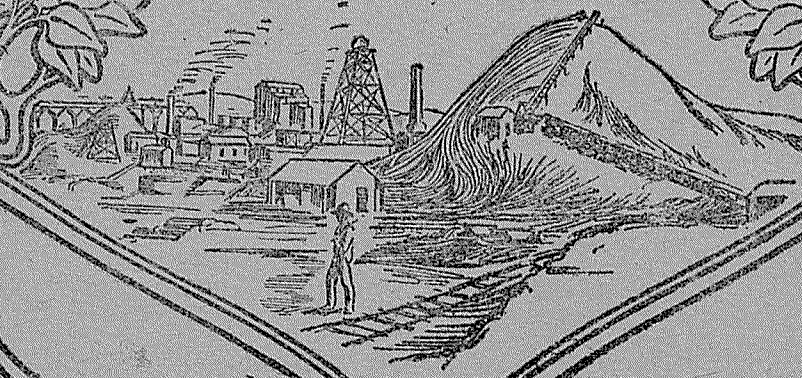
REPORT
OF THE
DEPARTMENT OF MINES
FOR THE YEAR
WESTERN · 1945. · AUSTRALIA



PRESENTED · TO · BOTH · HOUSES · OF · PARLIAMENT · BY · HIS · EXCELLENCY'S · COMMAND ·

1946.

WESTERN AUSTRALIA.

REPORT

of the

Department of Mines

FOR THE YEAR

1945

PERTH:
By Authority: WILLIAM H. WYATT, Government Printer

1946.

L19052/46

ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1945.

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STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines for the State of Western Australia for the Year 1945.

To the Hon. Minister for Mines.

Sir,—I have the honour to submit the Annual Report of the Department for the year 1945, together with reports from the officers controlling Sub-Departments and comparative tables furnishing statistics relative to the Mining Industry.

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

Department of Mines,
Perth, May 31st, 1946.

Division I.

The Hon. Minister for Mines,—

I have the honour to submit, for your information, a report on the Mining Industry for the year 1945.

The estimated value of the mineral output of the State for the year was £2,884,342 (calculating gold at £4 4s. 11.45d. per fine ounce); an increase in value of £66,094 compared with the figure for the preceding twelve months. The estimated value of the premium paid to gold producers amounted to £A3,020,265, bringing the gross value of all minerals up to £A5,904,607, an increase of £A166,927 compared with the 1944 production.

There were increases in quantities and values of alunite, asbestos, glass sand, glauconite, gypsum, kyanite, phosphatic guano, pyrites and tin. Clays showed an increase in quantity but a decrease in value. Decreases in quantities and values were shown in antimony, arsenic, bentonite, beryl ore, bismuth, coal, copper ore, dolomite, felspar, mica, red ochre, soapstone, tantalite, tungsten ores and vermiculite.

The estimated value of gold received at the Perth Branch of the Royal Mint and exported in gold-bearing material was £A5,010,541 (and equalled 84.86 per cent. of all minerals). (See footnote to Table 1 (a), Part II.)

Other minerals realised:—Coal, £572,896; pyrites, £102,053; phosphatic guano, £46,656; arsenic, £41,771; alunite, £23,902; silver, £22,757; asbestos; £44,641; gypsum, £9,136; tungsten ores, £8,946; glauconite, £4,500; tin, £4,370; felspar, £4,321; red ochre, £3,086; clays, £1,424; beryl ore, £953; dolomite, £502; copper ore, £364; vermiculite, £254; glass sand, £227; bismuth, £152; bentonite, £120, and tin-tantalum, £915. As the final valuation figures of the tin-tantalite produced are not yet to hand, it has been estimated at the value of the tin content only.

Dividends paid by mining companies amounted to £458,479, being a decrease of £356,236, when compared with the previous year. (See Table 6, Part II.)

To the end of 1945, the total amount distributed by gold mining companies in dividends was £41,743,143. To the same date, the value of the mineral production amounted to £233,808,243, of which gold accounted for £213,311,810 based on normal values; but premiums on sale of gold during the years 1920-1924 and since 1930, increase the total value of gold and mineral productions by £63,146,312.

GOLD.

The quantity of gold reported as being received at the Perth Branch of the Royal Mint (463,521.34 fine ounces), together with that contained in bullion, concentrates and other gold bearing materials exported for treatment (5,029.38 fine ounces) totalled 468,550.72 fine ounces, and exceeded that of 1944 by 2,285.97 fine ounces (*Vide* Table 1 (a) of Part II.)

On the other hand, the total gold yield for the year, reported directly to the Department by the producers was 469,906.48 fine ounces, which was a decrease of 2.681.75 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, 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 stage or near transitory stage from the producer at the end of the year. Then again, unfortunately, a small percentage of the production is not reported to the Department, despite the strict surveillance. For these and other reasons 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, etc. The calculated average value per ton of ore treated in the State as a whole, increased from 22.604 shillings per ton in 1944, to 23 shillings per ton in 1945, calculating gold at the rate of £4 4s. 11.45d. per fine ounce, but the averaged premium obtained during the twelve months (151.75 per cent.) would more than double this estimate. For East Coolgardie Goldfield (which produced approximately 64.56 per cent, of the State's reported yield of gold), the calculated average value of the ore treated decreased from 24.835 shillings per ton to 24.597 shillings per ton. The estimates for the East Murchison (Wiluna Gold Mines), Mount Margaret (Sons of Gwalia), and Dundas Goldfields (Norseman Gold Mines and Central Norseman Gold Corporation) were 11.152s. (10.210s.); 32.076s. (31.165s.); 23.403s. (28.687s.) respectively; 1944 figures are shown in parenthesis.

The tonnage of ore reported to have been treated in 1945, viz., 1,736,592 tons was 40,536 tons less than the previous year and 2,555,117 tons less than the record established in 1940. Decreased tonnages were reported from the various goldfields as follows:—East Murchison, 105,078; Murchison, 2,845; Yalgoo, 283; Mount Margaret, 4,243; North Coolgardie, 1,087; Broad

Arrow, 111; North-East Coolgardie, 375; Coolgardie, 17,616; Yilgarn, 5,329. Those showing increased tonnages were:—Pilbara, 2,314; Peak Hill, 293; East Coolgardie, 91,169 and Dundas 2,861 tons respectively.

MINING GENERALLY—GOLD.

The official figure of gold out-put, viz., that comprising Royal Mint receipts, plus exported gold, shows an increase over that for 1944 and thus we have arrested the decline caused by war.

With the cessation of hostilities, a further improvement will undoubtedly be shown during 1946, although there are a number of serious difficulties to be overcome before anything like a return to normal conditions can be achieved.

These difficulties are chiefly:—

(a) The delay in return or replacement of machinery commandeered during the war.

(b) The serious shipping shortage which has made the importation of stores of all description a problem. As pre-war stocks have been exhausted, this matter has been and is a constant anxiety to mine owners.

(c) Mining, in common with other primary industries, has not a high priority in regard to tyres, lime, cement, etc., and this has affected progress.

(d) Inability to procure certain machinery which normally comes from England and America. New mining ventures are delayed in commencing operations on this account.

Labour is now again becoming available, and it is pleasing to record that a number of the mines forced to close through enlistment of men, have now re-opened. At time of writing, such number included Big Bell, Triton, Ora Banda Amalgamated, Burbidge, Hannan's North and Evanston.

During 1945, the maintenance of mines closed as a result of the war, was continued, and the expenditure incurred for the twleve months totalled £48,750. Such maintenance finally ceased on the 31st December last.

It has been noted that South Africa is obtaining considerable financial support for its mining ventures from English investors. Every endeavour should be made to interest some of these investors in this State's deposits. The Western Australian mining industry has paid in dividends to 31/12/1945, the sum of £41,743,143, and this is a handsome return on an out-put valued at £297,000,000. A relaxation in some of the restrictions imposed by the Commonwealth Government in regard to the raising of capital and the pegging of shares, etc. would help in encouraging investment generally and bringing new capital into Western Australia. The value of increased gold production from the dollar exchange viewpoint, would in itself, seem to warrant determined action being taken to stimulate mining operations.

Progress in the investigation into aluminium therapy has continued and an Australian doctor with a long experience in silicosis treatment, is now in Canada studying the process and results. It is expected that a decision in connection with its introduction into our industry will be made during 1946.

A pleasing feature in the goldfields is the search for new mines being conducted by a number of the larger operating companies. The main districts in which these operations are proceeding are Southern Cross, Hampton Plains, Kalgoorlie, Porphyry and Norseman. It is noticeable that so far such work is confined to companies previously established in this State, and no new capital has yet been introduced.

Gold had one further rise in price, of 1s. 9d., during 1945 and is now valued at £10 15s. 3d. per fine ounce.

GOLD TAX.

The total gold tax collections from Western Australia since the Act came into force in 1939, until 31/12/1945 amount to £3,550,150 2s., made up as follows:—

	£	s.	d.
Total to 31/12/1940	926,907	15	1
Year ended 31/12/1941	869,990	17	10
Year ended 31/12/1942	616,879	4	9
Year ended 31/12/1943	394,335	9	2
Year ended 31/12/1944	347,401	19	6
Year ended 31/12/1945	394,634	15	8
	£3,550,150	2	0

The amounts refunded to prospectors and low grade producers over the same period, total £748,896 16s. 11d. The refunds for 1945, totalled £148,725 7s.

The industry is still a handsome, and as will be noted, a rising contributor to Commonwealth revenue.

MINERALS.

The main feature in regard to the mineral industry, was the activity taking place in the North-Western portion of the State. Three noteworthy deposits are now being developed on up-to-date lines and with considerable capital. These comprise:—

(a) The Blue Spec antimony-gold mine at Nullagine.

(b) The Hamersley Range asbestos deposit.

(c) The Cockatoo Island iron deposit at Yampi Sound.

All are large employers of labour and should be producing for many years This is the type of activity which the North-West needs in order to develop and populate it.

In other parts of the State, a considerable production took place in regard to pyrites (from which is obtained sulphuric acid for superphosphate manufacture), alunite (source of potash), gypsum (used in the manufacture of plaster of paris), felspar (required for making glass and bottles), tin, guano, arsenic, silver and red ochre. Many other minerals were also produced as shown in Table 1.

COAL.

The out-put of coal for 1945 showed a decrease of 14,959 tons as compared with 1944, the tonnage produced being 543,362.

A determined effort is being made to have production increased to the point where it will meet the present day demands for industry, railways and power. Such increase required is approximately 50 per cent. of present day production.

A new open cut has been commenced by the Amalgamated Collieries of W.A. Limited and this will shortly be in production. More men have been engaged for the mines and considerable development and other work commenced. During 1946, the Department proposes to undertake a geophysical and geological examination of this field in order to obtain by latest scientific methods as complete a picture as possible of the coal deposits.

The operations on a coal seam at Eradu, near Geraldton, were greatly restricted because of the extreme shortage of cement. Such shortage necessitated a change of programme and work is proceeding with the cement available.

MINING DEVELOPMENT ACT.

The expenditure incurred in rendering assistance to mine owners and the industry generally, under the provisions of this Act, totalled £7,790 8s. 4d. and in the preceding year, £9,553 3s. 10d.

PART II.—MINERALS.

TABLE 1.—*Quantity and Value of Minerals, other than Gold and Silver, produced and/or exported during Years* 1944 *and* 1945.

Description of Minerals.	1944.		1945.		Increase or Decrease for Year compared with 1944.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£A.	Tons.	£A.	Tons.	£A.
Alunite (Potash	943·20	14,229	**1,358·80**	**23,902**	+ 515·60	+ 9,673
Antimony	*3·62	*252	*Nil*	*Nil*	— 3·62	— 252
Arsenic	2,304·00	48,384	**1,989·00**	**41,771**	— 315·00	— 6,613
Asbestos (Anthophyllite)	23·00	226	**81·00**	**870**	+ 58·00	+ 644
Asbestos (Chrysotile)	12·04	656	**19·64**	**918**	+ 7·60	+ 262
Asbestos (Crocidolite)	273·49	9,973	**991·30**	**42,873**	+ 717·81	+ 32,900
Bentonite	290·90	660	**50·00**	**120**	— 240·90	— 540
Beryl Ore	*386·96	*12,602	**33·61**	†953	— 353·35	— 11,649
	lbs.		lbs.		lbs.	
Bismuth	*1,042·00	482	**506·00**	**152**	— 536·00	— 330
	tons.		tons.		tons.	
Clays	1,615·50	1,726	**2,363·00**	**1,424**	+ 747·50	— 303
Coal	558,322·11	583,076	**543,362·55**	**572,896**	— 14,959·56	— 10,180
Copper Ore	†46·01	367	**39·57**	**364**	— 6·44	— 3
Dolomite	158·51	795	**105·35**	**502**	— 53·16	— 293
Felspar	1,958·50	10,531	**1,234·50**	**4,321**	— 724·00	— 6,210
Glass Sand	157·50	204	**175·00**	**227**	+ 17·50	+ 23
Glauconite	144·00	3,600	**180·00**	**4,500**	+ 36·00	+ 900
Gypsum	3,604·45	3,722	**7,232·50**	**9,136**	+ 3,628·05	+ 5,414
Kyanite	*Nil*	*Nil*	§**19·95**	**100**	+ 19·95	+ 100
	lbs.		lbs.		lbs.	
Mica	8,367·50	1,279	*Nil*	*Nil*	— 8,367·50	— 1,279
	tons.		tons.		tons.	
Phosphatic Guano	2,215·00	12,183	**8,483·00**	**46,656**	+ 6,268·00	+ 43,648
Pyrites	*43,648·00	68,340	**66,504·00**	**102,053**	+ 22,856·00	+ 33,713
Red Ochre	945·00	7,707	**650·00**	**3,086**	— 295·00	— 4,621
Soapstone	262·00	828	*Nil*	*Nil*	— 262·00	— 828
Tantalite	10·20	†12,916	*Nil*	*Nil*	— 10·20	— 12,916
Tin	10·77	†2,351	**21·76**	**4,370**	+ 10·99	+ 2,019
Tin-Tantalum	20·16	†2,045	**6·17**	†**915**	— 13·99	— 1,130
	units.		units.		units.	
Tungsten Ores (Scheelite)	3,899·73	21,420	**1,638·00**	**8,946**	— 2,261·73	— 12,474
	tons.		tons.		tons.	
Vermiculite	123·00	738	**59·00**	**254**	— 64·00	— 484
	...	821,292	...	**871,309**	...	+ 50,017

TABLE 1 (a).—*Quantity and Value of Gold and Silver exported and minted during Years* 1944 *and* 1945

	Fine ozs.	£A.	Fine ozs.	£A.	Fine ozs.	£A.
Gold (exported and minted)	466,264·75	‡4,899,997	**468,550·72**	**‡5,010,541**	+ 2,285·97	+ 110,544
Silver (exported)	123,198·97	15,807	**146,024·96**	**22,757**	+ 22,825·99	+ 6,950
Total	...	4,915,804	...	**5,033,298**	...	+ 117,494

* Adjusted figures. † Incomplete. ‡ Included in the value of Gold shown are the following estimated premiums :—1944, £A2,919,432 ; 1945, £A3,020,265. § Late reported for 1938.

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	*1,282,867	6·59
1945	20,170,624	§205,587	...
Total since 1902 ...	631,378,314	240,131,034	38·08

Exclusive of Arsenic prior to 1935. † Including Ship's Stores. * Approx. 25 per cent. only of gold bullion production exported. § No gold bullion 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 1945

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

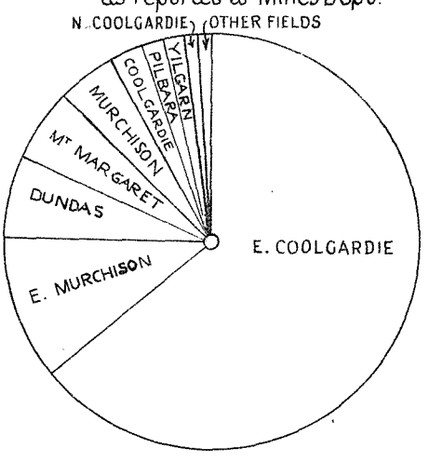


FIG.2 Gold produced from various Goldfields as given by the Export and Mint Returns.

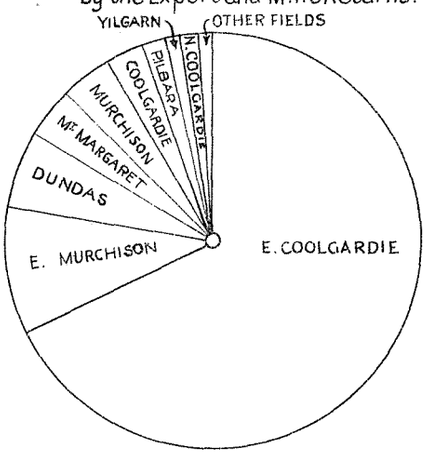


FIG.3 Value of Gold and other Minerals.

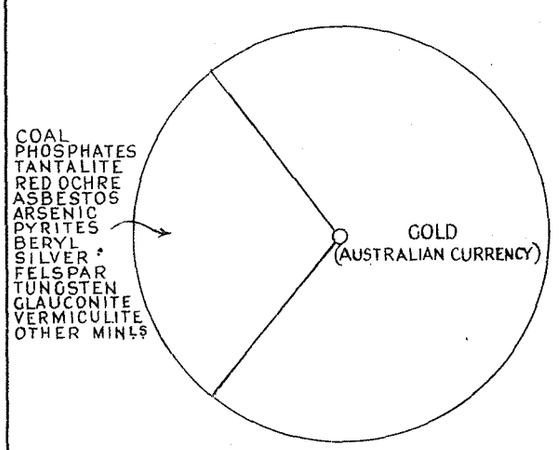


FIG.4 Value of Minerals other than Gold.

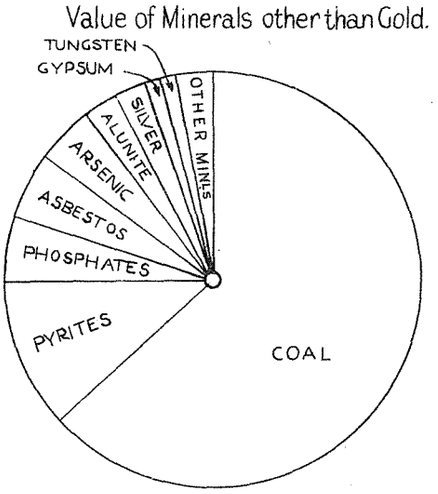


FIG.5 Areas of land leased for Gold mining on various Goldfields.

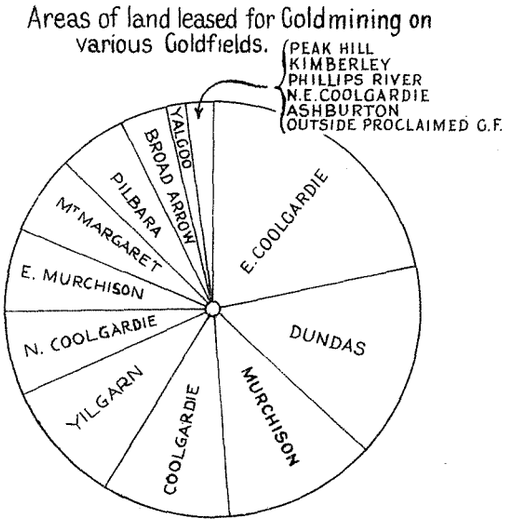


FIG.6 Output of Gold in the States of Australia and the Dominion of New Zealand.

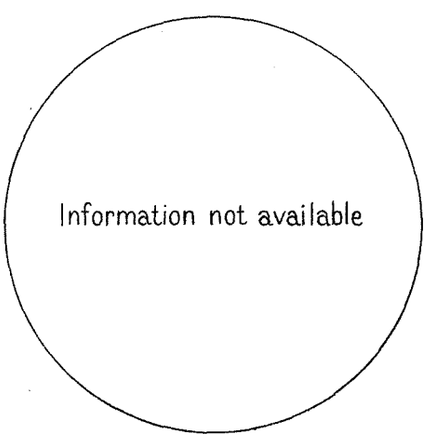


DIAGRAM OF GOLD OUTPUT

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.

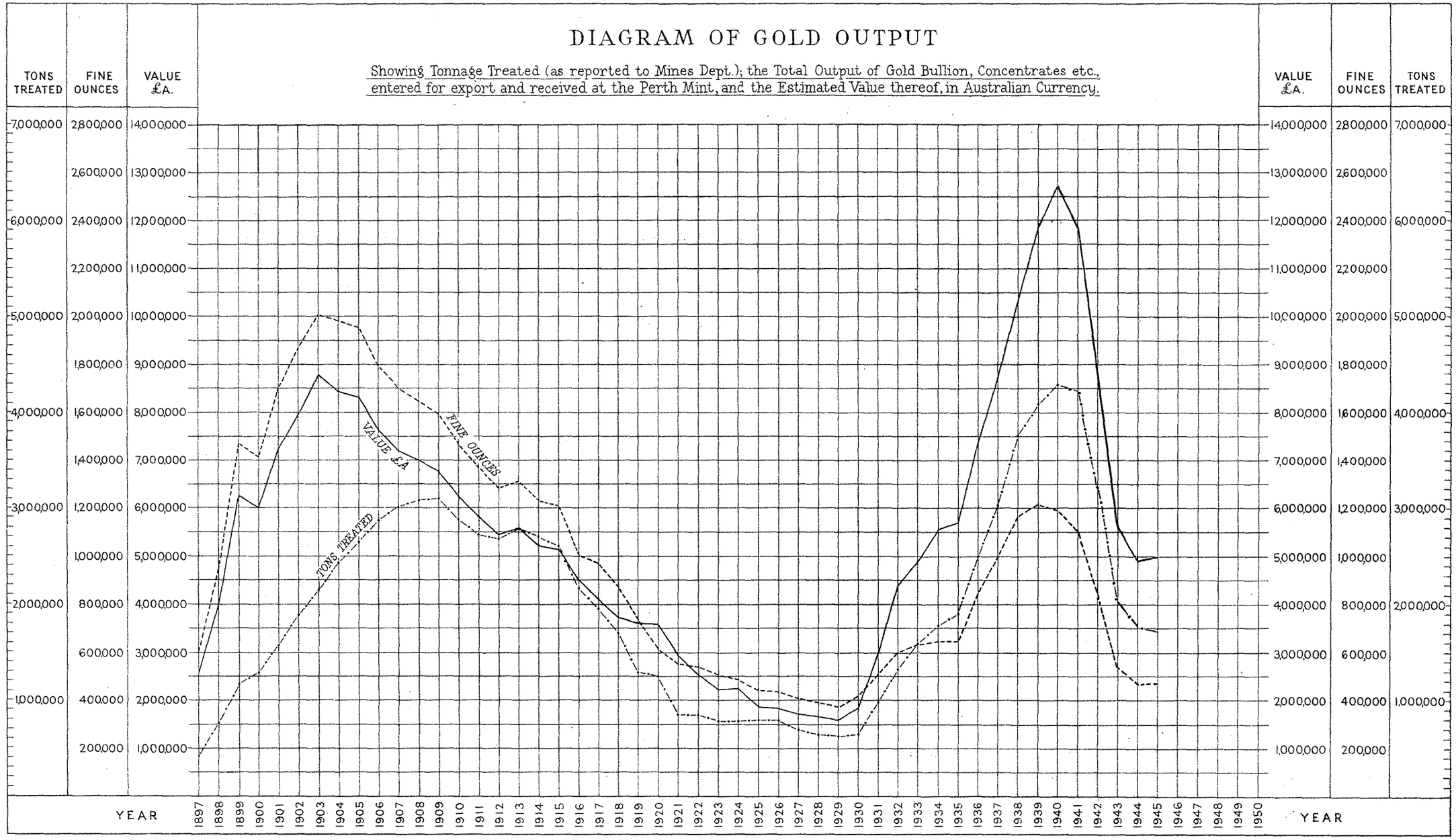


TABLE 3.

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.)	
	1944.	1945.	1944.	1945.	1944.	1945.
	fine ozs.	fine ozs.	%	%	shillings.	shillings.
1. Kimberley	199	107	·042	·023	...	...
2. Pilbara	14,707	9,066	3·111	1·929	79·953	43·428
3. Ashburton	18	39	·004	·008	...	...
4. Gascoyne	...	...	...	...	...	...
5. Peak Hill	565	541	·119	·115	*232·004	92·154
6. East Murchison	58,743	50,380	12·431	10·721	10·210	11·152
7. Murchison	18,267	21,378	3·865	4·549	38·348	48·271
8. Yalgoo	926	877	·196	·187	45·003	50·849
9. Mt. Margaret	27,543	26,747	5·828	5·692	31·165	32·076
10. North Coolgardie	5,451	4,836	1·153	1·029	67·600	71·281
11. Broad Arrow	2,361	1,587	·499	·338	113·702	81·606
12. North-East Coolgardie	465	197	·098	·042	74·833	91·452
13. East Coolgardie	279,660	303,373	59·177	64·560	24·835	24·597
14. Coolgardie	14,720	12,886	3·115	2·742	22·663	29·136
15. Yilgarn	10,818	5,938	2·289	1·264	45·148	33·563
16. Dundas	38,125	31,891	8·068	6·787	28·687	23·403
17. Phillips River	16	8	·003	·002	*226·666	...
18. Outside Proclaimed Goldfield ...	9	55	·002	·012	...	...
Totals and Averages	472,588	469,906	100·000	100·000	22·604	23·000

* Principally from Sands.

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 1944, *and* 1945.

Goldfield.	1944.				1945.			
	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	...	...	99·60	49·80	...	...	107·38	35·79
2. Pilbara	300·57	101·49	282·73	95·47	264·83	103·76	135·21	53·02
3. Ashburton	...	...	17·50	5·83	...	...	...	19·44
4. Gascoyne	...	...	...	...	...	...	...	...
5. Peak Hill	20·65	8·60	56·52	23·54	55·44	20·79	60·15	22·55
6. East Murchison	1,362·22	736·50	163·63	88·47	1,366·40	680·70	179·28	89·32
7. Murchison	291·29	149·40	131·42	67·40	230·94	117·63	131·15	66·81
8. Yalgoo	194·33	79·50	102·89	42·09	162·88	66·63	97·43	39·85
9. Mt. Margaret	395·37	212·20	144·96	77·80	488·81	191·58	184·46	72·29
10. North Coolgardie	149·00	59·60	118·50	47·40	115·33	42·71	96·72	35·82
11. Broad Arrow	65·37	28·00	87·44	37·48	47·23	22·34	45·33	21·44
12. North-East Coolgardie ...	62·00	25·36	51·66	21·13	15·26	6·78	16·44	7·31
13. East Coolgardie	882·19	463·07	257·75	135·30	844·07	456·39	244·26	132·07
14. Coolgardie	525·80	255·60	140·19	68·15	458·45	193·77	157·15	66·42
15. Yilgarn	199·67	103·91	106·06	55·19	168·97	85·44	66·72	33·73
16. Dundas	535·37	281·70	180·69	95·07	576·24	299·29	158·66	82·41
17. Phillips River	...	1·20	...	3·19	...	...	8·30	2·77
18. Outside Proclaimed Goldfields	...	...	9·48	3·16	...	...	27·53	11·01
Total Averages ...	756·87	387·68	201·27	103·10	725·39	362·85	196·28	98·18

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.

State.	Output of Gold.	Value.	Percentage of Total.	
			Output of Commonwealth.	Output of Australasia.
INFORMATION NOT YET AVAILABLE.				

TABLE 6.

Dividends, etc., paid by Western Australian Mining Companies during 1945, *and the Total to date.*

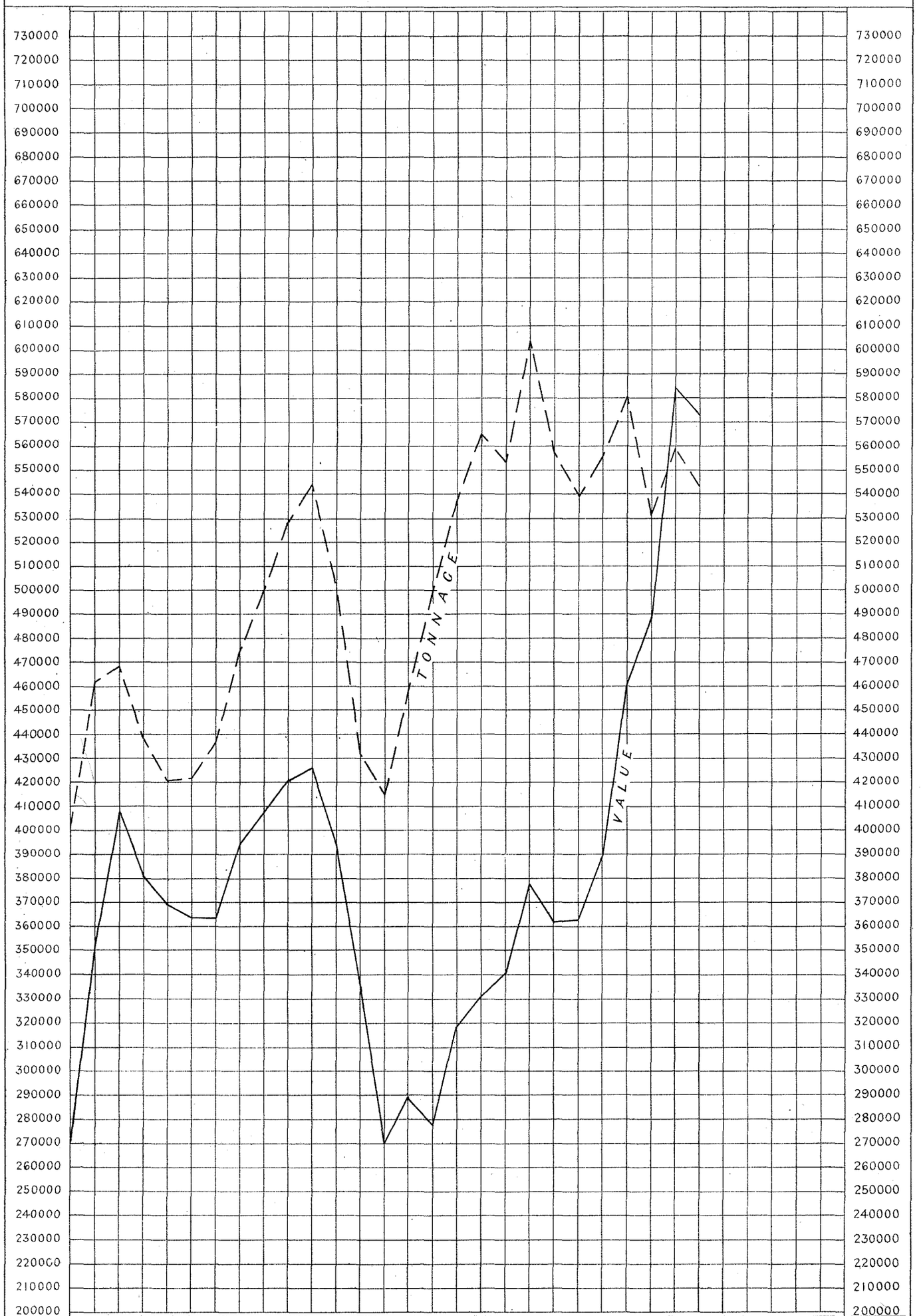
(Mainly compiled from information supplied to the Government Statistician's Office by the Chamber of Mines, of Western Australia.)

Goldfield.	Name of Company.	Dividends Paid.	
		1945.	Grand Total to end of 1945.
		£	£
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.	9,375	165,626
	Various Companies	...	2,714,945
Mt. Margaret	Sons of Gwalia, Limited	16,250	1,932,863
	Western Mining Corporation, ...	16,242	181,239
	Various Companies	...	777,047
North Coolgardie	do. do.	...	712,551
Broad Arrow	do. do.	...	92,500
North-East Coolgardie	do. do.	...	129,493
East Coolgardie	Boulder Perseverance, Ltd.	22,482	(*a*) 2,417,783
	Golden Horseshoe (New) Ltd.	13,750	(*b*) 4,010,000
	Gold Mines of Kalgoorlie, Ltd.	30,688	328,063
	Great Boulder Proprietary Ltd.	62,500	6,848,463
	Kalgoorlie Enterprise Mines, Ltd.	11,000	243,375
	Lake View & Star, Ltd.	140,000	(*c*) 3,479,500
	North Kalgurli (1912), Ltd.	41,250	868,750
	Paringa Mining and Exploration Co., Ltd.	19,317	198,540
	South Kalgurli Consolidated, Ltd.	15,625	(*d*) 1,107,192
	Various Companies	...	10,754,854
Coolgardie	do. do.	...	388,770
Yilgarn	do. do.	...	1,205,556
Dundas	Central Norseman Gold Corporation	60,000	260,000
	Various Companies	...	786,162
	Totals	458,479	41,743,143

(*a*) Also £45,091 in bonuses and profit-sharing notes in years 1935–36. (*b*) Also £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 £55,000 Capital returned in year 1932 by Golden Horseshoe (New), Ltd.

DIAGRAM OF COAL OUTPUT

Showing Quantities and Values as reported to Mines Dept. from 1919 onwards



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
£ 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							£ 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	543362							TONS

TABLE 7.

Quantity and Value of Minerals, other than Gold and Silver, reported to the Mines Department during 1945.

Goldfield, District or Mineral Field.	1945.		Increase or Decrease as compared with 1944.	
	Quantity.	Value.	Quantity.	Value.
ALUNITE (Potash)—	tons.	£A.	tons.	£A.
Yilgarn	1,358·80	23,902	+ 515·60	+ 9,673
ANTIMONY—				
Pilbara (Nullagine)	*Nil*	*Nil*	— 3·62	— 252
ARSENIC—				
East Murchison (Wiluna)	1,989·00	41,771	— 315·00	— 6,613
ASBESTOS (Anthophyllite)—				
Outside Proclaimed Goldfield	81·00	870	+ 58·00	+ 644
ASBESTOS (Chrysotile)—				
Outside Proclaimed Goldfield	19·64	918	+ 7·60	+ 262
ASBESTOS (Crocidolite)—				
Outside Proclaimed Goldfield	991·30	42,873	+ 717·81	+ 32,900
BENTONITE—				
Outside Proclaimed Goldfield	50·00	120	— 240·90	— 540
BERYL ORE—				
Pilbara	11·13	324	— 290·98	— 8,731
Murchison	3·00	104	— 18·53	— 555
Coolgardie	19·23	519	— 9·48	— 342
Outside Proclaimed Goldfield	·25	6	— 37·55	— 1,375
BISMUTH—	lbs.		lbs.	
Outside Proclaimed Goldfield	506·00	152	— 536·00	— 330
CLAYS—	tons.		tons.	
Outside Proclaimed Goldfield	2,363·00	1,424	+ 747·50	— 303
COAL—				
Collie	543,362·55	572,896	— 14,959·56	— 10,180
COPPER ORE—				
Phillips River	*Nil*	*Nil*	— 1·21	— 130
East Murchison (Lawlers)	9·12	159	+ 1·82	+ 128
East Murchison (Black Range)	*Nil*	*Nil*	— 19·50	— 117
East Murchison (Wiluna)	*Nil*	*Nil*	— *	— 35
Yalgoo (Fields Find)	30·45	205	+ 30·45	+ 205
DOLOMITE—				
Murchison	105·35	502	— 53·16	— 293
FELSPAR—				
Coolgardie	1,234·50	4,321	— 724·00	— 6,210
GLASS SAND—				
Outside Proclaimed Goldfield	175·00	227	+ 17·50	+ 23
GLAUCONITE—				
Outside Proclaimed Goldfield	180·00	4,500	+ 36·00	+ 900
GYPSUM—				
Outside Proclaimed Goldfield	7,232·50	9,136	+ 3,628·05	+ 5,414
KYANITE—				
Outside Proclaimed Goldfield	†19·95	100	+ 19·95	+ 100
MICA—	lbs.		lbs.	
Outside Proclaimed Goldfield	*Nil*	*Nil*	— 8,367·50	— 1,279
PHOSPHATIC GUANO—	tons.		tons.	
Outside Proclaimed Goldfield	8,483·00	46,656	+ 6,268·00	+ 43,648
PYRITES—				
Dundas	66,504·00	102,053	+ 22,856·00	+ 33,713
RED OCHRE—				
Murchison (Cue)	50·00	320	— 24·00	— 243
Outside Proclaimed Goldfield	600·00	§ 2,766	— 251·00	— 4,298

* Quantity of Ore not reported. † Late reported for 1938. § Incomplete

TABLE 7—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported to the Mines Department during 1945—*continued.*

Goldfield District or Mineral Field.	1945.		Increase or Decrease as compared with 1944.	
	Quantity.	Value.	Quantity.	Value.
	tons.	£A.	tons.	£A.
SOAPSTONE—				
Greenbushes	*Nil*	*Nil*	— 262·00	— 828
TANTALITE—				
Pilbara	*Nil*	*Nil*	— 10·20	— 12,916
TIN—				
East Murchison	·25	50	+ ·25	+ 50
Greenbushes	10·70	2,069	+ 9·80	+ 1,893
Pilbara	10·81	2,251	+ ·94	+ 76
	units.		units.	
TUNGSTEN ORES (Scheelite)—				
Murchison (Cue)	*Nil*	*Nil*	— 11·00	— 59
Coolgardie	*Nil*	*Nil*	— 16·00	— 90
Yilgarn	1,638·00	8,946	— 2,235·00	— 12,325
	tons.		tons.	
TIN-TANTALUM—				
Greenbushes	6·17	‡915	— 13·99	— ‡1,130
VERMICULITE—				
Outside Proclaimed Goldfield	59·00	254	— 64·00	— 484

‡ Tin content value only.

TABLE 8.

Quantity of Coal raised during 1944 *and* 1945, *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	1944 ...	558,322	583,076	207	673	830	634
	1945 ...	**543,363**	**572,896**	**224**	**636**	**854**	**632**

The quantity and value of coal raised during the year 1945 showed a decrease amounting to 14,960 tons and £10,180 respectively. The average number of men employed during the year decreased by 20, and the number of tons raised per man employed decreased by 2 tons when compared with figures for 1944.

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

TABLE 9.

Total Number and Acreage of Leases, Mineral Claims, and Prospecting Areas held for Mining on 31*st December,* 1944 *and* 1945.

Leases and Other Holdings.	1944.		1945.	
	No.	Acreage.	No.	Acreage.
Gold Mining Leases on Crown Land	1,302	21,743	**1,316**	**21,991**
Gold Mining Leases on Private Property	3	72	**3**	**72**
Mineral Leases on Crown Land	175	38,474	**176**	**38,515**
Mineral Claims	149	8,291	**154**	**8,875**
Prospecting Areas	*386	6,453	†**498**	**8,430**
Totals	2,015	75,033	**2,147**	**77,883**

* Includes 50 Prospecting Areas for Minerals of a total area of 1,277 acres.
† Includes 20 Prospecting Areas for Minerals of a total area of 462 acres.

PART IV.—MEN EMPLOYED.

TABLE 10.

Average number of Men reported as engaged in Mining during 1944 *and* 1945.

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1944.	1945.	1944.	1945.	1944.	1945.
Kimberley	...	4	3	...	...	4	3
Pilbara	Marble Bar	104	107	...	...	104	107
	Nullagine	50	64	...	...	50	64
Ashburton	...	3	2	...	...	3	2
Gascoyne	...	...	...	...	...	...	...
Peak Hill	...	24	24	...	...	24	24
East Murchison	Lawlers	78	90	...	...	78	90
	Wiluna	571	458	...	...	571	458
	Black Range	15	16	...	...	15	16
Murchison	Cue	86	116	...	...	86	116
	Meekatharra	74	75	...	...	74	75
	Day Dawn	20	25	...	...	20	25
	Mt. Magnet	91	104	...	...	91	104
Yalgoo	...	22	22	...	...	22	22
Mt. Margaret	Mt. Morgans	64	75	...	...	64	75
	Mt. Malcolm	244	239	...	...	244	239
	Mt. Margaret	46	56	...	...	46	56
North Coolgardie	Menzies	74	75	3	4	77	79
	Ularring	23	27	1	1	24	28
	Niagara	9	12	...	...	9	12
	Yerilla	9	21	1	2	10	23
Broad Arrow	...	63	74	5	3	68	77
North-East Coolgardie	Kanowna	15	18	2	2	17	20
	Kurnalpi	7	9	1	1	8	10
East Coolgardie	East Coolgardie	2,056	2,297	16	17	2,072	2,314
	Bulong	11	12	1	2	12	14
Coolgardie	Coolgardie	200	178	...	...	200	178
	Kunanalling	16	16	...	...	16	16
Yilgarn	...	196	176	...	...	196	176
Dundas	...	401	387	...	...	401	387
Phillips River	...	5	3	...	...	5	3
State Generally	...	3	5	...	...	3	5
Total—Gold Mining	...	4,584	4,786	30	32	4,614	4,818
MINERALS OTHER THAN GOLD.							
Alunite	...	77	120	...	...	77	120
Arsenic	...	22	19	...	...	22	19
Asbestos	...	102	107	...	...	102	107
Bentonite	...	1	1	...	...	1	1
Beryl	...	25	3	...	...	25	3
Bismuth	...	1	1	...	...	1	1
Clays	...	7	5	...	...	7	5
Coal	...	880	860	...	...	880	860
Copper Ore	...	1	2	...	...	1	2
Dolomite	...	2	1	...	...	2	1
Felspar	...	8	8	...	...	8	8
Glass Sand	...	1	1	...	...	1	1
Glauconite	...	2	2	...	...	2	2
Gypsum	...	8	10	...	...	8	10
Mica	...	30	...	...	...	30	...
Phosphatic Guano	...	27	27	...	...	27	27
Pyrites	...	40	54	...	...	40	54
Red Ochre	...	2	3	...	...	2	3
Soapstone	...	1	...	...	...	1	...
Tantalite	...	48	...	...	...	48	...
Tin	...	5	13	...	...	5	13
Tin-Tantalum	...	13	4	...	...	13	4
Tungsten Ore (Scheelite)	...	11	11	...	...	11	11
Vermiculite	...	2	1	...	...	2	1
Total—Other Minerals	...	1,316	1,253	...	...	1,316	1,253
GRAND TOTAL	...	5,900	6,039	30	32	5,930	6,071

PART V.—ACCIDENTS.

TABLE 11.

MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING 1944 AND 1945.

A.—According to Locality of Accident.

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1944.	1945.	1944.	1945.	1944.	1945.
1. Kimberley	...	...	...	...	...	...
2. West Kimberley	...	...	...	...	...	...
3. Pilbara	...	1	11	14	11	15
4. West Pilbara	...	...	...	...	...	...
5. Ashburton	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...
7. Peak Hill	...	...	...	...	...	...
8. East Murchison	2	1	78	80	80	81
9. Murchison	...	...	16	35	16	35
10. Yalgoo	...	...	...	...	...	...
11. Mount Margaret	...	...	20	24	20	24
12. North Coolgardie	...	...	10	2	10	2
13. North-East Coolgardie	...	...	...	...	...	...
14. Broad Arrow	...	1	...	...	...	1
15. East Coolgardie	4	7	338	345	342	352
16. Coolgardie	...	...	10	21	10	21
17. Yilgarn	...	...	12	4	12	4
18. Dundas	1	1	78	65	79	66
19. Phillips River	...	...	...	...	...	...
MINING DISTRICTS—						
Northampton	...	...	...	...	...	...
Greenbushes	...	...	...	...	...	...
Collie	1	1	242	275	243	276
South-West	1	...	2	4	3	4
Totals	9	12	817	869	826	881

From the above table it will be seen that the number of fatal accidents for the year 1945 was 12, as against 9 in 1944. The number injured showed an increase of 52. In the report of the State Mining Engineer, published in Division II of this report, these accidents are classified according to their causes.

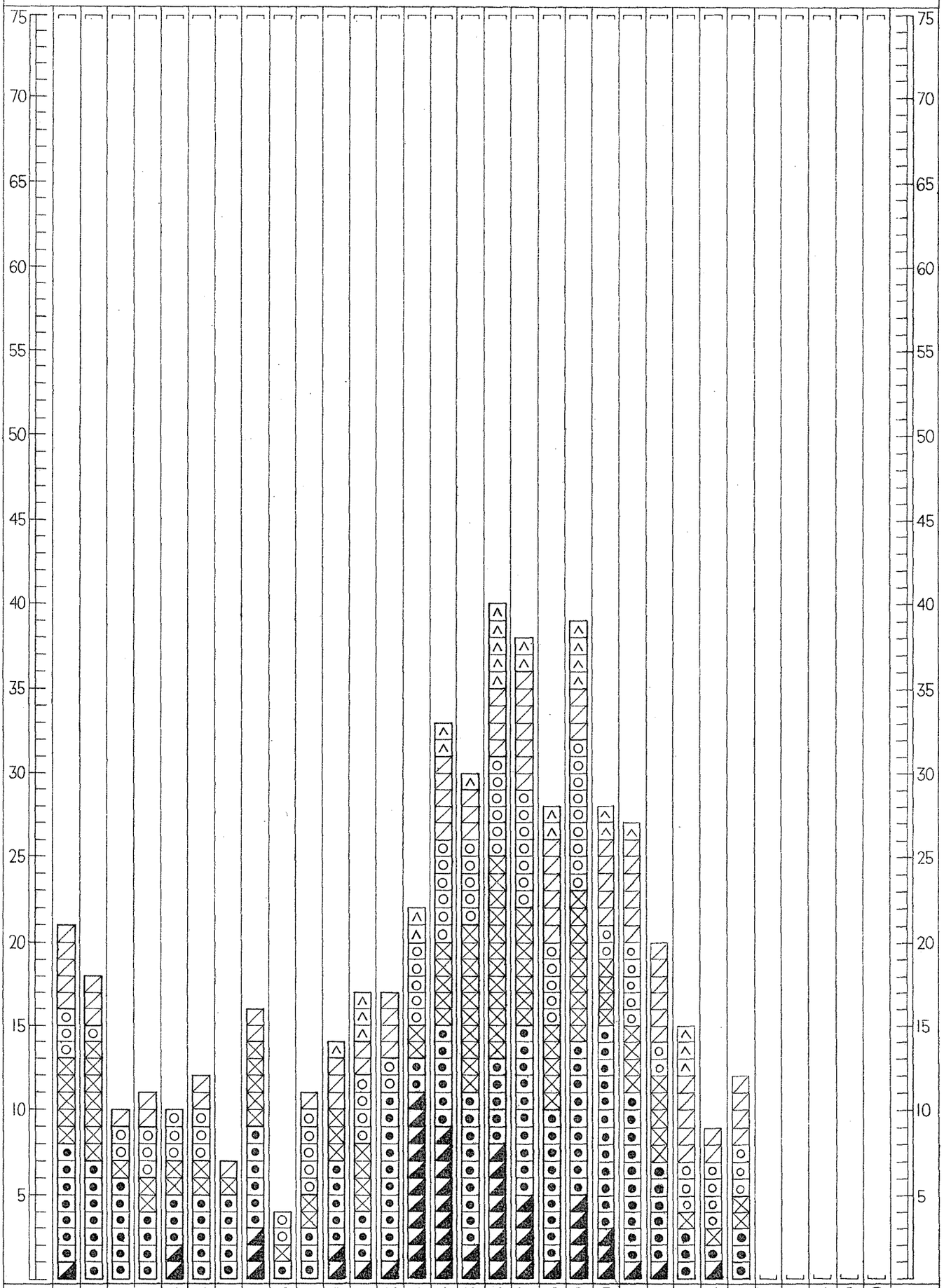
B.—According to Causes of Accidents.

Cause.	1944.		1945.		Comparison with 1944.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	1	5	...	6	— 1	+ 1
2. Falls of Ground	1*	55	3	50‡	+ 2	— 5
3. In Shafts	1	11	2	19	+ 1	+ 8
4. Miscellaneous Underground ...	4	548	3	608	— 1	+ 60
5. Surface	2	195†	4	184§	+ 2	— 11
6. Fumes	...	3	...	2	...	— 1
Totals	9	817	12	869	+ 3	+ 52

* Includes 1 fatal accident in Quarries. † Includes 2 serious accidents in Quarries. ‡ Includes 2 serious accidents in Quarries. § Includes 2 serious accidents in Quarries.

DIAGRAM OF ACCIDENTS

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



Explosions Falls of Ground In Shafts Misc. Underground On Surface Fumes

PART VI—STATE AID TO MINING.

(A) *State Batteries.*

The number of State Batteries existing at the end of the year was 22, with three leased. From inception to the end of 1945, gold and tin to the value of £12,576,344.312 including gold premium estimated at £3,180,578.638, have been received from the State Batteries. 2,650,771.19 tons of auriferous ore have been treated and have produced £9,301,310.514 plus estimated premium of £3,180,578.638 and 81,810.5 tons of tin ore produced tin to the value of £93,882.96 and residues to the value of £572.2.

During the year, 20,078.25 tons of ore were crushed for 21,385.05 ounces of bullion, estimated to contain 18,113.1 fine ounces of gold, equal to 18 dwts. 1 grain per ton. The average value of tailings produced was 5 dwts. 21.6 grains, making the average head value of 23 dwts. 22.6 grains. The estimated value of gold produced was 18,113.1 ounces by amalgamation and 2,478.68 ounces from tailings treatment, a total of 20,591.78 ounces valued at £A202,324.571.

The working expenditure for all plants for the year was £38,138 19s. 5d. and the revenue £20,425 13s. 5d., which shows a loss of £17,713 6s. on the year's operations.

The capital expenditure since inception of the scheme has been £542,298 10s. 5d.; £406,164 4s. 7d. from the General Loan Fund, £93,726 4s. 5d. from Consolidated Revenue, £28,621 13s. 5d. from Assistance to Gold Mining Industry and £13,786 8s. from Commonwealth Assistance to Metalliferous Mining.

Head Office expenditure including insurance under the Workers' Compensation Act and Payroll Tax was £5,101 11s. 1d. as against £4,276 10s. 3d. for 1944.

The working expenditure from inception to the end of the year exceeds revenue by £116,221 15s. 7d.

(B) *Geological Survey of Western Australia.*

The work of the Geological Survey during the year 1945, is represented by the following reports which are published in the Annual Progress Report of the Geological Survey in Division IV. of this report. These comprise:—

Pyrite, "Iron King" Mine, Norseman, W.A. Interim report on Geological Survey and Underground Diamond Drilling Programme.

Report on Underground Water Supplies, Salmon Gums District—Southern Mallee—Eucla Division, W.A. (Centre of area Lat. 35° 00′ S., Long. 121° 40′ E.)

Report on the Bidaminna Lake Phosphate Deposits, 26 miles North-West of Gingin, South-West Division, W.A. (Approx. Lat. 31° 08′ S., approx. Long. 115° 33′ E.)

Koolyanobbing (Trig. Station M.Y.1) Iron Ore Deposits—Summary Report.

Proposed Drilling in the vicinity of the Clackline (Baker's Hill) Ironstone Deposits.

Sampling of some Lakes near Baladjie and Mt. Palmer for Alunite.

Boring at Site of Proposed Repatriation Building (Reserve 8828)—Water Analyses.

Notes on some soils and the Geology in the vicinity of Northam.

Chalk and Marl Samples from Gingin, Muchea and Bullsbrook.

Port Hedland Water Supply—Interim Report.

Report on "Coodawa" Talc Deposit, approx. six miles East-North-East of Three Springs, Victoria District, South-West Division.

A Geological Reconnaissance in the Eastern Portion of the Kimberley Division, Western Australia. (Between Latitudes 15° 30′ S. and 18° S., and Longitudes 128° 15′ E. and 129° E.)

Report on the Hill 60 Lode, Mt. Magnet Gold Mines Ltd., Mt. Magnet, W.A.

Geological Notes on Boring in the Mt. Palmer District, Yilgarn Goldfield.

Report on the Geology of Tindals, Coolgardie Goldfield.

Report on the Availability of Shale at the State Brick Works, Byford.

During 1945, compilation of several Bulletins was completed and the following are now in the press:—

Mineral Resources of Western Australia, Bulletin No. 3; Tantalum and Niobium, by K. R. Miles, D.Sc., F.G.S., Geological Survey of W.A. and Dorothy Carroll, Ph.D., D.I.C., and H. P. Rowledge, A.A.C.I., A.W.A.S.M., Government Chemical Laboratories.

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

Geological Survey of W.A., Bulletin No. 101, The Mining Groups of the Yilgarn Goldfield, North of the Great Eastern Railway, by R. S. Matheson, B.Sc., Geological Survey of Western Australia.

Authority to print is awaited for the following Bulletins:—

Geological Survey of Western Australia, Bulletin; on the Greenbushes Mineral Field, by R. A. Hobson, B.Sc. (Hons.) and R. S. Matheson, B.Sc., Geological Survey of Western Australia.

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.

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.

Field officers of the Geological Survey continue to provide much practical assistance to prospectors and miners in the course of their field work, and the head office of the Geological Survey continues to meet numerous requests for information concerning the geology and mineral resources of the State.

(C) *Assistance Under Mining Development Act,* 1902.

The following statement shows the sums advanced during the year 1945 under this Act:—

	£	s.	d.
1. Advanced in aid of mining work and equipment of mines with machinery	6,738	1	1
2. Providing means of transport, equipment and sustenance for prospectors	774	14	8
3. Other assistance granted from the vote during the year on various matters totalled	277	12	7
	£7,790	8	4

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 5,183, against 5,064 for the preceding year, showing an increase after all adjustments, of 119 boilers.

Of the total 5,183 useful boilers, 3,120 were out of use at the end of the year, 2,066 thorough and 202 working inspections were made and 2,062 certificates were issued.

Permanent condemnations totalled 21 and temporary condemnations 16. There were two conversions. Eleven boilers were transferred beyond the jurisdiction of the Act.

The total number of machinery groups registered was 18,908 against 18,213 for the previous year, showing an increase of 695.

Inspections made totalled 11,233 and 3,197 certificates were granted.

The total mileage travelled for the year was 58,549 against 53,389 miles for the previous year, showing an increase of 5,160 miles. The average miles travelled per inspection was 4.33 as against 3.98 miles per inspection for the previous year.

