding and parting sands from foundries, raw and milled products from mineral dressing plants, coke and clinker dusts and an encrustation from an assay furnace suspected of being lead bearing. In most cases free silica content and particle size of the fine dust particles were required.

TABLE 3.

MINERALOGY, MINERAL TECHNOLOGY AND GEOCHEMISTRY DIVISION.

Source and Description of Samples received during 1948.

SAMPLES RECEIVED	Pay.	Free.	Superintendent of State Batteries.	State Mining Engineer.	Geological Survey Department.	Departmental (Director, Government Chemical Laboratories).	Department of Industrial Development.	Public Works Department.	Public Works Department—Perth Hospital Construction.	Metropolitan Water Supply, Sewerage and Drainage Department.	Department of Public Health.	Department of Agriculture.	Chief Inspector of Factories.	Radio-Active Mineral Survey.	Minister for Mines.	Government Stores Department.	Police Department—Criminal Investigation Branch.	Department of Lands and Surveys.	State (W.A.) Alunite Industry.	Pay—State Brick Works.	Pay—Local Governing Bodies.	Pay—State Engineering Works.	Pay—Aeronautical Inspection Directorate.	Pay—Wood Distillation, Charcoal Iron and Steel Industry.	Pay—Department of Supply and Shipping.	Pay—University of Western Australia.	Pay—State Housing Commission.	TOTAL.
Alloys and Metals	2	....	....	....	....	....	11	1	6	....	....	....	....	....	....	....	....	....	....	....	1	1	1	....	....	....	....	23
Ceramics—																												
Clays	....	7	....	....	2	5	....	....	....	....	....	....	....	....	....	....	....	....	....	6	....	....	....	....	....	....	....	20
Kyanite	8	....	....	....	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	16
Magnesite	2	1	....	....	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	....	....	....	15
Natural Mineral Pigments—																												
Ochre and oxides	11	9	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	22
Metallic Ores and Minerals—																												
Antimonial Gold ore	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Antimony	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Atomic minerals	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Bismuth	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Beryllium	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Copper ores	....	23	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	23
Copper tailings	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Gold ores	18	114	1	3	30	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	166
Gold concentrates	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Gold, Umpire	1	....	44	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45
Gold tailings	....	....	169	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	169
Heavy Sands	26	25	....	....	166	....	....	....	....	....	....	....	....	827	....	....	....	....	....	....	....	....	....	....	....	....	....	1,044
Iron ores	6	1	....	....	7	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	16
Lead ores	27	53	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	80
Manganese	7	3	....	....	11	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22
Meteorite	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	2
Tantalite	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tin ore	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Tin concentrates	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Tungsten concentrate	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tungsten ores	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Zinc	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Other Economic Ores and Minerals—																												
Actinolite (flux)	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Bauxite	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Chromium	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Dolomite	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Garnet	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Graphite	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Limestone	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Spongolite	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Vermiculite	....	3	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Potash products	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	3

Talc	2																												2
Minerals and Rocks for Complete Analysis—																													
Iron ore							1																						1
Rocks					3																					3			6
Mineral Specimens for Determination	61	407		11	376	8	3					2			2			2							2				524
Miscellaneous—																													
Ashes and clinker (gold)																	1												1
Balance Weights							21																						21
Building lime									2																		1		3
Caustc lime			15																										15
Cement						1		4		3																			8
Dunbricks																											2		2
Flyash								14																					14
Limestone and sand		3																1											4
Moulding sand	1																												1
Plaster and gypsum	9	3																											12
Precipitate (mine pump)				3																									3
Riders																24													24
Roofing tiles and material							1	2																					3
Soil (excavated tank)								3																					3
Industrial Hazard—																													
Asbestos (processed)													2																2
Clinker dust											3																		3
Coke dust											1																		1
Foundry sand													5																5
Furnace door crust				1																									1
Limestone											1																		1
Parting powder													1																1
Superphoshpate works											13																		13
Rock											1																		1
	198	664	231	18	313	15	41	24	8	3	19	2	8	827	2	24	1	3	3	6	1	1	1	6	4	3	3	2429

DIVISION OF INDUSTRIAL CHEMISTRY. ANNUAL REPORT FOR THE YEAR 1948.

By A. Reid, M.A. B.Sc., A.R.I.C.

GENERAL REVIEW.

1. The lack of accommodation and of adequate equipment has been even more in evidence this year than last, and has not only restricted the help that could be given to industry but has blanketed the prosecution of industrial research to the stage of full-scale production. A promising method of bentonite treatment, for example, has had to be left at the test-tube stage; work on modern fluid-bed processes for plaster, dead-burnt magnesia, and roasting of minerals generally have had to be set aside; research on the production of beryllium, caesium and other rare metals could be carried out only on a totally inadequate scale.

The officers of the Division record with pleasure the courtesy and co-operation of manufacturers and suppliers in the course of their work.

CLASSIFICATION OF WORK.

2. The activities of the Division come under four main headings.

(i) assistance to State Industries.

(ii) consultative work.

(iii) advice on production difficulties.

(iv) laboratory research.

(i) *State Industries-Wundowie Charcoal Iron Works.*

3. Owing to a temporary shortage of laboratory staff at the Wundowie works an officer of the Division was made available for a total period of five weeks during October and November. During that time he was able to establish better organisation of the chemical laboratory and generally to check up on analytical procedures and methods. His reports also revealed a number of weaknesses in the laboratory set-up which were thus brought to the attention of the management and subsequently rectified.

4. The Division was called into consultation on the disposal of waste pyroligneous liquor at Wundowie. A visit was made to the works and samples taken which were subsequently analysed by the Government Analyst.

5. In the early part of the year some research was made by the Division into the published literature on blast furnace slags. An extensive list of references and abstracts was prepared which led to a more thorough understanding of slag problems at Wundowie.

(ii) *Consultative Work.*

6. The Division daily receives enquiries by phone or personal calls on a wide variety of subjects. Sources of supply of raw and finished materials, ruling prices, chemical and physical constants of substances, suitability of materials for specific purposes are common subjects. Advice was given on the feasibility of starting up small scale industries such as manufacture of table salt, cosmetics, special soaps, polishes etc. Sources of published information on a number of topics were indicated and the general trend of such information briefly summarised. Altogether the enquiries were spread over a wide range of endeavour, steels, alloys, paints, cosmetics, detergents, deodorants, depilatories, adhesives, clays, to mention a few.

(iii) *Production Difficulties.*

7. Typical examples of this type of work follow.

(a) Storage batteries.

8. Failure of batteries in service was traced to contamination of the electrolyte by iron derived from the paste of the positive plate. When acquainted with this the enquirer took the necessary steps to prevent a recurrence.

(b) Increasing production from a water-well.

9. A water well expected to give 3,000 gallons/hour gave only 1,000 gallons The bore was treated with an alkali to peptise clay which had coagulated on the sand grains. Production increased to 2,000 gallons/hour. The bore was then washed with a surface-active agent and a steady rate of 3,500 gallons of water was achieved.

(c) Polishes.

10. Breaking of emulsions used as car polishes was found due to incorrect addition of the emulsifier and (probably) inadequate means of mixing.

(iv) *Laboratory Research.*

(a) Bentonites and clays.

11. Work has been begun and carried on intermittently as staff was available on the industrial utilisation of Western Australian bentonites and clays. As a first step the mineralogical composition was investigated. The research done pointed to saponite as the chief constituent of Marchagee bentonite, a conclusion previously reached on analytical data by the late Dr. E. S. Simpson. Samples were sent to Dr. R. E. Grim of the Illinois Geological Survey and as a result of a very thorough investigation he has confirmed these findings.

12. Saponite is a much more difficult material to treat than montmorillonite, the principal mineral of the majority of bentonites, since it tends to break down in acid and alkali solutions of only moderate strength. A method of treatment which gave promise of much improvement of Marchagee bentonite was, however, devised on a beaker-scale. This consists of bacterial fermentation to remove organic matter followed by a salt treatment. In order to discover if this improved material would be satisfactory for foundry sands tests would have to be made in a number of foundries and would require altogether about ½ ton of finished product. With present facilities all that could be produced in the laboratory is 2-3lb. per week. The further development of this project, therefore, awaits provision of suitable facilities.

13. An oil-company required a clay which could be used to prepare drilling mud for boring operations. Experiments showed that Marchagee bentonite could be peptised to provide a suitable mud. This mud is now in use and is understood to have given satisfaction. It is learnt that Marchagee bentonite will be used for a similar purpose in boring operations at Collie in 1949.

14. The remarkable adsorptive properties of bentonite for water suggested that it might be possible to add it to very light sandy soils in order to improve their water-retention. A client interested in this aspect has had very promising results from as little as 2 per cent. addition to grey, ''greasy'' sands. It was found in the laboratory that for this purpose heating of the bentonite to 200°C. and grinding it finely increased appreciably the amount of water which could be held by the bentonite. It is learnt that a soil conditioner based on bentonite is to be marketed.

15. Marchagee bentonite has also found a use as a suspender in bituminous emulsions and as an improver in certain types of polish.

(b) Beryl.

16. A proposed process for treatment of the Western Australian mineral Beryl has been examined. Some laboratory work was done on small amounts of material and the possibility of producing caesium salts and beryllium oxide from this mineral was satisfactorily established. It is proposed to do further work on this subject using larger quantities of raw material.

Difficulties of space and of equipment in the continuance of this important work have clearly to be met and, unless the requisite facilities are available the research will reluctantly have to be suspended.

(c) Fluid Bed Processes.

17. Attention has been given to the possibility of applying the fluid bed principle to the heat-treatment of a number of Western Australian minerals. It is quite clear that the principle can be applied to such materials as gypsum for plaster production, to the manufacture of dead burnt magnesia from magnesite, to quick-lime production and to other heat-treatment processes, and the prospects of increased production, lower cost, and higher quality produced are such as to warrant the earliest attention to this project. A very little can be done in the laboratory space now available and work can only go ahead when a pilot plant is set up.

(d) Calcium carbide.

18. A suggestion to make a calcium carbide by direct reduction from the carbonate has been examined on paper. Possibilities of successful application exist but nothing can be done meantime.

(e) By-products from Lurgi Gas.

19. Some consideration has been given to the manufacture of chemicals from Lurgi gas. The project requires the full attention of a chemical engineer for some months and this at the moment cannot be arranged.

TABLE No. 4.

INDUSTRIAL CHEMISTRY DIVISION.

Source and Description of Samples received during 1948.

	Departmental.	Industrial Development.	Total.
Cast Iron (Metters)	3	....	3
Faulty Welding (Rheem)	1	....	1
Effluent (Wundowie)	....	6	6
Indian Bentonite	3	....	3
Vitrenite (steel coating)	....	1	1
Ethyl Acetate (Wundowie)	1	....	1
Furniture Polish	1	....	1
	9	7	16

FUEL TECHNOLOGY DIVISION.

Annual Report for the Year Ended 31st December, 1948.

By R. P. Donnelly, M.A., B.Sc. (Oxon.), A.M.I. Chem. Eng. M. Inst. Fuel, M. Inst. Gas Eng.

The major subjects worked and reported on during the past year are:—

The Gasification of Collie Coal.

The Reactivity of Collie Coal.

The Drying and Storage of Collie Coal.

The Analysis of Collie Coal.

The Ash Fusion Characteristics of Coal from the Siderite Section of the Co-operative Mine.

In addition proximate analyses and Calorific Values have been determined on a total of 90 samples of coal taken by the State Geological Survey in 1947 and on 108 coal and other samples of miscellaneous origin submitted in the course of the year. Amongst these is included coal from the Irwin River and coal from the Shott's area at Collie.

Carbonisation assays have been carried out on a number of Western Australian coals. None has shown coking properties. Only one isolated and exceptional sample showed useful gas and tar yields.

Ten samples of coal have been received from the Tasmanian Department of Mines for coking tests under pressure and for carbonisation assay.

In the field of applied Fuel Technology, work has been done on slag formation and combustion behaviour during pulverised firing of Collie coal. Assistance has been given to the State Charcoal Iron Works at Wundowie in the measurement of temperature on wood carbonising retorts. Advice has been sought on several matters by individual firms.

Work on the development of gas burning appliances has been done in conjunction with the State Gas Undertaking.

No practical work has yet been done on wood and sawdust burning appliances.

The Division has had considerable assistance and advice from Dr. Parker, Director of the Fuel Research Board, London; Dr. Hollings, Controller of Research The Gas Light and Coke Company, London; Dr. Dent, Assistant Director of Research, The Gas Research Board, London; Professor Riley, Director of Research to the British Iron and Steel Federation.

The regular receipt of Abstracts from the British Coal Utilisation Research Association, London, and from the National Gas Association of Australia, Melbourne is also acknowledged.

Membership of the Fuel Research Board and the Institution of Gas Engineers and of the Institution of Chemical Engineers and subscriptions to the British Fuel Abstracts also enables the Division to keep abreast of developments in the field of Fuel Technology.

Developments.

As soon as the coal sample preparation facilities are in being at Collie a survey of the working mines will be commenced. Additionally the Government Geologist's programme of deep bore survey will provide a considerable number of samples. This work in itself will be of great long term value.

Development of the gasification of Collie coal will also continue to occupy much time and attention.

The laboratory, however, as yet does very little work in the fields of fuel economy and fuel utilisation. Such work can show an immediate return by making the existing coal supplies go further and in reducing fuel costs to industry and public utilities. The largest individual coal consumers are the State Railways Department and the State Electricity Commission who account for more than three-quarters of the coal delivered from Collie. For that reason a small percentage decrease on their coal consumptions would show a greater total saving than decreases in the individual coal consumptions of smaller users although it is normally amongst the smaller consumers that the uneconomical use of fuel is most apparent.

A first step to secure development is the setting up of a Fuel Efficiency Committee representing the several interests involved, or to add this function to that of existing Committees already dealing with coal.

Gasification of Collie Coal.

Collie coal does not coke nor does it give valuable yields of gas or tar. Carbonisation as a method of gas production is, therefore, not applicable to Collie coal.

The coal is, however, highly reactive and this in addition to its non-coking properties makes it fairly suitable for complete gasification in water gas plant and most suitable for complete gasification with steam and oxygen under pressure.

Water gas production as a method of gasification may be the most appropriate method of gas supply in the smaller centres of population. The production of both blue water gas and producer gas from Collie coal is scheduled for investigation.

The growing needs of the metropolitan area of Perth and of the South-West portions of the State require the production of gas of higher calorific value than can be produced by a blue water gas plant. Enrichment of blue water gas with oil has the disadvantage that gas production is dependent to some extent on outside fuel resources.

Pressure gasification of Collie coal with steam and oxygen, it is believed, will give gas of sufficiently high calorific value. The production of gas under pressure also has the attraction that advantage may be taken of the central position of the Collie coalfield in the South-West area of development as a pressure gas producing and distribution centre.

For example if gas is made at Collie at 400 lb. per square inch pressure, the needs of the metropolitan area for many years to come could be met by a ten inch diameter pipeline from Collie.

Discussions have taken place with a number of authorities on gasification and a comprehensive report has been issued. Its conclusions are:—

(1) That steam-oxygen pressure gasification is suited to Collie coal.
(2) That the process itself is thoroughly reliable.
(3) The cost of gas making will not be greater than the present costs of making gas from New South wales coal.

Work done in the Laboratory in connection with gasification includes carbonisation assays, tests on coking characteristics of Collie coal under pressure and measurements of the reactivity of Collie coal.

The pressure coking tests carried out at 450°C and 400 psig. showed that Collie coals did not cohere or coke at all under these conditions. They are, therefore, suitable for pressure gasification. Carbonisation assays and reactivity measurements are reported separately.

The points upon which finality cannot be reached without actual working experience of Collie coals are:—

(1) The exact Calorific Value which can be reached,
(2) The make of gas per ton of coal,

A number of carbonisation assays on Western Australian coals have been conducted with results as follows:
Yields per ton of Coal.

Coal.	Temperature of assay.	Solid Residue cwts.	Tar, gallons.	Gas c. ft.	Gas, C.V. B.Th.U.	Therms.	Per cent. Ash plus moisture in coal.
Griffin Mine, Collie, W.A.	900°C 600°C	11.2 12.94	2.44 5.1	8,500 3,180	386 307	32.8 9.8	.... 24.93
Co-operative Mine, Collie, W.A.	900°C 600°C	12.30 14.11	2.8 5.1	7,830 2,810	405 362	34.2 10.2	.... 23.53
Maitland Coal, N.S.W.	900°C	12.57	18.94	11,600	702	81.4	8.86
Coal from Shotts (3673/46) Collie, W.A.	900°C	9.7	22.7	11,270	759	85.6	27.26
Eradu W.A.	600°C	12.26	1.0	2,802	194	54.4	40.0
Fly Brook W.A.	600°C	10.74	6.2	3,840	334	12.8	24.46

WORK IN CONNECTION WITH POWER STATIONS.

East Perth Power Station.

Samples of slag from the front walls of the B Station pulverised fuel boiler furnaces were characterised as refused deposits of ordinary Collie coal ash of relatively high ash fusion temperature. The suggestion was made that these deposits would not adhere to the wall and build up if the layer of insulating brick between the boiler wall and the secondary air box was removed.

The samples were also submitted to the Fuel Research Board in London who have much experience in boiler furnace deposits. They agreed with our conclusions and made the further suggestion that adjustment of the angle of flare of the burners might be of assistance.

Analysis of Fly Ash and Slag East Perth B Station Boilers.

	Slag.	Fly Ash.
Silica	62.83	56.38
Alumina	16.24	21.87
Oxide of Iron	16.53	12.42
Manganese Oxide ..	Trace	0.08
Lime	1.07	1.00
Ignition Loss	0.20	—
Carbon	n.d.	3.35
Ash Fusion Temperature (Reducing Atmosphere)	1380°C	

Collie Power Station.

The temperature of the pulverised coal burners were measured. An average figure of 750°C was obtained.

Samples of ash showed that 4.5 per cent. of the original coal was left unburnt in the ash. Fly ash samples showed 5.8 per cent. unburnt coal.

From these results it was concluded that combustion of the coal in the burners was reasonably complete. The cause of the low flame temperature must then be associated with the method of combustion air admittance.

SIDERITIC COAL FROM CO-OPERATIVE MINE COLLIE COALFIELD.

A number of samples of coal collected by the Assistant Mining Engineer from what is termed the Siderite Section of the Co-operative Mine have been examined and ash fusion points determined.

Coal from this section has in the past been associated with the occurrence of siderite (iron carbonate) in the seam. A number of years ago the use of coal from the section fell into disfavour as it was said to give excessive clinker formation.

The presence of siderite has been confirmed in this section. It has been found as laminar interspersions of up to 1/8in. thickness in the bedding planes of the coal. It has been identified both by mineralogical examination and by analysis.

The average ash fusion temperature (under reducing conditions) of the majority of the samples from the siderite section is 1250°C and the ash content is not unduly high. Such coals will form clinker but clinkering should not be serious subject to the provisos: (1) that since Collie coals do not coke and break down to small size in furnaces, firebed conditions are more intense; (2) as the normal ash fusion point (1350°C) of Collie coals reduces clinkering tendency to a minimum the greater tendency of these siderite coals to form clinker is more quickly noticed.

Only two samples of coal have manifested ash fusion points below 1200°C; they are from Nos. 14 and 19 Bords (Nos. 7415 and 7416). These would have been clinker forming coals, but their low ash fusion point was not confirmed on resampling (Nos. 8150-53).

It has been suggested that this sideritic coal will not cause trouble if used admixed with coals of higher ash fusion temperature. This view is supported by the determinations made.

So far as our laboratory work goes beneficiation of the coal by washing to remove siderite will not be useful. One sample of coal, when separated into high and low ash content fractions of sink and float gave ash fusion points as follows:—

Samples 7415 and 7416—

Low ash fraction	1130°C
High ash fraction	1230°C
Unwashed coal	1140°C

This result indicated that the intrinsic ash in the coal and not foreign matter such as siderite is mainly responsible for low ash fusion points.

ASH CONTENTS AND FUSION POINTS OF COALS FROM SIDERITE SECTION.

Mark	Origin.	Ash Dry Basis. %	†Ash Fusion Temperature (Reducing Conditions.) °C.
3443	No. 6 Bord above Stone Band	9.40	1335
3444	No. 6 Bord below Stone Band	11.85	1310
4972	No. 6 Bord	10.28	1280
4973	No. 2 Bord	10.63	Over 1290
4974	No. 1 Bord	9.73	1250
7415	Face No. 14 Bord	10.98	1160*
7416	Face No. 19 Bord	11.14	1140*
7417	Specimen Piece	24.40	1250
8150	Rib Samples .... No. 14 Bord	9·74	1250
8151	Above Stone Band	10.51	1230
8152	Rib Samples .... No. 14 Bord	9.14	1250
8153	Below Stone Band	9.70	1250
Normal Ash Fusion Point—			
	Co-operative Mine		1380
	Griffin Mine		1280
	Wyvern Mine		1200
	Proprietary Mine		1220
	Stockton Mine		1380

* Exceptional. † Fluid Point.

ANALYSIS OF COLLIE COAL.

Western Australian coals from the Collie coalfield are hydrous sub-bituminous coals with an ultimate analysis dry and ash free C, 73-77 per cent.; H, 4-5 per cent.; O, 14-18 per cent.

The coal in the seam is characterised by:—

(1) High moisture content—about 20 per cent.

(2) Proneness to atmospheric oxidation.

(3) Absence of coking properties.

(4) Moderately high volatile matter—about 28 per cent.

As a consequence of these properties Collie coals present difficulties in sample preparation, in moisture determination and in the determination of volatile matter.

In respect of Calorific Value and ultimate analysis oxidation in sample preparation may falsify the determinations. The correction to "as received" or "dry" or "dry and ash free" basis will, if the moisture is not properly determined, also be incorrect.

This position has long been realised in these and other laboratories when working on Collie coal. The formulation of correct methods of analysis has, therefore been a first task in establishing the Fuel Laboratory.

The details of methods used and the grounds for adoption must necessarily form the subject of a separate report. Briefly, however, moisture determinations are done by displacement of the water by boiling solvents (Dean and Stark method) with separation, collection and measurement of the displaced water. Ash determinations are done by two stage heating, first to 450°C and then to the final temperature of 775°C. Volatile matter determinations are made by similar two stage heating, using the B.S.S. Standard of 925°C as the standard final temperature of determination. Air drying, if used to facilitate grinding, is limited to not more than five hours at 50°C or under to avoid atmospheric oxidation. Because of this limitation on air drying the moisture determinations on the coals are made on 2 lb. samples taken from the coal after a preliminary crushing to under ½in. size.

To confirm our methods of analysis samples of coal have been sent to the Fuel Research Board in London who have agreed to both the methods and the results.

Geological Survey (1947)

Ninety (90) coal samples taken from the working mines at Collie of the State Geological Survey department were analysed. These results are not reported in full here as there is reason to suspect that the coals had to some extent become oxidised during the somewhat lengthy period between sampling and analysis. The results will eventually be combined with the new survey which we have to make of the Collie field.

Coal from Shott's Town Site—Collie.

Twenty-three (23) samples from the Shott's Townsite obtained by the Goldfields Coal Syndicate have been sent by the State Mining Engineer for proximate analysis and calorific value determinations.

These samples were taken with a percussion drill and had been washed free from extraneous matter. The water content of the samples is not, therefore, characteristic of the coal in the seam. Therefore all sample analyses are returned on an arbitrary 20 per cent. water basis. It is unlikely that the ash content of the samples is substantially affected by the water washing treatment used.

COAL FROM SHOTT'S TOWNSITE.

Bore.	Depth.	Seam Thickness.	Water.	Ash.	Matter.	Fixed Carbon.	Calorific Value.	
							As Received.	Dry and Ash Free.
	Feet.	Feet.						
B8	95	1	38.88	3.26	25.58	32.28	7,280	12,580
	122	6¼	36.22	3.03	27.12	33.63	7,590	12,490
	165½	6	35.49	3.36	27.41	33.74	7,570	12,590
	184½	7	43.31	3.53	23.98	29.18	6,570	12,850
Z1*	72⅔	3	20.00	8.90	30.19	40.91	9,160	12,890
	179½	6	20.00	4.72	32.02	43.36	9,640	12,800
	218	5¾	20.00	3.00	31.06	45.94	9,810	12,750
	231¾	7	20.00	3.62	30.72	45.66	9,730	12,730
B10*	114	2	20.00	5.20	....	....	9,440	12,620
	144	6½	20.00	5.33	....	....	9,420	12,620
	176	6¾	20.00	3.59	....	....	9,460	12,620
	200	6	20.00	4.17	....	....	9,560	12,600
D6*	199	1½	20.00	6.24	29.07	44.69	9,580	....
	200½	3	20.00	7.26	39.22	33.52	10,360	14,150
C_3*	54	5½	20.00	2.07	30.02	47.91	9,880	....
	82½	6	20.00	4.71	29.53	45.76	9,660	12,830
	90	1¼	20.00	8.68	33.80	37.50	9,095	12,750
E_1*	35¼	6	20.00	3.63	29.37	47.00	9,890	12,950
	73	5¾	20.00	4.80	29.12	46.08	9.560	12,710
E_2*	60	5½	20.00	3.07	29.97	46.96	9,935	12,910
	83	5½	20.00	3.68	29.28	47.04	9,850	12,900
Z_2*	102	6	21.72	4.60	30.83	42.85	9,365	12,700
	132½	5½	21.57	4.93	30.69	42.81	9,390	12,700

* These samples returned on an arbitrary 20 per cent. of water as received basis.

COAL FROM COLLIEBURN.

Samples obtained by the Geological Survey Bores at Collieburn, gave the following results :

Sample No.	Depth.	Water.	Ash.	Volatile Matter.	Fixed Carbon.	Calorific Value.	
						As received.	Dry and Ash Free.
	Feet.						
GCB.1	165½–168	15.52	9.07	27.64	47.77	9,294	12,320
GCB.2	168 –171	18.41	3.95	30.96	46.68	9,565	12,320
GCB.3	171 –175	18.30	4.59	28.21	48.90	9,642	12,500
GCB.4	175 –178¾	18.97	5.42	28.35	47.26	9,423	12,460
GCB.5	284½–289	19.72	5.07	31.46	43.75	9,644	12,820
GCB.6	440 –445	16.65	16.80	28.18	....	8,350	12,540
GCB.7	701½–704½	20.04	6.17	28.85	44.94	9,470	12,890

Coal Samples from Irwin River.

The Irwin River coal seams were visited on 29th July, in company with the Assistant State Mining Engineer, Mr. M. Ridgeworth, Road Board Secretary, Mingenew, and Mr. R. Holmes, of Mingenew. Coal samples were taken at the end of the tunnel driven by C. Morrow in 1945. The coal seam is 6 feet thick and consists of soft, clayey coal.

Sample A was from the top 2 feet.

Sample B was from the bottom 4 feet.

Sample C was a single lump of better looking coal from the bottom 4ft. of the seam.

Sample.	Water.	Ash.	Volatile Matter.	Fixed Carbon.	Calorific Value.		Ash Dry Basis.	Volatile Matter Dry and Ash Free.	Sulphur.
					As received.	Dry and Ash Free.			
A-Top 2ft.	27.83	26.84	16.79	28.54	5,390	11,880	37.18	37.03	0.53
B-Bottom 4ft.	31.64	15.20	18.98	34.18	6,560	12,340	22.23	35.70	1.1
C-One lump from bottom 4 ft.	22.15	17.44	24.78	35.63	7,415	12,270	22.39	41.00	0.95

A further sample submitted to the Department of Industrial Development by Mr. J. L. Hughes of Mullewa gave a moisture content of 26.30 per cent. and an ash content of 58.20. The sample was small and very much contaminated. It was obtained when drilling for water at Wongondy.

Coal from Phoenix Mine.

A sample of coal taken by the Government Geologist for the new Phoenix Mine gave the following proximate analysis and calorific value.

Moisture	20·16	
Ash	5·37	6·72 Dry
Volatile Matter	27·44	36.83 Dry and
Fixed Carbon	47·03	Ash Free
	100·00	
Calorific Value	10,090	B.Th. U./lb.
Calorific Value—Dry and Ash Free	13,550	

Coal from Kimberleys.

Three samples of coal from Udialla Station in the Kimberleys were analysed. The coal was of low grade.

Moisture	12·35
Ash	24·80
Volatile Matter	29·80
Fixed Carbon	33·05
Calorific Value—As received	6,980
Calorific Value—Dry and Ash Free	11,100
Per cent. Sulphur	0·73

Briquette Samples.

Two samples of briquettes submitted were subjected to a Shatter test. The briquettes did not fracture under test. It was stated that Collie coal had been used in their manufacture. The low ash content of the samples suggested that a considerable percentage of a binder had been incorporated.

	Sample A.	Sample B.
Water	7·27	7·03
Ash	5·41	4·80
Volatile Matter	4·83	4·28
Calorific Value—As received	12,600	12,725
Calorific Value—Dry and Ash Free	14,430	14,430

The porosity of the briquettes was 22.23 per cent.

EFFECT OF STORAGE ON COLLIE COALS.

Summary.

It has been shown that Collie coal can be stored without deterioration in bins covered with damp sawdust. The condition in which the coal is preserved is equal to that secured by the under water storage experiments of the Western Australian Government Railway's Laboratory reported in 1946. These latter experiments led to the utilisation of underwater storage of coal in bulk at Midland Junction. The present experiments suggest that where coal has to be stored in smaller quantities it can be preserved without deterioration in strength or quality if the heap is kept superficially damp and if it is retained by side walls which restrain air circulation through the coal.

These experiments have been carried out in the Fuel Laboratory of the Western Australian Government. The results for under water storage experiments are quoted by permission of the Commissioner for Railways, Western Australian Government.

Coal samples from the Co-operative and Wyvern mines stored for six months from January to June, 1948, covered with damp sawdust in open drums standing in the open showed no development of fragility or deterioration in quality when compared with reference samples which had been preserved in sealed drums stored under cover.

Similar samples stored in open drums in the open completely unprotected against the influence of the weather showed a considerable increase in fragility and some deterioration in quality amounting to about 1.0% drop in calorific value in the case of the Wyvern coal and about 0.5% in the case of the Co-operative coal. The increase in fragility as measured by the Shatter Indices is also greater for the Wyvern coal.

The fragility was measured by the standard drop shatter test in which 50 lb. of coal is dropped for three repeated falls from a height of 6in. on a steel plate plate and then graded on sieves. 3in. and 1in. sieves were used and the percentage of the original weight of coal taken which remains on 3in. is called the over 3in. index and the per cent. which remains on a 1.0in. sieve is called the over 1.0in. index.

Inspection of Table I shows even the coal stored in open drums was not reduced to fine slack and the initial inspection of these samples showed that they were only markedly weathered in the surface layers.

Results obtained by Dr. Kent and Mr. Gartland for storage tests at the Midland Junction works of the West Australian Government Railways are quoted in Table II. These experiments led to the adoption of underwater storage of coal at Midland Junction. Experiments carried out on coal stored dry in a bin also showed that there was marked increase in fragility, although not complete disintegration, and about 2.5 per cent. decrease in calorific value. Another one ton sample of coal stored in a pile gave a shatter index of 60 per cent. over 1½in. against 89.4 per cent. for coal stored under water and 40.5 per cent. for coal stored dry in the bin. This again is short of complete disintegration of the stored coal. The coal used in this case was Proprietary and the storage period twelve months from April, 1942, to April, 1943.

It is concluded from these experiments that it is not difficult to protect Collie coal from weathering. The main principles to be observed are protection at the sides by shuttering or by a wall of some kind and a covering over the top which can consist of sawdust or fine coal which is preferably kept damp. Coal left in heaps is to some extent self protecting as the formation of fines on the surface of the pile protects the underlying coal from marked deterioration. General experience of storage of Collie coal supports this view.

This work was undertaken at the suggestion of Mr. A. J. Gibson during his Royal Commission of enquiry into the West Australian Government Railways. It has been carried out by the Fuel Laboratory of the West Australian Government Laboratories. Thanks are due to the Griffin and Amalgamated Collieries for providing the coal samples used and to Mr. J. Gillespie, Inspector of Mines at Collie for obtaining and despatching the samples.

TABLE I.

WYVERN AND CO-OPERATIVE COAL STORED FOR SIX MONTHS, 12-1-48 TO 30-6-48 IN 44 GALLON DRUMS 20 IN. DIAMETER BY 3 FEET HIGH.

(Open drums had tops removed and six 2 in. square holes cut at regular intervals round base to promote ventilation and effect drainage.)

	WYVERN COAL.			CO-OPERATIVE COAL.		
	Stored in damp condition, sealed in 44 gall. drum.	Stored under damp sawdust in open 44 gall. drum.	Stored dry in open 44 gall. drum.	Stored in sealed 44 gall. drum in water.	Stored under damp sawdust in open 44 gall. drum.	Stored dry in open 44 gall. drum.
Shatter Indices—						
Over 3 in.	46	41	14	70	62	14
Over 1 in.	81	81	45	90	91	72
Under 1 in.	19	19	55	10	9	28
Analyses—Air Dry Basis—						
Per cent. moisture	16·07	13·37	15·45	15·77	15·20	16·57*
Per cent. Ash	2·77	4·03	5·31	8·26	7·35	7·45
Per cent. Volatile Matter	30·10	33·86	29·44	22·85	22·87	20·70
Calorific Value, B.Th.U./lb.	10,700	10,830	10,290	10,380	10,640	10,310
Per cent. Ash Dry Basis	3·30	4·65	6·28	9·81	8·67	9·13
Per cent. V.M., Dry Ash Free	37·10	41·0	37·16	30·10	29·53	27·92
Calorific Value, Dry Ash Free	13,180	13,100	12,980	13,670	13,730	13,600

* 18·4 per cent. moisture before air drying.

TABLE II.

PROPRIETARY COAL WESTERN AUSTRALIAN GOVERNMENT RAILWAYS STORAGE EXPERIMENTS OVER TWELVE MONTHS, 24-4-42 TO 24-4-43.

	Stored under water.	Stored in open drums—dry.	One ton of coal stored in a pile.
Shatter Indices—			
Over 1½ in.	89·4	40·5	61·6
Under 1½ in.	10·6	59·5	28·4
Analyses—			
Per cent. Moisture	20·8	10·50	....
Per cent. Ash	6·78	6·70	....
Per cent. Volatile Matter	22·70	26·80	....
Calorific Value (B.Th.U./lb.)	9,462	10,460	....
Per cent. Ash Dry Basis	8·50	7·6	....
Per cent. V.M. Dry Ash Free	31·40	32·70	....
Calorific Value, Dry Ash Free	13,100	12,725	....

SHATTER TESTS OF SAMPLES OF COLLIE COALS DRIED IN THE PILOT FLEISSNER PLANT, SOUTH AUSTRALIA, MARCH, 1946.

Summary.

In 1946 samples of Proprietary and Griffin coal were sent to South Australia to find out if Collie coal could be successfully dried in the high pressure Fleissner pilot coal drying plant. Samples of the dried product were returned to us for our inspection in sealed tins. These samples have now been inspected and subjected to shatter testing. The average water content of the samples was 9.0 per cent. and the coal was still strong and resistant to shatter.

It is concluded that Collie coal could be successfully part dried by the Fleissner process. There are also indications that further investigation of the drying of Collie coal may indicate that simpler drying methods merit investigation.

In the Fleissner Process coal is heated in pressure vessels by saturated steam at about 300 lb. presure. The coal is thereby raised to a temperature of 400°F (200°C) throughout its mass without suffering initial shrinkage due to loss of water The steam pressure is then gradually reduced and the coal is finally dried off and cooled in a current of air and discharged.

The method has special merit when applied to drying of lignite. Whether the use of pressure in heating is necessary for Collie coals is a question which needs investigation as pressure vessels are expensive to build, maintain and to operate. The actual results from the Fleissner Processing set out below are, however, satisfactory.

Results.

Bulk samples of Griffin and Proprietary coals were sent to the I.C.I. Works at Osborne, South Australia, to be dried in the experimental pilot Fleissner plant installed there in 1946.

These bulk samples were dried in a number of batches (35 in all) and specimens from each batch were returned in sealed tins. The total bulk of coal and the size of lump were sufficient to enable us to carry out shatter tests (11/8/48) with the following results:—

Griffin over one inch—74.2 per cent.

Proprietary over one inch—74.3 per cent.

The virtual identity of the results for the two coals is probably not accidental. One explanation is that the strength of Collie coal is associated with its moisture content and it is evident that there is need for further work in this direction to explain the behaviour of Collie coal in both drying and in heating.

From a practical point of view the present results are satisfactory as the amount of small coal formed from this artificially dried coal in the shatter test (25 per cent. under one inch) was not great and compares with the figures which we have for fresh Wyvern and Co-operative coals:—

Wyvern over one inch—81 per cent.

Co-operative over one inch—90 per cent.

The percentage of water in these samples was 9.0.

This work was originated in 1946 with the possibility of railing coal to Kalgoorlie in view. As the rail charges to Kalgoorlie are high some degree of expenditure on drying may be considered. Our results show that product from the Fleissner drying plant is still sufficiently robust to stand the journey to the Goldfields without undue breakage in transit.

REACTIVITY OF COLLIE COAL IN RELATION TO LURGI PRESSURE GASIFICATION.

Summary.

Reactivity measurements have been made on the solid semi-coke residues prepared from Collie coals by heating to 400°C under pressures of 300-400 psig. These conditions of temperature and pressures were comparable with those which would exist in the upper zones of the fuel bed of a Lurgi Generator. The residues were found to be highly reactive. The results of the investigation therefore, support the view that Collie coal will behave satisfactorily in gasification by the Lurgi steam oxygen pressure process.

EXPERIMENTAL.

General.

The method used is the measurement of the conversion of CO_2 to CO when pure carbon dioxide is streamed over the solid carbonaceous fuel maintained at 750, 850 and 950°C. The results are then compared with those obtained by other workers using the same method. The reaction involved is:—

$$CO_2 + C = 2CO.$$

F. J. Dent, working on cokes prepared from English coals and on wood charcoal used this method with a CO_2 rate of 5 litres/hr. through a column of coke 7/8 in. diameter x 2.75 in. long giving a space velocity of 3.0 volumes per minute. We have used a reaction tube of the same dimensions, but of slightly smaller capacity, giving a space velocity of 3.33 volumes per minute at 5 litres/hr.

Preparation of Cokes.

Coal samples from Griffin and Co-operative Mines were heated in a closed steel tube to a temperature of 400-500°C. The gases evolved from the coal were allowed to build up pressure to a maximum of 400 psig., controlled by venting as required through a needle valve.

The Griffin coal was taken up to 400°C and 400 psig. over a 45 minute heating period. The Co-operative coal was taken 475°C and 290 psig. over a 100 minute period.

The semi-coke residues were then crushed below 7 and on 20 B.S. and used to measure the reactivity towards CO_2.

Apparatus.

Fig. 1 shows the apparatus used in the reactivity determinations. The nitrogen and carbon dioxide used were obtained from cylinders. Both gases were passed through a train to remove oxygen and water vapour.

The flow rate was controlled by the constant pressure governor on the gas cylinders and a fine piece of thermometer acted as a choke. A flow gauge was used to measure the rate of flow.

The tube containing the semi-coke was a Vitreosil reaction tube $2\frac{1}{4}$ in. x 1 in. o.d., 25 ml. capacity with 4 in. x $\frac{1}{4}$ in. o.d. x $\frac{3}{8}$ in. i.d. tubulars.

The sample under test was heated in the reaction tube and maintained for a subsequent time of 30 minutes at the desired temperature of test in nitrogen, streaming at the rate of 5 litres per hour. This treatment is calculated to remove any gas which the coke itself can give up.

The rate of flow used was 5 litres per hour giving a space velocity of 3.33 volumes per minute.

An Orsaat gas analysis apparatus was used to determine carbon dioxide in the gas leaving the reaction tube. Carbon monoxide content was then assumed to be (100—per cent. CO_2) per cent.

An electric furnace, wound to give even temperature conditions over its length, was used to heat the reaction tube. It had been previously found that the temperature inside the reaction tube when nitrogen was flowing was the same as that in the furnace tube. The temperature of the furnace, measured by a pyrometer, was therefore used as a measure of the temperature of the reaction.

The reactivities were determined at 750, 850 and 950°C in that order. Figures were also obtained at 850°C on samples which had been previously reacted at 950°C.

Results.

Table 1 gives the main digest of results. The amount of CO in the products of reaction is a measure of reactivity which can be compared with results obtained on other fuels by other workers using the same method. The reactivity is also comparable with the equilibrium curve for maximum conversion to CO at any temperature according to Boudouard Fig. 3.

From these results both coals appear to be as reactive as wood charcoal. As a general observation non-coking coals are reactive because they develop maximum capillary surface none of which is overlaid or drawn together by the plastic coal constituents which are responsible for development of coking property.

At all temperatures reactivity decreases until it approximates to a steady value. It is this steady value which is used for comparative reactivity measurements.

TABLE III.

REACTIVITY OF GRIFFIN AND CO-OPERATIVE COKES AT 750, 850 AND 950°C.

Experiment No.	Coal Carbonised and temperature of test.	CO_2 litres /hour.	CO in products per cent.							
			Time of sampling (minutes).							
			10	25	40	55	70	85	100	120
4/84A	Griffin, PC4 750°C	5	23·0	18·5	17·0	....	15·5	....	....	15·5
4/84	Griffin, PC4 850°C	5	63·7	59·8	53·3	57·7	55·0	54·0	54·0	....
4/84	Griffin, PC4 950°C	5	90·7	87·0	....	84·6	....	82·0	....	....
4/81	Griffin, PC4 750°C	2·5	*Preceding test sample.* Flow rate cut to 2·5 l/hr. after 85 minutes.							93·3
4/82	Co-op., PC5 750°C	5	38·0	34·5	30·0	28·0	23·5	22·5	22·5	22·5
4/83	Co-op., PC5 850°C	5	72·5	69·0	68·0	65·0	61·8	62·5	62·5	62·0
4/83	Co-op., PC5 950°C	5	97·4	95·6	94·9	94·2	94·5	93·6	....	92·0

This fall in activity is no doubt caused by initial reaction with the more active centres on the coke. When these are used up reactivity then falls off.

The same effect is produced more rapidly by subjecting coke used at a higher temperature (950°C) to reaction at a subsequent lower temperature (850°C). The rate of reaction at the lower temperature is very much less than that for fresh coke as Table IV.

TABLE IV.

REACTIVITY OF CO-OPERATIVE AND GRIFFIN SEMI-COKES AT 850°C AFTER REACTION AT 950°C.

Coal.	Rate of CO_2.	Per cent. CO in Products.									
		Time in minutes.									
		10	25	40	60	75	90	105	120	135	165
Co-operative	5·0	49·4	44·0	46·0	41·0	41·5	41·5	....	41·5	....	....
	2·5	....	....	....	....	....	....	....	....	52·2	52·6
		55	75	90	105	Time in minutes. 120	140	155			
Griffin	5·0	57·7	54·6	....	54·1	....	....	....	....	....	....
	2·5	....	....	....	....	74·0	72·8	67·1	....	....	....

TABLE V.

Sample.	Temp. °C.	CO_2 litres/hr.	Rate of Formation of CO litres/hr.
Griffin PC4	750	5	0·95
	850	5	3·7
	850	2·5	5·9
	950	5	7·0
	950	2·5	7·38
Co-operative PC5	750	5	1·28
	850	5	4·5
	950	5	8·5

Conclusions.

The reactivity measurements show that the semi-cokes prepared from Collie coals are highly reactive.

TABLE 5.

FUEL TECHNOLOGY DIVISION—SOURCE AND DESCRIPTION OF SAMPLES RECEIVED DURING 1948.

Nature of Sample and Source.	State Mining Engineer.	Departmental.	Government Geologist.	Industrial Development.	Free.	Pay, Public.	Total.
Coal—							
Shotts	34	....	2	....	....	....	36
Siderite Section, Co-operative Mine	9	....	....	....	....	....	9
Irwin River	3	....	....	1	....	....	4
Collie Power House	....	1	....	....	....	....	1
Newcastle (Gas Works)	....	1	....	....	....	....	1
Phoenix, Collie	....	1	....	....	....	....	1
Collie—Pressure Coking Test	....	3	....	....	....	....	3
Collie—Weathering Test	....	6	....	....	....	....	6
Collie	....	7	....	....	....	....	7
Cardiff—East Perth Power Station	....	1	....	....	....	....	1
Tasmanian	....	10	....	....	....	....	10
Co-op.—East Perth Power Station (Washability)	....	1	....	....	....	....	1
Proprietary	....	....	1	....	....	....	1
Collie-Burn	....	....	7	....	....	....	7
Fly Brook	....	....	2	....	....	....	2
Kimberley	....	....	....	....	3	....	3
Coal Briquettes	....	....	....	....	3	....	3
Coke—Welshpool	....	3	....	....	....	....	3
Slag—East Perth Power Station	....	1	....	....	....	....	1
Fly Ash—Collie Power House	....	1	....	....	....	....	1
Ash—Collie Power House	....	1	....	....	....	....	1
Fuel Oil	....	4	....	....	....	1	5
Wood (Siam)	....	....	....	....	....	1	1
Total	46	41	12	1	6	2	108

APPENDIX 1.

GRAPEFRUIT SURVEY—ANALYTICAL FIGURES FOR GRAPEFRUIT GROWN IN GOSNELLS, KALAMUNDA, BINDOON DISTRICTS.

Date of Collection, 20th October, 1948.

Grower	W. F. Green.	W. F. Green.	W. F. Green.	A. Brockway.	H. Berle.	A. Heslop.	R. E. Blamire.	R. Smith.	E. Hart.	R. Fewster.
District	Gosnells.	Gosnells.	Gosnells.	Roleystone.	Maida Vale.	Lesmurdie.	Kalamunda.	Chittering.	Bindoon.	Muchea.
Soil	Sandy loam.	Heavy river flat clay subsoil.	Red clay deep loam.	Gravelly loam hillside.	....	Deep red loam.	Deep Sandy loam.	....	....	....
Variety	Marsh's Seedless.	Marsh's Seedless.	Marsh's Seedless.	Marsh's Seedless.	Marsh's Seedless	Marsh's Seedless.	Marsh's Seedless.	Marsh's Seedless.	Marsh's Seedless.	Marsh's Seedless.
Weight of 5 fruits (grams)	1,331	1,020	1,132	1,303	1,698	1,360	1,190	1,415	1,203	1,586
Analysis of juice strained through linen 30 threads to the inch—										
Volume of juice	560	430	520	600	760	560	530	560	500	780
Per cent. v/w	42·1	42·2	45·9	46·0	44·8	41·2	44·5	39·6	41·6	49·2
w/w	43·5	43·8	47·6	47·6	46·4	42·7	46·1	41·1	43·0	51·0
Specific gravity	1·034	1·037	1·034	1·037	1·036	1·037	1·035	1·038	1·034	1·037
Equivalent to °Brix	8·6	9·3	9·3	8·6	9·0	9·3	8·8	9·5	8·6	9·3
Acidity (ml. N/10 soda per 10 ml. juice)	26·3	27·9	27·0	27·2	24·2	27·4	25·0	20·8	22·0	23·2
Vitamin C (mgm ascorbic acid per 100 ml. juice)	33·2	46·8	43·8	42·3	31·0	32·5	34·0	34·7	34·7	33·2

ANALYSIS OF COMPOSITE SAMPLES OF GRAPEFRUIT BULKED IN PROPORTION TO YIELD OF JUICE.

Total sugars (calculated as invert sugar) per cent. w/v	6·6
Invert sugar, per cent. w/v	4·5
Sucrose, per cent. w/v.	2·0
Ash, per cent. w/v	·24
Phosphoric anhydride (P_2O_5) per cent. w/v	·03
Alkalinity of ash (mls N/10 HCl per 100 ml juice)	31·2
Formol titration (mls N/10 NaOH per 100 ml juice)	13·5

APPENDIX 2.

FIELD TESTS FOR RADIO-ACTIVE MINERALS IN THE COOLGARDIE DISTRICT.

By J. N. A. Grace, A.W.A.S.M., A.A.C.I.
Senior Mineralogist and Research Officer.

During August I visited Coolgardie, spending three days in the district. Using an "Austmac" portable Geiger-Muller counter, field tests were carried out over many pegmatite areas and several types of mine dumps for the possible presence of radio-active minerals. I was accompanied by Senior Geologist McMath of the Geological Survey Branch who provided the transport and drove us to the various localities.

The first area to be examined was the large open-cut workings of the Felspar Quarry situated about four miles south of Londonderry. A massive biotite lens, 15 to 20 feet wide, occurs near the entrance of the east side of the main quarry. From the biotite extending south several feet, the rock of the quarry face shows a surface coating of black and brown. The counter recorded a reading somewhat above the average background near both the biotite and the areas of black and brown staining.

Samples were collected and later were examined at the laboratory. All count figures quoted below, except where otherwise stated, were obtained by using a sensitive laboratory model Geiger counter.

Lab. No. 5655/48. Massive Biotite.

A pale coloured biotite mica with a little felspar and quartz and traces of pucherite, bismite, magnetite and monazite. No pleochroic haloes were observed in the biotite.

Uranium, U—0.001 per cent.

Radio-activity—Slight (190 counts per minute against background count of 160 per minute).

Lab. No. 5656/48. Brown and Black Staining.

Consists of a brown staining, penetrating felspar to depth of about ¼in., and a black surface coating. The black coating consists mainly of manganese oxides with a little limonite. The brown staining consists mainly of limonite, and the felspar is largely altered to kaolin. Traces of pucherite and bismite were present. No monazite, xenotime or other radio-active minerals were detected.

Uranium, U—0.001 (slightly less) per cent.

Radio-activity—Slight (200 counts per minute 160 background).

A lens of beryl, probably about five tons, at the north-east corner of the main quarry gave a normal background reading on the counter. At the north-western end of the quarry, columbite can be seen in the face following a line for 30 to 40 feet in scattered crystals. Both columbite and felspar in this area frequently show a bright yellow staining. Moderately high readings for radio-activity were obtained on the portable counter in this area.

The smaller quarry gave no count appreciably above the background. But at the entrance, where columbite had been gathered to form a stock pile, a high count was recorded on the portable counter. Selected pieces of columbite with yellow and whitish fine grained coating gave a count of 2,000 per minute, background count being about 60 per minute. Samples of columbite and felspar with yellow mineral were taken from the main quarry and from the dump of columbite.

Lab. No. 5657/48. Columbite and Felspar, Main Quarry.

This sample consisted of approximately equal amounts of columbite and felspar, both minerals showing thin films and veins of yellow bismite and bright yellow greenish yellow pucherite.

Uranium, U—0.002 per cent.

Radio-activity—Moderate (500 counts per minute 160 background).

Lab. No. 5658/48. Columbite from Dump.

This sample was taken from a dump of columbite which had been collected from the same area in the main quarry as sample Lab. No. 5657/48. It consisted mainly of lumps of columbite and associated felspar, quartz and kaolin, with thin films and veins of pucherite and bismite.

The average specific gravity of apparently clean columbite was 6.15, equal to—

	%
Tantalic oxide, Ta_2O_5	38.5
Niobic oxide, Nb_2O_5	43.5

Radio-activity of the whole (large) sample was 850 counts per minute, background being 160. The source of the radio-activity was traced by determining the uranium and thorium in—

(a) clean columbite;

(b) yellow minerals;

(c) felspar, kaolin, quartz.

The piece of columbite selected for analysis was apparently free from pucherite and bismite and had a radio-active count of 550 per minute, background being 160.

	(a) Columbite	(b) Yellow mineral	(c) White and a little yellow
	%	%	%
Uranium, U	0.005	trace	trace
Thorium, Th	0.03	n.d.	nil

Radio-activity appears to be associated with the columbite and not with the pucherite or bismite. Similar results had previously been obtained from columbite in the Wodgina area.

The next area visited was Tantalite Hill and surrounding pegmatites. Apart from very slight radio-activity associated with occurrences of biotite mica, no radio-activity was detected. During the rest of the time available, tests were made on various pegmatites at Gibraltar, Grosmont, Ubini and elsewhere.

At the Grosmont mica mine, lepidolite mica is plentiful also a second lithia bearing mica. On the portable Counter the lepidolite might have been slightly radio-active, the other mica more so, but still only very weak. Three samples were collected.

Lab. No. 5659/48. Lepidolite.

Large sheets of lepidolite mica with a little felspar.

Uranium, U	nil
Radio-activity	nil

Lab. No. 5660/48. Lepidolite, fine.

Fine grained lepidolite mica, felspar and quartz.

Uranium, U	nil
Radio-activity	nil

Lab. No. 5661/48. Light brown mica.

Pale lithia bearing mica, in large sheets, with a little felspar.

Uranium, U	trace
Radio-activity	Slight, (180 counts per minute 160 background.)

At Mercers Find near Ubini, amblygonite is fairly plentiful, also lepidolite. Count on the test machine was perhaps very slightly above normal or normal.

No radio-activity was detected at any of the mine dumps tested. Except where previously indicated all places which were tested gave only the normal average background count.

Division VIII.

Annual Report of the Chief Inspector of Explosives for the Year 1948.

The Under Secretary for Mines,

I have the honour to submit for the information of the Hon. Minister for Mines, in compliance with Section 45 of the Explosives Act, 1895, my report on the working of the Branch for the year 1948.

The quantity of explosives imported into the State during the year is shown in Table No. 1, and Table No. 2 giving a comparison of the quantities imported during the past five years.

TABLE No. 1.

Importation of Explosives into Western Australia during 1948.

	lbs.
Gelignite	2,817,700
Gelatine Dynamite	346,650
Permitted Explosives	621,600
Blasting Powder	35,000
Total	3,820,950
Detonators No. 6: Number ..	3,380,000
Detonators (Electric):	124,000
Detonators (Delay):	10,000
Fuse: (Yards)	5,085,600

TABLE No. 2.

Explosives.	1944.	1945.	1946.	1947.	1948.
	lb.	lb.	lb.	lb.	lb.
Gelignite	1,481,500	1,634,850	3,038,950	3,379,650	2,817,700
Gelatine Dynamite	154,800	235,300	297,500	548,800	346,650
Permitted Explosives	160,000	945,250	472,250	443,750	621,600
Powder (Blasting and Pellet)	11,150	15,000	15,000	22,500	35,500
Detonators (No.)	1,300,000	1,814,000	2,543,500	3,360,000	3,514,000
Fuse (Yards)	1,864,800	3,768,000	4,318,533	5,344,800	5,085,600

The following tests were made during the year for the purpose of determining the suitability for use, chemical stability and velocity of detonation of explosives:—

Explosives	1,625
Fuse	413

The following table shows the number of Licenses issued during the year:—

Magazines on Government Reserves ..	54
Magazines used in Government Departments and on private property ..	115
Store Licenses Model A	75
Store Licenses Model B	1
Fireworks Licenses	317
Importation Licenses	2

The quantity of explosives used in the different classes of industry for the years 1947 and 1948 is given hereunder:—

	1947 lb. used.	1948 lb. used.
Gold Mining ..	3,620,700	3,263,150
Coal Mining ..	246,450	268,600
Agriculture ..	32,950	73,800
Quarrying	147,300	132,650
Mining and Base Metals	48,050	65,400
Government Departments	84,800	58,650
Miscellaneous ..	61,350	61,850
	4,241,600	3,924,100

To ensure compliance with the Act, inspections of licensed stores and magazines were conducted during the year. Numerous breaches, mostly of a minor nature, were detected, and recommendations accordingly made for their rectification. It was necessary to have the undermentioned explosives destroyed:—

Date.	Place.	Kind and Quantity.	Reason for Destruction.
April	Cunderdin	15 plugs Gel. " 60 "	Chemical deterioration.
„	Kellerberrin	12 plugs Gel. " 60 "	do. do.
May	Woodman's Point	730 lb. Blasting powder	Absorption of moisture and white ant attack on cases.
August	Cockatoo Island....	31,200 lb. Gel. " 60 "	Severe exudation and deliquescence.
„	Yampi Sound	4,150 lb. Gel. Dyn. " 75 "	do. do.
„	Port Hedland	40 lb. Gel. " 60 "	Absorption of moisture and exudation.
October	Woodman's Point	69 cases Ge. " 60 "	Low heat test.
„	Kalgoorlie	8 cases Gel. " 60 "	do.

Representing a considerable increase over the previous year's importations, 31 shipments of fireworks, mostly manufactured in Great Britain and Hong Kong, were received in 1948. Samples from each consignment were examined for prohibited admixtures under the Act, and in many instances were submitted to firing tests. Of the hundreds of specimens handled only a very few had to be rejected. As evidenced by correspondence and inquiry, there seems a genuine desire on the manufacturers' part to supply pyrotechnic goods conforming with the letter and spirit of requirements.

Metropolitan stores retailing fireworks were visited, and directions intended as safety measures given in a number of instances. Time did not permit of similar inspections in country districts where, however, the dangers are somewhat less.

The subject of fireworks figured prominently at a conference held in Melbourne early in 1948. The desirability, not only of uniformity in regulations but in the interpretation thereof, was stressed. Cases are recorded where fireworks rejected in one State have been acceptable elsewhere, and although differences still exist between the several Acts, much was accomplished in the direction of bringing individual opinions into agreement. Whilst most fireworks comply with chemical requirements, attention has been accorded varieties which for other reasons are considered dangerous, and which may, therefore, be banned from sale. In one instance, overlapping labels on double bangers obliterated the words "Do not" from an injunction intended to read, "Do not hold in the hand after lighting." Another case to which attention was drawn by the Queensland Chief Inspector of Explosives, referred to the arsenical content of certain Hong Kong fireworks. Arsenic equivalent to 2.2 grains As_2O_3—which is about the adult lethal dose—was found in "Smoke and Voice" and "Black Devils," but strangely analyses of similar lines intended for use in W.A. disclosed only the traces of arsenic to be expected in commercial chemicals. "Torpedoes" and "Flying Imps," which on ignition execute a series of erratic movements near ground level and sometimes explode at the end of their flight, are also looked upon with disfavour. The shop-goods class of fireworks, generally being of no national importance and always associated with certain risks, it is the policy of this branch to see that the element of danger is kept to a minimum.

A fatality connected with the use of commercial explosives occurred at Red Hill on July 9th, 1948. A shot-firer on a road construction job lit the last of 36 charged holes when, according to a press report, the fuse "ran." An almost immediate explosion blew the man's body into the line of fire of the remaining 35 charges, thereby precluding any attempt at rescue. Investigation disclosed that a bulldozer used to tow away a portable compressor had run over the fuse leading to No. 36 hole, severing an indeterminate amount and possibly lifting the priming charge. What, therefore, appeared to be a safe length of fuse remaining might not have amounted to more than a few inches. On testing, the severed fuse and samples from the original reel were found to burn well within the Mines Regulations' specified rate of 80 to 100 seconds per yard, a fact which in conjunction with other observations, completely discounted the assertion that "running" fuse caused the tragedy. In a report to the Coroner, who found that death was accidental with no blame attributable to anyone, recommendations were made as to the future storage of explosives on such jobs, and particularly was the use of auxiliary fuse and multiple safety igniter advised whenever the slightest doubt existed as to the length or soundness of a fuse already in a hole.

Means for reducing the cost of explosives, especially to the gold mining industry, which consumes some 83 per cent. of the State's importations, have been kept in mind. Discussions on a scheme embodying the unloading at Esperance and conveyance north by rail were resumed with Messrs. Nobels in Melbourne last February without, however, finality being attained. On return, a few days were spent in Esperance, when certain features favourable to the plan were defined. The Newtown Jetty, sufficiently remote from habitation for safety but at present devoid of its decking, could probably be reconditioned. Leading from this jetty are the well-defined remains of an old road which can be followed through the scrub for about half a mile. Should the area be declared an explosives reserve, the road would form a good foundation for rail. At least 12 mounded 30 ton magazines, six or more of which might be transferred from Woodman's Point, would be required. Staff quarters and a testing laboratory would also be necessary. Against the initial and maintenance expenses of such a scheme must be considered the saving of 1,000 miles return sea voyage between Esperance and Fremantle, and the fact that Esperance is 189 miles nearer Kalgoorlie by rail than is Woodman's Point. Due to the sparsely populated country traversed by the line north of Esperance, a substantial increase over the present upper limit of 1,100 cases of explosive per train appears justifiable. Back-loading of the ship, stability of the goldmining industry, and many other points connected with the economics of the whole project must be considered, and of course a major diversion of explosives traffic from Fremantle would not obviate the necessity for maintaining handling and storage facilities near the metropolitan area.

Another plan, which it is hoped will operate before the close of 1949, provides for the lengthening of Woodman's Point Jetty to accommodate Nobel's vessel "Taranui" or ships of similar size intended to carry up to 15,000 cases of explosives. Except for small schooners which are able to berth at the present jetty, vessels are obliged to tranship their explosives to lighters in Gage Roads—an expensive, time-consuming operation, sometimes delayed by rough seas.

A year ago, shipments of explosives arrived with up to one per cent. of the cases loose-lidded or damaged, sometimes beyond repair. The matter was discussed with Messrs. Nobels, who pointed out their difficulties, accentuated by post-war conditions, in obtaining adequate amounts of pinus radiata and nails. Representations on behalf of all Australasian and New Zealand Explosive Departments to the Prime Minister for augmented supplies were successful, with consequent improvement in the cases during recent months. A feature also kept in mind is damage in transit or handling, to which end closer inspection has been instituted at Gage Roads and Woodman's Point. Also, a rigid-platform type of unloading net, which obviates the crushing action characteristic of the conventional sling, is at present under experiment.

In North America, 99 per cent. of commercial explosives are bulk packed—that is to say, there is no subdivision of the 50 lb. cases into ten-five pound cartons. Several small trial consignments of bulk-packed gelignite were received from the Australian factory during the year. The physical condition was satisfactory, and no deterioration occurred on storage of the re-sealed cases after opening for inspection. A few recommendations were made as to the means for obviating the deformation of the plugs occasionally experienced. It is understood that the manufacturers purpose further large-scale trials, although of course carton packaging will still be necessary for small users.

Considerable anxiety has been caused during the year through the encroachment of Coogee campers on the northern boundary of Woodman's Point Explosive Reserve, and by trespassers within the area. Several persons were warned, and a young man was recently prosecuted for discharging a firearm near the magazines. Entrance is usually effected through gaps under the fence caused by shifting sand, whilst there is also evidence of direct vandalism. Additional labour has been engaged and good progress made with repairs, but the time is approaching when sections of the fence will have to be renewed.

Lasting over a fortnight, the inaugural conference of Australasian and New Zealand Chief Inspectors of Explosives commenced in Melbourne on February 16, 1948. In addition to a wide field of discussion embracing commercial explosives, fireworks and hazardous cargoes such as ammonium nitrate and sodium chlorate, there was much interchange of opinion on the protection of magazines from lightning, precautions against static electricity and other relevant topics. A large-scale demonstration of free-running explosives in a blast at Reid Bros. and Reid's quarry was attended, a fireworks factory inspected, several days spent at Nobel's factories, and visits paid to the laboratories and magazine area of the Victorian Explosives Department. The return journey was broken at Adelaide to investigate South Australian methods for the handling, storage and testing of explosives.

Following an association with the Mines Department of 49 years, for the last 27 of which he occupied the position of Chief Inspector af Explosives, Mr. T. N. Kirton retired on April 30th. To his capability, tact and thorough knowledge are largely due the reputation earned by this Branch and the esteem with which it is regarded. During our several months' collaboration prior to my assuming office on May 1st, Mr. Kirton was at all times helpful and evinced a sympathetic understanding of the problems besetting his successor. Even now in his retirement he is equally ready to offer advice and assistance, and I feel privileged to have succeeded an officer who assuredly commands the goodwill and respect of all to whom he is known.

To the staff of the Explosives Reserve and particularly to Mr. T. K. Wood, of this office, I wish to extend gratitude for services well and faithfully performed. Appreciation is likewise recorded of the help given by other Government departments and officers, notably the Chemical Branch, where many analyses of pyrotechnic samples have been conducted through the year. Finally, the co-operation and cordial relationships shown by the explosives manufacturers (Nobel Australasia Limited) and their W.A. agents (Elder Smith and Company Limited) toward this Branch are also greatly to be commended.

F. F. ALLSOP,
Chief Inspector of Explosives.

21st March, 1949.

Division IX.

Report of Chairman, Miner's Phthisis Board, and Superintendent, Mine Workers' Relief Act.

The Under Secretary for Mines.

I have the honour to submit for the information of the Honourable Minister for Mines, my report on this branch of the Mines Department for the year 1948.

Under arrangements similar to previous years, the Commonwealth Health Department continued the periodical examination of mine workers, the work being carried on continuously by the health laboratory at Kalgoorlie, and by a mobile laboratory which visits the mining centres in the various goldfields. The goldfields not visited during the year were the Ashburton, Gascoyne, Kimberley, West Kimberley, Phillips River, Pilbara and West Pilbara, which with the exception of the West Kimberley, Pilbara and West Pilbara are remote and contain few mine workers.

MINE WORKERS' RELIEF ACT.

Examinations under the Mine Workers' Relief Act during the year totalled 5,134 compared with 6,450 for the previous year, a decrease of 1,316 which can be ascribed to the fact that the mobile laboratory did not operate for the first six months.

The results of the examinations for 1948, together with those for the previous years are shown in the tables annexed hereto. A graph is also attached illustrating the trend of the examinations since their inception in 1925. In explanation of these figures I desire to make the following comments:—

Normal, etc.

These number 4,827 or 94.02 per cent. of the men examined, and include men having first class lives or suffering from pneumoconiosis only, the figure for the previous year being 93.34 per cent.

Early Silicosis.

These number 263, a decrease of 75 compared with the previous year. Of these, 24 were new cases, and 239 had been reported previously, the figures for 1947 being 101 and 231 respectively. Early silicotics represent 5.12 per cent. of the men examined, the percentage for the previous year being 5.24.

Advanced Silicosis.

Of the 35 cases reported, 18 were men who advanced from early silicosis during the year, the other 17 having been previously reported. Advanced silicotics represent 0.68 per cent. of the men examined, the figure for the previous year being 0.9.

Silicosis Plus Tuberculosis.

Four cases were reported, compared with 25 for the previous year, and represent 0.08 per cent. of the men examined.

Tuberculosis Only.

Five cases were reported compared with eight for the previous year, and represent 0.10 per cent. of the men examined.

General.

It is pleasing to note that the alarming increase in the cases of silicosis early and advanced, and silicosis plus tuberculosis in 1947 has not continued, and the figures for 1948 have returned to practically normal.

MINES REGULATION ACT.

Examinations under the Mines Regulation Act totalled 1,494. This was in addition to the 5134 examined under the Mine Workers' Relief Act. These examinations show a decrease of 630 compared with the previous year.

The 1,494 men comprise 919 new applicants, and 575 re-examinees for the initial certificate.

Particulars of the examinations are as follows:—

NEW APPLICANTS.

Normal	805
Pneumoconiosis	20
Silicosis Early	—
Silicosis Advanced	—
Query Tuberculosis	18
Tuberculosis	1
Pneumoconiosis plus Query Tuberculosis	—
Pneumoconiosis plus Tuberculosis	—
Silicosis Early plus Query Tuberculosis	—
Silicosis Early plus Tuberculosis	1
Silicosis Advanced plus Query Tuberculosis	—
Silicosis Advanced plus Tuberculosis	1
Other conditions	73
	919

Of the above applicants for admission to the industry, 805 received the Initial Certificate (Form 2), one received a Re-admission Certificate (Form 6), 83 received Special Certificates (Form 9), seven received Temporary Rejection Certificates (Form 3), 22 received Rejection Certificates (Form 4) and one received a Prohibition Certificate (Form 11). Thus of 919 new applicants, 805 were eligible for employment anywhere on a mine, 84 were eligible for surface employment, and 30 were not eligible for any employment on a mine. The percentage of rejects (over three per cent.) for the year was unusually high, and can no doubt be attributed to the war service of many of the applicants.

RE-EXAMINATIONS.

Normal	376
Pneumoconiosis	93
Silicosis Early	28
Silicosis Advanced	2
Query Tuberculosis	26
Tuberculosis	2
Pneumoconiosis plus Query Tuberculosis	—
Pneumoconiosis plus Tuberculosis	—
Silicosis Early plus Query Tuberculosis	—
Silicosis Early plus Tuberculosis	—
Silicosis Advanced plus Query Tuberculosis	—
Silicosis Advanced plus Tuberculosis	—
Other conditions	48
	575

These men had previously been examined, and some were engaged in the industry prior to this examination. Three hundred and seventy-six received the Initial Certificate (Form 2), two received Temporary Rejection Certificates (Form 3), four received Rejection Certificates (Form 4), 55 received Re-admission Certificates (Form 6), 136 received Special Certificates (Form 9), and two received Prohibition Certificates (Form 14). Thus of the 575 men examined 376 were eligible for employment anywhere on a mine, 191 were eligible for surface employment and eight were not eligible for any employment.

Grouping the two sets of figures discloses that the following certificates were issued under the Mines Regulation Act:—

Initial Certificate (Form 2)	1,181
Rejection Certificate (Temporary) (Form 3)	9
Rejection Certificate (Form 4) ..	26
Re-admission Certificate (Form 6) ..	56
Special Certificate (Form 9) ..	219
Prohibition Certificate (Form 11) ..	1
Prohibition Certificate (Form 14) ..	2
	1,494

The percentage of men of normal health to the number examined was 79, compared with 78 for the previous year.

MINER'S PHTHISIS ACT.

The amount of compensation paid during the year totalled £29,198 12s. 3d., compared with £32,171 4s. 6d. for the previous year, a decrease of £2,972 12s. 3d., which is due to the death of some of the beneficiaries and to the attainment of the age of 16 years by some of the dependant children.

The number of beneficiaries under the Act on the 31st December, 1948, was 251, being 41 ex-miners and 210 widows.

J. THOMAS,
Superintendent Mine Workers' Relief Act.

23/3/1949.

TABLE SHOWING RESULTS OF PERIODICAL EXAMINATION OF MINE WORKERS FROM INCEPTION OF EXAMINATIONS (1925) TO 31st DECEMBER, 1948.

First Examination (1925–26).

		Per cent.
Normal, etc.	3,239 =	80·5
Silicosis Early	459 =	11·4
Silicosis Advanced	183 =	4·5
Silicosis plus Tuberculosis	131 =	3.3
Tuberculosis only	11 =	·3
Total number of men examined	4,023 =	100·0

Second Examination (1927).

			Per cent
Normal, etc.—			
Previously reported as normal, etc.	2,290		
New cases (*i.e.*, cases examined for the first time)	826		
		3,116 =	83·6
Silicosis Early—			
Previously reported as early	348		
New cases	33		
		381 =	10·2
Silicosis Advanced—			
Previously reported as Advanced	85		
New cases	8		
		93 =	2·5
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	13		
Previously reported as Silicosis Early	27		
Previously reported as Silicosis Advanced	62		
New cases	26		
		128 =	3·4
Tuberculosis only		10 =	·3
Total number of men examined		3,728 =	100·0

PERIODICAL EXAMINATION OF MINE WORKERS—*continued.*

Third Examination (1928).

			Per cent.
Normal, etc.—			
Previously reported as Normal, etc.	2,738		
New cases	239		
		2,977 =	85·5
Silicosis Early—			
Previously reported as Normal, etc.	47		
Previously reported as Silicosis Early	303		
New cases	12		
		362 =	10·4
Silicosis Advanced—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	16		
Previously reported as Silicosis Advanced	79		
New cases	2		
		98 =	2·8
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	10		
Previously reported as Silicosis Early	14		
Previously reported as Silicosis Advanced	10		
New cases	8		
		42 =	1·2
Tuberculosis only—			
Previously reported as Normal, etc.	3		
New cases	1		
		4 =	·1
Total number of men examined		3,483 =	100·0

Fourth Examination (1929).

			Per cent.
Normal, etc.—			
Previously reported as Normal, etc.	2,099		
New cases	21		
		2,120 =	81·9
Silicosis Early—			
Previously reported as Normal, etc.	100		
Previously reported as Silicosis Early	224		
New cases	2		
		326 =	12·6
Silicosis Advanced—			
Previously reported as Silicosis Early	34		
Previously reported as Silicosis Advanced	60		
		94 =	3·6
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	8		
Previously reported as Silicosis Early	14		
Previously reported as Silicosis Advanced	19		
		41 =	1·6
Tuberculosis only—			
Previously reported as Normal, etc.		7 =	·3
Total number of men examined		2,588 =	100·0

Fifth Examination (1930).

			Per cent.
Normal, etc.—			
Previously reported as Normal, etc.	2,751		
New cases	34		
		2,785 =	81·9
Silicosis Early—			
Previously reported as Normal, etc.	133		
Previously reported as Silicosis Early	247		
New cases	3		
		383 =	11·3
Silicosis Advanced—			
Previously reported as Silicosis Early	22		
Previously reported as Silicosis Advanced	43		
New cases	2		
		67 =	2·0
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	6		
Previously reported as Silicosis Early	60		
Previously reported as Silicosis Advanced	46		
New cases	2		
		114 =	3·3
Tuberculosis only—			
Previously reported as Normal, etc.	47		
New cases	3		
		50 =	1·5
Total number of men examined		3,399 =	100·0

Sixth Examination (1931).

			Per cent.
Normal, etc.—			
Previously reported as Normal, etc.	2,530	=	84·0
Silicosis Early —			
Previously reported as Normal, etc.	94		
Previously reported as Silicosis Early	252		
		346 =	11·5
Silicosis Advanced—			
Previously reported as Silicosis Early	18		
Previously reported as Silicosis Advanced	35		
		53 =	1·8
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	4		
Previously reported as Silicosis Early	35		
Previously reported as Silicosis Advanced	19		
		58 =	1·9
Tuberculosis only—			
Previously reported as Normal, etc.		25 =	·8
Total number of men examined		3,012 =	100 0

ERIODICAL EXAMINATION OF MINE WORKERS—*continued.*

Seventh Examination (1932).

			Per cent.
Normal, etc.		3,835 =	89.5
Silicosis Early—			
Previously reported as Normal, etc.	35		
Previously reported as Silicosis Early	338		
		373 =	8.7
Silicosis Advanced—			
Previously reported as Silicosis Early	6		
Previously reported as Silicosis Advanced	47		
		53 =	1.2
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	3		
Previously reported as Silicosis Early	9		
Previously reported as Silicosis Advanced	4		
		16 =	.4
Tuberculosis only—			
Previous reported as Normal, etc.		8 =	.2
Total number of men examined		4,285 =	100.0

Eighth Examination (1933).

			Per cent.
Normal, etc.		2,920 =	86.5
Silicosis Early—			
Previously reported as Normal, etc.	57		
Previously reported as Silicosis Early	322		
		379 =	11·2
Silicosis Advanced—			
Previously reported as Normal, etc.	1		
Previous reported as Silicosis Early	15		
Previously reported as Silicosis Advanced	44		
		60 =	1·8
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	2		
Previously reported as Silicosis Early	9		
Previously reported as Silicosis Advanced	4		
		15 =	.4
Tuberculosis only—			
Previously reported as Normal, etc.	3	3 =	.1
Total number of men examined		3,377 =	100.0

Ninth Examination (1934).

			Per cent.
Normal, etc.		5,140 =	92.4
Silicosis Early—			
Previously reported as Normal, etc.	54		
Previously reported as Silicosis Early	315		
		369 =	6.6
Silicosis Advanced—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	24		
Previously reported as Silicosis Advanced	12		
		37 =	.7
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	6		
Previously reported as Silicosis Advanced	6		
		12 =	.2
Tuberculosis only—			
Previously reported as Normal, etc.	5	5 =	.1
Total number of men examined		5,563 =	100.0

Tenth Examination (1935).

			Per cent.
Normal, etc.		4,437 =	92.3
Silicosis Early—			
Previously reported as Normal, etc.	35		
Previously reported as Silicosis Early	303		
		338 =	7.0
Silicosis Advanced—			
Previously reported as Silicosis Early	24		
Previously reported as Silicosis Advanced	2		
		26 =	.6
Silicosis plus Tuberculosis—			
Previously reported as Silicosis Early		5 =	.1
Tuberculosis only—			
Previously reported as Normal, etc.	2	2 =	.0
Total number of men examined		4,808 =	100.0

Eleventh Examination (1936).