Two hundred and eighty six applications for engine-drivers' and boiler attendants' certificates were received and dealt with, and 237 certificates, all classes, were granted as follows:—

Winding Competency (including certificates issued under regulation 40 and section 60)	5
First Class Competency (including certificates issued under regulations 40 and 45, and sections 60 and 63)	31
Second Class Competency (including certificates issued under regulation 40 and section 60)	19
Third Class Competency (including certificates issued under regulations 40 and 45, and sections 60 and 63 of Act)	32
Locomotive Competency (including certificates issued under regulation 40 and section 60)	9
Traction Competency (including certificate issued under regulation 40 and section 60)	1
Internal Combustion Competency (including certificates issued under regulation 40, and section 60)	49
Crane and Hoist Competency (including certificates issued under regulation 40 and section 60)	10
Boiler Attendants' Competency (including certificates issued under regulation 40 and section 60)	71
Interim	—
Copies	9
Transfers	1
	237

The total revenue from all sources during the year was £8,207 5s. 5d. as against £7,894 18s. 2d. for the previous year, showing an increase of £312 7s. 3d.

The total expenditure for the year was £8,209 0s. 3d. as against £8,293 19s. 10d. for the previous year, showing a decrease of £84 19s. 7d.

PART VIII.—CHEMICAL AND MINERALOGICAL LABORATORIES.

The Government Mineralogist, Analyst and Chemist reports a considerable expansion of the work of the Government Chemical and Mineralogical Laboratories during the year.

In order to meet post-war requirements, much more attention has had to be devoted than in the past to the study of properties of non-metallic minerals and to methods for their beneficiation with a view to their industrial uses. Additional staff and special equipment were provided to deal with work of that nature.

The amount of gold assaying, that had decreased considerably during the war years, is showing a steady increase and it is anticipated, on return to normal conditions in the gold mining industry, that this work will again reach pre-war importance.

Officers attached to the mineralogy section continue to provide information concerning the mineral resources of the State, by personal contact with prospectors and others and by special field visits to selected localities, to give advice on the spot regarding the mineral occurrence, its mineral associations, treatment and preparation for marketing.

The following publications dealing with the mineral resources of the State were prepared during the year:—

Mineral Resources Bulletin No. 1, "Census of Western Australian Minerals."

Mineral Resources Bulletin No. 3, "Tantalum and Niobium."

Folder: "Mineral Resources of Western Australia, 1945 Edition."

With the implementing of the Government's policy to concentrate all its chemical work in the Government Chemical Laboratories, the amount of work submitted by various departments has increased rapidly, and covers a wide range of investigations that now tax the capacity of the new buildings in Adelaide Terrace, Perth.

PART IX.—SCHOOL OF MINES.

(a) Kalgoorlie—The individual enrolment for 1945, exclusive of correspondence course students, reached a maximum of 372 compared with 383 in 1944, while correspondence course enrolments totalled 85, made up of 15 civilian and 70 service and ex-service men.

During the year six full time and 20 part time discharged service personnel were admitted for tuition under the Commonwealth Reconstruction Training Scheme. R.A.A.F. personnel stationed at Kalgoorlie were also accommodated in regard to classes as in previous years.

In the Metallurgical Laboratory 19 new investigations into the treatment of ores and minerals were completed.

(b) Wiluna and Norseman—The individual enrolments at the former again decreased in number owing to the reduction of mining operations at that centre, but Norseman experienced a very satisfactory year.

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

In 1945, all goldfields were visited with the exception of Ashburton, Gascoyne, Kimberley, Phillips River and West Kimberley.

The number of examinations conducted was 3,334 compared with 4,468 for 1944.

STAFF.

During the year several changes took place in senior positions as a result of retirement, resignation and transfer.

Dr. B. H. Moore, Director of the School of Mines, retired on 31/12/1945, having reached the age of 65 years. Dr. Moore, who is a scientist of distinction in addition to being an educationist, has done much for both the mining industry and the School of Mines. His has been a household name in mining circles in the State. Mr. R. W. Fletcher, B.Sc., a young man with considerable geological, mining and teaching experience, has succeeded him as director.

Mr. F. G. Forman, Government Geologist, resigned in order to accept a private appointment, and the vacancy has been filled by the appointment of Mr. H. A. Ellis, B.Sc., A.O.S.M. Both these officers are able and experienced geologists and Mr. Ellis is expected to do well in his new position.

Mr. E. J. R. Hogg, Superintendent of the Mine Workers' Relief Act, was successful in obtaining the appointment of assistant manager in the State Insurance Office. Mr. Hogg had been many years with this department and had carried out his duties in a particularly efficient and capable manner.

Many of our younger officers have now been discharged from the fighting services and have returned to the department.

The faithful service given by all members of the staff over the war years has been greatly appreciated and I would like to take this opportunity of acknowledging it. While mining is becoming very active again and consequently is increasing the work of the department, there will be more staff to share the volume and responsibility and lighten the burden borne by the few during the years 1940-1945.

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

I have, etc.,

A. H. TELFER,
Under Secretary for Mines.

Department of Mines,
Perth, 31st May, 1946.

Division II.

Report of the State Mining Engineer for the Year 1945.

The Under Secretary for Mines.

Sir,—I have the honour to submit, for the information of the Hon. the Minister for Mines, my report on this branch of the Mines Department for the year 1945.

STAFF.

Inspector Boyland has returned from service abroad and has resumed duty at Leonora.

Mr. M. Ryan has been appointed Inspector of Mines at Kalgoorlie and Mr. J. Haddow has been appointed Assistant Ventilation Inspector.

Mr. S. Hunter has been elected Workmen's Inspector of Mines at Cue in succession to Mr. W. E. Boyce and Mr. J. Gillespie has been elected Workmen's Inspector of Mines at Wiluna in the position rendered vacant by the retirement of Mr. McMennemin.

ACCIDENTS.

Fatal and serious accidents on mines and quarries reported to the Department for the year are shown below. Corresponding figures for 1943 are shown in brackets.

There were 12 (9) fatal and 869 (817) serious accidents, including 1 (2) fatal and 279 (244) serious on coal mines and quarries.

Of the fatal accidents 10 (7) occurred in gold mines, 1 (1) in coal mines and 1 (0) in an asbestos mine.

The total number of serious accidents reported from gold mines was 590 (573). The average number of men employed in such mines was 4,786 (4,584). The average accident rate per 1,000 men employed on gold mines was thus 2·09 (1·53) for fatal and 123·28 (125·00) for serious accidents.

On the coal mines the number of serious accidents was 275 (242) while the average number of men employed was 860 (880). The average accident rate was therefore 1·16 (1·14) fatal and 319·76 (275·00) serious accidents per 1,000 men employed.

TABLE A.

SERIOUS ACCIDENTS—1945.

Goldfield.	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	....	....	4	....	2	....	....	3	2	1	....	1	2	....	....	....	....	....	9	....	....	25
Yilgarn	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Coolgardie	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	2
Dundas	....	....	....	....	....	3	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	7
Mt. Margaret	....	....	1	....	....	2	2	....	5	1	....	....	....	1	....	....	1	....	....	2	1	....	16
North Coolgardie	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Murchison	....	....	....	....	....	2	....	....	1	1	1	....	....	....	1	....	....	....	....	2	....	....	8
Murchison	1	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	4
Pilbara	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	1
South-West Mining District	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Collie Coalfield	....	2	3	4	2	10	....	....	7	1	3	....	....	4	....	....	....	....	....	8	6	3	53
Total	2	4	4	8	2	20	2	....	18	5	5	....	1	7	1	....	1	1	....	26	7	3	117

Goldfield.	Minor Injuries.												
	Fractures.		Head.	Eyes.	Shoulder.	Arm.	Hand.	Back.	Rib.	Leg.	Foot.	Other Minor.	Total Minor.
	Finger.	Toe.											
East Coolgardie	9	3	7	14	14	15	91	51	3	56	35	22	320
Yilgarn	....	....	....	....	....	1	1	....	....	1	....	....	3
Coolgardie	....	....	....	1	1	1	9	2	....	3	2	....	19
Dundas	....	....	1	3	1	2	14	10	5	7	14	1	58
Mt. Margaret	1	1	....	....	....	....	1	....	....	1	....	4	8
North Coolgardie	....	....	....	1	....	....	....	....	....	....	....	1	2
East Murchison	2	2	1	9	1	3	18	9	2	12	8	5	72
Murchison	....	5	....	3	....	2	8	3	....	4	2	4	31
Pilbara	....	1	2	1	....	2	4	2	....	....	....	1	13
South-West Mining District	....	....	1	....	....	1	1	....	....	1	....	....	4
Collie Coalfield	5	9	4	8	9	13	27	25	3	23	25	71	222
Total	17	21	16	40	26	40	174	102	13	108	86	109	752

A classification of the serious accidents showing the nature of the injuries sustained is given in Table A. Table B shows the number of fatal accidents recorded year by year for the past five years and death rate per 1,000 men employed.

TABLE B.

	1941.	1942.	1943.	1944.	1945.
Fatal accidents to men engaged in mining (exclusive of quarries) ...	27	20	15	8	12
Total number of men engaged in mining (average)	14,021	9,100	6,227	5,930	6,071
Accident death rate per 1,000 men engaged in mining	1·93	2·23	2·41	1·35	1·97
Fatal accidents at quarries	...	...	...	1	...

FATAL ACCIDENTS.

Following is a brief description of all fatal accidents that were reported on mines during the year.

Name and Occupation.	Date.	Mine.	Details and Remarks.
		Falls of Earth (3).	
Mosconi, Stephano (Miner)...	11–1–45	South Kalgurli Consolidated, Ltd.	This miner was injured by a piece of rock which fell from the back whilst he was boring a face in a stope, on 3rd January. He died in hospital on 11th January as a result of injuries to the spine. Deceased was a miner of wide experience and the unfortunate accident was due to "head" in the ground.
Gray, William James (Driver)	13–12–45	Central Norseman Gold Corporation, Ltd.	A fall of earth in a stope struck Gray and caused severe injuries to which he succumbed on the following day. No danger was anticipated.
Demasi, Vincenzo (Shoveller and Trucker)	18–12–45	Boulder Perseverance, Ltd.	Demasi was killed by a large fall of rock whilst working as a trucker. The place had been scaled down before work commenced. There was no evidence of carelessness or neglect.
		In Shafts (2).	
Bird, Horace Victor (Skipman)	19–2–45	Wiluna Gold Mines, Limited	A piece of steel rail falling down the shaft entered the skip in which Bird and his mate, the skipman, were travelling. It is presumed that the rail was a piece from the lining of an ore pass which became caught up in the shaft and was later dislodged by the moving skip. Bird was struck on the head and leg and after four months in hospital made a fair recovery. Subsequently he became subject to headaches and came to Perth for treatment. An operation on the brain was performed and Bird subsequently died.
Haddow, George James (Mine owner)	8–9–45	Grace Darling ...	This man, the owner of a small mine, was struck by a piece of stone whilst inspecting the shaft. He fell about 20 feet to the bottom of the shaft, the principal injury received being a fracture of the lower jaw. The accident occurred on the 21st January and Haddow died, as the result of cerebral abscess, on the 8th September.
		Miscellaneous Underground (3).	
Kelly, Robert (Set rider) ...	11–6–45	Co-operative Colliery	Kelly, who was a set-rider, was riding on the set and was about to have it lowered to the flat. The load became detached owing to the opening out of the shackle and he was struck by one of the runaway skips. He was killed instantly.
Condren, Patrick James (Bogger)	15–9–45	Oroya South Shaft, Gold Mines of Kalgoorlie, Ltd.	This accident was caused by a truck coming off the line. Condren was pushing the truck with an electric loco. and when it came off the line, he was crushed between the loco. and the truck. Death was due to asphyxia and damage to the spinal column.
Saunders, Charles Henry (Timberman)	22–8–45	Boulder Perseverance, Limited	Saunders, a timberman, was working in a manway, which had not been covered. The withdrawal of ore from chutes caused some stone to fall down the manway. He sustained a fractured skull, but two others also in the manway escaped serious injury. He was placed in hospital in Perth for treatment, but did not recover.

FATAL ACCIDENTS—*continued.*

Name and Occupation.	Date.	Mine.	Details and Remarks.
		Surface (4).	
Kuring, Henry (Change room attendant)	23–4–45	Great Boulder Pty. Gold Mines Ltd.	This man, who was a change room attendant, went to the saw bench to fill a bucket with sawdust to sprinkle on the floor. He was found shortly afterwards in a kneeling position, unconscious, having apparently been struck by a bolt of the fastener of the belt driving the circular saw, which was in motion at the time. He died a week later without regaining consciousness. The belt was railed off and there was no reason for him to collect the sawdust at that particular point, except that it was somewhat dryer there.
Trenholme, Richard ...	24–7–45	Asbestos Mine, Wittenoom Gorge	Trenholme was operating a flying fox when the brake failed to function and the ascending bucket, out of control, struck him. He was thrown against a steel drill driven into the wall which penetrated his skull.
Donovan, John Thomas (Plant Labourer)	11–9–45	Oroya South Shaft, Gold Mines of Kalgoorlie, Ltd.	Donovan entered the fine ore bin to clear a stoppage. Apparently he was covered by a sudden rush of ore and suffocated. He was alone at the time.
Pember, Barnabus Leslie (Mill Hand)	18–9–45	Great Boulder Pty. Gold Mines, Ltd.	Pember was found severely injured near the revolving shaft of an Oliver filter. His clothing had been torn off and wrapped around the shaft. He was removed to hospital but died soon after.

Table C shows the total number of fatal and serious accidents that were reported during the year, classified according to the gold or mineral field in which they occurred, and also according to their causes. Table II, showing fatal and serious accidents and the districts in which they occurred, is forwarded herewith for your Annual Report, together with a diagram showing the fatal accidents year by year according to their causes.

TABLE C.

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

	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	2	16	...	8	...	2	2	255	3	62	7	345
2. Mt. Margaret ...	...	...	...	1	...	6	...	...	...	8	...	9	...	24
3. Coolgardie	...	...	...	1	...	2	...	...	...	9	...	9	...	21
4. North Coolgardie ...	...	...	...	...	...	...	...	...	...	...	...	2	...	2
5. North-East Coolgardie	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6. Broad Arrow ...	...	...	...	...	1	...	...	...	...	...	...	...	1	...
7. Dundas	...	...	1	5	...	...	...	...	...	44	...	16	1	65
8. Yilgarn	...	...	...	1	...	...	...	...	...	2	...	1	...	4
9. Murchison	...	2	...	1	...	...	...	...	...	20	...	12	...	35
10. East Murchison ...	...	1	...	1	1	3	...	...	...	50	...	25	1	80
11. Peak Hill	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12. Yalgoo	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13. Northampton ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14. Greenbushes ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15. South-West ...	...	...	...	2	...	...	...	...	...	...	...	2	...	4
16. Phillips River ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17. Collie	...	1	...	22	...	...	...	...	1	215	...	37	1	275
18. Pilbara	...	...	...	...	...	...	...	...	...	5	1	9	1	14
19. West Pilbara ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
20. Ashburton	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals for 1945 ...	...	6	3	50	2	19	...	2	3	608	4	184	12	869
Totals for 1944 ...	1	5	1	55	1	11	...	3	4	548	2	195	9	817

WINDING MACHINERY ACCIDENTS.

There were seven accidents involving winding machinery. Five of these were overwinds, in one case a winding rope on a bailing tank broke and in another a trailer skip became derailed.

Overwinds.

(1) This was an error in judgment on the part of the driver. Overwind gear operated and no damage was done.

(2) The brake lever slipped to the "off" position when bailing tanks were out of balance. One tank went to the bottom and some damage was done to ropes.

(3) The throttle jammed and the end of the rope was pulled into the engine room. The only damage was a broken indicator.

(4) A skip was overwound during tests on spillage. No damage was done.

(5) The driver's attention was distracted and he failed to reverse his engine. Counterweight and guides were damaged.

Broken Rope.

(1) The rope on a bailing tank broke during bailing operations.

Skip Derailment.

(1) A trailer skip became derailed. There was no apparent cause.

PROSECUTIONS.

Ten persons were prosecuted under the provisions of the Mines Regulation Act. All prosecutions were successful and fines were imposed in every case.

The manager of a mine was prosecuted for rising without permission from the inspector.

The manager of a mine was prosecuted for breach of the ventilation regulations.

Three men were prosecuted for breaking ventilation and sanitation rules, three for firing at unauthorised times and two for failure to guard the approaches to a shot.

EXEMPTIONS.

In accordance with the provisions of section 34, subsection 4 of the Mines Regulation Act, 1906-38, fifteen certificates were issued, exempting the holders from the operations of sub-section 1 (b) of the same section. In 1944 the number of certificates issued was 20.

SUNDAY LABOUR.

Eighty-seven permits to work on Sunday were issued under section 54 (4) of the Coal Mines Regulation Act, 1902-26, to various mines in the Collie Coalfield.

ADMINISTRATION.

(Amendments of Acts).

The Mining Act, 1904-1937.

(a) Mining Act Amendment Act, 1945, amending section 277 (formerly section 297A).

(b) Amendment to Regulations 98, 99, 127, Forms Nos. 57, 69, 70 and 71, and Lease Forms Nos. 1, 2, 3, 4, 5, 6 and General Lease Form. Gazetted 29/6/1945.

Mines Regulation Act, 1906-1938.

(a) Amendment to Regulation 7. Gazetted 16/3/1945.

(b) New Regulation 15A—Use of locomotives underground. Gazetted 14/12/45.

Inspection of Machinery Act, 1921.

(a) Amendment to Districts and boundaries thereof as provided by section 5. Gazetted 9/2/1945.

Mine Workers' Relief (War Service) Act, 1940.

(a) Mine Workers' Relief (War Service) Amendment Act, 1945, amending section 3.

VENTILATION.

Inspector Lloyd's report on his work as ventilation officer is quoted in full hereunder:—

> During the early part of the year, considerable difficulty was experienced, owing to war conditions, in obtaining materials necessary for the proper ventilation of "dead end" places, and had it not been for the co-operation of the management and men in scouring disused and abandoned workings and salvaging old galvanised piping, the greater portion of the already restricted development work must of necessity have ceased.
>
> Even when damaged piping had been reconditioned, it was frequently found there was insufficient length to allow the machine man to keep his venturi cloth up to the face. Venturi cloths were in very short supply and frequently in a poor state of repair owing to lack of manpower for repairing same. Such places were always found to be fairly well watered.

In order to overcome the difficulty in obtaining venturi cloths, brought about mainly through shortage of rubber, a number of mines placed orders with a local firm of tent makers for supply of venturis manufactured from canvas, but on account of the humid conditions underground and severe treatment to which they are subjected, together with the fact that under high pressure from a fan, the weave permits the air to escape and so reduce the discharge output, these were found to be unsuitable.

Since the cessation of hostilities in the latter part of the year and the revival of the mining industry, mining companies have become most eager to push on with their development programmes. There is still an acute shortage of material and in my opinion this will continue for some time.

During the year, the temperatures throughout the mines, except where difficulty was experienced in obtaining men for winze sinking, thus resulting in faulty ventilation of the mine, were found to be reasonable and within those laid down in the Regulations. Where temperatures exceeded these figures, and material was not available, or due to manpower shortage, winze development could not be continued in order to improve the ventilation conditions of a particular working place, the place was stopped and the men withdrawn.

In connection with the matter of introducing Kata standards to regulate conditions in mines, a series of readings, together with the temperature and velocity were recorded in a number of mines in the various districts.

Accidents.

Accidents from fumes as reported to this office for the year were as follows:—

	Serious.	Minor.
East Coolgardie Goldfield ..	Nil	21
Dundas Goldfield	Nil	5
Total	Nil	26

In most cases, the employee returned to work either the following day or within a few days and invariably did not seek medical advice.

All managers of mines situated in or about Kalgoorlie have been informed that fuming accidents, whether regarded as serious or otherwise, must be immediately reported to this office in order that the working place may be inspected and statements obtained from any witness.

Prosecutions.

There were six prosecutions undertaken during the year for breaches of the Mines Regulation Act, 1906-38, in respect to ventilation and in all cases a conviction was recorded and a fine imposed.

Dust Sampling.

Owing to staff shortage I was again called upon to carry out general inspection duties and consequently dust sampling was carried out on a restricted scale. It will be noted the average count of particles registered in levels, stoping and development shows an increase over the figures as registered in previous years and is accounted for by the fact that sampling was carried out for only approximately one-third of the year.

A summary of dust sampling will be found on page 19.

GOLD MINING.

The ore production 1,736,952 tons, and the gold yield 469,906 fine ounces for this year are very nearly the same as for last year. The corresponding figures were 1,777,128 tons and 472,588 fine ounces.

The average grade of 5.41 dwt. per ton is slightly higher than the figure of 5.32 dwt. per ton for the previous year.

DUST SAMPLING.

Summary of Samples taken during 1945.

Month.	Level.		Development.		Stoping.		Surface.		Number of Places showing count of 1,000 p.p.c.c.			
	No.	Average Count.	No.	Average Count.	No.	Average Count.	No.	Average Count.	Level.	Development.	Stope.	Surface.
January	...	...	...	...	...	...	...	...	...	...	...	...
February	8	168	...	...	...	...	...	...	1	...	...	...
March	...	...	...	...	...	...	...	...	...	...	...	...
April	...	...	3	426	1	279	...	...	...	...	...	...
May	1	175	3	270	5	311	...	...	...	...	...	...
June	...	...	8	263	11	231	2	381	...	1	...	...
July	...	...	...	...	...	...	...	...	...	...	...	...
August	...	...	...	...	...	...	...	...	...	...	...	...
September	...	...	...	...	...	...	...	...	...	...	...	...
October	...	...	...	...	...	...	...	...	...	...	...	...
November	...	...	...	...	...	...	...	...	...	...	...	...
December	...	...	...	...	...	...	...	...	...	...	...	...
	9	169	14	299	17	257	2	381	Total 2			

The tonnage treated and gold won per man employed were 360.51 tons and 97.53 fine ounces, respectively, both of which are less than the corresponding figures, 387.7 tons and 103.2 ounces for the previous year.

Table E, which shows the gold output classified by districts according to the output of the individual mines, indicates an increased return from prospecting and small mines.

State Batteries treated 20,078 tons for a return of 18,113 ounces, which is an increase over the figures, 18,261 tons for 15,596 ounces in the previous year.

The number of mines producing 5,000 ounces and over for the year was 19, which is an increase of two on last year. The mines which have been added to the list are Mountain View and Emu Gold Mines, Limited.

Table G shows the output and yield for the principal mines of the State. Except for a decline on four mines, there has been a considerable improvement in output.

The work of rehabilitation has been commenced on some mines which did not produce any gold during the year.

Among smaller mines, the most successful were:—

Mine	Tons	Ounces	Dwt./Ton
Barbara	1,569	1,048	13.36
Blue Spec	4,722	1,375	5.82
Democrat	483	1,748	72.38
Lady Mary	595	835	28.10
Lister's	1,080	585	10.83
New Brew	485	1,160	47.84
Radio	769	627	16.31

Table D shows the production statistics for each year since 1929.

TABLE D.

Gold Production Statistics.

Year.	Tons Treated. (2,240 lbs.)	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 ozs.	£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	55·38	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

Note.—In this table the figures given are those reported to the Department by the various producers.

TABLE E.

Classification of Gold Output for 1945, 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.		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.	
		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.).	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	107	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ashburton Goldfield	39	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pilbara Goldfield—																											
Marble Bar	97	8	319	2	360	....	....	....	....	....	....	....	....	....	....	1	6,370	....	....	....	....	....	....	....	....	....	....
Nullagine	305	9	239	....	....	....	....	1	1,375	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Peak Hill Goldfield	13	4	189	2	340	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Murchison Goldfield—																											
Lawlers	77	6	184	....	....	....	....	....	....	....	....	....	....	....	....	1	7,017	....	....	....	....	....	....	....	....	....	....
Wiluna	446	3	45	3	349	....	....	....	....	....	....	....	....	....	....	1	5,834	....	....	....	....	1	35,016	....	....	....	....
Black Range	31	1	7	2	538	1	835	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Murchison Goldfield—																											
Cue	202	3	122	3	988	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Meekatharra	183	11	399	4	774	....	....	1	1,160	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Day Dawn	229	2	34	....	....	....	....	....	....	....	....	....	....	....	....	1	7,745	....	....	....	....	....	....	....	....	....	....
Mt. Magnet	162	7	241	3	707	....	....	....	....	....	....	....	....	....	....	1	8,430	....	....	....	....	....	....	....	....	....	....
Yalgoo Goldfield	11	10	403	2	463	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Margaret Goldfield—																											
Mt. Morgans	140	6	279	2	478	2	1,540	1	1,748	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Mt. Malcolm	41	6	333	1	370	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	20,792	....	....	....	....	....	....
Mt. Margaret	120	11	328	2	577	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North Coolgardie Goldfield—																											
Menzies	45	6	129	2	706	....	....	....	....	1	2,739	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ularring	280	3	141	3	449	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Niagara	75	2	35	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yerilla	58	....	....	1	180	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Broad Arrow Goldfield	511	15	306	4	770	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
North-East Coolgardie Goldfield—																											
Kanowna	134	1	31	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Kurnalpi	33	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
East Coolgardie Goldfield—																											
East Coolgardie	947	13	224	7	1,558	2	1,565	....	....	....	....	....	....	....	....	1	8,079	2	30,389	3	69,573	1	31,064	....	....	2	159,901
Bulong	23	1	51	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Coolgardie Goldfield—																											
Coolgardie	322	16	584	4	710	2	1,169	1	1,048	....	....	....	....	....	....	1	8,263	....	....	....	....	....	....	....	....	....	....
Kunanalling	260	1	5	3	526	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yilgarn Goldfield	130	17	551	3	851	1	627	....	....	....	....	1	3,779	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Dundas Goldfield	162	11	358	4	1,077	....	....	....	....	....	....	....	....	....	....	1	5,626	....	....	1	24,669	....	....	....	....	....	....
Phillips River Goldfield	....	2	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
State Generally	55	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	5,238	175	5,545	57	12,771	8	5,736	4	5,331	1	2,739	1	3,779	....	....	8	57,364	2	30,389	5	115,034	2	66,080	....	....	2	159,901

TABLE F.

Classification of Gold Output, 1941–1945.

Range of Output.	1945.			1944.			1943.			1942.			1941.		
	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	127,149	15·0	1	170,550	15·4
50,000–100,000	2	159,901	34·1	2	155,870	33·0	3	202,875	38·1	2	146,795	17·4	4	279,155	25·2
40,000– 50,000	...	...	...	...	...	...	...	...	...	2	87,082	10·3	3	131,557	11·9
30,000– 40,000	2	66,080	14·0	1	39,030	8·3	...	...	...	4	134,164	15·8	1	38,145	3·5
20,000– 30,000	5	115,034	24·5	5	123,141	26·0	5	121,408	22·8	3	69,679	8·2	6	146,278	13·2
10,000– 20,000	2	30,389	6·5	4	56,193	12·0	8	115,886	21·8	7	101,217	12·0	8	107,847	9·8
5,000– 10,000	8	57,364	12·2	5	43,143	9·1	4	24,407	4·6	7	49,124	5·8	9	62,514	5·6
4,000– 5,000	...	...	...	3	13,125	2·8	2	8,329	1·6	4	19,032	2·3	3	12,796	1·2
3,000– 4,000	1	3,779	0·8	...	...	...	3	9,626	1·8	5	16,999	2·0	5	16,992	1·5
2,000– 3,000	1	2,739	0·6	2	4,990	1·0	1	2,276	0·4	4	9,692	1·2	5	11,018	1·0
1,000– 2,000	4	5,331	1·1	3	4,435	0·9	4	5,250	1·0	9	12,946	1·5	19	27,040	2·4
500– 1,000	8	5,736	1·2	11	7,614	1·6	14	9,635	1·8	27	18,253	2·2	35	24,906	2·3
100– 500	57	12,771	2·7	72	15,598	3·3	87	21,345	4·0	130	29,963	3·5	180	41,730	3·8
Under 100	175	5,545	1·2	155	4,753	1·0	193	5,127	1·0	330	10,569	1·2	396	13,193	1·2
Sundry Claims, P.A's., etc.	...	5,238	1·1	...	4,696	1·0	...	5,583	1·1	...	13,108	1·6	...	21,696	2·0
Total	214	469,907	100·0	263	472,588	100·0	324	531,747	100·0	535	845,772	100·0	675	1,105,477	100·0

Note.—Individual producers include private and State Battery cyanide treatment plants.

TABLE G.—MINES PRODUCING 5,000 OUNCES AND UPWARDS FOR THE PAST FIVE YEARS.

Mine.	1945.			1944.			1943.			1942.			1941.		
	Tons treated.	Ounces Gold.	Dwt. per Ton.	Tons treated.	Ounces Gold.	Dwt. per Ton.	Tons treated.	Ounces Gold.	Dwt. per Ton.	Tons treated.	Ounces Gold.	Dwt. per Ton.	Tons treated.	Ounces Gold.	Dwt. per Ton.
1. Big Bell Mines, Limited	....	....	....	....	....	....	26,354	4,220	3·20	376,550	46,117	2·45	423,420	45,984	2·17
2. Blue Bird Gold Mines, N.L.	....	....	....	....	....	....	154	243	31·56	1,590	1,517	19·08	3,569	4,214	23·61
3. Boulder Perseverance, Limited	85,806	23,666	5·52	75,987	20,389	5·37	81,965	22,985	5·61	107,377	32,757	6·10	121,313	38,145	6·29
4. Burbidge Gold Mines	....	....	....	....	....	....	4,350	411	1·89	29,920	2,634	1·76	45,115	5,107	2·26
5. Central Norseman Gold Corporation,	73,488	24,669	6·71	71,521	29,675	8·30	76,864	27,089	7·05	89,085	39,994	8·98	121,212	53,913	8·89
6. Comet Gold Mines, Limited	10,515	6,370	12·12	12,968	13,125	20·02	12,905	13,265	20·56	12,977	13,324	20·54	15,844	12,221	17·32
7. Consolidated Gold Areas	....	....	....	....	27	....	8,127	2,276	5·60	22,195	5,762	5·19	31,152	6,642	4·26
8. Consolidated Gold Mines of Coolgardie, Limited	890	145	3·26	20,745	2,267	2·18	32,983	5,127	3·11	43,169	8,252	3·82	72,507	13,175	3·63
9. Cox's Find (Western Mining Corporation, Limited)	....	....	....	....	....	....	....	....	....	5,636	3,236	11·48	21,890	12,397	11·33
10. Edna May Amalgamated Gold Mines, Ltd.	10,861	3,779	6·96	12,409	4,271	6·88	8,681	3,332	7·68	11,797	5,684	9·64	17,371	9,367	10·78
11. Emu Gold Mines, Limited	27,541	7,017	5·09	18,816	4,539	4·82	28,567	7,049	4·93	30,827	7,792	5·06	18,484	3,119	3·37
12. Evanston Gold Mine	....	....	....	....	1,335	....	3,120	796	5·10	9,959	4,448	8·95	15,284	6,219	8·01
13. First Hit Gold Mine	4,410	2,739	12·42	5,850	4,315	14·75	4,260	3,099	14·55	5,624	3,849	13·69	7,760	5,397	13·91
14. Gladiator Gold Mine	....	....	....	....	....	....	....	....	....	18,733	4,876	5·21	29,220	6,034	4·13
15. Gold Mines of Kalgoorlie, Limited	109,334	25,357	4·64	98,544	22,969	4·66	87,928	21,610	4·92	132,651	30,278	4·56	162,274	43,053	5·36
16. Great Boulder Pty. Gold Mines Limited	276,778	71,560	5·17	248,313	64,878	5·22	283,201	63,302	4·47	328,277	81,057	4·94	392,779	93,216	4·75
17. Hannan's North (Broken Hill Pty. Ltd.)	....	....	....	....	....	....	695	441	12·69	38,939	14,298	7·34	40,444	16,211	8·26
18. Hill 50 Gold Mine, N.L.	31,108	8,430	5·42	32,082	9,571	5·98	36,459	10,054	5·52	38,068	11,533	5·90	30,863	10,688	6·93
19. Kalgoorlie Enterprise, Limited	40,889	11,861	5·80	37,349	9,490	5·08	54,027	16,110	5·96	62,241	19,911	6·40	70,806	22,495	6·35
20. Lake View and Star, Limited	279,579	88,340	6·32	278,171	90,990	6·54	260,720	87,196	6·69	402,071	127,149	6·32	618,191	170,550	5·52
21. Moonlight Wiluna, Limited	19,117	5,834	6·10	75,375	12,019	3·19	100,577	17,790	3·54	113,791	24,798	4·36	105,881	26,141	4·94
22. Mountain View	1,495	7,745	103·62	....	....	....	....	....	....	....	....	....	....	....	....
23. Norseman Gold Mines, N.L.	40,580	5,626	2·74	38,980	6,837	3·52	58,215	11,734	4·03	80,428	18,731	4·66	138,813	26,220	3·78
24. North Kalgurli (1912) Limited	107,737	31,064	5·77	91,444	27,443	6·00	78,181	25,721	6·58	115,488	40,965	7·09	140,911	45,415	6·44
25. North Kalgurli (Croesus Section)	....	....	....	....	....	....	....	....	....	7,488	2,172	5·80	65,450	14,025	4·27
26. Ora Banda Amalgamated, N.L.	....	....	....	1,295	1,103	17·04	16,230	4,109	5·06	20,745	5,262	5·07	24,065	6,649	5·52
27. Paringa Mining and Exploration Ltd.	81,378	20,550	5·05	67,295	15,446	4·50	74,108	17,104	4·62	83,798	22,185	5·29	92,289	22,460	4·87
28. Phoenix Gold Mines, Limited	29,431	8,263	5·61	28,507	8,061	5·66	24,719	6,695	5·42	28,214	7,942	5·63	33,831	9,631	5·69
29. South Kalgurli Consolidated, Ltd.	63,253	18,528	5·86	56,685	15,603	5·51	63,065	19,135	6·07	75,470	22,696	6·01	91,874	27,467	5·98
30. Spargo's Reward Gold Mine, N.L.	....	....	....	....	....	....	....	....	....	20,533	4,820	4·69	27,182	7,468	5·49
31. State Batteries	20,078	18,113	18·04	18,262	15,595	17·08	19,074	18,591	19·49	40,396	27,309	13·52	73,001	43,518	11·92
32. The Sons of Gwalia, Limited	67,871	20,792	6·13	72,653	22,657	6·24	75,774	24,003	6·34	99,004	31,135	6·39	134,365	42,520	6·33
33. Triton Gold Mines, N.L.	....	....	....	....	....	....	....	....	....	33,272	10,391	6·24	75,742	21,495	5·67
34. Wiluna Gold Mines, Limited	334,638	35,016	2·09	392,246	30,028	1·99	479,069	52,377	2·19	548,226	65,738	2·40	568,900	72,586	2·55
35. Yellowdine Gold Development Ltd.	....	18	....	3,756	1,997	10·64	14,695	5,536	7·53	27,687	8,430	6·09	41,097	13,711	6·67
36. Youanmi Gold Mines, Limited	....	....	....	....	....	....	....	....	....	3,893	2,825	14·51	73,858	17,023	4·61
Total	1,716,777	445,482	5·19	1,759,253	443,639	5·04	2,015,067	487,314	4·84	3,067,119	759,867	4·95	3,946,657	974,476	4·94
Other Sources (excluding large retreatment plants)	19,715	14,066	14·27	17,875	19,766	22·19	35,944	33,739	18·77	158,585	72,786	9·19	264,117	116,638	8·85
Total (excluding large retreatment plants)	1,736,592	459,548	5·29	1,777,128	463,405	5·22	2,051,011	521,053	5·08	3,225,704	832,743	5·16	4,210,774	1,019,114	5·18
Golden Horseshoe Sands Retreatment	....	8,079	....	....	9,183	....	....	10,694	....	....	13,029	....	....	12,421	....
Morgans Sands Retreatment	....	....	....	....	....	....	....	....	....	....	....	....	....	1,942	....
GRAND TOTAL	1,736,592	467,627	5·38	1,777,128	472,588	5·32	2,051,011	531,747	5·19	3,225,704	845,772	5·24	4,210,774	1,105,477	5·25

TABLE H.

Development Footages reported by the Principal Mines for 1945.

Goldfield.	Mine.	Shaft Sinking.	Driving.	Cross-cutting.	Rising and Winzing.	Diamond Drilling.	Total.
		feet.	feet.	feet.	feet.	feet.	feet.
Pilbara	Comet Gold Mines, Limited	25	671	276	282	...	1,254
	Blue Spec Gold Mines, N.L.	...	370	55	50	750	1,225
East Murchison	Emu Gold Mines, Limited	...	534	80	312	...	926
	Wiluna Gold Mines, Limited	...	2,334	1,443	1,371	265	5,413
Murchison ...	Big Bell Mines, Limited	...	290	51	300	313	954
	Hill 50 Gold Mines, N.L.	...	885	141	159	...	1,185
	Triton Gold Mines, N.L.	...	410	34	206	314	965
Mount Margaret	Sons of Gwalia, Limited	...	597	318	10	240	1,165
North Coolgardie	First Hit Gold Mine	...	308	134	77	1,172	1,691
	Porphyry Gold Mine	62	...	...	...	8,127	8,189
	Timoni Gold Mine	160	...	...	57	...	217
East Coolgardie	Boulder Perseverence, Limited	...	3,534	...	1,589	3,022	8,145
	Gold Mines of Kalgoorlie, Limited ...	...	3,804	1,400	1,711	4,695	11,610
	Great Boulder Pty. Gold Mines	25	7,384	1,828	2,085	6,258	17,580
	Kalgoorlie Enterprise, Limited	...	1,269	...	744	952	2,965
	Lake View and Star, Limited	...	6,137	1,332	2,438	6,952	16,859
	North Kalgurli (1912) Limited	...	4,510	1,295	1,595	5,058	12,458
	Paringa Mining and Exploration Co. Ltd.	98	1,957	797	515	2,759	6,126
	South Kalgurli Consolidated Ltd.	158	2,602	652	532	4,913	8,857
Coolgardie ...	Barbara Gold Mine	285	399	110	9	...	803
	Phoenix Gold Mine	...	282	20	45	...	347
Yilgarn ...	Edna May Amalgamated Gold Mines, Ltd.	...	426	288	188	430	1,332
	Edward's Reward	...	100	...	...	...	100
	Radio Gold Mine	...	85	35	...	...	120
Dundas ...	Central Norseman Gold Corporation, N.L.	...	4,982	171	1,073	5,420	11,646
	Norseman Gold Mines, N.L.	...	1,159	13	944	536	2,652
	Norseman Gold Mines (Iron King) ...	173	2,328	64	1,492	1,080	5,137
	Totals	986	47,357	10,537	17,784	53,256	129,920

OPERATIONS OF THE PRINCIPAL MINES.

EAST COOLGARDIE GOLDFIELD.

The total ore treated on this field during 1945 was 1,048,342 tons and the gold won was 303,373 fine ounces, which is an increase of about 10 per cent. on the figures for 1944. The average grade was 5.79 dwt. per ton, which is practically the same as for the previous year. The average number of men employed was 2,328 as against 2,067 for 1944. This year about 65 per cent. of the total production of the State has come from the East Coolgardie field.

The principal mines:—

Lake View and Star, Limited.

The average monthly output was 25,910 tons, compared with 26,265 tons for the previous year.

No mining was done on the Ivanhoe lease, and all productive work was confined to levels above the 2630ft. Horizon. 55.8 per cent. of the ore milled came from the Lake View and Associated Mines, and the balance of 44.2 per cent. from the Western Group.

The tonnage broken in stopes amounted to 215,363, 81·9 per cent, being in shrink stopes, 0·5 per cent. in filled stopes and 17·6 per cent in leading stopes.

Development footage for the year ending June, 1945, was 9,985·5 feet, being 1,284 feet more than the preceding year.

The so-called "minor lodes" received the most attention and good results were obtained for work done on the No. 3 lode West Branch, No. 1 lode, Chaffers East lode and Morrison's East lode.

A discovery was made at the 2120ft. level North of the Horseshoe No. 2 Shaft, where a North-West drive has been driven 76.5 feet in ore averaging 5.4 dwt. over 53 inches.

The No. 4 lode ore shoot in Chaffers was successfully developed at the 1200ft. and 2300ft. levels.

An ore shoot on the No. 2 Tetley's lode at the Lake View is being developed, and indications are encouraging for an extension of this fine ore body which, between the Associated 700ft. and 1000ft. levels, yielded a large tonnage of good grade ore.

At the Lake View 400ft. level an East crosscut was started and is being driven to intersect the No. 3 Cross lode. To date 154 feet has been completed, leaving 150 feet to be done to reach the objective.

No. 4 Lode.

A total of 503 feet of development work was completed. Driving amounted to 409 feet, of which 70 feet was in lode averaging 2·4 dwt. over a width of 50 inches and 339 feet in ore averaging 5·2 dwt. over 63 inches. All the work was done in the Chaffers Lease on the 1200ft., 1400ft., 1700ft. and 2360ft. levels.

No. 3 Lode.

Total of 211 feet of development was completed on the above lode. Driving accounted for 158·5 feet.

The 1200ft. level South Drive off the main crosscut from the Horseshoe No. 2 Shaft was advanced 44·5 feet in a strong lode which averaged 1.6 dwt. over 48 inches. The North drive on the 2180ft. level from the main crosscut off Chaffers Shaft was continued 114 feet in ore that averaged 4·2 dwt. over a width of 53 inches.

No. 2 Lode.

A total of 348 feet of development work was done on the No. 2 lode, the greater part of which was winzing done in preparation for stoping.

Minor Lodes.

A total of 3,835·5 feet of development work was completed.

Driving amounted to 3,268·5 feet, 176·5 feet being in the slide, 1,147 feet in lode averaging 2·6 dwt. over 50 inches and 1,945 feet in ore averaging 5·7 dwt. over 59 inches.

No. 1 Lode.

The main ore shoot on the No. 1 lode in the Horseshoe Mine was developed by North and South drives at the 1300ft. and 1400ft. levels.

Driving amounted to 276 feet, of which 252.5 feet was in ore worth 6·1 dwt. over a width of 57 inches.

Outstanding results were disclosed by the 1300ft. level North drive, which was advanced 171 feet in ore averaging 6·8 dwt. over 61 inches.

No. 6 Lode.

This lode was developed in the Horseshoe lease at the 2000ft. and 2240ft. levels. 207 feet of driving was completed. The only ore disclosed was at the 2000ft. level South 86 feet for 6·8 dwt. over a width of 123 inches.

No. 3 Lode West Branch.

Outstanding results were obtained from both the lateral and vertical development.

A total of 503·5 feet of driving was completed on the 2240ft., 2480ft. and 2630ft. levels, of which 462.5 feet were in ore averaging 6·4 dwt. over 61 inches.

The 2480ft. level North drive was advanced 233·5 feet in ore 5·7 dwt. over 53 inches.

Early in 1945 a West crosscut from the 2630ft. level No. 3 lode intersected the downward extension of this ore body. A north drive advanced 130 feet gave a result of 7·5 dwt. over 6 feet.

From the 2480ft. level winze 902 feet South at a depth of 42 feet intersected 288 inches of ore showing abundant free gold and telluride. It is impossible to estimate accurately the value of the ore by sampling, however, assay values from sectional samples show 23·85 ounces to the ton.

Chaffers East Lode.

600ft. and 800ft. levels—284 feet of driving was done. The South drive at the 600ft. level was advanced 77 feet in low grade material.

On the 800ft. level 150 feet of ore averaged 4·9 dwt. over 54 inches.

Morrison's East Lode.

Driving was carried out on the 400ft., 700ft., 1100ft., 1200ft., 1355ft. and 1525ft. levels. A total of 608 feet was completed, of which 252 feet were in ore averaging 5·2 dwt. over 55 inches.

700ft. level North drive was advanced 67 feet in ore 7·3 dwt. over 55 inches.

The work on the 400ft., 1355ft. and 1525ft. levels yielded poor results.

Associated Mine.

294 feet of development work was done on the 200ft. and 600ft. levels. Of this, 62.5 feet was in slide and 107 feet in ore that averaged 1·9 dwt. over 50 inches and 124 feet went 5·2 dwt. over 56 inches.

Lake View Mine.

2,722 feet of development work was done, driving 1,773 feet, of which 236 feet was in slide, 931 feet in lode averaging 2.4 dwt. over 49 inches and 606 feet in ore averaging 6·1 dwt. over 57 inches.

Driving was done on the 300ft., 400ft., 500ft., 600ft., 800ft., 1000ft., 1200ft., 1400ft., 1600ft. and 2300ft. levels.

On the 600 ft. level a North drive of 93 feet being in ore 6·1 dwt. over 53 inches. At the 1200ft. level East drive exposed 51 ft. of ore 7·3 dwt. over 64 inches. 1400ft. level South drive was extended 106 feet and averaged 5·2 dwt. over 57 inches.

Great Boulder Pty. Gold Mines, Limited.

Development.

1100ft. level—Driving on the Cross lode opened up payable values.

2 Lode West Branch has been advanced 80 feet in low values.

1200ft. level—A little crosscutting has been done of no importance.

1650ft. level—Intermediate level of the Ash lode has been extended by driving North and South in good values.

2190ft. level—Some driving on the 17 lode was done in low values.

2400ft. level—Driving and crosscutting done, but is not of much interest.

Main Shaft—Development.

At the 600ft. level Cross Caunter lode payable values were opened up.

700ft. level—The new lode section 41 to 44D was opened up for a distance of 300 feet in payable values.

Edwards Shaft.

This shaft has been repaired below the 2800ft. horizon and shaft sinking commenced.

Development.

1600ft. level No. 1 East lode was intersected and developed for 220 feet in payable values.

No. 1 East lode 210 feet of payable values was opened up.

1750ft. level—B lode was extended for 220 feet in the South drive for payable values, and on No. 1 East lode 200 feet was opened up in payable ore.

2050ft. level—A crosscut North-East is being driven to intersect Conroys lode, and is expected to cut it at another 80 feet.

2500ft. level—Main lode East branch was developed for 170 feet in good ore, and again on this level a crosscut has just cut Conroys lode.

2600ft. level—The main lode East branch was driven for 240 feet in low grade ore.

Lake Shaft—Development.

A little development was done on the 400ft., 500ft., 900ft. and 1000ft. levels. At the 10 on No. 1 East lode, 200 feet of driving opened up payable values of the distance.

Alluvial Quarry.

This quarry, or open cut, has worked throughout the year and has greatly assisted the tonnage. The ore appears to be patchy, but has been broken in a large body and treated.

The old tailings dump situated South of the fitting shop has been retreated, and this now leaves a large area for further exploration of the alluvial bearing ground.

North Kalgurli (1912) Limited.

North Kalgurli Shaft.

200, 300 and 400 Ley lode appears to be a caunter following an eastern shear. Leading stopes have been taken off and values are good.

200ft. level section 2 South—A lode is being worked with widths up to 15 feet. Still being developed and values are payable.

700 and 800 No. 2 Cross lode in section 2 North is being developed. The 800 is showing up well. This is in the main Cross lode channel.

All other levels that were being explored in the previous years are still being carried on.

An ore pass system has been completed at 3, 4, 5, 6 and 7 levels, and ore pocket loading stations have also been completed.

Kalgurli Shaft.

Australian East lode on the 4, 5, 6 and 8 levels, has been developed and stoped throughout the year, and produced good average grade ore.

On the 200ft. level N.E.D. West branch has been developed, and on the 4, 5 and 6 levels this lode has been stoped.

The main lode at the 10, 14 and 15 levels has been extended in good values.

On the 6 level a connection was made to the South Kalgurli. This has greatly facilitated ventilation.

During the year the main shaft has been retimbered and repairs carried out for 400 feet, leaving about another 400 to do.

On the 1600ft. level work is being carried out with a view to installing loco. haulage between the North Kalgurli shaft and the Kalgurli shaft. Before this can be finalised the North Kalgurli shaft will have to be sunk 400 feet.

There is still 700 feet of driving to be done on the 1600ft. level to make the connection.

Croesus Proprietary Plant.

Reconditioning is being carried on by the South Kalgurli Company.

Croesus Proprietary Poppet Legs.

It is anticipated that the old legs will be dismantled at an early date and steel legs put up in their place.

Development figures for this year show an increase of 2,000 feet over the preceding year.

South Kalgurli Consolidated.

During the year the Main Shaft was sunk a further 158 feet to a total depth of 2,128 feet.

A plat was excavated and a new level opened at a vertical depth of 2,050 feet.

Progressive exploration of various levels has been carried out as manpower became available, and a considerable amount of development and stoping was done on the cross lode series on different levels.

At the No. 3 level Hainault Shaft, the Lake View lode was developed and exposed for a length of 498 feet. Ore averaged 5 dwt. per ton over the width of the drive.

This company is still crushing its ore at the Kalgurli Ore Treatment plant, but latest information is that their engineers are busy re-conditioning the Croesus Proprietary plant.

Paringa Mining and Exploration Co. Ltd.

This mine has worked steadily throughout the year on the Main, South and Federal Shafts.

At the Paringa lease stoping and development work was carried out on some of the levels, and high grade ore was found in patches.

The 500ft. and 640ft. levels of the North Shaft again gave high values in stoping.

This same shoot is being worked at the 800ft. level.

The Federal Shaft was sunk to the 500ft. horizon, and levels are being driven. The exploration of this lease is being pushed and the general opinion is that it is going to open up exceptionally well.

The mill has been running continuously and giving good results.

Diamond drilling on the Northern lease, i.e., Cassidy's Hill, is still being continued and reports of the records of the holes drilled are promising.

Gold Mines of Kalgoorlie, Limited.

Iron Duke.

Development was chiefly on the Nos. 3, 5 and 9 levels. Ore continued on extensions of shears on these levels, particularly on Southern extensions of the B and C lodes on No. 5 level.

A fair tonnage of good grade ore was developed on the No. 9 level in the True Blue lease.

Australia East.

Developments on the Northern section continued to prove satisfactory and tonnage broken from the open cuts increased.

Oroya South.

Development of flat lodes in the hanging wall of the Cross lode proved a considerable amount of ore from the 9 to the 13 level in the Blue Gap lease.

The manpower position is improving and sufficient men have returned to increase tonnage to 10,000 tons per month.

Boulder Perseverance, Limited.

Development footage accomplished increased by 10 per cent. in comparison with the previous year. Tonnage broken decreased by 10 per cent., being about 60 per cent. of the pre-war figure. The amount of ore treated increased by 8 per cent. to about 70 per cent. of the pre-war figure.

Work was done on all levels from 500ft. to 2200ft. and at the end of the year the 200ft., 300ft. and 400ft. levels were being put in order for the resumption of work which had been suspended during the war years.

Kalgoorlie Enterprise Mines, Limited.

Filling with classified and thickened flotation tailings was continued in certain stopes, and other stopes were prepared for filling by this method.

A beginning was made with filling depleted shrinkage stopes above 9, 11 and 12 levels with old residues quarried from a dump. A 20 H.P. electric scraper-hauler was installed for this purpose, the filling being transported a distance of 1,000 feet by Diesel motor truck. Approximately 40,000 tons of filling was transported.

Ore treatment, ore breaking and development were carried on at the same scale as in the preceding year, being about 50 per cent. of the work done in the pre-war years.

Broken Hill Proprietary, Ltd.—Hannan's North.

This mine has just completed the installation of a new 6 inch G.I. main air line down the main shaft.

Five machines are at present breaking ore, and the plant is expected to start operations early in 1946.

There are about 60 men now employed.

Development work will be resumed at an early date.

MT. MONGER DISTRICT.

The following are the principal mines in the Mt. Monger District.

Haoma Mine.

This mine has completed its most successful year, and from 1,402 tons of ore mined, and treated in the Huntington Mill, 816.86 ounces of fine gold were obtained over the plates.

The development work carried out during the year was mainly to prospect and develop the 200ft. level. At a distance of 122 feet South of the Main Shaft, a crosscut was put out East for 40 feet and intersected a small reef carrying good values. This reef was driven on for 20 feet both North and South of the crosscut, when the values became poor in both faces.

Another crosscut was driven East at a distance of 30 feet North of the Main Shaft on the No. 2 level. It cut a small low grade reef 15 feet East of the main lode. This reef was driven on for 20 feet with values improving in the face.

Daisy Mine.

This mine mined and treated 689 tons of ore for a recovery of 483 fine ounces over the plates.

Development work was continued on the No. 2 and No. 3 levels on the footwall reef, and the vertical shaft was sunk 20 feet to a depth of 170 feet below the surface brace. This shaft was originally sunk vertically to the 100ft. level, where it struck the main lode, then

it followed the lode down on a Southerly pitch, at an angle of 45°, to the 300ft. level. When the footwall reef was located the shaft was continued vertically from the 100ft. level. The footwall reef was cut at 130 feet and is still in the shaft at 170 feet. When this shaft is completed it will improve the ventilation on the footwall reef and facilitate the hauling of ore.

Caledonian Mine.

This small mine is worked by a party of four, who obtained four good crushings for the year. The ore was obtained from development work on the 250ft. level, and stoping above this level.

COOLGARDIE GOLDFIELD.

The ore production for the year amounted to 37,953 tons, which yielded 12,886 fine ounces. The decline from last year's position is due to the closing down of the *Tindals Mine* early in the year.

Phoenix Gold Mines maintained their output for the preceding year and also carried out some development.

The *Surprise Mine* mined 1,240 tons for 465 fine ounces by amalgamation. Australian Mines Management and Secretariate have abandoned their option on the property.

Barbara Mine.—This mine was developed during the year under option conditions and results were saisfactory. The ore treated for the year was 1,569 tons and the return of gold was 1,048 fine ounces.

Lloyd George Mine was equipped with head-frame, ore bin, steam winch and self-tipping skip. Considerable development was done and 200 tons of ore were treated for a recovery of 51 fine ounces.

Spargo's Reward has been closed down since the cessation of the maintenance grant.

The *Lister Mine* produced 837 tons, which yielded 316 fine ounces of gold by amalgamation. A new treatment plant is in course of construction.

The *Premier Mine* was below last year's production with 230 tons for 326 fine ounces.

DUNDAS GOLDFIELD.

This goldfield produced 115,825 tons of ore yielding 31,891 ounces of fine gold. The tonnage treated is greater than for last year, while the gold yielded has fallen. The average grade of ore has fallen from 6·7 to 5.5 dwt. per ton.

Norseman Gold Mines treated 40,580 tons, a little more than they did in the previous year, but the yield of 5,626 ounces was less than for the previous year. This mine has had a very difficult time during the war years and its future success depends upon projected development.

Central Norseman Gold Corporation has operated the *Phoenix Mine* to produce 73,488 tons of ore, yielding 24,668 fine ounces, both tonnage and yield being lower than for the previous year. The average grade of 6·72 dwt. per ton was also less than for last year. A large amount of development has been done and some good ore has been opened up.