			Per cent.
Normal, etc.		6,972 =	94.7
Silicosis Early—			
Previously reported as Normal, etc.	29		
Previously reported as Silicosis Early	323		
		352 =	4.8
(Note.—Of the 352 cases of Early Silicosis reported 23 were already suffering from Early Silicosis and 4 from Pneumoconiosis when re-admitted to the industry on the Re-Admission Certificate under Regulation 7 of the Mines Regulation Act, 1906).			
Silicosis Advanced—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	15		
Previously reported as Silicosis Advanced	4		
		20 =	.3
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	3		
Previously reported as Silicosis Early	8		
		11 =	.1
Tuberculosis only	8	8 =	.1
Total number of men examined		7,363 =	100.0

PERIODICAL EXAMINATION OF MINE WORKERS—*continued.*

Twelfth Examination (1937).

			Per cent.
Normal, etc.		7,487 =	95.4
Silicosis Early—			
Previously reported as Normal, etc.	15		
Previously reported as Silicosis Early	319		
		334 =	4.3
(Note.—Of the 334 cases of Early Silicosis reported 37 were already suffering from Early Silicosis when re-admitted to the industry on the Re-Admission Certificate under Regulation 7 of the Mines Regulation Act, 1906.)			
Silicosis Advanced—			
Previously reported as Silicosis Early	14		
Previously reported as Silicosis Advanced	4		
		18 =	.2
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	10		
		11 =	.1
Tuberculosis only	2	2 =	.0
Total number of men examined		7,852 =	100.0

Thirteenth Examination (1938).

			Per Cent.
Normal, etc.		6,833 =	95·68
Silicosis Early—			
Previously reported as Normal, etc.	13		
Previously reported as Silicosis Early	266		
		279 =	3.91
(Note.—Of the 279 cases of Silicosis Early reported, 32 were already suffering from Early Silicosis and 4 from Pneumoconiosis when re-admitted to the industry on Re-admission Certificates under Regulation 7 of the Mines Regulation Act, 1906.)			
Silicosis Advanced—			
Previously reported as Normal, etc.			
Previously reported as Silicosis Early	15		
Previously reported as Silicosis Advanced	2		
		17 =	.24
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	8		
Previously reported as Silicosis Advanced			
		9 =	.13
Tuberculosis only—			
Previously reported as Normal, etc.	3	3 =	.04
Total number of men examined		7,141 =	100.00

Fourteenth Examination (1939).

			Per Cent.
Normal, etc.		6,670 =	95.63
Silicosis Early—			
Previously reported as Normal, etc.	18		
Previously reported as Silicosis Early	264		
		282 =	4.04
(Note.—Of the 282 cases of Early Silicosis reported, 28 were already suffering from Early Silicosis and one from Pneumoconiosis when re-admitted to the industry on Re-Admission Certificates under Regulation 7 of the Mines Regulation Act, 1906.)			
Silicosis Advanced—			
Previously reported as Normal, etc.—			
Previously reported as Silicosis Early	7		
Previously reported as Silicosis Advanced	3		
		10 =	.14
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	9		
Previously reported as Silicosis Advanced	1		
		11 =	.16
Tuberculosis only—			
Previously reported as Normal, etc.	2	2 =	.03
Total number of men examined		6,975 =	100.00

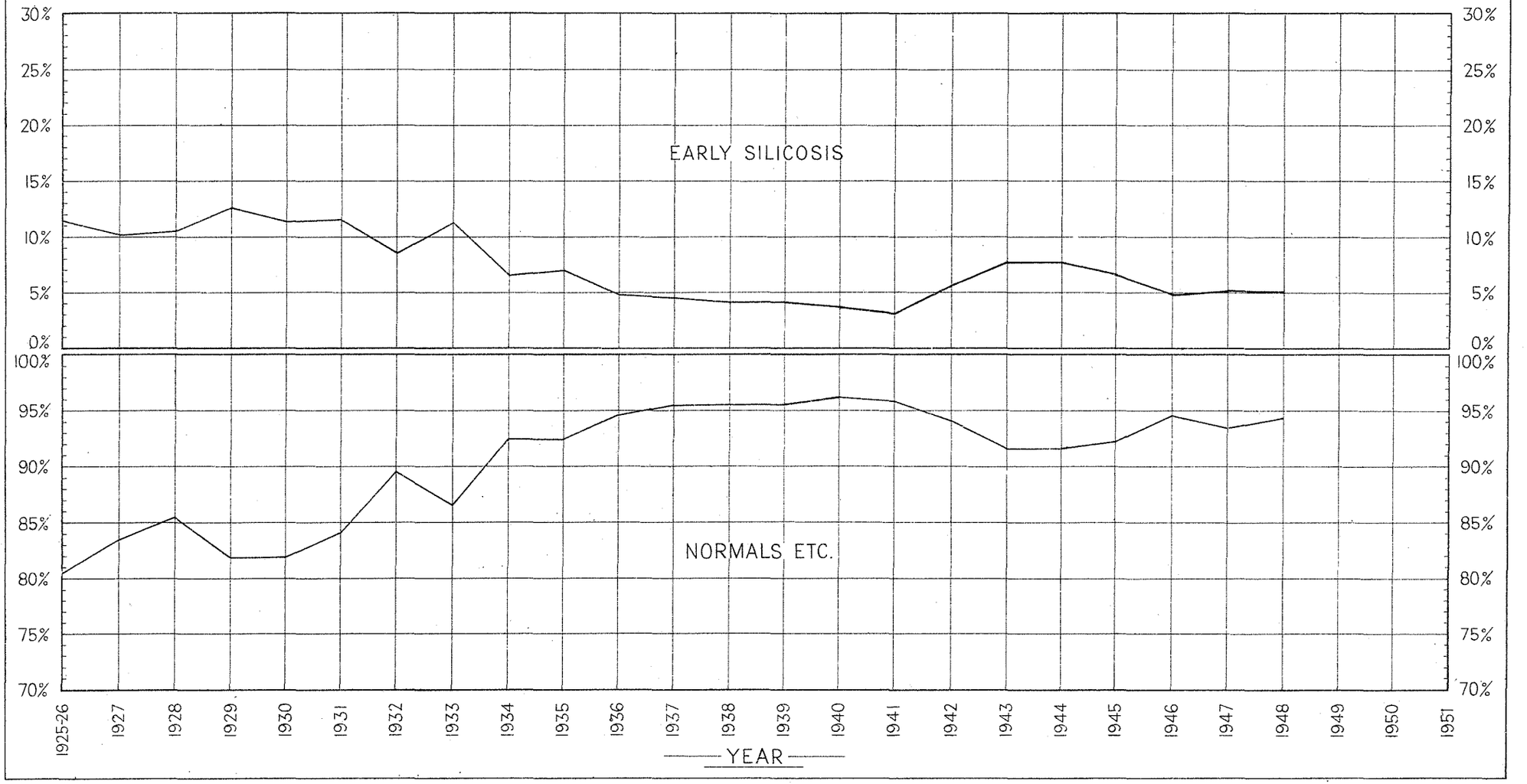
Fifteenth Examination (1940).

			Per Cent.
Normal, etc.		7,023 =	96.218
Silicosis Early—			
Previously reported as Normal, etc.	12		
Previously reported as Silicosis Early	245		
		257 =	3.521
(Note.—Of the 257 cases of Early Silicosis reported, 23 were suffering from Early Silicosis and 12 from Pneumoconiosis when re-admitted to the industry on Re-Admission Certificates under Regulation 7 of the Mines Regulation Act, 1906.)			
Silicosis Advanced—			
Previously reported as Normal, etc.			
Previously reported as Silicosis Early	10		
Previously reported as Silicosis Advanced	1		
		11 =	.151
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.			
Previously reported as Silicosis Early	4		
Previously reported as Silicosis Advanced			
		4 =	.055
Tuberculosis only—			
Previously reported as Normal, etc.	4	4 =	.055
Total number of men examined		7,299 =	100.000

PERIODICAL EXAMINATION OF MINE WORKERS

GRAPH No.1

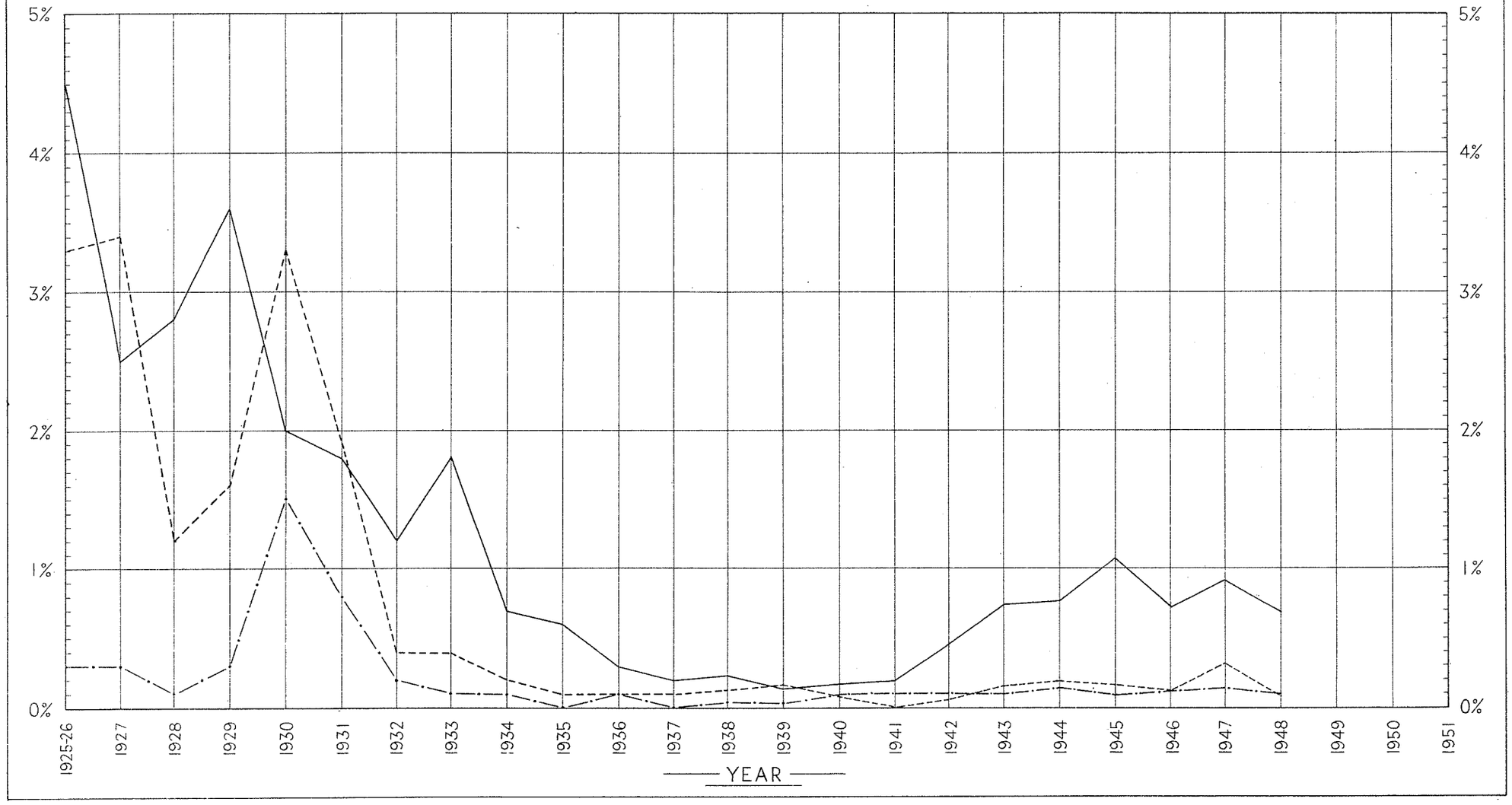
Showing Percentages of Normals and Early Silicotics, from 1925-26 onwards



PERIODICAL EXAMINATION OF MINE WORKERS

GRAPH No. 2

Showing Percentages of Silicosis Advanced, Silicosis plus Tuberculosis and Tuberculosis only, from 1925-26 onwards



Silicosis Advanced ———— *Silicosis Plus Tuberculosis* - - - - - - - - *Tuberculosis Only* ·—·—·—·—·

PERIODICAL EXAMINATION OF MINE WORKERS—*continued.*

Sixteenth Examination (1941).

			Per cent.
Normal, etc.		6,840	= 95.785
Silicosis Early—			
Previously reported as Normal, etc.	32		
Previously reported as Silicosis Early	248		
		280	= 3.921
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	11		
Previously reported as Silicosis Advanced	3		
		14	= .196
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	....		
Previously reported as Silicosis Advanced	....		
Tuberculosis only—			
Previously reported as Normal, etc.		7	= .098
Total number of men examined		7,141	=100.000

Seventeenth Examination (1942).

			Per cent.
Normal, etc.		5,469	= 93.905
Silicosis Early—			
Previously reported as Normal, etc.	61		
Previously reported as Silicosis Early	264		
		325	= 5.580
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	20		
Previously reported as Silicosis Advanced	5		
		25	= 0.430
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	2		
Previously reported as Silicosis Advanced	....		
		2	= 0.034
Tuberculosis only—			
Previously reported as Normal, etc.		3	= 0.051
Total number of men examined		5,824	=100.000

Eighteenth Examination (1943).

			Per cent.
Normal, etc.		3,932	= 91.47
Silicosis Early—			
Previously reported as Normal, etc.	63		
Previously reported as Silicosis Early	262		
		325	= 7.57
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	25		
Previously reported as Silicosis Advanced	7		
		32	= 0.75
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	5		
Previously reported as Silicosis Advanced	....		
		5	= 0.12
Tuberculosis only—			
Previously reported as Normal, etc.		4	= 0.09
Total number of men examined		4,298	= 100.00

Nineteenth Examination (1944).

			Per cent.
Normal, etc.		4,079	= 91.51
Silicosis Early—			
Previously reported as Normal, etc.	70		
Previously reported as Silicosis Early	270		
		340	= 7.45
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	21		
Previously reported as Silicosis Advanced	14		
		35	= 0.76
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	7		
Previously reported as Silicosis Advanced	....		
		8	= 0.15
Tuberculosis only—			
Previously reported as Normal, etc.		6	= 0.13
Total number of men examined		4,468	= 100.00

PERIODICAL EXAMINATION OF MINE WORKERS—*continued*

Twentieth Examination (1945).

			Per cent.
Normal, etc.		3,071	= 92.11
Silicosis Early—			
Previously reported as Normal, etc.	54		
Previously reported as Silicosis Early	166		
		220	= 6.60
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	26		
Previously reported as Silicosis Advanced	10		
		36	= 1.08
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	3		
Previously reported as Silicosis Early	2		
Previously reported as Silicosis Advanced	....	5	= 0.15
Tuberculosis only—			
Previously reported as Normal, etc.		2	= 0.06
Total number of men examined		3,334	= 100.00

Twenty-first Examination (1946).

			Per cent.
Normal, etc.		5,294	= 94.43
Silicosis Early—			
Previously reported as Normal, etc.	89		
Previously reported as Silicosis Early	172		
		261	= 4.66
Silicosis Advanced—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	36		
Previously reported as Silicosis Advanced	2		
		39	= 0.69
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	3		
Previously reported as Silicosis Early	1		
Previously reported as Silicosis Advanced	2		
		6	= 0.11
Tuberculosis only—			
Previously reported as Normal, etc.		6	= 0.11
Total number of men examined		5,606	= 100.00

Twenty-second Examination (1947).

			Per cent.
Normal, etc.		6,021	= 93.34
Silicosis Early—			
Previously reported as Normal, etc.	101		
Previously reported as Silicosis Early	237		
		338	= 5.24
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	49		
Previously reported as Silicosis Advanced	9		
		58	= 0.90
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	13		
Previously reported as Silicosis Early	11		
Previously reported as Silicosis Advanced	1		
		25	= 0.30
Tuberculosis only—			
Previously reported as Normal, etc.		8	= 0.12
Total number of men examined		6,450	= 100.00

Twenty-third Examination (1948).

			Per cent.
Normal, etc.		4,827	= 94·02
Silicosis Early—			
Previously reported as Normal, etc.	24		
Previously reported as Silicosis Early	239		
		263	= 5·12
Silicosis Advanced—			
Previously reported as Normal, etc.	....		
Previously reported as Silicosis Early	18		
Previously reported as Silicosis Advanced	17		
		35	= 0·68
Silicosis plus Tuberculosis—			
Previously reported as Normal, etc.	1		
Previously reported as Silicosis Early	3		
Previously reported as Silicosis Advanced	....		
		4	= 0·08
Tuberculosis only—			
Previously reported as Normal, etc.		5	= 0·10
Total number of men examined		5,134	= 100·00

Men employed in the outlying districts were not examined during 1929 or 1931 ; only those employed in Kalgoorlie and surrounding districts being examined. The increase in numbers diagnosed as Early Silicosis and Tuberculosis in 1930 was due to the improved plant and radiographic technique.

Only new miners and those whose previous diagnosis warranted review were examined in the outlying districts, during 1933.

Mining Statistics to 31st December, 1948.

TABLE OF CONTENTS.

TABLE I.

PRODUCTION OF GOLD AND SILVER FROM ALL SOURCES, SHOWING IN FINE OUNCES THE OUTPUT AS REPORTED TO THE MINES DEPARTMENT DURING 1948, AND THE TOTAL PRODUCTION TO DATE.

(*Note.*—Lease numbers in brackets indicate that the holding was *voided* during the year.)

(*Note.*—* denotes mainly derived from treatment of tailings.)

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.
Kimberley Goldfield.												
Brockman	109	Mt. Bradley	....	....	....	....	....	....	....	193·00	50·94	....
		Voided leases	....	....	....	....	....	....	....	1,352·75	1,404·40	....
		Sundry claims	....	....	....	....	....	7·62	7·62	2,484·00	1,871·92	....
Halls' Creek	...	Voided leases	....	....	....	....	....	....	....	423·00	477·76	....
		Sundry claims	....	....	....	....	12·64	27·73	....	204·55	159·68	12·64
Mt. Dockerell	95	Irish Lass	....	....	....	....	....	9·17	13·66	341·00	266·75	....
		Voided leases	....	....	....	....	....	....	....	832·70	939·34	93·00
		Sundry claims	....	....	....	....	....	....	20·03	160·00	89·64	....
Panton	114 (115) (116) (117) (118) 119	Granite Leases	....	....	....	....	....	....	....	8·25	1·77	....
		Voided leases	....	....	....	....	....	....	....	34·70	138·70	....
		Sundry claims	....	....	....	....	....	....	....	6·15	18·01	....
Mary	....	Voided leases	....	....	....	....	....	....	....	399·00	210·03	....
		Sundry claims	....	....	....	....	....	....	....	46·85	53·66	....
Ruby Creek	98	Goliath	....	....	....	....	....	....	....	120·70	103·72	....
	97	Ruby Queen	....	....	....	....	....	....	....	2,919·25	1,631·30	2·14
	100	St. Lawrence	....	....	....	....	....	....	....	10·00	11·32	....
	96	West-and-Left	....	....	....	....	....	....	....	10·00	5·30	....
		Voided leases	....	....	....	....	....	....	16·05	12,761·50	9,499·48	....
		Sundry claims	....	....	....	....	....	12·71	....	281·25	183·30	....
		From Goldfield generally :— Reported by Banks and Gold Dealers	70·20	425·30	....	....	....	8,333·28	701·32	·75	1·54	....
		Totals	**70·20**	**425·30**	....	....	**12·64**	**8,390·51**	**758·68**	**22,589·40**	**17,118·56**	**107·78**
† West Kimberley Goldfield.												
Napier Range	Mc 29	Devonian Silver Lead Mine	....	....	....	....	4,762·11	....	....	....	....	4,762·11

† All Production prior to 1948 shown under State generally.

Pilbara Goldfield.

MARBLE BAR DISTRICT.

Bamboo Creek	856	Bulletin	....	....	....	....	....	....	8·36	3,156·00	999·41	....
	850	Federation	....	....	240·00	291·44	....	....	....	1,776·00	1,484·44	....
	866, 901	Greater Bonnie Doon (1935), Ltd.	....	....	....	....	....	....	....	2,530·00	1,043·86	....
	866	(Bonnie Doon)	....	....	....	....	....	....	....	204·00	78·03	....
	707	Kitchener	....	....	....	....	....	....	....	9,969·50	13,718·62	....
	1010	Mickey	....	....	43·00	9·56	·58	....	....	1,697·00	453·85	·58
	740, 794, 878	Mt. Prophecy Leases	....	....	....	....	....	....	....	8,310·50	8,354·45	....
	740	(Mt. Prophecy)	....	....	....	....	....	....	1·11	1,040·50	1,898·07	....
	794	(Perseverance)	....	....	....	....	....	....	....	290·50	584·21	....
	817	Prince Charlie	....	....	594·00	117·06	22·80	....	3·68	3,080·00	3,340·30	30·11
	1075	Queen	....	....	98·00	44·51	....	....	....	196·00	137·83	....
	924	True Blue	....	....	....	....	....	....	....	2,057·25	84·54	....
		Voided leases	....	....	....	....	....	13·54	550·72	18,375·85	25,744·37	....
		Sundry claims	....	....	....	....	....	8·97	307·83	4,984·85	2,979·99	....
Boodalyerrie	....	Voided leases	....	....	....	....	....	....	292·07	120·25	587·86	....
		Sundry claims	....	....	....	....	....	....	7·16	....	....	....
Lalla Rookh	....	Voided leases	....	....	....	....	....	....	4·78	3,612·00	4,946·33	574·01
		Sundry claims	....	....	....	....	....	....	....	7,943·00	7,675·09	....
Marble Bar	927, etc.	Comet Gold Mines, Ltd.	....	....	2,471·00	2,635·44	12·36	....	....	109,081·94	99,358·27	12·36
		Prior to transfer to present holders	....	....	....	....	....	....	....	2,195·75	1,235·42	....
	1063	General	....	....	9·75	11·87	·29	....	....	230·50	476·45	·29
	912	Homeward Bound	....	....	273·25	47·34	....	....	....	6,292·25	3,111·75	....
	1054	Illareen	....	....	....	....	....	....	....	40·00	6·32	·36
	(1050)	Stray Shot	....	....	14·00	2·28	·09	....	....	110·25	79·57	·09
		Voided leases	....	....	....	....	....	....	199·09	40,018·80	40,154·49	....
		Sundry claims	....	....	126·25	25·17	·12	67·08	251·77	19,725·79	12,433·52	·17
North Pole	1040	Normay	....	....	....	....	....	....	....	69·00	31·07	....
		Voided leases	....	....	....	....	....	....	....	548·00	400·52	....
		Sundry claims	....	....	....	....	....	....	....	549·75	286·38	....
North Shaw	....	Voided leases	....	....	....	....	....	7·53	....	1,072·45	996·29	....
		Sundry claims	....	....	....	....	....	2·84	567·06	179·75	121·72	....
Pilgangoora	....	Voided leases	....	....	....	....	....	16·65	....	2,255·00	403·60	....
		Sundry claims	....	....	....	....	....	161·08	8·13	481·60	146·39	....
Sharks	....	Voided leases	....	....	....	....	....	1·43	....	1,720·75	1,951·08	....
		Sundry claims	....	2·39	14·00	5·63	·97	163·14	47·93	1,128·75	1,651·21	·97
Talga	....	Voided leases	....	....	....	....	....	....	93·15	1,799·00	1,760·68	....
		Sundry claims	7·12	....	....	....	·70	71·82	85·18	1,975·90	1,499·86	·70
Tambourah	....	Voided leases	....	....	....	....	....	....	73·90	1,576·50	1,882·29	....
		Sundry claims	....	....	....	....	....	89·52	294·75	3,742·25	2,689·78	....
Warrawoona	1087											
		Town Talk	....	....	300·45	36·69	3·80	....	....	300·45	36·69	3·80
		Voided leases	....	....	....	....	....	....	16·99	12,748·80	18,830·50	....
		Sundry claims	....	....	119·00	6·32	....	70·98	623·67	6,597·79	4,234·72	....
Western Shaw	....	Voided leases	....	....	....	....	....	....	....	1,222·50	957·80	....
		Sundry claims	....	....	....	....	....	22·34	67·47	71·50	81·49	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

PILBARA GOLDFIELD—*continued.*

MARBLE BAR DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Wymans Well	1084	New Copenhagen	....	....	300·00	7·75	....	....	....	300·00	7·75	....
	1013	Trump	....	....	214·25	24·90	1·13	....	....	2,761·30	488·89	1·13
		Voided leases	....	....	....	....	....	....	42·86	2,977·29	1,258·44	....
		Sundry claims	....	....	27·00	12·83	·74	4·47	51·52	2,502·96	1,260·78	·74
Yandicoogina	....	Voided leases	....	....	....	....	....	....	140·76	3,159·20	6,218·83	....
		Sundry claims	....	....	....	....	....	4·32	239·89	574·50	642·82	....
	From District generally :—											
	Sundry Parcels treated at :											
		State Battery, Bamboo Creek	....	....	....	*147·63	....	....	....	40·00	*10,225·54	181·04
		State Battery, Marble Bar	....	....	....	*363·98	....	....	....	12·00	*10,394·74	....
		Ironclad Battery	....	....	....	....	....	....	....	....	*237·71	....
		The Great North Western Gold Co., Ltd.	....	....	....	....	....	....	....	....	*271·37	·65
		Various Works	....	....	....	....	....	....	....	237·95	*1,391·56	....
	Reported by Banks and Gold Dealers		48·12	....	....	....	1·13	14,245·07	436·76	....	·90	2·40
	Totals		**55·24**	**2·39**	**4,843·95**	**3,790·40**	**44·71**	**14,950·78**	**4,416·59**	**297,643·42**	**301,076·44**	**809·40**

NULLAGINE DISTRICT.

Eastern Creek	276L	Rose	....	....	26·00	24·61	1·04	....	....	82·50	96·72	1·04
		Voided leases	....	....	....	....	....	8·96	8·19	5,261·00	9,567·00	11·77
		Sundry claims	....	....	....	....	....	....	12·74	1,409·10	1,600·71	16·90
Elsie	....	Voided leases	....	....	....	....	....	....	....	586·25	1,675·91	....
		Sundry claims	....	....	....	....	....	....	8·28	58·00	188·08	....
McPhee's Creek	....	Voided leases	....	....	....	....	....	....	....	113·00	137·92	....
		Sundry claims	....	....	....	....	....	....	....	134·00	197·09	....
Middle Creek	279L	All Nations	....	....	204·00	46·08	....	....	....	838·50	255·51	·15
	229L	Barton	....	....	1,055·50	524·40	1·35	1·22	....	2,666·00	803·12	1·35
	231L, etc.	Blue Spec Leases	....	....	4,483·00	3,173·94	....	....	....	25,613·39	13,312·82	....
	247L	Hopetoun North	....	1·02	74·00	15·92	....	....	1·02	1,286·50	312·38	·08
	267L	Little Wonder	....	....	168·00	20·63	....	....	....	3,394·00	890·35	....
		Voided leases	....	....	....	....	....	....	....	11,857·15	10,005·43	....
		Sundry claims	....	....	6·00	2·80	....	....	....	4,935·10	2,145·42	....
Mosquito Creek	....	Voided leases	....	....	....	....	....	1·07	30·12	8,232·30	12,814·22	....
		Sundry claims	....	....	....	....	....	....	181·64	3,692·94	3,780·41	....

Nullagine	292L	Alice	....	78·31	12·50	41·46	6·96	....	78·31	12·50	41·46	6·96
	295L	Chrysler South	....	....	127·00	63·26	....	....	....	127·00	63·26	....
	283L	Grant's Hill	....	....	11·00	3·56	·04	....	....	35·00	8·02	·04
	294L	Nullagine View	....	42·79	17·00	140·88	10·64	....	42·79	17·00	140·85	10·64
	289L	Paul's Leader	....	73·08	....	....	2·33	....	249·05	14·50	275·27	9·53
		Voided leases	....	....	....	....	....	....	40·56	8,802·75	12,388·03	....
		Sundry claims	....	34·41	23·50	91·29	·06	315·53	633·33	5,849·05	10,205·26	4·92
Twenty Mile Sandy	256L	Bill Jim	....	....	....	....	....	....	....	1,982·50	1.022·55	....
		Voided leases	....	....	....	....	....	....	3·20	5,221·20	7,971·21	....
		Sundry claims	....	....	121·50	72·98	1·51	33·10	30·50	7,411·85	6,075·02	1·64
		From District generally :—										
		Sundry parcels treated at :										
	MA 7L	Shamrock Battery	....	....	....	*24.44	1.00	....	....	....	*24.44	1.00
		Twenty-Mile Sandy Cyanide Plant	....	....	....	*113.84	.37	....	....	12.00	*1,443.32	.37
		Various Works	....	....	....	....	....	....	....	112.50	*6,340.55	....
		Reported by Banks and Gold Dealers	90·77	....	....	....	2.34	9,469.64	97.45	....	29.81	3.14
		Totals	**90·77**	**229·61**	**6,329.00**	**4,360.09**	**27.64**	**9,829.52**	**1,417.18**	**99,757.58**	**103,812.17**	**69.53**

Ashburton Goldfield.

Belvedere	....	Voided leases	....	....	....	....	....	....	9.88	1,560.00	435.86	176.48
Dead Finish	47	Star of the West	....	....	181.00	40.76	....	....	....	930.50	474.43	....
		Voided leases	....	....	....	....	....	....	....	281.50	279.51	....
		Sundry claims	....	....	....	....	....	....	11.89	78.75	235.31	....
Melrose	....	Voided leases	....	....	....	....	....	....	....	2,704.00	840.26	213.11
		Sundry claims	....	....	....	....	....	12.41	21.88	562.00	262.78	6.40
Mt. Edith....	....	Sundry claims	....	....	....	....	....	....	....	5.00	3.97	....
Mt. Mortimer	....	Sundry claims	....	....	....	....	....	364.63	315.64	44.50	40.25	74.47
Uaroo	....	Voided leases	....	....	....	....	....	....	....	....	....	7,713.22
		From Goldfield generally :—										
		Sundry claims	....	....	....	....	1,202.14	....	....	....	....	1,202.14
		Reported by Banks and Gold Dealers	·86	....	....	....	....	8,884.23	120.11	....	7.12	....
		Totals	**·86**	....	**181.00**	**40.76**	**1,202.14**	**9,261.27**	**479.40**	**6,166.25**	**2,579.49**	**9,385.82**

Gascoyne Goldfield

Bangemall	....	Voided leases	....	....	....	....	....	....	6.22	350.70	313.82	....
		Sundry claims	....	....	....	....	....	88.97	33.55	36.30	203.47	....
		From Goldfields generally :—										
		Reported by Banks and Gold Dealers	....	....	....	....	....	604.47	1.80	....	....	....
		Totals	....	....	....	....	....	**693.44**	**41.57**	**387.00**	**517.29**	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

PEAK HILL GOLDFIELD.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Egerton	556P	Pegasus	....	38·46	72.00	120.29	....	....	123.30	1,429.00	3,407.09	....
		Voided leases	....	....	....	....	....	60.86	30.91	5,077.25	2,842.45	....
		Sundry claims	....	....	....	....	....	235.35	23.51	1,501.77	791.34	....
Horseshoe	568P	Horseshoe Lights	....	....	1,616.00	342.81	....	....	....	2,697.75	608.14	....
	575P	Labourchere Main Lode	....	....	535.00	60.38	....	....	....	535.00	60.38	....
	565P	Nathan Bitter	....	....	43.00	16.99	....	....	....	518.00	138.87	....
		Voided leases	....	....	....	....	....	15.57	1,975.37	3,798.38	2,512.94	2.00
		Sundry claims	....	....	....	....	....	20.12	829.58	1,812.05	691.38	....
Jimblebar		Voided leases	....	....	....	....	....	....	172.75	7,526.25	2,561.95	.58
		Sundry claims	....	....	....	....	....	13.79	65.95	1,048.05	574.16	....
Mt. Fraser		Voided leases	....	....	....	....	....	....	....	389.50	320.96	....
		Sundry claims	....	....	....	....	....	88.28	40.61	400.75	341.14	....
Mt. Seabrook		Voided leases	....	....	....	....	....	....	5.05	620.25	428.26	....
		Sundry claims	....	....	....	....	....	....	....	1,079.10	798.80	....
Peak Hill	512P	Atlantic	....	....	11.00	9.38	....	1.69	2.87	4,472.25	569.68	....
	511P	Commercial	....	....	61.00	4.21	....	....	....	2,838.75	487.90	....
	584P	Dazzle Star	....	....	64.00	4.74	....	....	....	64.00	4.74	....
	567P	Miner Bird	....	....	267.00	121.24	....	....	....	759.00	406.27	....
	553P	Morning Star	....	....	11.00	10.16	....	....	4.43	2,768.25	373.29	....
	506P	No. 1 North	....	....	....	....	....	....	86.47	6,057.20	1,452.66	....
	492P	North Star	....	....	....	....	....	23.20	69.63	13,147.50	2,064.51	....
	573P	Wimpie	....	....	302.00	40.61	....	....	....	572.00	53.75	....
		Voided leases	....	....	....	....	....	7.39	920.21	520,947.33	246,951.81	2,285.63
		Sundry claims	....	28·60	12.00	4.58	....	61.51	306.63	34,025.85	8,920.37	....
Ravelstone		Voided leases	....	....	....	....	....	....	101.64	4,219.85	3,117.68	....
		Sundry claims	....	....	....	....	....	....	....	553.60	283.17	....
Wilgeena	572P	O.K.	....	....	50.00	3.35	....	....	....	50.00	3.35	....
		Voided leases	....	....	....	....	....	....	23.54	128.50	146.79	....
Wilthorpe		Voided leases	....	....	....	....	....	....	....	47.00	20.93	....
		Sundry claims	....	....	....	....	....	....	....	89.00	25.71	....
Yowerina		Voided leases	....	....	....	....	....	....	....	19.50	36.46	....
		Sundry claims	....	....	....	....	....	....	....	117.25	203.16	....

From Goldfield generally :—												
Sundry parcels treated at :												
State Battery, Peak Hill	....	....	....	....	....	....	*154.50	....	....	3.05	15.00	*6,855.69	....
Australian Machinery and Investment Co.	....	....	....	....	....	....	....	....	....	....	....	*1,677.23	....
Various Works	....	....	....	....	....	....	....	....	....	....	30.00	*5,661.37	*23.12
Reported by Banks and Gold Dealers	....	....	....	....	....	....	....	....	2,846.65	444.36	....	12.51	....
Totals	....	....	....	....	....	**67·06**	**3,044.00**	**893.24**	....	**3,374.41**	**5,229.86**	**619,354.93**	**295,406.89**	**2,311.33**

East Murchison Goldfield.

LAWLERS DISTRICT.

Kathleen Valley	1330	Beth-Heno	....	....	257.83	177.30	....	....	....	912.33	469.52	....
	1348	Mt. Harris	....	....	321.00	173.78	....	....	....	398.83	213.82	....
		Voided leases	....	....	....	....	....	....	144.85	78,824.00	48,174.48	....
		Sundry claims	....	....	61.00	11.72	....	14.37	526.03	5,430.75	2,384.74	....
Lawlers	1236, etc.	Australian Gold Production, Ltd.	....	....	10.00	37.44	....	....	....	10.00	37.44	....
	1236, etc.	(Emu Gold Mines, Ltd.)....	....	....	2,806.00	542.18	....	....	....	336,363.68	82,100.22	452.00
		Prior to transfer to present holders	....	....	....	....	....	30.02	....	168.50	1,216.93	....
	1340	Never-Can-Tell	6·71	....	10.00	4.02	....	6.71	....	129.50	40.00	....
		Voided leases	....	....	....	....	....	....	692.45	1,285,225.72	491,374.15	14,350.93
		Sundry claims	....	15·01	270.00	210.06	....	400.21	403.52	17,205.48	9,490.37	268.34
Sir Samuel	1333	Vanguard	....	....	....	....	....	....	....	1,566.00	206.03	....
		Voided leases	....	....	....	....	....	....	359.03	273,477.55	141,386.56	10,227.52
		Sundry claims	15·01	....	22.00	3.58	....	53.89	64.96	7,170.00	4,457.72	....
From District generally :—												
Australian Machinery and Investment Co.	....	....	....	....	....	....	....	....	....	5.00	*4,291.25	*29.00
Prior to transfer to present holders	....	....	....	....	....	....	....	....	....	....	*1,371.33	*15.64
Australian Machinery and Investment Co., Ltd. (McPherson's Cyanide Plant)	....	....	....	....	....	2.12	....	12.03	*4,265.25	....
Great Eastern Mining Syndicate	....	....	....	....	....	....	....	....	....	*352.19	.12
Tallon Doon Battery	....	....	....	....	....	....	....	....	....	*101.50	....
Vanguard Cyanide Plant	....	....	....	*50.63	*3.18	....	....	4.00	*892.31	3.18
State Battery, Sir Samuel (leased)	....	....	....	2.34	....	....	....	53·50	*2,350.16	....
Various Works	....	....	....	....	....	....	2.35	1,699.50	26,067.02	936.09
Reported by Banks and Gold Dealers	23·45	·82	....	....	....	6,400.91	101.91	.05	9.84	....
Totals	**30·16**	**15·83**	**3,757.83**	**1,213.05**	**3.18**	**6,891.23**	**2,295.10**	**2,008,656.42**	**821,252.83**	**26,282.82**

WILUNA DISTRICT.

Coles	662v	Black Adder	....	....	229.00	76.70	....	....	....	1,577.50	760.65	....
		Voided leases	....	....	....	....	....	....	....	830.50	156.85	....
		Sundry claims	....	....	....	....	....	....	21.03	3,844.50	1,507.23	....
Corboys	671v	Barinidgee	....	....	215.00	111.53	....	....	....	350.00	167.24	....
	435v	Old Toscana	....	....	....	*113.08	....	5.24	....	991.50	901.12	....
	669v	Vinaurum	....	....	....	*20.87	....	....	....	683.00	411.48	....
		Voided leases	....	....	....	....	....	....	1.25	12,428.29	8,667.18	5.00
		Sundry claims	....	....	309.00	100.22	....	21.58	....	8,840.35	4,984.83	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued

EAST MURCHISON GOLDFIELD—*continued.*

WILUNA DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Gum Creek	....	Voided leases	....	....	....	....	....	20.75	1.36	1,380.00	595.73	....
		Sundry claims	....	....	....	....	....	....		407.25	131.08	....
Mt. Eureka	....	Voided leases	....	....	....	....	....	....	....	142.25	96.36	....
		Sundry claims	....	....	....	....	....	....	44.54	783.75	548.56	....
Mt. Keith....	....	Voided leases	....	....	....	....	....	....	227.29	20,259.50	13,551.08	....
		Sundry claims	....	....	....	....	....	4.81		3,862.50	2,480.03	....
New England	....	Voided leases	....	....	....	....	....	5.74	95.70 5.78	5,364.25	3,490.87	....
		Sundry claims	....	....	....	....	....	9.31		4,534.75	3,111.97	....
Wiluna	674J	Essex....	....	....	970.00	193.06	....	....	....	1,983.00	438.05	....
	631J	Gypsy Gold Mines	....	....	....	....	....	....	....	55.50	22.29	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,962.75	267.42	....
	676J	International	....	....	3,115.50	807.71	....	....	....	3,491.50	881.47	....
	677J	Lucky Hit	....	....	204.00	38.18	....	....	....	399.00	71.19	....
	675J	Tried Again	....	....	9.50	1.21	....	....		61.25	3.93	....
	194J, etc.	Wiluna Gold Mines, Ltd.	....	....	22.50	*11,819.58	*1,898.00	....	....	7,345,465.00	1,329,961.47	7,657.41
		Prior to transfer to present holders			....	....	....	....	....	341,730.57	133,457.92	89.32
		Voided leases	....	....	....	....	....	....	574.76	1,080,124.83	318,097.39	1,349.40
		Sundry claims	....	....	217.25	77.39	....	105.39	219.08	26,428.55	10,662.73	.33
	From District Generally :—											
	Sundry Parcels treated at :—											
	Black Adder Battery		....	....	....	....	....	....	....	....	*154.02	....
	Coolgardie Brilliant Battery		....	....	....	*15.89	....	....	....	....	*235.23	....
	Toscana Cyanide Plant		....	....	....	....	....	....	....	....	*2,577.90	....
	Waratah Cyanide Plant		....	....	....	....	....	....	....	....	*753.10	....
	Wiluna East Battery		....	....	....	*30.87	....	....	....	....	*30.87	....
	State Battery, Wiluna				....	*441.65	....	....	....	637.00	*22,608.90	218.70
	Various Works		....	....	....	....	....	....	....	....	*1,237.68	12.68
	Reported by Banks and Gold Dealers		....	....	....	7.01	....	49.54	56.58	....	58.49	....
	Totals		....	....	**5,291.75**	**13,854.95**	**1,898.00**	**222.36**	**1,247.37**	**8,868,618.84**	**1,863,082.31**	**9,332.84**
BLACK RANGE DISTRICT.												
Barrambie	972B, 976B	Sheelite Leases	....	....	88.50	85.85	....	....	....	886.25	952.68	....
	972B	Sheelite	....	....	....	....	....	....	....	105.50	108.88	....
	976B	Sheelite, North	....	....	....	....	....	....	...	92.75	92.83	....

		Voided leases	....	....	....	....	....	....	22.49	17,359.42	16,200.76	125.60
		Sundry claims	....	....	....	....	....	5.07	170.20	833.55	915.51	....
Bellchambers	....	Voided leases	....	....	....	....	....	....	111.80	4,349.27	3,130.56	....
		Sundry claims	....	....	....	....	....	....	....	1,008.30	547.06	....
Birrigrin	....	Voided leases	....	....	....	....	....	....	820.68	12,042.93	15,086.09	....
		Sundry claims	....	....	....	....	....	....	179.92	2,487.55	1,238.22	....
Currans	....	Voided leases	....	....	....	....	....	18.24	222.89	7,252.25	3,116.68	....
		Sundry claims	....	....	....	....	....	....	29.38	2,158. 5	827.18	....
Errolls	....	Voided leases	....	....	....	....	....	14.17	152.29	14,170.50	9,328.92	....
		Sundry claims	....	....	....	....	....	6.53	399.11	964.75	595.45	....
Hancock's	1074B	Apples	....	....	137.75	1,533.02	....	....	443.79	809.75	2,500.72	....
		Voided leases	....	....	....	....	....	....	6,524.37	32,624.50	33,433.33	55.72
		Sundry claims	....	....	24.50	4.32	....	4.21	142.89	8,459.10	3,219.53	....
Maninga Marley	....	Voided leases	....	....	....	....	....	....	195.20	60,833.48	48,494.40	22.55
		Sundry claims	....	....	....	....	....	....	158.16	3,079.65	1,768.16	....
Montague	967B, 998B	North End Leases	....	....	1,694.00	292.37	....	....	....	38,467.95	5,290.85	....
		Voided leases	....	....	....	....	....	....	100.17	39,672.65	16,888.02	....
		Sundry claims	....	....	22.75	23.26	....	....	71.09	5,041.35	3,171.19	....
Nungarra	1085B	Sonny James	....	....	....	....	....	....	....	12.25	2.30	....
		Voided leases	....	....	....	....	....	25.94	952.34	9,483.75	3,643.38	....
		Sundry claims	....	....	75.25	10.89	....	50.27	1,458.06	7,636.40	2,953.69	....
Sandstone	959B, etc.	Atlas Gold Mines, Ltd.	....	....	27.75	11.96	....	....	....	986.75	180.56	....
		Prior to transfer to present holders	....	....	....	....	....	....	136.06	537.75	686.59	....
	1076B, 1080B....	Black Range Gold Mines, Ltd.....	....	....	....	....	....	....	....	84.00	14.34	....
	1075B	Doolette, South	....	....	371.50	304.17	....	....	217.54	1,778.50	2,221.01	....
	958B	Lady Mary	....	117.05	147.75	396.37	....	....	117.05	7,036.75	7,001.35	2.28
		Voided leases	....	....	....	....	....	4.75	4,010.09	692,530.07	444,309.77	11,754.22
		Sundry claims	....	....	140.50	14.61	....	44.95	1,421.07	15,372.70	6,792.15	....
Youanmi	1046B	Camberra	....	....	....	....	....	....	....	1,501.00	443.13	....
		Voided leases	....	....	....	....	....	.36	126.92	729,996.55	273,437.23	10,474.10
		Sundry claims	....	....	....	....	....	1.07	18.79	6,258.55	1,814.66	....
	From District Generally :—											
	Sundry Parcels treated at :—											
	State Battery, Sandstone	....	....	....	....	....	....	....	....	290.50	*23,005.08	*59.53
	State Battery, Youanmi	....	....	....	....	....	....	....	....	40.00	*5,461.83	....
	North End Cyanide Plant	....	....	....	....	....	....	....	....	....	*4,934.14	....
	L.T.T. 1056H Dume Parkov	....	....	....	....	....	....	....	....	55.50	4.43	....
	Various Works	....	....	....	....	....	....	....	....	37.00	*6,505.69	....
	Reported by Banks and Gold Dealers	2.44	....	....	....	....	1,459.55	52.23	....	20.38	....
	Totals	**2.44**	**117.05**	**2,730.25**	**2,676.82**	....	**1,635.11**	**18,254.58**	**1,726,338·22**	**950,338.73**	**22,494.00**

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MURCHISON GOLDFIELD

CUE DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Big Bell	2050, etc.	Big Bell Mines, Ltd.	....	....	424,584.00	51,769.74	21,506.57	....	....	3,162,014.00	403,066.45	140,563.08
	2050	(Little Bell)	....	....	....	....	....	....	4.49	579.75	60.95	....
		Voided leases	....	....	....	....	....	....	....	401.00	422.83	....
		Sundry claims	....	....	....	....	....	.39	6.32	359.50	339.41	....
Cuddingwarra	(2255)	Margaret	....	....	14.75	9.98	....	....	....	14.75	9.98	....
		Voided leases	....	....	....	....	....	10.59	132.46	102,020.41	56,131.93	100.71
		Sundry claims	....	....	586.25	303.17	....	18.46	379.49	9,408.39	5,472.67	9.00
Cue	2247	Victory	....	....	69.25	50.80	....	....	....	161.25	108.13	....
		Voided leases	....	....	....	....	....	202.71	911.60	288,796.44	221,102.80	69.11
		Sundry claims	....	....	935.50	341.80	....	252.92	894.70	43,396.24	19,604.33	....
Eelya	2241	Eaglehawk	....	....	....	....	....	....	....	81.00	16.63	....
		Voided leases	....	....	....	....	....	....	8.78	1,069.00	1,811.26	....
		Sundry claims	....	....	129.25	57.05	....	6.20	143.81	1,717.15	978.74	....
Mindoolah	....	Voided leases	....	....	....	....	....	3.07	2.54	9,380.28	5,672.31	42.97
		Sundry claims	....	....	....	....	....	....	29.30	3,130.60	2,301.25	....
Reedy	2253	Rand No. 3	....	....	2,155.50	1,077.18	....	....	....	2,488.50	1,186.20	....
	1977, etc.	Triton Gold Mines, N.L.	....	....	42,378.00	15,651.80	1,288·38	....	....	702,409.00	221,075.22	20,461.06
		Prior to transfer to present holders	....	....	....	....	....	....	....	16,338.50	7,471.50	5.00
		Voided leases	....	....	....	....	....	1.46	214.65	6,552.93	10,128.90	1.22
		Sundry claims	....	9·72	99.80	38.81	....	170.71	130.45	5,565.00	2,386.30	....
Tuckabianna	2237	Gidgie	....	....	183.75	117.57	....	....	....	2,603.65	1,011.53	....
	2244	Winston	....	....	54.25	17.67	....	....	198.46	125.25	57.80	....
		Voided leases	....	....	....	....	....	649.70	297.68	12,908.48	7,321.43	....
		Sundry claims	....	·91	52.25	28.35	....	143.17	481.47	4,612.85	2,577.14	....
Tuckanarra	(2079)	Batchelor	....	....	5.75	10.80	....	70.72	75.39	456.00	392.23	....
		Voided leases	....	....	....	....	....	14.65	3,435.71	19,034.00	22,436.76	172.77
		Sundry claims	....	19·38	6.25	49.20	....	115.23	789.31	9,904.55	10,254.69	....
Weld Range	2256	Never-Can-Tell	....	....	9.25	5.11	....	....	....	9.25	5.11	....
	(2252)	Peter	....	....	18.75	6.77	....	....	....	121.00	104.64	....
		Voided leases	....	....	....	....	....	....	23.64	1,593.75	834.35	....
		Sundry claims	....	....	13.00	1.53	....	....	3.90	1,364.00	1,110.38	....

From District Generally :—															
Sundry Parcels treated at :—															
State Battery, Cue			....	....	....	*501.76	....	....	....	76.25	*22,278.18	*110.22
State Battery, Tuckanarra (leased)			....	....	....	....	....	....	....	518.50	*5,535.57	....
Various Works			....	....	....	....	....	....	....	7,158.52	*29,387.81	*1,147.77
Reported by Banks and Gold Dealers			11·21	....	....	....	....	3,358.21	103.62	....	22.62	....
Totals			11·21	30·01	471,295.55	70,039.09	22,794.95	5,018.19	8,267.77	4,416,369.74	1,062,678.03	162,682.91

MEEKATHARRA DISTRICT.

Abbott's	....	Voided leases	....	....	....	....	....	....	26.45	36,841.35	38,775.28	....
		Sundry claims	....	....	41.75	17.65	....	....	5.29	3,720.77	2,266.62	....
Burnakura	1849N	New Alliance	....	....	....	....	....	....	....	132.25	114.39	....
		Voided leases	....	....	....	....	....	....	3,247.59	39,040.45	30,775.77	26.90
		Sundry claims	....	....	143.25	91.44	....	17.03	129.24	2,361.30	1,255.19	1.54
Chesterfield	....	Voided leases	....	....	....	....	....	29.02	420.32	6,875.26	7,500.57	.80
		Sundry claims	....	....	42.75	22.18	....	....	42.19	960.55	740.97	....
Gabanintha	1854N	Golden Star	....	....	....	....	....	....	....	290.50	268.46	....
	1896N	Mab	....	....	152.50	206.41	....	....	....	246.75	421.67	....
	1725N	New Brew	....	....	345.25	452.24	....	....	....	4,189.85	5,774.34	....
		Voided leases	....	....	....	....	....	11.79	28.82	23,826.75	14,039.87	815.57
		Sundry claims	....	....	116.25	82.63	....	16.78	158.94	4,180.25	2,575.51	....
Garden Gully	1927N	Sabbath	....	....	33.75	17.03	....	....	....	33.75	17.03	....
		Voided leases	....	....	....	....	....	26.36	74.91	30,238.32	21,847.71	1,102.59
		Sundry claims	....	11·23	....	....	....	....	18.74	2,905.44	1,695.15	....
Gum Creek	....	Voided leases	....	....	....	....	....	25.27	91.96	3,893.08	3,819.91	....
		Sundry claims	....	....	....	....	....	4.37	84.86	727.25	636.85	....
Holden's	1551N	New Waterloo	....	....	....	....	....	....	.99	1,468.00	918.92	....
		Voided leases	....	....	....	....	....	....	18.00	16,593.00	6,401.50	....
		Sundry claim	....	....	....	....	....	164.95	49.07	425.15	279.25	....
Jillawarra	1871N	Werribie	....	....	40.75	45.88	....	....	128.85	451.25	749.62	....
		Voided leases	....	....	....	....	....	....	1,134.68	1,548.55	2,815.78	....
		Sundry claims	....	....	36.25	24.78	....	173.02	150.04	440.75	403.14	....
Meeka Pools	....	Voided leases	....	....	....	....	....	....	....	111.58	82.27	....
		Sundry claims	....	....	....	....	....	....	2.84	233.57	205.38	....
Meekatharra	1861N	Adele May	....	....	....	....	....	....	....	24.00	28.00	....
	1922N	Albury Heath	....	....	40.50	46.53	....	....	....	40.50	46.53	....
	1855N	Commodore	....	....	50.00	41.61	....	....	....	1,065.25	369.45	....
	1553N	Consols North	....	....	....	....	....	....	....	659.75	1,359.33	....
	1571N	Coolgardie Brilliant, N.L.	....	....	875.00	237.84	....	....	....	875.00	237.84	....
	1571N	(Pharlap)	....	....	425.00	129.72	....	....	....	8,107.50	4,907.48	....
	1900N	Danube	....	....	261.50	27.74	....	....	....	368.75	73.09	....
	814N, 1894N	Fenian Leases	....	....	....	*117.49	....	....	....	329,406.69	261,729.70	....
	477N	Fenian	....	....	....	....	....	....	....	8,831.75	18,289.22	....
	1890N	Gold Jay	....	....	....	....	....	....	12.12	49.25	217.06	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MURCHISON GOLDFIELD—*continued.*

MEEKATHARRA DISTRICT—*continued.*

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1948.					TOTAL PRODUCTION.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Meekatharra—*contd.*	1893N	Halcyon	....	....	1,019.50	124.27	....	....	.78	3,133.75	474.97	....
	1888N	Haveluck	....	56.94	565.50	266.66	....	....	56.94	1,422.00	580.71	....
	1559N	Ingliston	....	6.52	17.50	27.04	....	....	498.32	1,798.30	1,623.79	....
	1542N	Ingliston Alberts	....	....	....	....	....	....	....	305.50	446.00	....
	1542N (1566N) (1575N)	(Ingliston Alberts Leases)	....	....	....	....	....	....	....	2,983.70	1,283.06	....
	1895N, etc.	Ingliston Consols Extended Leases	....	....	....	....	....	....	....	873,719.47	357,046.42	....
	475N	Prior to transfer to present holders	....	....	....	....	....	....	....	1,536.25	4,248.25	.30
	1920N	Ingliston South	....	....	259.75	268.57	....	....	....	259.75	268.57	....
	1547N	Lady Central	....	....	....	....	....	....	19.36	32.75	26.05	....
	1547N (1576N)	(Meekatharra Central Gold, N.L.)	....	....	....	....	....	....	5.29	4,842.25	2,463.30	....
	1547N (1576N)	Lady Central Leases	....	....	....	....	....	....	11.06	2,951.42	5,198.33	....
	1899N	Marmont	....	....	....	....	....	....	89.33	60,425.20	43,171.40	....
	1906N	Marmont Extended	....	....	....	....	....	....	....	1,748.95	1,813.96	....
	580N (888N)	(Marmont Extended Leases)	....	....	....	....	....	....	....	152.00	129.61	....
	1577N	Mopoke	....	....	....	....	....	....	12.47	1,338.25	820.16	....
	1860N	New Gwalia	....	....	....	....	....	....	....	544.50	127.40	....
	1529N	Prohibition	....	....	2,150.00	817.79	....	....	....	2,850.00	1,375.45	.04
	1529N, etc.	(Prohibition Gold Mining Co., N.L.)	....	....	....	....	....	....	....	24,844.25	4,978.31	11.83
	1529N	Prior to transfer to present holders	....	....	....	....	....	....	....	29,422.00	4,971.30	....
	(1909N)	United	....	1.28	....	....	....	....	1.28	....	....	....
		Voided leases	....	....	....	....	....	3.88	1,323.77	394,231.73	218,173.39	2,454.74
		Sundry claims	....	....	304.75	70.75	....	229.71	622.94	24,139.70	9,555.49	....
Mistletoe	....	Voided leases	....	....	....	....	....	4.15	1,000.24	417.00	486.21	....
		Sundry claims	....	....	....	....	....	119.14	71.85	19.75	2.03	....
Mt. Maitland	....	Voided leases	....	....	....	....	....	....	....	88.00	80.11	....
		Sundry claims	....	....	....	....	....	....	....	420.75	240.86	....
Munara Gully	....	Voided leases	....	....	....	....	....	....	....	13,283.50	6,559.93	....
		Sundry claims	....	....	....	....	....	....	34.23	1,009.75	373.74	....
Nannine	(1911N)	Bayley's Island Margaret	....	....	105.02	24.62	....	....	....	105.02	24.62	....
	1872N	Blue Pedro	....	....	928.40	209.36	....	....	....	8,571.40	1,961.01	....
	1580N	Caledonian	....	....	844.59	259.49	....	....	2.18	2,176.09	885.12	....
	1919N	Devils Dice	....	....	87.25	8.88	....	....	....	483.05	110.71	....
		Voided leases	....	....	....	....	....	37.25	826.58	113,302.32	72,373.24	167.45
		Sundry claims	....	3.09	....	....	....	120.08	1,248.76	6,109.43	4,658.63	....
Quinns	....	Voided leases	....	....	....	....	....	7.30	1,186.50	33,356.91	13,464.37	90.70
		Sundry claims	....	....	....	....	....	15.07	1,289.65	3,841.67	2,718.33	....

Ruby Well	....	Voided leases	....	....	....	....	....	....	....	43.46	7,461.00	4,046.70	....
		Sundry claims	....	....	....	....	....	1,015.87	409.39	520.25	629.60		....
Stake Well	....	Voided leases	....	....	....	....	....	....	200.12	21,362.00	9,566.18		....
		Sundry claims	....	....	....	....	....	31.91	34.73	1,003.60	584.54		....
Star of the East....	....	Voided leases	....	....	....	....	....	....	....	27,244.00	20,305.40		....
		Sundry claims	....	....	....	....	....	....	....	127.62	94.97		....
Yaloginda	1853N	Bluebird	....	....	285.00	28.70	....	....	....	4,287.00	1,247.91		....
	1898N	Rocklee	....	....	....	....	....	....	....	72.00	41.37		....
		Voided leases	....	....	....	....	....	19.03	1,972.23	28,103.54	14,567.99		8.68
		Sundry claims	....	....	62.25	10.32	....	61.89	647.51	10,315.42	4,861.13		....
	From District generally :—												
	Sundry Parcels treated at :												
	State Battery, Meekatharra		....	....	....	*554.91	....	....	....	88.50	*24,562.55		*19.00
	Meekatharra Sands Treatment and Mining, N.L.		....	....	....	*3,340.34	....	....	....	....	*3,482.01		....
	Various Works		....	....	....	....	....	....	....	172.75	*6,729.60		*342.17
	Reported by Banks and Gold Dealers		26.40	....	....	....	....	12,156.56	179.70	13.50	40.66		....
	Totals		**29.49**	**75.97**	**9,234.01**	**7,572.87**	....	**14,290.43**	**17,614.57**	**2,247,801.70**	**1,285,114.29**		**5,042.31**

DAY DAWN DISTRICT.

Day Dawn	(652D)	Creme D'or	....	....	....	....	....	....	....	252.00	181.21		....
	573D, etc.	Mountain View Gold, N.L.	....	....	1,394.60	5,798.12	12.63	....	....	1,394.60	5,798.12		12.63
	573D	Prior to transfer to present holders	....	....	....	....	....	....	94.05	10,060.78	32,623.97		....
	576D	New Fingall....	....	....	....	....	....	6.12	6.84	3,230.00	1,226.01		....
		Voided leases	....	....	....	....	....	160.64	826.65	1,921,704.61	1,225,385.07		169,210.44
		Sundry claims	....	....	196.50	85.26	....	96.42	508.85	12,899.26	6,392.94		....
Lake Austin	....	Voided leases	....	....	....	....	....	613.00	3,079.62	36,872.20	51,050.49		....
		Sundry claims	....	....	....	....	....	59.07	965.39	3,215.69	1,262.84		....
Mainland	....	Voided leases	....	....	....	....	....	.41	3,296.77	7,575.62	25,026.07		....
		Sundry claims	....	....	....	....	....	17.85	771.56	1,337.95	701.31		....
Pinnacles	....	Voided leases	....	....	....	....	....	4.90	1,213.68	18,117.00	9,869.29		....
		Sundry claims	....	50.17	20.00	13.59	....	62.93	496.67	4,295.92	1,656.81		....
	From District generally :—												
	Sundry Parcels treated at :												
	G. Arrigoni, L.T.T. 1078H		....	....	....	....	....	....	....	25.25	2.68		....
	Various Works		....	....	....	....	....	....	16.61	962.75	1,985.65		....
	Reported by Banks and Gold Dealers		59.32	....	....	....	....	2,130.57	37.30	....	12.57		....
	Totals		**59.32**	**50.17**	**1,611.10**	**5,896.97**	**12.63**	**3,151.91**	**11,314.09**	**2,021,943.63**	**1,363,175.03**		**169,223.97**

MOUNT MAGNET DISTRICT.

Jumbulyer	1410M	Gold Bug	....	1.45	186.50	34.70	....	....	1.45	329.00	177.54		....
		Voided leases	....	....	....	....	....	....	13.37	680.10	361.74		....
		Sundry claims	....	....	47.50	46.95	....	20.32	116.27	1,198.45	870.22		....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MURCHISON GOLDFIELD—*continued.*

MOUNT MAGNET DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Lennonville	1308M	Empress	....	....	25.00	42.06	....	....	....	460.00	167.30	....
	1379M	Galtee Moore	....	....	250.00	66.44	....	....	....	5,971.00	1,575.59	....
	1378M	Gambier Lass	....	....	....	....	....	....	5.85	419.00	101.26	....
	1446M	Piedmont	....	....	79.50	60.05	....	....	....	79.50	60.05	....
	1430M	Souvenir	....	....	99.50	129.39	....	....	....	366.50	551.35	....
		Voided leases	....	....	....	....	....	....	3,221.06	144,105.05	126,066.62	458.82
		Sundry claims	....	....	61.75	83.52	....	23.30	108.82	13,947.02	5,422.27	....
Mt. Magnet	1255M, etc.	Edward Carson Leases	....	....	....	....	....	....	....	17,890.50	12,783.83	7.00
	1286M	Evening Star	....	....	....	....	....	....	36.37	3,109.32	1,223.17	....
	1287M	Havelock	....	....	....	....	....	....	11.05	4,332.50	840.14	....
	1282M, etc.	Hill 50 Gold Mine, N.L.	....	....	50,771.00	13,416.79	268.52	....	....	419,323.90	121,427.22	1,209.02
	1246M	(Neptune)	....	....	....	19.30	....	....	829.41	8,787.65	4,122.61	.21
	1361M	Jupiter	....	....	100.00	88.95	....	....	.83	537.00	230.72	....
	1444M	Late Comer	....	....	100.00	72.69	....	....	....	100.00	72.69	....
	1447M	Morning Star	....	....	35.00	7.73	....	....	....	35.00	7.73	....
	1441M	Perseverance	....	....	284.00	31.04	....	....	....	407.00	43.94	....
	(1443M)	Rhoda	....	....	22.50	6.34	....	....	....	22.50	6.34	....
	1442M	Robins Nest	....	....	30.75	38.50	....	....	....	30.75	38.50	....
	1281M, etc.	Saturn Leases	....	....	71.75	139.60	....	....	101.24	37,484.75	5,910.64	....
	(1412M)	Swan Bitter Gold Mining Co., N.L.	....	....	....	3.86	....	....	18.02	14,112.45	5,305.65	.02
		Prior to transfer to present holders	....	....	....	....	....	....	320.21	6,081.25	3,180.61	....
	1322M	Three Boys	....	....	....	....	....	....	231.11	500.78	668.29	....
	(1445M)	Windbag	....	....	23.50	6.91	....	....	....	23.50	6.91	....
		Voided leases	....	....	....	....	....	29.26	9,104.68	771,885.16	296,257.95	851.37
		Sundry claims	....	....	487.00	195.14	....	122.27	2,626.24	58,594.45	28,950.13	4.49
Mt. Magnet East	....	Voided leases	....	....	....	....	....	63.29	764.53	5,522.28	2,811.75	....
		Sundry claims	....	....	....	....	....	....	37.22	418.25	428.29	....
Moyagee	1355M	Moyagee	....	....	....	*228.06	*22.20	....	....	2,621.25	5,106.19	375.25
	1355M (1398M)	Moyagee leases	....	....	....	....	....	....	....	4,641.00	5,489.13	382.52
		Voided leases	....	....	....	....	....	....	23.59	5,132.35	7,617.85	....
		Sundry claims	....	....	....	....	....	14.44	176.21	1,516.25	1,746.42	....
Paynesville	....	Voided leases	....	....	....	....	....	....	1,613.34	449.77	1,116.15	....
		Sundry claims	....	....	....	....	....	3.36	540.21	882.57	1,372.00	....
Winjangoo	....	Voided leases	....	....	....	....	....	.99	191.88	72.00	69.98	....
		Sundry claims	....	....	....	....	....	....	223.32	237.53	71.58	....

From District generally :—												
Sundry parcels treated at :												
State Battery, Boogardie	....	....	....	*4 4.01	....	....	....	125 26	*33,652 05	4.20
L.T.T. 1048H, B. Caratti, Cyanide Plant	....	....	....	....	....	....	....	3.00	30 38	....
Empress Battery	....	....	....	....	....	....	....	....	*36 98	....
Heine's Tailings Treatment Plant	....	....	....	*162.70	3.78	....	....	....	*162 70	3.78
Heine's Tailings Treatment Plant	....	....	....	....	....	....	....	....	*48 68	5.26
Welcome Cyanide Plant	....	....	....	....	....	....	....	10 00	*941.39	....
Various Works	....	....	....	....	....	....	....	43 06	*17,428.03	1.00
Reported by Banks and Gold Dealers	.18	....	....	....	....	2,259.25	88.43	8.00	64 95	.22
Totals	**.18**	**1.45**	**52,675 25**	**16,314 73**	**294.50**	**2,536.48**	**20,404.62**	**1,532,496.65**	**694,625 54**	**3,303.16**

Yalgoo Goldfield.

Bilberatha	....	Voided leases	....	....	....	....	....	1.27	90.94	3,384.50	1,845.05	....
		Sundry claims	....	....	....	....	....	....	6.64	3,075.05	1,401.56	....
Carlaminda	....	Voided leases	....	....	....	....	....	1.28	3.39	2,056.57	862.42	3.30
		Sundry claims	....	....	....	....	....	....	....	1,368.50	600.68	....
Field's Find	907	Brown's Reward	....	....	....	....	....	....	....	300.00	75.91	....
	907, etc.	Brown's Reward leases	....	....	....	....	....	....	....	4,540.55	3,800.16	....
	1119	Field's Find Central West	....	....	70.00	15.65	.80	....	....	121.00	29.65	.80
	1119 (1114)	Field's Find Central West leases	....	....	....	....	....	....	....	4,625.00	1,074.53	56.69
	1207	Rose Marie	....	....	24.00	16.16	....	....	....	201.67	153.38	....
		Voided leases	....	....	....	....	....	....	226.72	40,635.41	28,671.03	....
		Sundry claims	....	....	11.50	3.70	....	5.77	179.54	5,445.75	1,766.79	....
Goodingnow	1063	Ark	....	....	225.00	180.20	....	....	1.23	1,246.00	612.70	....
	1102	Astor	....	....	73.00	48.55	....	....	....	5,515.75	2,974.19	....
	1198	Aster South	....	....	....	....	....	....	....	498.50	114.17	....
	1025	Carnation	....	....	811.00	743.31	....	....	....	18,016.55	13,359.33	....
	1206	Orchid	....	....	....	....	....	....	....	157.50	33.74	....
	1145	Oversight	....	....	....	....	....	....	....	2,053.35	709.40	....
	1208	Oversight South	....	....	362.00	173.08	....	....	....	597.00	206.86	....
	1085	Sweet William	....	....	....	....	....	....	2.97	792.00	249.45	....
		Voided leases	....	....	....	....	....	146.70	277.66	49,369.06	46,525.98	....
		Sundry claims	....	....	....	....	....	152.96	169.70	10,082.25	5,080.62	....
Gullewa	1189	King Solomon's Mine	....	....	....	....	....	....	....	315.00	135.89	5.79
	1189	(King Solomon's Mines, Ltd.)	....	....	....	....	....	....	....	5,130.10	2,101.25	26.49
		Voided leases	....	....	....	....	....	....	19.05	34,468.50	18,729.37	81.42
		Sundry claims	....	....	....	....	....	....	170.45	4,391.25	1,918.24	....
Kirkalucka	....	Voided leases	....	....	....	....	....	....	....	61.25	45.10	....
		Sundry claims	....	....	....	....	....	....	17.79	257.30	126.29	....
Messenger's Patch	1197	Gnow's Nest	....	....	....	....	....	8.64	....	115.00	248.42	....
		Voided leases	....	....	....	....	....	....	349.71	39,721.51	28,314.92	1,083.01
		Sundry claims	....	....	9.75	4.97	.07	463.12	333.98	1,595.10	588.36	.07
Mt. Farmer	....	Voided leases	....	....	....	....	....	....	....	64.00	40.19	....
		Sundry claims	....	....	....	....	....	....	....	462.90	145.06	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

YALGOO GOLDFIELD—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Mt. Gibson	....	Voided leases	....	....	....	....	....	....	6.44	526.50	888.70	....
		Sundry claims	....	....	22.00	21.18	....	1.03	44.72	1,072.85	481.92	1.00
Ninghan	....	Voided leases	....	....	....	....	....	....	....	10.00	1.41	....
		Sundry claims	....	....	....	....	....	....	....	324.75	123.28	....
Noongal	1201	Hard-to-Find	....	....	....	....	....	....	....	114.00	111.83	....
	1203	Revival	....	....	....	....	....	....	....	80.00	132.93	4.04
		Voided leases	....	....	....	....	....	7.88	31.96	11,069.75	5,526.90	....
		Sundry claims	....	....	....	....	....	39.32	310.31	8,499.05	3,561.25	....
Nyounda	....	Voided leases	....	....	....	....	....	....	217.63	416.00	183.91	....
		Sundry claims	....	....	....	....	....	....	30.88	722.00	180.83	....
Pinyalling	1217	Broken Doll....	....	200.30	....	....	....	....	200.30	....	....	....
		Voided leases	....	....	....	....	....	....	93.80	2,296.35	959.50	....
		Sundry claims	....	....	6.50	89.26	....	3.13	134.09	1,463.00	844.00	....
Retaliation	....	Voided leases	....	....	....	....	....	....	....	5,089.25	1,872.98	....
		Sundry claims	....	....	....	....	....	....	....	778.25	304.71	....
Rothsay	....	Voided leases	....	....	....	....	....	....	24.06	40,680.75	10,775.84	....
		Sundry claims	....	....	....	....	....	....	.73	6,469.50	2,562.03	....
Wadgingara	....	Voided leases	....	....	....	....	....	....	....	691.11	650.63	....
		Sundry claims	....	....	....	....	....	....	....	2,131.30	559.83	....
Warda Warra	....	Voided leases	....	....	....	....	....	....	....	10,760.50	5,862.04	....
		Sundry claims	....	....	....	....	....	....	....	933.75	369.87	....
Warriedar	....	Voided leases	....	....	....	....	....	....	....	13,661.50	4,607.88	7.30
		Sundry claims	....	....	....	....	....	....	2.84	8,782.85	1,892.46	....
Yalgoo	....	Voided leases	....	....	....	....	....	....	3.23	6,314.50	9,965.18	....
		Sundry claims	....	....	7.50	11.56	....	....	23.56	2,622.75	1,010.02	....
Yuin	....	Voided leases	....	....	....	....	....	....	127.12	68,139.50	27,908.57	130.13
		Sundry claims	....	....	....	....	....	....	4.70	335.50	67.53	....
		From Goldfield generally :—										
		Sundry parcels treated at :										
		State Battery, Payne's Find	....	....	....	....	....	....	....	38.50	*4,529.92	....
		State Battery, Warriedar	....	....	....	....	....	....	....	....	*6,503.21	....

State Battery, Yalgoo	....	....	....	....	....	....	....	....	....	*1,193.63	....
P. W. Nevill's Cyanide Plant	....	....	....	*48.67	....	....	....	....	....	*291.65	*72.23
W. J. Green's Tailings Treatment Plant	....	....	....	....	....	....	....	....	....	*11.90	.94
Various Works	....	....	....	....	....	9.42	....	664.00	*3,021.45	*26.67
Reported by Banks and Gold Dealers	7.23	....	....	....	....	935.54	58.32	....	34.44	.11
Totals	**7.23**	**200.30**	**1,622.25**	**1,356.29**	**.87**	**1,776.06**	**3,164.46**	**435,351.63**	**259,532.92**	**1,499.99**

Mt. Margaret Goldfield.

MOUNT MORGANS DISTRICT.

Australia United....	Voided leases	....	....	....	....	....	....	1,911.63	15,913.69	23,305.76	1.76
	Sundry claims	....	....	....	....	....	....	580.98	1,307.50	2,227.65	....
Eucalyptus	Voided leases	....	....	....	....	....	....	2,878.56	1,603.85	3,251.01	....
	Sundry claims	....	....	....	....	....	....	588.28	2,129.30	1,973.15	....
Linden	522F .... Ailsa	....	....	....	....	....	....	....	1,025.00	525.35	....
	539F .... Democrat	....	1.19	724.50	1,241.15	....	....	1.19	3,946.25	6,770.46	....
	554F .... Devon	....	....	....	....	....	....	....	11.50	13.39	....
	553F .... Local Lady	....	....	769.00	1,407.95	....	....	....	1,354.00	2,109.47	....
	521F .... North Democrat	....	....	293.00	367.14	....	....	....	2,782.75	5,449.08	....
	529F .... Second Fortune	....	....	....	....	....	....	....	517.00	282.05	....
	Voided leases	....	....	....	....	....	7.53	565.78	60,096.31	48,051.10	.68
	Sundry claims	....	....	108.00	53.06	....	132.11	244.96	18,962.10	13,660.11	....
Mt. Margaret	M.A. 12F .... Mt. Margaret Mission Station	....	....	....	....	....	113.08	18.87	403.00	133.14	.09
	Voided leases	....	....	....	....	....	12.13	1.89	8,900.39	5,291.51	12.55
	Sundry claims	....	9·06	70.00	4.74	....	25.22	111.18	1,771.35	657.36	....
Mt. Morgans	511F, etc. .... Morgans Gold Mines, Ltd.	....	....	....	....	....	....	....	4,466.80	*13,776.04	....
	Prior to transfer to present holders	....	....	....	....	....	....	16.66	779,578.43	354,225.86	5,552.63
	550F .... Multi Millionaire	....	....	32.00	5.54	....	....	....	41.25	9.38	....
	547F .... Vodice	....	....	....	....	....	....	....	543.50	115.94	....
	Voided leases	....	....	....	....	....	17.95	148.79	60,689.50	34,638.22	77.86
	Sundry claims	....	....	33.50	12.08	....	36.41	395.41	4,889.82	3,271.83	....
Murrin Murrin	....	....	....	....	....	....	....	....	....	....	....
	Voided leases	....	....	....	....	....	10.43	231.35	136,940.22	104,029.97	29.60
	Sundry claims	....	....	63.75	9.76	....	51.15	557.24	6,425.33	4,432.98	....
Redcastle	557F .... Trixie	....	....	....	....	....	....	....	62.00	6.27	....
	Voided leases	....	....	....	....	....	4.49	436.54	4,107.20	4,043.41	....
	Sundry claims	....	....	....	....	....	....	113.84	1,133.57	636.03	....
Yundamindera	510F .... Landed At Last	....	....	....	....	....	....	....	4,332.00	683.02	....
	(558F) .... Spud Murphy	....	....	80.00	14.69	....	....	....	180.00	32.69	....
	Voided leases	....	....	....	....	....	....	110.93	73,973.85	49,178.64	5.82
	Sundry claims	....	....	65.00	38.69	....	3.01	271.93	6,474.35	4,733.14	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MT. MARGARET GOLDFIELD— *continued.*

MOUNT MORGANS DISTRICT—*continued.*

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1948.					TOTAL PRODUCTION.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
		From District Generally :—										
		Sundry Parcels treated at :—										
		L.T.T. 1065 H. McPheoson	....	....	....	....	....	....	....	....	.58	....
		Crocker's Plant, M.A. 14F	....	....	....	....	....	....	....	10.00	18.70	....
		Hill End Cyanide Plant, 482F	....	....	....	....	....	....	....	....	*556.95	....
		Rymers Cyanide Plant	....	....	....	....	....	....	....	....	*1,162.22	....
		Turbett's Cyanide Plant	....	....	....	....	....	....	....	....	*1,232.20	....
		State Battery, Linden	....	....	8.00	*551.26	....	....	9.16	293.29	*14,045.37	....
		Various Works	....	....	....	....	....	....	....	1,257.81	5,587.24	99.97
		Reported by Banks and Gold Dealers	22.81	....	....	....	....	2,955.54	141.84	10.30	95.75	.68
		Totals	**22.81**	**10.25**	**2,546.75**	**3,076.16**	....	**3,369.05**	**9,337.01**	**1,206,133.21**	**710,213.02**	**5,781.64**
		MOUNT MALCOLM DISTRICT.										
Cardinia	1808c	Inglewood	....	....	225.00	22.56	....	....	....	225.00	22.56	....
	1795c	Rangoon	....	....	....	....	....	....	6.49	250.00	118.60	....
		Voided leases	....	....	....	....	....	13.87	1,591.66	4,600.24	3,979.15	....
		Sundry claims	....	....	....	....	....	4.25	119.83	1,865.25	575.01	.66
Diorite	1786c	Puzzle	....	....	473.00	187.29	....	....	....	2,505.00	2,539.77	....
		Voided leases	....	....	....	....	....	....	945.65	36,103.03	32,335.98	33.18
		Sundry claims	....	....	8.00	4.88	....	11.21	329.32	4,623.80	4,427.56	....
Dodger's Well	....	Voided leases	....	....	....	....	....	....	57.90	1,373.30	1,936 52	....
		Sundry claims	....	....	....	....	....	.95	28.32	1,440.25	904.23	....
Lake Darlot	1823c	Billie	....	....	80.00	188.89	....	....	....	113.00	226.16	....
	1814c	British King	....	....	25.00	3.24	.33	....	....	25.00	3 24	.33
	1784c	British King, West	....	....	347.00	213.24	7.20	....	....	1,004.00	1,070 26	7.20
	1820c	The Dragon	....	....	358.00	160.48	....	....	....	673.00	398 82	....
	(1816c)	Zangbar	....	....	60.00	7.05	....	....	....	729.00	109 49	....
		Voided leases	....	....	....	....	....	....	4,482.18	68,021.46	49,995.88	.03
		Sundry claims	....	....	18.00	9.02	....	67.68	557.70	7,740.34	5,173 23	2.60
Leonora	1594c	Leonora Central G.M. Co., N.L.	....	....	....	....	....	....	....	8,621.00	853 23	....
	1788c	Little Gwalia	....	....	105.00	25.25	....	....	....	740.00	57 83	....
	1341c, etc.	Sons of Gwalia, Ltd.	....	....	60,093.00	18,139.26	1,512.16	....	....	5,314,130.53	2,167,525.29	152,868.26
		Prior to transfer to present holders	....	....	....	....	....	....	....	109,081.00	55,989.21	8.66
		Voided leases	....	....	....	....	....	....	1,866.86	166,178.00	89,768.33	94.57
		Sundry claims	....	....	162.00	79.99	....	37.73	351.39	17,916.25	11,519.88	....