Development of the *Princess Royal Mine* has been continued and on the *Lady Miller*, diamond drilling has been commenced.

The *Second Try*, with 720 tons for 470 ounces, is the most successful of the small producers.

Some very good ore has been obtained from the *Onkaparinga*, the returns showing 194 tons for 331 ounces.

The *Bronzewing* treated 158 tons for a return of 155 ounces.

YILGARN GOLDFIELD.

In this field 15,038 tons were treated for a return of 5,937 ounces. There has been a reduction in the tonnage treated as compared with last year and the gold won amounts to only half of last year's production. This field depends upon a number of small mines for its production and these have been seriously hampered by lack of manpower and supplies.

Edna May Amalgamated is the largest mine in the field and this year produced 10,861 tons, yielding 3,779 ounces, which is about 88 per cent. of last year's output.

The *Radio* mined and treated 768 tons for a return of 627 ounces of gold by amalgamation. The tonnage treated is greater than for last year and the return somewhat less.

Sunshine Reward had rather a poor year to produce 1,220 tons of ore yielding 492 ounces.

The *White Horseshoe* obtained 252 fine ounces by amalgamation from the treatment of 329 tons.

BROAD ARROW GOLDFIELD.

Neither of the large mines, *Ora Banda United* and *Ora Banda Amalgamated*, produced any ore.

Prospecting shows, of which the most successful were *Kimra* and *New Mexico*, produced 1,587 ounces of fine gold.

NORTH COOLGARDIE GOLDFIELD.

The *First Hit* was taken over by tributers towards the end of the year. This year's figures of 4,410 tons treated for a return of 2,739 fine ounces are not as good as last year's return.

Prospecting was fairly active in the *Ularring District* and the production of 4,836 fine ounces is only slightly below last year's figure.

The *Porphyry Mine* at Edjudina is being systematically drilled.

MOUNT MARGARET GOLDFIELD.

The returns for this goldfield were also a little below those for last year. The total ore treated was 70,877 tons and the yield was 26,747 fine ounces.

The *Sons of Gwalia*, which mined and treated 67,871 tons for a return of 20,792 fine ounces, was responsible for most of the output.

The *Puzzle*, which produced 370 fine ounces from 275 tons, and the *Boomerang*, which produced 361 ounces from 43 tons, are the most successful among the smaller mines.

EAST MURCHISON GOLDFIELD.

The ore treated from this goldfield amounted to 383,960 tons, which is 35 per cent, less than for last year. The gold produced was 50,380 fine ounces, which is relatively high compared with last year's return on account of a higher average grade from the *Moonlight*. This mine has now closed down.

Wiluna Gold Mines, which treated 334,638 tons for 35,016 fine ounces, is near the end of its resources.

MURCHISON GOLDFIELD.

This goldfield produced 21,378 ounces from the treatment of 37,644 tons of ore. The gold won is greater than for last year, while the tonnage treated is less. The average grade of the ore treated has risen from 9·0 to 11·4 dwt, per ton.

Big Bell and *Triton* did not produce any gold during the year and *Hill 50* was slightly below the previous year's output, both in tonnage and grade, to produce 8,430 ounces from 31,108 tons.

The improvement in the output of gold is due to the very rich ore obtained by the *Mountain View* and to good returns from the smaller mines, of which *New Brew*, with 1,160 ounces from 485 tons, was the most successful.

PILBARA GOLDFIELD.

The ore treated was 17,744 tons and the gold recovered was 9,065 ounces. The rise in tonnage treated is due principally to the operations of *Blue Spec*, which

treated 4,722 tons for a return of 1,375 ounces. The very considerable reduction in the gold output is due to the falling off in the grade of the ore treated at the *Comet Mine*. The treatment of 10,515 tons for 6,370 ounces indicates a grade of 12·12 dwt. per ton as compared with 20·02 for the previous year.

COAL MINING.

The output of the Collie Coalfield during 1945 as compared with 1944 is shown in the following tabulation:—

Mine.	1945.		1944.	
	Tons.	Value £A.	Tons.	Value £A.
Proprietary	127,229	138,154	143,159	155,354
Co-operative	62,113	68,439	76,687	84,009
Cardiff	60,034	62,069	76,095	79,574
Stockton	90,029	97,854	107,449	114,682
Stockton Open Cut	112,781	114,219	66,779	65,527
Total, Amalgamated Collieries	452,186	480,735	470,169	499,146
Griffin	77,699	78,303	78,482	74,706
Wyvern	13,478	13,857	9,670	9,224
Total, Griffin Co.	91,177	92,160	88,152	83,930
Grand Total	543,363	572,895	558,321	583,076

The output from the Open Cut has been increased from 66,779 tons to 112,781 tons, an increase of approximately 46,000 tons, but in spite of this, the total output has declined by 29,500 tons. The average number of men employed was 860, which is 20 less than were employed in the previous year.

Proprietary Mine.

The number of working places in this mine is 110, as compared with 112 last year. The haulages at 10 and 11 levels were converted from D.C. to A.C. This has released the converter set on the surface, which has been transferred to the Co-operative Mine. Development has made fair progress.

Co-operative Mine.

Fifty-seven places were available for coal production in this mine as against 54 in the previous year. The stone drive on the main dip has holed through and the haulage is now being graded. The motor-converter from the Proprietary has been installed. Increased output from this mine is expected in the coming year.

Cardiff Mine.

The extraction of pillars is proceeding on this mine. The coal beyond the fault is being bored with a view to opening up this section.

Stockton Mine.

At the close of the year 46 places were available for the production of coal and coal is also being won from the bottom of the seam in places previously worked. The use of a scraper loader in the dip headings has increased the rate of development.

Stockton Open Cut.

Production from this source has been greatly increased and the coal thus won has been of great value in emergencies. The area has been extended to take in sections already mined by bord and pillar methods which still contain much coal in the pillars.

Griffin Mine.

Four scraper loaders are being used here and there are 34 places for hand mining. The output has been well maintained and this year's production is almost equal to that of last year. The dip headings struck a downthrow fault, but it has been possible to work round it and the main development will be commenced again.

Wyvern Mine.

Although the output from this mine is greater than for last year, it is not as great as was anticipated. Development has been retarded by difficulty in securing equipment and some faults have been encountered. Water has also caused some trouble.

Conclusion.

What might have been a good year has been spoiled by industrial troubles. The actual rate of production has been much as for the previous year, but two major stoppages have had a disastrous effect on the output.

All coal produced was distributed by the Western Australian Coal Committee.

During the year the Collie mines were inspected by Mr. A. Donne, manager of the State Coal Mine, New South Wales, who submitted a report to the Government.

Coal in the Northern Districts.

Investigations at the Irwin River revealed one seam of about 5 feet in thickness, but the coal was rather high in ash.

Operations have been resumed at Eradu, but on account of limited supplies of cement it has not been possible to make a great deal of progress.

MINERALS OTHER THAN GOLD AND COAL.

This year has been notable for the expansion of industrial mineral production, Alunite, Asbestos, Gypsum and Pyrites all showing substantial increases on last year's figures. There has been little demand for strategic minerals. No Tantalite has been produced, apart from the Tin-Tantalite deposit at Greenbushes, and no Mica has been mined. The production of Beryl has also declined owing to the lower prices now offering.

The total value of mineral production other than gold and coal for the year amounted to £321,170 as compared with £236,792 for the previous year.

Alunite.

The Department of Industrial Development has continued operations at Chandler. Alterations to plant have produced an improvement in the tonnage treated, and the percentage of potash recovered. The unit price received for the product has also improved. The tonnage treated this year was 21,628 tons, as against 19,236 tons treated last year, and the potash produced was 1,359 tons, as against 943 tons, the value being £23,902, as against £14,229.

Antimony.

No antimony was marketed during the year. The production of antimonial concentrates is proceeding at Blue Spec, but none has yet been shipped.

Arsenic.

The production of arsenic has declined from 2,304 tons valued at £48,384 to 1,989 tons valued at £41,771. With the cessation of gold mining at Wiluna, the production of arsenic in the State will cease.

Asbestos.

The total production of asbestos for the year is compared with last year's production below—

Variety.	1945.		1944.	
	Tons.	Value £.	Tons.	Value £.
Crocidolite	991	42,873	273	9,973
Chrysotile	20	918	12	656
Anthophyllite	81	870	23	226

Crocidolite.

The expansion of the industry has proved that the fibre produced is of high quality and can compete with similar products from other sources. The development of the mines has shown that the deposits continue underground from the faces of the gorges.

The establishment of the industry on a scale where it can produce fibre at a profit still calls for considerable outlay and expansion, but the early stages of development have been negotiated in the face of considerable difficulty.

The remote situation of the mines accentuates the transport troubles, which are common at the present

time. Shortages of manpower, of plant and of building materials have also affected the development programme adversely.

The plant of Australian Blue Asbestos, Limited, is illustrated by photograph.

Chrysotile.

The production of chrysotile has claimed some attention during the year and a good demand exists for white fibre in the milling grades. The known deposits produce a high percentage of spinning grades and this product is not so easily marketed. White asbestos occurs over a large area of country, but is not so regular in its occurrence or in quality as the blue. Mining has been limited to exploitation of high grade deposits by small syndicates.

Anthophyllite.

Associated Engineers Corporation has erected a plant at Fremantle, where the ore from Bindi Bindi is milled. The plant produces a satisfactory product, which is marketed in three grades.

Production for the year was 81 tons valued at £870.

Bentonite.

Production of this mineral declined. The tonnage produced at Marchagee was 50 tons valued at £120.

Beryl.

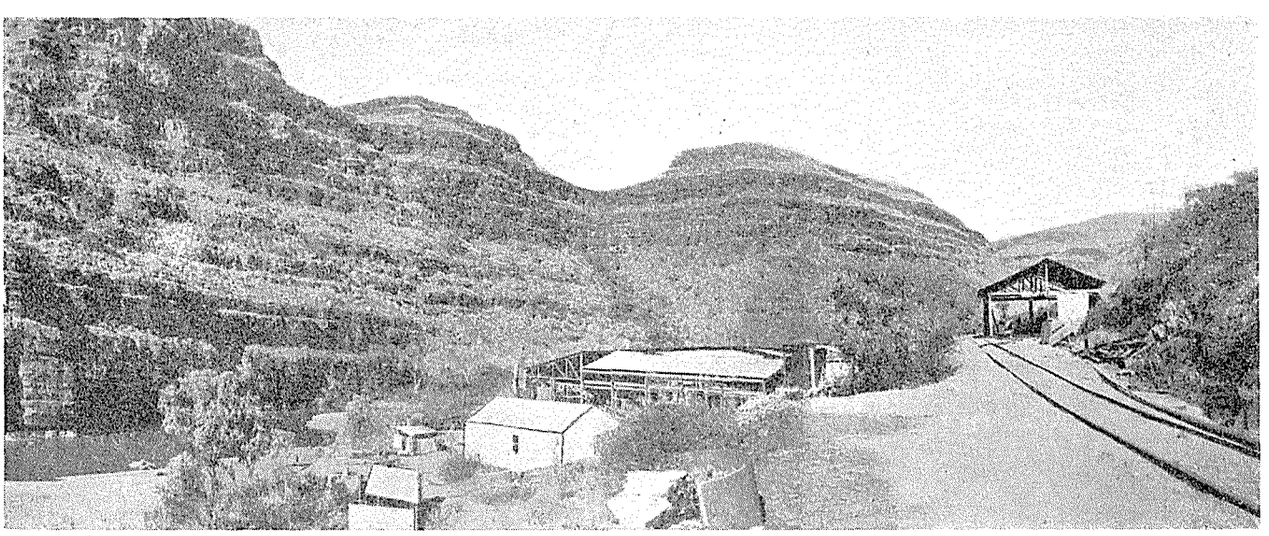
The prices now offering for beryl are lower than those obtained previously and prospectors have not been interested to any great extent. The year's production of 34 tons valued at £953 contains a parcel of 19 tons from the felspar quarry at Londonderry.

Bismuth.

Small parcels of bismuth are produced from Yinnietharra. The production for this year is 506 lb. valued at £152.

Clays.

The total production of clays, excluding Bentonite, amounted to 2,363 tons valued at £1,424. The heavy demand for building materials is reflected in the increase over last year's figures of 1,615 tons valued at £1,726.



Plant of Australian Blue Asbestos, Limited, Wittenoom Gorge.

Copper.

The output of metallic copper was 23·5 tons derived from Lawlers and Field's Find. The concentration plant at Ravensthorpe treated trial parcels of copper-gold ore. The smelting of concentrate produced a matte and a roasting furnace to reduce the sulphur content has been added in the smelting section. Accumulated concentrates will be smelted early next year.

Diatomaceous Earth.

No production was reported for the year.

Dolomite.

Local industries absorbed the output of 105 tons valued at £502 from Mount Magnet.

Felspar.

A further fall of 700 tons was experienced in the year's production from the Australian Glass Manufacturers Company's quarry at Londonderry. The shortage of manpower and difficulty in securing shipping have adversely affected the production of Western Australian felspar and a larger proportion of the company's requirements is obtained elsewhere. The production for the year was 1,234 tons valued at £4,321.

Glass Sand.

The production of 175 tons valued at £227 is comparable with the figures for the previous year.

Glauconite.

This mineral is obtained from the Gingin greensand. The quantity won was 180 tons valued at £4,500, the figures being slightly higher than those for the previous year.

Graphite.

No production was reported.

Gypsum.

Compared with the figures for the previous year, there has been a big increase in production. Figures for this year are 7,233 tons valued at £9,136 and for the previous year 3,604 tons valued at £3,722. The local manufacturers of plaster board use most of this material.

Kyanite.

A parcel of 20 tons of this material realized £100. It was obtained in the vicinity of Bridgetown.

Phosphatic Guano.

The British Phosphate Commission produced 8,483 tons valued at £46,656.

Pyrites.

The Iron King Mine stepped up its production to obtain 66,504 tons of concentrates and crushed ore valued at £102,053. This is a big increase on last year's production of 23,702 tons valued at £68,340.

Diamond drilling has revealed a considerable body of ore and further development below No. 4 level is being carried out. The programme provides for the sinking of six winzes.

Red Ochre.

This mineral is obtained from Wilgie Mia and from Opthalmia Ranges. The total production for the year was 650 tons valued at £3,086, being slightly less than the production for the previous year.

Silver.

The quantity of silver exported amounted to 146,025 fine ounces valued at £22,757. The whole of this output was obtained as a by-product in the mining of gold.

Soapstone.

No production was reported during the year.

Tin.

The total production was 22 tons valued at £4,370. Greenbushes produced 11 tons and 11 tons was produced in the Pilbara.

Tin-Tantalite.

Dredging operations at Greenbushes have produced 6 tons of tin-tantalite concentrate. The actual value will depend upon the results of treatment. The approximate value is £980.

Tungsten.

The only producer was the Edna May Mine at Westonia, which continued treatment of residues for the recovery of wolfram and scheelite. Operations yielded 26 tons of concentrate valued at £8,946.

Vermiculite.

The Young River deposits were worked for a return of 59 tons valued at £254. This is lower than the figure for the previous year, which was 123 tons valued at £738. The whole output was processed by the local manufacturers.

CONCLUDING REMARKS.

There is little of importance to note in the gold mining industry for the year so far as production is concerned. Shortage of manpower and materials prevented full advantage being taken of the cessation of hostilities. Mines such as Big Bell, Triton and Hannan's North were preparing at the end of the year for full scale resumption of operations, but will probably not be in full production until the latter half of the current year.

The number of men engaged in the industry was about 200 higher than in 1944, as the release of servicemen had not reached large proportions at the end of the year.

The average price of gold for the year reached an all-time high level at 213·87s. per fine ounce, the previous record being 213·70s. in 1941.

It is confidently anticipated that the gold mining industry will now advance steadily and resume its former pre-eminence in the State.

Coal production for the year was 15,000 tons behind the 1944 production, a very unsatisfactory position, considering that the demand had increased. Two serious industrial stoppages contributed largely to this deficiency, and only the fact that the Stockton Open Cut produced 112,000 tons, 46,000 tons above previous year's output, saved the State from a disastrous coal shortage. Imports of coal from New South Wales were insufficient to make up the local deficiency and industry was much hampered generally in consequence.

Mr. Arthur Donne, Manager of the Lithgow State Colliery in New South Wales, was engaged late in the year to advise the Government on ways and means of increasing production, and it is anticipated that the implementation of his recommendations will bring about a more satisfactory state of affairs.

The value of minerals other than gold and coal produced for the year shows a considerable increase over the previous year, due principally to increased production of pyrites, asbestos, phosphatic guano and alunite.

Some interest is being shown in the kyanite deposit at Yanmah, the 20 tons produced being a trial parcel. A large and valuable deposit is indicated in this locality if the tests prove the material to be satisfactory.

The rehabilitation of the mining industry generally has entailed extra work on the part of the technical staff, and I wish to record my appreciation of the loyal support of the Assistant State Mining Engineer and all Inspectors of Mines during the year under review.

I would also like to take this opportunity to acknowledge the friendly co-operation and assistance rendered by all Departmental officers with whom I have had dealings.

JOHN S. FOXALL,
State Mining Engineer.

APPENDIX No. 1.

Coal Mines Regulation Act, 1902-1926.

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

Office of the State Mining Engineer,
Mines Department,
Perth, 2nd April, 1946.

The Under Secretary for Mines.

Sir,—We submit herewith, for the information of the Hon. Minister for Mines, the Annual Report of the Board of Examiners for the year 1945.

Examinations for Certificates.

Examinations for both First and Second Class Certificates were advertised to be held in April and October, but no candidates were forthcoming.

Meetings.

As there was no business to be transacted, it was considered unnecessary to call any meeting of the Board during the year.

No examinations being held, there were no papers available for exchange with kindred Boards.

We have the honour, etc.,

(Sgd.) JOHN S. FOXALL,
State Mining Engineer,
(Chairman.)

(Sgd.) H. A. ELLIS,
Government Geologist,
(Member.)

(Sgd.) JAMES GILLESPIE,
Inspector of Mines, Collie,
(Member.)

APPENDIX No. 2.

REPORT ON ACTIVITIES OF BOARD OF EXAMINERS FOR UNDERGROUND SUPERVISORS FOR 1945.

Mines Department,
Kalgoorlie, 22nd January, 1946.

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

I beg to submit the underground report on the operations of the Board of Examiners for Underground Supervisors during the year ended 31st December, 1945.

A total number of twenty-two candidates sat for examinations. Nineteen at Kalgoorlie, one at Menzies, one at Norseman and one at Perth.

Examinations were held in June, October and December. The oral examinations in June were conducted by Mr. E. E. Brisbane, Dr. B. H. Moore and Mr. Verran. In October by Mr. J. S. Foxall, Dr. Moore and Mr. Verran in Kalgoorlie and by Mr. J. E. Lloyd at Norseman. One in December was conducted by Dr. Moore and Mr. Verran, and another in December at Perth by Mr. Foxall, Mr. Brisbane and Dr. Moore.

Of the twenty-two candidates who sat for examination, nineteeen were successful in obtaining certificates.

Two duplicate Certificates of Competency were issued during the year.

No Certificates of Service or Duplicate Certificates of Service were issued.

Following are the names of persons to whom certificates were granted:—

Underground Supervisors' Certificates of Competency.
1945.

575 Barrett, Charles Albert.
580 Beatson, Keith Alexander
581 Benbow, Charles Alfred.
582 Boyd, John Porter.
583 Cockram, Charles.
576 Dewar, Franklin Hector.
584 Davidson, Roy Elyn.
585 Fowler, Francis Kersley.
586 Good, David William Norman.
587 Hume, Allan.
588 Illingworth, James Cedric.
577 Maley, George Morrison.
589 Marshall, Daniel Leonard Stanley.
593 McCann, Richard Leslie.
594 Powell, George W.
590 Reibel, Richard Louis.
578 Sweetnam, William.
579 Usher, Edward John.
591 Westlow, Robert Herbert.

Duplicate Certificates of Competency.

592 Marriott, Robert Brown.
595 Morris, Leslie William.

(Sgd.) BRON FARISS,
Secretary to Board of Examiners
for Underground Supervisors.

APPENDIX No. 3.

THE FUTURE OF GOLD MINING IN WESTERN AUSTRALIA.

By C. F. ADAMS, B.E., F.S.A.S.M.
District Inspector of Mines, Cue.

Much has been written recently in current periodicals and the daily press, concerning the role to be played by gold after the present war.

The general concensus of opinion is that gold will at least maintain its value for a considerable time to come, with the possibility of a rise rather than a fall, which is my interpretation of the jargon customarily adopted by the economics wizards of the day. In the main there are two simple reasons for this statement; firstly the straightening out of the chaos in Europe is not possible while there is a multiplicity of paper currencies without backing, and in which nobody, including the holders, has any faith. The second reason is that the British Empire, Russia, and America in that order produce between them almost all the world's gold. A third reason could be added. It is that the next war, which is inevitable, will be financed, as ever, through the medium of gold, by those possessing it, after having been provoked by those who have none.

In passing it is interesting to recall that not so long ago, fears were expressed by many that America might refuse to take any more gold from overseas, since she was holding gold to the extent of 22,500 million dollars. At the present day this sum represents approximately one quarter of the war expenditure of Great Britain alone.

If then, gold is necesary to the world as a whole we are entitled to assume that there is a future for the mining of it in this State. The signs at present are that mine operators, from the smallest to the largest, are becoming increasingly aware of this fact, and are on the look out for suitable prospects.

From the point of view of anyone with capital to invest the immediate future of gold mining in the West is bound up with:—

(1). The treatment of ultra low grade surface deposits which will probably be made possible by the use of modern earth moving equipment and special methods of milling.

(2). The location of new deposits. By present methods of prospecting the odds against finding new deposits are fairly high, and are a function of the size of the deposit, its distance from civilisation, and from the nearest hotel. It is however to be expected that great advances will be made in the technique of geophysical prospecting probably through the medium of ultra short wave radio, though nothing tangible can be expected for many years to come. Since the intention here is to deal with the immediate future of gold mining, geophysical methods must be discarded for the time being, but the time will surely come when ore bodies will be precisely determined quantitatively and qualitatively by this means, and it is suggested that major mining companies should subsidise research in geophysics to a much larger extent than they do.

(3). The rehabilitation of known deposits which have been partly worked. There are many such deposits which will at least bear a preliminary investigation and the idea behind this paper is to present such an investigation of the Nannine area, and to show that the combination of circumstances now existing in respect of this area warrants its consideration by an operating group of medium size.

The information here presented has been gathered from the lease registers in the Mining Registrar's Office at Meekatharra, the annual reports of the Mines Department's Statists, and notes of various Inspectors of Mines. It is also based on information contained in Bulletin 14 of the Geological Survey, the geological plan facing page 60 of the same Bulletin, and the tracing accompanying this paper, which is taken from the plan in the Mining Registrar's Office at Meekatharra.

Here follow some explanations which should simplify the study of the figures presented.

At the top of each table of production figures will be seen an apparently jumbled set of numbers, which are lease numbers taken from the lease register. During the history of most mines ground is pegged and repegged with slight differences many times, and if a repegged lease is not identical with a former lease it gets a new name and number, but often takes in parts of several old leases all with different numbers. The result is that it is a laborious business to trace production figures from a given patch of ground that has changed its number many times. This work has, however, been done in the case of all figures shown here, and the jumbled set of figures referred to above represents a rough figure diagram of the leases. The top line of figures gives the numbers of the leases as they existed in 1904 when Bulletin 14 was printed, and as they are shown on the geological plan facing page 60. The bottom line of figures represents the numbers as shown on the current lease plan, a tracing of which is supplied. Intermediate figures represent repegging between the two periods showing approximately, various overlappings. Many intermediate figures have been omitted for simplification, since no production figures were quoted, the leases apparently having been repegged for sale or "dummying" purposes. In the figure diagram the left hand side of the page represents the Northern end, with South on the right.

It will be noted that some of the figures are followed by the letter N, while others are not. In the early days it was customary to add a letter, usually the first letter from the name of the centre, to all lease numbers, but this practice was later abandoned, and the number is now prefixed by the letters G.M.L. for Gold Mining Lease. Leases are now commonly referred to by their numbers only, and here, prefixes and suffixes have been omitted where space demanded it.

It will be seen immediately that the figures quoted here to the end of 1903 do not agree with Gibson's figures in Bulletin 14. The reason for this becomes plain on examination of the geological plan in Bulletin 14, where it will be seen that there are two major lines of quartz reef; firstly the Mount Hall—Royalist line, and secondly the Champion—Caledonian line, and also a third area to the North represented on the plan by 249N, in which both reef and lode were mined. From the point of view of this investigation it is desirable to trace the individual production of each line of ore, whereas Gibson quoted figures supplied by particular mining companies. Some of these companies worked simultaneously and supplied figures for leases on two of the lines, while at other times two companies worked leases on the same line. Where possible figures have been segregated and presented for the particular line of ore to which they are applicable. For cases in which it was not clear that any such segregation could be made with any degree of certainty, a table of composite production figures is shown.

All figures supplied to, and reported by the Statist up to and including the year 1903 showed returns as bullion. In 1904 and 1905 the task of reducing total bullion figures to fine gold was undertaken and the re-

sults published together with the three previous year's productions for fine gold, in the Annual Report for 1906. In the accompanying tables sub-totals at 1903 show this adjustment and all gold thereafter is shown as fine ounces.

During the years 1930-1935 inclusive, no statistics were published in the Annual Reports of the Department from which the tables were drawn. This omission was probably caused by lack of funds due to the depression, and the figures would be in the possession of Perth office, but it was not deemed expedient at this stage to send for them. A table is presented which shows that for the period in question 2953 tons were treated for 2790.63 ounces, an average of slightly less than 1 oz. to the ton, which is considerably better than the average for the total of the three lines of reef. This ore was won from the whole Nannine District, so that probably only part of it came from the area in question. The omission of this small amount will have little effect on an investigation of so broad a scope as this, and seeing that the average of ore omitted is higher than the remainder, any bias is against rather than for the general proposition.

In the remarks column certain figures appear showing dollied and specimen gold and cyanide gold, but these amounts are also included for their respective year in the column showing ounces.

Abbreviations D. & S. Dollied and Specimens.

MT. HALL—NANNINE—ROYALIST LINE OF REEF.

	16N	166N	25N			
				55N	54N	47N
					678N	
	1,717	1,718	1,715	1,713		1,181
						1,000

Year.	Lease No.	Tons.	Ozs.	Ozs./ton.	Remarks.
Before 1897 ...	54N, 25N, 166N, 55N	2,445	5,213·00	2·11	
1897	54N, 25N, 166N, 55N	232	230·03	·99	
1898	16N, 25N, 160N, 54N, 55N	515	291·81	·57	
1899	16N, 25N, 166N	1,444	4,466·58	3·10	
1900	16N, 25N, 166N	915	2,866·26	3·14	Includes 22·5 oz. D. & S.
1901	16N, 25N, 166N	32	1,364·26	42·63	
1902	16N, 25N, 166N	809	881·82	1·09	
1903	16N, 25N, 166N	1,475	1,833·31	1·24	
		7,867	17,147·07	2·18	Bullion.
		7,867	14,360·45	1·82	Fine
1904	16N, 25N, 166N	2,079	2,440·44	1·17	
1905	16N, 25N, 166N	870	766·83	·88	
1906	16N, 25N, 166N	1,165	586·66	·50	
1907	16N, 25N, 166N	829	863·82	1·04	
1908	16N, 25N, 166N	1,661	1,019·73	6·1	
1909	16N, 25N, 166N	1,886	1,912·85	1·01	
1910	16N, 25N, 166N	1,754	2,961·23	1·69	
1911	16N. 25N, 166N	2,094	1,493·28	·71	
1912	16N, 25N, 166N, 1181N	566	419·19	·74	
1913	16N, 25N, 166N	2,519	582·73	·23	
1914	16N, 25N, 166N	725	243·95	·34	
1915	16N, 25N, 166N	350	170·89	·49	8·71 D. & S.
1916	16N, 25N, 166N	188	110·11	·58	
1917	166N	60	76·58	1·28	37·47 D. & S.
1918	166N	60	36·55	·61	17·38 D. & S.
1919	166N	54	173·93	3·22	133·72 D. & S.
1920	166N	25	96·42	3·96	40·07 D. & S.
1921	166N	15	59·87	4·00	
1922	166N	...	303·79	...	
1923	166N	...	112·12	...	
1924	166N	48	131·98	2·75	
1925	166N	5	10·46	2·09	
1936	1715	11	8·88	·81	
		24,831	28,942·74	1·16	Fine.

1926–1929 inclusive, and 1937–1943 inclusive, no production. 1930–1935 inclusive, no figures available.

CALEDONIAN, CHAMPION, LINE OF REEF.

15N 7N 13N 17N 11N 10N 8N

43 37

374 447 446 168 264 275 308

483N 473N 297 273

684 754 791 543

817

997

1,039 1,335

1,700 1,645 1,644 1,580 1,562

Year.	Lease No.	Tons.	Ozs.	Ozs./ton.	Remarks.
Before 1897 ...	7N	24	75·00	3·12	Bullion.
1897	7, 8, 10, 11, 13, 17	9,796	5,614·32	·57	Bullion.
1898	8, 10, 11, 13, 17	1,561	1,369·03	·88	Bullion.
1899	8, 10, 11, 13, 17	770	668·30	·87	Bullion.
1900	8, 10, 11, 13, 17, 273	4,878	2,607·15	·53	Bullion.
1901	8, 10, 11, 13, 17, 273	1,649	1,445·90	·88	Bullion.
1902	7, 8, 10, 11, 13, 15, 17, 273 ...	5,191	3,588·50	·69	Bullion.
1903	7, 8, 10, 11, 13, 17, 273	1,413	3,990·35	2·82	Bullion.
		25,282	19,358·55	·76	Bullion.
		25,282	16,042·34	·63	Fine.
1904	8, 10, 11, 13, 17, 543	740	515·99	·70	
1905	8, 10, 11, 13, 17, 543	856	824·31	·96	
1906	8, 10, 11, 13, 17, 543	661	389·11	·59	
1907	8, 543, 684, 754	1,315	313·37	·24	
1908	8, 543, 754, 791	1,646	1,197·11	·73	538·94 Cyanide.
1909	8, 543, 754, 791, 817	1,755	830·25	·47	14·79 D. & S., 237·75 cyanide.
1910	8, 791, 817, 1039	385	381·36	·99	18·08 D. & S., 229·46 Cyanide.
1911	8, 543, 791, 897	2,972	990·65	·33	
1912	543, 791, 817, 1039	724	231·73	·32	
1913	... ...	...	...	...	
1914	1335	100	33·94	·34	
1915	1335	80	14·03	·18	
1936	1580, 1645, 1700	123	88·93	·72	
1937	... ...	75	30·90	·41	
1938	... ...	65	62·94	·97	
1939	... ...	...	...	...	
1940	... ...	35	26·87	·74	
1943	... ...	...	5·42	...	
		36,814	21,979·25	·60	Fine.

1916–1929 inclusive, and 1941–1942 inclusive, no production. 1929–1935 inclusive, no figures available.

QUEEN OF THE LAKE LODE.

167N

249N

605N 752N

1,028N

1,585N 1,564N 1,581N 1,589N

1,872N

Year.	Lease No.	Tons.	Ozs.	Ozs./ton.	Remarks.
1899	249N	1,060	437·90	·41	Bullion.
1900	249N	90	85·00	·94	Bullion.
1901	249N	1,258	794·80	·63	Bullion.
1902	249N	189	166·65	·88	Bullion.
1903	249N	...	...	...	
To end of 1903	... ...	2,597	1,484·35	·57	Bullion.
To end of 1903	... ...	2,597	1,241·20	·48	Fine.
1904	249N	...	...	...	
1905	249N	208	93·72	·45	Fine.
1906	249N	...	...	...	
1907	752N	32	22·29	·70	Fine.
1908	752N	131	31·97	·24	Fine.
1909	... ...	...	...	...	
1910	1028N	19	4·10	·22	Fine.
Before 1936 ...	1564N	6,125	615·56	·10	Fine.
1936	1564N	3,754	359·94	·09	Fine.
1937	1564N	6,333	497·13	·08	Fine.
1938	1564N	3,604	927·27	·26	Fine.
1939	1564N	...	378·43	...	Cyanide.
1940	1872N	664	178·17	·27	
1941	1872N	5,492	1,225·79	·22	
1942	1872N	848	236·95	·28	
1943	1872N	...	9·21	...	
		29,807	5,821·73	·19	

1911–1929 inclusive, no production. 1930–1935 inclusive, no figures available.

COMPOSITE PRODUCTION FIGURES.

Queen of the Lake—Caledonian—Champion.

Year.	Lease No.	Tons.	Ozs.	Ozs./ton.	Remarks.
Before 1897 ...	167N, 168N	7,374	5,943·00	·81	Bullion.
1897	167N, 168N	1,185	551·40	·46	Bullion.
		8,559	6,494·40	·76	Bullion.
		8,559	4,997·50	·58	Fine.

Champion—Royalist.

Year.	Lease No.	Tons.	Ozs.	Ozs./ton.	Remarks.
1896	7, 15, 42, 44, 45, 47	9,951	5,848·00	·59	Bullion.
1899	7, 15, 42, 44, 45, 47	2,516	1,258·01	·50	Bullion.
1900	7, 15, 42, 44, 45, 47	1,000	437·15	·44	Bullion.
1901	7, 15, 42, 44, 45, 47	...	1,322·55	...	Cyanide Bullion.
1902	7, 15, 42, 44, 45, 47	...	2,093·80	...	Cyanide Bullion.
		13,467	10,959·51	·81	Bullion.
		13,467	8,965·51	·67	Fine.

TOTAL OF COMPOSITES.

Lease No.	Tons.	Ozs.	Ozs./ton.	Remarks.
167, 168	8,559	4,997·50	·58	Fine.
7, 15, 42, 44, 45, 47	13,467	8,965·51	·67	Fine.
	22,026	13,963·01	·63	Fine.

TOTAL PRODUCTION FIGURES FOR THE THREE LINES OF ORE.

	Tons.	Ozs.	Ozs./ton.
Mt. Hall–Nannine–Royalist	24,831	28,942·74	1·16
Caledonian–Champion	36,814	21,979·25	·60
Queen of the Lake	29,807	5,821·73	·19
Total of Composites	22,026	13,963·01	·63
	113,478	70,706·73	·62

TOTAL PRODUCTION FOR THE WHOLE NANNINE DISTRICT TO THE END OF 1943.

	Tons.	Ozs.	Ozs./ton.
	127,328	81,385·96	·64
For three lines of ore	113,478	70,706·73	·62
	13,850	10,679·23	·77

VOIDED LEASES AND SUNDRY CLAIMS.

	Tons.	Ozs.	Ozs./ton.
1936	97,521	74,278·74	·76
1929	94,568	71,488·11	·75
	2,953	2,790·63	·94

HISTORY OF THE AREA.

The following outline has been culled from the remarks of various Inspectors of Mines, and from Annual Reports of the Mines Department.

1891—Gold was first found in payable quantities at Nannine by Bayley before he found Coolgardie. The first lease pegged in the Murchison was 1N, later becoming 16N, and known as the Mount Hall, and is now part of 1717 and 1718.

1895—1N, later 16N, then a 12 acre lease, employed 22 men and was equipped with a 10-head battery.

25N, a 9 acre lease, employed four men but had no battery.

20N, in the Queen of the Lake area, was an 8 acre lease equipped with a 10-head battery and employed four men.

1896—A 20-head mill was being erected on leases 10N, 11N, 13N, 17N, by the Champion Reefs Mining Co., Ltd. They employed 40 men and held 51 acres of ground. Queen of the Lake area employed eight men.

1897—According to W. F. Greenard, Inspector of Mines of the day, the batteries at the Champion and Champion Extended crushed ore at a cost to themselves of 7s. 10d. per ton, and mining costs were 13s. 4d. per ton, a total of 21s. 2d. per ton, or approximately 5 dwts. per ton with fine gold at £4 5s. per ounce.

1900—The first cyanide plant known as the Nannine Cyanide Works, was erected and started operations.

1902—Champion Reefs had 30-head of stamps and Champion Extended had 20-head, while the Mt. Hall—Royalist line, had been amalgamated and had a 10-head battery on the job. It was officially stated that mining at depth at Nannine was rather disappointing.

1904—Champion Reefs now using a cyanide plant of eight vats.

1906—Caledonian. "A main shaft" was 230 feet deep and the reef 2 to 6 feet wide "said to average 30 dwts." The Caledonian Extended was "said to be similar in width and values to the Caledonian."

1907—Caledonian. The shaft reached a depth of 180 feet with 110 feet of drive from the bottom. The results were disappointing.

Note discrepancy in figures for depth of shaft. Both reports are by F. J. Lander, Inspector of Mines.

Nannine. Bottom level at the centre shaft was at 200 feet with gold showing freely going North.

A State Battery was erected and started crushing.

1909—The Mt. Hall lease was being worked again. At the 140 ft. level drives were 150 feet North and 50 feet South of the shaft, while at the 100 ft. level they were 100 feet North and 100 feet South. The Champion was taken up again and worked by a party of six men. 40 feet below the surface the reef was 6 feet wide and 15 dwts. to the ton.

1911—In the first half of the year the Mt. Hall reef was worked over an average width of 2 feet for an average value of 20 dwts. During the second half of the year the Nannine section was worked and averaged 12 feet wide and 12 dwts from which 15 men broke 200 tons per month. New machinery was about to be erected consisting of an 80 H.P. gas engine, 10-head mill, cracker, grinding pans, ore bins and tanks. Mine was looking better than in the previous year.

Caledonian. Bewick Moreing and Co. held an option and did several months' work but turned the mine down.

1912—"The Nannine gold mine which is the oldest mine on the Murchison, is now only 200 feet deep and has been practically full of water during the past year. The returns from this mine are 21,985 tons of ore for a return of 36,639 ozs. of gold

The management is now showing signs of doing something of a practical nature. A 10-head mill has been erected together with ore bins, elevator, rock breaker, wheeler grinding pan at the bottom of each copper table, concentrating tables and electric light. The power will be supplied with a 30 H.P. suction gas engine."

So wrote Inspector Deeble for 1911 and 1912. Note the discrepancy in the horsepower of the engine, and it is difficult to see where his gold production figures came from.

1913—The Nannine mine is working day shift only which has limited the output.

"This mine has a large amount of ore opened up by drives and the manager states the greater part is payable."—Inspector Deeble.

1914—There is very little mining doing at this place (Nannine) and the only mine that has kept the place going during the year is now under exemption (presumably the Nannine).

The State battery was closed down and removed on March 5th.

1915—"The Nannine gold mine has been employing on the average of five men and has treated 390 tons for a return of 233.75 oz.

Although one of the oldest mines on the goldfield the lowest level is only 200 feet which is very surprising in view of the fact that very rich gold was obtained from the surface down to that depth."—Deeble.

1917—Nannine has been very quiet during the year.

1924—"The Nannine gold mine has been worked on a small scale during the year, but on account of the water the mine had to be worked on a larger scale to obtain satisfactory results. The ground has been worked by different parties under different names. The records show that 28,333 tons have been treated for 41,997 ounces of gold and this amount has apparently been taken out of the reef for a length of 2,000 feet. The deepest point is 174 feet. This result speaks for itself but to go deeper it would be necessary to instal pumping machinery to cope with the water."—Deeble.

After 1925 practically nothing was done except prospecting in the Nannine area until the recent pre-war gold boom.

The above statements are presented for what they are worth, and although containing discrepancies, they give a general idea of conditions.

The three pages which follow are a copy of a report in this office, which is fairly explicit, and has therefore been quoted in full.

THE NANNINE DISTRICT.

I visited the following mines in this district on 29th January, 1909:—

G.M.L. 166N, Nannine Gold Mine, owned by J. G. Robinson..

The battery is being overhauled and repaired and only a little development work is being done underground. The Mt. Hall lease to North and Royalist lease to South under the same ownership are not being worked.

I went in the new main shaft to the 200ft. level at which point the reef is 69 feet to the East and shows a width of 66 inches. The reef is continuous in North drive to the face at 275 feet from crosscut, and some stoping has been done at points where values were particularly good. The face shows 90 inches of solid quartz plus 30 inches of ore on footwall separated from main body by a seam of country. The reef is almost vertical in greenstone country rock, which is solid good standing ground but not difficult to break.

The quartz is bluish-grey in colour and carries iron pyrites in veins and scattered through the stone. The assay value of the face is given as 12 dwts. per ton of which 6 dwts. is recoverable by amalgamation and the balance by cyanide treatment.

The South drive has been carried 260 or 270 feet from crosscut and the extension of this is the only work now in hand. At about 100 feet South of the crosscut a hard diorite dyke was met with and has proved about 160 feet wide. This dyke has dip South on footwall side of reef of about 18 feet in 100 feet and about 5 feet in 100 feet on footwall side, and an East and West strike. The strike of the reef is about 3° West of North. The above figures are from Mr. Robinson. He has picked up the reef on South side of dyke and to the West of line of reef as seen in drive.

On the 130ft. level the reef was cut East of shaft at about 74 feet. To the South the drive was extended South until the fault was reached, and to the North the level was opened for 270 feet. Above this level a considerable amount of stoping has been done at points where good values were met with. The country rock at this level is much softer than that of the 200ft. level, but stands well.

The richer shutes of gold bearing stone pitch North at an angle of 30° and very rich patches are occasionally met with.

In the portion of the mine inspected by me there is certainly a fine body of stone, and it should be payable throughout if it could be passed direct to a large battery. The further testing of the reef at depth is also much to be desired and in view of the length of reef as shown through and beyond, the three leases named, and its size at 200 feet good results might well be anticipated.

G.M.L. 830N, 12 acres, Possingham and others.

This is on the same line of reef as the Nannine mine and to the South of that property. A shaft has been sunk 20 feet and the best of the stone being raised is of the estimated value of 10 dwts. per ton.

The shallow water level and the accumulation of water in neighbouring workings will be against sinking the shaft much deeper.

G.M.L. 273, *"Caledonian," Meehan, Irving, Douglas, McNamara, Bond, Davis and Anderson.*

No mining is at present being carried on. The inflow of water (level at 50 feet) is about 2,000 gallons per hour and boiler power is not quite sufficient to permit of pumping and hoisting for further shaft sinking. The question of increasing power is now under consideration. The cost of firewood amounts to about £45 per month.

A crushing of 250 or more tons is now being sent to the battery. This has been broken from the North stope above 100ft. level. The value of the ore is estimated at from 8 to 10 dwts.

The reef is at the contact line of granite and greenstone and the ore is described as making in bulges on the granite side. The best values are in the bulges.

The reef at the lowest level (190 feet) is stated at 8 feet wide, to be highly mineralised and yielding an assay value of 11¾ dwts. per ton. A crushing of 820 tons gave a gross content of 9½ dwts. per ton.

G.M.L. 791 *N, 5 acres, P. Colliston.*

This is on the South end of the Champion reef adjoining the Caledonian. The reef shows a solid face 6 feet in width, dipping about 45 feet West and is now being worked at a depth of 30 feet on the incline.

The gold occurs in flat chutes following narrow seams in the quartz and a little is also found throughout the solid stone.

A crushing of 190 tons yielded 15½ dwts. by amalgamation and sands assayed 5 dwts.

The enclosing country is greenstone.

G.M.L. 754*N*, 24 *acres, Arnold and others.*

On the Champion reef, at a point East of old battery site. The stone being mined is some left by the original company and there is a great quantity of it.

The gold occurs along the hanging wall side in a narrow seam, and in the quartz a little distance from the wall.

A crushing of 30 tons yielded 18 oz. total. A parcel of 150 tons is now being broken out, of the estimated value of 8 dwts. per ton.

On same lease West of main reef is a reef that is almost vertical and estimated at 11 dwts. per ton at water level. The owners will try this later on.

The shaft through which the ore is being hauled is circular in shape, is timbered, and the ground appears to be standing very well.

G.M.L. 840*N*, 24 *acres, "Annie and Margaret," Voak, Isepponi and Minghini.*

This is at the North end of the Champion reef, but doubtful if it be a continuation of same. Sinking has been carried to water level (50 feet). The stone being raised is a vughy quartz, ironstained and associated with muscovite in fine specks. The owners estimate the value at 8 dwts. per ton.

P.A. 336*N*, 18 *acres, "The New Year," Hartigan and Moss.*

South-West of Nannine mine.

The reef in this lease has, in past years, been taken out to the surface for a length of 400 to 500 yards and a width between walls of about 40 inches; but to what average depth I could not ascertain. The walls are granite. The reef has strike slightly East of North with a Westerly dip.

The present owners are working on the reef in a shaft 50 feet from surface. There is a width of about 12 inches of very hard, banded, dark coloured quartz, mineralised to some extent. Prospects of free gold are estimated at 20 dwts. per ton.

The mine is on the plain almost at lake level and the inflow of water is about 1,200 gallons per 24 hours. The owners unwatered the shaft and workings with buckets and windlass, and the steady inflow compels them to maintain a considerable abount of bailing. This, together with the very hard quartz prevents them making much progress in mining.

From the statements made by one of the owners it is probable that an application will be made under the Mining Development Act, 1902, for assistance to cope with the water. Said owner considers that a windmill would do all that is required.

The above mines are all that I visited on this trip to Nannine.

E. DAVENPORT CLELAND,
Inspector of Mines.

The information as presented up to this point is more or less factual, being mostly a matter of record, and from it we are entitled to draw certain reasonable conclusions. With these conclusions will be presented other information (the authority for which will be quoted) perhaps of a less factual nature, but nevertheless of some credibility.

The first point that anybody inclined to show interest in this proposition will seize upon, is the reason for the abandonment of the option on the Caledonian held by Bewick, Moreing and Co. in 1911. I have no documentary evidence of this option, but have seen a blue print of the assay plan made during its currency. This plan was shown to me in 1941 by Mr. E. B. E. Threadgold, who was then the proprietor of the local hotel in Nannine and also was continually interested in a small and practical way in mining in the area. Shortly after this Mr. Threadgold joined the Air Force and his present whereabouts is not known to me.

From memory I would say that the sampling was largely confined to the bottom level, and that approximately 150 assays showed a length of 300 feet of ore averaging 6 dwts. per ton over a width of 5 feet. These figures I cannot guarantee to be exact, but affirm that anyone relying on them would not be badly misled. Compare these figures with those shown for the years 1906 and 1907 in the history of the field as set out above.

The history of the Great Fingall Mine which was operated by Bewick, Moreing and Co., shows that it was well past its prime in 1911, so that apparently they were looking for something to help them out, but even though on the down grade the figures for the Fingall for that year showed an average extraction of 8.1 dwt. Hence it is not surprising that it did not take long to decide that the Caledonian with ore of a tenor of 6 dwt. was not a suitable prospect.

Referring back now to the production table for the Caledonian Champion line of reef, from 1912 onwards, it is reasonable to deduce that the abandonment of the option by Bewick, Moreing and Co. relegated the entire line of reef to the status of a prospectors outfit, and the boom of the early nineteen thirties seems to have done little to bring it to the fore again, though production figures for the boom period show a considerable increase in grade for small tonnages.

In general, the Champion Caledonian line of reef can be said to have been a medium grade producer with a fair amount of reasonably high grade dirt available. The Caledonian G.M.L. 1580 is held by W. Robinson, now of the A.I.F., under Wartime exemption.

Turning now to the Queen of the Lake area we see immediately that it has always been a low grade proposition, though in its early stages some medium grade ore apparently was selectively mined.

The figures for the period just before 1936 to 1939 inclusive, for the lease 1564 are interesting. They show that 19,816 tons were mined and treated for a return by amalgamation and cyanidation of 2,778.33 oz., equivalent to a recovery of 2.8 dwt. per ton. During this period the mine was equipped with a 40-year-old steam winder and much other junk from the old Fingall, and the most decrepit 5-head mill that I have seen still operating. Most of this plant is still on the ground.

The 1940-1943 figures for G.M.L. 1872 are also of interest. During this period the lease was operated by a syndicate of four prospectors, who applied to the

Mines Department for funds to erect a battery. The application, which was reported on by myself, was refused on the grounds of insufficient development, and the fact that war conditions were then beginning to be felt in the industry. The prospectors were persuaded to cart their dirt 26 miles to Triton Gold Mines, who were then crushing outside ore in an effort to keep their mill at full production. The result was that the men sent up to 40 tons per day to Triton from which they made a handsome profit, and when conditions got too bad they were able to get exemption on their lease and walk out without having a plant on their hands and a debt over their heads. They also did a good turn to Triton Gold Mines Ltd. This lease is one of the only two in the area that is still held (under wartime exemption) and the holders intend to work it immediately conditions became more favourable. The ore is 25 feet wide in places and of a somewhat patchy nature. The prospectors mined it by hand and sent the lot to Triton and were paid on assay on a sliding scale, and the ore was treated together with Triton ore. The recovery works out at 4.7 dwt. The ore body which is a faulted extension of that on G.M.L. 1564 is worthy of further exploration laterally and in depth. The deepest part is 100 feet where the ore is 13 feet wide in a crosscut from the bottom of a winze. Samples taken from this crosscut and assayed at Triton showed consecutive assays and widths of 5 feet at 2 dwt. 5 gr., then 5 feet at 9 dwt. 2 gr. and 3 feet at 5 dwt. 19 gr.

The most interesting of the three lines of ore is the Mt. Hall-Nannine-Royalist line of reef, and more references have been made to it in the past by other observers, than to the other ore bodies of Nannine.

From its record it must be classed as a high grade show, in the main with some shoots of very rich stone and patches of specimen. In only three of the years of the 29 for which averages are shown did the grade fall below half an ounce to the ton. Patches of good stone have apparently been worked to a maximum depth of 200 feet over a length of at least 2,000 feet and widths of 2 to 12 feet. A reasonable inference to draw is that there would be considerable amounts of stone left in the old workings with a grade of from 5 dwt. to 10 dwt., since nowhere is it stated that the reef cuts out or is of a lenticular nature. In fact Gibson states that it can be "followed in an almost perfectly straight line on the surface for a distance of over a mile." On the geological plan it actually scales about 92 chains and the plan shows that by 1903 shafts had been sunk over almost the entire length, showing that some gold must have been found south of the Royalist lease although no production is shown in the records.

In the past it has been noted as a mine of promise on four occasions, firstly by Cleland in 1909, and three times by Deeble in 1912, 1915, and 1924, but it is obvious from subsequent records that the mine was never worked on the scale that either of them expected.

All of these leases are now open for pegging.

Speaking now of the three lines of ore from a general point of view one notices that the figures roughly reflect changes of the day, such as decreased production during the years of the war of 1914-18, the post-war depression, and to a lesser extent the gold boom of the nineteen-thirties. The last of these three points catches the imagination. It is a fact that of all the gold mining towns on the Murchison Railway, Nannine alone derived no benefit from the last gold boom, and one would expect a very definite reason for this.

The accepted reason, given to me about the last half of 1939, was that the failure of Nannine was caused by the avarice of one man, J. G. Robinson. Robinson gained control of the Mount Hall-Nannine-Royalist line of reef very early in the piece. He is shown as manager of the Royalist in the year 1895 and he retained his hold over these leases till his death in Nannine just after I came to Cue in 1939 or 1940. It is clear that this reef is the plum of the Nannine district and anyone seeking to revive mining would be likely to concentrate on it as a first string. Actually Western Mining Corporation are said to have bored some holes on the reef with favourable results, but Robinson is said to have wanted £40,000 cash, but I do not know the exact terms, or the lease or leases for which he wanted this money. At any rate his son, W. Robinson (referred to before as the holder of the Caledonian) verbally confirmed all of the above in general terms to me, so that there is some justification for the accepted opinion.

GEOLOGY.

Bulletin 14 gives a complete exposition, and though it was printed 42 years ago, there have been few additions of importance to our general knowledge since that time. The plan shows that the gold occurs in association with a granite-greenstone contact, which is the common mode of all the major deposits of Western Australia. Experience has shown that in this type of deposit the gold is more permanent when found on the greenstone side of the contact, as the bulk of it is at Nannnie. Although there are many similar deposits in the West, which have been worked and abandoned when the grade dropped, all authorities are agreed that there is no known scientific reason for assuming that since the grade has dropped to such an extent in the first 200 feet vertically, it is likely that in another 200 feet there will be no gold at all. This means that the rich gold was due to the surface enrichment of otherwise ordinary grade deposits, for which only vague reasons can be given.

A few remarks about the Queen of the Lake area should be in order. On the plan quartz reefs are shown, but no lodes, though in the context Gibson briefly describes the lode as being "a highly altered belt of greenstone, and has no defined limits." From this description and the plan it might be thought that this lode is the usual Murchison variety of quartz—ironstone dyke, many of which are shown on the plan. This is not the case. The lode is, as described by Gibson, a highly altered greenstone, but in the bottom of the winze on G.M.L. 1872 at 100 feet below the surface a shear is apparent which defines the hanging wall of the lode. This lode appears to me to be a faulted extension of that worked by Bernales on G.M.L. 1564, the fault being caused by one of the quartz ironstone dykes cutting through and displacing to the East that section of the lode now to be seen on G.M.L. 1872. Near the surface, weathering has been so great as to preclude the ready determination of the exact character of the lode.

It is interesting to speculate on the likeness between the Mt. Hall-Nannine-Royalist line of reef and the Great Fingall reef. The general geology is very similar and Cleland, describing the Nannine reef at the 200ft. level says: "The quartz is bluish grey in colour and carries iron pyrites in veins and scattered through the stone." The Fingall was a bluish grey quartz carrying pyrites, and made bulges as does the Nannine, which is considerably narrower but probably longer than the Fingall. The Fingall did not attain any great prominence until taken in hand by a strong company. Like the Nannine it showed a falling off in value at shallow depths, but a considerable enrichment took place below 400 feet.

The following random production figures give an idea of the history of the Fingall:—

	Tons.	Ounces.	Ozs./ton.	Remarks.
Before 1897 ...	32,552	21,764	·67	Bullion.
1902	75,939	124,680	1·64	Bullion.
1903	98,200	157,272	1·60	Bullion.
1904	141,976	156,702	1·10	Fine.
1905	181,534	159,774	·88	Fine.
1906	222,892	121,163	·54	Fine.

The mine was first found by Heffernan in 1892 or thereabouts, and was operated till 1899 by Consolidated Murchison Gold Mines Ltd., and taken over by Great Fingall Consolidated in that year. The figures bear out the statement that the enrichment took place, and show how subsequent large scale operation is able to decrease grade and increase tonnages to be profitably mined. Something similar might be done on a smaller scale with the Nannine.