Malcolm	....	Voided leases	....	....	....	....	....	11.65	47.07	62,656.53	47,563.43	....
		Sundry claims	....	....	19.50	5.24	....	5.75	33.39	4,348.97	2,661.32	.12
Mertondale	....	Voided leases	....	....	....	....	....	....	....	89,024.75	60,935.32	1,497.58
		Sundry claims	....	....	29.00	15.02	....	1.82	85.74	3,194.91	2,289.29	....
Mt. Clifford	....	Voided leases	....	....	....	....	....	....	1,623.35	9,556.96	16,492.17	....
		Sundry claims	....	....	11.00	6.58	....	53.98	351.65	5,534.70	3,481.75	....
Pig Well	....	Voided leases	....	....	....	....	....	....	....	13,587.32	14,676.58	63.68
		Sundry claims	....	....	....	....	....	....	34.61	2,896.65	1,225.46	....
Randwick	1794c	Mighty Splash	....	....	....	....	....	....	7.27	759.00	79.01	....
		Voided leases	....	....	....	....	....	....	239.49	10,141.65	9,653.78	....
		Sundry claims	....	....	....	....	....	66.57	164.02	2,488.64	1,307.45	....
Websters Find	....	Voided leases	....	....	....	....	....	30.30	....	22,167.50	14,377.65	....
		Sundry claims	....	....	....	....	....	36.84	695.68	2,356.15	1,530.56	....
Wilsons Creek	....	Voided leases	....	....	....	....	....	....	....	333.50	168.27	....
		Sundry claims	....	....	....	....	....	.70	4.24	316.00	261.12	....
Wilsons Patch	....	Voided leases	....	....	....	....	....	....	99.38	28,863.35	13,050.19	1.05
		Sundry claims	....	....	58.00	17.80	....	4.68	50.57	1,572.16	1,389.46	....
	From District Generally :—											
	Sundry Parcels treated at :—											
	State Battery, Darlot	....	....	....	*163.14	....	....	....	10.00	*537.13	....
	H. J. Maund, L.T.T. 1091H	....	....	....	....	....	....	....	....	*59.62	....
	H. J. Maund, L.T.T. 1012H	....	....	....	....	....	....	....	....	*90.67	....
	K. J. McPherson, L.T.T. 1044H	....	....	....	....	....	....	....	....	*89.29	*12.82
	Reefer Cyanide Plant	....	....	....	*74.10	....	....	....	20.00	*2,818.25	*22.38
	Various Works	....	....	....	....	....	....	....	789.50	*21,936.35	*123.15
	Reported by Banks and Gold Dealers	6.28	....	....	....	....	3,445.62	249.87	21.50	51.57	....
	Totals	**6.28**	....	**62,071.50**	**19,323·03**	**1,519.69**	**3,793.60**	**14,023.63**	**6,008,598.19**	**2,646,255.92**	**154,736.27**

MOUNT MARGARET DISTRICT.

Burtville	2446T	Boomerang	....	....	94.75	481.26	88.33	....	....	867.50	5,490.94	137.78
	2476T	Happy Find	....	....	207.50	1,039.93	49.83	2.60	....	643.00	2,241.83	49.83
	(2485T)	Karridale	....	....	11.25	13.90	....	....	....	152.25	68.93	....
	2480T	Mocking Bird	....	....	33.00	43.64	....	....	....	128.90	196.52	....
	2138T	Nil Desperandum	....	....	17.50	80.27	....	....	5.30	1,525.62	3,304.36	....
		Voided leases	....	....	....	....	....	2.29	413.80	68,990.93	104,704.63	275.27
		Sundry claims	....	....	24.50	39.30	....	2.65	208.27	7,225.91	5,382.37	....
Duketon	....	Voided leases	....	....	....	....	....	5.35	3,216.10	31,889.42	22,542.63	....
		Sundry claims	....	....	10.00	13.52	....	....	528.26	2,397.65	2,160.10	29.76
Eagle's Nest	....	Voided leases	....	....	....	....	....	....	145.34	534.50	1,238.22	....
		Sundry claims	....	12.77	5.25	3.67	....	24.07	487.05	1,046.35	360.11	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MT. MARGARET GOLDFIELD—*continued.*

MOUNT MARGARET DISTRICT—*continued.*

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1948.					TOTAL PRODUCTION.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.
Erlistoun	2141T	King of Creation G.M.'s Pty., Ltd.	....	....	....	....	....	....	....	6,358.00	1,288.92	11.00
		Prior to transfer to present holders	....	....	....	....	....	....	....	13,723.00	3,199.66	....
	2345T	Morgood	....	....	196.50	164.59	....	....	....	532.50	504.52	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	106,057.00	75,902.56	4,316.81
	2500T	Westralia	....	....	....	1.56	....	....	....	....	1.56	....
		Voided leases	....	....	....	....	....	10.07	393.41	29,885.15	20,409.38	....
		Sundry claims	....	....	30.00	13.59	....	1,181.65	148.23	5,464.59	3,715.76	....
Euro	....	Voided leases	....	....	....	....	....	....	65.14	91,821.50	37,678.25	....
		Sundry claims	....	....	....	....	....	4.87	73.04	1,308.50	793.54	....
Laverton	2216T	Beria Main Lode	....	....	....	....	....	....	4.74	6,550.35	1,516.89	....
	(2408T, etc.)	Gladiator Gold Mines Pty., Ltd.	....	....	....	....	....	....	....	103,538.00	25,979.51	....
	2245T, etc.	Lancefield Leases	....	....	2,265.25	732.23	....	....	....	8,596.25	2,026.66	....
	2245T	(Lancefield Extended, West)	....	....	....	....	....	....	....	881.25	846.77	....
	2489T	(Wedge)	....	....	....	....	....	....	....	222.00	21.19	....
	2478T	Lancefield, North	....	....	679.00	94.63	....	....	....	1,923.00	388.41	....
	2499T	Pinnacles	....	....	11.50	3.05	....	....	....	11.50	3.05	....
	T.L. 2T, 5T, etc.	United Gold Recoveries, Pty., Ltd.	....	....	....	*517.29	*376.34	....	....	....	*671.77	*423.46
		Voided leases	....	....	....	....	....	28.59	2,024.11	1,964,884.27	785,630.10	56,923.16
		Sundry claims	....	....	94.25	18.45	....	215.58	1,475.35	16,991.50	9,029.30	....
Mt. Barnicoat	....	Voided leases	....	....	....	....	....	....	23.08	1,788.50	654.65	....
		Sundry claims	....	....	50.25	140.34	....	....	.68	1,220.50	1,054.23	....
Mt. Shenton	....	Voided leases	....	....	....	....	....	....	....	15.00	26.65	....
		Sundry claims			....	....	....	....	....	279.25	209.67	....
	From District Generally :—											
	Sundry Parcels treated at :—											
	State Battery, Laverton		....	....	....	*362.81	....	....	....	97.50	*9,012.86	*15.64
	D. Cable's Cyanide Plant, L.T.T. 1067H		....	....	....	*16.13	....	....	....	....	*28.14	....
	D. Cable's Cyanide Plant, L.T.T. 978H, 979H....		....	....	....	*78.57	....	....	....	....	*1,335.70	....
	G. E. Grey's Cyanide Plant, L.T.T. 1029H		....	....	....	....	....	....	....	....	*5,555.28	.24
	J. Shepherd's Cyanide Plant, M.A. 23T		....	....	....	....	....	....	....	....	*99.55	....
	Various Works		....	....	....	....	....	....	....	159.50	*12,377.72	....
	Reported by Banks and Gold Dealers		....	....	....	....	....	2,507.63	108.08	....	26.76	....
	Totals		....	**12.77**	**3,730.50**	**3,858.73**	**514.50**	**3,985.35**	**9,319.98**	**2,477,710.64**	**1,147,679.65**	**62,182.95**

North Coolgardie Goldfield.

MENZIES DISTRICT.

Comet Vale	5719z	Coonega	....	....	....	....	....	....	....	8.00	5.21	....
	5732z	Central Coonega	....	....	....	....	....	....	....	58.00	15.03	....
	5476z	Sand Queen Gladsome Mines, N.L.	....	....	....	8.48	....	....	....	42,216.75	14,658.22	6.45
		Prior to transfer to present holders	....	....	....	....	....	....	....	75,754.50	59,007.25	1,505.65
		Voided leases	....	....	....	....	....	....	419.74	148,660.47	119,413.11	3,839.28
		Sundry claims	....	....	73.50	48.62	....	....	40.19	1,841.91	961.93	....
Goongarrie	5740z	Gull's Blow	....	....	85.00	70.10	....	....	....	85.00	70.10	....
	5735z	Pretty Easy	....	1.22	....	....	....	....	1.22	....	....	....
		Voided leases	....	....	....	....	....	.94	1,384.04	29,828.79	18,060.05	....
		Sundry claims	....	.71	111.50	96.99	....	46.46	2,054.17	2,591.27	3,048.20	....
Menzies	(5703z)	Aspacia	....	....	44.00	40.64	....	....	23.47	1,442.50	1,179.87	5.24
	5543z	Black Swan	....	....	....	....	....	....	....	982.63	1,619.74	9.08
	5736z	Bodington	....	2.82	20.00	40.95	....	....	2.82	20.00	40.95	....
	5694z	Dark Horse	....	....	....	....	....	....	....	83.00	293.76	....
	(5511z, etc.)	First Hit Gold Mines (1934), Ltd.	....	....	146.00	201.00	....	....	....	68,473.70	49,060.96	6,676.23
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,672.75	4,687.69	....
	5542z	Good Block Leases	....	....	19.00	41.78	....	....	7.32	1,491.00	2,319.67	....
	5714z	Lady Harriet North	....	....	....	....	....	....	....	21.00	4.01	....
	5549z	Lady Harriet	....	....	....	....	....	....	....	548.00	164.46	....
	5520z	Mignonette	....	....	....	....	....	....	....	453.50	336.89	....
	5741z	New Start	....	....	7.00	4.72	....	....	....	7.00	4·72	....
	5733z	Olive Branch	....	....	144.75	72.31	....	....	....	183.50	138.32	....
	5535z (5671z)	Woolgar Gold Mines, Ltd.	....	....	....	....	....	....	....	42.00	8.85	....
		Voided leases	....	....	....	....	....	45.42	1,101.94	932,585.50	724,289.76	13,581.15
		Sundry claims	....	3.28	296.50	310.16	....	49.50	597.55	31,997.94	24,579.82	776.49
Mt. Ida	5537z, etc.	Goldfields Aust. Develop. Co., Ltd.	....	....	900.00	668.04	63.45	....	....	12,682.00	7,208.07	332.63
	5537z	(Mt. Ida Gold Mines, Ltd.)	....	....	....	....	....	....	....	17,638.50	8,075.96	558.74
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,512.75	737.95	....
		Voided leases	....	....	....	....	....	....	92.21	68,731.17	72,679.14	106.63
		Sundry claims	....	16·66	....	....	....	48.14	339.91	15,805.41	8,056.73	.12
Twin Hills	....	Voided leases	....	....	....	....	....	....	....	582.30	574.93	....
		Sundry claims	....	....	....	....	....	....	....	97.80	86.69	....
	From District generally :—											
	Sundry Parcels treated at :											
	Lady Harriet Battery, M.A. 65z		....	....	....	*338.69	....	....	....	279.50	*17,505.08	*30.00
	State Battery, Mt. Ida		....	....	....	....	....	....	....	1,866.25	*6,829.04	....
	P W. Maher Cyanide Plant, L.T.T. 1100H		....	....	....	5.39	....	....	....	....	5.39	....
	Sanders Cyanide Plant, L.T.T. 1107H		....	....	....	*90.77	*114.58	....	....	....	*90.77	*114.58
	Sanders Cyanide Plant, L.T.T. 1043H		....	....	....	*44.24	*66.00	....	....	....	*215.46	301.67
	Yunndaga Sands Syndicate, L.T.T. 1035H		....	....	....	*7.94	....	....	....	....	*43.06	....
	Gold Tailings Ltd. Cyanide Plant		....	....	....	....	....	....	....	....	*345.87	5.84
	Various Works		....	....	....	....	....	....	....	2,512.30	*37,947.97	2,453.31
	Reported by Banks and Gold Dealers		3.15	....	....	....	....	1,439.64	382.80	35.00	7.72	....
	Totals		**3.15**	**24.69**	**1,847.25**	**2,140.82**	**244.03**	**1,630.10**	**6,447.38**	**1,462,791.69**	**1,184,378.40**	**30,303.09**

TABLE 1.—*Production of Gold and Silver from all sources, etc.*—continued

NORTH COOLGARDIE GOLDFIELD—*continued.*

ULARRING DISTRICT.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1948.					TOTAL PRODUCTION.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Davyhurst	1016U, 1085U....	New Gallion	....	....	....	....	....	....	....	5,293.30	2,002.37	119.67
	1136U	New Golden Pole	....	....	135.00	79.87	....	....	2.63	1,207.00	196.41	....
		Voided leases	....	....	....	....	....	2.93	150.01	165,536.32	125,804.71	5,408.47
		Sundry claims	....	44.33	154.00	42.50	....	....	208.48	13,309.44	5,612.88	....
Morleys	1101U	Emerald	....	....	....	....	....	....	26.24	674.00	1,188.88	....
	1094U	First Hit	....	....	127.00	224.68	....	....	....	1,120.25	3,330.96	....
	1081U	Mabel Gertrude	....	....	133.00	147.51	....	....	....	646.00	825.79	....
	1089U	Paramount	....	....	377.00	284.89	....	....	....	1,756.50	1,694.79	....
	1078U	Rabbit	....	....	200.50	177.94	....	....	265.66	574.50	1,057.42	....
	1074U	Two Chinamen	....	54.65	307.00	446.34	....	....	3,466.48	1,261.50	3,394.79	....
		Voided leases	....	....	....	....	....	....	122.80	484.50	775.48	....
		Sundry claims	....	....	10.50	2.47	....	2.16	932.23	1,515.25	2,361.74	....
Mulline	1107U	Ajax West	....	....	94.50	104.76	....	....	1.37	539.25	1,054.31	....
	1070U	Riverina	....	....	35.00	7.18	....	....	....	35.00	7.18	....
	(1069U), 1070U	(Riverina Gold Mines Pty., Ltd.)	....	....	....	....	....	....	....	32,085.50	11,669.45	.07
		Voided leases	....	....	....	....	....	....	274.09	102,630.22	103,358.09	530.75
		Sundry claims	....	....	22.00	14.11	....	10.82	198.67	10,550.89	8,667.03	1.10
Mulwarrie	1113U	Oakley	....	....	226.00	226.51	....	....	....	661.50	779.50	....
		Voided leases	....	....	....	....	....	....	165.29	19,480.68	26,369.21	38.47
		Sundry claims	....	....	....	....	....	.80	282.29	3,102.33	2,704.43	....
Ularring	....	Voided leases	....	....	....	....	....	....	563.34	9,771.60	13,907.76	....
		Sundry claims	....	....	....	....	....	....	....	671.50	309.48	....
	From District generally :—											
	Sundry Parcels treated at :											
	State Battery, Mulline		....	....	....	....	....	....	....	639.99	*16,459.89	....
	State Battery, Mulwarrie		....	....	....	....	....	....	....	613.18	*6,564.16	....
	E. Rowe, M.A. 13U		....	....	....	....	....	....	....	....	*21.65	....
	Waihi Battery, M.A. 14U		....	....	....	*40.25	....	....	....	5.00	*691.99	....
	Waihi-Golden Pole Cyanide Plants		....	....	....	....	....	....	....	....	*936.58	....
	Prior to Amalgamation		....	....	....	....	....	....	....	....	*5,032.24	....
	Various Works		....	....	....	....	....	....	15.82	233.15	*1,784.67	....
	Reported by Banks and Gold Dealers		.31	....	....	....	....	111.82	63.08	100.00	22.67	....
	Totals		**.31**	**98.98**	**1,821.50**	**1,799.01**	....	**128.53**	**6,738.48**	**374,498.35**	**348,586.51**	**6,098.53**

NIAGARA DISTRICT.

Desdemona	....	Voided leases	....	....	....	....	....	....	7.12	9,809.00	7,555.81	12.04
		Sundry claims	....	....	....	....	....	....	8.99	2,225.45	892.48	....
Kookynie	928G	Altona	....	....	349.50	388.42	....	....	....	349.50	388.42	....
	911G	Cosmopolitan South	....	....	207.00	121.93	....	....	....	1,301.00	624.09	....
	925G	New South Champion	....	....	60.00	103.35	....	....	....	150.00	217.04	....
		Voided leases	....	....	....	....	....	3.35	347.30	744,557.21	394,129.55	5,375.97
		Sundry claims	....	....	311.25	140.76	....	56.74	103.40	8,742.55	6,524.65	.18
Niagara	....	Voided leases	....	....	....	....	....	....	104.54	85,876.50	52,365.05	....
		Sundry claims	....	....	19.00	10.34	....	28.10	97.22	14,319.66	8,072.23	....
Tampa	902G	Grafter	....	....	....	....	....	....	....	192.00	20.30	....
		Voided leases	....	....	....	....	....	....	41.58	50,285.57	23,267.41	174.24
		Sundry claims	....	....	....	....	....	32.60	283.40	8,041.33	4,113.02	....
	From District generally :—											
	Sundry Parcels treated at :											
	Owen Bros. Plant, M.A. 65G	....	....	....	*31.91	....	....	....	....	....	*31.91	....
	Grafter Battery	....	....	....	....	....	....	....	....	....	*137.63	....
	Niagara State Battery	....	....	....	....	....	....	....	....	....	*10.08	....
	Various Works	....	....	....	....	....	....	....	....	1,220.50	16,226.67	41.17
	Reported by Banks and Gold Dealers	.98	....	....	....	....	1,591.58	823.66	....	63.53	....	
	Totals	**.98**	....	**946.75**	**796.71**	....	**1,712.37**	**1,817.21**	**927,070.27**	**514,639.87**	**5,603.60**	

YERILLA DISTRICT.

Edjudina	1011R, etc.	Paget Gold Mines of Edjudina, Ltd.	....	....	....	....	....	....	....	841.50	187.51	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	738.75	559.80	....
		Voided leases	....	....	....	....	....	....	18.44	33,943.45	42,627.48	37.79
		Sundry claims	....	....	25.00	12.76	....	....	26.89	6,873.58	4,788.93	....
Patricia	....	Voided leases	....	....	....	....	....	....	....	4,158.50	5,396.40	25.40
		Sundry claims	....	....	....	....	....	....	....	47.00	20.78	....
Pingin	....	Voided leases	....	....	....	....	....	....	48.34	17,463.30	10,742.77	....
		Sundry claims	....	....	....	....	....	....	154.86	5,623.59	3,466.70	....
Yarri	1320R	Margaret	....	....	124.00	42.95	....	....	....	196.00	60.55	....
	1126R, etc.	Porphyry (1939) G.M., N.L.	....	....	....	....	....	....	....	66,715.00	9,867.95	261.86
	1126R, etc.	Edjudina Gold Mining Co., N.L.	....	....	....	....	....	....	....	30,220.00	5,409.93	507.51
		Prior to transfer to present holders	....	....	....	....	....	....	....	124.50	38.89	....
	1319R	Valerie May	....	....	26.00	40.87	....	....	....	60.00	136.64	....
		Voided leases	....	....	....	....	....	6.30	87.08	44,196.75	21,056.75	2.00
		Sundry claims	....	....	720.00	146.53	....	.87	5.93	15,357.05	5,708.09	....
Yerilla	1321R	Yerilla King	....	....	....	....	....	....	....	319.50	192.20	....
		Voided leases	....	....	....	....	....	....	3,107.25	16,161.93	12,733.54	13.93
		Sundry claims	....	....	14.00	8.31	....	19.30	54.93	2,472.58	1,567.83	....
Yilgangie	1221R	Golden Hill	....	....	57.00	17.99	....	....	....	1,015.00	480.64	....
	(1323R)	Snowy	....	....	34.00	35.82	....	....	....	34.00	35.82	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

NORTH COOLGARDIE GOLDFIELD—*continued.*

YERILLA DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.
	1176R, etc.	Western Mining Corporation	....	....	753.00	716.07	....	....	....	1,399.75	1,162.96	....
		Prior to transfer to present holders	....	....	....	....	....	....	.85	1,244.75	1,830.28	....
		Voided leases	....	....	....	....	....	....	9.94	1,383.75	984.34	....
		Sundry claims	....	....	45.00	13.64	....	121.67	98.20	3,161.80	1,957.95	....
		From District Generally :—										
		Sundry Parcels treated at :—										
		State Battery, Yarri	....	....	....	*216.72	....	....	....	271.50	*7,713.36	3.50
		State Battery, Yerilla	....	....	....	....	....	....	....	....	*43.52	....
		Various Works	....	....	....	....	....	2.17	....	642.25	6,049.24	....
		Reported by Banks and Gold Dealers	....	....	....	....	....	1,161.37	160.08	....	4.11	....
		Totals	....	....	**1,798.00**	**1,251.66**	....	**1,311.68**	**3,772.79**	**254,935.78**	**144,824.96**	**851.99**

Broad Arrow Goldfield.

Bardoc	(2219w)	Gippslander	....	....	33.00	11.65	....	....	....	70.00	48.53	....
	2246w	Ora Munda	....	....	21.00	29.58	....	....	....	56.50	116.13	....
	(2241w)	Zoroastrian	....	....	....	2.10	....	....	....	472.00	40.60	....
		Voided leases	....	....	....	....	....	....	2,335.41	84,760.09	55,493.03	203.60
		Sundry claims	....	.66	825.50	122.47	....	54.95	1,194.11	15,615.53	7,802.11	....
Black Flag	2229w	Bellevue	....	....	60.00	27.23	....	....	37.54	201.50	191.41	....
		Voided leases	....	....	....	....	....	27.81	405.90	48,223.79	28,152.20	....
		Sundry claims	....	....	....	....	....	712.92	251.59	7,557.21	4,691.13	....
Broad Arrow	2039w	Golden Arrow	....	....	66.00	22.49	....	....	....	5,647.50	829.20	....
	2239w	Good Luck	....	....	8.00	15.77	....	....	9.33	73.50	92.43	....
	(1958w)	Grace Darling	....	1.15	285.75	122.26	....	....	4.70	4,434.75	2,862.28	....
	(2244w)	Highland Fling	....	5.09	60.25	35.46	....	....	131.25	60.25	40.41	....
	(2216w)	Kimra	....	....	62.50	8.13	....	....	....	1,131.25	1,287.09	....
	1771w	North Duke	....	....	....	....	....	....	1,670.51	236.80	634.35	....
	1933w	Oversight Tara United	....	....	....	....	....	....	1,147.01	860.29	919.45	....
		Voided leases	....	....	....	....	....	70.32	7,489.92	140,655.55	112,202.14	20.23
		Sundry claims	....	160.89	337.75	162.09	....	1,007.72	3,027.27	31,079.89	16,158.66	.11
Cane Grass	....	Voided leases	....	....	....	....	....	....	27.77	669.82	460.72	....
		Sundry claims	....	....	....	....	....	....	227.55	717.45	505.06	....

Carnage	....	Voided leases	....	....	....	....	....	176.04	659.31	2,402.00	2,170.67	....
		Sundry Claims	....	....	48.75	5.50	....	....	6.61	1,840.08	874.56	....
Cashmans	....	Voided leases	....	....	....	....	....	67.51	813.76	8,172.15	7,090.91	....
		Sundry claims	....	.76	38.25	8.41	.05	....	40.31	1,035.52	322.16	.05
Christmas Reef	2175w	New Mexico	....	....	172.50	649.59	....	....	....	786.85	1,999.45	....
		Voided leases	....	....	....	....	....	....	29.68	794.77	216.24	....
		Sundry claims	....	....	....	....	....	....	307.15	2,792.39	2,593.52	....
Fenbark	2188w	Golden Penny	....	....	173.25	86.64	....	....	....	2,568.00	524.39	....
	2228w	New Fenbark	....	....	201.50	52.35	....	....	....	389.00	86.11	....
		Voided leases	....	....	....	....	....	....	4.42	3,319.50	1,959.75	....
		Sundry claims	....	....	....	....	....	....	51.96	2,702.52	951.92	....
Grants Patch	2242w	Lady Agnes	....	....	316.75	106.44	....	....	2.11	582.00	208.81	....
	2227w	Magpie	....	...	46.00	97.01	....	....	....	341.50	517.04	....
	1962w, etc.	Ora Banda Amalgamated Mines, N.L.	....	....	....	261.02	....	....	....	167,562.00	62,289.02	175.00
		Prior to transfer to present holders			....	....	....	....	....	12,424.50	9,540.07	....
	2208w	Wentworth	....	....	196.25	90.75	....	....	....	1,187.50	390.03	....
	2224w	Whip Pole	....	...	263.25	150.77	....	....	....	390.00	214.61	....
		Voided leases	....	....	....	....	....	....	258.52	14,783.10	4,672.25	....
		Sundry claims	....	....	79.25	61.70	....	....	356.66	5,604.79	2,843.47	....
Ora Banda	(1336w, etc.)	Associated Northern Ora Banda, N.L.	....	....	4.75	16.40	6.40	....	....	2,732.25	435.48	11.27
		Prior to transfer to present holders	....	....	....	....	....	....	....	315,958.95	123,252.22	1,664.70
	1943w, etc.	Ora Banda United Mines, Ltd.	....	....	....	....	....	....	....	2,182.25	74.80	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	76,612.22	14,630.93	....
		Voided leases	....	....	....	....	....	....	845.72	24,580.60	12,604.69	....
		Sundry claims	....	....	77.25	18.65	....	....	336.76	12,412.25	4,200.52	....
Paddington	2122w	Pakeha	....	....	314.00	113.41	....	....	....	2,626.90	875.01	....
		Voided leases	....	....	....	....	....	5,566.30	463.31	189,669.41	84,534.17	18.96
		Sundry claims	....	....	90.00	45.12	....	1,714.16	291.43	16,018.98	9,032.01	....
Riches' Find	(2252w)	Old Venture	....	....	16.50	13.52	....	....	....	16.50	13.52	....
	(2250w)	Pamelia	....	....	22.25	25.97	....	....	....	22.25	25.97	....
	2257w	Yalbalro	....	....	34.50	107.93	....	....	....	34.50	107.93	....
		Voided leases	....	....	....	....	....	....	7.01	7,357.09	5,283.87	71.36
		Sundry claims	....	8.63	19.00	66.89	....	....	220.89	1,621.30	1,764.95	.13
Siberia	2248w	Beauty	....	....	34.50	135.23	....	....	....	53.00	217.34	....
		Voided leases	....	....	....	....	....	1.07	2,649.28	28,875.97	31,534.00	....
		Sundry claims	....	....	206.75	184.29	....	289.06	1,233.18	20,572.79	12,689.90	....
Smithfield	....	Voided leases	....	....	....	....	....	....	....	4,700·71	1,174·69	....
		Sundry claims	....	....	38.00	27.48	....	....	123.37	2,531.59	989.21	....
	From District Generally :—											
	Sundry Parcels treated at :—											
		State Battery, Ora Banda	....	....	....	*351.71	....	....	....	128.05	*19,203.66	....
		Brearleys Cyanide Plant	....	....	....	....	....	....	....	....	*23,74.39	*1,277.68
		P. Doherty, L.T.T. 1026H	....	....	....	....	....	....	....	71.00	2.79	....
		Golden Arrow Cyanide Plant	....	....	....	*245.09	....	....	....	36.00	*3,267.63	....
		Ora Banda Tailings Syndicate Retreatment Works	....	....	....	*5.93	....	....	....	....	*38.64	....
		T. J. Hennebury's Plant, L.T.T. 1015H	....	....	....	....	....	....	....	....	.26	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

BROAD ARROW GOLDFIELD—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Smithfield—*contd.*		Minnie Palmer Cyanide Plant	....	....	....	....	....	....	....	....	*3,082.62	....
		R. G. Oliver's Plant, L.T.T. 1014H	....	....	....	....	....	....	....	....	20.88	....
		Various Works	....	....	....	....	....	2,275.66	1.24	16,896.02	43,961.92	1,875.77
		Reported by Banks and Gold Dealers	22.27	....		....	....	9,963.11	131.39	61.68	90.35	....
		Totals	**22.27**	**177.18**	**4,153.00**	**3,487.03**	**6.45**	**21,926.63**	**26,793.93**	**1,297,974.10**	**707,476.26**	**5,268.86**

North-East Coolgardie Goldfield.

KANOWNA DISTRICT.

Gindalbie	1561x	Kurrajong	....	....	32.75	12.24	....	....	....	49.00	17.79	....
	1540x	Lady Betty	....	313.59	71.25	218.96	....	....	1,096.56	389.25	942.84	....
		Voided leases	....	....	....	....	....	....	19.94	44,077.78	39,512.90	38.31
		Sundry claims	....	....	41.50	15.78	....	....	716.52	4,914.27	2,787.84	....
Gordon	1568x	Mt. Eba	....	....	132.00	43.01	....	....	....	188.75	55.08	....
	1532x	Sirdar	....	....	....	*33.48	....	....	92.66	4,838.60	3,423.44	517.61
		Voided leases	....	....	....	....	....	....	589.88	48,723.78	16,562.53	....
		Sundry claims	....	....	....	....	....	....	177.38	2,044.45	1,170.95	....
Kalpini	....	Voided leases	....	....	....	....	....	....	38.73	13,543.50	6,753.78	.07
		Sundry claims	....	....	....	....	....	24.70	269.72	1,492.50	1,026.37	....
Kanowna	1564x	John Terence	....	....	36.25	54.56	....	....	....	61.25	105.38	....
	1569x	Kanowna Red Hill	....	....	262.50	117.16	....	....	4.35	321.25	136.65	....
	1566x	Lady Robinson	....	....	24.00	16.71	....	....	....	24.00	16.71	....
		Voided leases	....	....	....	....	....	24.94	4,511.34	684,992.35	380,159.53	2,482.24
		Sundry claims	....	....	190.50	63.65	....	118.94	2,154.37	24,779.27	11,350.08	1.50
Mulgarrie	....	Voided leases	....	....	....	....	....	....	1,216.63	6,902.26	4,197.98	....
		Sundry claims	....	....	....	....	....	....	16.78	1,261.75	631.40	....
Six Mile	....	Voided leases	....	....	....	....	....	....	1,603.72	559.00	767.72	....
		Sundry claims	....	....	....	....	....	....	54.14	739.25	225.56	....
		From District generally :—										
		Sundry parcels treated at :										
		Various Works			....	....	....	330.42	867.52	158,935.05	153,205.89	....
		Reported by Banks and Gold Dealers	15.36	....	....	3.41	....	105,992.52	36.91	.50	104.96	....
		Totals	**15.36**	**313.59**	**790.75**	**578.96**	....	**106,491.52**	**13,467.15**	**998,837.81**	**623,155.38**	**3,039.73**

KURNALPI DISTRICT.

Jubilee	....	Voided leases	....	....	....	....	....	....	....	145.13	2,122.50	1,465.16	....
		Sundry claims	....	....	....	....	....	25.57	13.52	1,219.25	511.63	....
Kurnalpi	....	Voided leases	....	....	....	....	....	371.18	3,166.80	4,052.51	3,957.71	6.27
		Sundry claims	....	....	....	....	....	324.12	727.39	4,305.36	2,089.90	....
Mulgabbie....	....	Voided leases	....	....	....	....	....	....	1,402.66	226.75	7,845.87	4.95
		Sundry claims	....	....	....	....	....	8.06	2,770.97	1,263.45	2,221.03	....
	From District generally :—											
	Sundry parcels treated at :											
	Various Works		....	....	....	....	....	....	....	101.50	388.63	....
	Reported by Banks and Gold Dealers		....	....	....	....	....	12,104.93	68.59	....	2.35	....
	Totals		....	....	....	....	....	**12,833.86**	**8,295.06**	**13,291.32**	**18,482.28**	**11.22**

East Coolgardie Goldfield.

EAST COOLGARDIE DISTRICT.

Binduli	6025E	Belle of Kalgoorlie	....	....	47.50	3.41	....	....	....	488.25	65.42	....
		Voided leases	....	....	....	....	....	....	....	803.10	385.19	....
		Sundry claims	....	....	62.25	25.49	....	....	13.01	4,875.02	1,656.67	....
Boorara	5486E	Olympian	....	....	61.50	59.20	....	....	....	1,603.75	927.45	3.01
		Voided leases	....	....	....	....	....	....	459.07	306,930.82	171,842.83	408.36
		Sundry claims	....	....	21.25	2.04	....	.49	145.56	2,806.34	1,410.05	....
Boulder	5465E	Birthday Gift	....	....	....	....	....	....	....	5,382.14	1,376.87	....
	6145E	Boomerang	....	....	77.00	8.00	....	....	....	77.00	8.00	....
	5690E	Boulder Perseverance, Ltd.	....	....	135,832.32	32,323.76	16,271.18	....	....	2,197,932.15	875,790.23	275,231.93
		Prior to transfer to present holders	....	....	....	....	....	....	....	3,306,942.88	1,841,159.00	203,821.43
	6077E	Brown Hill Consols	....	....	....	....	....	....	....	66.00	5.87	....
	5472E	Golden Key	....	....	17.25	6.06	....	18.27	22.78	432.25	165.02	....
	5159E, etc.	Gold Mines of Kalgoorlie, Ltd.	....	....	161,516.00	40,412.29	7,832.03	....	....	1,468,523.86	409,908.52	119,513.06
	5466E	(South Star)	....	....	....	....	....	....	233.46	4,237.43	1,494.78	....
	5466E	Prior to transfer to present holders	....	....	....	....	....	....	5.22	1,835.75	748.78	....
	5159E, etc.	(Lake View South (G.M.K.), Ltd.)	....	....	....	....	....	....	....	62,278.38	21,536.66	....
	5692E, etc.	Prior to transfer to present holders	....	....	....	....	....	....	545.23	527,790.53	568,643.05	4,844.50
	4366E, etc.	Great Boulder Pty. Gold Mines, Ltd....	....	....	326,685.00	81,457.03	47,538.72	....	1.53	8,775,436.97	4,961,982.26	949,844.75
	5845E	Happy Returns	....	....	....	....	....	....	....	446.00	112.82	....
	5345E, etc.	Kalgoorlie Enterprise Mines, Ltd.	....	....	53,883.87	16,692.19	1,366.66	....	....	600,857.00	186,685.04	18,227.69
		Prior to transfer to present holders	....	....	....	....	....	....	....	15,320.68	8,957.01	....
	4334E, etc.	Lake View & Star, Ltd.	....	....	502,534.00	137,500.42	19,911.21	....	....	8,253,679.30	2,728,709.34	220,345.94
		Prior to transfer to present holders	....	....	....	....	....	....	8.49	15792500.38	9,149,223.80	1,348,055.82
	5431E, etc.	North Kalgurli (1912), Ltd.	....	....	211,784.21	56,803.55	10,053.93	....	111.55	2,110,026.27	716,895.17	194,773.95
	5413E, etc.	North Kalgurli (1912), Ltd. Croesus										
		Pty. Group	....	....	....	....	....	....	51.20	90,159.00	19,261.22	....
	5891E	(New Croesus)	....	....	....	....	....	....	....	193.00	48.74	....
	5700E, etc.	Prior to transfer to present holders	....	....	....	....	....	43.99	....	4,018,436.01	2,815,911.21	97,625.03
	5429E, etc.	North Kalgurli United Mines, Ltd.	....	....	....	....	....	....	....	4,661.51	928.18	232.93
		Prior to transfer to present holders	....	....	....	....	....	....	....	131.74	76.74	....
	5853E, etc.	Paringa Junction North Leases	....	2.70	351.54	175.20	....	....	7.82	1,686.79	701.11	....
	5853E	(Paringa Junction)	....	....	....	....	....	....	....	123.75	17.77	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

EAST COOLGARDIE GOLDFIELD—*continued.*

EAST COOLGARDIE DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.
Boulder—*continued*	5854E	(Paringa Junction North)	....	....	....	....	....	....	....	60.50	10.64	....
	5855E	(Paringa Junction South)	....	....	....	....	....	....	....	1,473.25	228.42	....
	5434E, etc.	Paringa Mining and Exploration Co., Ltd.	....	....	100,641.74	22,507.97	2,445.39	....	....	931,156.55	223,965.24	16,650.77
		Prior to transfer to present holders	....	....	....	....	....	1.07	.79	57,618.03	24,452.83	....
	6095E	Raymond	....	....	46.50	11.79	....	....	....	115.50	17.89	....
	5695E, etc.	South Kalgurli Consolidated, Ltd.	....	....	77,395.09	19,037.32	80.86	....	....	2,640,671.76	1,019,339.79	25,866.58
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,344,254.70	531,792.77	17,722.97
		Voided leases	....	....	....	....	....	109.90	11,998.25	621,233.84	472,550.60	6.85
		Sundry claims	....	....	....	....	....	24.58	210.25	11,539.99	4,267.18	....
Cutters Luck	6056E	New Black Cat	....	12.69	13.25	18.53	....	45.87	112.75	44.25	221.84	....
		Voided leases	....	....	....	....	....	....	20.83	12.25	9.13	....
		Sundry claims	....	....	40.75	3.60	....	8.11	501.65	792.40	366.19	....
Feysville	....	Voided leases	....	....	....	....	....	....	110.93	561.30	394.24	....
		Sundry claims	....	....	....	....	....	....	199.00	1,117.10	620.09	....
Hampton Plains	P.P.L. 311	R. J. Beavis	....	....	993.75	89.23	....	....	....	993.75	89.23	....
	P.P.L. 1	Consolidated Gold Areas, N.L.	....	....	535.50	48.24	....	....	....	140,704.23	37,087.38	5,835.85
	P.P.L. 9	Consolidated Gold Areas, N.L.	....	....	....	....	....	....	....	215.75	4.27	....
	P.P.L. 86	Golden Hope, N.L.	....	....	....	....	....	....	....	5,964.00	2,006.14	....
	P.P.L. 192	Golden Hope North	....	....	....	....	....	....	....	353.00	201.02	....
	P.P.L. 177	Great Northern	....	....	....	....	....	....	....	29.75	5.36	....
	P.P.L. 12	Junction Extended	....	....	....	....	....	....	....	3,581.75	527.74	....
	P.P.L. 227	J. McGrath	....	....	....	....	....	....	....	215.75	47.87	....
	P.P.L. 252	Mount Martin	....	....	....	....	....	....	....	14,953.75	5,574.11	....
	P.P.L. 289	Mount Martin	....	....	....	....	....	....	....	....	*157.41	....
	P.P.L. 279	Mutooroo	....	....	....	....	....	....	....	6,151.88	1,087.26	....
	P.P.L. 175	F. C. Schoppe	....	....	392.50	42.92	....	....	....	392.50	42.92	....
	P.P.L. 277	New Hope	....	....	1,270.25	173.05	....	....	17.23	58,208.55	10,713.92	....
	P.P.L. 371	Victory	....	....	423.25	57.41	....	....	....	1,717.50	224.47	....
	P.P.L. 81	Villers Brettaneaux	....	....	....	....	....	....	....	3,562.02	1,435.55	....
		Voided leases	....	....	....	....	....	4,565.62	203.94	110,492.44	36,077.27	69.60
		Sundry claims	....	....	29.25	14.63	....	2.68	70.85	46,386.16	8,494.60	....
Kalgoorlie	5927E	A.I.F.	....	....	....	....	....	....	....	31.00	10.34	....
	6048E	Auld Acquaintance	....	....	....	....	....	....	....	7.50	2.36	....
	5519E, etc.	Barbican Corporation, Ltd. (Hannans Enterprise)	....	....	....	....	....	....	....	362.00	79.80	....