This seems a convenient stage at which to refrain from pushing this comparison any further, lest one be charged with wishful thinking, a common complaint in these days.

MINING.

In examining the records from the angle of difficulties to be expected in the actual mining of the ground, only two indications can be found, both dealing with the Nannine Mine. The first one appears at the bottom of page 58 of Bulletin 14 where Gibson has noted that "the country at this depth (120 feet) is very soft and broken." Cleland in 1909 states, "The reef is almost vertical, in greenstone country rock, which is solid, good standing ground, but not difficult to break." This refers to the 200ft level, whereas Gibson was unable to inspect this level since it was under water at the time of his visit. Cleland also records that "the country rock at this level (130 feet) is much softer than at the 200ft. level, but stands well."

In 1940 I examined a small part of the upper workings of the Caledonian (G.M.L. 1580). They were in soft oxidised ground, and the drives were lightly timbered, while the stopes above had been filled. At that time, this filling was being run out by W. Robinson and E. B. Threadgold, and sent to Triton mill. I then formed the opinion that the ground could have been mined without filling and very little timber.

On G.M.L. 1872 in the Queen of the Lake area worked by the party of prospectors referred to before, the ground down to 70 feet was sufficiently soft to be augered, and the prospectors worked it by this means, without using timber, but leaving pillars here and there. Widths up to 25 feet were worked where the ore bulged, but the ore channel at 100 feet has been consolidated, being about 13 feet wide and in harder ground.

The gist then, of available information, is that the problems to be faced in mining are normal. None of the inspectors of the past has commented on mining difficulties, which one would have expected them to do if there had been any. In effect, no news is good news, as in the case of the water question.

TREATMENT.

From the records it is plain that all ore mined in the Nannine area was crushed by various stamp batteries and the sands cyanided in ordinary leaching plants, usually a considerable time after crushing, since in the earliest days of the field the cyanide process was not in commercial use.

Cleland has noted the presence of iron pyrites in his report on the Nannine, G.M.L. 166N, and states that of a 12 dwts. face, 6 dwts. is recoverable on plates and 6 dwts. by cyanidation. I was also informed by the prospectors that worked G.M.L. 1872, in the Queen of the Lake area (and which has been referred to before), that at the bottom of the winze at 100 feet below the surface, sulphides were encountered in the ore. The winze bottom is below the static water level of the country.

It is also to be recalled that Deeble, describing additions to plant in 1912 (see History of the Area) says that the new plant was equipped with a Wheeler grinding pan at the bottom of each copper table, and concentrating tables.

No mention is made at any time of any minerals such as antimony, arsenic or copper, which would considerably complicate extraction processes. It is probable that the combination of gold and pyrites is of a mechanical nature, as in the case of most Murchison mines, for example, Meekatharra, Triton, Great Fingall, and Hill 50. These mines treated their ore by ordinary methods for the most part, although for a time concentration and roasting was used at both Great Fingall and Meekatharra. It seems then that we are entitled to expect that the treatment of Nannine ores is a problem of moderate dimensions only.

With further regard to the problem of treatment, it might be expected that an examination of the history and production figures for cyanidation only, would be informative. The results of such an examination prove to be more or less inconclusive, but they will now be set out as a matter of general interest.

The first cyanide plant was erected in Nannine and treated some ore in 1900. In 1907 a plant known as Finey Brothers cyanide works was in operation on Tailings Area 14N, which was just West of the Mount Hall-Nannine-Royalist reef and worked with three vats. In 1908 and 1909 the Nannine leases are shown as having a 3-vat plant, while Finey Bros. plant is not listed. It is probable that these three plants are identical, but had changed hands in the course of time. In 1910 this plant had been extended to four vats. In 1904 and 1905 the Champion Reefs Gold Mining Co. Ltd. had a plant of eight vats and the Champion Extended operated a small plant for a short time a year or two later. By 1915 all cyanide plants had apparently disappeared from Nannine, the last to go being the Nannine plant, which is listed up to 1914. The State battery erected in 1907 and closed in 1914 also used cyanidation. Production figures show no cyanidation returns after 1912, until 1939, when sands from the ore worked on G.M.L. 1564 by the Bernales interests were treated in a plant erected for the purpose. It will be seen from the production tables that a relatively small amount of dirt was mined at Nannine during this period and records show that the only remaining stamp battery was situated on the Mt. Hall-Nannine-Royalist reef, which was still in existence in 1926, but appears to have been got rid of shortly after. From this we deduce that after 1912 some of the dirt crushed in Nannine was not cyanided, while some of the ore mined there was probably crushed in State batteries at other centres.

The total amount of cyanide gold reported from Nannine is as follows:—

Mine.	Year.	Ozs.
Caledonian-Champion	1908	538·94
Caledonian-Champion	1909	237·75
Caledonian-Champion	1910	229·46
Composites: Champion-Royalist	1901	1,322·55
Composites: Champion-Royalist	1902	2,093·80
Nannine Cyanide Works ...	1907	355·60
Nannine Cyanide Works ...	1908	1,409·66
State Battery Total	...	404·11
Queen of the Lake	1939	378·43
		6,970·30

Note that neither here nor in the previous tables is any cyanide production shown for the Mt. Hall-Nannine-Royalist reef, which was the richest of the three. The figures in the above table for the Nannine cyanide works probably should be added to this reef though this is not certain.

When reporting cyanide gold the Statist does not show what tonnage of ore was actually cyanided for any particular amount of gold. The above total reported production for the total reported tonnage mined (127,328) for the same period works out at an average of 1.1 dwt. per ton. It is unlikely that this grade would have been payable in those days, and the assumption again is that only the richer parts of the sands were treated.

Old photographs of the cyanide plants show that the vats were of about 20 tons capacity and since records show that cyanide production was limited to a comparatively few years, it again appears as if treatment was confined to the richer sands, particularly since the biggest plant had only eight vats (Champion Reefs Gold Mine Ltd.). In short, the plants were too small to have treated all the sands that had been mined, in so short a time.

Clearly then, the study of cyanidation gives us no positive information regarding future treatment processes, since we cannot get sufficient information to decide on even a rough average extraction by amalgamation or cyanidation for any or all of the lines of ore.

Before leaving the subject of ore treatment there is a further consideration worthy of mention. The parallel series of hematite bearing quartzites shown on the geological plan form the crest of a ridge which in several places falls sharply away both to the East and West. This is not apparent from the plan since no contours are shown. The Nannine lease (166N) is about 70 feet above the township. The gradients are such that a mill site could be chosen which would eliminate elevation to some extent and facilitate disposal of tailings, thus making for simplicity and low capital and operating costs.

WATER.

Cleland has recorded the quantities of water to be expected in the Caledonian (273N) which was making 2,000 gallons per hour, and the New Year (336N) to the South of the Caledonian, with an inflow of 1,200 per hour, both in 1909.

Deeble, in 1912, notes that the Nannine mine was "practically full of water during the past year," but does not at any stage give the amount to be coped with. Again in 1924 Deeble refers to water in the Nannine Mine, and at first sight it would seem that the inflow was troublesome. A glance at the production table for that year puts a different complexion on the matter, since it shows that only 48 tons of stone were treated, so that the handling of any water at all would be a serious burden on this small scale, as he points out.

None of the writers of the past have reported any of the mines to have ever been in any real difficulties with water. It would appear that nearly all of them allowed the water to rise and lowered it again more than once during their lifetime, with the usual pumping equipment of the day.

It is to be inferred that the amount of water to be handled in any of the mines above 200 feet is moderate, and insufficient to increase mining costs to any extent, when worked on a reasonable scale.

Another look at the geological plan in Bulletin 14 brings to light the fact that Lake Annean is less than half a mile from the Mt. Hall-Nannine-Royalist reef. Though this lake is normally dry an unlimited supply of salt water suitable for milling purposes could be got by sinking a hole in it a few feet deep.

The attached tracing shows two Government water reserves so that the question of fresh water for domestic purposes has apparently already been settled. There is at present a standpipe in the main street, and the area has in the past supported a population of about 1,000 people, according to rumour.

PROPOSAL.

Having now presented such of the available information as is relevant and reasonably reliable, and having also left out much hearsay evidence of a far fetched nature, I submit a proposition, which in my opinion merits the serious consideration of any mining company with sufficient funds, organisation and honest intent, to be able to take advantage of it.

The proposition is that such a company should take over the whole area in question with a view to working together the three lines of ore with a central mill and power plant. This would mean either the individual pegging or the obtaining of a reserve over practically all of the leases shown on the tracing. It has been stated here before that only two gold mining leases are held in the area, and apart from this the only other ground held is a machinery area, which is part of G.M.L. 1564. This area is held by Bernales interests to protect the machinery that they have on it, and gives them surface rights only.

I am sufficiently familiar with the policy of the Mines Department to be able to say with confidence that the Minister for Mines would be in favour of any company of repute who approached him with a view to acquiring the ground now, even though the company could not work it at present. Much of this Department's time is at present taken up with ways and means of rehabilitating the gold mining industry in the State, and those in control of the Department would naturally prefer to see, if possible, a centre like Nannine go ahead as the result of large scale operations, rather than remain as it was before the war.

The two leases already held at G.M.L. 1872, in the name of Fisher and Lynch and others, and G.M.L. 1580 by W. Robinson, who is now in the army. Fisher is at present working a mine in Cue, while Lynch has mining interests in Meekatharra. All of these men are well known to me, and from various talks that I have had with them, I would say that there would be little difficulty in getting options over their ground on the most reasonable of terms.

Following the acquisition of the ground, a preliminary testing campaign could be undertaken as soon as conditions permit.

It seems plain that the successful amalgamation of the mines into a single unit is largely dependent on what happens below the 200 feet horizon in the Mt. Hall-Nannine-Royalist line of reef, so that the preliminary campaign should be directed at first, to establishing this line. I would attempt this by drilling it to a depth of 500 feet with at least six holes, but more if possible. Incidentally it has been noted that Western Mining Corporation are said to have bored some holes, and it would be worth money to know the results. If such boring showed that the reef was present at that depth, the next step would be to thoroughly sample the reef on the surface, particularly on the South end, then all accessible workings above water level, and finally below water after pumping the mine out. If this reef shows promise similar work could be undertaken on the others with greater confidence, since after the amalgamation we would look to this reef to be the "sweetener" for the other two.

I would again stress the idea that from the point of view of a large company, the amalgamation of all the ore bodies is to be striven for. In the past, companies have been interested in one or other of the shows, but conditions have apparently not been suitable for amalgamation, and if they are not suitable now they never will be.

We have been dealing here with the immediate future of goldmining through the medium of the rehabilitation of old mines. Let us recall that of all the mines that came into prominence during the last gold boom, by far the larger proportion were old mines and groups of mines dressed up, such as Lake View and Star and other Kalgoorlie mines, Wiluna, Big Bell, Triton, Hill 50, Tindalls, etc. The only two that can be readily called to mind which were new finds, are Comet at Marble Bar, and Yellowdine, which are both comparatively small.

Here follows a brief summary of the advantages of the proposal, most of which have been dealt with more fully in the context:—

1. The bulk of the ground can be got at practically no cost, probably by negotiation with the Minister for Mines. This is a considerable advantage. Every mining man has seen potential deals held up and finally fall through because of avaricious men holding the ground and trying to squeeze large sums of money from a wealthy company in return for an asset of very doubtful value in some cases. The two remaining leases are held by reasonable individuals.

2. A railway passes within half a mile of all mines, and the advantages of this are numerous and obvious.

3. Roads and other civic facilities are already established to a more or less extent.

4. No apparent mining difficulties.

5. Moderate milling problems, with better than average mill sites available.

6. Water troubles do not seem to exist.

In short the past records of the area are encouraging and all of what might be termed the prime factors of mining as listed above, are in favour of the proposal. In fact, no evidence could be found of any serious handicap, whereas nearly all such propositions usually bristle with such difficulties as transport, water, acquiring ground, etc.

There attaches to the proposition the element of risk, which is, however, present in the most watertight mining proposition that has ever been, or will ever be propounded.

Company executives are inclined at present to assure one, with some show of fervour, that they are anxious to acquire mining properties to work in the post-war years, but all of them seem to be looking for something with vast quantities of ore, proved and blocked out, for clearly the possession of such a property largely eliminates the element of risk. In short companies seem to prefer to buy for large sums of money proved gold in situ, rather than attempt to prove it themselves even at considerably less cost.

I have in this diatribe accused myself at one stage of wishful thinking, and I now level the same charge at these company executives. No such mine exists in the West, and my contention is that any new mines that appear in the immediate future, will be brought to light along lines here suggested.

C. ADAMS,
Inspector of Mines.

Cue, 6th January, 1945.

Index to State Mining Engineer's Annual Report for 1945.

Division III.

Report of the Superintendent of State Batteries.

THE UNDER SECRETARY FOR MINES:

I have the honour to report for the information of the Honourable Minister on the operations at State Batteries for the year ending 31st December, 1945.

The cessation of hostilities with Japan had little influence on the manpower shortage until towards the close of the year and at the moment our managers have sufficient battery staff to handle the available ore.

20,078.25 tons were crushed and showed an increase of 1,760 tons on the 1944 figures, which is a good sign, but transport difficulties, especially the short supplies of trucks, tyres and petrol, are greatly restricting prospecting.

Tailing treatment was again seriously affected by manpower shortage and treatment fell from 17,267 tons in 1944 to 12,216 tons, and being the profitable side of our transactions, resulted in increased working loss.

However, I am glad to report that the position has eased considerably, and it is expected that all accumulations, and most of the current year's tailing will be handled during 1946, if material, including galvanised iron, timber, and cement supplies is available for vat replacements at an early date.

There have been sharp increases in the price of firewood, quicksilver, machinery spares and foundry repairs with a general upward tendency shown in the cost of almost all requisites, though not to such a degree as for the first mentioned items.

New plant is almost unprocurable and at very advanced prices, and suggests that there is a new level of costs for industry, and at State Batteries increased costs must be expected, though with post-war tonnages the loss per ton would be considerably reduced.

The estimated value of the gold produced was £202,324, an increase of £49,654 on the previous year's figure, and approximately £10 per ton, whilst the estimated average value of the ore treated was £11 16s. 8d. per ton.

The average value of the ore crushed was 23 dwt. 22.6 grains per ton and at present prices constitutes an all-time record. The main contributor to this high yield was the Day Dawn Options, which includes part of the old No. 2 Day Dawn lease.

Very high values were cleaned up, and brought the average value of the 2,750 tons of ore crushed at Cue to £13 1s. 7d. at £4 4s. 11½d. per ounce, or approximately £A30.

Meekatharra, Norseman, Ora Banda and Sandstone all produced ore above the year's high average: details of the average value of the ore crushed at each plant are shown on Schedule 2 attached to this report. Laverton, which has fortunately a comparatively new 10-head plant was re-started during the year after being idle for some years, and has good prospects of a long continuous run, the main supplier being the old Lancefield Mine, where Cable Brothers are working the surface deposits left by the old company. The opening of this battery has resulted in increased activity in this district, which is a large one including the old time rich field at Burtville and the Erliston.

The Department has continued its policy of starting up batteries in moribund districts when small tonnages have been available, despite the cost entailed. This has resulted in relief to the local business people and has assured new and returning prospectors that crushings can be put through within a reasonable period. The reopening of these closed down plants has disclosed that very considerable expense will be entailed in renewals to pipe lines, tanks, vats and buildings, which deteriorate considerably whilst idle.

DETAILS OF PRODUCTION.

	Fine Ozs.	Value. (£4 4s. 11½d.)	Premium.	Total.
		£	£	£
By Amalgamation	18,113·10	76,986·18	100,931·87	117,918·05
Cyanidation	2,478·68	10,532·09	13,874·427	24,406·517
	20,591·78	87,518·27	114,806·297	202,324·567

VALUE PER TON.

The estimated average fine gold recovered per ton was 18 dwt. 1 gr. and the average value of tailing 5 dwt. 21.6 grs. giving a head value of 23 dwt. 22.6 grs.

The figures for 1944 were 13 dwt. 6.11 grs. by amalgamation and 5 dwt. 4 grs. in the tailing, equal to 18 dwt. 10.1 grs. as against the 1939 figure of 12 dwt. 23.1 grs. per ton.

ESTIMATED PERCENTAGE RECOVERY.

The whole of the tailing was not treated and a small percentage of copper tailing was segregated at Marble Bar and Meekatharra as untreatable, but applying the average extraction of 78% obtained by our tailing treatment plants to the average value of tailing produced, the estimated percentage recovery would be as follows:—

Head Value	23 dwts. 22·6 grs.	% Rec.
Recovery by Amalgamation	18 dwts. 1·0 grs.	75·35
Estimated Recovery by Cyanidation on 5 dwts. 21·6 grs. at 78%	4 dwts. 14·448 grs.	19·23
	22 dwts. 15·448 grs.	94·58

RECEIPTS AND EXPENDITURE.

The working expenditure for all plants for the year was £38,138 19s. 5d. and revenue received £20,425 13s. 8d., showing a loss of £17,713 4s. 5d. Milling costs increased from 25s. 4·6d. in 1944 to 26s. 3·4d., and tailing treatment from 16s. 11·7d. to 19s. 2·7d.

Tailing revenue rose from 14s. 9·6d. to 16s. 9·1d. A comparative synopsis later in the report gives the details for 1944 and 1945.

OUTPUT SINCE INCEPTION.

	£
Production at Par	
By amalgamation	7,469,707.840
By tailing treatment	1,831,602.674
	9,301,310.514
Gold Premium	
By amalgamation	2,427,238.341
By tailing treatment	753,340.297
	3,180,578.638
Total Australian Currency	12,481,889.152
Estimated value of tin produced ..	94,455.160
	12,576,344.312

MILLING.

Excluding the leased batteries at Darlot, Linden and Mount Sir Samuel, and St. Ives, which is closed down, one 20-stamp, seven 10-stamp, and ten 5-stamp mills were available for public crushing but no ore was crushed at Mt. Ida, Yalgoo or Warriedar. Laverton, Ora Banda, Wiluna and Yarri were re-started after some years of idleness.

Fifteen batteries, an increase of three over the previous year, crushed 336 parcels, aggregating 20,078.25 tons or an average of 59.76 tons per parcel as against 18,261.75 tons and 57.60 tons respectively in 1944.

The estimated yield by amalgamation of 18 dwt. 1 gr. per ton has rarely if ever been exceeded and represents 75.35% of the total value of the ore crushed.

Kalgoorlie, our largest plant, had a very disappointing year possibly owing to the keen demand for labour on the mines, and from a pre-war return of approximately 20,000 tons per annum, the tonnage crushed dropped to 1,140½ tons.

Coolgardie crushed 5,220 tons, an increase of 3,134 tons for the year; Meekatharra 2,398.25 tons, an increase of 504 tons; and Ora Banda put through 1,423¼ tons, the first return for some years.

Cue, Boogardie and Norseman outputs were below the 1944 figures, which is hard to account for, but is probably due to the call for labour by the local mines at Big Bell and Reedys, and transport difficulties.

The North-West batteries showed a slight improvement and the prospects at Bamboo Creek are good at the moment.

Marble Bar tonnage increased its 1944 tonnage from 940.5 tons to 1,416.25 tons.

The leased battery at Darlot was idle, but quite a number of prospectors are again on the field. That at Mt. Sir Samuel did little work, but the lessee of the Linden battery crushed 1,331 tons for high values, a considerable increase on the previous year's figures.

Repairs and renewals were heavy, due in part to the inferior class of labour available, and the cost of starting up plants closed down for some years.

£2,947 1s. 5d. was expended under this heading for milling, equal to 2s. 11.5d. per ton.

Sundries including travelling and away from home allowances, and head office charges, cost 5s. 2d. per ton.

The away from home allowances were heavy on account of the inability of the local districts to supply even unskilled labour.

TAILING TREATMENT.

Nine tailing plants were in operation and treated 12,216 tons of tailing for a recovery of 2,478 fine ounces worth £A24,406.

Costs are out of the question with such small tonnages. Cue and Kalgoorlie were the only plants which treated over 1,500 tons and with tonnages of 2,952 and 3,810 made profits of £930 15s. 8d. and £39 9s. 7d. respectively.

The working cost was 13s. 2.8d. and the gross cost 19s. 2d., showing a loss of £1,506 for the year. The total cost in 1944 when 17,267 tons were treated, was 16s. 11.7d.

Revenue increased by 1s. 11.5d. to 16s. 9.1d. per ton.

Most of our tailing plants require new vats and pipes, and until such time as materials are available, these renewals will have to stand over. In the meantime prospectors will have to wait for their final payment, and the revenue will suffer additional reductions for interest payments, but it will enable us to accumulate reasonable tonnages to start up on.

COMPARATIVE SYNOPSIS AND RESULTS AT STATE BATTERIES.

For the 12 months ending December 31st, 1944 to 1945.

	1944.			1945.		
	Tons.	Expenditure per ton.	Revenue per ton.	Tons.	Expenditure per ton.	Revenue per ton.
		s. d.	s. d.		s. d.	s. d.
Milling	18,261·75	25 4·0	10 11·7	20,078·25	26 3·4	10 1·7
Tailing	17,267·00	16 11·7	14 9·6	12,216·00	19 2·7	16 9·1

RECEIPTS AND EXPENDITURE.

	Tons.	Expenditure.	Revenue.	Loss.
		£ s. d.	£ s. d.	£ s. d.
Milling	20,078·25	26,432 10 6	10,225 12 5	16,206 18 1
Tailing	12,216·00	11,743 8 11	10,237 1 0	1,506 7 11
Total	32,294·25	38,175 19 5	20,462 13 5	17,713 6 0

GENERAL LOAN FUND EXPENDITURE.

	£ s. d.
Coolgardie Weighbridge	140 9 7
Portable Conveyor Kalgoorlie ..	13 8 7
Portable Conveyor Meekatharra ..	88 3 3
Wifley Table Coolgardie	4 0 0
	£246 1 5

CARTAGE SUBSIDIES.

Subsidies amounting to £911 13s. 10d. were paid on 2,211 tons of ore treated. Of this tonnage 1,943 tons were crushed at State Batteries and 268 tons at private plants, the payments being £790 11s. 7d. and £121 2s. 3d. respectively.

The figures for 1944 were 3,686 tons, which claimed subsidies totalling £1,461 7s. 5d.

HEAD OFFICE EXPENDITURE.

	£ s. d.
Salaries	3,058 2 11
Pay Roll Tax	526 7 6
Workers' Compensation	521 6 5
Postage	12 10 4
Travelling Expenses	236 19 11
Retiring Allowances	625 6 3
Sundries	20 17 9
	£5,101 11 1

Last year cost of administration was £4,276 10s. 3d. The increase for 1945 is composed of retiring allowances to Inspector Bisset and Engineer McLean, and a slight increase in salaries.

STAFF.

I wish to place on record the Department's appreciation of the services of Mr. L. P. Bisset, Inspector of State Batteries who retired from the service during the year.

Mr. Bisset joined the State Batteries staff as an assayer in 1903 and resigned to take up private business in 1904, rejoining the service in 1905 to occupy the position of manager for many years. He was appointed Inspector of State Batteries in 1932. During the war period he was loaned to the Department of Civil Defence and later assisted the Under Secretary in the special Department dealing with Strategic Minerals.

Erection Engineer A. S. McLean also reached the retiring age during the year after 10 years of service.

Mr. McLean was responsible for the erection of many of our more modern plants and his services were availed of by the Federal Government in the erection of the tantalite plant at Wodgina.

Manager E. Speering was another old servant, who retired after many years' work outback. At the time of his retirement he was stationed as manager at Sandstone.

I have to thank the Goldfields Staff for their year's work under trying conditions, and the officers at Head Office for assistance during the period.

GENERAL REMARKS.

The increase of approximately 10 per cent. in the tonnage crushed can be considered with some satisfaction, and the extremely high return of £202,324 from 20,078 tons is some justification for the loss incurred during the year.

The gross working profits in the years preceding the commencement of the war were less than 10 per cent. of the revenue received and even with a return to pre-war tonnages a working profit cannot be visualized with our present charges for treatment.

During the revival after 1930, the Department followed the practice of substituting modern 10-head plants equipped with mechanical feeding equipment including rockbreaker, elevator bins, etc. for the old 5-head hand-fed batteries whenever possible, and the reduced working costs fully justified this policy.

Boogardie, Cue, Laverton, Marble Bar and Ora Banda were so equipped but we still have a number of 5-stamp hand-fed mills in many remote centres, where tonnages have been too small to justify the capital cost of the erection of larger and more economical units.

If the anticipated revival in prospecting eventuates and most of these small plants can be replaced by 10-stamp ones and our present larger mills kept fully employed, the reduction in crushing costs would take care of a good deal of the increased cost of fuel, wages, etc. If tonnage is not available to keep the more mechanically operated plants running to capacity, their usefulness is greatly discounted by the deterioration of the equipment during periods of enforced idleness.

It is to be hoped that the cost of fuel oil, now considerably more than double its pre-war cost, will fall.

Firewood has increased in almost the same degree and I see little likelihood of cheaper supplies.

The same can be said of machinery prices and the cost of replacements and foundry repairs.

All the abovementioned increases offset considerably the economy effected by mechanisation.

D. F. BROWNE,
Superintendent of State Batteries.

SCHEDULE NO. 1.

Return showing Tons Crushed, Gold Yield by Amalgamation, Average per Ton in Shillings, and Total Value without Premium for Year ended 31st December, 1945.

Battery.	Tons Crushed.	Gold Yield Bullion.	Value per Ton in Shillings and Pence.	Total Value without Premium.
		ozs.	s. d.	£
Bamboo Creek	631·00	162·95	18 7·1	586·62
Boogardie	1,039·25	462·30	32 0·3	1,664·28
Coolgardie	5,220·25	2,579·95	35 7·0	9,287·82
Cue	2,750·00	9,440·65	247 2·1	33,986·34
Kalgoorlie	1,140·50	633·60	40 0·1	2,280·96
Laverton	554·75	185·55	24 1·0	667·98
Marble Bar	1,416·25	484·85	24 7·7	1,745·46
Meekatharra	2,398·25	2,626·30	68 10·1	9,454·68
Norseman	959·00	1,291·75	96 11·3	4,650·30
Ora Banda	1,423·25	1,425·95	72 1·3	5,133·42
Paynes Find	777·50	278·25	25 9·3	1,001·70
Peak Hill	203·00	109·35	38 9·4	393·66
Sandstone	820·00	1,389·75	122 0·3	5,003·10
Wiluna	410·00	53·95	9 5·7	194·22
Yarri	335·00	259·90	55 10·3	935·64
	20,078·25	21,385·05	76 8·2	76,986·18

SCHEDULE NO. 2.

Number of Parcels Treated, Tons Crushed, and Head Value for Year ended 31st December, 1945.

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, t £4 4s. 11½d. per oz.
			ozs. dwts.	ozs. dwts.	ozs. dwts.	ozs. dwts.	dwts. grs.	£ s. d.
10	Bamboo Creek	631·00	162 19	138 0	248 12	386 12	12 6	2 12 1
18	Boogardie	1,039·25	462 6	391 11	140 6	531 17	10 6	2 3 7
73	Coolgardie	5,220·25	2,579 19	2,185 4	1,380 10	3,565 14	13 16	2 18 1
45	Cue	2,750·00	9,440 13	7,996 5	472 0	8,468 5	61 14	13 1 7
39	Kalgoorlie	1,140·50	633 12	536 11	186 19	723 10	12 17	2 14 0
8	Laverton	554·75	185 11	157 3	208 2	365 5	13 4	2 15 11
14	Marble Bar	1,416·25	484 17	410 14	831 6	1,242 0	17 13	3 14 6
29	Meekatharra	2,398·25	2,626 6	2,224 10	734 5	2,958 15	24 16	5 4 10
36	Norseman	959·25	1,291 15	1,094 2	127 9	1,221 11	24 10	5 3 9
33	Ora Banda	1,423·25	1,425 19	1,207 16	873 17	2,081 13	29 6	6 4 3
9	Payne's Find	777·50	278 5	235 14	66 0	301 14	7 18	1 12 11
5	Peak Hill	203·00	109 7	92 13	45 15	138 8	13 15	2 17 10
8	Sandstone	820·00	1,389 15	1,177 2	404 16	1,581 18	38 14	8 3 11
5	Wiluna	410·00	53 19	45 14	104 0	149 14	7 7	1 10 11
4	Yarri	335·00	259 18	220 3	100 6	320 9	19 3	4 1 3
336		20,078·25	21,385 1	18,113 2	5,924 3	24,037 5	23 22	5 1 7

Average tons per parcel	59·76.
Average yield by amalgamation per ton (fine gold)	18 dwts. 1 gr.
Average value by amalgamation per ton	£3 16s. 7d.—Australian, £8 18s. 2d.
Average head value of tailings per ton (fine gold)	5 dwts. 21·6 grs.
Average value of tailings per ton	£1 5s. 2d.—Australian, £2 18s. 6d.

SCHEDULE NO. 3.

Direct Purchase of Tailings for Year ended 31st December, 1945.

Battery.	Tons Purchased.	Amount Paid for Tailings.	Amount Paid A/c. Premium.
		£ s. d.	£ s. d.
Bamboo Creek	370·00	520 8 6	226 10 2
Boogardie	148·25	22 16 1	79 12 6
Coolgardie	3,599·75	2,345 2 4	3,214 1 10
Cue	1,737·75	579 5 7	875 15 7
Kalgoorlie	444·25	240 11 1	1,126 18 1
Laverton	476·75	375 17 10	243 10 7
Marble Bar	571·75	1,830 2 11	85 8 10
Meekatharra	963·00	332 12 10	597 5 8
Norseman	122·00	22 15 2	14 14 9
Ora Banda	523·00	1,106 3 7	716 13 3
Peak Hill	164·75	67 2 0	...
Sandstone	793·50	965 1 6	572 15 7
Wiluna	336·25	165 6 4	107 2 1
Yarri	222·00	179 15 4	116 9 3
	10,473·00	8,753 1 1	7,976 18 2

SCHEDULE NO. 4.

Tailings Treatment for 1945.

Battery.	Tonnage.	Yield.	Value.	Premium.	Total.
		fine ozs.	£	£	£
Bamboo Creek	224	44·57	189·641	251·087	440·728
Boogardie	1,112	103·03	437·912	580·346	1,018·258
Coolgardie	1,485	583·27	2,477·527	3,251·345	5,728·872
Cue	2,952	500·10	2,125·146	2,804·015	4,929·161
Kalgoorlie	3,810	747·94	3,176·943	4,187·917	7,364·860
Marble Bar	175	54·34	230·821	306·112	536·933
Meekatharra	1,299	153·78	653·215	858·909	1,512·124
Norseman	390	33·73	145·381	190·027	335·408
Sandstone	769	257·92	1,095·504	1,444·669	2,540·173
	12,216	2,478·68	10,532·090	13,874·427	24,406·517

SCHEDULE No. 5—Milling and Tin.

Statement of Receipts and Expenditure for the Year ended 31st December, 1945.

Battery.	Tonnage Crushed.	Expenditure.									Receipts.		Profit.	Loss.
		Management.	Wages.	Stores.	Total Working Expenditure.	Cost per Ton.	Renewals and Repairs.	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	631·00	79 18 9	468 6 8	375 17 3	924 2 8	29 3·6	98 12 1	238 5 3	1,261 0 0	39 11·6	330 6 9	10 5·6	....	930 13 3
Boogardie	1,039·25	108 19 1	335 16 10	200 6 6	645 2 5	12 5·0	226 14 10	264 19 7	1,136 16 10	21 10·3	516 13 3	9 11·3	....	620 3 7
Coolgardie	5,220·25	621 2 2	1,437 11 10	1,134 0 5	3,192 14 5	12 2·8	533 10 4	1,079 19 0	4,806 3 9	18 4·9	2,173 4 0	8 3·9	....	2,632 19 9
Cue	2,750·00	317 19 1	623 12 6	795 16 3	1,737 7 10	12 7·6	594 9 2	646 16 3	2,978 13 3	21 7·9	1,617 10 10	11 9·2	....	1,361 2 5
Kalgoorlie	1,140·50	335 17 11	554 14 0	464 16 6	1,355 8 5	23 9·1	241 5 0	307 11 11	1,904 5 4	33 4·6	545 15 0	9 6·8	....	1,358 10 4
Laverton	554·75	105 14 1	225 8 10	149 15 11	480 18 10	17 3·9	103 8 8	118 1 8	702 9 2	25 3·7	262 1 10	9 5·4	....	440 7 4
Linden	....	....	....	....	....	....	....	64 16 2	64 16 2	....	95 8 2	....	30 12 0	....
Marble Bar	1,416·25	392 12 11	624 5 10	565 2 0	1,582 0 9	12 4·1	263 18 5	406 8 7	2,252 7 9	31 9·7	746 8 11	10 6·5	....	1,505 18 10
Meekatharra	2,398·25	399 0 4	1,110 4 3	826 17 0	2,336 1 7	19 5·8	144 12 0	654 19 11	3,135 13 6	26 1·8	1,307 2 3	10 10·8	....	1,828 11 3
Mt. Ida	....	....	....	17 8	17 8	....	....	....	17 8	....	....	....	....	17 8
Mt. Sir Samuel	....	....	....	33 8 4	33 8 4	....	....	10 0 0	43 8 4	....	3 9 9	....	....	39 18 7
Norseman	959·25	498 17 2	648 2 4	597 4 9	1,744 4 3	36 4·5	183 3 8	241 12 7	2,169 0 6	45 2·8	534 1 1	11 1·6	....	1,634 19 5
Ora Banda	1,423·25	234 2 4	389 6 5	450 11 1	1,073 19 10	15 1·1	165 12 10	339 18 4	1,579 11 0	22 2·4	629 17 10	8 10·2	....	949 13 2
Paynes Find	777·50	181 8 4	507 14 9	208 4 4	897 7 5	23 0·8	58 16 10	212 19 3	1,169 3 6	30 0·6	413 6 8	10 7·6	....	755 16 10
Peak Hill	203·00	32 10 2	186 0 10	37 8 7	255 19 7	25 2·6	....	88 14 6	344 14 1	33 11·5	93 16 2	9 2·9	....	250 17 11
Pinjin	....	....	....	37 0 9	37 0 9	....	....	4 2 9	41 3 6	....	....	....	....	41 3 6
Sandstone	820·00	346 18 5	473 10 8	245 19 2	1,066 8 3	26 0·1	168 0 8	311 10 2	1,545 19 1	37 8·4	441 5 2	10 9·1	....	1,104 13 11
St. Ives	....	....	....	4 15 0	4 15 0	....	....	....	4 15 0	....	3 19 6	....	....	15 6
Wiluna	410·00	63 7 8	110 15 4	109 17 1	284 0 1	13 10·2	46 15 7	84 8 3	415 3 11	20 3·0	233 6 9	11 4·6	....	181 17 2
Yalgoo	....	....	31 5 0	....	31 5 0	....	....	26 7 11	57 12 11	....	....	....	....	57 12 11
Yarri	335·00	115 19 3	274 12 5	128 3 8	518 15 4	30 11·6	118 1 4	142 11 1	779 7 9	46 6·3	179 5 3	10 8·4	....	600 2 6
Head Office	....	....	....	....	....	....	....	....	....	....	54 1 9	....	54 1 9	....
	20,078·25	3,834 7 8	8,001 8 6	6,366 2 3	18,201 18 5	18 1·5	2,947 1 5	5,244 3 2	26,393 3 0	26 3·4	10,181 0 11	10 1·7	84 13 9	16,296 15 10
Coolgardie Treatment Plant	....	....	....	....	....	....	....	2 7 6	2 7 6	....	7 11 6	....	5 4 0	....
Sale Stores	....	....	....	....	....	....	....	....	....	....	37 0 0	....	....	....
Total	20,078·25	3,834 7 8	8,001 8 6	6,366 2 3	18,201 18 5	18 1·5	2,947 1 5	5,246 10 8	26,395 10 6	26 3·4	10,225 12 5	10 1·7	89 17 9	16,296 15 10
														89 17 9
Total Loss	....	....	....	....	....	....	....	....	....	....	....	....	....	16,206 18 1

SCHEDULE No. 6—Tailing Treatment.

Statement of Receipts and Expenditure for the Year ended 31st December, 1945.

Battery.	Tonnage Treated.	Expenditure.									Receipts.		Profit.	Loss.
		Management.	Wages.	Stores.	Total Working Expenses.	Cost per Ton.	Renewals. and Repairs.	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	224	14 10 11	84 11 11	87 18 2	187 1 0	16 8·4	78 18 4	57 15 9	323 15 1	28 10·8	246 10 0	22 0·1	....	77 5 1
Boogardie	1,112	156 1 9	336 10 6	217 1 9	709 14 0	12 9·1	26 15 6	263 3 5	999 12 11	17 11·7	727 6 6	13 0·9	....	272 6 5
Coolgardie	1,485	229 10 6	514 1 2	541 8 6	1,285 0 2	17 3·7	96 9 9	368 18 6	1,750 8 5	23 6·9	1,325 10 7	17 10·2	....	424 17 10
Cue	2,952	293 5 0	627 11 6	517 16 5	1,438 12 11	9 8·9	226 13 3	620 2 7	2,285 8 9	15 5·8	3,216 4 5	21 9·5	930 15 8	....
Kalgoorlie	3,810	352 1 9	1,119 14 3	626 6 4	2,098 2 4	11 0·1	13 9 9	839 2 6	2,950 14 7	15 5·8	2,990 4 2	15 8·3	39 9 7	....
Marble Bar	175	4 17 0	85 9 6	53 17 3	144 3 9	16 5·7	30 16 3	80 7 8	255 7 8	29 2·2	120 2 5	13 8·7	....	135 5 3
Meekatharra	1,299	21 19 2	490 3 6	319 5 2	831 7 10	12 9·6	59 13 0	215 10 8	1,106 11 6	17 0·4	812 0 2	12 6·0	....	294 11 4
Norseman	390	128 10 4	82 19 11	170 18 9	382 9 0	19 7·3	104 12 1	83 3 2	570 4 3	29 2·9	202 6 9	10 4·5	....	367 17 6
Ora Banda	....	11 2 5	15 0 2	2 12 3	28 14 10	....	40 13 6	19 15 3	89 3 7	....	21 11 3	....	....	67 12 4
Paynes Find	....	20 8 1	68 8 8	86 12 3	175 9 0	....	9 14 9	31 9 6	216 13 3	....	16 17 8	....	....	199 15 7
Sandstone	769	235 19 1	312 6 2	255 10 1	803 15 4	20 10·8	216 7 1	175 6 6	1,195 8 11	31 1·1	555 15 8	14 5·4	....	639 13 3
Yarri	....	....	....	....	....	....	....	....	....	....	2 11 5	....	2 11 5	....
Total	12,216	1,468 6 0	3,736 17 3	2,879 6 11	8,084 10 2	13 2·8	904 3 3	2754 15 6	11,743 8 11	19 2·7	10,237 1 0	16 9·1	972 16 8	2,479 4 7
Total Loss	....	....	....	....	....	....	....	....	....	....	....	....	....	1,506 7 11

GENERAL WORKING ACCOUNT.

General Working Account for the Year ended 31st December, 1945.

	Milling. £ s. d.	Cyaniding. £ s. d.	Total. £ s. d.		Milling. £ s. d.	Cyaniding. £ s. d.	Total. £ s. d.
To Wages	13,646 4 0	5,791 12 8	19,437 16 8	By Revenue	10,188 12 5	10,237 1 0	20,425 13 5
,, Stores	6,862 5 11	2,943 1 0	9,805 6 11	,, Loss Carried Down	12,979 10 9	....	12,979 10 9
,, Battery Spares	392 3 8	....	392 3 8				
,, Water	1,835 16 7	375 15 0	2,211 11 7				
,, General Expenses	431 13 0	758 16 6	1,190 9 6				
,, Profit Carried Down	....	367 15 10	367 15 10				
	£23,168 3 2	£10,237 1 0	£33,405 4 2		£23,168 3 2	£10,237 1 0	£33,405 4 2

Profit and Loss Account.

	Milling. £ s. d.	Cyaniding. £ s. d.	Total. £ s. d.		Milling. £ s. d.	Cyaniding. £ s. d.	Total. £ s. d.
To Loss Brought Down	12,979 10 9	....	12,979 10 9	By Profit Brought Down	....	367 15 10	367 15 10
,, Administration	3,227 7 4	1,874 3 9	5,101 11 1	,, Gross Loss Carried Down	16,206 18 1	1,506 7 11	17,713 6 0
	£16,206 18 1	£1,874 3 9	£18,081 1 10		£16,206 18 1	£1,874 3 9	£18,081 1 10

General Profit and Loss Account.

	£ s. d.	£ s. d.		£ s. d.
To Gross Loss	17,713 6 0		By Net Loss Carried Down	47,582 9 10
,, Interest	20,282 0 0			
,, Sinking Fund	1,413 0 0			
,, Depreciation	7,787 1 5			
,, Superannuation	387 2 5			
		47,582 9 10		47,582 9 10
,, Balance Brought Forward		1,359,385 9 11		
,, Balance Brought Down		47,582 9 10	,, Balance Carried Down	1,406,967 19 9
		£1,406,967 19 9		£1,406,967 19 9

STATE BATTERIES.

Balance Sheet as at 31st December, 1945.

Liabilities.	£ s. d.	£ s. d.	Assets.	£ s. d.	£ s. d.
Capital Expenditure—			Plant and Buildings	77,498 10 6	
General Loan Fund	406,164 4 7		*Less* Depreciation	7,787 1 5	
Revenue	93,726 4 5				69,711 9 1
Assistance to Gold Mining Industry	28,621 13 5		*Stores Account—*		
Commonwealth Assistance	13,786 8 0		Outstations	....	14,040 17 0
			Suspense	....	219 19 1
Sundry Creditors—			Sundry Debtors	....	2,653 13 5
Cash Orders	1,094 6 9		Battery Spares	....	698 14 11
Other	2,285 16 11		Profit and Loss Account	....	1,406,967 19 9
Treasury Account	134,613 13 9				1,494,292 13 3
Superannuation	1,355 10 11				
Interest	676,628 0 0		Amount Paid for Tailings not Treated (including Premium Advance)	13,907 2 11	
Sinking Fund	136,016 14 6		Amount Due but not Paid for Tailings Untreated (including Premium Advance)	3,424 0 6	
		1,494,292 13 3			17,331 3 5
Purchase of Tailings Advance Account	....	14,000 0 0	Estimated Gold Premium	....	1,809 0 3
Sundry Creditors for Tailings Payments	2,249 12 2		Purchase of Tailings Cash Account	....	92 17 1
Advance of Premium	1,174 8 4				
Balance of Premium (Estimated)	1,809 0 3				
		5,233 0 9			
		£1,513,525 14 0			£1,513,525 14 0

ANNUAL PROGRESS REPORT OF THE GEOLOGICAL SURVEY BRANCH OF THE MINES DEPARTMENT FOR THE YEAR 1945.

Contents.

Division IV.

Annual Progress Report of the Geological Survey of Western Australia for the Year Ended 31st December, 1945.

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 progress of the Geological Survey for the year ended 31st December, 1945.

STAFF.

Strength as at December 31st.

Professional.		*Total.*
Government Geologist	H. A. Ellis, B.Sc., A.O.S.M.	4
Geologist, 1st class (senior)	R. A. Hobson, B.Sc. (Hons.)	
Geologist, 1st class	R. S. Matheson, B.Sc.	
Geologist, 2nd class	H. J. Ward, B.Sc.	

Clerical.		
Typist—temporary staff		4
Junior clerk—Female—Temporary staff		
Laboratory assistant—Male—Temporary staff		
Messenger		

Resignations, Promotions, New Appointments.

On August 17th, Mr. F. G. Forman resigned from the position of Government Geologist to take up an appointment with Australian Mines Management and Secretariate Ltd., Perth. He had been Government Geologist since 1934, and takes with him to the mining industry a wide knowledge of the geology of the mineral deposits of the State.

I was subsequently promoted from the position of Geologist 1st class (senior) to that of Government Geologist, and took over from Mr. Forman as from August 17th as Acting Government Geologist pending confirmation of my promotion.

In November, Mr. R. A. Hobson was promoted to Geologist 1st class (senior) to fill the vacancy created by my promotion to Government Geologist.

In October, Mr. H. J. Ward commenced duty as Geologist 2nd class, filling the vacancy caused by Dr. K. Miles' resignation in October, 1944. Considerable delay was experienced in filling this vacancy due to the difficulty in securing the release of successful applicants from their employment at the time of appointment.

Applications were called for the Geologist 1st class vacancy caused by the promotion of Mr. Hobson and myself. A selection has been made but the appointee will not be available for duty until early in 1946.

Increase in Staff.

Towards the end of the year the necessary approval was obtained for the addition of two Geologists 2nd class, and a Technical Assistant (female) to the strength of the existing professional staff in order that the survey should be able to play its part in the Departmental policy of increased assistance to our mining industry.

Unfortunately, no applications were received for the appointment as Technical Assistant, and this very essential appointment must remain vacant until such time as a suitable applicant is available. It is hoped that a temporary solution will be soon found whereby the functions of this appointment will be partially carried out, thus relieving professional officers of much technical office work.

Two suitable applicants have been appointed as Geologist 2nd class and their services should be available early in 1946.

Early in 1946 the professional staff will consist of:—

Government Geologist	1
Geologist 1st class (senior) ..	1
Geologists 1st class	2
Geologists 2nd class	3
Total	7

Following is a tabulated statement showing the relation between the area of the State and the availability of geologists during the year:—

Period.	No. of Geologists available including Govt. Geologist.	Area of State.	Square miles per Geologist.	Population.
1945—		sq. miles.		
Jan.-Aug.	4	975,920	243,980	493,000
Aug.-Oct.	3	....	325,300	....
Oct.-Dec.	4	....	243,980	....

Early in 1946 with the effective strength at 7 geologists (including the Government Geologist) the number of square miles per geologist will be 193,410.

It is obvious that with such a large area per geologist, only the most pressing needs of geological investigation can be met by the present staff.

ACTIVITIES OF PROFESSIONAL OFFICERS.

F. G. Forman.

Up to the time of his resignation in August, in addition to administrative duties, Mr. Forman undertook the following field work:—

Visited Victoria and New South Wales to inquire into methods of geological investigation of damsites on sedimentary areas.

Made three journeys to inspect development work on the Comet Gold Mine, Marble Bar, and one to the oil bore site, Nerrima Dome, West Kimberleys.

H. A. Ellis.

Completed a report on "Some Economic Aspects of the Principal Tantalum Bearing Deposits of the Pilbara Goldfield" in January, and from February to June inclusive, was at Norseman making a geological examination of the Iron King Pyrite Mine and supervising an underground diamond drilling programme undertaken as a result of the geological examination. During this period a geological reconnaissance was carried out in the Salmon Gums district with a view to advising on the possibilities of obtaining subterranean water fit for domestic or stock purposes in that area.

In July examined the Edna May Gold Mine, Westonia, with a view to advising on future development.

In August appointed Government Geologist and in addition to administrative duties visited the geological survey party in the East Kimberleys in September and in November and December visited various mining centres in the Yilgarn, Coolgardie and Dundas Goldfields.

R. A. Hobson.

In addition to carrying out field work in connection with an investigation into the corrosion of water pipes in the Northam District during January-March (incl.), also made short visits to Muchea, Gingin and Bullsbrook to collect chalk and marl samples. Visited Bell Bros. quarry at Guildford in May, and in November visited Port Hedland in connection with a proposed water supply scheme for that town. Compiled reports on boring for foundations on Reserve 8828 City area, Perth, for the pipe corrosion survey, Port Hedland water supply, and completed bulletins on the Mt. Margaret Goldfield and the Greenbushes Mineral Field. Compiled an index for and proof read 1944 Annual Report and Mineral Resources Bulletin No. 3.

In December, commenced field work at Collie in connection with boring for coal at Ewington.

R. S. Matheson.

In January completed a detailed report on the Dandaragan Phosphate deposits, and until April finalising reports on work done in 1944, proof reading Bulletin 101, and preparing for field work in the East Kimberley district. Left Perth on April 24th and travelled overland to Wyndham arriving there on May 24th. From May 24th to early September engaged on geological reconnaissance with Dr. C. Teichert of the University of W.A. in a strip of country between the Ord River and the Northern Territory border extending from the Pincombe Range in the North to the Hardman Range in the South. Examined bore cores from diamond drill holes at Ord River dam site during this period and proof read first proof of Dandaragan Phosphate Bulletin. On sick leave from September 11th to December 6th, during which period proof read and compiled index for 2nd proof of Bulletin 101. Compiling report on East Kimberley investigations during December.

H. J. Ward.

Joined the survey in October, and during October and November examined and reported on the State Brick Works, Cardup. At Norseman in December investigating the occurrence of alluvial gold on G.M.L. 1530, Second Try.

FIELD WORK.

Field Work in Progress as at December 31st.

(1) Examination of G.M.L. 1530, Second Try, Norseman.—H. J. Ward.

(2) Boring for coal, Ewington, Collie.—R. A. Hobson.

Field Work Authorised for 1946.

(1) Completion of 1 and 2 above.

(2) Making of a general geological map of the pegged area on Loc. 59, Hampton Plains, Coolgardie.

(3) Commencement of geological mapping along pipe line routes between the Northam-Wyalkatchem-Merredin loop line and the Great Eastern Railway.

(4) Participation in the Geophysical Survey of the Collie Coal Field in conjunction with geophysicists from Mineral Resources Survey, Canberra.

(5) Participation in an oil survey of the Fitzroy Basin, West Kimberley District in conjunction with geologists from Mineral Resources Survey, Canberra.

(6) The commencement of a detailed examination of 900 square miles of country surrounding Coolgardie—Coolgardie Goldfield.

(7) The commencement of a geological reconnaissance of an area of some 12,000 square miles of unmapped country in the Yalgoo, Murchison and Gascoyne Goldfields extending northwards from Yalgoo to the Gascoyne River.

TRANSPORT.

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

Type.	Load Capacity.	Speedo reading. 31st Dec., 1945.	Purchased.
Dodge Utility	15 cwt.	82,680	1935 (new).
Dodge Utility	15 cwt.	79,923	1935 (new).
Ford Utility	18 cwt.	32,424	1945 (second-hand)
International Utility	15 cwt.	22,650	1945 (second-hand)

All of these vehicles are costly to maintain on the class of work they are called upon to do, and heavy maintenance charges can be anticipated for the coming year. Two additional vehicles will be needed and have been promised for the 1946 field season.

SERVICE TO THE GENERAL PUBLIC.

A steady stream of enquiries for geological information both personal and written, continues to be met by the professional staff, and our literature is sought by individuals and institutions all over the world.

Field officers give advice to prospectors and syndicates operating in areas where field work is proceeding, and Government Departments freely call upon the Survey for technical advice on questions of building foundations, underground water supply, engineering geology, etc. These services will continue to be met within the limits of the staff available.

PUBLICATIONS.

Issued During 1945.

Mineral Resources of Western Australia, Bulletin No. 1; Census of Western Australian Minerals, by Dorothy Carroll, Ph.D., D.I.C., Government Chemical Laboratories. Published by Department of Mines, Perth, 1945.

In the Press.

Mineral Resources of Western Australia, Bulletin No. 3; Tantalum and Niobium, by K. R. Miles, D.Sc., F.G.S., Geological Survey of W.A., and Dorothy Carroll, Ph.D., D.I.C., and H. P. Rowledge, A.A.C.I., A.W.A.S.M., Government Chemical Laboratories.

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

Geological Survey of W.A. Bulletin No. 101, The Mining Groups of The Yilgarn Goldfield, North of The Great Eastern Railway, by R. S. Matheson, B.Sc., Geological Survey of Western Australia.

Compiled and Awaiting Authority to Print.

Geological Survey of Western Australia Bulletin; on the Greenbushes Mineral Field, by R. A. Hobson (Hons.) and R. S. Matheson, B.Sc., Geological Survey of Western Australia.

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.

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.

H. A. ELLIS,
Government Geologist.

December 31, 1945.

PYRITE.

IRON KING MINE—NORSEMAN, W.A.

Approx. Lat. 32°-10′ S.

Approx. Long. 121°-50′ E.

Interim Report

on

A Geological Survey and Underground Diamond Drilling Programme—G.M.Ls. 1460, 1481, 1502, 1580 Dundas G. F.

by

H. A. Ellis, B.Sc., A.O.S.M.

Introduction.

A geological survey of the above mine was commenced on 1st March, 1945, and on 19th March underground diamond drilling was commenced with the object of testing the mineralised zone for the existence of possible additional parallel ore bodies over that portion of the ore-body already opened up at the Nos. 3 and 4 levels—a distance of some 1,350 feet.

The primary object of this survey and underground diamond drilling programme was—

(1) To ascertain as far as possible from surface and underground examination the nature and probable extent of the deposits.

(2) To prove or disprove the existence of parallel ore bodies capable of being mined from the same openings as are in use in mining the deposits already known to exist.

(3) To test the main ore body by underground diamond drilling at as deep an horizon as possible below the No. 4 level (the deepest level at which ore is being mined—May, 1945).

Results.

(a) *Geological Survey.*—The sulphide ore body is of replacement origin and occurs as a series of overlapping lenses in a strong shear zone in metamorphosed basic lavas and sediments (greenstones) of Pre-Cambrian age. The shear zone strikes approximately North and South and dips at from 45° to 55° to the West with occasional steeper or flatter dips.

The outcrop can be traced at intervals on the surface as a gossan consisting of limonite and quartz over a distance of some 5,000 feet, but outcrop conditions are such that it is not possible to state that the outcrop is continuous over this length.

From this total length of outcrop ore has been mined from a vertical depth of 260 feet over a length of approximately 1,300 feet in a section of the lode situated more or less centrally along the line of outcrop. Over this section ore widths have varied from 30 feet to 3 feet (true widths) and the ore has been of a high grade, containing on the average about 30% of sulphur.

In the deepest workings (No. 4 level, 260 feet vertical depth) the shear zone in which the pyrite has been deposited is strongly defined on the hanging wall and in the ends of the North and South drives on the lode.

The ore has shown a general tendency to become narrower in width from the surface to the No. 4 level, though there are notable exceptions in which the ore has become thicker between the Nos. 3 and 4 levels, the significance of which is not apparent on account of insufficient information below the No. 4 level.

The grade of the ore continues to be high in the deepest workings.

In appendix 1 details of ore-widths and the depths at which it was cut in surface diamond drill holes in 1942 and 1943, and the distances along the strike from the existing workings at which the ore occurred are given.

Good grade pyritic ore of an average width of 16 feet is continuous over a length of 1,300 feet at No. 3 level (vertical depth 190 feet) with ore still showing in the drive faces, and the same lens of ore is continuous over the same distance with an average width of 11 feet at the No. 4 level (vertical depth of 260 feet) with ore still showing in both ends.

There are no obvious geological factors controlling ore deposition other than the main controlling influence of the shear zone, which, as previously stated, has a known length of some 5,000 feet and is strong, well defined, and heavily mineralised in the present lowest level of the mine (May, 1945).

(b) *Underground Diamond Drilling.* A total of 557 feet of diamond drilling distributed in eight holes and suitably placed to test the existence of possible ore bodies parallel to those already known and being worked has been completed, and has established the fact that there are NO parallel ore bodies in either the hanging wall or foot wall country over that section of the deposit already opened up over a length of approximately 1,200 feet to a vertical depth of 260 feet.

Owing to the Westerly dip of the ore body and the lack of suitable crosscuts extending in a Westerly direction, it has NOT been practicable to effectively test the ore body *below* the No. 4 level by underground diamond drilling.

Ore Reserves.—Proved ore above the No. 4 level not yet mined amounts to approximately 86,000 tons, of which approximately 60,000 tons can be extracted. At the present rate of production (6,000 tons of ore per month) this is equivalent to ten months' supply.

There is not sufficient information available about the ore bodies *below* the No. 4 level to justify an estimate being made of probable ore reserves in this part of the mine, nor is it possible on account of insufficient information to make an estimate of probable ore reserves in that part of the lode cut by surface diamond drill holes *North* of the existing underground workings (see appendix 1).

Development.—The following development work is in progress (May 4, 1945):—

(1) The ore body is being driven on at the South end of the footwall drive on the No. 4 level, where the ore is at present 14 feet wide with the hanging wall NOT exposed. The ore is high grade.

(2) The plat is being cut from the bottom of the three compartment shaft recently sunk 100 feet below No. 4 level, in preparation for crosscutting to the lode to start No. 5 level.

The cutting of an ore-bin of 370 long tons capacity below No. 5 level, and the cutting of a transfer pass between No. 4 and 5 levels is contemplated. This automatically necessitates the sinking of the main shaft another 89 feet below No. 5 level. All ore will then be hauled from No. 5 level.

Future Development.—There were two directions in which future development could have proceeded prior to the decision being made to sink the main shaft to the No. 5 level.

(1) Laterally to the North and South from the 3 and 4 levels towards ore located in distant surface diamond drill holes.

(2) Downwards from No. 4 level on encouraging widths of ore.

In the writer's opinion the decision to develop in depth was the correct one, and such development work as can be financed by the company is already in progress in this direction.

An urgent necessity exists, which the present financial position of the company is unable to meet, to carry out a programme of winzing for the following reasons:—

(1) To enable ore to be proved and developed sufficiently for approximately two years' supply at the present rate of production.

(2) To enable a development and stoping programme to be laid out in advance of driving which will enable the ore both above and below No. 4 level to be more cheaply mined.

A knowledge of the ore bodies gained from winzing is essential to the efficient working of the mine, and in the case of the present ore bodies which change disconcertingly in thickness and attitude, it is even more essential to know as much about them as possible before driving on them.

There is an immediate necessity for the sinking of six winzes each of approximately 120 feet in depth over 1,200 feet length of No. 4 level.

There is a high degree of probability on geological grounds that these winzes would prove ore to an average width of 10 feet over this length and depth, provided an endeavour is made to find both walls of the ore body at intervals of 40 feet (allowance has been made for this necessity in the following estimated cost).

Using a conversion factor of 10 cubic feet of ore per ton this would give an estimate of possible ore reserves to be proved as

$$\frac{1200 \times 120 \times 10}{10} = 144{,}000 \text{ tons.}$$

Estimated Cost and Time of Winzing.

Cost per Winze:	£
10 feet of crosscut for chamber at £6 per foot	60
Supply of timber, equipping brace, etc.	25
120 feet of sinking (5ft. x 5ft.) at £7 per foot	840
3/16ft. crosscuts at 40ft. intervals at £7 per foot	336
	1,261

Estimate for one winze say £1,270
Estimate for six winzes say £7,620

Time.—It is estimated that each winze would take two and a half months to sink, and that two winzes could be sunk simultaneously, making the total time required for winzing equal to seven and a half months.

It is thus obvious that early action is necessary to commence this work in view of the fact that proved ore reserves are sufficient for ten months' production only.

Surface Diamond Drilling Programme.—Appendix 1 is a copy of a recommendation already made for surface diamond drilling.

Finance has been sought for approximately 4,000 feet of surface driamond drilling, and an estimate of the time required to do this work is as follows:—

One machine working—	
4 x 800ft. holes at three months per hole	12 months
2 x 400ft. holes at one and a half months per hole ..	3 months
Total	15 months

If two machines were available the time would be approximately halved.

This programme is purely exploratory and is designed to obtain information of the required nature to decide on a long term policy re the future of the pyrite industry.

Conclusions.

(1) The pyritic ore bodies at the "Iron King" mine show possibilities of being able to provide the raw material necessary to supply the sulphur requirements of the superphosphate industry in Western Australia.

(2) Much exploratory and development work is necessary to maintain present production, or to increase it over the next few years, and to lay the foundation for an estimate of probable ore reserves on which to base a long term development and production programme.

(3) The ore channel extends over a length of 5,000 feet at the surface, and in the central portion of this length widths of up to 30 feet of high grade ore have been proved in drill holes, and in actual mining to a vertical depth of 260 feet.

(4) No geological factors unfavourable to the assumption that the ore bodies will continue in depth below No. 4 level have been discovered in the course of the geological examination, although with notable exceptions, there has been a general tendency for the ore widths to be somewhat narrower at the No. 4 level than above it.

(5) Details of ore widths encountered in surface drill holes given in appendix 1, indicate that the strong shear zone in which the deposits occur is occupied by encouraging widths of pyritic ore at intervals over at least 3,300 feet of its length, at depths varying from 90 to 160 feet below the surface. Mining operations at 260 feet vertical depth have proved the existence of good grade ore over a length of 1,200 feet, with ore still continuing in the drives and underfoot.

(6) The shear zone and mineralisation is still strong in the deepest workings (260 feet V.D.) and in the absence of definite geological evidence to the contrary, the assumption that ore will continue in depth is therefore a first class geological and mining risk, and one which must be accepted in any exploratory or development programme designed to prove ore reserves, or establish possible ore reserves.

(7) The underground diamond drilling programme did *NOT* disclose the existence of parallel ore bodies over that portion of the deposits already opened up over a lengths of approximately 1,200 feet to a depth of 260 feet (vertical).

(8) The "Iron King" pyrite deposit is the only one so far known in Western Australia which is likely to be able to provide the sulphur requirements of the superphosphate industry for some years to come.

Recommendations.

If it is desired that pyrite be continued to be produced in the future at the present rate, or at an increased rate, then the following recommendations will need to be carried out as soon as possible:—

(1) That finance to the extent of £7,620 be made available immediately to Norseman Gold Mines N.L. to enable work to be commenced on the six winzes to be sunk from the No. 4 level over a length of 1,200 feet of lode, as outlined under the heading "Future Development."

(2) That the surface diamond drilling programme be commenced as soon as possible.

9th May, 1945.

APPENDIX I.

PYRITE.

IRON KING MINE—NORSEMAN.

Surface Diamond Drilling.

19th March, 1945.

It is recommended that a contract be let to a suitable organisation capable of conducting a surface diamond drilling programme designed to test the pyrite ore-bodies of the Iron King Mine at a distance of approximately 1200 feet down the direction of dip, equivalent to a vertical depth of approximately 800 feet below the collar of the main shaft.

(The ore body strikes approximately N. and S. and dips at approximately 45° W.—R.L. collar of main shaft is 5.72 feet above datum.)

(2) The programme would involve 4 vertical holes of 800 feet ± and 2 of 400 feet ± the latter to test the lode in the gaps in the existing line of bores to the North of the main shaft. A total of 4,000 feet ± of drilling would be called for.

(3) The deepest workings are at present (March, 1945) on the No. 4 level (R.L.—262 ft.) and even if the underground diamond drilling programme at present in progress succeeded in doubling the reserves above the No. 4 level, which it is unlikely to do, the future of the mine and the pyrite industry must rest on the continuation of the ore bodies to at least 800 feet V.D. in the vicinity of the present main shaft and underground workings.

(4) The testing of the ore bodies by diamond drill at a depth of 400 feet below the surface in the gaps between the existing holes to the North of the main workings (see para. 5 (c)), is advisable in order that development to the North from the No. 5 level may be planned. (The main shaft is being sunk and is now down 80 feet below No. 4 level.)

(5) The folowing information is submitted in support of this recommendation:—

(a) R.L. Collar Main Vertical Shaft + 5.72 feet.
No. 3 Level RL = —188 feet.
Length of drive 1300 feet (530′ N., 770′ S. of main shaft).
Drive in ore all the way.
Good ore in both ends—shear strong.

(b) *No. 4 Level* RL = —262 feet.
Length of drive 1220 feet (590′ N., 630′ S. of main shaft).
Drive in ore all the way.
Good ore in both ends—shear strong.

Hanging wall Drive 180 feet in ore with probable continuation of lode established for another 220 feet—this is a parallel ore body and additional to main drive distance.

A winze has been sunk in pyrite for 70 feet at 110 feet North of the main shaft.

(c) *Surface Diamond Drilling.*

The lode has been cut at the following points:—
NORTH of the *existing underground workings* of the No. 4 level.
(1) 270 feet N., R.L. top of lode—178 feet, approx. true width 14 feet of pyritic lode material.
(2) 1,080 feet N., R.L. top of lode—225 feet, approx. true width 25 feet lode material carrying lenses of pyrite up to 4 feet thick.

(3) 1,432 feet N., R.L. top of lode—270 feet, approx. true width 40 feet of lode material carrying lenses of pyrite up to 12 feet thick.

(4) 1,756 feet N., R.L. top of lode—330 feet, approx. true width of lode 10 feet; all carrying lenses of pyrite up to 12 feet thick.

SOUTH of the *existing underground workings* of the No. 4 level.

(1) 300 feet S., R.L. top of lode= —80 feet approx. true width of lode 10 feet; all pyrites.

(6) The 800 feet diamond drill holes would be aimed at proving the nature of the lode at approximately three times the distance down the dip at which information is at present available, and along the strike for approximately 700 feet N. and 700 feet S. from the main shaft —the extent of the proved ore at No. 4 level.

(7) Pyritised quartz and greenstone occurs at a vertical depth of 1,976 feet at the bottom of the Ajax shaft, situated some 3 miles N. of and at only a slightly higher elevation than the Iron King Mine, and it is a reasonable assumption that at this depth conditions were still favourable for the deposition of pyrite at the Iron King Mine, providing the structure persists in depth.

(8) An additional 2,000 feet of surface diamond drilling could be used with advantage if it were considered desirable to gain further information about the orebodies in depth north of the existing underground workings on the No. 4 level.

(9) It is considered that if this surface diamond drilling programme reveals the continuation of a mineralised shear carrying pyrite of encouraging dimensions at a V.D. of 800 feet in any of the proposed four deep holes, then ordinary mining risks may be taken on the thickness of the ore below the No. 4 level and between the holes.

March 19th, 1945.

ADDENDUM TO IRON KING PYRITE MINE REPORT.

Since the above report was compiled (May, 1945), additional stoping, sinking of the main shaft from No. 4 to No. 5 level (R.L. No. 5 level = —372 feet) and cross-cutting to the lode at this level and driving on it North and South has been carried out.

This additional work, together with some microscopic investigations of thin slices of wall rocks and unreplaced rock in the pyritic lode material kindly undertaken by Dr. R. Prider of the Department of Geology, University of W.A., has resulted in a better understanding of the structural relation between the ore body and associated wall rocks than that which the writer was able to form at the time of the examination in May.

The structural picture is now clearly revealed to be that of pyritic replacement of a zone of metamorphosed sediments of varying thickness, partially sheared and partially drag-folded into flatly North pitching structures (pitches vary from 15° to 20° to the North) of a shape which definitely places all of the associated rocks on the West limb of a North pitching anticline (or the East limb of a North pitching syncline). The metamorphosed sediments which have been selectively replaced now consist mainly of quartz-biotite hornfels, and occur between walls of quartz-dolerite greenstones, medium to coarse grained epidiorites, and medium to coarse grained amphibolites (all three, types of the Younger Intrusive Greenstones) and biotite-hornblende-plagioclase schists representing sheared metamorphosed lavas or tuffs of the Older Greenstone Series.

It is a type of ore-occurrence frequently seen in the Mt. Margaret and Yilgarn Goldfields, only in these areas the lodes are auriferous instead of pyritic.

The incompetent sediments between the more competent meta-lavas (both of the Older Greenstone Series) and Younger Greenstone intrusives have yielded to differential movement and pressure by shearing and folding, the folds playing an important part in defining the shape of the pyritic ore bodies where these selectively replace the more siliceous zones in the crumpled metasediments. A realisation of this fact explains the apparent extreme irregularity in thickness and attitude of the ore body between the 3 and 4 levels, and also makes it apparent why the pyrite has been so difficult to mine by ordinary mining methods.

At the end of December, 1945, the drives on the ore at the No. 5 level (R.L.—372 feet) had been advanced 200 feet North and 200 feet South from the cross-cut in mixed pyrite and pyrrhotite of an average width of 6 feet containing 24 per cent. sulphur. The advent of pyrrhotite at the No. 5 level in sufficient quantity to interfere with the established flotation process for normal pyrite was not predictable from the nature of the ore at the No. 4 level, where high grade, easily floated pyrite occurred.

In a diamond drill hole extended Westwards from the No. 5 plat before cross-cutting, the main lode was cut and showed pyrrhotite plus pyrite in the core, and a parallel ore body 9 feet wide containing 11.4 per cent. sulphur, showed arsenical pyrite in addition to pyrite. This lode was cut 39 feet west of the main lode and had not been previously cut in surface bores.

Mining and production of pyrite was still in progress as at December, 1945.

January 16th, 1946.

REPORT ON UNDERGROUND WATER SUPPLIES.

Salmon Gums District—Southern Mallee—Eucla Division, W.A.

Centre of Area Lat. 33° -00′ S.
Long. 121° -40′ E.

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

Introduction.

The "Southern Mallee" is the name given to the wheat and sheep farming district situated between Norseman and Esperance on the Coolgardie-Esperance railway line. Salmon Gums, a small township situated in approximately Lat. 33° -00′ S., and approximately Longitude 121° -40′ E., is the main centre in which are situated a Post Office, hotel, stores and garage and the headquarters of the district branch of the Agricultural Bank.

The district is now classified as a "marginal area" and wheat growing is restricted in favour of sheep breeding. A very large number of the original holdings have been abandoned by the settlers, and at present (June, 1945) there are approximately 80 farmers carrying on restricted wheat growing and sheep breeding.

The whole of the area lies in the saline ground water zone of Western Australia, and the provision of adequate water supplies for stock has always been a problem.

As the result of drought conditions over a long period prior to May, 1945, surface dams on many of the farms became empty, and water for stock and domestic purposes had to be carted long distances from key dams (Government owned). In an endeavour to solve the water supply problem, the services of a water diviner were obtained by the local member of Parliament for the district, and after he failed dismally to locate anything but extremely saline water (an easy thing for anyone not a water diviner to do), the writer was instructed to examine the district with a view to advising on the possibility of the location of subterranean supplies of useful stock or domestic water.

The examination was carried out during the period May 23rd-June 1st, 1945.

Area Examined.

A geological reconnaissance was carried out over an area extending from Beete Siding in the North to Scaddan Siding in the South, a distance of 54 miles and to an average distance of 13 miles East of the railway line, and 14 miles West of the railway line, a total area of approximately 730 square miles,

Topography, Vegetation, Rainfall and Geology.

The "Southern Mallee" is a wide, flat to gently undulating stretch of country, with either sandy or light calcareous puffy soils originally thickly timbered mainly with the numerous eucalypt species commonly referred to as "Mallee." The general elevation of the country is between 800 feet above sea level at the Northern end and about 600 feet above sea level at the Southern end, with no prominent elevations.

The underlying rocks where visible, are either granite, gneiss, or sedimentary beds of lacustrine origin, mainly of a sandy nature and of limited extent. Granite and highly banded biotite gneiss are widespread as sub-surface rocks, but nowhere do they outcrop as bare rock surfaces of any extent.

Shallow salt lakes are liberally distributed over much of the area, and some of them are in the nature of "clay pans," which after a heavy storm accumulate considerable quantities of usable stock water, which under the influence of evaporation gradually becomes too saline for use.

The average annual rainfall is in the vicinity of 12 inches, received mainly over the winter months in a considerable number of wet days on which the daily rainfall is in the nature of light showers. This has an important bearing on the question of subterranean water storage. Occasional summer thunderstorms are of sufficient intensity to cause enough run-off to fill dams, and normal winter rains are relied on to fulfil this function.

Present Sources of Water Supply.

The main sources are:—

(1) Roof catchment and galvanised iron storage tanks at the farmhouse.

(2) Earth dams, really excavated tanks—mainly uncovered—one or more to each farm.

(3) A series of well constructed excavated tanks—covered and equipped with pumps—Government owned. These are the "Key Dams" on which many of the settlers rely, and from which water for stock and domestic use is carted for upwards of 30 miles in some instances in dry times.

In only one instance (West of Scaddan) was groundwater available for stock, despite many attempts to secure it in the past from shallow boreholes.

Prospects of Obtaining Supplies from Subterranean Sources.

Rainfall, vegetation, soil and rock outcrop conditions are entirely unfavourable over the whole area for the collection and storage of useful subterranean supplies of either domestic or stock water.

The low rainfall and the manner in which it falls, the high loss from transpiration and evaporation, and the clayey nature of much of the soil, combined with the lack of suitable natural catchment areas with suitable adjacent sandy storage beds are the reasons why no useful supplies of water can be found in the area.

This applies equally to normal groundwater and artesian or sub-artesian water.

Geological conditions necessary to provide artesian or sub-artesian water of useful quality do not exist in the area, and it is quite useless sinking any bores in the hope of encountering this class of water.

The solution of the water supply problem obviously depends on sources other than those of a subterranean nature.

June, 20th, 1945.

REPORT ON THE BIDAMINNA LAKE PHOSPHATE DEPOSITS.

26 Miles N.-W. of Gingin, South-West Division, W.A.
Approx. Lat. 31°-08′ S.
Approx. Long. 115°-33′ E.

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

Locality.

These deposits are situated in approximate Longitude 115°-33′ E., approximate Latitude 31°-8′ S. in some caves in sandy limestone near the South-Western edge of Lake Bidaminna, 26 miles air line North-West of Gingin. The distance by road from Gingin to the deposits is 32 miles, the road surface being capable of carrying loads of up to three tons all the year round. Gingin is approximately 50 miles by road North of Perth. The caves examined are situated on Swan Location 1645 approximately 2,060 yards on a true bearing of 218° from the North-East corner of Swan Location 1644. They are best approached from the North-Eastern corner of Location 1644, proceeding South down the East side of the lake (dry in summer) and then West and North-West along the margin of the lake.

The examination was carried out on November 28th, 1944.

Topography and Geology.

The country in the vicinity of Bidaminna Lake is undulating to hilly, the hills rising to 230 feet above the general level of the surrounding country, the maximum elevation above sea level being 360 feet. Where exposed, the rock consists of sandy limestone of Tertiary Age, usually referred to as coastal limestone. It is covered for the most part with white sand, or brown sandy loam, and the whole area is covered with thick low scrub and a moderately dense growth of eucalytpus and banksia species. The cave area is particularly overgrown with long grass, vines and fallen timber, and carries a dense growth of wattles (acacia species).

The Phosphate Deposits.

The phosphatic material occurs on the floors of the caves as a fine greyish powdery material, and has been formed from the decomposition of excreta and remains of birds, bats, marsupials and rabbits which frequent the caves.

The caves are normal solution cavities collapsed to sink holes in some cases and lie at a general elevation of about 30 feet above the level of the Western lake margin. The entrance to the main cave from which evidence suggested the phosphatic material had been obtained in the past, faces North-East, and is about 30 feet long by about three feet high. The cave is about 75 feet long with an average width of 50 feet and an average height of eight feet, maximum height 12 feet, minimum height four feet. The floor is irregular in contour being occupied by large and small sandy limestone blocks set in a loose sandy matrix. The phosphatic material occurs as a thin covering to this boulder and sand mixture.

Four samples were taken from the following points in the main cave:—

Sample No. 1: From South end of cave floor. Top 12 inches removed—sample taken from between a depth of 12 inches and 14 inches over an area of 12 inches by 12 inches—some bones in sample—numerous lumps of sandy limestone over half an inch in diameter removed from sample by hand.

Results:

		%
Lab. No. 5280/44	"Citrate Soluble P_2O_5"	2.00
	Acid Soluble P_2O_5	1.48
	Total Acid Soluble P_2O_5	3.48
	Nitrogen	0.32
	Potassium	Trace

Sample No. 2: From North end of cave floor. Top 3 inches over an area of 12 inches by 12 inches. numerous lumps of sandy limestone over half an inch in diameter removed from sample by hand.

Results:

		%
Lab. No. 5281/44	"Citrate Soluble P_2O_5"	4.69
	Acid Soluble P_2O_5	4.22
	Total Acid Soluble P_2O_5	8.91
	Nitrogen	0.86
	Potassium, not more than	0.3

Sample No. 3: From a depth of 15 inches to 18 inches below sample No. 2 over an area of 12 inches by 12 inches—limestone in excess of half an inch diameter removed by hand.

Results:

	%
Lab. No. 5282/44 "Citrate Soluble P_2O_5"	0.54
Acid Soluble P_2O_5	0.57
Total Acid Soluble P_2O_5	1.11
Nitrogen	0.06
Potassium, not more than	0.2

Sample No. 4: From centre of cave floor—a vertical channel sample over a depth of 24 inches; limestone in excess of half an inch diameter removed by hand.

Results:

	%
Lab. No. 5283/44 "Citrate Soluble P_2O_5"	1.18
Acid Soluble P_2O_5	0.62
Total Acid Soluble P_2O_5	1.80
Nitrogen	0.31
Potassium, not more than	0.2

In these four samples the total Acid Soluble P_2O_5 varies from 1.11% to 8.91%; the minimum 1.11% being recorded for the sample taken from the section 15-18 inches below the cave floor surface (Sample No. 3) and the maximum 8.91% from the first three inches below the cave floor surface (Sample No. 2).

These results are in agreement with the obvious mode of occurrence of the phosphate-bearing material. Sample No. 4, representing a channel sample four inches by three inches by 24 inches deep, starting from the surface of the cave floor, is a fair section of the deposit, and gives a value of 1.80% Total Acid Soluble P_2O_5.

Five other caves in the vicinity of the one described and sampled as above were inspected, but none contained sufficient material to warrant samples being taken.

Conclusions.

(1) The Bidaminna Lake cave deposits of phosphate-bearing material consist of thin layers of sand containing bones and excreta of kangaroos, rabbits, birds and bats, overlying and disseminated through large blocks and smaller fragments of calcareous sandstone.

(2) The deposits are of small extent, of variable low grade, and are not of commercial importance.

(3) They are not of value as a source of potash or nitrogen.

(4) After screening through half inch mesh they might be of value as a low grade phosphatic fertiliser for use on a local farm, but the small quantity available offsets even this use.

August 17th, 1945.

KOOLYANOBBING (TRIG. STATION M.Y.1) IRON ORE DEPOSITS

Summary Report.

By R. A. Hobson, B.Sc. (Hons.).

INTRODUCTION.

As a result of the embargo, placed on the export of iron ore from Australia by the Commonwealth Government in 1938, attention was directed to the known deposits of iron ore, and a survey of these was proposed. This work was commenced at Koolyanobbing in 1938. The work at that centre was completed in the same year. In 1939 the proposed survey was abandoned, and no additional centres were examined.

The Koolyanobbing iron ore deposits are situated 30 miles, bearing N. 26° E., from Southern Cross railway station, and are readily accessible from Southern Cross. In the same vicinity there was, in 1938, a small amount of gold mining in progress, and in addition to the prospectors' tracks, there were also many old tracks made by sandalwood cutters. The deposits were first brought to the notice of the Geological Survey in 1916[1], and, available information was summarised by Maitland[2] in 1919.

Field work was commenced by Mr. H. A. Ellis in June and continued until August, when the writer took over. The scheme of work devised by Mr. Ellis was continued, and the work was carried out under his direction. Field work was completed in November. The surrounding country was examined by Mr. R. S. Matheson and a geological map on a scale of 40 chains to an inch was prepared. Detailed geological maps in the vicinity of the ore bodies were prepared by the writer and all ore bodies were systematically sampled. In all 425 samples were taken and submitted to the Government Chemical Laboratory for analyses.

As a result of this work three new lenses of ore were found, one of which is considerably larger than those previously known. Details regarding ore reserves are given later in this report. The ore bodies consist, with one exception, of brown ore, with varying proportions of coarse micaceous hematite or fine grained massive hematite—the brown ore being in excess of the hematite. In one ore body the amount of hematite appears to be in excess of the brown ore. All the larger ore bodies, and many of the smaller ones, are associated with jaspilite, and are believed to have been formed by metasomatic replacement of the jaspilite. Jaspilite forms the backbone of a conspicuous ridge trending in a general north-westerly direction. This ridge has been examined for iron deposits over a distance of 13 miles.

GENERAL GEOLOGY.

The ore bodies form a series of irregularly shaped lenses, generally with their longer axes parallel to the strike of the jaspilite. With the exception of ore body E (plate I) they consist predominantly of massive and banded brown iron ore, which may sometimes be earthy, and associated coarse micaceous hematite or fine-grained hematite. In ore body E, the proportion of hematite is believed to exceed that of the brown ore. The brown ore of Koolyanobbing has been compared by Mr. Ellis with that at Mt. Caudan, and the two found to be quite similar. Drilling at Mt. Caudan has shown[3] that the surface brown ore passes at depth into pyrrhotite with some siderite and magnetite. It is therefore considered that the ore bodies at Koolyanobbng will consist, in part, of sulphides at depth. The coarse micaceous hematite is seen to occur in vein quartz, and also in narrow veinlets intrusive into the jaspilite. It is of a later age than the hematite of the jaspilite. Generally the micaceous hematite is quite unaltered at the surface, but is seen in places to be altered to brown ore. This is considered to have taken place under the influence of sulphate solutions, derived from iron sulphides.[4] Small residual fragments of micaceous hematite are frequently seen in the brown ore, and there may be appreciably more hematite at depth than at the surface. Some of the finer grained banded hematite occurring at the south-east end of Dowd's Hill, and in ore body D, is also probably of intrusive origin, and has metasomatically replaced the jaspilite. Ore body A contains an appreciable proportion of very fine-grained massive hematite, which may be of sedimentary origin, and formed at the same time as the jaspilite.

In some places, the jaspilite is much folded, while elsewhere it has a steady strike. The broad nature of

[1]Blatchford, Torrington, The Koolyanobbing iron ore deposits, Yilgarn Goldfield, Ann. Prog. Rept. Geol. Survey 1916, pp. 13-15, 1917.

[2]Maitland, A. Gibb, The iron deposits of Western Australia, extract from the Mining Handbook, Geological Survey Memoir, No. 1, Chpt. 11, p. 9, 1919.

[3]Maitland, A. Gibb, op. cit. p. 9.

[4]Personal communication, Dr. E. S. Simpson to Mr. Ellis.

the folding is indicated by the shape of the ridge. The ore deposits occur either in folded portions of the jaspilite or elsewhere, and no structural control is apparent. The folds in the Koolyanobbing Hills plunge northward, while those at Dowd's Hill plunge South-eastward. Major faulting is absent, and minor faulting is observed at only one place, although it may exist elsewhere.

On the east side of the Koolyanobbing Hills is what has been called a cemented scree. This occurs only in the vicinity of the ore bodies, and only on the east slope of the hills. It consists of angular fragments of iron ore, with a ferruginous cement, and may provide a small tonnage of iron ore. No estimate can be given of its likely thickness.

The jaspilite is similar to those occurring throughout Western Australia. It varies from the typical black and red jaspilite, with approximately 50 per cent. iron oxides, to a siliceous jaspilite, containing very little iron oxide. It forms bold outcrops. The broad strike is north-westward, and the dip north-eastward at 60°.

The hanging wall and footwall of the jaspilite are a greenstone schist, exposures of which are infrequent. The footwall schist and the hanging wall schist appear similar, but where seen are always very weathered.

As can be seen from the map, both slopes of the hills are soil covered. It is probable that this soil mainly overlies greenstone schist, and that the boundaries of the iron ore as shown on the map are nearly true boundaries.

ORE BODIES.

Description of Individual Ore Bodies:

On plate I these have been given distinguishing letters. They are arranged below in order of their size.

Ore Body E, Dowd's Hill (3.8 *miles N. 31° W. of M.Y.*1).—Consists of fine-grained banded and massive hematite, abundant micaceous hematite, and an appreciable quantity of brown iron ore. Hematite predominates. Banding decreases and micaceous hematite increases going north-westward. This ore body contains much more hematite than any of the other ore bodies.

Ore Body C, Koolyanobbing Hills.—Consists of massive brown ore, with a very minor quantity of banded brown ore.

Ore Body D, Koolyanobbing Hills.—Consists of banded and massive brown iron ore with an appreciable quantity of micaceous hematite.

Ore Body A, Koolyanobbing Hills.—Consists of massive and banded brown ore, with an appreciable quantity of fine-grained crystalline hematite. This ore body is second to ore body E in the amount of hematite it contains.

Ore Body B, Koolyanobbing Hills.—Massive brown ore, with a minor quantity of banded ore.

Sampling and analyses.

At the conclusion of the geological mapping, sample lines were set out at right angles to, or at least oblique to, the strike of the ore bodies, and at approximately 100 feet intervals. Chip samples were taken along these lines, over lengths of approximately 100 feet or 50 feet, depending upon the width of the ore body along the sample line. Care was taken to obtain a great number of small chips, representative of the ore which was crossed. These samples were quartered in the field to give a final sample of approximately two pounds. In all, 425 samples were obtained and submitted for analyses. Iron was determined for all samples. The samples were then grouped into 20 groups and the following determinations made for each group:—Fe, SiO_2, H_2O, TiO_2, P, S, and specific gravity. Only a summary of the results of this work is given in this report, but full details are available at the Geological Survey.

Ore reserves.

The probability of the brown ore passing into sulphides below water level has already been pointed out. It is considered a reasonable supposition that the nature of the ore bodies will not materially change until water level is reached. Accordingly a qualified estimate of the ore likely to be available down to water level has been prepared, and results are given in table 1. The assumptions on which this estimate is based are set out below the table. In making this estimate only the principal ore bodies have been considered. The tonnage obtainable from the remaining ore bodies and the cemented scree would not materially affect the estimate. The depth to water was estimated from mine workings and a "lake" in the vicinity.

The grade of the ore, as indicated by surface samples, is given in table 1.

TABLE I.

ORE RESERVES.

Locality.	Ore body.	Qualified estimate of tonnage to water level.* Tons (2240 lbs.)	Iron calculated from analyses of individual samples.	Range of principal constituents from partial analyses of group samples.						Specific gravity.
				Fe.	SiO_2.	H_2O.	TiO_2.	P.	S.	
			%	%	%	%	%	%	%	
Koolyanobbing Hills	A.	7,500,000	63·4	63·24–63·66	1·42–2·67	4·89–6·56	Tr.–0·03	0·04–0·13	0·03–0·04	4·39
	B.	4,750,000	60·3	60·30	4·60	7·40	0·02	0·05	0·02	4·14
	C.	16,000,000	58·5	57·93–59·15	3·11–7·06	6·39–7·82	0·20–0·50	0·04–0·08	0·08–0·11	4·02
	D.	9,000,000	59·1	55·53–60·48	3·93–8·70	7·30–8·61	0·05–0·15	0·05	0·04–0·07	4·05
Dowd's Hill	E.	32,000,000	62·7	61·23–64·05	1·40–4·44	3·10–8·09	0·02–0·03	0·11–0·22	0·01–0·04	4·34

* These estimates are based on the following assumptions :—

1. That the ore bodies will persist without change in nature to water level. Below that depth it is considered likely that all ore bodies will contain some sulphides, and that some ore bodies will consist almost entirely of sulphides. The calculations are based on the results of surface sampling only.
2. That they will maintain their surface dimensions to water level. There is no geological reason for supposing that this assumption is not substantially correct although small variations are to be expected.
3. The ore bodies have been assumed to have a steady dip of 60° eastward. It is known that the dips of the ore bodies vary, but 60° is considered a fair average figure.

Proposed drilling.

To provide information about the ore bodies below the surface it is recommended that diamond drilling be undertaken. A proposed programme is set out in table 2, and the bore sites are indicated on plate 1. It is proposed to intersect the ore bodies approximately 400 feet below water level. The proposed bores are arranged in order of priority, but the programme would, of course, be subject to modification as the drilling progressed. It is considered that ore bodies E and A might be workable below water level, and that E has a better chance than A,

TABLE 2.

PROPOSED BORING AT KOOLYANOBBING.

Ore body.	Proposed site.	Depression angle.	Estimated distance to ore body.	Estimated total length of bore.
		degrees.	feet.	feet.
E.	E_1	45	500–600	1,000–1,100
	E_2	45	450	1,000
	E_3	45	700	840
A.	A_1	45	710	850
	A_2	45	690	790
	A_3	45	690	1,030
C.	C_2	45	500–850	550–900
	C_1*	37	980	1,030
D.	D_1	45	640	950

* Alternative to C_2.

Proposed sites and directions of bores are indicated on map. All bores estimated to intersect ore bodies at 400 feet below water level.

ADDITIONAL INFORMATION AVAILABLE.

The following additional information is available at the Geological Survey:—

Reports.

i. Interim report on the Koolyanobbing iron deposits by R. A. Hobson.

ii. Koolyanobbing (Trig. Station M.Y.1) iron ore deposits. Notes on tables by R. A. Hobson. These notes are accompanied by detailed tables giving information regarding ore reserves.

iii. A number of mineral specimens were examined at the Chemical Laboratory and reports are available.

Maps.—The following is a list of available maps and plans:—

i. Geological map of Koolyanobbing (Trig. Station M.Y.1) iron deposits. Scale—5 chains to an inch. Published with this report.

ii. Geological map of Koolyanobbing (Trig Station M.Y.1) iron deposits. Sheet 1. Scale—2½ chains to an inch.

iii. Do. but sheet 2.

iv. Geological map of Dowd's Hill iron deposit. Scale—2½ chains to an inch.

v. Geological subsurface map in vicinity of Koolyanobbing. Scale—40 chains to an inch. By R. S. Matheson.

vi. Sample map of Koolyanobbing (Trig Station M.Y.1) iron ore deposits. Sheet 1. Scale—2½ chains to an inch.

vii. Do. but sheet 2.

viii. Sample map of Dowd's Hill iron ore deposit. Scale—2½ chains to an inch.

PROPOSED DRILLING IN THE VICINITY OF THE CLACKLINE (BAKER'S HILL) IRONSTONE DEPOSITS.

By R. A. Hobson, B.Sc. (Hons.)

INTRODUCTION.

During 1899, approximately 13,000 tons of ironstone were mined in Western Australia for use as a flux at the Fremantle Smelting Works. This the first production of ironstone in Western Australia. Of this quantity 1,540 tons came from Clackline. During the next few years more quarries were opened up and by the end of 1907 the production from Clackline was, according to official figures, 18,253 tons. No production is recorded after 1907, but it is likely that there was appreciable production after that date. Various official inspections have been made of these quarries, but no detailed work has been done in the past. It was thought likely that the ironstone had been formed by the oxidation of a sulphide ore body. Accordingly it was proposed to test this idea by drilling, and the writer was instructed to prepare a topographical and geological map of the locality to enable suitable drill sites to be selected.

The ironstone deposits are located on locations 15417, 16254, 17564, 18913 (Avon District, refer litho 27D/40) and are reached by a track which turns north off the main Perth-Northam road in the vicinity of the Clackline Firebrick Company's works—3·1 miles beyond Baker's Hill and 1·1 from Clackline. The track follows an old surveyed road and quarry number V, frequently referred to locally as the main quarry, is 2·1 miles from the main road. Other quarries in the vicinity of Coate's Siding and Wundowie were briefly inspected, but no detailed work was done at these places. The ironstone appeared similar to that at Clackline.

The country in the vicinity of the Clackline deposits has been mapped on a scale of 200 feet to an inch, with contours at intervals of 10 feet, using a plane table and a telescopic alidade. All the old quarries and such rock outcrops as could be found have been located. Outcrops are very scarce and most of the area mapped is covered with soil, frequently with abundant laterite rubble. There are also scattered outcrops of laterite. All of the old quarries have been at least partly filled with broken rubble and many are thickly overgrown.

CONCLUSIONS AND RECOMMENDATIONS.

The ironstone is believed to be a variation of the laterite. No explanation is offered as to why the iron has been concentrated into irregular patches, but these patches grade into material which is light yellow brown in colour and which probably has a low iron content and a comparatively high aluminium content. This aluminous material appears to differ only from typical laterite in the absence of pisolitic structure. The iron of the limonite is considered to have been derived mainly from ferromagnesian minerals but possibly also from iron oxides. The only sulphides likely to be present below the zone of oxidation are those which are normally present in minute amounts in many rocks. There is no reason for supposing the existence of massive sulphide ore bodies. Accordingly drilling is not recommended.

LITERATURE.

The following list contains all the references to the Clackline ironstone deposits in Mines Department publications:—

King, H. S.,* Report of the Department of Mines of the Colony of Western Australia for the year 1899, p.6, 1900.

Maitland, A. Gibb,* Ferruginous conglomerate at Coate's Siding, Annual Report of the Geological Survey for the year 1897, p.10, 1898.

Maitland, A. Gibb, The mineral wealth of Western Australia, Geological Survey Bulletin No. 4, p.95, 1900.

Maitland, A. Gibb, Annual Report of the Geological Survey for the year 1902, p.10, 1903.

Maitland, A. Gibb, The iron deposits of Western Australia, Extract from The Mining Handbook, Geological Survey Memoir, No. 1, p.12, 1919.

Maitland, A. Gibb, & Montgomery, A., The geology and mineral industry of Western Australia, Geological Survey Bulletin, No. 89, p.66, 1924.

Simpson, E. S., Notes from the Departmental laboratory, Geological Survey Bulletin, No. 6, pp.36-37, 1902.

Simpson, E. S.,* Annual report of the Geological Survey for the year 1919, p.38, 1920.

Simpson, E. S., The mineral resources of Western Australia, Pamphlet, p.8 1932.

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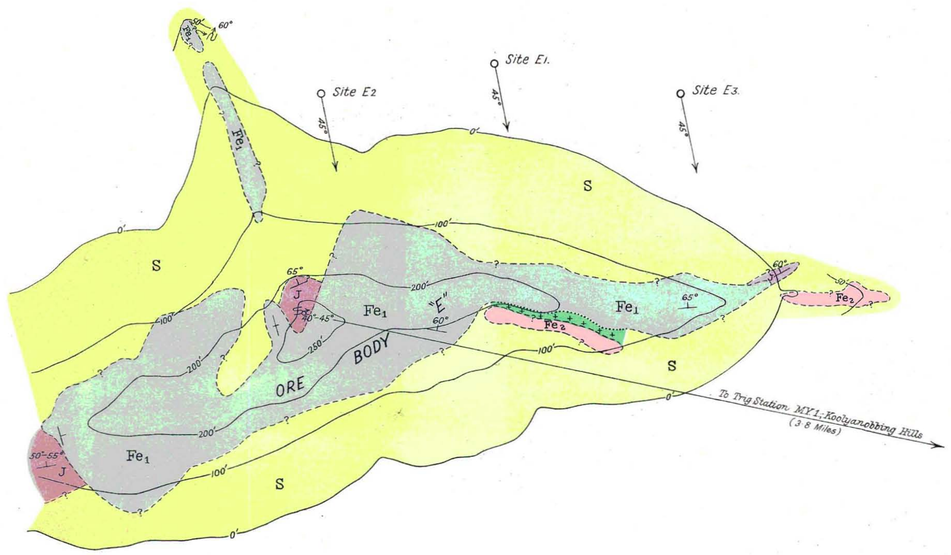
*Indicates the more important references.

INSET

DOWD'S HILL

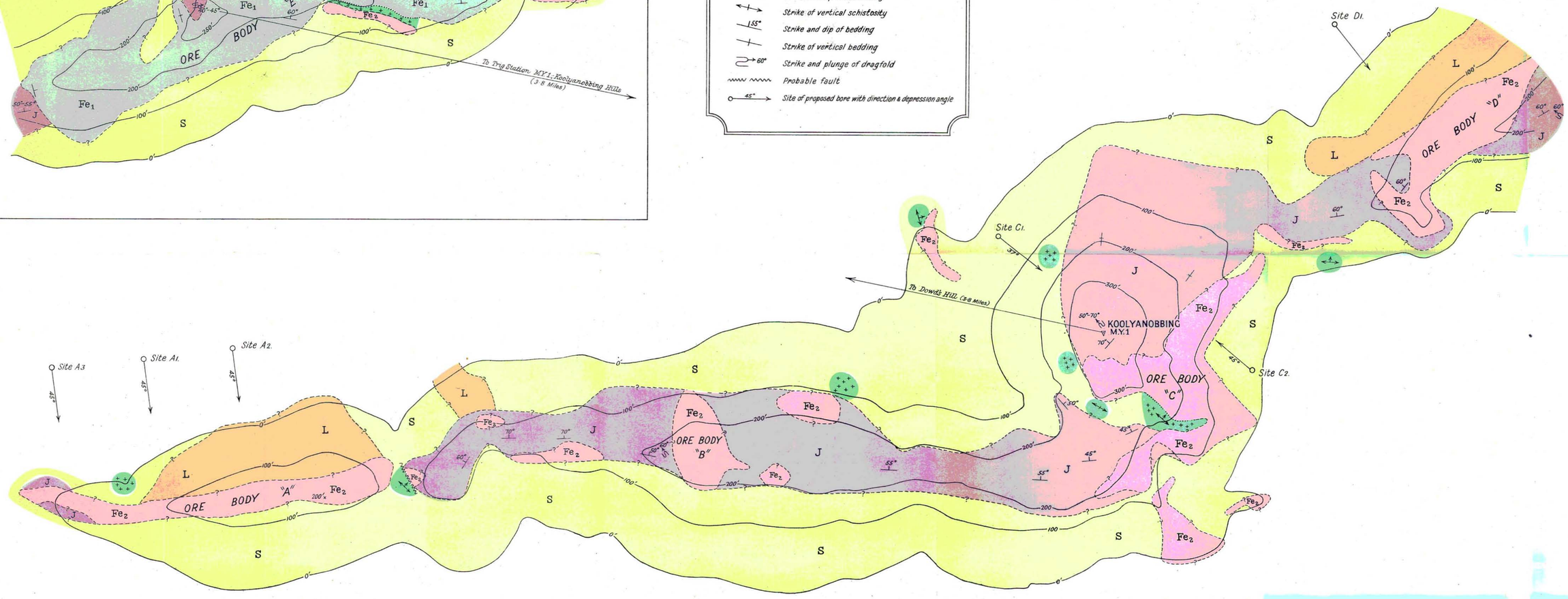


LEGEND

- Fe_1 — Iron ore consisting of fine-grained banded and massive hematite, abundant micaceous hematite and an appreciable quantity of brown ore. Hematite predominating.
- Fe_2 — Massive and banded brown iron ore, with or without micaceous hematite or fine-grained hematite. Brown ore predominating.
- J — Jaspilite
- L — Cemented Scree
- S — Soil-covered Areas
- Outcrops of greenstone schist with no observed strike and dip.
- Outcrops of greenstone schist with observed strike and dip.

REFERENCE TO SIGNS

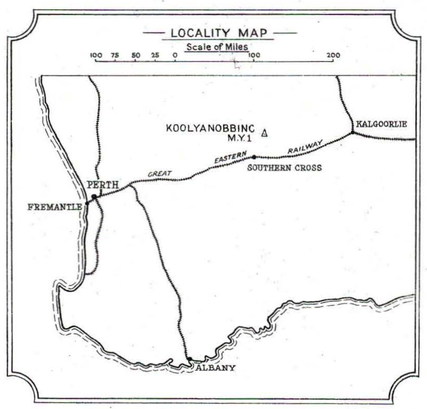
- Geological boundary
- Doubtful geological boundary
- Strike and dip of schistosity
- Strike of vertical schistosity
- Strike and dip of bedding
- Strike of vertical bedding
- Strike and plunge of dragfold
- Probable fault
- Site of proposed bore with direction & depression angle



KOOLYANOBBING HILLS

LOCALITY MAP

Scale of Miles 100 75 50 25 0 100 200



WESTERN AUSTRALIA — IRON SURVEY

Geological Map of Koolyanobbing (Trig Station MY1) Iron Deposits

Scale 5 chains to an inch

5 4 3 2 1 0 5 10 15

To accompany report by R.A. Hobson.
Reduced and generalised from original maps on a scale of 2½ chains to an inch
Surveys by H.A. Ellis, R.A. Hobson and M. Griffiths — July to Nov. 1938.
Geology by R.A. Hobson — Aug. to Nov. 1938.

J. McLOUGHLIN

Ref. No. W.A. 1

Simpson, E. S., & Gibson, C. G., The distribution and occurrence of the baser metals in Western Australia, Geological Survey Bulletin No. 30, p.100, 1907.

Geological Survey File 12/1900.

GENERAL GEOLOGY.

The only rock, other than ironstone or laterite, exposed in the vicinity of the quarries is a banded quartzite consisting of alternating thin bands of limonite and sugary quartz. This rock resembles the jaspilites of the goldfields and forms a series of outcrops bounded by either soil or laterite. The mapping has shown the existence of at least four bands of quartzite striking North-West and dipping vertically. The widest of these bands has a width of approximately 130 feet, but the average width would be less than this—approximately 60 to 70 feet. The remainder of the area mapped is covered by either soil or laterite and no outcrops of the underlying rocks occur. It is probable that these consist of greenstones and schists of various types similar to those occurring in the vicinity of the Clackline Firebrick Company's works.[1] Towards the North-East corner of the area mapped laterite and laterite rubble, which elsewhere is generally abundant in the soil, disappear and small fragments of quartz are thickly strewn on the ground. An occasional larger fragment of sugary quartz fragments have been derived from quartzites, probably the continuation of those seen at Clackline.

Sixteen hundred feet South-West from the North-East corner of location 7000 water-worn quartzite pebbles are to be found. These have only a very local distribution and appear to represent the remnants of an alluvial fan. They can be seen along the boundary fence of a cleared paddock. These pebbles have not been noted elsewhere in the vicinity.

THE IRONSTONE.

General Description.

The ironstone, which has been mined, consists of high grade limonite apparently occurring as isolated patches having an average thickness of 8-10 feet. The distribution of the limonite as shown on the map is exceedingly doubtful. The true distribution could only be determined by pit sinking or otherwise testing the ground beyond the faces of the existing quarries. No sampling of the faces of the quarries was undertaken, but many of them show what appears to be good grade limonite.

Twenty-nine quarries, varying considerably in dimensions and shape, are found in the vicinity. The largest of these measures approximately 400 feet by 150 feet by 8-10 feet deep while the deepest is 18 feet deep. They may be either somewhat oval in shape or long and narrow. They do not appear to be associated with any individual rock horizon. The average depth would not exceed 10 feet and might not be more than 8 feet. Appreciable quantities of the material, which has been quarried, have been discarded.

The face of quarry number V. showed the following section:—

Zone A. 0 ft.—4 ft. Consists largely of rounded fragments of limonite, light yellow in colour on the outside and some clay, with occasional "floaters" of ironstone.

Zone B. 4 ft.—11 ft. Limonite, with numerous small elongated cavities frequently filled with uncemented silica grains.

Zone C. 11 ft.—18 ft. Solid limonite. This is the material used as a flux.

Zone D. 18 ft. + Underlying rock.

The widths of zones A, B, and C, vary considerably in different portions of the quarry and it is reported that when the quarry was first opened up zone A was very thin or absent and that zone B was absent. Dr. Simpson[2] gives the following partial analyses of average samples from this same quarry face. There is also included in the following table an analysis of a grab sample from a quarry on location 18913 (probably quarry number XXVIII.).

Location	17564 (Quarry V.).				18913 (?Quarry XXVIII).
Depth	0–3 ft.	3–5 ft.	5–16 ft.	16–18 ft.	2–8 ft .
Description of material sampled.	Loose yellow pebbly laterite.	Mottled yellow and brown cellular laterite.	Stony brown iron-ore, with innumerable veinlets of glassy black ore.	Stony brown iron-ore.	Cellular brown limonite, partly dull, partly glassy.
Fe_2O_3	54·28	56·36	76·68	76·68	77·58
Mn_2O_3	17·70	16·38	·34	3·22	1·00
Al_2O_3			3·06		3·38
TiO_2	·67	·54	*Nil*	*Nil*	trace
SiO_2	15·42	10·84	6·34	6·60	3·62
H_2O+	10·80	13·85	12·65	12·14	12·80
$H_2O—$	1·52	1·81	1·19	1·73	1·66
P_2O_5	....	....	·02	....	·02
SO_3	....	....	·16	....	·30
CaO	....	....	*Nil*	....	·10
MgO	....	....	*Nil*	....	trace
	100·39	99·78	100·58	100·37	100·46

Zone A corresponds to Simpson's 0—3 feet, zone B to 3—5 feet, and zone C to 5—18 feet. Simpson further states, "It is evident that the surface material down to 5 feet on location 17564 contains over 20 per cent. of admixed gibbsite (aluminium hydrate) and is a much poorer iron ore than that which lies below it and forms the main portion of the deposit." The boundary between zone A and zone B is not sharp and defined, neither is it a flat or even an approximately flat plane. The junction as seen in the face of the quarry is very irregular. The material of zone B consists of closely spaced interlacing veinlets of limonite, separated by elongated cavities containing a yellow clay-like material or less frequently a whitish clay-like material. When the rock is first broken these cavities also contain loose silica grains which readily pour out. It seems certain to the writer that zones B and C have been formed in the same way and at the same time. Simpson's suggestion, that while zone B is a laterite, zone C may represent the outcrop of a sulphide ore body, cannot be accepted.

At about the centre of the North face of this same quarry—quarry V.—banded quartzite, consisting of alternating thin bands of sugary quartz and limonite, is seen. The banding is quite conspicuous, but when the face is examined closely the limonite is seen to cut across the quartz bands. The face of the quarry immediately East and West consists mainly of limonite, but contains small (up to a few inches in length) remnants of the sugary quartz bands. A shallow hole was sunk on the floor of the quarry about three feet from the face and on the strike of the banded quartzite. At a depth of about two feet this passed into a banded quartzite consisting of well defined quartz and limonite bands, and appearing similar to the banded quartzites which outcrop elsewhere in the vicinity. It appears then that by concentration of the limonite and leaching of the silica that the ironstone could be formed from the banded quartzite.

Further East in the same quarry another shallow hole was sunk into the floor of the quarry. At a depth of about four feet material, which is definitely a weathered rock, was obtained. Alteration is too great for the rock type to be recognisable, but is quite different from the banded quartzite found in the first mentioned shallow hole. Shallow holes were also sunk close to the faces in the floors of two other quarries—quarries XI and XXIV —and from each very weathered rock, which might be a greenstone or gneiss, was obtained. In all holes the transition from limonite to weathered rock was sharp, and was especially sharp in quarry XXIV. In the faces of quarries XII and XX small pockets of a very weathered greenstone or gneiss were seen surrounded by limonite. While some of the quarries are associated with banded quartzites, others are definitely not. It appears likely then that the limonite may be formed from either a greenstone or a gneiss or from the banded quartzites.

The four shallow holes showed that in quarries V, XI and XXIV the bottom of the quarry is the bottom of the limonite. There is no indication in any of the quarries of an attempt to quarry to any depth, and it seems cer-

[1] Matheson, R. S., Report on the Clackline Firebrick clay pits, Annual Progress Report of the Geological Survey for the year 1927, p 13, 1928.

[2] Simpson, E. S., Clackline iron ores. Annual Progress Report of the Geological Survey for the year 1919, p. 38, 1920.

tain that the bottom of the quarry is the bottom of the limonite in all instances. Conversations with men who previously worked these ironstone quarries confirms this idea.

Zone A, in quarry V, consists mainly of round fragments of limonite and of soil, but also contains some larger "floaters" consisting mainly of limonite. Some of these show as outcrops immediately above the face. Small scattered outcrops of limonitic material may then mean solid limonite at some distance below the surface. In an attempt to fix the probable boundaries of the limonite patches it was found that there was a gradation from the limonite to a rock which resembles the limonite in general appearance, but which is light yellow-brown in colour and which probably contains very little iron. Both the non-ferruginous material and the limonitic floaters are non-pisolitic and somewhat cellular. The non-ferruginous material would generally be regarded as a laterite. Typical pisolitic laterite is to be found in the North-West corner of location 18913.

Origin of the Ironstone.

Under the heading of "general description" some reference has already been made to the origin of the ironstone. The writer believes that the ironstone is a limonitic laterite, and that the iron is derived mainly from ferromagnesian minerals, but possibly also from ironoxides. The only sulphides likely to be present below the zone of oxidation are the small amounts normally contained in many rocks. The reasons for believing this are given briefly below. Where details have already been given they are not repeated here.

(i) The ironstone occurs as scattered isolated patches having an average thickness of approximately 10 feet, at or nearly parallel to the present land surface. The base of the limonite is well defined and its boundary against the underlying rock is sharp.

(ii) Broadly the ironstone appears to be associated with a series of greenstones and schists having a general North-West strike and a width of perhaps a mile. The area mapped is not sufficiently large to enable the width of this series to be given with any degree of certainty. It is bounded on the North-East by massive quartzites and possibly also on the South-West side by quartzites. The quarries do not follow any particular horizon within this series, nor do they appear to have any regular arrangement such as might be expected if defined sulphide ore bodies existed.

(iii) The outcrops of limonite grade into a material having a similar general appearance, but containing very little iron. This material differs from typical laterite only in being non-pisolitic.

(iv) The occurrence of gibbsite in zones A and B of quarry V, as reported by Simpson suggests that these zones are of lateritic origin. Simpson himself was evidently of this opinion. It now seems certain that the ironstone of zone C has the same origin as the material of zone B.