	5735E	Bonnie Lass....	....	....	....	....	....	....	....	250.50	74.67	....
	5449E, etc.	The Broken Hill Pty. Co., Ltd.	....	....	42,963.00	12,878.03	....	....	3.99	396,088.01	153,416.79	1,843.28
		Prior to transfer to present holders	....	....	....	....	....	....	....	1,558.49	316.58	....
	6046E	Colleen Bawn	....	....	103.50	12.16	....	....	....	516.00	83.76	....
	5867E	Concord	....	....	....	....	....	....	8.64	184.75	67.22	....
	5839E	Coronation	....	....	....	....	....	....	....	40.00	9.03	....
	5913E	Devon Consols	....	....	....	....	....	....	93.19	1,432.21	480.02	....
	5924E	Federal	....	....	....	....	....	....	....	36.25	4.51	....
	5737E	Golden Mile Channel	....	....	....	....	....	....	.97	2,631.25	204.76	....
	6019E	Golden Seam	....	....	....	....	....	....	....	201.00	161.16	....
	5904E	Great Patience	....	....	....	....	....	....	1.07	261.00	68.16	....
	6044E	Kapai....	....	....	....	....	....	....	....	51.00	4.55	....
	5878E	Lady May	....	....	....	....	....	....	62.05	2,615.00	683.85	....
	6091E	Lesanben	....	53.31	19.75	42.28	....	....	93.60	56.25	114.93	....
	6057E	Little Ray	....	....	....	....	....	....	....	96.75	16.25	....
	4547E, etc.	Mount Charlotte (Kalgoorlie) G.M's., Ltd.	....	....	....	....	....	....	....	1,234.00	252.17	....
		Prior to transfer to present holders	....	....	....	....	....	....	5.72	48,292.60	13,930.79	....
	5437E	North End Extended	....	....	11.50	7.15	....	....	996.89	367.85	528.94	....
	5468E	Phar Lap	....	....	13.50	3.49	....	....	....	487.50	352.57	....
	5415E, etc.	Return Leases	....	....	24.75	5.03	....	....	5.64	3,723.50	649.47	....
	5933E, etc.	Sceptre Leases	....	....	....	....	....	....	....	28.00	4.63	....
	5852E, etc.	Pedestal Leases	....	....	522.25	133.07	....	....	....	613.25	146.56	....
	6024E	(Trident)	....	....	....	....	....	....	....	58.75	36.67	....
	5852E	(Pedestal)	....	....	....	....	....	....	....	1,608.75	444.93	....
		Voided leases	....	....	....	....	....	242.48	9,558.67	963,443.20	397,427.64	44,017.12
		Sundry claims	....	....	88.75	16.89	....	232.41	1,122.17	59,185.04	22,949.75	....
Wombola	6051E	Big Bull	....	....	31.50	44.61	....	....	....	129.50	124.16	....
	5688E, 5967E	Caledonian Leases	....	....	159.00	61.17	....	....	....	308.00	137.33	....
	5688E	(Caledonian)	....	....	....	....	....	....	....	4,275.00	3,632.98	....
	5967E	(North Caledonian)	....	....	....	....	....	....	1.27	22.25	8.15	....
	5497E, 5500E	Daisy Leases	....	....	800.25	501.26	5.92	....	....	1,370.25	797.92	5.92
	5497E	(Daisy)	....	....	....	....	....	....	....	6,282.25	5,031.93	....
	5500E	(Happy-Go-Lucky)	....	....	....	....	....	....	....	2,075.25	1,675.85	....
	6032E	Dry Mount	....	....	134.00	210.47	....	....	....	411.50	779.90	....
	5962E	"G.D.N."	....	....	7.50	7.48	....	....	68.71	76.00	290.84	....
	4766E	Great Hope	....	....	....	1.29	....	....	....	28.00	6.75	....
	4766E	(Pericles Gold Mines, Ltd.)	....	....	....	....	....	....	358.11	4,728.03	19,305.86	....
	5525E, etc.	Haoma Leases	....	....	730.00	526.90	....	....	....	7,995.50	5,396.14	....
	5689E	(Haoma)	....	....	....	....	....	....	....	2,168.00	1,948.36	....
	5525E	(Xmas Flat)	....	....	....	....	....	....	....	330.25	264.74	....
	6043E	Launa Doone	....	....	384.00	144.55	....	....	....	534.50	259.42	....
	6043E, 5872E	(Launa Doone Leases)	....	....	....	....	....	....	....	32.50	42.76	....
	5872E	(Everley)	....	....	....	....	....	....	....	101.00	136.35	....
	5961E	Loganberry	....	....	....	....	....	....	....	288.25	101.02	....
	5798E	Maranoa	....	....	232.50	154.21	....	....	32.17	2,756.50	1,486.32	....
	5493E, 5616E	New Milano, N.L.	....	....	94.00	226.89	....	....	.25	17,390.75	11,622.24	479.00
	5493E	(Milano)	....	....	....	....	....	....	....	4,012.75	11,676.72	....
	5616E	(Leslie)	....	....	....	....	....	....	....	602.00	939.10	....
	6022E	Proprietary	....	....	....	....	....	....	....	469.75	423.90	....
	5866E	Rosemary	....	....	....	....	....	....	....	32.50	67.19	....
	6107E	Spinifex	....	....	83.00	35.48	....	....	....	83.00	35.48	....
		Voided leases	....	....	....	....	....	....	2,037.96	20,812.81	19,403.72	....
		Sundry claims	....	.21	353.00	308.48	....	....	711.10	21,643.18	13,487.76	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

EAST COOLGARDIE GOLDFIELD—*continued.*

EAST COOLGARDIE DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Dollied and Specimens. Fine ozs.	Ore treated. Tons (2,240 lb.).	Gold therefrom. Fine ozs.	Silver. Fine ozs.
Wombola—*contd.*		*From District generally :—*										
		Sundry claims	....	....	....	....	....	11,014.57	465.61	5,440.46	2,541.10	....
		Sundry Parcels treated at :										
		Zurich's Plant, L.T.T. 1099H	....	....	....	.54	....	....	....	....	.54	....
		Cavalier's Plant, L.T.T. 1092H	....	....	....	*118.63	....	....	....	10.50	*150.06	....
		Prior to transfer to present holders	....	....	....	....	....	....	....	....	*1,538.16	*1,507.65
		Golden Horseshoe (New), Ltd., T.L's. 101, etc.	....	....	....	*9,982.04	*15,501.10	....	....	....	*286,394.34	284,441.15
		Pericles Cyanide Plant	....	....	....	*237.43	....	....	....	....	*3,155.82	....
		Polkinghorne's Cyanide Plant	....	....	....	....	....	....	....	....	*149.38	....
		Poynton's Plant, M.A. 1	....	....	....	....	....	....	....	9.50	6.06	....
		State Battery, Kalgoorlie	....	....	7.50	*1,417.03	....	....	....	324.70	*23,608.74	*39.40
		Various Works	....	....	....	....	....	384.36	64.70	41,115.02	*264,204.51	*12,606.81
		Fox's Plant, L.T.T. 1084H	....	....	....	*6.60	....	....	....	....	*6.60	....
		Reported by Banks and Gold Dealers	56.59	....	....	432.17	....	16,751.37	9,956.00	355.65	3,937.70	....
		Totals	**56.59**	**68.91**	**1,621,418.77**	**434,988.66**	**121,007.00**	**33,445.77**	**40,699.87**	**55192914.75**	**28145947.43**	**3,844,021.33**
		BULONG DISTRICT.										
Balagundi	....	Voided leases	....	....	....	....	....	....	2,408.98	1,110.68	1,473.73	12.92
		Sundry claims	....	....	....	....	....	3.51	291.91	769.51	484.97	....
Bulong	1311Y	Blue Quartz	....	....	....	....	....	....	....	784.00	214.24	....
	(1315Y)	Lady Gwen	....	....	103.75	10.80	....	....	34.47	664.25	140.36	....
	1308Y	Southern Cross	....	....	515.25	89.65	....	....	1.30	2,449.75	417.70	....
		Voided leases	....	....	....	....	....	107.54	8,490.35	104,142.55	85,090.08	....
		Sundry claims	....	6.10	87.25	7.49	....	1,655.86	1,607.89	14,953.98	17,491.82	....
Majestic	....	Voided leases	....	....	....	....	....	19.45	63.91	1,317.94	647.62	....
		Sundry claims	....	....	17.50	2.77	....	42.88	154.58	1,926.55	948.06	....
Morelands	....	Sundry claims	....	....	90.75	13.83	....	....	.13	273.75	72.34	....
Mount Monger	....	Voided leases	....	....	....	....	....	....	2,771.39	1,437.85	1,256.10	....
		Sundry claims	....	....	....	....	....	215.60	....	379.05	308.48	....
Randalls	....	Voided leases	....	....	....	....	....	....	60.04	33,180.35	11,100.46	....
		Sundry claims	....	....	....	....	....	20.70	8.11	4,814.31	1,211.05	....
Taurus	....	Voided leases	....	....	....	....	....	2.06	3.70	1,765.10	909.84	....
		Sundry claims	....	....	....	....	....	112.69	51.88	2,608.35	1,037.88	....

Trans Find	P.P.L. 308A	Dawn of Hope	....	....	25.75	11.77	....	....	2.87	1,118.25	326.53	....
		Voided leases	....	....	....	....	....	....	....	983.92	865.71	....
		Sundry claims	....	....	....	....	....	....	5.93	795.25	330.72	....
		From District generally :—										
		Sundry Parcels treated at :										
		Various Works	....	....	....	....	....	....	....	6,102.15	*6,675.38	....
		Reported by Banks and Gold Dealers	....	....	....	....	....	25,198.12	70.15	.01	28.44	....
		Totals	....	**6.10**	**840.25**	**136.31**	....	**27,378.41**	**16,027.59**	**181,577.55**	**131,031.51**	**12.92**

Coolgardie Goldfield.

COOLGARDIE DISTRICT.

Bonnievale	5596, etc.	Coolgardie Gold Mines, Ltd.	....	....	82.50	73.86	.83	....	....	82.50	73.86	.83
	5596	(Jenny Wren)	....	32.22	41.00	51.22	....	....	182.45	989.30	1,165.40	4.17
	5622	Lucky Hit	....	....	87.75	62.28	....	....	....	841.25	406.30	....
	4600	Melva Maie	....	....	116.50	98.24	....	....	....	1,991.40	3,321.16	1.70
		Prior to transfer to present holders	....	....	....	....	....	....	....	614.50	1,099.21	11.63
	5767	Red Ridge	....	....	108.00	53.63	....	....	....	108.00	53.63	....
		Voided leases	....	....	....	....	....	....	30.03	352,675.34	188,804.77	....
		Sundry claims	....	2.60	23.25	35.60	....	....	161.29	6,232.43	4,595.51	....
Bullabulling	....	Voided leases	....	....	....	....	....	....	....	776.81	668.19	....
		Sundry claims	....	....	....	....	....	5.21	15.98	1,318.26	561.29	....
Burbanks	5605	Burbanks Deeps	....	....	....	....	....	....	....	103.00	53.46	....
	5443	New Gift	....	....	....	....	....	....	2.00	625.50	228.69	....
		Voided leases	....	....	....	....	....	14.90	372.17	415,756.21	304,615.58	521.06
		Sundry claims	....	....	124.75	49.50	....	55.05	477.11	14,828.85	8,647.19	....
Cave Rocks	5645	Gold Coin	....	....	2,021.00	419.84	....	....	....	2,657.50	578.05	....
	5665	Nornadeen	....	....	....	....	....	....	....	779.00	162.42	....
	5793	Two Cees	....	....	56.00	9.01	....	....	....	56.00	9.01	....
		Voided leases	....	....	....	....	....	....	....	2,302.05	588.18	....
		Sundry claims	....	....	363.50	153.75	....	....	50.00	4,223.90	1,015.48	....
Coolgardie	5679	Ada	....	....	....	....	....	....	....	1,130.25	107.11	....
	5822	Brilliant	....	....	40.00	4.85	....	....	....	40.00	4.85	....
	5637	Caledonia	....	....	....	....	....	....	7.30	2,558.25	488.26	....
	5245, etc.	Consolidated Gold Mines of Coolgardie, Ltd.	....	....	....	....	....	....	....	282,560.70	50,610.27	4,812.12
		Prior to transfer to present holders	....	....	....	....	....	....	4.55	1,946.35	547.45	3.22
	5653	Gleesons	....	....	....	....	....	....	....	1,925.00	922.37	....
	5686	Hillside	....	..	8.25	6.56	....	....	....	20.25	24.23	....
	5598	King Solomon	....	....	68.25	11.09	....	2.69	....	793.00	125.48	....
	5713	Lady Grace	....	....	33.50	13.11	....	....	....	162.75	198.32	....
	5643	Lloyd George South	....	....	....	....	....	....	....	....	10.25	....
	5743	Moya Jan	....	....	238.00	89.24	....	....	....	1,267.75	513.46	....
	5239, etc.	Phoenix Gold Mines Pty., Ltd.	....	....	12,865.00	4,224.78	....	....	....	240,385.00	66,719.54	2.54
		Prior to transfer to present holders	....	....	....	....	....	....	2.74	167.56	237.80	....
	(5754)	United	....	....	94.00	34.13	....	....	....	578.50	410.81	....
		Voided leases	....	....	....	....	....	1,299.02	4,660.89	572,574.43	327,076.78	.96
		Sundry claims	....	2.28	463.42	141.89	....	205.49	2,676.37	65,406.70	24,070.61	....

TABLE 1.—*Production of Gold and Silver from all sources, etc.*—continued.

COOLGARDIE GOLDFIELD—*continued.*

COOLGARDIE DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Eundynie	5624	Eundynie	....	....	....	4.79	....	....	....	54.00	76.35	....
		Voided leases	....	....	....	....	....	.92	16.09	31,697.20	16,423.28	1.75
		Sundry claims	....	....	....	....	....	....	10.18	658.19	314.69	....
Gitraltar	5723	Lloyd George	....	....	100.00	15.41	....	....	....	370.00	83.60	....
	5684	Winston Churchill	....	....	....	....	....	....	....	60.00	12.96	....
		Voided leases	....	....	....	....	....	....	33.97	38,592.63	20,097.49	....
		Sundry claims	....	....	92.25	27.76	....	1.39	50.76	3,035.95	1,308.27	....
Gnarlbine	....	Voided leases	....	....	....	....	....	....	13.95	2,731.75	1,341.60	....
		Sundry claims	....	....	....	....	....	....	4.90	1,186.10	504.18	....
Hampton Plains	P.P.L. 330	Barbara	....	....	....	....	....	....	....	2,157.75	1,655.63	....
	P.P.L. 361	Mistletoe	....	....	....	....	....	....	....	20.00	5.11	....
	P.P.L. 419	Chatanooka	....	....	....	....	....	....	....	749.25	214.00	1.10
	P.P.L. 338	Dry Hill	....	....	4.00	3.52	....	....	....	43.00	58.42	....
	P.P.L. 427	Easter Gift	....	....	....	....	....	....	....	21.75	3.04	....
	P.P.L. 119	Golden Eagle	....	....	....	....	....	....	7.63	2,807.59	2,548.42	....
	P.P.L. 348	Hampton Gold Mining Areas, Ltd.	....	....	....	....	....	....	....	43.75	4.69	....
	P.P.L. 348	Goldfields Australian Development Co., Ltd.	....	....	....	....	....	....	....	78.00	12.89	....
	P.P.L. 334, 448	Hampton Gold Mining Areas, Ltd.	....	....	....	....	....	....	....	1,538.25	453.60	....
	P.P.L. 454	Hampton Gold Mining Areas, Ltd.	....	....	....	....	....	....	....	48.75	7.53	....
	P.P.L. 435	Lady Jess	....	....	....	....	....	....	2.79	151.00	30.47	....
	P.P.L. 355	Lady Marie	....	....	....	....	....	....	....	373.25	109.58	....
	P.P.L. 319	Lady May	....	....	....	....	....	....	....	1,742.25	981.39	....
	P.P.L. 389	Lassie Come Home	....	....	....	....	....	....	....	30.00	6.54	....
	P.P.L. 315	Malvern Star	....	....	....	....	....	....	....	16.00	10.14	....
	P.P.L. 316	Surprise G.M.	....	....	....	....	....	....	....	7,189.00	3,425.59	....
	P.P.L. 436	May	....	....	....	....	....	....	....	4.50	1.35	....
	P.P.L. 429	Maureen Anne	....	....	....	....	....	....	....	14.75	2.15	....
	P.P.L. 328	Daniel Finn	....	....	....	....	....	....	....	19.75	11.18	....
	P.P.L. 437	Two Crows	....	....	....	....	....	....	....	15.00	5.57	....
		Voided leases	....	....	....	....	....	....	403.05	8,518.25	7,798.76	....
		Sundry claims	....	....	....	....	....	1.63	132.06	1,738.25	799.38	....
Higginsville	5647	Fair Play	....	....	3,234.00	254.99	....	....	....	12,668.00	2,091.75	....
	5293	Two Boys	....	....	....	*200.96	.01	....	....	460.00	*950.97	.01
	5293 (5526)	(Two Boys)	....	....	....	....	....	....	....	6,888.00	3,193.95	....
	5666	Wartime	....	....	....	....	....	....	26.28	64.00	75.43	.06
		Voided leases	....	....	....	....	....	....	347.65	38,077.35	17,363.06	159.44
		Sundry claims	....	37.78	....	....	....	....	187.25	3,638.23	1,920.14	....

Larkinville	5667	Ground Lark	....	....	39.00	12.02	....	....	7.96	236.25	58.40	....
		Voided leases	....	....	....	....	....	22.77	46.48	2,098.91	3,198.09	....
		Sundry claims	....	....	....	....	....	....	147.20	448.53	1,029.03	....
Logans	5324, etc.	Spargo's Reward Gold Mine (1935), N.L.	....	....	....	2.56	....	....	....	105,397.50	26,320.67	....
		Voided leases	....	....	....	....	....	....	....	1,263.31	607.26	....
		Sundry claims	....	....	110.00	9.00	....	....	128.95	1,881.35	888.61	....
Londonderry	5250	Vice Regal	....	....	281.50	42.30	.35	....	1.91	4,338.00	1,352.18	.35
		Voided leases	....	....	....	....	....	....	93.13	29,817.35	20,886.19	....
		Sundry claims	....	....	....	....	....	16.68	38.72	3,199.17	2,466.94	22.42
Mungari	5785	Repulse	....	....	806.25	91.19	....	....	....	1,137.50	126.65	....
		Voided leases	....	....	....	....	....	....	17.71	735.00	331.78	....
		Sundry claims	....	....	26.25	26.29	....	1.77	153.24	2,443.44	697.15	....
Paris	5311, 5500	Lister's Gold Mine	....	....	225.00	160.81	....	.88	....	5,280.00	3,489.96	75.95
	5311, etc.	(Lister's Gold Mine)	....	....	....	....	....	....	....	8,582.00	4,423.84	....
	5500	(Paris Central)	....	....	....	....	....	....	....	113.00	24.16	....
	5514	Paris	....	....	....	4.53	....	....	....	879.00	404.61	3·24
		Voided leases	....	....	....	....	....	....	4.30	463.00	209.47	....
		Sundry claims	....	....	....	....	....	....	....	2,104.25	515.32	....
Red Hill	....	Voided leases	....	....	....	....	....	14.87	1,551.81	40,797.40	31,070.65	....
		Sundry claims	....	....	58.50	8.94	....	15.29	90.33	1,403.02	724.13	....
Ryans Find	....	Voided leases	....	....	....	....	....	....	....	54.16	151.69	....
		Sundry claims	....	....	14.75	127.17	....	....	.44	116.44	355.83	....
St. Ives	5628, etc.	Ives Reward Leases	....	....	....	....	....	....	....	1,617.00	450.47	....
		Voided leases	....	....	....	....	....	63.34	146.87	37,701.46	15,756.31	....
		Sundry claims	....	....	80.00	11.86	....	211.25	944.85	4,158.56	1,453.58	....
Wannaway	....	Voided leases	....	....	....	....	....	....	28.61	1,831.95	1,465.70	....
		Sundry claims	....	2.37	43.50	54.78	....	....	193.79	1,297.82	1,270.40	....
Widgiemooltha	5794	Bluebird	....	53.26	8.00	9.22	....	....	53.26	8.00	9.22	....
	5663	Bobs	....	....	....	....	....	....	....	16.00	4.94	....
	5702	Cardiff Castle	....	....	160.05	44.98	....	....	....	1,735.05	436.63	....
	5451	Host Group	....	12.75	....	4.53	....	....	12.75	1,601.00	438.91	....
		Voided leases	....	....	....	....	....	9.42	1,114.94	20,848.70	11,364.28	.17
		Sundry claims	....	25.49	122.00	35.42	....	46.49	456.07	15,800.86	6,725.74	.07
	From District Generally :—											
	Sundry Parcels treated at :—											
	State Battery, Coolgardie	....	....	....	*910.13	....	....	....	771.01	*33,967.17	*9.65
	Aust. Machinery and Invest. Co., Ltd., Cyanide Plant	....	....	....	.96	....	....	....	....	* 3,044.44	*86.31
	Frank's Cyanide Plant	....	....	....	....	....	....	....	....	*1,343.17	....
	Ajax Treatment Plant	....	....	....	*10.57	....	....	....	....	*10.57	....
	Imperial Battery	....	....	....	....	....	....	....	26.00	*340.76	....
	Listers Cyanide Plant	....	....	....	....	....	....	....	....	*269.23	....
	Paris Central Cyanide Plant	....	....	....	....	....	....	....	....	*77.64	....
	Parry's Cyanide Plant	....	....	....	....	....	....	....	....	*23.77	....
	Widgiemooltha Cyanide Plant	....	....	....	....	....	....	....	....	*1,165.31	....
	Various Works	....	....	....	....	....	7.75	....	3,871.61	26,465.97	223.06
	Reported by Banks and Gold Dealers	38.91	1.22	....	8.25	.60	14,801.30	718.84	48.25	74.95	.60
	Totals	**38.91**	**169.97**	**22,239.72**	**7,615.52**	**1.79**	**16,798.11**	**15,831.60**	**2,450,101.63**	**1,278,109.29**	**5,942.41**

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

COOLGARDIE GOLDFIELD—*continued.*

KUNANALLING DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Carbine	970s	Carbine	....	....	....	....	....	....	....	13,820.00	7,047.96	....
	970s	(Carbine Leases)	....	....	....	....	....	....	687.98	51,991.86	39,862.25	....
		Voided leases	....	....	....	....	....	....	....	20,116.00	5,470.81	....
		Sundry claims	....	....	....	....	....	136.08	93.96	5,932.28	2,012.75	....
Chadwin	....	Voided leases	....	....	....	....	....	....	....	4,781.55	5,232.25	2.50
		Sundry claims	....	....	313.00	72.06	.25	14.28	78.02	5,672.55	2,828.85	.25
Dunnsville	1033s	Wealth of Nations	....	....	31.25	6.92	....	....	....	59.25	15.15	....
		Voided leases	....	....	....	....	....	....	828.58	17,489.60	8,642.30	....
		Sundry claims	....	13.18	24.50	134.08	....	3.35	1,034.08	2,558.06	1,932.45	....
Jourdie Hills	....	Voided leases	....	....	....	....	....	....	18.00	28,009.74	19,401.09	28.45
		Sundry claims	....	....	....	....	....	1.86	49.81	1,673.00	819.25	1.05
Kintore	(1028s)	Caint Ore	....	....	35.00	6.01	....	....	....	35.00	6.01	....
	(1026s)	Makalee	....	....	542.25	304.60	....	....	....	749.75	376.18	....
		Voided leases	....	....	....	....	....	18.70	169.33	54,044.64	39,197.31	677.88
		Sundry claims	....	....	306.75	116.50	....	111.91	102.70	3,657.13	2,293.62	....
Kunanalling	1024s	Kioro	....	....	172.75	120.85	....	....	....	491.45	305.11	....
	987s	Premier	....	....	12.00	26.60	....	.23	....	4,108.00	2,458.60	....
	987s, etc.	(Kunanalling Gold, N.L.)	....	....	....	....	....	....	....	6,482.50	5,440.77	....
		Prior to transfer to present holders			....	....	....	....	....	699.00	847.30	12.78
	988s	Premier North	....	....	....	....	....	....	....	410.00	288.08	....
	(1034s)	Victory	....	....	284.00	81.84	....	....	....	284.00	81.84	....
		Voided leases	....	....	....	....	....	85.90	1,734.92	117,678.66	91,323.50	27.99
		Sundry Claims	....	....	567.75	265.43	....	216.53	808.12	14,222.17	9,402.36	....
Kundana	....	Voided leases	....	....	....	....	....	....	....	465.00	68.12	....
		Sundry claims	....	....	....	....	....	....	....	431.50	50.37	....
		From District Generally :—										
		Sundry Parcels treated at :										
		Goldfields Aust. Development & Treatment Works	....	....	....	....	....	....	....	....	*548.07	....
		Various Works	....	....	....	....	....	42.23	....	1,782.26	*5,061.33	....
		Reported by Banks and Gold Dealers	·41	....	....	....	....	858.71	17.93	....	5.85	.49
		Totals	**·41**	**13·18**	**2,289.25**	**1.134.89**	**.25**	**1,489.78**	**5,623.43**	**357,635.95**	**251,019.53**	**751.39**

Yilgarn Goldfield.

Blackbornes	....	Voided leases	....	....	....	....	....	....	....	....	1,282.50	341.37	....
		Sundry claims	....	....	....	....	....	....	....	....	392.50	81.15	....
Bullfinch	3345, etc.	Copperhead	....	....	....	....	....	....	....	....	7,427.32	2,076.32	....
	3378, etc.	Copperhead Deeps	....	....	....	....	....	....	....	....	13,554.65	4,102.83	....
	3337, etc.	Easter Gift Leases	....	....	....	....	....	....	....	....	1,597.00	472.43	....
		Prior to transfer to present holders			....	....	....	....	48.03	3,594.26	1,169.82	....	
	3400	Frances May	....	....	....	....	....	....	7.74	8,683.55	3,341.69	....	
	3397	Goldfinch	....	....	32.00	9.89	....	....	6.73	6,488.03	2,643.99	....	
	3350	Rising Sun	....	....	....	....	....	....	2.30	37,059.53	10,837.80	....	
		Voided leases	....	....	....	....	....	....	10.14	490,361.07	185,489.03	27,958.41	
		Sundry claims	....	....	11.00	3.91	....	8.47	37.04	7,333.75	3,965.20	....	
Corinthian	3398, 3425	Corinthian Leases	....	....	....	....	....	....	....	3,081.83	1,770.09	....	
	3398	(Corinthian)	....	....	....	....	....	....	....	7,383.75	2,543.16	....	
	3425	(Corinthian, North)	....	....	....	....	....	....	....	3,951.00	1,934.78	....	
	4180	Deliverance	....	....	164.00	72.77	....	....	....	327.00	127.29	....	
		Voided leases	....	....	....	....	....	....	23.46	138,241.40	33,293.21	....	
		Sundry claims	....	2.00	....	....	....	....	2.68	1,088.35	640.61	....	
Eenuin	4020	Birthday	....	....	....	....	....	....	2.25	45.00	193.97	.01	
	4129	Birthday West	....	....	....	....	....	....	....	13.00	7.78	....	
	4130	Birthday West Extended	....	....	25.00	47.21	....	....	....	39.00	107.23	....	
	4042	Birthday South	....	....	....	....	....	....	1.03	15.00	50.50	....	
	4067	Lone Pine	....	....	30.00	6.09	....	....	....	191.75	55.92	....	
	3936	Newfield Central	....	....	37.00	75.97	....	....	....	343.00	526.82	....	
	3936	(Yellowdine Gold Areas, N.L.)	....	....	....	....	....	....	....	7,341.50	7,605.06	....	
		Voided leases	....	....	....	....	....	....	178.46	1,749.81	1,841.75	....	
		Sundry claims	....	....	16.00	5.54	....	2.50	73.97	2,367.60	1,654.51	....	
Evanston	3868, etc.	Evanston Gold, N.L.	....	....	....	93.93	....	....	....	12,333.20	5,358.12	....	
	3868	(Evanston)	....	....	....	....	....	....	....	48,125.30	25,848.30	10.14	
	3870	(Evanston East)	....	....	....	....	....	....	....	34.00	13.59	....	
	3888	(Goldies)	....	....	....	....	....	....	....	200.00	43.15	....	
	3895	(Blue Peter)....	....	....	....	....	....	....	....	1,288.00	285.84	....	
	3997	Gravel Pit	....	....	....	....	....	....	79.27	238.80	160.25	....	
		Voided leases	....	....	....	....	....	....	....	2,247.76	1,310.63	....	
		Sundry claims	....	....	....	....	....	4.98	....	583.35	148.67	....	
Forrestonia	....	Voided leases	....	....	....	....	....	....	....	1,185.00	298.15	....	
		Sundry claims	....	....	....	....	....	....	....	372.00	141.78	....	
Golden Valley	(3575), etc.	Great Bingin Leases	....	....	....	....	....	....	....	16,771.00	10,248.61	....	
	(3573)	(Marie's Find)	....	....	....	....	....	....	....	742.00	353.15	....	
	(3822)	(Queen Marie)	....	....	....	....	....	....	....	180.50	164.83	....	
	4173	Inspiration	....	....	20.00	27.75	....	....	....	79.00	128.21	....	
	3248	Radio Deeps	....	....	....	....	....	....	....	5,720.58	6,297.01	....	
	2994, etc.	Radio Leases	....	....	1,635.00	1,769.17	93.57	....	2.70	21,059.80	42,635.14	393.12	
	4242	Three Colors	....	....	12.00	12.64	....	....	....	12.00	12.64	....	
		Voided leases	....	....	....	....	....	....	36.34	13,099.84	11,424.59	10.99	
		Sundry claims	....	104.70	12.00	96.36	....	4.58	234.16	6,464.77	4,783.96	1.02	
Greenmount	....	Voided leases	....	....	....	....	....	45.99	21.62	125,022.64	31,575.09	944.50	
		Sundry claims	....	....	....	....	....	.46	4.27	2,976.58	788.58	....	