(v) Observations in quarry V show that the limonite has formed from the banded quartzite and it seems likely that it has also formed from the other rocks underlying the quarry.

Two other origins have been suggested for the ironstone. The first[3] of these is that it is the outcrop of a sulphide ore body and the second[4] is that it is bog iron ore. Arguments for and against these ideas are summarised in the following paragraphs. It is not considered necessary to develop these arguments fully.

Taking the origin from a sulphide ore body first. It is known that elsewhere in Western Australia limonite ore bodies are the outcrops of sulphide ore bodies, but it must be remembered that residual limonite deposits can also be formed in other ways[4].

Against the idea that the ironstone represents the outcrop of a sulphide ore body the following arguments are advanced.

(i) The boundary is very indefinite and the ironstone grades into material with a comparatively high alumina and a low iron content.

(ii) A series of sulphide ore bodies would be expected to have some regular arrangement, and this would be reflected in the outcrops. No such arrangement exists at Clackline.

(iii) In quarry V the irostone is seen to have formed from the banded quartzite by elimination of the silica.

Considering now the possibility of the ironstone being a bog iron ore. This was suggested because of the sheet like distribution of the limonite and because of the existence of water worn pebbles on location 7000. The sheet like distribution of the limonite is equally well explained by taking it to be a variation of the laterite. The water worn pebbles on location 7000 have a very limited distribution, and there are no indications of the existence of extensive alluvial deposits. The following arguments can be advanced against the ironstone being a bog iron ore.

(i) The formation of the ironstone from the banded quartzite in quarry V.

(ii) The ironstone deposits occur at or parallel to the present land surface. They are found in the bottom of the valley on both sides, and at the head of the valley. They occur neither at one level nor on an inclined plane.

(iii) Small pockets of very weathered rock occur occasionally in the faces of the quarries surrounded by limonite. These would not be expected in bog iron ores, but are easily explained if the deposits have formed by the surface alteration of the underlying rocks.

SAMPLING OF SOME LAKES NEAR BALADJIE AND MT. PALMER FOR ALUNITE.

By R. A. Hobson, B.Sc. (Hons.).

INTRODUCTION.

In April 1942 the writer was instructed to check sample two lakes for alunite—one near Baladjie (plate III) and the second near Mt. Palmer (plate IV). Attention was directed to Baladjie by a sample taken by Forman[1] in 1931 during a general examination of the Lake Brown lake system, and to the lake near Mt. Palmer by a sample sent to the Government Chemical Laboratory by Rutherford[2] in 1933. More details regarding these samples are given in a later section of this report.

The present sampling was done with a 2-inch hand boring plant using an auger bit or a shell bit. Analyses were made in the Government Chemical Laboratory.

A number of preliminary samples were taken by the writer from the lake near Baladjie, including one sample from almost the same spot as Forman's sample. Not one of these samples contained any alunite and no further sampling was undertaken. Evidently there was some error in connection with the 1931 sample.

Preliminary sampling of the lake at Mt. Palmer was favourable and subsequent systematic sampling indicated the existence of 290,000 tons of material containing 59 per cent. alunite. Preliminary samples were taken from other lakes in the same vicinity, but except for samples A76 and A77, the alunite content of all samples was low. A76 and A77 were taken from a lake which is probably too small to be of any commercial value.

BALADJIE.

Plate III.

Forman's sample was taken from approximately 70 chains North of the North-East corner of location 706, jst North of Baladjie railway siding, and was reported

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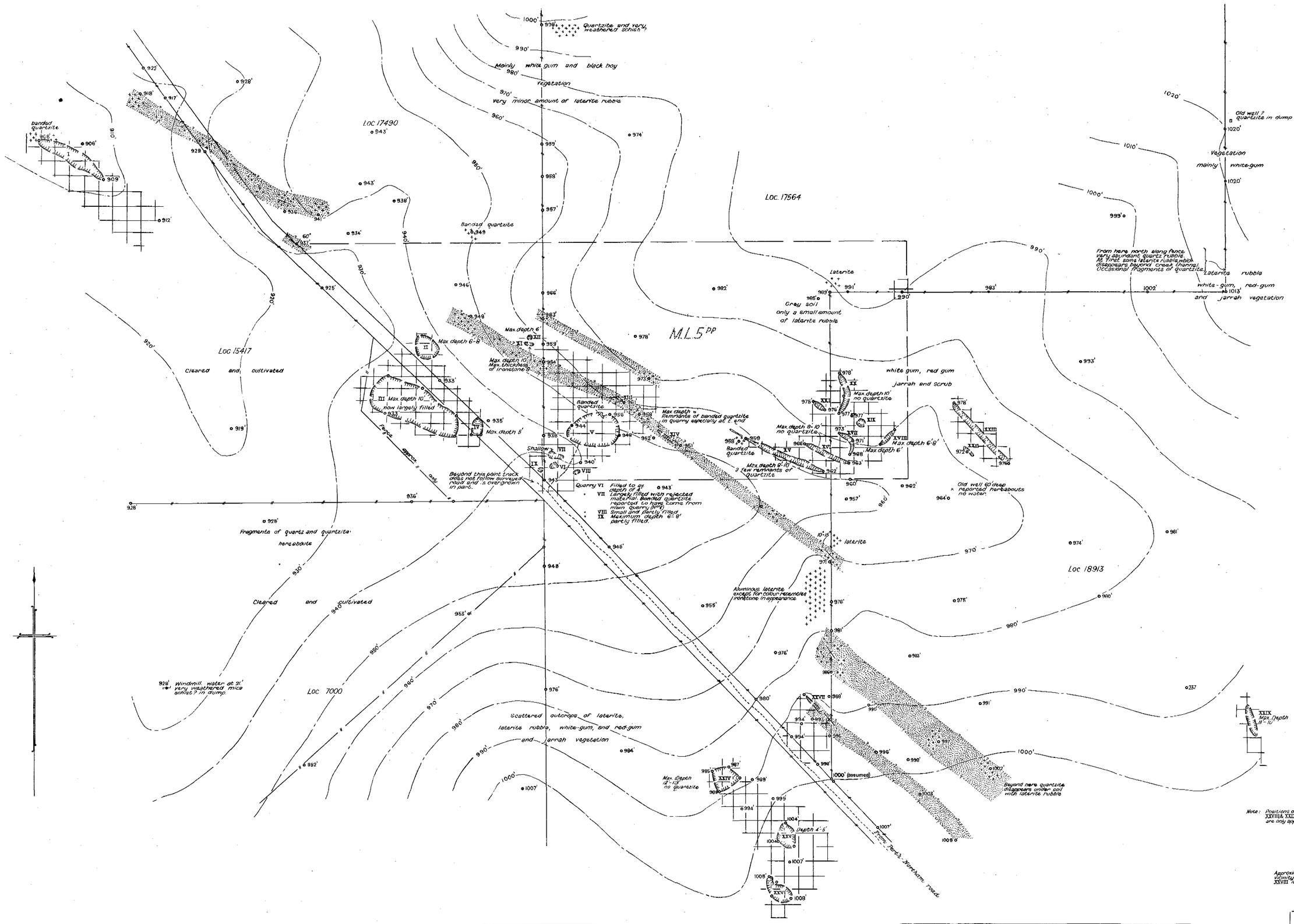
[3]Simpson, E. S., op. cit., Annual Report for 1919, p. 38.

[4]Personal communication Government Geologist and Mr. H. A. Ellis.

[4]Lindgren, Waldemar, Mineral deposits, Fourth Edition, Fourth Impression, p. 355, 1933.

[1]Forman, F. G., Progress report on the alunite survey of the Lake Brown lake system, Annual Progress Report of the Geological Survey of Western Australia for the year 1931, p. 18. sample S 26. Refer also to an unpublished map which accompanied the original report.

[2]Surveyor D. Rutherford.



— LEGEND —

Banded ferruginous quartzite

Probable distribution of limonite

Note: The remainder of the area is covered with either soil or laterite.

REFERENCE TO SIGNS

- Quarry (numbered)
- Outcrop
- Approximate geological boundary
- Strike of vertical beading
- Strike and plunge of dragfold
- Contour
- Fence on surveyed location boundary
- Surveyed location boundary, no fence
- Fence off location boundary
- Abandoned mineral lease
- Spot levels

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

THE CLACKLINE IRONSTONE DEPOSITS

Scale of feet

200 100 0 200 400 600

Survey information for base map from Lands Department and from Mines Department Additional plane table and telescopic alidade surveys by R.A. Hobson. The datum for levels is the south-west corner of location 18913 which is assumed to be 1000 feet. Refer to Lands Department Ltr No 27/3/40.

Geology by R.A. Hobson. A.p. 1941.

to contain 62.8 per cent. alunite. Samples were taken by the writer from the same locality as the original sample and from half a mile North, South, East and West of the original locality. The localities of the sample holes are shown on plate III, which also gives the samples taken from each hole. In all 13 samples and two specimens were taken. Not one of the samples contained any alunite. Information about these samples is summarised in table I.

The lake at Baladjie was covered with a hard white salt crust from two to three inches thick. A specimen of this (A5) is described as "Salt crust consisting essentially of halite (common salt) with some gypsum (hydrated calcium sulphate) and traces of calcium and magnesian salts." Immediately below this there was a layer, 12 to 18 inches thick, consisting of very abundant salt crystals and some grey mud, but softer than the white surface layer. Below this, and generally extending to approximately 7 feet 6 inches, was a sludge of grey mud with abundant salt or gypsum crystals. Frequently this was too fluid to be recovered with a shell bit, and no sample could be obtained. A number of fair samples were, however, taken and sufficient material was obtained to show alunite had any been present. Below about 7 feet 6 inches the drill entered a yellow brown clay from which good samples were obtained. Generally only one sample of this yellow brown clay was taken from each hole.

The water in the lake appeared neutral to litmus paper when tested in the field, but laboratory tests showed it to be alkaline.

MT. PALMER.

As already mentioned attention was first directed to this locality by a sample submitted to the Chemical Laboratory by Surveyor D. Rutherford in 1933. This sample contained approximately 50 per cent. alunite. It was taken from a small lake in the vicinity of the one mile post on the boundary line between Jilbadgie Locations 61 and 62. This lake is about three and a half miles South-South-East from Mt. Palmer and is East of the main lake. Timber was being cut in this locality in April, 1942, for use by the Yellowdine Gold Development Ltd., and the lake is readily accessible by timber tracks. Four preliminary sample holes (samples A16 to A25) were drilled into this lake by the writer and samples forwarded to the Chemical Laboratory for examination. Preliminary examination of these indicated that final results were likely to be favourable and the writer then systematically sampled this lake at 5 chain intervals. The locality of this lake is shown on plate IV. Plate V gives the positions of sample holes, the depths of the samples and the percentage alunite for each sample. Samples A42 to A75 were taken from this lake in addition to the preliminary samples mentioned above. Details regarding these samples and also the results of analyses are set out in the table II. The surface of the lake was covered with 1 to 2 inches of brown mud, which was excluded from all samples. The upper portions of all sample holes consisted of a very stiff grey mud. Towards the bottoms of the holes the mud was white in colour and also more plastic. Frequently it became slightly gritty just before the bottom

TABLE I.

SAMPLING OF LAKE TWO MILES NORTH OF BALADJIE FOR ALUNITE.
(Refer Plate III).

Hole No.	Depth in hole.	Sample No.	5% NaOH soluble SO_3.	Equal to alunite.	Reaction (pH) 1–5 water suspension. Glass electrode.	Reaction to litmus.	Notes.
2	ft. in. ft. in.		%	%			
	0 0— 1 0	...	...	...	...	...	0 to 1 in. salt crust, 1 in. to 12 in. very abundant salt crystals. No sample above 12 in. Hard band or bands at 4 ft. 9 in. to 5 ft. 3 in. Specimen A3 from about 5 ft. Bottom of hole at 6 ft 6 in. in yellow-brown clay with some quartz.
	1 0— 3 0	A1	*Nil*	*Nil*	7·90	Alkaline	
	3 0— 5 0	A2	Trace	*Nil*	8·08	Alkaline	
	5 0— 6 6	A4	Trace	*Nil*	7·98	Alkaline	
4	0 0— 5 6	...	...	...	...	...	Specimen A5 from surface crust, which is 2½ in. thick. No recovery 0 ft. to 5 ft. 6 in. Into yellow brown clay at 7 ft. 6 in., which continues to 11 ft. 6 in. Bottom of hole at 11 ft. 6 in.
	5 6— 7 6	A6	Trace	*Nil*	8·14	Alkaline	
	7 6— 9 6	A7	Trace	*Nil*	7·90	Alkaline	
	9 6—11 6	...	...	...	...	...	
6	0 0— 7 6	...	...	...	...	...	No recovery 0 ft. to 7 ft. 6 in. At 7 ft 6 in. into yellow brown clay as at hole 4.
	7 6— 9 6	A8	Trace	*Nil*	7·96	Alkaline	
8	0 0— 3 0	...	...	...	...	...	No recovery 0 ft. to 3 ft. from bit. Sample A9 is a grab sample from a separate shallow hole and was taken 2 ft. below surface. At 4 ft. 6 in. into yellow brown clay. Hard band at 5 ft. 6 in. Drilled to 8 ft. 6 in.
	3 0— 4 6	A10	Trace	*Nil*	8·22	Alkaline	
	4 6— 6 6	A11	Trace	*Nil*	7·91	Alkaline	
	6 6— 8 6	...	...	...	...	...	
	Grab sample	A9	*Nil*	*Nil*	8·21	Alkaline	
10	0 0— 4 3	...	...	...	...	...	No recovery 0 ft. to 4 ft. 3 in. Grey mud with abundant salt (?) crystals from 4 ft. 3 in. to 7 ft. 3 in. At 7 ft. 3 in. into yellow-brown clay.
	4 3— 7 3	A12	Trace	*Nil*	8·11	Alkaline	
	7 3— 9 3	A13	Trace	*Nil*	8·00	Alkaline	
12	0 0— 4 0	...	...	...	...	...	0 to 2 in. salt crust, 2 in. to 18 in. very abundant salt (?) crystals. 18 in. to 4 ft. no recovery. At 6 ft. 9 in. into yellow brown mud.
	4 0— 6 9	A14	Trace	*Nil*	8·07	Alkaline	
	6 9— 8 9	A15	Trace	*Nil*	7·92	Alkaline	

Note.—Laboratory numbers are 1414 to 1426.

of the alunite bearing mud was reached. This mud bottomed on a grit no samples of which were taken. The sound during drilling indicated quite definitely when the grit had been reached.

In order to obtain a factor for converting cubic yards to tons the samples, after all analyses had been completed, were packed tightly into a box and weighed. It was found that 1 ton of dry material from the lake occupied 1·02 cubic yards. Details regarding this information are set out below the table II.

For the purpose of estimating the quantity of material likely to be available only the area indicated on plate V was considered. The average depth was calculated and also the average alunite content—due allowance being made for the fact that samples were not always taken over the same length. Details of this calculation are set out below table II.

According to my calculations 290,000 tons of material are likely to be available, with an average alunite content of 59 per cent.

In this same locality there are a number of smaller lakes from which a few samples were taken. Four samples were also taken from the main lake. The localities of all these samples are indicated on plate IV, together with the alunite content of each sample. Details regarding these samples are also given in table III. Included also in this table are the details regarding a sample from Lake Koorkoordine, near Southern Cross. Except for samples A76 and A77 the alunite content of all samples is low. Samples A76 and A77 were obtained from a small lake close to the South-East corner of location 662. This lake is quite small, being approximately circular in shape and about 15 chains in diameter.

TABLE II.

SAMPLING OF LAKE IN VICINITY OF ONE MILE POST, EAST BOUNDARY, JILBADGI LOCATION 661, YILGARN GOLDFIELD.

Site.	Depth in hole.	Length over which sample taken = A.	Total thickness of alunite bearing material = B.	Laboratory number.	Sample number.	5% NaOH soluble SO_3. %	Equal to alunite % = C.	Reaction (pH) 1–5 water suspension. Glass electrode.	Sample number.	A. x C.
C	0 ft. 2 in.—2 ft. 2 in.	2 ft.	5 ft. 0 in.	1525	A16	23·49	60·60	4·76	A16	121·2
	2 ft. 2 in.—4 ft. 2 in.	2 ft.		1526	A17*	24·38	62·90	4·47	A17	125·8
	4 ft. 2 in.—5 ft. 2 in.	1 ft.		1531	A18	22·57	58·20	4·45	A18	58·2
	5 ft. 2 in.—7 ft. 2 in.	2 ft.		1527	A19	5·30	13·70	4·58	A19	....
E	0 ft. 2 in.—2 ft. 2 in.	2 ft.	4 ft. 0 in.	1528	A20	23·43	60·50	4·57	A20	121·0
	2 ft. 2 in.—4 ft. 2 in.	2 ft.		1532	A21	22·49	58·00	4·45	A21	116·0
U	0 ft. 2 in.—2 ft. 2 in.	2 ft.	4 ft. 0 in.	1529	A22	23·49	60·60	4·54	A22	121·2
	2 ft. 2 in.—4 ft. 2 in.	2 ft.		1533	A23	23·69	61·10	4·48	A23	122·2
VII.	0 ft. 2 in.—2 ft. 2 in.	2 ft.	4 ft. 0 in.	1530	A24	23·27	60·00	4·60	A24	120·0
	2 ft. 2 in.—4 ft. 2 in.	2 ft.		1534	A25	24·04	62·00	4·52	A25	124·0
A	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	6 ft. 10 in.	1752	A42	23·83	61·48	5·29	A42	296·9
	5 ft. 0 in.—7 ft. 0 in.	2 ft. 0 in.		1753	A43	18·86	48·66	5·22	A43	97·3
G	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	4 ft. 10 in.	1754	A44	23·51	60·66	4·96	A44	293·0
H	0 ft. 6 in.—5 ft. 0 in.	4 ft. 6 in.	4 ft. 6 in.	1755	A45	22·22	57·33	5·09	A45	258·0
I	0 ft. 2 in.—4 ft. 6 in.	4 ft. 4 in.	4 ft. 4 in.	1756	A46	23·05	59·46	4·88	A46	256·5
J	0 ft. 2 in.—2 ft. 0 in.	1 ft. 10 in.	1 ft. 10 in.	1757	A47	13·71	35·37	4·63	A47	....
B	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	4 ft. 10 in.	1758	A48	24·36	62·85	5·00	A48	257·5
K	0 ft. 2 in.—5 ft. 0 in.	4 ft 10 in..	5 ft. 10 in.	1759	A49*	25·21	65·02	5·22	A49	314·0
	5 ft. 0 in.—6 ft. 0 in.	1 ft. 0 in.		1760	A50	23·21	59·88	5·17	A50	119·7
L	0 ft. 3 in.—5 ft. 0 in.	4 ft. 9 in.	4 ft. 9 in.	1761	A51	24·12	62·23	5·22	A51	295·6
M	0 ft. 6 in.—5 ft. 0 in.	4 ft. 6 in.	5 ft. 6 in.	1762	A52	19·53	50·38	4·86	A52	226·7
	5 ft. 0 in.—6 ft. 0 in.	1 ft. 0 in.		1763	A53	22·37	57·71	5·59	A53	57·7
N	0 ft. 6 in.—4 ft. 0 in.	3 ft. 6 in.	5 ft. 6 in.	1764	A54	22·57	58·23	5·15	A54	203·8
	4 ft. 0 in.—6 ft. 0 in.	2 ft. 0 in.		1765	A55	23·67	61·07	6·42	A55	122·1
O	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	4 ft. 10 in.	1766	A56	25·11	64·78	5·59	A56	312·9
P	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	4 ft. 10 in.	1767	A57	25·59	66·01	5·82	A57	318·8
Q	0 ft. 2 in.—4 ft. 6 in.	4 ft. 4 in.	4 ft. 4 in.	1768	A58	24·05	62·04	5·41	A58	268·6
R	0 ft. 2 in.—1 ft. 9 in.	1 ft. 7 in.	1 ft. 7 in.	1769	A59	18·37	47·39	5·35	A59	74·9
S	0 ft. 2 in.—1 ft. 9 in.	1 ft. 7 in.	1 ft. 7 in.	1770	A60	20·11	51·88	4·86	A60	82·0
T	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	4 ft. 10 in.	1771	A61	23·79	61·37	6·00	A61	296·4
D	0 ft. 2 in.—5 ft. 0 in.	4 ft. 10 in.	4 ft. 10 in.	1772	A62	24·67	63·64	6·08	A62	307·4
V	0 ft. 2 in.—1 ft. 9 in.	1 ft. 7 in.	1 ft. 7 in.	1773	A63	16·78	43·29	5·36	A63	68·4
W	0 ft. 2 in.—2 ft. 0 in.	1 ft. 10 in.	1 ft. 10 in.	1774	A64	22·90	59·08	5·70	A64	108·1
Y	0 ft. 2 in.—1 ft. 6 in.	1 ft. 4 in.	1 ft. 4 in.	1775	A65	15·85	40·89	5·06	A65	54·4
F	0 ft. 2 in.—2 ft. 0 in.	1 ft. 10 in.	1 ft. 10 in.	1776	A66	22·62	58·36	5·09	A66	106·8
Z	0 ft. 2 in.—2 ft. 6 in.	2 ft. 4 in.	2 ft. 4 in.	1777	A67	24·24	62·54	5·49	A67	145·7
II.	0 ft. 2 in.—2 ft. 6 in.	2 ft. 4 in.	2 ft. 4 in.	1778	A68	21·94	56·60	5·00	A68	131·8
III.	0 ft. 1 in.—2 ft. 0 in.	1 ft. 11 in.	1 ft. 11 in.	1779	A69	19·85	51·21	4·67	A69	98·3
IV.	0 ft. 2 in.—2 ft. 4 in.	2 ft. 2 in.	2 ft. 2 in.	1780	A70	22·61	58·33	4·92	A70	126·6
V.	0 ft. 2 in.—4 ft. 9 in.	4 ft. 7 in.	4 ft. 7 in.	1781	A71	23·68	61·09	5·88	A71	279·8
VI.	0 ft. 2 in.—4 ft. 6 in.	4 ft. 4 in.	4 ft. 4 in.	1782	A72	24·41	62·97	5·80	A72	272·7
VIII.	0 ft. 2 in.—4 ft. 6 in.	4 ft. 4 in.	5 ft. 10 in.	1783	A73	24·27	62·61	5·75	A73	271·1
	4 ft. 6 in.—6 ft. 0 in.	1 ft. 6 in.		1784	A74	23·79	61·38	6·34	A74	92·1
IX.	0 ft. 2 in.—4 ft. 0 in.	3 ft. 10 in.	3 ft. 10 in.	1785	A75	23·46	60·52	5·11	A75	231·8

33) 126 ft. 6 in. — 126 ft. 10 in.

3 ft. 10 in.

= 3·83 ft.

= 1·27 yards = average depth

126·5) 7477·0 — 7477·0

59·1 = Average % alunite

*A17	K_2O insoluble in H_2O	6·88%
	Na_2O insoluble in H_2O	0·63%
*A49	K_2O insoluble in H_2O	6·83%
	Na_2O insoluble in H_2O	0·31%

Area—

Y III. M H J V W .... 278,300 (yards)²

Volume of alunite bearing material .... 278,300 × 1·27 (yds)³

Tons " " " .... $\frac{278{,}300 \times 1{\cdot}27}{1{\cdot}022}$

= 291,400

÷ 290,000

Average % alunite = 59%

Factor for converting cubic yards to tons—

Wt. of box + samples .... 104½ lb.

Wt. of box 9

Wt. of samples .... 95½ lb.

Samples used A42 to A71 (inclusive), except A47, A63, and A75.

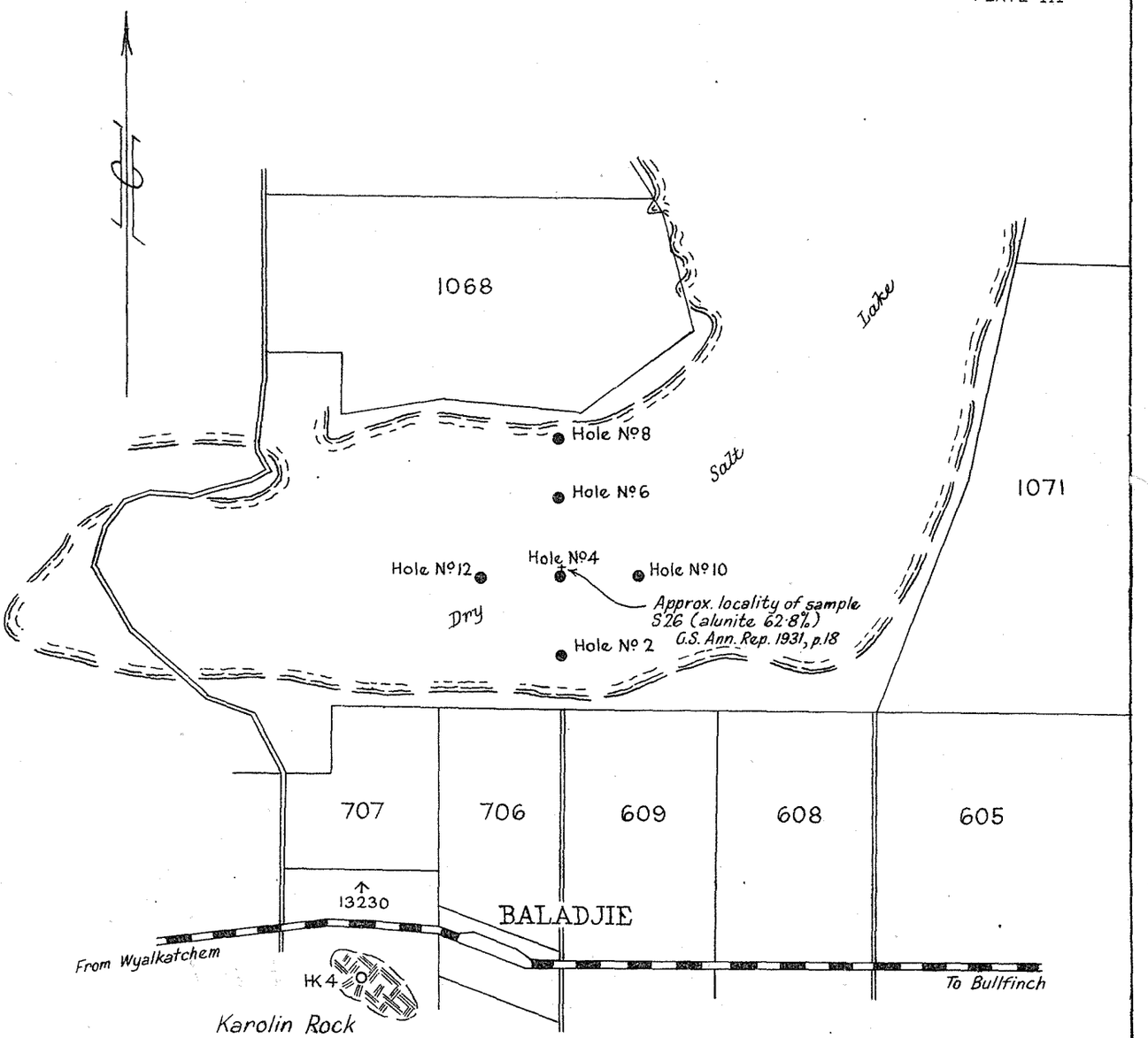
Size of box 18⅛ in. × 12½ in. × 9¼ in.

Volume of box $\frac{145 \times 97 \times 37}{8 \times 8 \times 4 \times 1728}$ (ft.)³

= 1·177

1 ton occupies $\frac{1{\cdot}177 \times 2 \times 2240}{191 \times 9 \times 3}$ (yds.)³

= 1·022 (yds.)³



Hole No 2

0"-12" No sample
1'-3' Sample A1
3'-5' Sample A2
5'-6'6" Sample A4
Specimen A3 from 5'3"

Hole No 4

0'-5'6" No sample
5'6"-7'6" Sample A6
7'6"-9'6" Sample A7
9'6"-11'6" No sample
Specimen A5 from surface

Hole No 6

0'-7'6" No sample
7'6"-9'6" Sample A8

Hole No 8

0'-3' No sample from bit, but A9 (grab sample) from 2' in separate hole
3'-4'6" Sample A10
4'6"-6'6" Sample A11

Hole No 10

0'-4'3" No sample
4'3"-7'3" Sample A12
7'3"-9'3" Sample A13

Hole No 12

0'-4' No sample
4'-6'9" Sample A14
6'9"-8'9" Sample A15

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

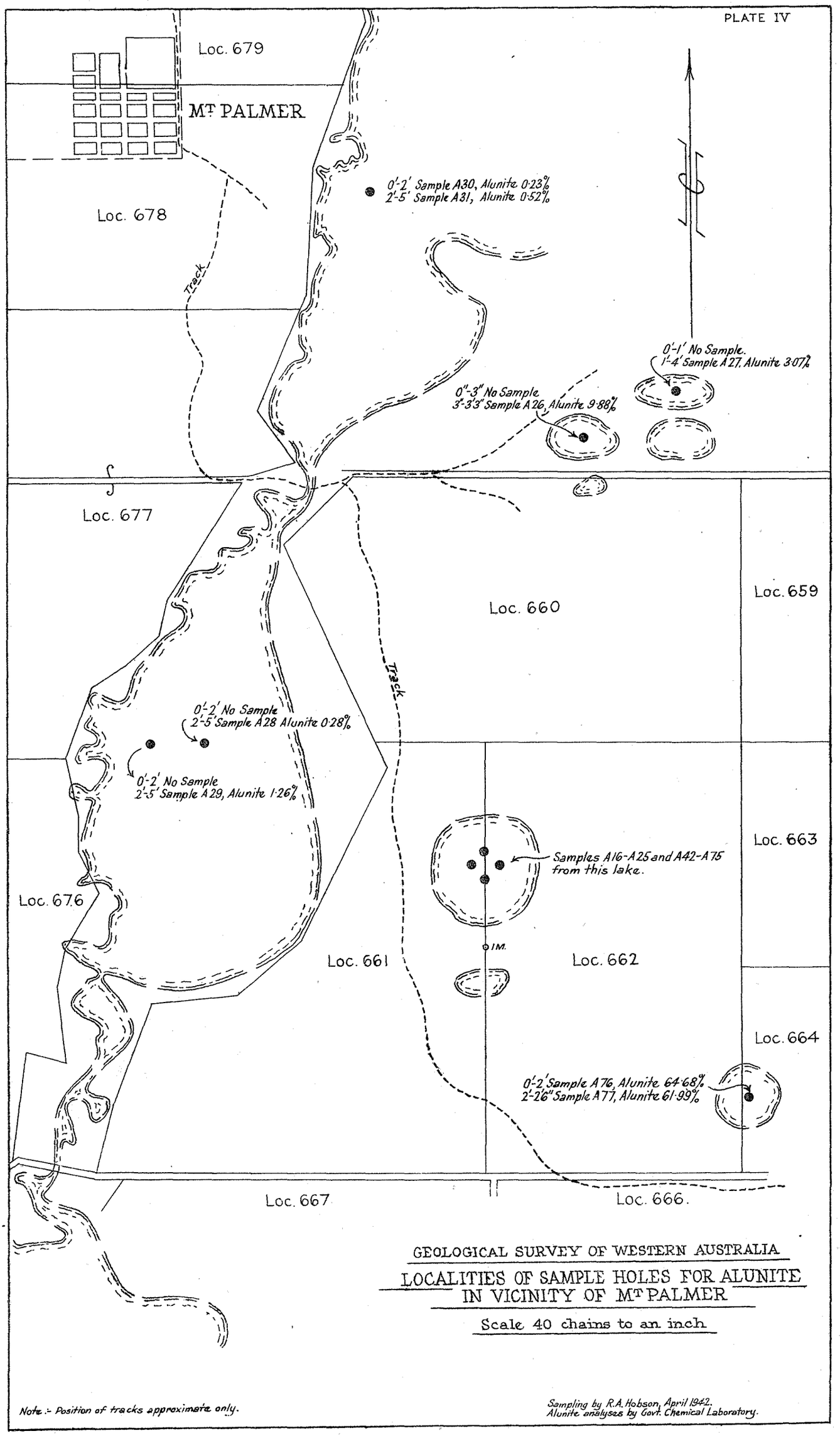
SAMPLE HOLES FOR ALUNITE IN LAKE NORTH OF BALADJIE

Scale 80 chains to an inch

Map from Lands Dept. Litho 53/80

Sampling by R.A. Hobson, April 1942
Alunite analyses by Govt. Chemical Laboratory

PLATE IV



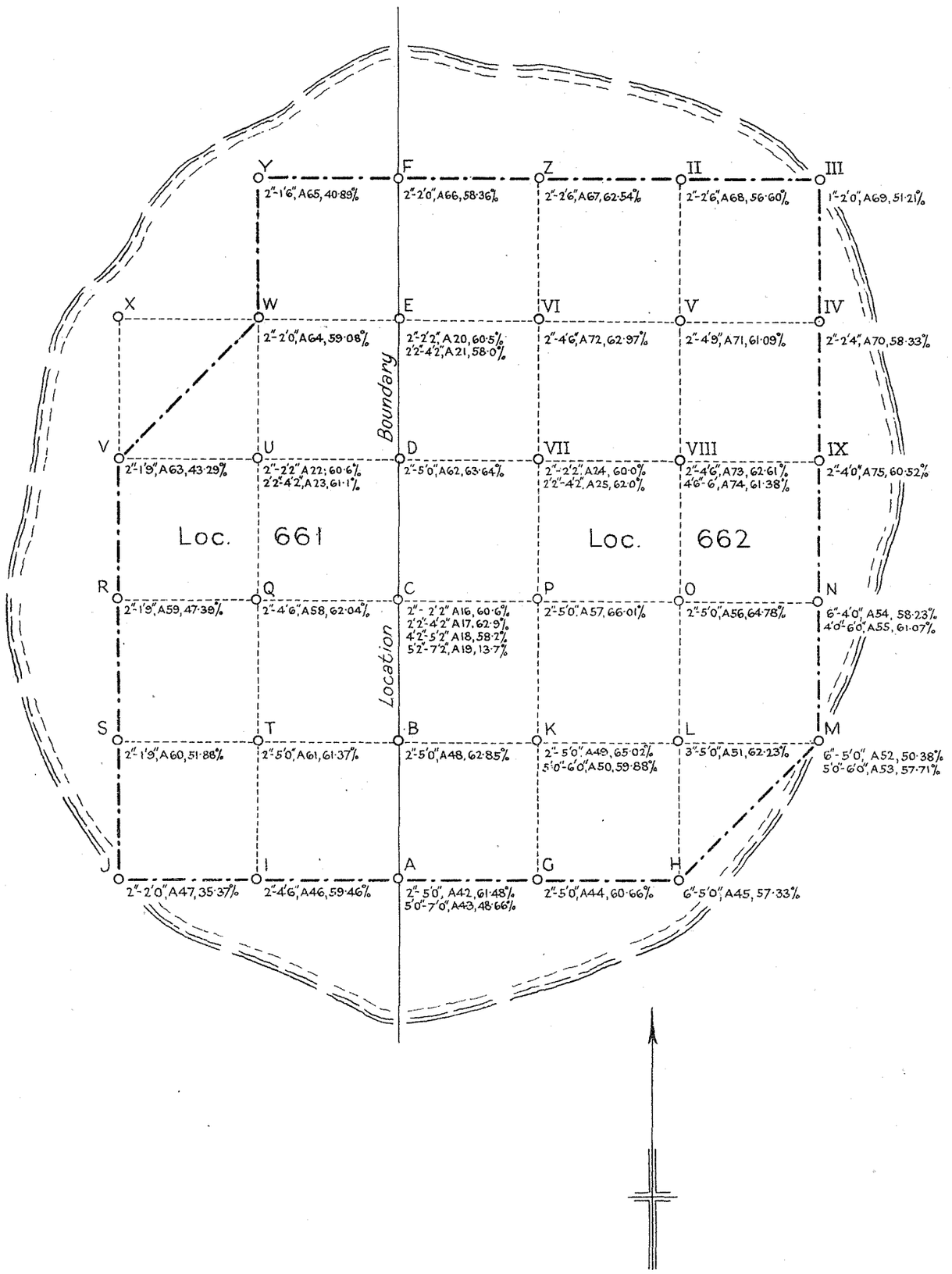
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

LOCALITIES OF SAMPLE HOLES FOR ALUNITE IN VICINITY OF Mt PALMER

Scale 40 chains to an inch

Note :- Position of tracks approximate only.

Sampling by R.A. Hobson, April 1942.
Alunite analyses by Govt. Chemical Laboratory.



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SAMPLE HOLES FOR ALUNITE

Lake in vicinity of 1 mile post, east boundary, Jilbadji Loc. 661

Scale 5 chains to an inch

— Reference —

Site of sample hole	OP
Depth in sample hole, sample number and alunite percentage respectively	2"-5'0", A57, 66·01%
Boundary of area considered when estimating quantity and grade of material, likely to be available.	——·——·——

Sampling by R.A. Hobson, April 1942
Alunite analyses by Govt. Chemical Laboratory

— LOCALITY MAP —

Scale: 300 Chains = 1 inch

300 200 100 0 300 600 900

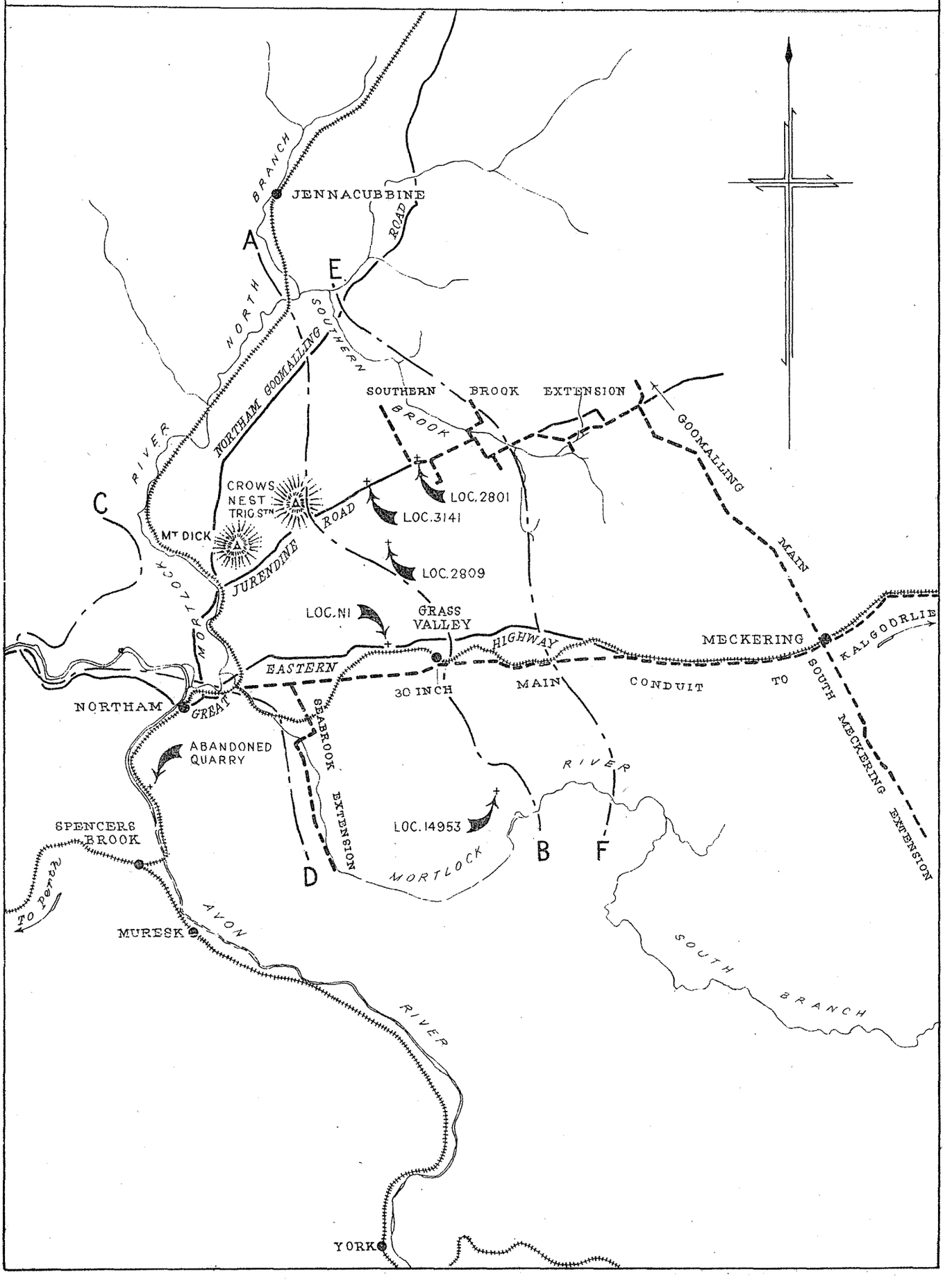


TABLE 2A.

NOTES ON BORE HOLES SHOWN IN TABLE 2.

Site.	Notes.
C	Gritty below 5 ft. 2 in.
E	At 4 ft. 6 in. red gritty material. No sample 4 ft. 2 in. to 4 ft. 6 in.
U	Gritty at 4 ft. 6in. No sample 4 ft. 2 in. to 4 ft. 6 in.
VII.	Gritty at 5 ft. No sample 4 ft. 2 in. to 5 ft.
A	Gritty at 5 ft.
G	Hole drilled to 6 ft. Gritty at 6 ft. No sample 5 ft. to 6 ft.
H	Gritty at 5 ft. 6 in. No sample 5 ft. to 5 ft. 6 in.
I	Gritty to bit at 5 ft. No sample 4 ft. 6 in. to 5 ft.
J	Red grit at 2 ft.
B	Gritty at 5 ft. 6 in. No sample 5 ft. to 5 ft. 6 in.
K	Becoming gritty at 6 ft.
L	Becoming gritty below 5 ft.
M	Slightly gritty 6 in. to 1 ft. 6 in., but good from 1 ft. 6 in. to 5 ft. Becoming gritty again at 6 ft.
N	Slightly gritty and white below 4 ft. More gritty at 6 ft. No sample 5 ft. to 6 ft.
O	White below 5 ft. Definitely gritty at 6 ft. No sample 5 ft. to 6 ft.
P	Slightly gritty at 5 ft. and definitely gritty at 6 ft.
Q	Very gritty at 5 ft. No sample 4 ft. 6 in. to 5 ft.
R	Gritty below 1 ft. 9 in.

TABLE 3.

PRELIMINARY SAMPLING OF SOME LAKES IN THE VICINITY OF SOUTHERN CROSS AND MT. PALMER.

Locality.	Lab. No.	Sample No.	Depth.	5% NaOH soluble SO_3.	Equal to alunite.	Reaction (pH) 1–5 water suspension. Glass electrode.	Notes.
			ft. in ft. in.	%	%		
Small lakes immediately north of Jilbadji location number 660, vicinity Mt. Palmer. Refer Plate IV.	1745	A26	0 3—3 3	3·83	9·88	5·11	0 in. to 3 in., no sample.
	1746	A27	1 0—4 0	1·19	3·07	5·06	0 ft. to 1 ft., no sample.
Main lake immediately east of Meier's Find. Refer Mines Litho M.172. Also Plate IV. Meier's Find is on Jilbadji location number 677	1747	A28	2 0—5 0	0·11	0·28	7·16	0 ft. to 2 ft., no sample.
	1748	A29	2 0—5 0	0·49	1·26	7·32	0 ft. to 2 ft., no sample.
Six chains east of north-east corner of G.M.L. 3676, vicinity Mt. Palmer. Mines Litho M.172 and Plate IV.	1749	A30	0 0—2 0	0·09	0·23	7·47	
	1750	A31	2 0—5 0	0·20	0·52	7·20	
Lake Koorkoordine, approximately half a mile north-east from the lake crossing on the main Bullfinch-Southern Cross Road	1751	A41	2 0—5 0	0·53	1·37	7·55	0 ft. to 2 ft., no sample.
Lake close to south-east corner of Jilbadji location number 662, vicinity Mt. Palmer. Refer Plate IV.	1786*	A76	0 0—2 0	25·07	64·68	5·18	
	1787	A77	2 0—2 6	24·03	61·99	4·85	

* Lab. No. 1786, K_2O insoluble H_2O 6·84, Na_2O insoluble H_2O 0·53. *Note.*—Samples A32–A40 were taken from Baladjie and subsequently discarded.

BORING AT SITE OF PROPOSED REPATRIATION BUILDING (RESERVE 8828)—WATER ANALYSES.

By R. A. Hobson, B.Sc. (Hons.)

During boring operations at the above site[1] two water samples were collected from bore C1. Details regarding these samples and the results of analyses are given below. Reference should also be made to the log of bore C1.

Sample A—Taken from water flowing over top of 8 inch casing and probably coming mainly from a fine to medium grained sand at 29 feet 6 inches to 46 feet 6 inches.

Sample C—Taken from inside 6 inch casing after pumping, with casing at 62 feet 6 inches, and coming mainly from a coarse sand and pebble bed at 62 to 64 feet.

[1]Hobson, R. A., Boring at site of proposed Repatriation Building—Reserve 8828, Ann. Prog. Rept. Geol. Survey 1944, pp. 28-29, 1945.

Result of analyses:—

	A	C
	Parts per million.	
Carbonate, CO_3	59	75
Sulphate, SO_4	13	7
Chloride, Cl	165	158
Nitrate, NO_3	1	1
Calcium, Ca	25	27
Magnesium, Mg	16	14
Sodium, Na	99	105
Potassium, K	1	1
Iron and Aluminium oxides Fe_2O_3 and Al_2O_3	6	5
Silica, SiO_2	8	7
	393	400

Assumed combination.		
Calcium carbonate, $CaCO_3$ ..	62	67
Magnesium carbonate, $MgCO_3$ ..	31	49
Magnesium sulphate, $MgSO_4$ ..	16	—
Potassium sulphate, K_2SO_4 ..	—	1
Sodium sulphate, Na_2SO_4 ..	—	10
Sodium nitrate, $NaNO_3$ ..	1	1
Magnesium chloride, $MgCl_2$ ..	16	—
Sodium chloride, NaCl ..	252	260
Potassium chloride, KCl ..	1	—
Iron and Aluminium oxides Fe_2O_3 and Al_2O_3	6	5
Silica, SiO_2	8	7
	393	400
Total hardness (calc. as $CaCO_3$)	128	125
Reaction, pH	7.7 faintly alkaline	7.7 faintly alkaline

NOTES ON SOME SOILS AND THE GEOLOGY IN THE VICINITY OF NORTHAM.

By R. A. Hobson, B.Sc. (Hons.).

INTRODUCTION.

Late in 1944 a committee was appointed to investigate certain technical problems associated with the proposed wheat belt water supply scheme. Amongst other things the committee desired information regarding the external corrosion of buried pipes. It was recognised that this corrosion was related to the soils. The work to be described was undertaken by the writer in co-operation with Mr. H. M. Wilson, District Engineer, Goldfields Water Supply, Kalgoorlie. Soon after the work was commenced the co-operation of Dr. Teakle, Plant Nutrition Officer, Department of Agriculture, was sought and freely given. Dr. Teakle visited the area, while the field work was in progress, and arranged for one of his officers, Mr. S. T. Smith, to assist with field work, and later to carry out a number of laboratory determinations.

Mr. Wilson and the writer agreed at the start of the work that until the causes of corrosion of existing pipe lines were known no work could be done away from existing water supply schemes. Field work was commenced in the vicinity of Northam, having as its object the determination of the causes of corrosion on existing pipe lines. The writer's attention was concentrated on the soils and geology, while that of Mr. Wilson was directed mainly toward the conditions of the pipes. All phases of the work were, however, freely discussed by Mr. Wilson and the writer. Soil samples, ground water samples, and samples of both corroded and uncorroded pipes were submitted for laboratory examination. Sufficient information regarding the soils and the pipes has been accumulated to enable a correlation between pipe condition and soil data to be commenced. This correlation is being undertaken by Mr. Wilson.

OUTLINE OF WORK DONE.

Three pipe lines, all in Northam-Meckering district, were examined in detail, and in addition a brief reconnaissance geological examination of the area was made. The pipe lines examined were: Southern Brook extension, South Meckering extension, and Seabrook extension. The positions of these pipe lines is shown on plate VI.

Soil samples were taken at varying intervals, the soil profile described and the distribution of the soil groups noted. The condition of the pipe at each test site was noted, and any geological information recorded. From the samples the following soil properties were determined —the laboratory work being done mainly by Mr. Smith:—

i. The specific conductivity, at 60° F, of the soil saturated with water.

ii. The specific conductivity of a 1 to 5 soil water suspension.

iii. The amount of chloride, expressed as sodium chloride, in a 1 to 5 soil water suspension.

iv. The pH of a 1 to 5 soil suspension both in water and in normal potassium chloride.

In the office a lot of time was spent in plotting the various soil properties (conductivity, pH, percentage chloride, etc.) against each other, partly to detect mistakes in determinations, but mainly to see if these are related to each other, and, if so, the nature of the relation.

All information regarding the soils and the geology has been collected together by the writer and a report submitted to the committee. Field work took from 23rd January to 23rd March and office work, including the writing of the report to 13th August. During this period some time was spent on other work.

SCOPE OF REPORT TO COMMITTEE.

In addition to summarising all field and laboratory information regarding the soils and the geology this report reviews briefly previous work in connection with pipe corrosion. The main work has been done in America, principally by the National Bureau of Standards, but on two previous occasions the problem has been studied in Western Australia. A selected list of references is given. The report contains a summary and general conclusions for the guidance of the committee. It makes no attempt to correlate the information regarding the soils with the conditions of the pipes. It is recommended that any future work on the soils be undertaken by the Plant Nutrition Branch, Department of Agriculture, but that the Geological Survey should co-operate if geological information is desired.

SCOPE OF PRESENT NOTES.

The present notes do not contain any detailed information regarding the soils along the pipe lines. This information has been determined primarily for correlation with pipe condition and until the principal factors affecting the pipes are known no useful purpose would be served in publishing detailed soil information. All soil information has already been passed on to the Plant Nutrition Branch, and the remainders of all samples are stored in their collection.

Some general observations regarding the geology of the district, and its relation to the broader soil groups are of general interest and are published in full. Reference should be made to plate VI and also Lands Department litho 27/80.

GEOLOGY.

At the conclusion of the work in the vicinity of the pipe lines a very rapid geological reconnaissance was made of an area in the vicinity of Northam and Meckering. The object of this was to see what outcrop conditions were like, and to gain an impression of the general geology of the area. No geological map was prepared.

Soon after the commencement of work on the Southern Brook extension noticeable differences between the soils in the vicinity of Northam and those further to the east were seen. It was thought that this might be due to different underlying rocks.

In the area A B D C on plate VI the soils are red-brown to chocolate brown heavy textured soils—clayey loams at the surface. East of A B the soils are grey to brown in colour, and lighter textured than in the area A B D C—usually loams to sandy loams or loamy sands at the surface. West of C D the soils appeared similar to those East of A B, but very little work was done west of C D.

In the area A B D C there are only scattered outcrops, but some information can be gained from rock fragments in the soil, and from heaps of rocks in the paddocks. The underlying rocks are acid gneisses (sometimes garnetiferous), ferruginous quartzites, quartzites, amphibolites, ultra basic rocks, with numerous epidiorite or dolerite dykes. Good outcrops are to be found in small quarries along the Great Eastern Highway, and also along Jurendine Road. The ferruginous quartzites

outcrop well in the vicinity of Crows Nest Trig. Station; in the South-Western corner of block N1, close to the Great Eastern Highway; on block 14953, near the Northern boundary of block 48/1051 (old number). Block 14953 is approximately 4½ miles South-South-Westward from Grass Valley. No outcrops of the amphibolites were seen, but numerous fragments can be found in the paddocks. The ultra-basic rocks outcrop well between Mt. Dick and the Northam-Goomalling Road, and also on the Great Eastern Highway, 1.1 miles east of the Northam-Goomalling railway crossing. Serpentine rocks have previously been noted near York by C. G. Gibson.[1] It is believed that the red-brown to chocolate-brown colour of the soils is due to the presence of the ultra basic rocks, the basic rocks (amphibolites), and also the ferruginous quartzites.

East of the line E F (plate VI) the only rock outcropping is granite, either as large "rocks," or as small outcrops. Much of the country is covered with soil, and there are extensive areas of sand plain. West of the line E F no granite is seen until the area West of C D is reached.

In the area E F B A outcrops are not very frequent. Outcrops of acid gneiss and ferruginous quartzite occur along Jurendine Road, and also along the Great Eastern Highway. Occasional fragments of amphibolite were seen, and also two outcrops of what appears to be a very weathered greenstone—both on Jurendine Road, one on block 3141, and the other on block 2801 (see plate VI). The soils are similar in appearance to those East of the line E F, and it is likely that the principal rocks in the area E F B A are acid gneisses.

West of the line C D the principal rocks are granite and granitic gneiss, good outcrops of which can be seen in an abandoned quarry on the Northam-Spencers Brook Road, approximately three miles from the Northam railway station. At this quarry the biotite gneiss is seen to be intruded by pegmatite dykes parallel to the gneissosity, by aplite dykes and quartz reefs transverse to the gneissosity—the order of intrusion being pegmatite dykes, aplites, and quartz reefs. East of the quarry the gneiss grades into a granite, and back again into a gneiss. The gneiss is quite different in appearance from the gneisses seen in the area E F D C.

The strikes of the various gneisses and quartzites vary from N 10° W to N 40° W, and the dips from 30° to 60° to the North-East.

The evidence gathered indicates that the area E F D C is occupied by a series of metamorphosed sedimentary rocks, with basic and ultra-basic intrusives. The basic and ultra-basic rocks are abundant in the area A B D C, and are believed to account for the red-brown to chocolate brown colour of the soils. The area E F B A probably consists mainly of acid gneisses. Dr. Prider has told the writer[2] that similar rocks occur in the vicinity of Toodyay, and also at Muresk.

The rocks of the area E F D C resemble those found in the Goldfields further to the East. It is interesting to note that gold, silver, copper and wolfram have been reported from this area, but, except for wolfram on block 2809 (approximately three miles North of Grass Valley), samples taken by officers of the Geological Survey did not yield more than a trace of any of these minerals.[3]

CHALK AND MARL SAMPLES FROM GINGIN, MUCHEA AND BULLSBROOK.

By R. A. Hobson, B.Sc. (Hons.).

During 1944 samples of chalk were collected from Gingin and samples of marl from Muchea and Bullsbrook. Most of the old quarries were inspected and located. Chalk and marl from these localities have been used for a number of purposes during the past, including lime and cement making, but very little official information is available regarding these deposits.

Details of the samples collected and results of analyses are given in the table on page 55. The localities of the quarries in the vicinity of Muchea and Bullsbrook are shown on plate VII.

Brief notes regarding the three localities are given below.

Gingin.

Samples of chalk were collected from quarries on One Tree Hill and on Molecap Hill. The positions of these quarries and some information regarding the geology of Gingin is given in a report by Feldtmann, published in 1931[1]. No chalk is being quarried at the present time, but greensand is periodically carted from Molecap Hill for its glauconite content.

Muchea.

Six small quarries were examined in the vicinity of Muchea—five on reserve 2336 in the vicinity of the station, and the sixth on block 105, East of Muchea. Quarry number 5 is the largest. No work is in progress at the present time.

Bullsbrook.

Seven quarries were examined—six in the vicinity of the siding and the seventh approximately one mile North-North-West of the siding. It is reported that there are other quarries and also outcrops of marl between quarry number 7 and the road in the vicinity of quarry number 3. There are some old lime kilns near quarries numbers 5 and 7. No work is in progress at the present time.

PORT HEDLAND WATER SUPPLY—INTERIM REPORT.

By R. A. Hobson, B.Sc. (Hons.).

INTRODUCTION.

For many years the water supply at Port Hedland has been very unsatisfactory—the town being supplied with salt water for general use from wells situated approximately one mile East of the town. Water for cooking, drinking and laundry purposes has been obtained from rain water tanks or from railway wells at Poondana or at the Shaw River. From these last two places the water has been railed to Port Hedland and distributed around the town by carting. The supply from rainwater tanks has always been inadequate.

During 1925-26 a proposal to supply the town with water from the East branch of the Turner River, approximately two miles below Boodarie homestead, was investigated. The results of this investigation to August, 1926, have been summarised by Assistant Engineer Brady. Pumping tests were continued to November of the same year. It was estimated that the town would require 25,000 gallons of water per day. This figure is still accepted by the engineer for the North-West, and it is further stated that the salinity shall at no time exceed 100 grains per gallon and that is desirable that it shall not generally exceed 50 grains per gallon. At the same time some consideration was also given to other possible sources of supply. It was decided that the Turner River scheme showed the best prospects.

During the period October to November, 1943, eight bores were put down in the vicinity of Port Hedland by the 2/2 Aust. Boring Section, R.A.E., and potable water was obtained near the 12-mile creek (Pippingarra Creek). This water was utilised by an army camp and by a R.A.A.F. camp situated in the vicinity—supplies being obtained from separate sources. It has recently been suggested that Port Hedland might be supplied from this locality.

Previous investigations into the Turner River scheme had shown that as pumping proceeded there was a small, but steady, increase in salinity, and that on three occasions this had exceeded 64 grains per gallon. The maxi-

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[1]Gibson, C. G., The Argol Syndicates property at York, Rept. Dept. Mines, 1909, p. 168.

[2]Personal communication. Refer also Prider, R.T., The geology and petrology of part of the Toodyay district, Western Australia, Jour. Roy. Soc. West. Aust., Vol. XXVIII, pp. 83-137.

[3]Woodward, H.P., Northam district, Ann. Prog. Rept. Geol. Survey 1905, pp. 17-18.
Gibson, C. G., op. cit.
Blatchford, T., Discovery of wolfram at Grass Valley, Ann. Prog. Rept. Geol. Survey, 1917, pp. 7-8.

[1]Feldtmann, F. R., The glauconite deposits at Gingin, South-West Division, Ann. Prog. Rept. Geol. Survey for 1930, pp. 6-8, 1931.

imum salinity recorded was 77.5 grains per gallon. It was realised that, with continuous pumping there was a danger of the salinity increasing beyond the permissible limits. The quality of the water at the 12-mile creek appeared satisfactory, but doubt was expressed whether sufficient quantity could be obtained. The writer was required to investigate these two schemes, paying special attention to the points noted above.

The two localities were examined between 8th and 15th November, and previous reports on the Turner River scheme were made available to the writer. The present report is an interim one, but it is not anticipated that the conclusions arrived at will be changed in the final report. The completion of the final report must await the analyses of water samples collected during the field inspection.

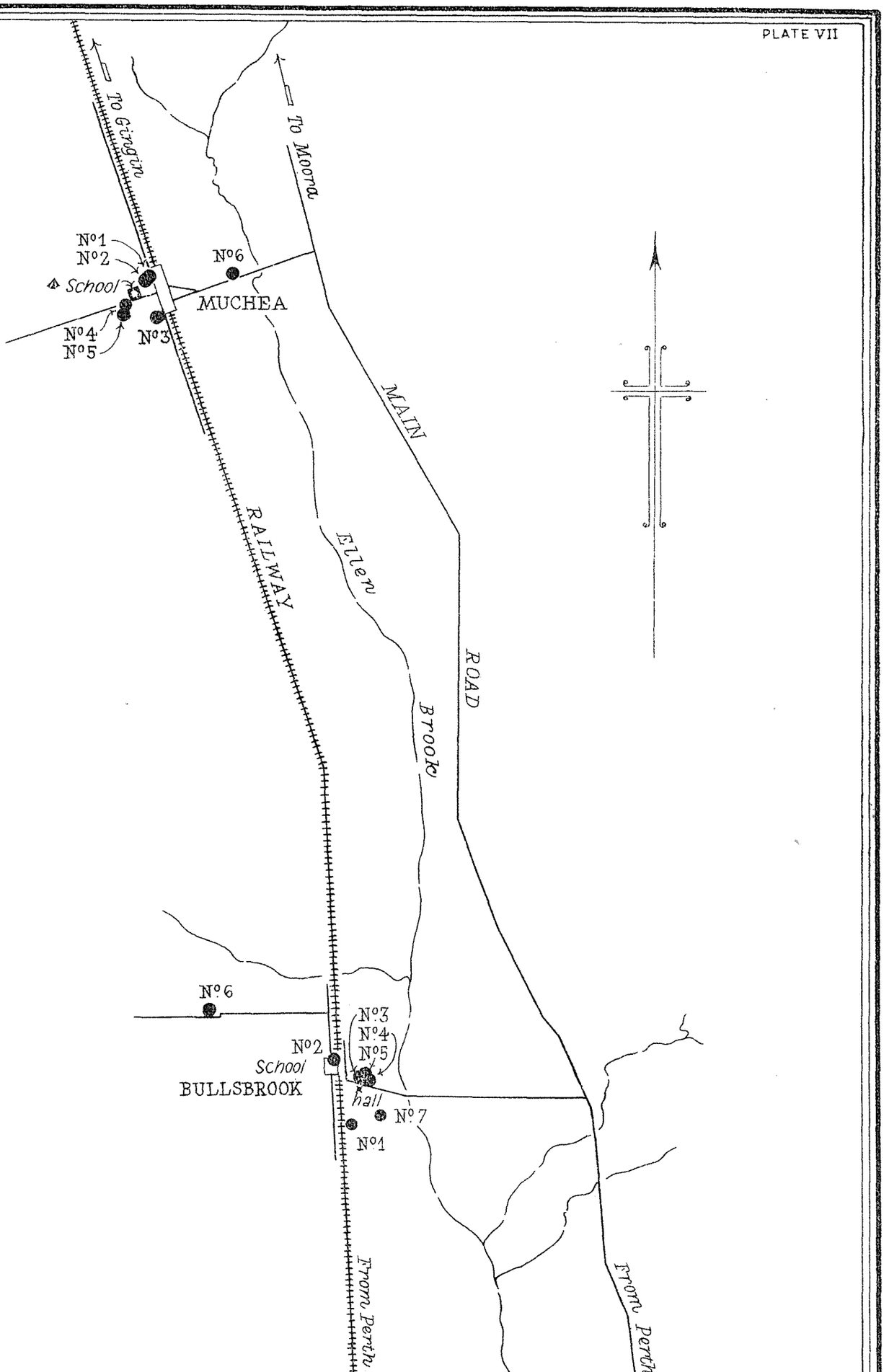
ACKNOWLEDGMENTS.

Three days were spent in the field with Mr. S. Byass, resident engineer, and the whole problem was thoroughly discussed with him. Field salinity tests of all samples were made by Mr. Byass, which greatly facilitated discussion. Transport and labour were arranged by Mr. L. Jones, the resident foreman at Port Hedland. Local files were made available by Mr. Jones. The writer's thanks are due to both Mr. Byass and Mr. Jones, who gave all possible assistance. The writer would also like to thank all residents who supplied information, more particularly Messrs. Taplin, Wilson, Grant (Boodarie Station), Richardson (Pippingarra Station), and F/L. Maggee (R.A.A.F.).

ANALYSES OF CHALK AND MARL SAMPLES FROM GINGIN, MUCHEA AND BULLSBROOK.

Locality.	Quarry No.	Sample No.		Description of Sample.	Insoluble in acid.	CaO.		MgO.		Notes regarding quarries. Approx. size, etc.
		Field.	Laboratory.			Per cent.	Equals $CaCO_3$.	Per cent.	Equals $MgCO_3$.	
					%		%		%	
Gingin	....	G.1	3855	North face of quarry on One Tree Hill, location 283, 0–4ft.	22·15	38·84	69·31	1·47	3·07	
	....	G.2	3856	As for G.1, but 4–8 ft.	16·76	42·71	76·22	0·61	1·28	8 ft. is bottom of quarry.
	....	G.3	3857	West face of quarry on One Tree Hill, location 283, 0–2 ft. 6 in.	21·09	39·49	70·47	1·60	3·35	
	....	G.4	3858	As for G.3, but 2 ft. 6 in.–5 ft. 6 in.	13·96	44·25	78·97	0·72	1·51	5 ft. 6 in. is bottom of quarry.
	....	G.5	3859	Quarry on Molecap Hill, location 103, 1–4 ft.	15·00	43·04	76·81	0·85	1·78	
	....	G.6	3860	As for G.5, but 4–7 ft.	15·85	41·75	74·51	0·67	1·40	
	....	G.7	3861	As for G.5, but 7–10 ft.	16·51	41·05	73·26	0·68	1·42	Sample G.7 was taken approximately 30 ft. north of G.6. G.7 is immediately above lower greensand. The chalk was therefore sampled 10 ft. above the top of the lower greensand.
Muchea	1	M.1	3862	South face, 1–4 ft.	29·99	34·08	60·82	1·34	2·80	35 ft. x 25 ft. x 6 ft., with 1 ft. of grey-black sand at the surface.
	2	M.2	3863	North face, 2–5 ft. 6 in.	21·60	39·58	70·63	1·46	3·05	50 ft. x 30 ft. x 5 ft., with 1·2 ft. of grey sand at the surface.
	3	M.3	3864	South face, 1–4 ft. 6 in.	27·01	33·62	60·00	1·63	3·41	50 ft. x 20 ft. x 6 ft., with 1 ft. of grey sand at the surface.
	4	M.4	3865	0–4 ft.	7·77	46·94	83·77	2·13	4·46	20 ft. x 15 ft. x 4 ft., with 6 in. of grey sand at the surface. Quarry No. 4 is the most Eastern of three small quarries on the south side of the road.
	5	M.5	3866	Centre south face, 1–4 ft.	14·63	42·98	76·70	2·09	4·37	260 ft. x 40 ft. x 8 ft., with up to 2 ft. of grey sand at the surface.
	5	M.6	3867	As for M.5, but 4–8 ft.	27·69	32·14	57·36	2·24	4·68	260 ft. x 40 ft. x 8 ft. with up to 2 ft. of grey sand at the surface.
	6	M.7	3868	West face, 1–4 ft.	7·22	46·27	82·57	2·02	4·22	60 ft. x 20 ft. x 7 ft., with up to 1 ft. of dry grey soil.
	6	M.8	3869	As for M.7, but 4–7 ft.	11·66	43·04	76·81	2·08	4·35	60 ft. x 20 ft. x 7 ft., with up to 1 ft. of dry grey soil.
Bullsbrook	1	B.1	3870	Centre north face, 2–5 ft.	10·98	43·98	78·49	1·65	3·45	250 ft. x 200 ft. x 5 ft., with up to 1 ft. of soil.
	1	B.2	3871	South side of small "island" in centre of quarry, 0–4 ft.	6·35	47·79	84·75	1·53	3·20	250 ft. x 200 ft. x 5 ft., with up to 1 ft. of soil.
	1	B.3	3872	Centre south face, 1–5 ft.	16·14	41·00	73·17	1·43	2·99	250 ft. x 200 ft. x 5 ft., with up to 1 ft. of soil.
	2	....	....	No sample	....	....	....	....	....	Approximate size 60 ft. x 20 ft. x 4 ft.
	3	B.4	3873	West face, 2–5 ft.	10·78	44·72	79·81	1·50	3·14	Now 90 ft. x 60 ft. x 8 ft., but was originally deeper, with 1–2 ft. of grey sand.
	3	B.5	3874	As for B.4, but 5–8 ft.	23·99	36·99	66·01	1·28	2·68	Now 90 ft. x 60 ft. x 8 ft., but was originally deeper, with 1–2 ft. of grey sand.
	4	B.6	3875	2–4 ft. 6 in.	6·07	48·76	87·01	1·17	2·45	70 ft. x 130 ft. x 7 ft.
	4	B.7	3876	As for B.6, but 4 ft. 6 in.–7 ft.	6·62	48·79	87·07	1·15	2·41	70 ft. x 130 ft. x 7 ft.
	5	B.8	3877	North face, 3–6 ft.	9·54	46·51	83·00	1·73	3·62	110 ft. x 60 ft. x 10 ft., with 3 ft. of grey sand and marl rubble.
	5	B.9	3878	As for B.8, but 6–10 ft.	14·41	44·25	78·97	1·71	3·58	110 ft. x 60 ft. x 10 ft., with 3 ft. of grey sand and marl rubble.
	6	B.10	3879	From small "island" in middle of quarry, 3–5 ft. 6 in.	10·00	44·92	80·16	1·47	3·07	160 ft. x 60 ft. x 9 ft., with up to 3 ft. of grey sand above the marl.
	6	B.11	3880	As for B.10, but 5 ft. 6 in.–8 ft.	12·63	42·86	76·49	1·79	3·74	160 ft. x 60 ft. x 9 ft., with up to 3 ft. of grey sand above the marl.
	7	B.12	3881	North face, 1–4 ft.	12·67	43·91	78·36	1·18	2·47	180 ft. x 100 ft. x 5 ft., with 1 ft. of grey sand. There is an old lime kiln nearby.
	7	B.13	3882	As for B.12, but 4–7 ft.	10·88	45·82	81·77	0·99	2·07	180 ft. x 100 ft. x 5 ft., with 1 ft of grey sand. There is an old lime kiln nearby.

PLATE VII



MARL QUARRIES IN VICINITY OF MUCHEA AND BULLSBROOK

Scale: 80 chains to an inch

80 60 40 20 0 40 80 120

R.A.H. 1-5-45

Table I.

TURNER RIVER INVESTIGATIONS, 1925-1926.

Test No.	Period of test. From.	Period of test. To.	Gallons pumped. Test.	Gallons pumped. Total to date.	Salinity. Grains/gall. Prior to test.	Start.	Finish.	Max.	No. of times salinity > 50 grs./gall. and values.	Calculated lowering of water table per 100,000 galls. pumped.	Notes.
1	12-7-25	25-7-25	320,000	320,000	7	11·0	30·5	77·5	2(64·5, 77·5)	1·14 in.	On five occasions salinity 40–50 grs./gall.
2	30-7-25	8-8-25	380,000	700,000	....	18·5	33·0	39·5	....		
3	10-8-25	14-8-25	130,000	830,000	....	24·5	30·5	42·0	....		
4	16-8-25	22-8-25	126,680	956,680	....	28·0	25·5	32·0	....		
5	24-11-25	11-12-25	517,877	1,474,557	....	7·0	21·5	77·0	1 (77)	1 in.	
6	7-6-26	6-7-26	1,122,600	2,597,157	....	10·5	20·0	22·0	....	1·27 in.	River ran approximately 3 months prior to commencement of test No. 6. Reported that river had not flowed since 1912.

NOTE.— (*a*) The salinity has exceeded 50 grs./gall. on three occasions—
(i) Value 64·5—occurred after three days continuous pumping with the plant speeded up to 4,160 galls./hour. Test number 1.
(ii) Value 77·5—occurred when the well forked due to heavy draw. Test number 1.
(iii) Value 77—occurred when the well was kept empty for cleaning out bottom.
(*b*) The following salinities are given for bores numbers 3 and 4 and for Boodarie Soak during tests 1–4.
No. 3 bore .... 3–5 grains/gall.
No. 4 bore .... 5–6 grains/gall.
Boodarie Soak .... 3–5 grains/gall.

TURNER RIVER SCHEME.

The proposed scheme.

Under the scheme investigated during 1925-1926 it was proposed to pump up to 25,000 gallons of water per day from the East branch of the Turner River, approximately 10 chains below Boodarie Soak and 26 chains above the upper limit of the tidal water. The information gained during the pumping tests is very briefly summarised in table I. The figures have been taken from the graphs for the most part and are only approximate. Pumping was the rate of approximately 25,000 gallons per day from a well 10 feet deep and containing 6 feet of water. The upper 7 feet 6 inches of the well was in sand and the remaining 2 feet 6 inches in clay. Saline water was known to occur East of the river (326 grs./gall. in bore 31), and also West of the river (116 grs/gall. in L1). Samples taken from bores 34, 3, 38, 41, 44, 48 and 49, all situated in the river bed had salinities varying from 3.5 to 8 grs./gall. Inspection of the rainfall records for Boodarie Station and for Pippingarra Station, which are the only records available at the time of writing, show that in 1923 average rainfall was recorded, while in 1924 the rainfall was very small (Boodarie 0.40 inches, Pippingarra 1.55 inches). In 1925 the rainfall was average, while in 1926 fair to average rainfall was recorded. In 1942 and 1943 more than average rainfall occurred. Since 1943 the rainfall has been below average—the last good rain occurring early in 1943.

In connection with the previous test the following points should be noted:—

(1) The good quality of the water in the river sands prior to pumping tests. The salinities being as given below:—

Shaft A—previous to number 1 test 7 grs./gall.
" " 5 test 7 grs./gall.
" " 6 test 10 grs./gall.
Various bores as given above—3·5 to 8 grs./gall.
Boodarie Soak, bores 3 and 4 during pumping tests —3 to 6 grs./gall.

(2) The high salinities (64.5 to 77.5 grs.—gall.) occurred when there was very little water in well—the rate of pumping having been temporarily increased (see note A, table I). The presence of saline water below the fresh water is indicated.

(3) The water table was lowered from 1 to 1·27 inches per 100,000 gallons of water pumped. Using the minimum figure of 1 inch it will be seen that, with pumping at the rate of 25,000 gallons per day, the water table would be lowered approximately 90 inches per year, *provided* the river did not flow and thus recharge the sands. This is greater than the depth of water in the well. It therefore appears likely that under the above conditions the well would have forked and the salinity increased appreciably with less than 12 months' pumping.

(4) At the present time there has been very little rain since early 1943. Average rain was recorded early in 1925.

(5) There is no record of the depth to the intake during the 1925-1926 pumping tests.

Present work.

Boodarie Soak was visited on Thursday, 8th November, and again on Monday, 12th November. The water being pumped by the mill, at the rate of 100-150 galls./hour, has a pronounced saline flavour, and according to field tests contained 280 grs. salt/gallon. Thus there has been a marked change in the quality of the water since 1925. The water from a shallow hole sunk in about the centre of river bed opposite to Boodarie Soak contained by field tests 103 grs. salt/gallon. The water from other shallow holes sunk in the river bed up to 30 chains below and 20 chains above Boodarie Soak contained, according to field tests from 36 to 197 grs. salt/gallon. Some of these waters had a pronounced saline flavour. The shallow hole 20 chains above Boodarie Soak is in the vicinity of bore number 40. No salinity is recorded for water from this bore, but bore 41, which is nearby, contained 4 grs. salt/gallon. Thus there has been a marked change in the salinity of the water in the river sands in this vicinity and it is no longer suitable for a town supply.

A sample of water taken from a shallow hole dug in the river bed approximatedly 18 chains above where the Port Hedland-Roebourne road crosses the East branch of the Turner River contained, according to field tests only, 3 grs. salt/gallon. It appears therefore that the quality of the water improves upstream.

According to local residents most of the water coming down the Turner River flows out to sea by the West branch. This statement is confirmed by the appearance of this branch. It is wider and contains a more vigorous tree and shrub growth. Water from Meerandaganna pool in the West branch contained 12 grs. salt/gallon, while water from a shallow hole dug 4 chains above this pool contained 6 grs. salt/gallon. Water from a shallow hole dug just above Moorambine pool contained 5 grs. salt/gallon. Moorambine pool is approximately 2 miles above the point where the Turner River divides into the East and West branches. Four other samples taken from wells East and West of the Turner River, near to or above the point where it divides, contained from 8 to 24 grs. salt/gallon. All salinity values given are those indicated by field tests. More details regarding these samples will be given later. It thus appears that above Meerandaganna Pool the river sands contain fresh water. Good quality water has also been recorded in the East branch near the Port Hedland-Roebourne road crossing.

Recommendations.

(1) It is recommended that the proposal (tested during 1925 and 1926) to supply Port Hedland with water from the East branch of the Turner River in the vicinity of Boodarie Soak be abandoned.

(2) About 5 miles above Boodarie homestead the Turner River divides into two branches—the East branch and the West branch. It appears likely that adequate supplies could be obtained from the Turner River above this point and it is recommended that this area should be tested. There is some evidence of the existence of fresh water in the East branch in the vicinity of Port Hedland-Roebourne road crossing, but as most of the water appears to flow out to sea through the West branch it is thought better to go above the point where the river divides and thus ensure that any water flowing down the Turner River will be available to recharge the water sands. Pumping to Port Hedland from this locality will require about 3 miles more pipe line than pumping from the site near Boodarie Soak.

(3) From a geological viewpoint it is necessary to determine the extent of the fresh water both in a horizontal and in a vertical direction. Fresh water is known to exist both on the East side and the West side of the river in existing wells. Only four wells were examined during the recent inspection.

(4) During any pumping tests it is desirable to record the following information in addition to the quantity of water pumped etc.

i. R.L. and salinity at the commencement of pumping each day.

ii. R.L. and salinity at the end of pumping each day.

iii. R.L. and salinity at any time the level in the well is dropped appreciably for any reason.

iv. R.L. of the intake.

12-MILE CREEK (PIPPINGARRA CREEK) SCHEME.

History.

The existence of good water in the vicinity of 12-Mile Creek has been known for many years. Tom's Well on the East bank of the creek was used many years ago to supply water for a 5-head battery and well C (see table II) has been in use for some time by Pippingarra Station. In 1943 four bores were put down by 2/2 Aust. Boring Section R.A.E. and good water obtained in three of these. At the present time three bores can be found —one near the R.A.A.F. well, the second (bore E) near the overhead tank, and the third (bore B) 8 chains North of the second. The bore near the R.A.A.F. well and bore E are dry and abandoned. Bore B is equipped with a pumping plant and water is being pumped to the overhead tank. Insufficient information is given in the Army records to enable the bores that can be found to be definitely identified. It seems likely that bore B is C.54 and that bore E is C.53. The bore near the R.A.A.F. well may be C.50, but Army records show this bore North of the railway The casing was pulled from bore C52 and its precise position cannot now be found. It is shown in Army records close to C.53 and C.54, but it is hard to reconcile this with the high salinity. Information regarding bores and wells in the vicinity of 12-Mile Creek is summarised in table 2.

Available information regarding the R.A.A.F. well is summarised below. This is taken partly from a P.W.D. file at Port Hedland.

(1) Well was sunk to 24 feet in April, 1945. Depth of water in the well was 4 feet 3 inches. A pumping test for 24 hours at about 450 galls. per hour lowered the water level by 12 inches.

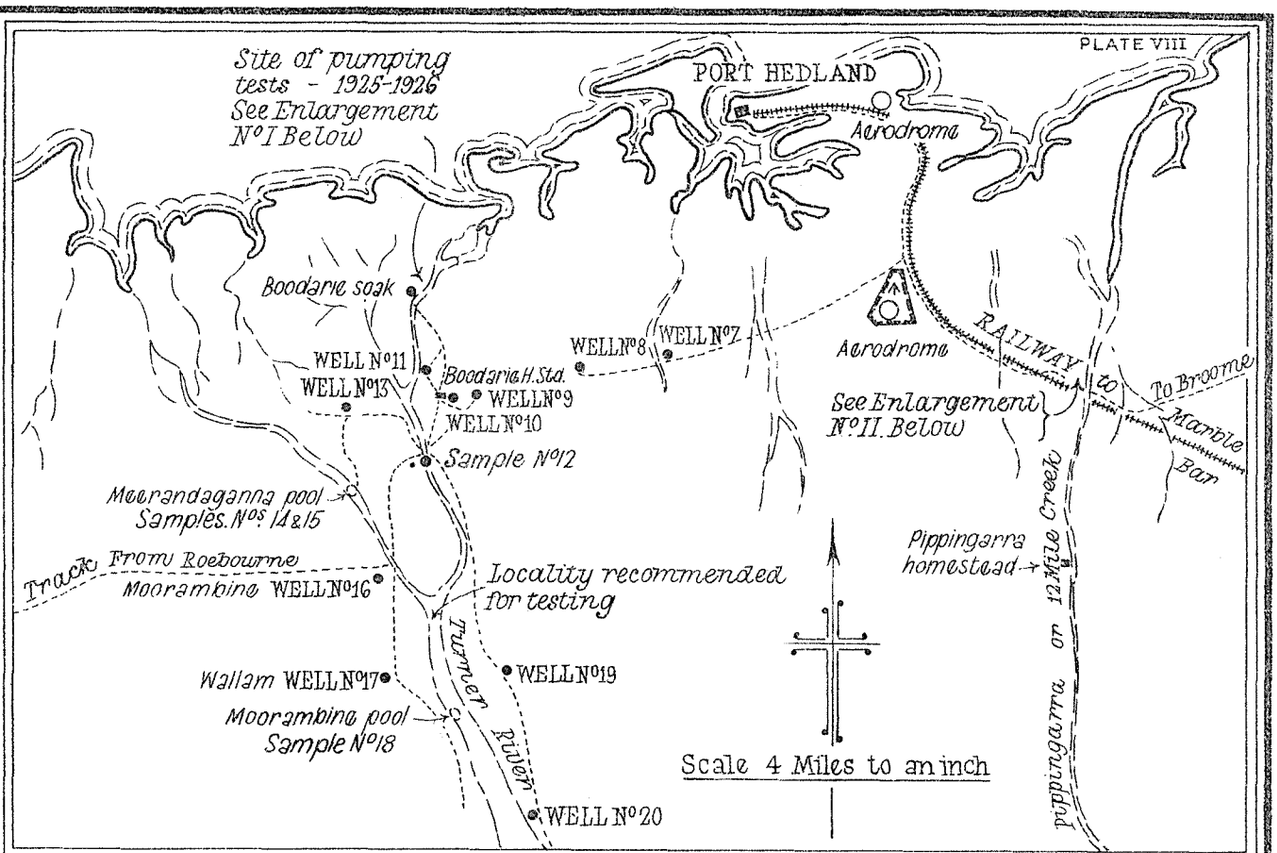
Table 2.

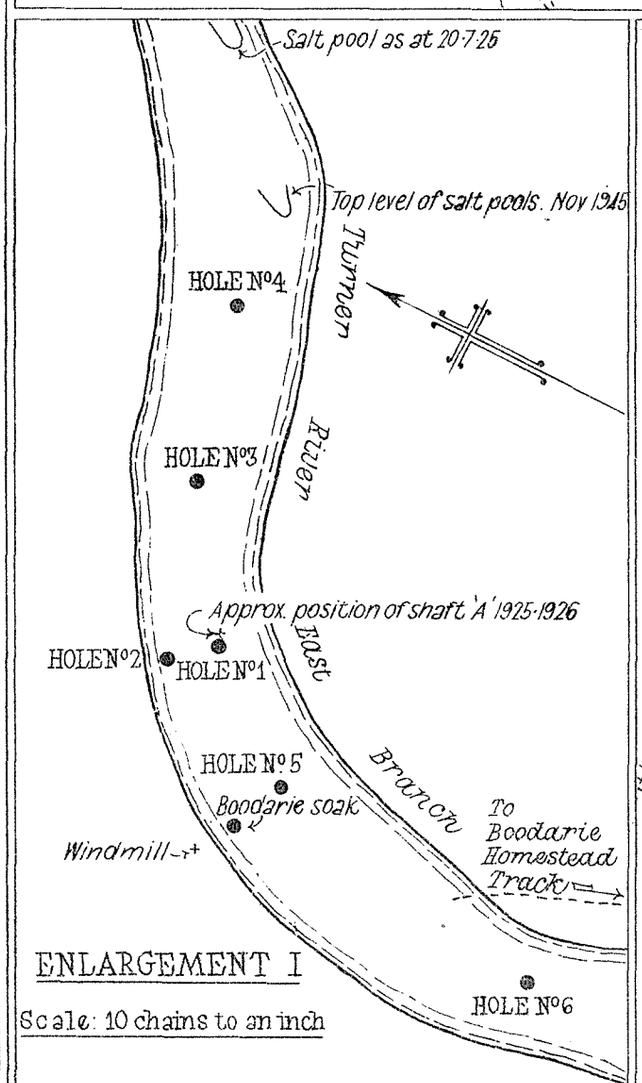
BORES AND WELLS AT 12 MILE CREEK.

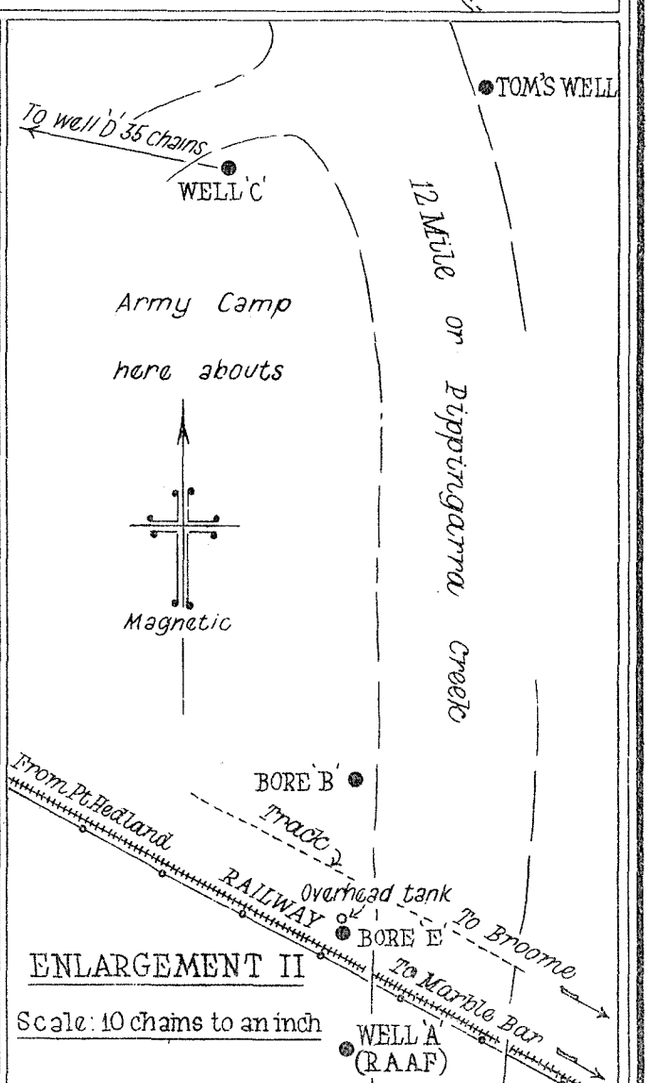
Name or number of well or bore.	Locality.	Depth in feet.		Salinity.		Notes.
		To water.	To bottom.	Field test, 1945.	Previous.	
R.A.A.F. well (Well " A ")	5 chains S. of railway and 1 chain W. of west bank of creek	21 ft. 10 in.	23 ft. 10 in.	grs. per gal. 14	grs. per gal. ...	Sunk April, 1945.
C. 50	12 Mile Creek ...	12 ft. 0 in.	24 ft. 0 in.	...	15	Quantity 1,000 galls. per hr. for 48 hour pumping test*.
C. 52	do. ...	12 ft. 0 in.	23 ft. 0 in.	...	+ 450	Quantity 400 galls. per hour by bailing test.*
C. 53 (Bore E?)	do. ...	12 ft. 0 in.	23 ft. 0 in.	...	9	Quantity 900 galls. per hr. by 48 hour pumping test.*
C. 54 (Bore B?)	do. ...	12 ft. 0 in.	55 ft. 0 in.	...	13	Quantity 1,000 galls. per hr. by 48 hour pumping test.*
Station well and mill (Well " C ")	45 chains N. of railway and 4 chains W. of west bank of creek	19 ft. 6 in.	23 ft. 4 in.	49	...	Well reported to have been 50 feet deep originally, but has silted up when creek flooded. Well not pumping at time of inspection. Intake above water level.
Tom's well ...	On E. bank of creek opposite to station well " C "	16 ft. 4 in.	31 ft. 10 in.	6	...	Well abandoned and partly filled with sticks and rubbish. Reported to have been used originally for a 5 head battery.
Well and mill (Well " D ")	Approximately ½ mile west of well " C "	34 ft. 1 in.	48 ft. 6 in.	214	...	

* Information from records of 2/2 Aust. Boring Section, R.A.E.

PLATE VIII







GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PORT HEDLAND WATER SUPPLY
LOCALITIES OF WATER SAMPLES

Nov. 1945

(2) During May water was pumped from this well at the rate of about 1400 galls./day, while during July this rate was increased to about 2,100 galls./day. No alteration in the rest level was noted. Salinity tests during July indicated from 14-16 grs./gall.

(3) During September the quantity of water available in this well dropped away. The well was deepened by 12 inches and the rest level of the water was then 31 inches, i.e., 32 inches lower than in April. Pumping lowered the water level by 12 inches in 10 minutes, and a further 3 inches in another 14 minutes. With further pumping the level remained steady. There was no change in the salinity.

(4) At the time of inspection there was 24 inches of water in the well. It is reported that the well can be forked in from 20 to 30 minutes, and that it takes approximately four hours for the water to return to rest level. A field salinity test gave 14 grs. salt/gall.

(5) The R.A.A.F. estimate that approximately 2,500 galls./day have been pumped from this well in recent months.

Water is being drawn in this well from a weathered granite, in which there are a number of horizontal or flatly dipping fractures. The surface in the vicinity is completely soil covered and the only rock exposures to be found are in shallow quarries near Pippingarra railway siding. Granite is exposed in these quarries. There are numbers of small more or less horizontal fractures. No well defined major jointing or fracturing system was observed.

Mr. Byass has already recommended that the R.A.A.F. well be deepened by 5 feet. It is probable that this would meet the immediate water requirements of the R.A.A.F.

Water for both R.A.A.F. and Army establishments in the vicinity is at present being drawn from bore B, situated approximately 10 chains North of the railway and 1 chain West of the West bank of the creek. According to figures supplied by the Army driver in charge of the pump, water is being pumped from this bore at the rate of approximately 500 galls./hr.—pumping being continuous for from 7 to 11 hours per day. An estimate made by the writer, over a period of 6 hours gave a figure of 350 galls./hour. Unfortunately the bore is sealed at the top and there are no means of measuring the depth to water in the bore and so noting the effect of this pumping. This had been going on for about one week prior to the writer's visit and was still continuing at the time he left. The depth of this bore is not known with certainty, but is presumed to be 55 feet. The salinity of water being pumped, as indicated by a field test, was 11grs./gall. According to Army records the first flow of water in bore C.54 (= bore B?) was noted at 47 feet.

It will be seen then that except for the original Army pumping tests over 48 hours, no bore in this vicinity has been pumped at anything like the rate that would be required to supply Port Hedland.

Geological considerations suggest that far greater supplies are likely to be obtained from the Turner River sands than from the vicinity of 12-Mile Creek. It remains to be proved, however, by pumping tests, whether or not a group of wells at the 12-Mile Creek could supply the amount of water required for Port Hedland. As the distance is appreciably less than to the Turner River, some further consideration must be given to this locality.

Recommendations.

(1) It is recommended that as soon as practicable pumping tests be carried out in the vicinity of the 12-Mile Creek. Three wells are available—the R.A.A.F. well, Tom's Well and well C. Well C is a station well and appropriate arrangements would have to be made with Mr. Richardson of Pippingarra Station. Tom's Well and well C would require cleaning out. The quality of water in well C is not as good as in the other two wells.

(2) It is further recommended that the R.A.A.F. well be progressively deepened and its maximum capacity be determined. Frequent salinity tests will be necessary as it is likely that saline water will be met with as the depth of the well increases. Suitable arrangements will, of course, have to be made with the R.A.A.F.

(3) The performances of the R.A.A.F. well and bore B (now being pumped by the Army) during the next few months should be carefully watched.

REPORT ON "COODAWA" TALC DEPOSIT.

Approx. Six Miles E.N.E. of Three Springs,
Victoria District, South-West Division.

By R. S. Matheson, B.Sc.

PLANS.

Geological Plan in the vicinity of the Coodawa Talc Deposit. Scale—50 feet to 1 inch.

GENERAL INFORMATION.

The Coodawa talc deposit was investigated by the writer during the period 14th to 16th September, 1944.

It is situated on location M839 about six miles East-North-East of Three Springs, a town on the Midland Railway Company's line to Geraldton, 193¼ miles from Perth. The distance by road from Three Springs to the deposit is about 7¼ miles. The deposit occurs on a low uncleared ridge on Mr. C. B. Barrett's farm, and the mineral rights are held by the Midland Railway Company.

No systematic mining has so far been carried out, the trial parcels produced to date having been obtained from the dumps of three wells. The buyers of the trial parcels of crude talc have been E. E. Rendle, 108 St. George's Terrace, Perth, and Minerals Pty. Ltd., Perth.

PRODUCTION.

The Midland Railway Company has advised that the total consignments of crude talc from Three Springs, to 1st September, 1944, amount to 27 tons 7 cwt. Details of the individual consignments are given below:—

Period.	Quantity.	Value F.O.R., Three Springs.	Remarks.
		£ s. d.	
May, 1944	7 tons 8 cwt. 1 qr.	22 4 9	Price reported by C. B. Barrett to be £3 per ton F.O.R. Three Springs.
June, 1944	13 tons 6 cwt.	39 18 0	
August, 1944	6 tons 12 cwt. 3 qrs.	19 18 3	
Total	27 tons 7 cwt.	82 1 0	

It is reported that about four tons were obtained from the dump of No. 2 Well, and about four tons from the dump of No. 3 well, while the remainder was obtained from the dump of No. 1 well. The parcels obtained from No. 1 well are said, with the exception of a sample of white and grey talc, to have consisted entirely of green talc, and that the parcels from Nos. 2 and 3 wells were mixtures of the different grades in the dumps.

GEOLOGY.

The deposit outcrops on a low ridge in gently undulating, and extensively soil covered country, on the Eastern side of the Yarra Yarra lake system. Owing to the paucity of outcrops, it is difficult to determine the general nature of the country rocks in which the deposit is situated, but they most likely consist of a gneissic complex of Pre-Cambrian age.

From reference to the accompanying plan, it will be seen that the talc deposit, which strikes in a North-South direction and has an indefinite dip, is exposed over a length of 800 feet and a maximum width of about 550 feet, at the Southern end of a large lenticular mass of highly metamorphosed rock. North of the area mapped, the rock mass becomes highly silicified and is intruded by numerous quartz veins, and, although outcrops are scarce, it is unlikely that more than a few thin seams of talc occur.

The deposit is bounded on the East by a fresh, bouldery, quartz-dolerite dyke, but the nature of the country on its Western side is rather indefinite. The only rock outcrops along the Western side are those of a siliceous quartz breccia, which may be a fault breccia or remnants of a siliceous cement capping. Until the origin of the breccia can be definitely established the Western boundary of the talc deposit should be regarded as being open to amendment.

South of a line drawn in an East-West direction through No. 1 well, the talc is compact and cryptocrystalline and its colour grades from white, through light grey, to pale green. The talc has a well developed conchoidal fracture, and "slickensided" surfaces are of common occurrence. In a number of places narrow seams of cross grained steatite* (Lab. No. 4024/44) have been developed on the "slickensided" surfaces. Many of the fractures are coated with manganese oxides, and in places these can be seen radiating from small limonite knots (Lab. Nos. 4025/44 and 4026/44) in the talc, suggesting that the limonite knots possibly represent weathered garnets. On the other hand the limonite knots may have resulted from the weathering of disseminated crystals of pyrites.

Due to the extensive fracturing, the talc breaks readily into small pieces precluding any possibility of the recovery of large talc blocks. The largest lumps of talc seen were about 9in. x 6in. x 4in. in size and even these possessed an incipient fracture.

The variations in colour of the talc appear to have resulted from weathering processes. The outcrops are generally white in colour, but a brownish stain is sometimes developed. There is a transition from white talc near the surface through light grey talc to pale green talc at depth. Indications of the change to pale green talc were met with in all wells in the vicinity of ground water level.

North of an East-West line through No. 1 well the talc outcrops have a dark grey colour and appear to be inferior in quality to the talc farther South. In the prospecting pit, however, the talc is becoming paler in colour with depth.

Over the whole of the deposit occur scattered, irregularly shaped boulders, of cellular and banded, opaline quartz, and also boulders of reef quartz. The cellular and banded opaline quartz has apparently weathered out of the deposit, as irregular masses enclosed in talc were noted in the walls of No. 2 well. Some of the cellular quartz masses have a peculiar pitted surface, which it is thought may possibly give an indication of the crystal structure of the original rock.

THE WORKINGS.

The workings consist of three wells and a prospecting pit, but only No. 2 well and the prospecting pit were accessible at the time of inspection (September, 1944).

No. 1 Well.

This well is reported to be 70 feet deep, but it was filled in to 30 feet from the surface at the time of inspection. As the well is closely timbered little information could have been obtained from an inspection. It is reported, however, that white talc with some brown staining was encountered at about 2 feet below the surface and persisted to a depth of 15 feet, the brown staining diminishing with depth. A transition to light grey talc is said to have commenced at 15 feet, and the proportion of light grey talc is said to have increased with depth to ground water level (40 feet V.D.?) where pale green talc began to appear.

Samples of these three different grades of talc (G.S.W.A. Nos. 2/2987, 2/2988 and 2/2989) were collected from the dump and submitted to the Government Chemical Laboratory for analyses and commercial tests. The results of this work are given in a later section of the report.

No. 2 Well.

This well is the domestic water supply for the homestead and is equipped with a windmill. The owner kindly pumped out this well to allow an inspection.

The well has a depth of 52 feet 6 inches, and ground water level is about 38 feet from the surface. Soil occurs in the well to about 5 feet from the surface, below which lenses and seams of intermixed white and light grey talc, and scattered irregular masses of cellular quartz, occur in a fairly soft decomposed matrix. There is an increase in compact talc with depth, and the soft decomposed material has almost entirely disappeared at 26 feet from the surface. From 26 feet to the bottom of the well the talc is composed chiefly of the white and light grey grades with the light grey predominating, but a greenish tinge appears in the talc below ground water level. Some greenish talc approaching the pale green grade of No. 1 well occurs at the bottom of No. 2 well. The talc throughout the well has a well developed conchoidal fracture, and "slickensided" surfaces are of common occurrence. Many of the fracture surfaces are stained with manganese oxides.

Two samples (G.S.W.A. No. 2/2990 and 2/2991) have been collected from this well.

No. 3 Well.

This well was inaccessible but it is said to have a depth of 62 feet 6 inches, and that water level is 38 feet from the surface. There is reported to be a chamber 10 feet long, 12 feet wide and 6 feet high extending South-East from the bottom of the well.

The well is said to show a transition from white talc near the surface, through light grey talc, to pale green talc at depth, and these three grades of talc are showing in the dump. The talc at the bottom of the well is said to occur as fairly large blocks, but it is likely that it will be found to have incipient fractures. Eyes of pale green talc occurring in white and in pale grey talc were noted in some of the material on the dump and surface manganese staining is fairly common. Pieces of talc with seams of cross-grained steatite were noted in the dump, and some pieces of talc with limonitic knots, which are believed to have resulted from the weathering of garnets or pyrites, are also present.

Prospecting Pit.

This pit is 4 feet deep and is sunk in dark grey, highly fractured talc. A few thin seams of talc lighter in colour occur at the bottom of the pit, suggesting that there may possibly be an improvement in colour with depth.

ECONOMIC CONSIDERATIONS.

The position with regard to ownership and cost of production at the time of inspection (September, 1944) was as follows:—

The Midland Railway Company owned the mineral rights of the ground on which the deposit is situated, but they had given permission to Mr. C. B. Barrett to mine the deposit on a royalty basis. The royalty paid to the Midland Railway Company for the trial parcels was 2s. 6d. per ton, but the company were asking for a future royalty at a flat rate of £50 per annum.

In addition to this royalty Mr. Barrett was obliged to pay a small royalty to Messrs. Carter and Johnson, who discovered the deposit.

The trial parcels were sold to Mr. E. E. Rendle, of Perth, who Mr. Barrett has appointed as his sole agent for one year from 1st September, 1944.

*"This determination is in accordance with H. S. Spence's definition of steatite in Can. Bur. Mines Bull. 803, p. 9. Spence states that "In the narrower, mineralogical sense, the term steatite is generally applied to massive, compact, cryptocrystalline talc, without visible grain, and usually of a pale yellow or cream colour."

The information below gives some idea of the cost of production:—

Price received by Barrett for trial parcels of crude talc from dumps	£3 per ton F.O.R.* Three Springs.
Cartage from deposit to Three Springs (7¼ miles) is equivalent to say	4s. 0d. per ton.
Royalty to Midland Railway Company on trial parcels	2s. 6d. per ton.
Freight Three Springs to Robbs Jetty, Fremantle, including shunting charges	17s. 10d. per ton. Minimum six ton lots.

The price manufacturers in the Eastern States are prepared to pay for this talc is not known, but it should command a fairly good price, as the commercial tests have shown that at least two of the grades fall within the specifications for cosmetic tales.

Since the time of inspection it is understood that the conditions as outlined above have been slightly changed. The right of mining the deposit has now passed to Mr. E. E. Rendle, who has agreed to pay Mr. Barrett a royalty of 10s. per ton, and, in addition, all other royalties.

ANALYSES AND TESTS.

Samples of white, light grey and pale green talc from the dump of No. 1 well, and also a sample of dark grey talc from the prospecting pit were submitted to the Government Chemical Laboratory for analyses and commercial tests. In addition to the work on the individual samples from No. 1 well commercial tests were carried out on the following blends of these samples:—Equal proportions of A, B and C; A and B; B and C; and C and A.

The results of the analyses and tests are given below:—

G.S.W.A. No. ...	2/2989	2/2987	2/2988	2/2996
Lab. No.	4020	4021	4022	4023
Field No.	A.	B.	C.	D.
	%	%	%	%
Silica, SiO_2 ...	62·08	62·47	62·07	60·52
Alumina, Al_2O_3 ...	0·46	0·58	0·72	1·23
Ferric oxide, Fe_2O_3 ...	0·08	0·20	0·15	0·25
Ferrous oxide, FeO ...	0·77	0·76	0·71	0·85
Manganese oxide, MnO ...	Trace	Trace	Trace	0·01
Magnesia, MgO	31·33	30·55	31·13	30·81
Lime, CaO	0·04	0·07	0·01	0·16
Soda, Na_2O	0·31	0·08	0·08	0·02
Potash, K_2O	0·01	*Nil*	*Nil*	0·02
Water, H_2O—	0·33	0·44	0·25	0·55
Water, H_2O+	4·68	4·80	4·92	5·19
Titanium dioxide, TiO_2 ...	0·01	0·02	0·01	0·03
Carbon dioxide, CO_2 ...	0·06	0·06	0·02	0·02
Phospheric oxide, P_2O_5 ...	*Nil*	0·03	0·15	0·04
Chromic oxide, Cr_2O_3 ...	*Nil*	Trace	*Nil*	Trace
Chloride, Cl	*Nil*	*Nil*	*Nil*	Trace
Sulphur trioxide, SO_3 ...	*Nil*	*Nil*	*Nil*	0·01
	100·16	100·06	100·22	99·71
Analyst:	C. E. S. Davis.	C. R. LeMesurier.	C. R. LeMesurier.	C. E. S. Davis.

Lab. No. 4020/44, *Mark A.*—Consisted of a number of pieces of dense compact, waxy looking, yellowish green talc.

A mineralogical examination showed this sample to be microcrystalline talc, uniform in texture with a little limonite.

The chemical composition is shown in the table.

Properties as Powder.—In the lump state the pieces break when nipped with a certain brittleness and grind easily in a wedgwood mortar to pass a 200 mesh screen with no grittiness.

The powder—200 mesh prepared from this sample was subjected to a number of tests from New Series No. 162 C.S.I.R. No. 147 as being the requirements of the cosmetic and other industries.

It was found to be good white in colour adhering well to the skin. It was moderately unctuous to the feel when rubbed between the fingers and was within the limits laid down for moisture, solubility in acid and loss on ignition. The grit content was found to be very low by the dye absorption test being under 1%.

Properties in Block Form.—The condition of the material as received was unsuitable for the performance of block and firing tests.

Conclusions.

This is a high grade talc producing a good white powder. Owing to the microcrystalline nature of the particles it is not so slippery to the feel as powders prepared from foliated flake talc. Nevertheless it should be of value in the cosmetic and other industries using talc.

Lab. No. 4021/44, *Mark B.*—Consisted of pieces of tough fine grained compact greyish to creamy white talc, some pieces showing considerable surface iron staining.

A mineralogical examination showed this sample to be microcrystalline talc, the particles being felted masses a little more coarsely crystalline than 4020, A, and with a little limonite.

The chemical composition is shown in the table.

Properties as Powder.—The lumps when broken grind easily in a wedgwood mortar to pass a 200 mesh screen with no grittiness.

The powder—200 mesh prepared from this sample was subjected to the test applied to 4042A. The colour was found to be white with a brownish tint due to iron staining. It was moderately unctuous with a little harshness to the feel when rubbed between the fingers. It adhered well to the skin and was within the limits laid down for moisture, solubility in acid and loss on ignition. The grit content by the dye absorption test was under 1%.

Properties in Block Form.—As in 4020, A, block and firing tests could not be carried out on this sample.

Conclusions.

This is a good grade talc, off-white in colour due to iron staining. As in 4020, A, it is not so slippery to the feel as powders produced from foliated flake talc, and has a slight harshness. It should be of value for use where the off-white colour does not interfere.

Lab. No. 4022, *Mark C.*—Consisted of a number of pieces of fine grained light grey talc with a little black staining and slightly iron stained.

A mineralogical examination showed this sample to be similar in composition and texture to B, with a little limonite.

The chemical composition is shown in the table.

Properties as Powder.—The lumps when broken grind easily in a wedgwood mortar to pass a 200 mesh screen with no grittiness.

The powder—200 mesh prepared from the sample was subjected to the tests applied to 4020, A, and 4021, B. The colour was found to be white with a light grey tint. It was moderately unctuous to the feel when rubbed between the fingers and adhered well to the skin. As in A, and B, it was within the limits laid down for moisture, solubility in acid and loss on ignition. The grit content by the dye absorption method was under 1%.

Properties in Block Form.—As in 4020, A, and 4021, B, block and firing tests could not be carried out on this sample.

*This price will no doubt be increased when mining operations are undertaken.

Conclusions.

This is a good grade talc producing a white powder with a greyish tint. As in A, and B, it is not so slippery to the feel as powders prepared from foliated flake talc, but should be of value in the cosmetic and other industries using talc.

Lab. No. 4023/44, *Mark D.*—Consisted of a number of pieces of talc varying in appearance from mottled grey to dense compact yellowish grey.

A mineralogical examination showed the mottled grey to have a wavy structure and to be slightly more coarsely crystalline than the rest. The dense yellowish grey pieces are similar to C. The whole consists of microcrystalline talc in part not so finely crystalline as A, B, and C.

The chemical composition is shown in the table.

Properties as Powder.—The lumps, when broken grind easily in a wedgwood mortar to pass a 200 mesh screen with no grittiness.

The powder prepared from this sample was subjected to the tests applied to A, B, and C. The colour was found to be greyish-white. It was moderately unctuous to the feel when rubbed between the fingers, and adhered well to the skin. As in A, B, and C, it was within the limits laid down for moisture and solubility in acid. The loss on ignition 5.19% is slightly in excess of the amount laid down, 5%. The grit content by the dye absorption method was under 1%.

Properties in Block Form.—As in A, B, and C, block and firing tests could not be carried out in this sample.

Conclusions.

This is a good grade talc producing a greyish-white powder. As in A, B, and C, it is not so slippery to the feel as powders prepared from foliated flake talc. It should be of value for use in talc industry where a good white colour is not required.

Lab. Nos. 4027, 4179-4181/44.—Powders were prepared from composite samples of equal portions of A, B, and C, A and B, B and C, and C and A.

An examination of these powders—200 mesh showed no alteration in the properties from those obtained in the individuals A, B, and C themselves except that the colour varied.

The powder prepared from A alone is the only one that gives a good white colour not tinted.

When A, B and C are mixed in equal proportions the powder—200 mesh is slightly off-white in colour and could only be used where a good white is not required.

When A is mixed with C in equal proportions the white is tinted grey to a less extent than in C alone and could possibly be used in all proportions for the cosmetic and other industries.

B is tinted brown and imparts this tint to a lesser extent both in mixtures with A and C and could be used for a number of purposes where this just off-white colour is not harmful.

CONCLUSIONS AND RECOMMENDATIONS.

As there is a paucity of outcrops, and the existing openings are all situated in a section of the deposit which has been more or less completely talcified, and partly weathered, it is difficult at this juncture to determine the nature of the rock from which the deposit has been formed. The low lime and carbonate content and the presence of traces of chromic oxide in the talc however (see analyses) suggests to the writer that it has been formed from an ultrabasic rock rather than from a dolomitic limestone. The association with the deposit of abundant cellular and banded, opaline quartz masses (common decomposition products of ultrabasic rocks) is supporting evidence for this belief, but, if this is the case, it must be assumed that parts of the deposit have been subjected to only partial talcification. It is expected that definite proof of the nature of the host rock will be obtained during future mining and prospecting operations.