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

YILGARN GOLDFIELD—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.
Holleton	37PP	Brittania	....	....	111.00	90.45	....	....	....	616.00	731.58	....
	4169	Holleton East	....	....	....	....	....	....	....	160.00	31.36	.15
		Voided leases	....	....	....	....	....	....	9.33	44,700.25	13,037.52	34.53
		Sundry claims	....	....	....	....	....	....	3.75	3,464.05	923.78	.20
Hope's Hill	(4199)	Hope's Hill	....	....	87.00	10.12	....	....	....	87.00	10.12	....
	3414	Pilot	....	....	....	....	....	....	....	19,446.12	2,948.68	....
	4033	Queen Elizabeth	....	....	....	....	....	....	....	169.00	77.68	....
		Voided leases	....	....	....	....	....	....	74.78	132,361.55	36,369.69	1.00
		Sundry claims	....	....	25.00	6.40	....	18.67	44.35	4,456.02	1,393.40	....
Kennyville	(4136)	Leviathan	....	....	84.00	11.16	....	....	....	266.00	94.19	....
	(4056)	Rainbow	....	....	29.00	10.86	....	....	....	29.00	10.86	....
	3875	Victoria	....	....	102.00	41.43	....	....	....	4,305.00	974.36	.63
		Voided leases	....	....	....	....	....	....	18.76	55,581.63	21,520.61	.59
		Sundry claims	....	....	....	....	....	....	5.06	8,478.50	2,275.41	....
Koolyanobbing	(4190)	Roberts Find	....	.99	30.50	30.74	....	....	.99	61.00	88.49	....
		Voided leases	....	....	....	....	....	....	....	1,707.05	884.28	....
		Sundry claims	....	....	28.00	16.07	....	.26	1.21	656.10	329.20	....
Marvel Loch	4046	Banker	....	....	55.00	15.91	....	....	....	165.00	47.71	....
	3987, etc.	Burbidge Gold Mines, N.L.	....	....	23,115.00	2,089.23	....	....	....	127,537.00	11,919.93	....
	3987	(Grand National)	....	....	....	....	....	....	....	19,739.00	2,647.30	....
	4243	Christmas Gift	....	1.82	....	....	....	....	1.82	....	....	....
	3957	Comet	....	....	112.50	31.84	....	....	....	1,199.50	677.52	6.85
	13PP	Cricket	....	....	....	....	....	....	....	1,616.00	921.75	....
	4039	Cromwell	....	....	180.00	26.32	....	....	....	295.00	41.37	....
	3966	Donovan's Find	....	....	....	....	....	....	....	200.05	56.02	....
	3942, etc.	Edward's Reward Leases	....	....	4,598.00	1,813.72	....	....	....	30,254.50	14,030.94	....
	3942	Edward's Reward	....	....	....	....	....	....	....	2,080.00	2,016.32	....
	3943	(Sunshine)	....	....	....	....	....	....	....	3,866.00	2,384.79	....
	4034	Firelight	....	....	345.00	128.21	....	....	....	1,589.00	418.02	....
	3724	Frances Firniss	....	....	....	....	....	....	....	9,850.00	4,206.18	....
	3718	Kurrajong	....	....	....	....	....	....	....	9,221.00	3,271.73	....
	3914	May	....	....	....	....	....	....	....	145.00	45.86	....
	4073	Mountain King	....	....	....	....	....	....	....	205.00	60.96	....
	3970	Mountain Queen	....	....	....	....	....	....	....	661.00	382.37	....
	3390, etc.	N.G.M., Ltd.	....	....	301.72	57.70	1.50	....	....	4,369.22	409.06	2.00
		Prior to transfer to present holders	....	....	....	....	....	....	....	2,675.00	459.60	....
	4068	Try Again	....	....	58.00	10.21	....	....	....	1,618.00	519.20	....
	4035	Undaunted	....	....	10.00	3.32	....	....	....	752.00	95.51	....
		Voided leases	....	....	....	....	....	....	1,494.77	640,170.21	186,398.74	2,466.10
		Sundry claims	....	....	149.00	17.30	....	11.35	230.20	34,427.86	13,041.90	.02

Mt. Jackson	3418	Clamp's Central	....	....	460.00	255.38	....	....	....	611.00	362.52	....
	3418	(Mt. Jackson G.M's., N.L.)	....	....	....	....	....	....	....	8,416.50	6,940.41	6.34
	3449	Die Hardy	....	....	296.00	200.50	....	....	....	788.50	698.61	....
	(4209)	Dolly Pot	....	....	15.00	10.50	....	....	....	15.00	10.50	....
		Voided leases	....	....	....	....	....	....	180.85	44,979.78	31,421.16	2,307.43
		Sundry claims	....	....	288.00	75.05	....	6.44	52.87	10,683.95	4,789.85	70.74
Mt. Palmer	3544, etc.	Yellowdine Gold Development Pty., Ltd.	....	....	....	....	....	....	....	304,256.50	155,886.94	....
		Prior to transfers to present holders	....	....	....	....	....	....	....	1,564.65	2,540.71	....
		Voided leases	....	....	....	....	....	....	....	67.25	22.90	....
		Sundry claims	....	....	....	....	....	1,643.48	18.19	395.25	367.90	....
Mt. Rankin	3555	No Trumps	....	....	66.00	10.45	....	....	....	5,271.37	829.74	....
		Voided leases	....	....	....	....	....	3.84	5.20	496.00	122.17	....
		Sundry claims	....	....	....	....	....	....	....	491.00	117.59	....
Parker's Range	4191	Centipede	....	11.33	266.50	148.86	....	....	17.85	314.50	205.13	....
	4174	Constance Una	....	....	135.00	217.89	....	....	....	350.00	859.88	....
	4198	Maroomba	....	31.31	140.00	101.45	....	....	91.89	180.00	116.95	....
	4000	Olga	....	....	60.00	69.53	....	....	....	187.00	236.68	....
	4201	Scots Greys	....	....	193.00	33.24	....	....	....	193.00	33.68	....
		Voided leases	....	....	....	....	....	.42	149.33	59,496.35	29,302.93	26.40
		Sundry claims	....	6·36	176.00	43.20	....	6.59	278.07	11,149.80	4,939.88	.08
Southern Cross	4082	Day Dawn	....	....	36.00	4.66	....	....	....	86.00	9.16	....
	4004	Excelsior	....	....	31.00	3.25	....	....	....	1,430.00	322.98	....
	4018	Frasers	....	....	....	....	....	....	....	1,359.50	162.12	....
	3944	Nil Desperandum	....	....	....	....	....	....	....	1,533.00	216.77	....
	3444, etc.	Western Mining Corporation	....	....	568.00	92.63	....	....	....	568.00	92.63	....
	3444, etc.	(Three Boys' Gold Mines, Ltd.)	....	....	....	....	....	....	....	10,157.00	1,392.95	1.26
	3444	(Three Boys)	....	....	....	....	....	....	....	4,180.00	727.75	....
	3934	(Three Boys North)	....	....	....	....	....	....	....	106.00	14.66	....
	3981	(Three Kings)	....	....	....	....	....	....	....	104.00	10.01	....
	3444, etc.	(Yellowdine Options, N.L.)	....	....	....	....	....	....	....	8,074.25	2,000.29	....
		Voided leases	....	....	....	....	....	4.89	261.35	453,476.68	215,028.52	364.41
		Sundry claims	....	6·36	14.00	2.44	....	95.90	642.09	8,163.66	2,623.21	....
Westonia	(3308, etc.)	Edna May (W.A.) Amalgamated G.M's. N.L.	....	....	3,248.00	*2,713.83	138.85	....	....	145,400.00	*62,875.03	*5,072.49
		Prior to transfer to present holders	....	....	....	....	....	....	....	4,092.00	2,867.26	....
	4023	Greenfinch	....	....	110.00	39.13	....	....	....	600.65	472.27	....
		Voided leases	....	....	....	....	....	....	4.06	445,495.49	314,459.63	21.78
		Sundry claims	....	....	20.75	28.71	.45	9.51	64.96	3,882.16	2,517.58	.45
	From Goldfield generally :—											
	Sundry parcels treated at :											
	Butcher Bird Cyanide Plant, M.A. 43		....	....	....	*74.55	....	....	....	....	*132.91	....
	Centenary Cyanide Plant		....	....	....	....	....	....	....	....	*472.85	....
	Beckwith & Trembaths Cyanide Plant (L.T.T. 1034H)		....	....	....	*6.38	*.49	....	....	....	*30.82	*.49
	Copperhead Cyanide Plant		....	....	....	*336.82	....	....	....	....	*16,809.79	....
	Holleton Cyanide Plant		....	....	....	....	....	....	....	....	*691.34	*47.50
	Howlett's Cyanide Plant		....	....	....	....	....	....	....	110.00	*13,405.34	....
	T. W. Howlett's Cyanide Plant		....	....	....	*398.05	....	....	....	....	*1,141.53	*16.75
	Invermay Cyanide Plant		....	....	....	....	....	....	....	....	*608.49	*3.57
	Kurrajong Cyanide Plant		....	....	....	....	....	....	....	....	*409.57	....

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

YILGARN GOLDFIELD—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1948.					Total Production.				
			Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons. (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons. (2,240 lb.).	Fine ozs.	Fine ozs.
		A. Maifri's Plant, L.T.T. 1045H	....	....	....	....	....	....	....	20.00	4.34	....
		Pilot Cyanide Plant	....	....	....	....	....	....	....	30.00	*3,753.59	....
		Pringle's Cyanide Plant, L.T.T. 1039H	....	....	....	....	....	....	....	....	*26.43	....
		Queen Anne Treatment Works	....	....	....	....	....	....	....	....	*169.05	....
		Radio Deeps Cyanide Plant	....	....	....	....	....	....	....	....	*1,588.67	....
		Three Boys Cyanide Plant	....	....	....	*371.59	....	....	....	7.00	*2,645.45	....
		Wesley's Cyanide Plant	....	....	....	30.38	....	....	....	....	*1,251.05	....
		Various Works	....	....	....	....	....	....	....	161.28	*61.553.57	*36.54
		Reported by Banks and Gold Dealers	....	....	....	17.98	....	314.38	70.45	....	30.85	....
		Totals	....	**158·51**	**37,537.97**	**11,918.67**	**234.86**	**2,182.71**	**4,494.37**	**3,710,852.95**	**1,685,155.75**	**39,806.49**
					Dundas Goldfield.							
Buldania	....	Voided leases	....	....	....	....	....	....	3.02	846.05	708.99	....
		Sundry claims	....	....	....	....	....	....	39.25	1,324.27	861.36	.72
Dundas	....	Voided leases	....	....	....	....	....	1.88	28.02	6,103.48	2,545.38	155.02
		Sundry claims	....	....	64.50	8.39	....	.76	413.85	2,071.75	1,097.94	18.32
Norseman	1596	Abbotshall	....	....	....	....	....	....	....	2,511.45	1,096.71	754.37
	(1672)	Attlee	....	....	7.00	.31	....	....	....	7.00	.31	....
	1468	Bronzewing	....	....	370.50	208.01	....	....	33.89	3,254.25	2,156.05	143.88
	1617	Caesar	....	....	....	....	....	....	....	54.00	42.72	....
	1288, etc.	Central Norseman Gold Corp., N.L.	....	....	118,763.00	39,150.32	29,925.48	....	....	1,091,752.20	391,056.87	348,387.07
		Prior to transfer to present holders	....	....	....	....	....	....	1,663.32	69,819.83	47,892.08	16,508.85
	1421	Dundas Gold Mines, N.L.	....	....	869.00	436.76	191.96	....	....	3,669.75	2,164.51	441.81
	1421	(Empress Gold Mines, N.L.)	....	....	....	....	....	....	....	567.50	516.08	54.61
	1315, etc.	Norseman Gold Mines, N.L.	....	....	....	....	....	....	....	964,099.00	240,900.95	353,206.54
		Prior to transfer to present holders	....	....	....	....	....	....	....	20,657.00	3,909.60	4,981.00
	1422	Onkaparinga	....	....	....	....	....	....	....	624.75	1,178.29	110.42
	1468, 1422	(Bronzewing and Onkaparinga Amal. Leases)	....	....	....	....	....	....	....	843.00	1,396.98	3.62
	(1530)	Second Try	.94	....	....	....	.04	4.96	4.37	2,096.50	1,280.83	147.49
	1667, etc.	Sun Leases	....	....	....	....	....	....	....	764.00	608.82	47.78
	1624	Valhalla	....	....	95.50	32.97	1.93	....	....	547.25	386.63	20.23
		Voided leases	....	....	....	....	....	9.31	10,562.89	893,870.72	587,965.10	36,787.67
		Sundry claims	....	....	500.25	91.17	2.75	1,052.09	3,393.11	45,567.95	21,742.86	190.35
Peninsula	1616	Day Dawn	....	....	....	....	....	....	....	522.25	480.31	3.80
		Voided leases	....	....	....	....	....	....	24.29	9,062.64	5,620.42	8.40
		Sundry claims	....	....	....	....	....	....	....	217.25	119.32	.97

		From Goldfield generally :—											
		Sundry Parcels treated at :											
		J. D. Parker's Plant, L.T.T. 1108H	....	....	12.00	3.80	.07	....	....	12.00	3.80	.07
		L. C. Petersen's Plant, L.T.T. 1115H	....	....	18.75	2.55	....	....	....	18.75	2.55	....
		E. Jackson's Plant, L.T.T. 1116H	....	....	101.25	20.42	....	....	....	101.25	20.42	....
		Princess Royal Cyanide Plant	....	....	47.00	*118.76	*106.89	....	....	47.00	*118.76	*106.89
		(Princess Royal Plant), L.T.T. 1022H	....	....	....	....	....	....	....	....	*53.80	*40.79
		(Young and Prince Cyanide Plant), L.T.T. 456H	....	....	....	....	....	....	....	....	*1,949.04	*1,571.78
		State Battery, Norseman	....	....	....	....	....	....	....	405.39	*24,627.10	*1,050.37
		Various Works	....	....	....	....	....	....	54.52	483.14	*12,857.24	*844.36
		Reported by Banks and Gold Dealers	....	....	....	....	....	1,181.77	48.76	47.50	18.62	.70
		Totals	**.94**	....	**120,848.75**	**40,073.46**	**30,229.12**	**2,250.77**	**16,269.29**	**3,121,968.87**	**1,355,380.44**	**765,587.88**

Phillips River Goldfield.

Hatters Hill	....	Voided leases	....	....	....	....	....	....	4.38	1,499.55	1,182.75	....
		Sundry claims	....	....	....	....	....	74.91	21.69	5,225.60	2,720.90	26.09
Kundip	(249) (260)	Beryl Gold Mines, Ltd.	....	....	82.00	11.39	....	....	....	2,654.00	2,375.87	197.78
	263	Hillsborough	....	....	....	2.77	....	....	....	....	2.77	....
		Voided leases	....	....	....	....	....	113.28	556.17	82,212.58	58,208.67	3,811.03
		Sundry claims	....	....	....	....	....	90.27	73.02	6,434.68	1,951.87	54.65
Mt. Desmond	....	Voided leases	....	....	....	....	....	....	1.40	9.00	3,905.46	6,891.59
		Sundry claims	....	....	....	....	....	....	....	....	32.81	51.01
Ravensthorpe	....	Voided leases	....	....	....	....	....	....	141.80	24,723.55	26,070.94	4,384.07
		Sundry claims	....	....	....	....	....	163.96	7.68	7,261.57	3,195.67	41.12
West River	....	Voided leases	....	....	....	....	....	....	....	....	10.34	31.06
		Sundry claims	....	....	....	....	....	....	....	....	6.60	3.44
		From Goldfield generally :—										
		Sundry Parcels treated at :										
		Cordingup Copper Smelter	....	....	....	....	....	....	....	....	*16.74	*4.27
		Cordingup Cyanide Plant	....	....	....	....	....	....	....	....	*909.37	*4.36
		Floater Cyanide Plant	....	....	....	....	....	....	....	12.00	*245.95	....
		Daw and Toleman's Cyanide Plant	....	....	....	....	....	....	....	....	*342.19	....
		Kundip Cyanide Plant	....	....	....	....	....	....	....	15.00	*15.25	....
		Various Works	....	....	....	....	....	....	....	....	*1,932.66	*496.46
		Reported by Banks and Gold Dealers	....	....	....	....	....	164.69	12.14	....	....	....
		Totals	....	....	**82.00**	**14.16**	....	**607.11**	**818.28**	**130,047.53**	**103,126.81**	**15,996.93**

OUTSIDE PROCLAIMED GOLDFIELD.

Burracoppin	....	Voided leases	....	....	....	....	....	....	....	710.85	706.38	....
		Sundry claims	....	....	....	....	....	....	....	372.75	213.97	....
Donnybrook	....	Voided leases	....	....	....	....	....	23.24	....	1,613.30	816.23	....
		Sundry claims	....	.74	....	....	....	44.01	43.03	119.50	15.71	15.18
Jimperding	1P.P., Avon	Hillsdale	....	....	....	....	....	....	....	1,261.75	298.05	....
Roebourne	68H, etc.	Corderoy Mines, Ltd.	....	....	....	....	....	....	....	1,954.50	451.44	10.79
		Voided leases	....	....	....	....	....	177.74	93.21	19,975.11	221,05.90	1,258.16
		Sundry claims	....	....	266.00	84.47	9.95	48.42	92.26	1,862.85	1,082.73	111.63
		Reported by Banks and Gold Dealers	....	....	....	....	....	6,086.74	170.45	103.50	228.32	.11
		From State generally :—										
		Sundry Parcels treated at :										
		Fremantle Smelters, Ltd.	....	....	....	....	....	....	....	....	*1,879.08	1,109.06
		Various Works	....	....	....	....	....	....	....	27.00	7,233.06	30,417.57
		Sundry Specimens	....	....	....	....	....	4.24	56.85	....	....	....
		Voided Leases and Sundry Claims	.38	....	....	....	....	245.83	16.83	201.60	43.58	....
		Reported by Banks and Gold Dealers	9.14	4.14	....	14.53	....	1,076.68	882.57	....	294.38	59.99
		Totals	**9.52**	**4.88**	**266.00**	**99.00**	**9.95**	**7,706.90**	**1,355.20**	**28,202.71**	**35,368.83**	**32,982.49**

TABLE II

PRODUCTION OF GOLD AND SILVER FROM ALL SOURCES, SHOWING IN FINE OUNCES THE OUTPUT, AS REPORTED TO THE MINES DEPARTMENT DURING THE YEAR 1948.

Goldfield.	District.	DISTRICT.						GOLDFIELD.					
		Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.
		Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lb.).	Fine ozs.	Fine ozs.	Fine ozs.
Kimberley	... ...	....	....	....	....	....	....	70.20	425.30	....	....	495.50	12.64
West Kimberley ...	... ...	....	....	....	....	....	....	....	....	....	....	....	4,762.11
Pilbara	Marble Bar ...	55.24	2.39	4,843.95	3,790.40	3,848.03	44.71	146·01	232.00	11,172.95	8,150.49	8,528.50	72.35
	Nullagine ...	90.77	229.61	6,329.00	4,360.09	4,680.47	27.64						
Ashburton	... ...	....	....	....	....	....	....	.86	....	181.00	40.76	41.62	1,202.14
Gascoyne	... ...	....	....	....	....	....	....	....	....	....	....	....	....
Peak Hill	... ...	....	....	....	....	....	....	....	67.06	3,044.00	893.24	960.30	....
East Murchison ...	Lawlers ...	30.16	15.83	3,757.83	1,213.05	1,259.04	3.18						
	Wiluna ...	....	....	5,291.75	13,854.95	13,854.95	1,898.00	32.60	132.88	11,779.83	17,744.82	17,910.30	1,901.18
	Black Range ...	2.44	117.05	2,730.25	2,676.82	2,796.31	....						
Murchison	Cue	11.21	30.01	471,295.55	70,039.09	70,080.31	22,794.95						
	Meekatharra ...	29.49	75.97	9,234.01	7,572.87	7,678.33	....						
	Day Dawn ...	59.32	50.17	1,611.10	5,896.97	6,006.46	12.63	100.20	157.60	534,815.91	98,823·66	99,081.46	23,102.08
	Mt. Magnet ...	.18	1.45	52,675.25	15,314.73	15,316.36	294.50						
Yalgoo	... ...	....	....	....	....	....	....	7.23	200.30	1,622.25	1,356.29	1,563.82	.87
Mt. Margaret ...	Mt. Morgans ...	22.81	10.25	2,246.75	3,706.16	3,739.22	....						
	Mt. Malcolm ...	6.28	....	62,071.50	19,323.03	19,329.31	1,519.69	29.09	23.02	68,048.75	26,887.92	26,940.03	2,034.19
	Mt. Margaret...	....	12.77	3,730.50	3,858.73	3,871.50	514.50						
North Coolgardie ...	Menzies ...	3.15	24.69	1,847.25	2,140.82	2,168.66	244.03						
	Ularring ...	.31	98.98	1,821.50	1,799.01	1,898.30	....						
	Niagara ...	.98	....	946.75	796.71	797.69	....	4.44	123.67	6,413.50	5,988.20	6,116.31	244.03
	Yerilla ...	....	....	1,798.00	1,251.66	1,251.66	....						
Broad Arrow ...	... ...	....	....	....	....	....	....	22.27	177.18	4,153.00	3,487.03	3,686.48	6.45
N.E. Coolgardie ...	Kanowna ...	15.36	313.59	790.75	578.96	907.91	....	15.36	313.59	790.75	578.96	907.91	....
	Kurnalpi ...	....	....	....	....	....	....						
East Coolgardie ...	East Coolgardie	56.59	68.91	1,621,418.77	434,988.66	435,114.16	121,007.00	56.59	75.01	1,622,259.02	435,124.97	435,256.57	121,007.00
	Bulong ...	....	6.10	840.25	136.31	142.41	....						
Coolgardie	Coolgardie ...	38.91	169.97	22,239.72	7,615.52	7,824.40	1.79	39.32	183.15	24,528.97	8,750.41	8,972.88	2.04
	Kunanalling ...	.41	13.18	2,289.25	1,134.89	1,148.48	.25						
Yilgarn	... ...	....	....	....	....	....	....	....	158.51	37,537.97	11,918.67	12,077.18	234.86
Dundas	... ...	....	....	....	....	....	....	.94	....	120,848.75	40,073.46	40,074.40	30,229.12
Phillips River ...	... ...	....	....	....	....	....	....	....	....	82.00	14.16	14.16	....
Outside Proclaimed Goldfields ...		....	....	....	....	....	....	9.52	4.88	266.00	99.00	113.40	9.95
		....	....	....	....	....	....	**534.63**	**2,274.15**	**2,447,544.65**	**659,932.04**	**662,740.82**	**184,821.01**

TABLE III.

RETURN SHOWING TOTAL PRODUCTION REPORTED TO THE MINES DEPARTMENT, AND RESPECTIVE DISTRICTS AND GOLDFIELDS FROM WHENCE DERIVED, TO 31ST DECEMBER, 1948.

Goldfield.	District.	DISTRICT.						GOLDFIELD.					
		Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.	Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	Silver.
		Fine ozs.	Fine ozs.	Tons (2,240lb.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lb.).	Fine ozs.	Fine ozs.	Fine ozs.
Kimberley	... ...	....	....	....	....	....	....	8,390.51	758.68	22,589.40	17,118.56	26,267.75	107.78
West Kimberley ...	... ...	....	....	....	....	....	....	....	....	....	....	....	4,762.11
Pilbara	Marble Bar ...	14,950.78	4,416.59	297,643.42	301,076.44	320,443.81	809.40	24,780.30	5,833.77	397,401.00	404,888.61	435,502.68	878.93
	Nullagine ...	9,829.52	1,417.18	99,757.58	103,812.17	115,058.87	69.53						
Ashburton	... ...	....	....	....	....	....	....	9,261.27	479.40	6,166.25	2,579.49	12,320.16	9,385.82
Gascoyne	... ...	....	....	....	....	....	....	693.44	41.57	387.00	517.29	1,252.30	....
Peak Hill	... ...	....	....	....	....	....	....	3,374.41	5,229.86	619,354.93	295,406.89	304,011.16	2,311.33
East Murchison ...	Lawlers ...	6,891.23	2,295.10	2,008,656.42	821,252.83	830,439.16	26,282.82	8,748.70	21,797.05	12,603,613.48	3,634,673.87	3,665,219.62	58,109.66
	Wiluna ...	222.36	1,247.37	8,868,618.84	1,863,082.31	1,864,552.04	9,332.84						
	Black Range ...	1,635.11	18,254.58	1,726,338.22	950,338.73	970,228.42	22,494.00						
Murchison	Cue	5,018.19	8,267.77	4,416,369.74	1,062,678.03	1,075,963.99	162,682.91	24,997.01	57,601.05	10,218,611.72	4,405,592.89	4,488,190.95	340,251.45
	Meekatharra ...	14,290.43	17,614.57	2,247,801.70	1,285,114.29	1,317,019.29	5,042.31						
	Day Dawn ...	3,151.91	11,314.09	2,021,943.63	1,363,175.03	1,377,641.03	169,223.07						
	Mt. Magnet ...	2,536.48	20,404.62	1,532,496.65	694,625.54	717,566.64	3,303.16						
Yalgoo	... ...	....	....	....	....	....	....	1,776.06	3,164.46	435,351.63	259,532.92	264,473.44	1,499.99
Mt. Margaret ...	Mt. Morgans ...	3,369.05	9,337.01	1,206,133.21	710,213.02	722,919.08	5,781.64	11,148.00	32,680.62	9,692,442.04	4,504,148.59	4,547,977.21	222,700.86
	Mt. Malcolm ...	3,793.60	14,023.63	6,008,598.19	2,646,255.92	2,664,073.15	154,736.27						
	Mt. Margaret...	3,985.35	9,319.98	2,477,710.64	1,147,679.65	1,160,984.98	62,182.95						
North Coolgardie ...	Menzies ...	1,630.10	6,447.38	1,462,791.69	1,184,378.40	1,192,455.88	30,303.09	4,782.68	18,775.86	3,019,296.09	2,192,429.74	2,215,988.28	42,857.21
	Ularring ...	128.53	6,738.48	374,498.35	348,586.51	355,453.52	6,098.53						
	Niagara ...	1,712.37	1,817.21	927,070.27	514,639.87	518,169.45	5,603.60						
	Yerilla ...	1,311.68	3,772.79	254,935.78	144,824.96	149,909.43	851.99						
Broad Arrow ...	... ...	....	....	....	....	....	....	21,926.63	26,793.93	1,297,974.10	707,476.26	756,196.82	5,268.86
N.E. Coolgardie ...	Kanowna ...	106,491.52	13,467.15	998,837.81	623,155.38	743,114.05	3,039.73	119,325.38	21,762.21	1,012,129.13	641,637.66	782,725.25	3,050.95
	Kurnalpi ...	12,833.86	8,295.06	13,291.32	18,482.28	39,611.20	11.22						
East Coolgardie ...	East Coolgardie	33,445.77	40,699.87	55,192,914.75	28,145,947.43	28,220,093.07	3,844,021.33	60,824.18	56,727.46	55,374,492.30	28,276,978.94	28,394,530.58	3,844,034.25
	Bulong ...	27,378.41	16,027.59	181,577.55	131,031.51	174,437.51	12.92						
Coolgardie	Coolgardie ...	16,798.11	15,831.60	2,450,101.63	1,278,109.89	1,310,739.60	5,942.41	18,287.89	21,455.03	2,807,737.58	1,529,129.42	1,568,872.34	6,693.80
	Kunanalling ...	1,489.78	5,623.43	357,635.95	251,019.53	258,132.74	751.39						
Yilgarn	... ...	....	....	....	....	....	....	2,182.71	4,494.37	3,710,852.95	1,685,155.75	1,691,832.83	39,806.49
Dundas	... ...	....	....	....	....	....	....	2,250.77	16,269.29	3,121,968.87	1,355,380.44	1,373,900.50	765,587.88
Phillips River ...	... ...	....	....	....	....	....	....	607.11	818.28	130,047.53	103,126.81	104,552.20	15,996.93
Outside Proclaimed Goldfields ...		....	....	....	....	....	....	7,706.90	1,355.20	28,202.71	35,368.83	44,430.93	32,982.49
		....	....	....	....	....	....	**331,063.95**	**296,038.09**	**104,498,618.71**	**50,051,142.96**	**50,678,245.00**	**5,396,286.79**

TABLE IV.

TOTAL OUTPUT OF GOLD (BULLION AND CONCENTRATES ENTERED FOR EXPORT AND GOLD RECEIVED AT THE ROYAL MINT, PERTH), FROM 1ST JANUARY, 1886 TO 31st DECEMBER, 1948; SHOWING IN FINE OUNCES THE QUANTITY CREDITED TO THE RESPECTIVE GOLDFIELDS.

Year.	Export.	Mint.	Total.	Export.	Mint.	Total.
		KIMBERLEY.			PILBARA.	
	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.
Prior to 1945	22,422·06	13,505·63	35,927·69	147,847·19	325,148·89	472,996·08
1945	....	113·81	113·81	....	8,203·99	8,203·99
1946	....	168·08	168·08	2,671·75	10,536·27	13,208·02
1947	....	350·75	350·75	2,645·68	7,733·88	10,379·56
1948	....	438·32	438·32	1,864·05	4,630·05	6,494·10
Total	22,422·06	14,576·59	36,998·65	155,028·67	356,253·08	511,281·75
		(*a*) WEST PILBARA.			ASHBURTON.	
Prior to 1945	4,351·11	26,760·61	31,111·72	4,104·96	5,861·73	9,966·69
1945	....	....	....	....	53·36	53·36
1946	....	....	....	....	54·21	54·21
1947	....	....	....	....	150·76	150·76
1948	....	....	....	....	11·00	11·00
Total	4,351·11	26,760·61	31,111·72	4,104·96	6,131·06	10,236·02
		(*b*) GASCOYNE.			(*c*) PEAK HILL.	
Prior to 1945	304·55	1,063·89	1,368·44	41,102·76	203,048·10	244,150·86
1945	....	....	....	....	389·95	389·95
1946	....	4·28	4·28	....	949·93	949·93
1947	....	....	....	....	1,086·25	1,086·25
1948	....	....	....	....	847·41	847·41
Total	304·55	1,068·71	1,372·72	41,102·76	206,321·64	247,424·40
		EAST MURCHISON.			MURCHISON.	
Prior to 1945	255,141·50	2,899,519·65	3,154,661·15	1,573,715·33	2,932,484·98	4,506,200·31
1945	3,723·82	43,178·04	46,901·86	....	18,498·50	18,498·50
1946	97·59	29,563·16	29,660·75	248·07	39,065·42	39,313·49
1947	70·79	22,591·28	22,662·07	125·56	89,592·05	89,717·61
1948	5·33	16,546·16	16,551·49	726·92	99,099·78	99,826·70
Total	259,039·03	3,011,398·29	3,270,437·32	1,574,815·88	3,178,740·73	4,753,556·61
		(*d*) YALGOO.			(*e*) MT. MARGARET.	
Prior to 1945	13,573·15	190,191·27	203,764·42	692,154·51	3,609,437·00	4,301,591·51
1945	....	788·86	788·86	413·27	20,775·71	21,168·98
1946	20·97	608·95	629·92	569·82	28,775·41	29,345·23
1947	24·08	1,117·24	1,141·32	222·01	28,525·15	28,747·16
1948	17·77	1,177·31	1,195·08	683·02	22,691·66	23,374·68
Total	13,635·97	193,883·63	207,519·60	694,042·63	3,710,184·93	4,404,227·56
		(*f*) NORTH COOLGARDIE.			(*g*) BROAD ARROW.	
Prior to 1945	263,175·14	1,979,723·88	2,242,899·02	122,448·17	409,921·20	532,369·37
1945	48·62	4,792·75	4,841·37	1·33	976·11	977·44
1946	57·05	5,869·50	5,926·55	17·67	3,751·69	3,769·36
1947	18·31	6,744·87	6,763·18	79·39	7,704·06	7,783·45
1948	62·57	5,104·50	5,167·07	24·26	3,569·00	3,593·26
Total	263,361·69	2,002,235·50	2,265,597·19	122,570·82	425,922·06	548,492·88
		(*f*) NORTH-EAST COOLGARDIE.			(*f*) EAST COOLGARDIE.	
Prior to 1945	235,876·16	456,547·59	692,423·75	7,021,629·06	21,285,117·96	28,306,747·02
1945	....	235·28	235·28	513·14	319,060·21	319,573·35
1946	11·85	500·01	511·86	1,334·89	425,167·70	426,502·59
1947	....	827·76	827·76	1,253·91	462,611·28	463,865·19
1948	4·18	386·07	390·25	709·52	448,958·23	449,667·75
Total	235,892·19	458,496·71	694,388·90	7,025,440·52	22,940,915·38	29,966,355·90
		(*h*) COOLGARDIE.			YILGARN.	
Prior to 1945	662,852·55	1,158,998·73	1,821,851·28	219,043·52	1,482,255·47	1,701,298·99
1945	55·55	11,590·78	11,646·33	12·47	5,160·98	5,173·45
1946	48·49	13,817·57	13,866·06	322·25	9,525·64	9,487·89
1947	20·98	13,620·32	13,641·30	259·88	19,909·27	20,169·15
1948	54·14	8,070·99	8,125·13	268·15	10,529·09	10,797·24
Total	663,031·71	1,206,098·39	1,869,130·10	219,960·27	1,527,380·45	1,747,286·72
		(*i*) DUNDAS.			(*j*) PHILLIPS RIVER.	
Prior to 1945	169,305·44	1,159,357·44	1,328,662·88	40,602·39	62,516·92	103,119·31
1945	55·81	29,157·22	29,213·03	....	109·98	109·98
1946	424·24	41,801·85	42,226·09	4·52	22·13	26·65
1947	204·09	35,441·76	35,645·85	....	29·13	29·13
1948	65·92	37,609·08	37,675·00	....	28·44	28·44
Total	170,055·50	1,303,367·35	1,473,422·85	40,606·91	62,706·60	103,313·51
		(¶) DONNYBROOK.			OUTSIDE PROCLAIMED GOLDFIELDS.	
Prior to 1945	282·21	557·53	839·74	21,413·17	35,933·33	57,346·50
1945	....	....	....	205·37	455·81	661·18
1946	....	....	....	260·98	691·72	952·70
1947	....	....	....	295·41	630·48	925·89
1948	....	....	....	167·89	634·98	802·87
Total	282·21	557·73	839·74	22,342·82	38,346·32	60,689·14

(*a*) Prior to 1st May, 1898, included with Pilbara, and abolished 12th July, 1929. (*b*) Prior to March, 1899, included with Ashburton. (*c*) From 1st August, 1897. (*d*) Prior to 1st April, 1897, included with Murchison. (*e*) From 1st August, 1897. (*f*) Prior to 1st May, 1896, included with Coolgardie. (*g*) From 1st September, 1897. (*h*) Declared 5th April, 1894, to which date included with Yilgarn. (*i*) Prior to 1893, included with Yilgarn. (*j*) Prior to 1902, included in Outside Proclaimed Goldfields. ¶ Abolished 4th March, 1908.

TABLE V.

TOTAL OUTPUT OF GOLD BULLION, CONCENTRATES, ETC., ENTERED FOR EXPORT AND RECEIVED AT THE PERTH BRANCH OF THE ROYAL MINT.

FROM 1st JANUARY, 1886.

Year.	Export.	Mint.	Total.	Estimated Value.
	fine ozs.	fine ozs.	fine ozs.	£A.
1886	270·17	...	270·17	1,147
1887	4,359·37	...	4,359·37	18,518
1888	3,124·82	...	3,124·82	13,273
1889	13,859·52	...	13,859·52	58,871
1890	20,402·42	...	20,402·42	86,664
1891	27,116·14	...	27,116·14	115,182
1892	53,271·65	...	53,271·65	226,284
1893	99,202·50	...	99,202·50	421,385
1894	185,298·73	...	185,298·73	787,099
1895	207,110·20	...	207,110·20	879,749
1896	251,618·69	...	251,618·69	1,068,808
1897	603,846·44	...	603,846·44	2,564,977
1898	939,489·49	...	939,489·49	3,990,697
1899	1,283,360·25	187,244·41	1,470,604·66	6,246,732
1900	894,387·27	519,923·59	1,414,310·86	6,007,610
1901	923,686·96	779,729·56	1,703,416·52	7,235,654
1902	707,039·75	1,163,997·60	1,871,037·35	7,947,661
1903	833,685·78	1,231,115·62	2,064,801·40	8,770,719
1904	810,616·04	1,172,614·03	1,983,230·07	8,424,226
1905	655,089·88	1,300,226·00	1,955,315·88	8,305,654
1906	562,250·59	1,232,296·01	1,794,546·60	7,622,749
1907	431,803·14	1,265,750·45	1,697,553·59	7,210,750
1908	356,353·96	1,291,557·17	1,647,911·13	6,999,881
1909	386,370·58	1,208,898·83	1,595,269·41	6,776,274
1910	233,970·34	1,236,661·68	1,470,632·02	6,246,848
1911	160,422·28	1,210,445·24	1,370,867·52	5,823,075
1912	83,577·12	1,199,080·87	1,282,657·99	5,448,385
1913	86,255·13	1,227,788·15	1,314,043·28	5,581,701
1914	51,454·65	1,181,522·17	1,232,976·82	5,237,352
1915	17,340·47	1,192,771·23	1,210,111·70	5,140,228
1916	26,742·17	1,034,655·87	1,061,398·04	4,508,532
1917	9,022·49	961,294·67	970,317·16	4,121,646
1918	15,644·12	860,867·03	876,511·15	3,723,183
1919	6,445·89	727,619·90	734,065·79	3,618,509
1920	5,261·13	612,581·00	617,842·13	3,598,931
1921	7,170·74	546,559·92	553,730·66	2,942,526
1922	5,320·16	532,926·12	538,246·28	2,525,812
1923	5,933·82	498,577·59	504,511·41	2,232,186
1924	2,585·20	482,449·78	485,034·98	2,255,927
1925	3,910·59	437,341·56	441,252·15	1,874,320
1926	3,188·22	434,154·98	437,343·20	1,857,715
1927	3,359·10	404,993·41	408,352·51	1,734,572
1928	3,339·30	390,069·19	393,408·49	1,671,093
1929	3,037·12	374,138·96	377,176·08	1,602,142
1930	1,753·09	415,765·00	417,518·09	1,864,442
1931	1,726·66	508,845·36	510,572·02	2,998,137
1932	3,887·07	601,674·33	605,561·40	4,403,642
1933	2,446·97	634,760·40	637,207·37	4,886,254
1934	3,520·40	647,817·95	651,338·35	5,558,873
1935	9,868·71	639,180·38	649,049·09	5,702,149
1936	55,024·58	791,183·21	846,207·79	7,373,539
1937	71,646·91	928,999·84	1,000,646·75	8,743,755
1938	113,620·06	1,054,171·13	1,167,791·19	10,363,023
1939	98,739·88	1,115,497·76	1,214,237·64	11,842,964
1940	71,680·47	1,119,801·08	1,191,481·55	12,696,503
1941	65,925·94	1,043,391·96	1,109,317·90	11,851,445
1942	15,676·48	832,503·97	848,180·45	8,865,495
1943	6,408·34	540,067·08	546,475·42	5,710,669
1944	1,824·99	464,439·76	466,264·75	4.899 997
1945	5,029·38	463,521·34	468,550·72	5,010,541
1946	6,090·14	610,873·52	616,963·66	6,640,069
1947	5,220·09	698,666·29	703,886·38	7,575,574
1948	4,653·72	660,332·07	664,985·79	7,156,909
Total	11,532,338·26	40,671,345·02	52,203,683·49	297,669,227

	1947.	1948.
	£A	£A
Estimated total par value of above production	218,922,421	221,747,299
Premiums received on sales of gold during 1920–1924 and 1930–1948 (approximate)	71,589,897	75,922,128
Estimated Total	£A290,512,318	£A297,669,227
Gross estimated value of gold won (including £161,448, bonus paid under the Commonwealth Bounty Act, 1930)	£A290,673,766	£A297,830,675

TABLE VI.—MINERALS OTHER THAN GOLD.

GENERAL RETURN OF ORE AND MINERALS, OTHER THAN GOLD, SHOWING THE QUANTITY PRODUCED AND THE VALUE THEREOF AS REPORTED TO THE MINES DEPARTMENT FROM THE RESPECTIVE GOLDFIELDS AND MINERAL FIELDS, DURING 1948, AND PREVIOUS YEARS.

Period.	ALUNITE (POTASH).				ARSENIC.†	
	Yilgarn Goldfield.		Total.		East Murchison Goldfield (Wiluna District).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£
Prior to 1945	943·20	14,229	943·20	14,229	33,622·70	637,285
1945	1,358·80	23,902	1,358·80	23,902	1,989·00	41,771
1946	1,735·80	41,658	1,735·80	41,658	1,624·50	33,935
1947	1,724·70	41,212	1,724·70	41,212	§1,191·13	28,738
1948	1,778·30	49,430	1,778·30	49,430	214·00	4,494
Total	**7,540·80**	**170,431**	**7,540·80**	***170,626**	**38,641·33**	**746,223**

* Includes Alunite valued at £195 from State Generally. † By-product by Wiluna G.M's., Ltd. § Includes 1·13 tons Arsenic valued at £24 from Yilgarn Goldfield.

Period.	ANTIMONY.*								
	East Murchison Goldfield.			Pilbara Goldfield.			Total.		
	Conc.	Metal.	Value.	Conc.	Metal.	Value.	Conc.	Metal.	Value.
	tons.	tons.	£	tons.	tons.	£	tons.	tons.	£
Prior to 1945	7,282·26	3,564·86	143,317	70·69	30·96	1,358	†7,373·73	3,607·38	145,166
1945	....	....	....	....	....	....	....	....	....
1946	601·40	306·07	13,981	388·53	155·94	9,477	989·93	462·01	23,458
1947	....	....	....	281·78	117·82	9,622	§287·23	119·82	9,731
1948	....	....	....	114·16	41·90	3,582	114·16	41·90	3,582
Total	**7,883·66**	**3,870·93**	**157,298**	**855·16**	**346·62**	**24,039**	**8,765·05**	**4,231·11**	**181,937**

* By-product of Gold Mining. † Includes 20·78 tons Conc. containing 11·56 tons Metal valued at £491 from State Generally. § Includes 5·45 tons Conc. containing 2·00 tons Metal valued at £109 from State Generally.

Period.	ASBESTOS.							
	Ashburton Goldfield.		Pilbara Goldfield.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	10·10	959	1,226·91	56,006	*2,397·01	79,210	*3,634·02	136,175
1945	....	....	....	....	1,091·94	44,662	1,091·94	44,662
1946	....	....	....	....	†374·06	13,525	†374·06	13,525
1947	....	....	50	7	1,042·56	37,386	1,043·06	37,393
1948	....	....	....	....	962·85	37,761	962·85	37,761
Total	**10·10**	**959**	**1,227·41**	**56,013**	**5,868·42**	**212,544**	**7,105·93**	**269,516**

* Includes 4·75 tons valued at £20 from East Coolgardie Goldfield. † Includes 3·5 tons valued at £21 from East Coolgardie Goldfield.

Period.	BERYL ORE.										BARYTES.	
	Pilbara Goldfield.		Murchison Goldfield.		Coolgardie Goldfield.		State Generally.		Total.		North-East Coolgardie Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	775·64	22,940	21·53	824	28·71	946	86·12	2,538	912·00	27,248	....	....
1945	11·13	324	3·00	104	10·23	519	·25	6	33·61	953	....	....
1946	15·49	581	....	....	....	....	....	....	15·49	581	10·00	50
1947	16·04	513	....	....	28·85	1,012	....	....	44·89	1,525	....	....
1948	30·17	1,767	....	....	4·68	267	....	....	34·85	2,034	....	....
Total	**848·47**	**26,125**	**24·53**	**928**	**81·47**	**2,744**	**86·37**	**2,544**	**1,040·84**	**32,341**	**10·00**	**50**

TABLE VI.—*Minerals other than Gold*—continued.

Period.	KAOLIN.		BENTONITE.		BISMUTH.		CLAYS.					
	State Generally.		State Generally.		State Generally.		Collie Mineral Field.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value..	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	261·00	1,055	465·63	1,030	5,000·40	1,648	1,051·00	738	9,563·30	5,913	10,614·30	6,651
1945	54·00	270	50·00	120	506·00	152	....	....	2,318·00	1,154	2,318·00	1,154
1946	....	....	62·00	186	....	....	....	....	2,682·00	1,341	2,682·00	1,341
1947	581·00	310	44·75	134	....	....	....	....	6,277·50	6,064	6,277·50	6,064
1948	146·00	292	268·75	806	....	....	....	....	4,858·50	4,113	4,858·50	4,113
Total	**1,042·00**	**1,927**	**891·13**	**2,276**	**5,506·40**	**1,800**	**1,051·00**	**738**	**25,699·30**	**18,585**	**26,750·30**	**19,323**

Period.	COAL.		COPPER ORE.									
	Collie Coalfield.		West Kimberley Goldfield.		Pilbara Goldfield.				West Pilbara Goldfield.		Ashburton Goldfield.	
					Marble Bar District.		Nullagine District.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
ior to 1945	17201872·32	11793616	109·52	1,709	32·87	386	14·00	480	82,745·45	748,482	353·07	6,431
1945	543,362·55	572,895	....	....	....	....	....	....	....	....	....	....
1946	642,286·70	730,104	....	....	....	....	....	....	....	....	....	....
1947	730,506·32	840,249	....	....	....	....	....	....	....	....	....	....
1948	732,938·42	880,236	....	....	....	....	....	....	....	....	....	....
Total	**19850966·31**	**14817100**	**109·52**	**1,709**	**32·87**	**386**	**14·00**	**480**	**82,745·45**	**748,482**	**353·07**	**6,431**

Period.	COPPER ORE—*continued.*											
	Peak Hill Goldfield.		East Murchison Goldfield. (Lawlers District).		Murchison Goldfield.		Yalgoo Goldfield.		Northampton Mineral Field.		Yandanooka Mineral Field.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	1,043·35	32,632	275·19	4,893	1,042·02	11,290	51·90	606	24,026·25	119,497	171·55	1,889
1945	....	....	9·12	159	....	....	30·45	205	....	....	....	....
1946	....	....	....	....	....	....	....	....	....	....	....	....
1947	....	....	....	....	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....	....	....	....	....
Total	**1,043·35**	**32,632**	**284·31**	**5,052**	**1,042·02**	**11,290**	**82·35**	**811**	**24,026·25**	**119,497**	**171·55**	**1,889**

Period.	COPPER ORE—*continued.*									
	Mt. Margaret Goldfield.		North Coolgardie Goldfield. (Menzies District).		East Coolgardie Goldfield (East Coolgardie District).		Phillips River Goldfield.		Yilgarn Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	47,860·52	230,846	6·12	51	50·67	379	95,757·64	588,935	16·00	77
1945	....	....	....	....	....	....	....	....	....	....
1946	....	....	....	....	....	....	74·00	105	....	....
1947	....	....	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....	....	....
Total	**47,860·52**	**230,846**	**6·12**	**51**	**50·67**	**379**	**95,831·64**	**589,040**	**16·00**	**77**

Period.	COPPER ORE—*continued.*				DIATOMACEOUS EARTH.		DOLOMITE.		DIAMONDS.		EMERALDS.	
	State Generally.		Total.		State Generally.		Murchison Goldfield. (Mt. Magnet District).		Pilbara Goldfield. (Nullagine District).		Murchison Goldfield. (Cue District.).	
	Quantity.	Value.	Quantity	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	carats.	£	carats (cut and rough).	£
Prior to 1945	5·11	56	253,561·23	1,748,639	40·00	640	158·51	795	....	24	18,373·00	1,609
1945	....	....	39·57	364	*30·00	480	105·35	502	....	....	....	....
1946	....	....	74·00	105	....	....	98·09	490	....	....	....	....
1947	....	....	....	....	5·00	50	56·85	285	....	....	....	....
1948	....	....	....	....	....	....	107·25	536	....	....	....	....
Total	**5·11**	**56**	**253,674·80**	**1,749,108**	**75·00**	**1,170**	**526·05**	**2,608**	....	**24**	**18,373·00**	**1,609**

* Late report for 1942.

TABLE VI.—*Minerals other than Gold*—continued.

Period.	EMERY.		FELSPAR.						GLASS SAND.	
	State Generally.		Coolgardie Goldfield.		State Generally.		Total.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	13·00	130	32,269·75	80,561	528·00	1,050	32,797·75	81,611	660·55	707
1945	....	....	1,234·50	4,321	....	....	1,234·50	4,321	175·00	227
1946	....	....	1,793·00	6,282	....	....	1,793·00	6,282	180·50	227
1947	....	....	1,226·00	4,291	....	....	1,226·00	4,291	364·40	469
1948	....	....	1,011·00	3,538	....	....	1,011·00	3,538	516·90	644
Total	**13·00**	**130**	**37,534·25**	**98,993**	**528·00**	**1,050**	**38,062·25**	**100,043**	**1,897·35**	**2,274**

	CUPREOUS ORE.		GADOLINITE.		GLAUCONITE.		GRAPHITE.		LEAD ORE.			
	Peak Hill Goldfield.		Pilbara Goldfield. (Marble Bar District).		State Generally.		State Generally.		Northampton Mineral Field.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	....	....	1·00	112	2,649·50	30,221	18·10	97	417,953·32	1,281,294	118·76	1,542
1945	....	....	....	....	180·00	4,500	....	....	....	....	....	....
1946	....	....	....	....	366·50	9,162	....	....	36·21	1,068	....	....
1947	*917·00	6,071	....	....	350·50	8,763	....	....	5·89	326	....	....
1948	258·65	2,204	....	....	319·00	7,975	....	....	1,345·19	92,492	....	....
Total	**1,175·65**	**8,275**	**1·00**	**112**	**3,865·50**	**60,621**	**18·10**	**97**	**419,340·61**	**1,375,180**	**118·76**	**1,542**

* Includes 409 tons valued at £2,968 late reported for years 1944, 1945 and 1946.

Period.	LEAD ORE—*continued.*		JAROSITE.		SOAP STONE.					
	Total.		Phillips River Goldfield.		Greenbushes Mineral Field.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	418,072·08	1,282,836	....	....	517·00	1,778	10·00	25	527·00	1,803
1945	....	....	....	....	....	....	....	....	....	....
1946	36·21	1,068	....	....	....	....	....	....	....	....
1947	5·89	326	9·54	37	....	....	....	....	....	....
1948	1,345·19	92,492	....	....	....	....	....	....	....	....
Total	**419,459·37**	**1,376,722**	**9·54**	**37**	**517·00**	**1,778**	**10·00**	**25**	**527·00**	**1,803**

Period.	GYPSUM.								IRON ORE.	
	Dundas Goldfield.		Yilgarn Goldfield.		State Generally.		Total.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	1,401·00	351	11,374·00	10,892	107,632·99	128,190	120,407·99	139,433	*58,064·35	37,048
1945	....	....	....	....	7,232·50	9,136	7,232·50	9,136	....	....
1946	212·00	317	4,012·00	6,018	11,126·16	14,819	15,350·16	21,154	....	....
1947	376·00	564	8,953·50	13,430	10,952·00	14,780	20,281·50	28,774	....	....
1948	....	....	15,870·00	24,527	9,651·50	10,646	25,521·50	35,173	7,222·20	26,165
Total	**1,989·00**	**1,232**	**40,209·50**	**54,867**	**146,595·15**	**177,571**	**188,793·65**	**233,670**	**65,286·55**	**63,213**

* Includes 450 tons from East Coolgardie Goldfield.

Period.	MAGNESITE.								MANGANESE.		PHOSPHATIC GUANO.	
	State Generally.		East Coolgardie. Goldfield (Bulong District).		Coolgardie Goldfield.		Total.		Peak Hill Goldfield.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	....	....	924·75	1,141	291·65	342	1,216·40	1,483	76·74	436	2,316·73	12,518
1945	....	....	....	....	....	....	....	....	....	....	8,483·00	46,656
1946	....	....	10·50	26	....	....	10·50	26	....	....	....	....
1947	....	....	73·00	73	....	....	73·00	73	....	....	....	....
1948	495·07	1,485	....	....	466·75	1,691	961·82	3,176	*1,644·85	10,442	....	....
Total	**495·07**	**1,485**	**1,008·25**	**1,240**	**758·40**	**2,033**	**2,261·72**	**4,758**	**1,721·59**	**10,878**	**10,799·73**	**59,174**

* Includes 20 tons valued at £180 from Mt. Margaret Goldfield and 24·85 tons valued at £112 from State Genera lly.

TABLE VI.—*Minerals other than Gold*—continued.

Period.	MICA.		PYRITES.		RED OXIDE.							
	State Generally.		Dundas Goldfield.		East Coolgardie Goldfield.		Murchison Goldfield (Cue District).		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	lb.	£	‡tons.	£	tons	£	tons	£	tons	£	tons.	£
Prior to 1945	*31,676·25	2,641	†108306·56	133,521	35·35	126	74·00	563	2,433·40	27,546	2,542·75	28,235
1945	....	....	35,564·00	102,053	....	....	50·00	320	600·00	8,677	650·00	8,997
1946	....	....	36,127·00	107,250	....	....	505·85	4,398	354·05	5,133	859·90	9,531
1947	....	....	44,337·00	187,621	....	....	823·40	8,123	191·20	2,635	§1,027·10	10,856
1948	....	....	37,499·00	164,203	....	....	381·37	4,109	185·00	2,682	566·37	6,791
Total	**31,676·25**	**2,641**	**261,833·56**	**694,648**	**35·35**	**126**	**1,834·62**	**17,513**	**3,763·65**	**46,673**	**5,646·12**	**64,410**

* Includes 7,868 lb. Crude Mica. † Includes 74·047,56 tons, value £45,496, from Mt. Margaret Goldfield. ‡ Amended tonnage.
§ Includes 12·50 tons valued at £98 from Pilbara and North-East Coolgardie Goldfields.

Period.	SILVER LEAD ORE.										SILVER LEAD ZINC ORE.	
	Pilbara Goldfield (Marble Bar District).		Ashburton Goldfield.		Kimberley Goldfield.		State Generally.		Total.		West Kimberley Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	195·35	3,658	2,973·78	37,905	....	....	....	....	3,169·13	41,563	....	....
1945	....	....	....	....	....	....	....	....	....	....	....	....
1946	....	....	....	....	....	....	....	....	....	....	....	....
1947	16·47	626	....	....	....	....	....	....	16·47	626	....	....
1948	....	....	126·76	7,159	4·07	197	2·07	63	132·90	7,419	713·46	14,358
Total	**211·82**	**4,284**	**3,100·54**	**45,064**	**4·07**	**197**	**2·07**	**63**	**3,318·50**	**49,608**	**713·46**	**14,358**

Period.	KYANITE.		TALC.		VERMICULITE.							
	State Generally.		East Coolgardie Goldfield.		East Coolgardie Goldfield (Bulong District).		Yilgarn Goldfield.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	....	....	110·55	227	95·40	677	20·00	60	848·55	5,158	963·95	5,895
1945	*19·95	100	....	....	....	....	....	....	59·00	354	59·00	354
1946	139·74	568	389·41	1,499	2·50	12	....	....	201·00	1,206	203·50	1,218
1947	2,931·00	14,597	213·00	813	....	....	....	....	82·00	492	82·00	492
1948	1,125·00	6,516	72·00	732	60·00	330	....	....	91·00	546	151·00	876
Total	**4,215·69**	**21,781**	**784·96**	**3,271**	**157·90**	**1,019**	**20·00**	**60**	**1,281·55**	**7,756**	**1,459·45**	**8,835**

* Late report for 1938.

Period.	TIN.											
	Kimberley Goldfield.				Pilbara Goldfield (Marble Bar District).				East Murchison Goldfield.			
	Quantity.			Value.	Quantity.			Value.	Quantity.			Value.
	Load.	Stream.	Total.		Lode.	Stream.	Total.		Lode.	Stream.	Total.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Prior to 1945	....	·60	·60	143	372·62	5,554·85	5,927·47	552,290	·14	....	·14	53
1945	....	....	....	....	....	8·46	8·46	1,804	·25	....	·25	50
1946	....	....	....	....	....	13·99	13·99	2,750	....	....	....	....
1947	....	....	....	....	....	17·90	17·90	4,109	....	....	....	....
1948	....	....	....	....	....	34·99	34·99	12,389	....	....	....	....
Total	....	**·60**	**·60**	**143**	**372·62**	**5,630·19**	**6,002·81**	**573,342**	**·39**	....	**·39**	**103**

TABLE VI.—*Minerals other than Gold*—continued.

Period.	TIN—*continued.*								TANTALITE.			
	Greenbushes Mineral Field.				Total.				Pilbara Goldfield (Marble Bar District).			
	Quantity.			Value.	Quantity.			Value.	Quantity.			Value.
	Lode.	Stream.	Total.		Lode.	Stream.	Total.		Lode.	Stream.	Total.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Prior to 1945	350·96	10,974·68	11,325·64	996,013	†724·32	*16,535·00	17,259·32	1,548,920	63·26	201·45	264·71	130,391
1945	....	31·87	31·87	6,485	·25	40·33	40·58	8,339	....	....	....	....
1946	....	14·53	14·53	3,088	....	28·52	28·52	5,838	....	·36	·36	281
1947	....	5·73	5·73	1,456	....	23·63	23·63	5,565	....	....	....	....
1948	....	2·00	2·00	596	....	36·99	36·99	12,985	....	·53	·53	166
Total	**350·96**	**11,028·81**	**11,379·77**	**1,007,638**	**724·57**	**16,664·47**	**17,389·04**	**1,581,647**	**63·26**	**202·34**	**265·60**	**130,838**

* Includes 4·72 tons valued at £360 and ·15 tons valued at £15 ; the product of Murchison and Coolgardie Goldfields respectively. † Includes ·60 tons valued at £46 from Yilgarn Goldfield.

Period.	TANTALITE—*continued.*								SILLIMANITE.	
	Greenbushes Mineral Field.				Total.				State Generally.	
	Quantity.			Value.	Quantity.			Value.	Quantity.	Value.
	Lode.	Stream.	Total.		Lode.	Stream.	Total.			
	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	£
Prior to 1945	....	11·51	11·51	9,079	*66·07	212·96	279·03	141,979	....	....
1945	....	....	....	....	....	....	....	....	....	....
1946	....	....	....	....	....	·36	·36	281	....	....
1947	....	....	....	....	....	....	....	....	....	....
1948	....	3·78	3·78	973	....	4·31	4·31	1,139	2·00	13
Total	....	**15·29**	**15·29**	**10,052**	**66·07**	**217·63**	**283·70**	**143,399**	**2·00**	**13**

* Includes 2·81 tons valued at £2,509 from Coolgardie Goldfield.

Period.	WOLFRAM.								SCHEELITE.			
	West Kimberley Goldfield.		Yalgoo Goldfield.		Murchison Goldfield.		Total.		Murchison Goldfield.		Yalgoo Goldfield.	
	Ore and Conc.	Value.	Ore and Conc.	Value.	Ore and Conc.	Value.	Ore and Conc.	Value.	Conc.	Value.	Conc.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	28·48	331	·72	115	238·64	1,148	*268·12	1,682	·16	59	2·99	1,050
1945	....	....	....	....	....	....	....	....	....	....	....	....
1946	....	....	....	....	....	....	....	....	....	....	....	....
1947	....	....	....	....	....	....	....	....	....	....	....	....
1948	....	....	....	....	....	....	....	....	....	....	....	....
Total	**28·48**	**331**	**·72**	**115**	**238·64**	**1,148**	**268·12**	**1,682**	**·16**	**59**	**2·99**	**1,050**

* Includes ·28 tons valued at £88 from Broad Arrow Goldfield.

Period.	SCHEELITE—*continued.*											
	Broad Arrow Goldfield.		Coolgardie Goldfield (Coolgardie District).		North Coolgardie Goldfield (Menzies District).		Yilgarn Goldfield.		Dundas Goldfield.		Total.	
	Conc.	Value.	Conc.	Value.	Conc.	Value.	Conc.	Value.	Conc.	Value.	Conc.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1945	1·01	75	16·76	4,167	6·45	1,030	59·72	21,312	·08	19	87·17	27,812
1945	....	....	....	....	....	....	26·08	8,946	....	....	26·08	8,946
1946	....	....	·40	150	....	....	4·27	1,402	....	....	4·67	1,552
1947	....	....	·47	130	....	....	9·81	3,710	....	....	10·28	3,840
1948	....	....	·41	196	....	....	6·86	3,717	....	....	7·27	3,913
Total	**1·01**	**75**	**18·04**	**4,643**	**6·45**	**1,030**	**106·74**	**49,087**	**·08**	**19**	**135·47**	**46,063**

TABLE VII.

Quantity and Value of Minerals, other than Gold and Silver, reported during year, 1948.

Number of Lease, Claim, or Area.	Goldfield.	Registered Name of Company or Lease.	Quantity.		Value.
		ALUNITE.			
			tons.	Crude Potash tons.	£A.
M.L.'s 43, etc.	Yilgarn	State (W.A.) Alunite Industry	39,131.00	1,778.30	49,429.80
		ANTIMONY.			
			Concentrates. tons.	Antimony. tons.	
G.M.L. 231L, etc.	Pilbara	Blue Spec G.M.'s, N.L.	114.16	41.90	3,581.93
		ARSENIC.			
G.M.L. 667J, etc.	East Murchison	Wiluna G.M.'s, Ltd.	214.00	....	4,494.00
		ASBESTOS (ANTHOPHYLLITE).			
Private Property (Bindi Bindi)	State Generally	Willcocks, W. H.	121.24	....	1,223.11
Private Property (Bindi Bindi)	State Generally	Midland Mining Co., Ltd.	163.00	....	2,950.00
			284.24	....	4,173.11
		ASBESTOS (CHRYSOTILE).			
M.C. 263H (Nunyerry)	State Generally	Hancock, L. G.	71.31	....	5,591.00
		ASBESTOS (CROCIDOLITE).			
M.C.'s 269H (Wittenoom Gorge)	State Generally	Australian Blue Asbestos, Ltd.	607.30	....	27,996.80
		BENTONITE.			
M.C.'s 282H, etc. (Marchagee)	State Generally	Fennell, W. G.	268.75	....	806.25
		BERYL ORE.			
			tons.	BeO Long. Ton Units.	£A.
M.C. 107	Pilbara	Tantalite, Ltd.	6.25	Not known	300.00
M.L. 365	Pilbara	Hooley, G. J.	11.50	139.75	742.42
Crown Lands	Pilbara	Lamont, G.	12.42	139.27	724.78
M.L. 101	Coolgardie	Scahill, E. and Party	3.87	46.89	220.37
P.A. 6239	Coolgardie	Duplex, S. A.	.81	10.33	46.50
			34.85	336.24	2,034.07
		CLAYS.			
M.C.'s 380H, etc. (Clackline)	State Generally	Clackline Refractories, Ltd.	2,007.50	....	1,003.75
M.L. 357H (Mt. Helena)	State Generally	Swan Portland Cement, Ltd.	1,112.00	....	58·17
M.C. 109H (Goomalling)	State Generally	H. L. Brisbane & Wunderlich, Ltd.	739.00	....	1,478.00
P.A. 312PP (Bakers Hill)	State Generally	Dunn & Pedler	1,000.00	....	1,050.00
			4,858.50	....	4,112.92
		COAL.			
M.L.'s 314, etc.	Collie	Griffin Coal Mining Co., Ltd.	89,434.80	....	109,930.40
		Wyvern Colliery	72,191.70	....	88,735.40
		Phoenix Colliery	1,480.00	....	1,819.20
M.L.'s 85, etc.	Collie	Amalgamated Collieries of W.A.—			
		Cardiff Mine	97,134.53	....	116,042.68
		Co-operative Mines	80,884.99	....	96,061.44
		Proprietary Mine	139,616.47	....	167,804.39
		Stockton Mine	106,247.88	....	126,546.89
		Stockton Open Cut	111,422.40	....	132,295.11
		Wallsend Open Cut	34,420.82	....	40,875.82
		Black Diamond Open Cut	104.83	....	124.48
			732,938.42	....	880,235.81

TABLE VII.—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1948.

Number of Lease, Claim, or Area.	Goldfield or Mineral Field	Registered Name of Company or Lease.	Quantity.		Value.
			tons.		£A.
		CUPREOUS ORE.		Average Assay. % Cu.	
M.C. 27P	Peak Hill	Oma, E. C.	35.45	....	265.88
L.T.T. 1P/48	Peak Hill	Edwards, M.	177.00	....	1,593.00
L.T.T. 5P/48	Peak Hill	Brown, W. H.	46.20	....	345.00
			258.65	11·36	2,203.88
		DOLOMITE.			
M.L.'s 10M, 11M (Mt. Magnet)	Murchison	Atkinson & Giles	107.25	....	536.25
		FELSPAR.			
M.L.'s 80, etc. (Londonderry)	Coolgardie	Australian Glass Manufacturers, Co. Pty., Ltd.	1,011.00	....	3,538.50
		GLAUCONITE.	Greensand. tons.	Glauconite. tons.	
Private Property (Gingin)	State Generally	Brook, G. E.	1,595.00	319.00	7,975.00
		GYPSUM.			
M.C.'s 208H, etc. (Lake Brown)	State Generally	H. B. Brady & Co. and G. R. Saunders (Jnr)	1,008.00	....	756.00
M.C.'s 31H, etc. (Baandee)	State Generally	Millars Timber & Trading Co.	1,412.00	....	2,118.00
M.C.'s 126H, etc. (Baandee)	State Generally	Perth Modelling Works, Ltd.	4,289.00	....	5,361.25
M.C.'s 293H (Woolundra)	State Generally	Ripper, P.	547.50	....	614.89
M.C.'s 208H, etc. (Lake Brown)	State Generally	Saunders, G. R. (Jnr)	2,395.00	....	1,796.25
M.C.'s 30, etc. (Yellowdine)	Yilgarn	Ajax Plaster Co., Ltd.	5,774.00	....	9,382.75
M.C.'s 9, etc. (Yellowdine)	Yilgarn	Perth Modelling Works, Ltd.	10,096.00	....	15,144.00
			25,521.50	....	35,173.14
		GLASS SAND.			
M.C. 365H (East Wanneroo)	State Generally	Leach, R. J.	283.90	....	341.50
M.C.'s 161H, etc. (Lake Gnangara)	State Generally	Leach, W. M.	233.00	....	302.00
			516.90	....	643.50
		IRON ORE.	Iron Ore. tons.	Pig Iron. tons.	
Crown Lands (Wundowie)	State Generally	The Charcoal Iron & Steel Industry	7,222.20	3,332.98	26,164.97
		KAOLIN.			
M.C. 247H (Mt. Kokeby)....	State Generally	Linton, J. B.	146.00	....	292.00
		KYANITE.			
M.C.'s 287H, 373H (Yanmah)	State Generally	Smith & Walmsley	1,125.00	....	6,516.00
		LEAD ORE AND CONCENTRATES.	Ore and Concentrates. tons.	Lead. tons.	
M.L. 31PP	Northampton....	Northampton Mining and Development Co. Pty., Ltd.	68.53	40.56	4,236.73
Private Property (Loc. 119)	Northampton....	Protheroe Lead Mine	1,248.19	985.47	86,603.00
P.A. 194	Northampton....	Jenkins & Camp	28.47	18.79	1,651.80
			1,345.19	1,044.82	92,491.53

TABLE VII—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1948.

Number of Lease, Claim or Area.	Goldfield or Mineral Field.	Registered name of Company or Lease.	Quantity.			Value.
SILVER LEAD ORE.			Ore. tons.	Lead. tons.	Silver. Fine ozs.	£A.
P.A. 127	Kimberley	Black and Gliddon	4.07	2.73	12.64	196.57
M.L. 118	Ashburton	Rose & Davies	24.79	16.05	239.28	1,420.77
M.L. 119	Ashburton	Perry, Camp, Rose & Davies	5.44	4.13	19.05	357.84
M.L. 120	Ashburton	Camp and Dunlop (Snr)	10.46	6.67	70.96	557.70
M.L. 121	Ashburton	Gray, M. E.	5.80	3.69	25.53	341.88
M.L. 122	Ashburton	Camp, Davies and Rose	2.73	1.53	14.61	117.40
M.L. 124	Ashburton	Camp, Perry, Griffiths and Johansen	1.87	1.27	5.98	119.79
M.C. 1	Ashburton	Nicol and Astrum	9.83	6.35	22.13	470.36
M.C. 2	Ashburton	Ibbotson, G. R.	18.92	10.54	352.57	1,031.08
M.C. 3	Ashburton	Camp and Dunlop	10.11	6.75	63.69	638.88
P.A. 200	Ashburton	Hamilton, Dunlop and Camp	27.52	20.80	203.66	1,635.71
P.A. 202	Ashburton	McConnell and Moore	4.32	2.37	69.60	166.80
P.A. 213	Ashburton	Bagoes Syndicate	3.96	2.71	37.01	230.87
P.A. 232	Ashburton	Bellchambers, A. C.	1.01	.75	78.07	70.00
P.A. 865H (Roebourne)	State Generally	Gordon, D. L.	2.07	.94	9.95	63.26
			132.90	87.28	1,224.73	7,418.91

SILVER LEAD ZINC ORE.			Ore. tons.	Lead tons.	Zinc. tons.	Silver. Fine ozs	£A.
M.C. 29	West Kimberley	Devonian Pty., Ltd.	713.46	275.68	150.93	4,762.11	14,357.53

MAGNESITE.			tons.		
M.L. 87	Coolgardie	Scahill and Gibbons	466.75	....	1,691.00
Private Property (Northam)	State Generally	The Charcoal Iron & Steel Industry	495.07	....	1,485.21
			961.82	....	3,176.21

MANGANESE.					
M.C. 24P	Peak Hill	Synnot, B. R.	1,600.00	....	10,150.00
Temp. Res. 1225H	Mt. Margaret	Bridgeman, H. V. S.	20.00	....	180.00
P.A. 330PP (Tenindewa)	State Generally	Stafford, C. J.	24.85	....	111.82
			1,644.85	....	10,441.82

PYRITES ORE AND CONCENTRATES.			Ore and Concentrates. tons.	Sulphur. tons.	
G.M.L.'s 1460, etc.	Dundas	Norseman G.M.'s, N.L.	37,499.00	15,728.93	164,203.00

RED OCHRE.					
M.C. 26 (Cue)	Murchison	Zadow, J. C.	381.37	....	4,109.50
M.L. 370H (Ophthalmia Range)	State Generally	Smith, R. J.	185.00	....	2,682.00
			566.37	....	6,791.50

SILLIMANITE.					
M.C. 380H (Clackline)	State Generally	Clackline Refractories, Ltd.	2.00	....	13.00

TALC.					
G.M.L. 5961E (Mt. Monger)	East Coolgardie	Collett, J. C.	72.00	....	732.00

TANTALITE.					
Crown Lands	Pilbara	Lamont, G.	.53	....	166.29
M.C.'s 56, etc.	Greenbushes	Freeman, F. E. D.	3.78	....	973.00
			4.31	....	1,039.29

TABLE VII—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1948.

Number of Lease, Claim or Area.	Goldfield or Mineral Field.	Registered name of Company or Lease.	Quantity.		Value.
			tons.		£A.
		TIN.			
M.C.'s 59, etc.	Greenbushes	Commercial Minerals Pty., Ltd.	1.50	....	442.50
Sundry Claims	Greenbushes	Sundry Claims	.50	....	153.99
D.C.'s 16, etc. (Moolyella)	Pilbara	Hansen and Johansson	2.92	....	1,050.51
Sundry Claims	Pilbara	Sundry Claims	32.07	....	11,338.48
			36.99	....	12,985.48
		TUNGSTEN ORES—SCHEELITE.			
			Concentrates. lb.	W.O. 3. lb.	
G.M.L. 3447, T.L. 132	Yilgarn	Edna May (W.A.) Amalg. G.M.'s, N.L.	15,351.99	10,408.61	3,717.37
G.M.L. 5714	Coolgardie	Urlich, M.	923.00	631.23	195.43
			16,274.99	11,039.84	3,912.80
		VERMICULITE.			
			tons.		
M.C. 187H (Young River)	State Generally	Perth Modelling Works, Ltd.	91.00	....	546.00
M.C. 3Y (Bulong)	East Coolgardie	Jones, R. L.	60.00	....	330.00
			151.00	....	876.00

TABLE SHOWING AVERAGE NUMBER OF MEN EMPLOYED ABOVE AND UNDER GROUND IN THE LARGER GOLDMINING COMPANIES OPERATING IN WESTERN AUSTRALIA DURING THE YEARS FROM 1939 TO 1948 INCLUSIVE.

Compiled from Quarterly Figures furnished by Companies concerned to the Mines Department up to 1942 and Monthly Figures thereafter.

COMPANY.	1939.			1940.			1941.			1942.			1943.			1944.			1945.			1946.			1947.			1948.		
	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.	Above.	Under.	Total.
Boulder Perseverance, Ltd.	141	147	288	160	149	309	158	157	315	144	102	246	117	96	213	116	101	217	127	115	242	178	148	326	195	159	354	185	148	333
Broken Hill Pty. Co., Ltd.	38	92	130	47	95	142	48	93	141	32	54	86	5	....	5	4	....	4	11	2	13	33	82	115	38	95	133	38	84	122
Consolidated Gold Area, N.L.	11	21	32	22	51	73	24	38	62	27	33	60	13	16	29	1	....	1	1	....	1	2	....	2	2	....	2	2	....	2
Golden Horseshoe (New),Ltd.	52	....	52	50	....	50	50	....	50	41	....	41	39	....	39	38	....	38	39	....	39	45	....	45	46	....	46	45	....	45
Gold Mines of Kalgoorlie, Ltd.	92	156	248	96	174	270	105	167	272	91	108	199	95	96	191	90	98	188	103	114	217	144	171	315	169	158	327	166	173	339
Great Boulder Pty., Ltd.	382	591	973	340	620	960	350	608	958	281	408	689	249	329	578	226	305	531	237	344	581	310	469	779	325	496	821	316	418	734
Kalgoorlie Enterprise, Ltd.	....	77	77	....	87	87	....	103	103	....	74	74	....	55	55	....	53	53	....	74	74	....	99	99	....	118	118	1	105	106
Lake View and Star, Ltd.	422	861	1,283	426	812	1,238	410	792	1,202	256	323	579	218	186	404	225	214	439	246	242	488	337	422	759	366	468	834	414	465	879
North Kalgurli (1912), Ltd.	66	195	261	91	220	311	82	286	368	48	154	202	37	91	128	42	107	149	52	131	183	62	173	235	66	213	279	76	265	341
Paringa Mining and Exploration Co., Ltd.	60	123	183	66	152	218	72	149	221	59	115	174	59	88	147	78	82	160	69	103	172	76	113	189	83	117	200	87	134	221
South Kalgurli Consolidated, Ltd.	159	150	309	158	153	311	151	143	294	131	98	229	67	77	144	43	74	117	51	80	131	80	91	171	103	105	208	107	111	218
Kalgurli Ore Treatment Co., Ltd.	76	....	76	76	....	76	80	....	80	67	....	67	65	....	65	67	....	67	68	....	68	73	....	73	69	....	69	69	....	69
New Milano, N.L.	....	....	....	15	13	28	29	17	46	20	15	35	6	8	14	1	....	1	2	....	2	2	1	3	2	2	4	2	1	3
Comet Gold Mines, Ltd.	55	44	99	43	28	71	44	36	80	59	31	90	54	28	82	47	30	77	42	33	75	43	32	75	17	7	24	7	10	17
Blue Spec Gold Mines, N.L.	2	2	4	10	11	21	9	4	13	6	4	10	5	4	9	28	7	35	32	12	44	38	17	55	36	24	60	17	12	29
Wiluna Gold Mines, Ltd.	326	485	811	267	361	628	255	342	597	247	292	539	255	282	537	237	244	481	214	196	410	168	96	264	117	5	122	69	....	69
Moonlight Wiluna Gold Mines, Ltd.	42	109	151	37	113	150	38	105	143	29	81	110	18	61	79	16	44	60	4	5	9	....	....	....	....	....	....	....	....	....
Emu Gold Mines, Ltd.	38	85	123	47	87	134	48	21	69	33	43	76	33	32	65	29	28	57	34	38	72	38	40	78	36	35	71	9	6	15
Youanmi Gold Mines, Ltd.	76	161	237	68	164	232	56	140	196	10	12	22	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Big Bell Mines, Ltd.	164	193	357	185	259	444	180	237	417	165	162	327	29	11	40	14	1	15	29	16	45	171	143	314	186	198	384	188	193	381
Triton Gold Mines, N.L.	83	223	306	83	239	322	82	223	305	36	74	110	4	10	14	8	15	23	11	23	34	41	66	107	83	178	261	64	95	159
Hill 50 Gold Mine, N.L.	25	45	70	31	40	71	33	41	74	28	42	70	32	42	74	32	41	73	41	45	86	55	48	103	49	55	104	55	67	122
Mt. Magnet Gold Mines, Ltd.	42	64	106	38	42	80	9	4	13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Sons of Gwalia, Ltd.	136	242	378	132	253	385	124	241	365	97	163	260	101	125	226	101	115	216	104	106	210	122	160	282	108	128	236	98	109	207
First Hit Gold Mine, N.L.	20	18	38	22	17	39	20	14	34	18	12	30	17	15	32	21	14	35	20	15	35	7	7	14	4	5	9	2	1	3
Gold Fields Australian Development Co., Ltd.	....	....	....	9	11	20	13	15	28	12	15	27	10	10	20	4	2	6	2	....	2	13	11	24	18	20	38	13	20	33
Ora Banda Amalgamated, Ltd.	35	50	85	30	45	75	30	45	75	26	38	64	22	26	48	7	5	12	4	....	4	11	20	31	23	44	67	5	4	9
Consolidated Gold Mines of Coolgardie, Ltd.	47	63	110	64	107	171	67	86	153	45	53	98	37	44	81	20	23	43	8	1	9	2	....	2	1	....	1	1	....	1
Phoenix Gold Mines, Ltd.	40	45	85	44	79	123	54	65	119	43	40	83	35	36	71	40	38	78	48	33	81	50	30	80	50	30	80	33	22	55
Burbidge Gold Mines, N.L.	....	....	....	....	....	....	38	....	38	25	2	27	3	....	3	....	....	....	....	....	....	18	....	18	15	4	19	14	4	18
Yellowdine Gold Development, Ltd.	67	81	148	60	84	144	57	74	131	41	47	88	30	28	58	13	9	22	2	....	2	4	....	4	2	....	2	2	....	2
Edna May Amalgamated, N.L.	40	61	101	40	61	101	39	62	101	29	35	64	30	35	65	35	36	71	33	34	67	29	42	71	28	33	61	11	9	20
Evanston Gold, N.L.	17	18	35	21	21	42	31	32	63	19	21	40	5	7	12	....	....	....	....	....	....	28	32	60	37	26	63	2	....	2
Central Norseman Gold Corporation, N.L.	75	252	327	107	333	440	112	223	335	91	148	239	82	117	199	72	115	187	77	135	212	103	201	304	111	251	362	117	268	385
*Norseman Gold Mines, N.L.	152	217	369	161	233	394	148	195	343	110	151	261	101	104	205	87	72	159	98	56	154	105	79	184	12	19	31	....	....	....
Sunshine Reward Amalgamated Leases	6	5	11	6	6	12	6	6	12	4	5	9	5	6	11	5	5	10	4	3	7	5	7	12	8	9	17	9	10	19
Dundas Gold Mines, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	2	4	13	17	9	22	31	7	17	24
Mountain View Gold, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	9	16	11	8	19
Mt. Charlotte (Kalgoorlie) Gold Mines, N.L.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	1	3	18	18	36
Porphyry (1939) Gold Mines, Ltd.	....	....	....	5	....	5	29	17	46	27	23	50	5	4	9	1	....	1	6	....	6	13	5	18	15	10	25	17	4	21
All other Operators	3,878	3,475	7,353	3,362	3,054	6,416	2,790	2,454	5,244	1,447	1,301	2,748	599	495	1,094	511	437	948	599	388	987	1,002	674	1,676	1,174	993	2,167	1,139	981	2,120
State Average (incl. Diggers)	6,865	8,351	15,216	6,419	8,174	14,593	5,871	7,235	13,106	3,844	4,279	8,123	2,488	2,591	5,079	2,266	2,348	4,614	2,424	2,394	4,818	3,416	3,545	6,961	3,612	4,037	7,649	3,416	3,762	7,178
*Also additional men engaged exclusively on Pyrites Production	....	....	....	....	....	....	....	....	....	....	....	....	6	27	33	7	33	40	5	49	54	4	53	57	78	56	134	79	44	123

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