Irrespective of the nature of the host rock, it is believed that the talc deposit has been formed from it by metamorphism and hydrothermal alteration, the changes probably taking place during the period of granitic intrusion responsible for the injection of the quartz reefs, and the formation of the granitic gneisses in the surrounding country. Later contact metamorphism associated with the intrusion of the quartz dolerite may have also assisted talcification however, and earth movements associated with this period of intrusion may have caused the extensive fracturing and ''slickensiding'' in the deposit. Subsequently to its formation the deposit appears to have been acted on by weathering agencies producing colour differences in the talc. This accounts for the white, grey and pale green grades of talc, which are met with in the deposit.

The available information indicates that the best talc in the deposit occurs South of an East-West line through No. 1 well, and in this section the talc is compact and cryptocrystalline, and its colour grades from white near the surface through light grey to pale green at depth. The presence of a well developed conchoidal fracture and numerous ''slickensided'' surfaces make the deposit unsuitable for the recovery of ''block'' talc, but there are good prospects for the production of large quantities of talc suitable for cosmetic use from the deposit. The chemical investigations have shown that the individual samples A and C, and blends of these two grades, both fall within the specifications for cosmetic talcs, while sample B, and blends of B in equal proportions with the other two grades, are slightly off-colour for cosmetic use due to the presence of iron staining. With a view to obviating the necessity of selectively mining the deposit or sorting material of grade B from the other grades, and with a view to obtaining the best price for the whole of the output, it is recommended that further tests be carried out to see if a product of cosmetic grade can be produced by mixing increased proportions of A and/or C with B. It is important to note that if the writer's assumption that grade A represents the original unweathered talc is correct, then adequate supplies of talc of this grade for blending purposes should be available at depth.

It is unfortunate that the extensive fracturing and ''slickensiding'' has been developed in the deposit, as the physical properties and chemical composition of the talc closely approach Spence's* specifications for talc of ''lava'' grade. If in the course of mining operations any part of the deposit becomes massive and blocky, and loses its incipient fracture, blocks of the talc should be submitted for block and fire tests to see if the material is of ''lava'' grade.

The section of the talc deposit North of an East-West line through No. 1 well (represented by sample D) is too dark in colour near the surface for cosmetic use, but is apparently quite suitable for use in the talc industry in the ground form where a good white colour is not required. There is scope for prospecting in this section as the colour of the talc may improve with depth. It is unlikely that this will be found necessary for some time to come however, as a considerable quantity of high grade talc available for development is already known to occur at the Southern end of the deposit.

If in the course of time the deposit as a whole is extensively prospected and developed, it is probable that further variations in grade of talc and silicified zones in the talc, which may necessitate selective mining, will be encountered.

*Spence, H. S., Can. Bur. of Mines, Bull. 803, pp. 10-11.

PLATE IX

FARTHER NORTH TALC ROCK BECOMES VERY SILICEOUS, AND CONTAINS ABUNDANT CELLULAR QUARTZ, BANDED QUARTZ AND REEF QUARTZ

MAGNETIC NORTH

York gum and jam

Decomposed Talc and cellular quartz

Reef quartz and cellular quartz

Siliceous Quartz breccia

Scattered boulders of Talc, cellular quartz, and reef quartz

Cleared country

Talc Boulders

TALC ROCK

ULTRA-BASIC ROCK

Scattered boulders of Talc, cellular quartz, and reef quartz

Prospecting pit 4' V.D.

Grey Talc

Bouldery Quartz-dolerite

No outcrops Red soil

Cleared country

Scattered boulders of Talc, cellular quartz, and reef quartz

Scattered boulders of Talc, cellular quartz, and reef quartz

METAMORPHOSED

York gum and jam

No outcrops Red soil

Cleared country

York gum and jam

Abundant scattered boulders of cellular quartz and reef quartz

(PROBABLY)

Nº1 WELL 70' V.D.

York gum and jam

Bouldery Quartz-dolerite

York gum and jam

TALC ROCK

White decomposed Talc with quartz veinlets

Nº3 WELL 626' V.D.

Nº2 WELL 526' V.D.

House Limits Approx.

DOLERITE

Bouldery Quartz-dolerite

York gum and jam

QUARTZ

Quartz-dolerite with Travertine capping

White weathered Talc

Weathered Talc

Weathered Talc

Cleared country

White talc with Quartz veinlets

INTRUSIVE

Bouldery quartz-dolerite

Numerous boulders of cellular quartz and reef quartz

York gum and jam

No outcrops Red soil

SILICEOUS QUARTZ BRECCIA

Bouldery quartz-dolerite

Cleared Country

York gum and jam

No outcrops Red soil, Quartz, and Ironstone pebbles

— REFERENCE —

- Soil
- Siliceous quartz-breccia (may be fault-breccia or cement capping)
- Quartz-dolerite (intrusive)
- Talc Rock (probably a metamorphosed ultra-basic rock)
- Observed geological boundaries
- Doubtful geological boundaries
- Stations
- Outcrops

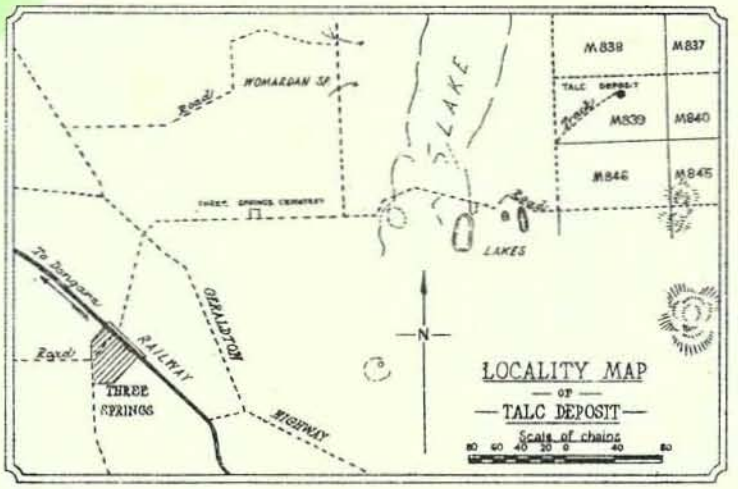
GEOLOGICAL PLAN VICINITY OF "COODAWA" TALC DEPOSIT

— LOCATION M839 —

APPROX. 6 MILES E.N.E. OF THREE SPRINGS

Scale of feet

50 40 30 20 10 0 50 100 200



Geology and Prismatic compass and pace survey by R.S. Matheson September 1944

GEOLOGICAL RECONNAISSANCE IN THE EASTERN PORTION OF THE KIMBERLEY DIVISION, WESTERN AUSTRALIA.

Between Latitudes 15° 30′ S. and 18° S., and Longitudes 128° 15′ E. and 129° E.

By R. S. Matheson, B.Sc., Geological Survey of Western Australia, and C. Teichert, Ph.D., D.Sc., University of Western Australia.

CONTENTS.

PLANS AND SECTIONS.

INTRODUCTION.

During the period June to August, 1945, the authors were engaged on a joint geological reconnaissance in the Eastern portion of the Kimberley Division. From the accompanying plans* it will be seen that the investigations were more or less confined to an area between the Ord River and the Northern Territory border and between latitudes 15°-30′ S. and 18° S.

The method of fieldwork was ground reconnaissance of selected small important areas combined wherever possible with interpretation from aerial photographs, which covered a large part of the district.

For the area between 15° 30′ and about 16° 50′ there is a complete coverage by E.-W. trimetrogon runs taken from 15,000 feet, while the upper Ord valley between White Mountain Range and Hardman Range is covered by series of overlapping verticals on a scale of about 16½ chains to 1 inch. Much of the intermediate area has a monotonous cover of basalt in which the absence of aerial photographic coverage was not seriously felt. Of great assistance were the sets of 80 chains to 1 inch topographic maps prepared by the Lands and Survey Department of W.A., and based on the aerial photographs.

The authors collaborated in all phases of the field work, but Teichert accepts full responsibility for the age determinations and correlations of sedimentary rocks based on palaeontological evidence.

The circumstances of the investigation allowed for a more detailed examination of the area than was possible by previous investigators, resulting in the discovery of a new Palaeozoic basin, and a much better understanding of the Cambrian stratigraphy, of the geological structure, and of the economic mineral possibilities of the area.

PREVIOUS FIELDWORK.

The earliest geological investigations in the area were carried out by E. T. Hardman, whose activities in the Kimberley Division during the years 1883-1884, included the mapping of the Hardman Basin. The chief object of Hardman's investigations, which were of a reconnaissance nature and were carried out under serious disabilities, was the mapping of belts of possible auriferous country. Although later work has shown that his age determinations of the rocks are at fault in some instances, his geological boundaries have been subject to only slight amendments.

Although the area under review was not actually traversed, the investigations in the East Kimberleys by H. P. Woodward in 1891, and by A. G. Maitland in 1901, no doubt influenced later geological mapping in the area.

The next geological investigations in the area were those of Dr. R. L. Jack in 1905-1906, during the course of a survey of the artesian water prospects in the Kim-

*The field plans on a scale of 80 chns. to 1 inch are available for inspection at the Geological Survey office.

berley Division. His investigations were of a very broad nature and his mapping was based largely on previous work. Although an extensive belt of Devonian rocks is shown on his map†, it is not supported by palaeontological evidence, and later work has shown that it includes rock formations of several different ages.

Further work was done in the East Kimberleys by T. Blatchford in 1921 and by D. J. Mahony in 1922, who made independent examinations of the supposed potential oil-bearing country near the junction of the Ord and Negri Rivers in the vicinity of the Oakes'—Durack bore. Both these investigations were confined to small areas, and previous ideas on the geology of the Hardman Basin were accepted.

In 1924 investigations were carried out by Dr. A. Wade to determine the petroleum prospects of the Kimberley Division and the Northern Territory, and this work included a reconnaissance of the East Kimberleys. During his investigations, in Western Australia, Dr. Wade was accompanied by T. Blatchford, while R. J. Winters, formerly an officer of the Geological Survey of the Northern Territory, acted as an assistant to the party. This work greatly advanced our knowledge of the geology of the East Kimberleys and brought about considerable alterations and additions to previous geological maps. Owing to the work in the East Kimberleys being rather, rushed, however, the party unfortunately overlooked the important Burt Range basin of palaeozoic rocks, and formed the conclusion that the East Kimberleys had no oil-bearing possibilities. The present work also indicates that the age determinations of the rocks are at fault in a few instances.

Valuable information concerning the geology in the vicinity of Argyle Station is contained in a report‡ prepared by T. Blatchford n 1927, who in the company of E. deC. Clarke, traversed the area while visiting Martin's Silver-Lead show on Speewah Station. It is in this report that reference is first made to the occurrence of the "zebra" rock on Argyle Station, and the reference to the Conglomerate or Ragged Range, about six miles East of Hearten's Homestead, is of considerable interest to the present work.

By reference to the bibliography it will be seen that, in addition to the fieldwork, examinations of fossil collections and of suites of rock specimens and of minerals have been carried out at various times. This work has been of great value to our present knowledge of the geology of the East Kimberleys.

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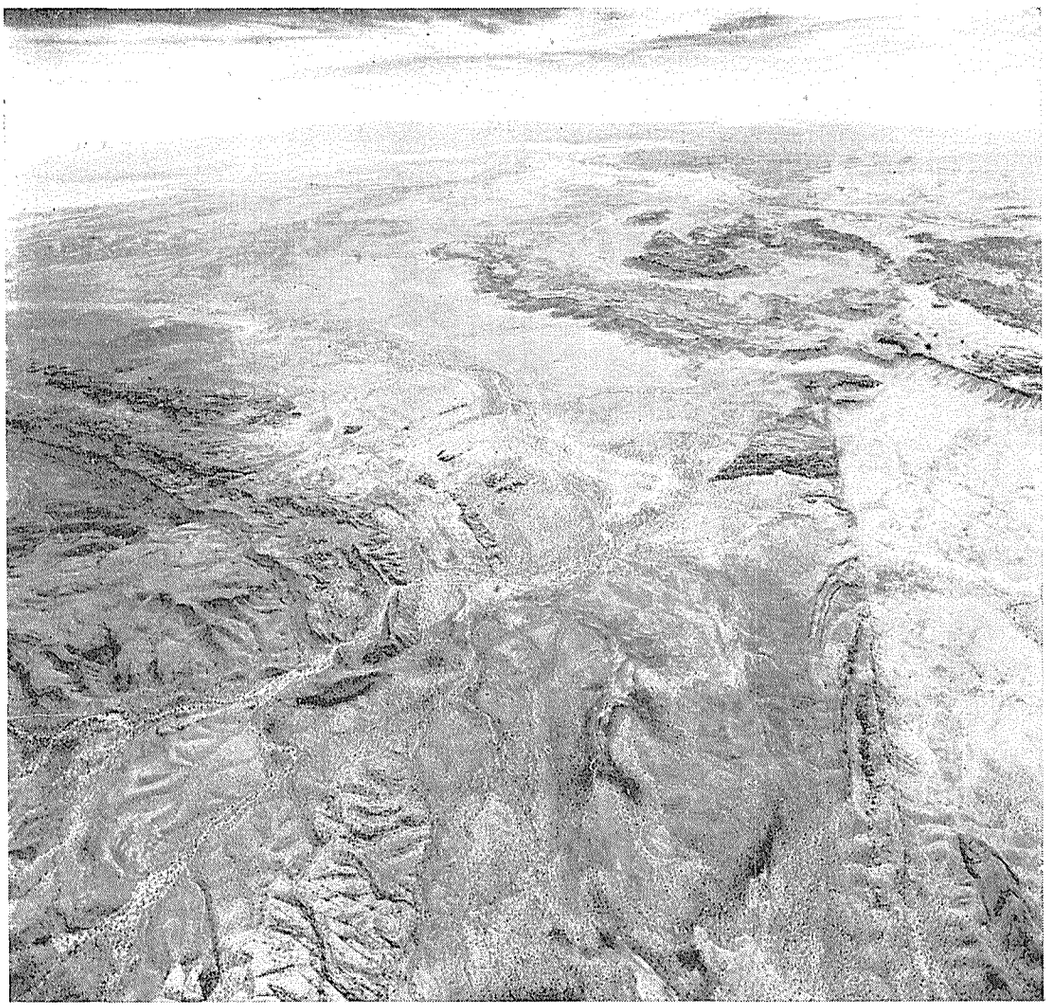


Fig. 1.—Aerial view looking north (Right Oblique 114, Run 127) of portion of the Burt Range Basin. Palaeozoic sediments meet the Pre-Cambrian complex with a faulted junction on the eastern side of the photograph, while there is an apparent overlap between the two on the western side.
(Photograph reproduced with permission of Joint Intelligence Committee, A.H.Q., Melbourne.)

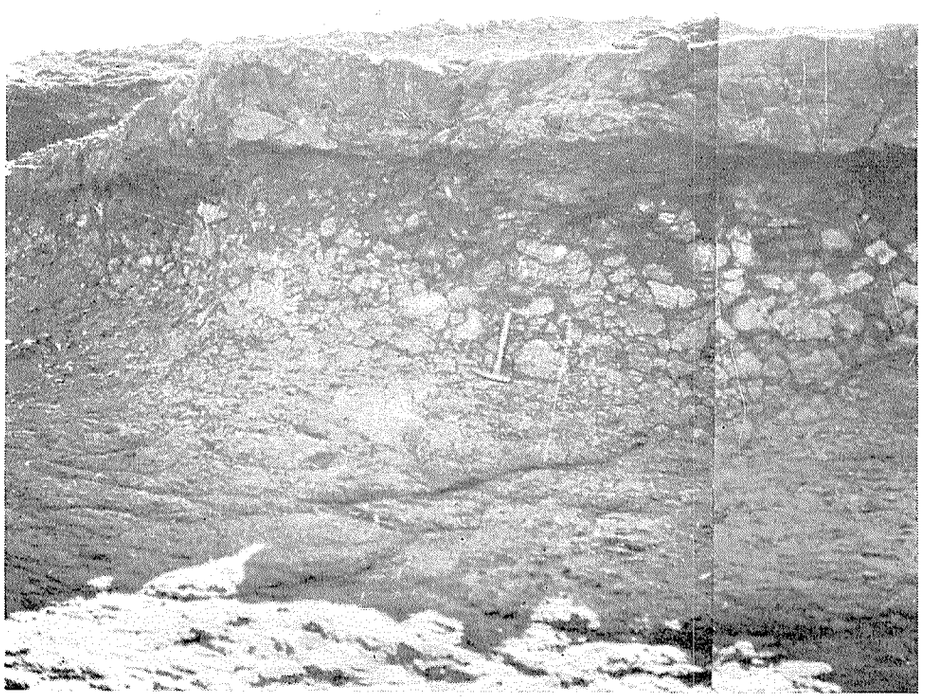


Fig. 2.—View of north-eastern bank of Behn River at the south-eastern edge of the Argyle Basin. Volcanic agglomerate can be seen underlying the basal shales of the Negri Series. (Photo: C. Teichert, donated.)

Fig. 3.—Aerial view looking north (Right Oblique 4, Run 128) from vicinity of Mt. Brooking. The Mt. Brooking series is in the south-east corner, and can be seen meeting the Pre-Cambrian complex with a faulted junction on its western side, and extending north-easterly to connect with the Burt Range Basin. Several major faults which intersect at Mt. Hensman are also well shown.

(Photograph reproduced with permission of Joint Intelligence Committee, A.H.Q., Melbourne.)

Fig. 4.—View looking north-easterly of a conglomerate hill in a down faulted block of (?) Permian rocks, about ½-mile north-east of Cockatoo Spring.

(Photo: R. S. Matheson, Neg. No. 590.)

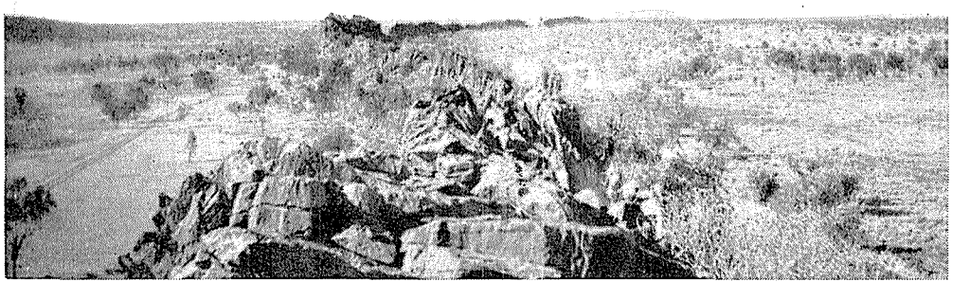


Fig. 5.—View looking north-easterly along the Rosewood Limestone Wall. Cambrian sediments occur to the south-east, and basaltic rocks to the north-west.
(Photo: R. S. Matheson, Neg. No. 593.)

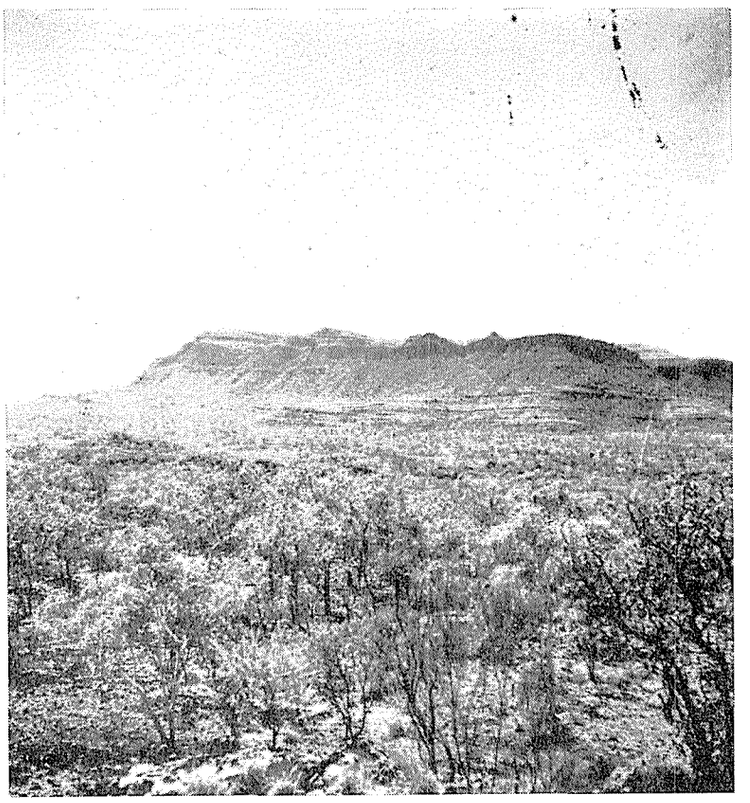


Fig. 6.—View looking north-easterly towards the Carboniferous and (?) Permian sections in the central part of the Burt Range. The erosion scarp is composed chiefly of the basal (?) Permian conglomerate.
(Photo: C. Teichert, donated.)

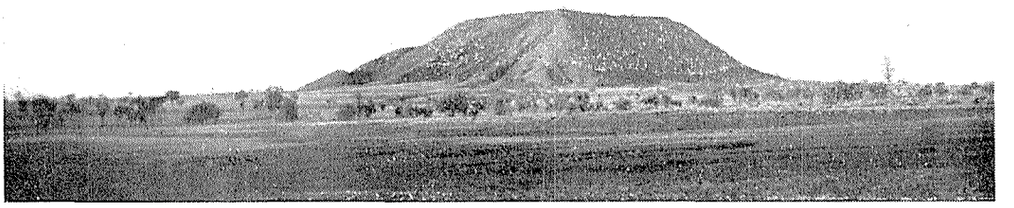


Fig. 7.—View of south-western side of Mt. Panton, Hardman Basin, which is composed of limestones and shales of the Negri Series. (Photo: R. S. Matheson, Neg. No. 599.)

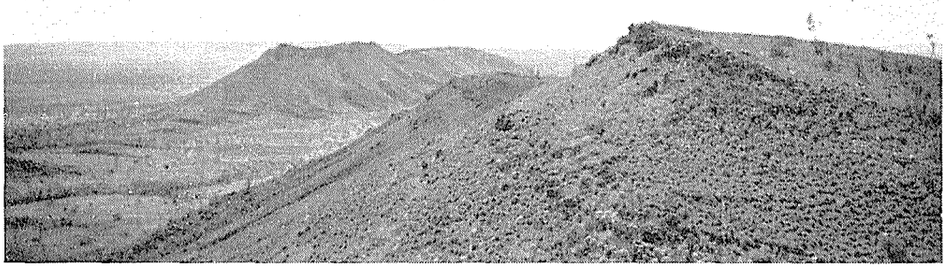


Fig. 8.—Distant view of south-eastern side of J 40 hill, White Mountain Range, Hardman Basin, which is composed chiefly of Cambrian sediments, but is capped by a thin layer of lacustrine sediments of Tertiary age. The entire slope in the foreground is also composed of Tertiary rocks (marls and siltstones capped by chert).

(Photo: R. S. Matheson, Neg. No. 597.)

Fig. 9.—View of Upper Devonian, cross bedded sandstone residual in the "Cockatoo Sands."

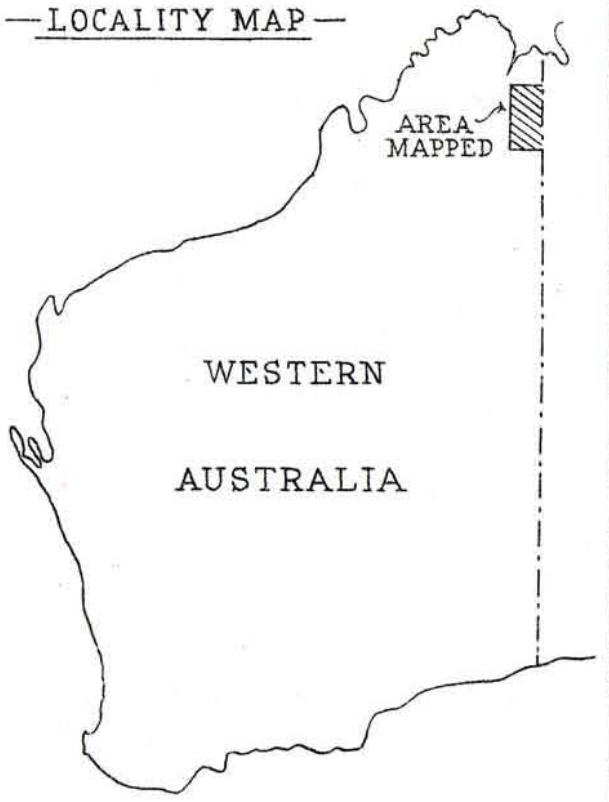
(Photo: R. S. Matheson, Neg. No. 587.)

Fig. 10.—View south along Carlton Range. A steeply dipping fault forms the backbone of the range, and is the junction between basaltic rocks to the west and Upper Devonian sandstones to the east.

(Photo: C. Teichert, donated.)

PLATE X

—LOCALITY MAP—



WYNDHAM
126°30'
MAIN
PRE-CAMBRIAN
Ivanhoe Crossing
DEV.
Country
ROAD
CAVE SPRING RA.
PINCOMBE RA.
VERTICAL STRIP RUN 125-136
DEVONIAN
DEVONIAN
Burt Range Series
Mt CECIL
KELLYS KNOB
Mt SEPTIMUS
PERMIAN (?)
CARBONIFEROUS
VERTICAL STRIP RUN 126
IVANHOE
STN.
BURT RA.
Cockatoo Series
PERMIAN (?)
Basalt
NIGGER H.
RIV.
VERTICAL STRIP RUN 127
BEASLEYS KNOB
DOWNS
PERMIAN (?)
Mt BROOKING
PRE-CAMBRIAN
VERTICAL STRIP RUN 128
VERTICAL STRIP RUN 135
RANGES
ARGYLE
Mt MISERY
PERMIAN (?)
To Newry Stn.
BASIN
Mt Elder Series
LOWER CAMBRIAN
Series
VERTICAL STRIP RUN 133
THE TWINS
PERMIAN (?)
ARGYLE
LOWER CAMBRIAN
Negri Series
STOCKADE
Country
129° E. LONG.
Rosewood Stn. Homestead
BYRNES H
VERTICAL STRIP RUN 134
CODEE
RIV.
CK.
Basalt
CK.
Mt EVELYNN
ORD
ROSEWOOD
AUSTRALIA
TERRITORY
POMPEYS PILLAR
TRACK
ROSEWOOD
LOWER CAMBRIAN
Negri Series
RIV.
BASIN
ROAD
Mt NYULASY
Mt PITT
LISSADELL
BOW
Basalt
Country
SPRING CREEK
Mt BEHN
WESTERN
MAIN
OF
NORTHERN
Mt JARRAD
TEXAS DOWNS
RANGE
NEGRI
BOUNDARY
Mt PARKER
TICALARA
BUNGLE
BUNGLE
OSMOND
OSMOND CK.
Mt ELDER
TERTIARY
RIV.
GLASS HILL
BASIN
Joins Mistake Ck.-Inverway Rd.
Mt BUCHANAN
MIDDLE AND (?) UPPER CAMBRIAN
ONLY
Mt PANTON
Mt Elder Series
LOWER CAMBRIAN
Negri Series
Mt RANFORD
HARDMAN
ORD
RIVER
EASTERN
DOUGHBOY H.
RUNS
RIV.
TRACK
LOWER CAMBRIAN
Mt NAPIER
TURNER
RANGE
DIXON
VERTICAL
ORD
RIV.
NICHOLSON
RIV.
Negri Series
To Nicholson Stn.
Country
PANTON
HARDMAN
RA.
TREE HILL
Basalt
NICHOLSON
ELVIRE RIV.
FLETCHER CK.
TURKEY CK.
McPHEE CK.
DENHAM
Conglomerate Range PERMIAN (?)
KING RIV.
PARRY CK.
16°0'
16°30'
17°0'
17°30'

— LEGEND —

UPPER TERTIARY	White Mountain Series	
PERMIAN (?)	Mt. Brooking Series	
CARBONIFEROUS		
UPPER DEVONIAN	Burt Range Series	
	Cockatoo Series	
MIDDLE & (?) UPPER CAMBRIAN	Mt Elder Series	
LOWER CAMBRIAN	Negri Series	
	Basaltic Rocks	
PRE-CAMBRIAN	Intrusives	
	Mosquito Creek Series	
	Greenstone Series (?)	

— REFERENCE —

- Geological boundaries
- Faults
- Probable faults
- Roads and tracks
- Axis and direction of pitch of synclinal fold
- Station names and boundaries (IVANHOE)
- Area covered by aerial photographs

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP

— OF —

— PORTION OF THE —

KIMBERLEY DIVISION

Between Lats 15°30'S. & 18°S. and Longs 128°15'E. & 129°E.

— BY —

R.S. Matheson, B.Sc., Geological Survey of Western Australia
and C. Teichert, Ph.D., D.Sc., University of Western Australia

Scale 10 miles to an inch

10 0 20 30

Survey base from Lands Dept. 800 chain lithos.
Geology from reconnaissance survey and interpretation of aerial photographs

June-Aug. 1945

ACKNOWLEDGMENTS.

The work of previous investigators in the East Kimberleys, in particular that of Mr. E. T. Hardman, Dr. A. Wade, and Mr. T. Blatchford, was of considerable assistance to the present work, and has been used freely in the preparation of this report.

The sets of aerial photographs were kindly made available by the Director General of Post War Reconstruction and by the Lands Department of Western Australia. The Lands Department also provided copies of their 80 chains to 1 inch series of maps of the area, and plans of the Border survey.

Helpful advice and practical assistance was received during the course of the investigations from Engineer D. Bryden, Public Works Department, and from Surveyor A. H. Richter, Lands Department.

The assistance and co-operation of local residents is also gratefully acknowledged.

GEOLOGY.

GENERAL DESCRIPTION OF AREA.

The area mapped is one in which there has been great geological interest since E. T. Hardman's investigations during the years 1883-1884. It covers an area of approximately 4,000 square miles, and is situated in the physiographic division, Ordland (Jutson, 1914 and 1934). The country in the Northern part of the area shows marked differences in relief, the ranges rising abruptly from the plains, but, in the Southern part, the contrast is not so great, and the low-lying areas of basaltic rocks and Cambrian sediments are broadly undulating, and are known locally as "Downs" country. The area is drained by the Ord River and its tributaries, the most important of which are the Denham, the Behn, the Bow, the Negri, the Panton, and the Elvire Rivers.

From Argyle Station Southwards and between the Ord River and the Western Australian border the country is composed chiefly of basaltic rocks and sediments of Cambrian age, which are bounded with a faulted junction on the Western side, by the pre-Cambrian complex. Scattered downfaulted blocks of sediments, probably of Permian age, occur along the fault junction however, and in the White Mountain Range (Hardman Basin), remnants of a series of Tertiary lacustrine sediments overlie the Cambrian sediments in two places.

North of Argyle Station a previously unmapped basin, of Upper Devonian and younger Palaeozoic rocks occupies the major portion of the area, reaching its greatest development in the Burt Range. From ground observations and aerial photography it is clear that this basin continues into the Northern Territory in a general North-Easterly direction, and that only its South-Western end is situated in Western Australia. Almost everywhere in Western Australia the Burt Range Basin is bounded by faults, and between its margins, and the Pre-Cambrian complex, to the West and to the South, is a wide, low-lying, faulted zone composed of fault blocks of basaltic rocks, Pre-Cambrian rocks, or Upper Devonian rocks. Owing to the presence of fault junctions between these different rock formations their relationships have not been definitely established.

It is of interest to record that the Burt Range Basin occurs in an area shown as Nullagine Series of Pre-Cambrian age, on the latest Geological Map of the State (1933), and it was not until 1941 that Palaeozoic sediments were first known to be present. In 1941, Mr. F. G. Forman reported the existence of sediments in the country East of Ivanhoe Homestead and collected a few specimens of fossiliferous limestone. Although the fossils differed from any of the known fossils from the Devonian of the West Kimberleys (Teichert, 1943), Teichert was of the opinion that these limestones were possibly also of Devonian age. The recent field work has shown that these fossiliferous limestones are part of the Burt Range Series of Upper Devonian age.

A detailed description of the geology of the area is given in the following pages.

GEOLOGICAL STRUCTURE.

Folding.

Both regional and local folding has occurred in the area, and the somewhat limited observations indicate that the regional folding is probably confined to the Cambrian and older rocks.

A study of the aerial photographs shows that although the Mosquito Creek Series has a general flat attitude it is broadly folded into pitching anticlines and synclines, which are in places broken by later faulting. On the right oblique aerial photographs Nos. 35 to 39 of run 135, a well defined North North-Easterly pitching, asymmetrical syncline can be seen in the Carr Boyd Ranges South-West of Argyle Homestead. The dip of the Western limb of this structure is obviously steeper than that of the Eastern limb, and the type of folding corresponds closely with that encountered in the Cambrian rocks. The older Greenstone Series (????), and possibly the younger Nullagine Series also, has been subjected to this system of folding, but in the vicinity of Wyndham the Nullagine Series appears to have a fairly uniform flat attitude.

The basaltic rocks and sediments of Cambrian age, which overlie the Pre-Cambrian complex, have also been regionally folded into asymmetrical structural domes and structural basins, the longer axes of which strike in a general North-Easterly direction. The basaltic rocks have a widespread distribution, but the sedimentary strata are only preserved in three major structural basins, which can be conveniently referred to as the Argyle, Rosewood and Hardman Basins. The Hardman Basin, which contains the thickest accumulation of sediments, is subdivided into two smaller basins, by anticlinal folding on a North-West-South-East axis. These two smaller basins are being referred to as the Dixon Range and Mt. Elder Basins. In all these basins the dips are much steeper on the Western than on the Eastern limbs, indicating that the folding is asymmetrical. Judging from observations made on the stratification in the basalt country between the structural basins, the basaltic rocks in these sections occur as structural domes.

As no indications of regional folding were found in the younger Palaeozoic rocks of the area, it would appear that the age of the latest period of regional folding is somewhere between Cambrian and Upper Devonian, but future field work may prove its existence in the Burt Range Basin. In all probability there were other periods of folding early in the Pre-Cambrian era.

Local folding occurs in the proximity of major faults, which intersect all the different ages of rocks in the area, with the exception of the Tertiary lacustrine sediments which have a very limited distribution. Local folding of the Mosquito Creek Series was seen close to major faults near the Ord River Dam site, and local folding of the Upper Devonian, Burt Range Series, was seen in the central Burt Range on the North-Western side of the Cockatoo Fault. In numerous other places along faults, the palaeozoic rocks show a local steepening in dip.

Faulting.

The area is intersected by a system of major faults, which is definitely post-Permian, and probably Tertiary or even younger in age. In most places the faulting has been of the block type, and it is more in evidence in the Northern than in the Southern part of the area mapped, but the country to the West of the Hardman Basin is probably also extensively faulted. As only a very general reconnaissance of the area was made, it is probable that a few major, and undoubtedly many minor faults occur in the area mapped which are not shown on the accompanying plans, but most of the faults governing the distribution of the different rock formations are indicated.

Very good evidence of faulting was obtained both from the aerial photographs and from ground observations. Along many of the major faults, ranges of hills terminate on a straight line sometimes with abrupt fault scarps; there are sudden changes from one rock formation to another which cannot be reconciled on lithological grounds or by folding; there are displacements of strata; the river and stream systems have an angular pattern; springs occur; there are razor-back ridges (e.g. Carlton Range); local folding is present; zones of silicified fault breccia occur, the brecciated material varying in character according to the nature of the country through which the fault is passing. Of particular geological interest are the sections of the faults where they pass through the Palaeozoic sandstones, and in these places the associated silicification has frequently produced a local hardening in the sand-

stones, increasing their resistance to erosion and giving them the appearance of quartzites. Without an appreciation of the factors involved in their formation these silicified sandstones could possibly be mistaken for Pre-Cambrian quartzites. Good examples of this can be seen at Martin's Bluff, at Mt. Cecil, at the Carlton Range, near Cockatoo Spring, and at the Hardman Range.

In the Northern part of the area most of the faults can be grouped into one or the other of two intersecting sets. One set of faults strikes in a general North to North-Easterly direction and the other in an East to East-North-Easterly direction, and both sets are generally steeply dipping. Blocks of country occurring between parallel faults belonging to these two different sets have in places been down-faulted as structural *graben*. A good example of this is the Ivanhoe Graben, which contains a down-faulted block of Upper Devonian rocks bounded on the Eastern and Western sides by the Pre-Cambrian complex, and on the South side by basaltic rocks. The fault blocks of basaltic or Pre-Cambrian rocks occurring to the East and South of the Ivanhoe Graben are also believed to be down-faulted, but to a lesser extent, and are probably step fault blocks on the Eastern side of a broader North-Easterly trending graben, situated between the Burt Range Basin and the ranges West of Ivanhoe Homestead.

Other fault blocks, consisting of probable Permian strata surrounded by older rocks, were seen near Cockatoo Spring and in the vicinity of Mt. Misery, and have been recorded at the Conglomerate or Ragged Range (Blatchford, 1928).

Only one major fault was noted in the Northern part of the area, which did not appear to belong to either of the two sets mentioned above. This fault strikes in a North-Westerly direction and dips flatly (about 25 degrees) North-Easterly and forms the junction between the Permian and Pre-Cambrian rocks North-East of Cockatoo Spring. This fault terminates to the North-West on the Cockatoo Fault and to the South-East on another major fault, and it seems likely that a very thick accumulation of Palaeozoic sediments will be found below the Permian strata, in the fault block bounded by these three faults. Further reference will be made to this fault block in the section dealing with the economic possibilities of the area.

The only major faulting noted at the Southern end of the area was at the Hardman Range, which is a long, razor-back range, about 500 feet high, about 30 chains wide and 12 miles long, composed mainly of red sandstones, occurring between two parallel steeply dipping faults, striking in a North-Westerly direction. The sandstones are comparable with those occurring in the Mt. Elder Series of the Hardman Basin, and the range is therefore regarded as a narrow block of these rocks down-faulted into the Negri Series.

Minor faulting, shearing, and jointing of the rocks was recognised in proximity to the major faults in many parts of the area, but the investigations were not carried out in sufficient detail for them to be shown on the accompanying plans. One minor fault, which deserves special mention however, occurs on the road to Nicholson Station at the South-East side of the Hardman Basin. The Brook enters the Hardman Basin in a gorge along the strike of this fault, and the fault is apparently of the hinge type, as the basal cherty limestone, which is level on both sides of the gorge at the edge of the basin, drops much more rapidly on the Northern than on the Southern side of the gorge in a downstream direction.

The investigations provided no evidence of the existence of more than one fault system in the area, and it is definitely younger in age than the supposed Permian rocks of the Burt Range. That the faulting is much younger than Permian, and possibly Tertiary to Recent in age, is suggested by the youthful physiographic expression of the fault lines by the control of the drainage by the fault system and by the fact that the remnants of Tertiary lacustrine sediments show evidence of having been slightly folded. Springs occur frequently along faults, and at fault intersections, showing that they are not completely sealed by silicification, and this also suggests a young geological age. Another interesting point about the springs is that some of them are hot, and this may indicate that they are of deep seated origin or that the movements associated with the faulting have not entirely ceased.

SOILS.

A detailed examination of the soils was not attempted, but during the course of the investigations some observations were made to determine whether or not the soils, particularly the black soil, were *in situ*. This is important from the geological viewpoint as large areas have been mapped as basalt by previous investigators, solely on the presence of black soil with basalt rubble.

It was found that, away from the alluviated areas in proximity to the Ord River, the basalt country frequently has an overburden of black soil with basalt rubble which is *in situ*, but in several places the black soil and basalt rubble have obviously been transported. In this respect, the degree of wearing of the basalt rubble is helpful to some extent, the rubble generally being less worn and more angular when *in situ*. Some of the basalts weather spheroidally however, and the roundness of the rubble may be misleading. In Stockade Creek, a few chains West of the main road, a 5 feet section of black soil with rounded basalt rubble, and which has undoubtedly been transported, can be seen overlying Cambrian limestones and sandstones. Similar and thicker sections were seen at the South-Eastern margin of the Argyle Basin, and in the Rosewood Basin.

Black soil is absent from the surface of the basalt in the banks of the Ord River near Ivanhoe Crossing, but the pink sandy loam overlying the basalt is probably a transported soil.

Sandy soils and "loose sands" are also prominent in the area, and their formation is attributed mainly to the denudation of the sandstones of the Cockatoo and Mt. Elder Series. They generally occur *in situ*, but some transportation, and mixing of adjacent soils, have occurred.

No attention was paid to the soils derived from the other Palaeozoic Series or from the Pre-Cambrian Series, as, in these areas, outcrops were sufficiently good for the soils to be disregarded as far as geological mapping was concerned.

STRATIGRAPHY.

General Classification.

Age.	Structural Unit.	Series.	Description.	Thickness.
Tertiary (? Upper)	Hardman Basin	White Mountain	Lacustrine sediments consisting of fossiliferous (*Planorbis hardmani*) cherts, siltstones and marl, occurring as remnants on the White Mountain Range, and unconformably overlying Cambrian sediments	370 ft.
Permian (?)	Burt Range Basin	....	Unsorted conglomerates (glacial?) and sandstone of the central and Southern Burt Range. Probable unconformity with carboniferous rocks in the central Burt Range. To the East the beds may pass upwards into the Mt. Brooking Series	1,000 + ft.
		Mt. Brooking	Unfossiliferous, grey and white shales and purplish sandstones occurring near Mt. Brooking, and which appear to extend North-Eastward and conformably overlie the conglomerates and sandstones of the Burt Range	700 + ft.

STRATIGRAPHY—*continued.*

General Classification—continued.

Age.	Structural Unit.	Series.	Description.	Thickness.
	Isolated Fault Blocks	....	Isolated belts of rocks, showing lithological resemblances to the Mt. Brooking series and the conglomerates and sandstones of the Burt Range, and also including the "Zebra" rock, and which are bounded by faults. They occur near Cockatoo Spring, near Mt. Misery, at the Ragged Range, and elsewhere	....
Carboniferous	Burt Range Basin	....	Bryozoan limestone, which appears to conformably overlie the top beds of the Upper Devonian strata in the central part of the Burt Range	350 ft.
Devonian (Upper)	Burt Range Basin	Burt Range	An upper section consisting of sandstones with worm burrows	1,000 ft.
			A lower section consisting of fossiliferous limestones with intercalated shales and calcareous sandstones	4,000 ft.
		Cockatoo	Fine to coarse-grained standstones, pebble beds, and conglomerates, conformably underlying the Burt Range Series. *Lepidodendron* impressions from Mt. Cecil	4,800 ft.
	Ivanhoe Graben	Burt Range	Fossiliferous limestones and shales occurring near Button's Crossing, which closely resemble the upper series of the Devonian of the Burt Range Basin	1,000 + ft.
		Cockatoo	Cross-bedded, brownish sandstones conformably underlying the fossiliferous limestones south of Button's Crossing	1,650 + ft.
Cambrian	Hardman Basin	Mt. Elder	Red shales and red and white sandstones which conformably overlie the Negri Series and which are believed to be middle and (?) upper Cambrian in age	2,000 ft.
		Negri	Fossiliferous and cherty limestones and calcareous shales of Lower Cambrian age	850–1,000 ft.
	Rosewood Basin	Negri	Limestones and shales lithologically similar to those belonging to the Negri Series in the Rosewood and Argyle Basins, and also occupying a structural basin in the basalt	350 + ft.
	Argyle Basin	Mt. Elder	Red sandstones and shales conformably overlying the Negri Series in the centre of the Basin	200 + ft.
		Negri	Fossiliferous and cherty limestones and calcareous shales of Lower Cambrian age	360–1,000 ft.

STRATIGRAPHY—*continued.*

General Classification—continued.

Age.	Structural Unit.	Series.	Description.	Thickness.
		Basaltic Rocks	Fine to medium grained basalts, amygdaloidal and vesicular basalts, volcanic agglomerates and possibly tuffs. Successive flows are present in the section. At the southern end of the area the basaltic rocks are flatly overlain by the Negri Series	3,000 + or — ft.
Pre-Cambrian	....	Nullagine	Quartzites, slates and shales which are not injected by quartz veins. They occur near Wyndham and elsewhere but not within the area mapped	....
	Intrusive Granite.			
	....	Mosquito Creek	Quartzites, slates and phyllites injected by quartz veins, which occur in the Carr Boyd Ranges, Pincombe Range and elsewhere	....
	....	Greenstone (?)	Schistose greenstones, metamorphosed basic lavas and rhyolitic porphyry, which are intruded by quartz veins In general they have a steeper attitude than the Mosquito Creek series and a more limited distribution. They occur North-East of Mt. Hensman and elsewhere	....

By reference to the above table and to the accompanying plans, it will be seen that a very thick sequence of Palaeozoic sedimentary rocks, which reaches its greatest development in the Burt Range Basin, occurs in the area under discussion. These rocks are overlain by remnants of a series of lacustrine sediments of Tertiary age, and underlain by a thick accumulation of basalt flows and pyroclastic rocks of Lower Cambrian age, which themselves are laid down on the Pre-Cambrian complex. No accurate measurements of the thickness of the basaltic rocks have been made, but it is of the order of a few thousand feet, and probably variable.

Pre-Cambrian.

The investigations in the area were concerned primarily with the Palaeozoic rocks, and as a consequence the pre-Cambrian complex did not receive much attention. The limited investigations which were carried out on the Pre-Cambrian complex however, suggests the presence of three different series, one of which is younger in age than the intrusive granite.

Greenstone Series (?)

This series has the most limited distribution in the area and its separation from the Mosquito Creek Series is based chiefly on lithological grounds. The series consists of steeply dipping schistose greenstones, metamorphosed basic lavas and rhyolitic porphyry, which are intruded by quartz veins and presumably also by granite. The most extensive area of these rocks occurs in the fault block extending North-Easterly from Mt. Hensman to the Burt Range, and it is known locally as the "Golden Gate" line of country. The schistose greenstones with quartz veins occurring near Thompson's Spring and near the junction of the Behn River and Stockade Creek are also believed to belong to this series.

Mosquito Creek Series.

This series consists of interbedded quartzites, slates and phyllites which are intruded by quartz veins and presumably also by granite. The series is folded and

faulted, but in general has a much flatter attitude than the Greenstone Series. The major portion of the Carr Boyd Ranges is composed of this series, and it was also noted at the Pincombe Range, in the Pre-Cambrian fault block East of Button's Crossing, along the Ord River South-West of Mt. Misery, and elsewhere.

About three and a half miles North-West of Cockatoo Spring (see Run 127, right 114) an apparent unconformity occurs between the Mosquito Creek Series and the Devonian basalt and agglomerate. The Mosquito Creek Series is composed of quartzites which dip 10° N. and are intruded by quartz veinlets. The overlying volcanic agglomerate has a thickness of approximately 80 feet, and appears to dip 25° N.E. It is not wished to stress the presence of an unconformity in this locality until observations are made over a wider area, as there is a possibility that the overlap may have been produced by faulting.

Nullagine Series.

No rocks belonging to this series were noted in the area mapped, but an examination of West Mt. Bastion and other hills in the vicinity of Wyndham suggests that they do occur in the district. The hills in the vicinity of Wyndham consist of flatly bedded quartzites, slates and shales, which are not injected by quartz veins and are therefore apparently younger in age than the granite. Mud cracks, ripple marks and "cone-in-cone" structure were noted in the series, indicating that the degree of metamorphism has not been great, but it has been greater than that in any of the Palaeozoic rocks of the district. Consequently the series is regarded as being of late Pre-Cambrian age. The similarity of the topography suggests that this series extends for considerable distances to the West and South of Wyndham, and to the South-East as far as House Roof and False House Roof hills.

The supposed Nullagine Series and the Mosquito Creek Series are lithologically similar, and their separation is based mainly on the absence of quartz veins in the former series, which however may only be a local feature. Until the absence of quartz veins in the supposed Nullagine Series has been established over a wider area, or an overlap is found between it and the Mosquito Creek Series, proof of the existence of the two series is inconclusive.

Intrusives.

Porphyritic biotite granite, which presumably is responsible for the quartz veins injecting the Greenstone and Mosquito Creek Series, was noted in several places in the area.

An extensive low-lying granitic area is intersected on the road to the Ord River Damsite, which turns off the main road in the vicinity of Mt. Brooking. A study of the aerial photographs suggests that the granitic belt extends in a North-Easterly direction as far as Mt. Hensman and occupies an area in the vicinity of 40 square miles.

Granite outcrops were also seen about three miles North-East of Cockatoo Spring, on the main road between Thompson's Spring and Mt. Brooking, and in Stockade Creek near its junction with the Behn River.

Granite is also reported (Blatchford, 1928, p. 14) to occur between the Carr Boyd Range and the Ord River, West of Argyle Homestead. It is said to show an intrusive relationship to Pre-Cambrian phyllites in this locality.

The granite is probably of the same age as that intruding the Lower Proterozoic rocks of the Northern Territory (Voisey, 1939, p. 139), and warrants further attention, as it may also contain economic mineral-bearing pegmatites and quartz reefs.

Cambrian.

Basaltic Rocks.

Basaltic rocks are encountered in various places throughout the whole of the area mapped, but their most widespread distribution is Southwards from the Argyle Basin. North of the Argyle Basin the occurrences of basaltic rocks are confined to scattered fault blocks.

The basaltic rocks show lithological resemblances throughout the whole of the area, and consist of interbedded layers of fine to medium grained basalts, amygdaloidal and vesicular basalts, volcanic agglomerates and possibly tuffs. The basaltic rocks are apparently composed of successive flows, as several different layers of volcanic agglomerate and amygdaloidal basalt are encountered in the section. This is well shown in the hills near Mt. Quirk on the South-Western side of Behn Gorge. The so-called "puy" hill (Jack, 1906, p. 17) in this locality appears to be only a normal section of two different basalt flows, and, over a thickness of 200 feet, two different layers of volcanic agglomerate and amygdaloidal basalt are encountered. Wade also disagrees with the interpretation of the hill as a "puy" (Wade, 1924, p. 33).

The junction between the basaltic rocks and the basal cherty limestone of the Negri Series, which is of late Lower Cambrian age, was seen at several places near the Rosewood and Hardman Basins; in the Behn Gorge, near the Sugar Spring limestone wall, at the junction of the Ord and Negri Rivers, near the junction of the Panton and Elvire Rivers, near Mt. Napier, and on the road to Nicholson Station about 22 miles from Ord River Station. At these widely separated localities the limestone appears to have been deposited more less conformably on a soft layer of volcanic agglomerate the surface of which shows no evidence of having been extensively eroded. It would appear therefore that no great time interval could have elapsed between the cessation of volcanic activity and the commencement of deposition of the Negri Series, and consequently the age of the basaltic rocks is considered to be early Cambrian. Supporting evidence for this belief is the fact that the basaltic rocks have been included in the same system of folding as the Cambrian sedimentary series.

The basal cherty limestone appears to be absent in the Argyle Basin, but a contact with the basaltic rocks seen in the Behn River shows that conditions are similar, the basal shales of the Negri Series overlying the volcanic agglomerate more or less conformably.

The base of the basaltic rocks was not seen, but from observations, as to its general attitude, made from a point about two miles West of the junction of the Ord and Negri Rivers, its thickness in this area must be in the vicinity of a few thousand feet. This estimate compares favourably with measurements made by Wade (1924, pp. 29, 32) on traverses to Mt. John and elsewhere.

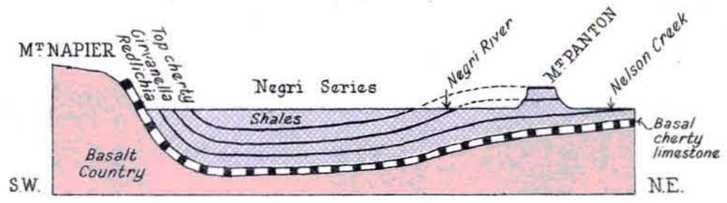
The vesicles in the basaltic masses in the agglomerate, and in the upper basalt layers, near the junction with the Negri Series are frequently filled, and the amygdales consist of chalcedonic quartz, quartz crystals, and/or calcite. Asphaltum which probably originated in overlying Palaeozoic sediments also occurs in the vesicles in isolated places (Simpson 1921, Blatchford 1922, Farquharson 1922, Mahony 1922). In addition, the vesicles are frequently coated with copper carbonates, and possibly also by copper silicates. Where the junction with basal cherty limestone is steeply inclined, there appears to have been a certain amount of redeposition of copper minerals, by circulating meteoric waters, in the bottom layers of the limestone. A specimen of cherty limestone from the footwall side of the Rosewood "limestone wall," submitted to the Government Chemical Laboratories for determination, was shown to contain *malachite* and *chalcocite* (Lab. No. 5433).

The copper minerals are apparently closely associated with the basaltic magma and their deposition probably occurred towards the end of consolidation. This association of copper with the Lower Cambrian basaltic magma is interesting, in so far as it suggests a possible age for the basic laccoliths, sills and dykes occurring in association with copper deposits in the Nullagine Series, North-West Division.

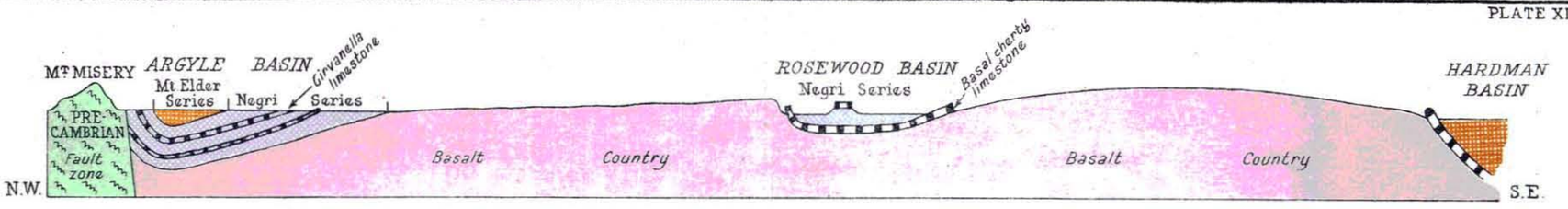
North of the Argyle Basin the basaltic rocks were seen in several places, including Kelly's Knob, Carlton Range, Ivanhoe Crossing, Ivanhoe Homestead, Martin's Bluff, between Martin's Bluff and Button's Crossing, and about three and a half miles North-West of Cockatoo Spring. Most of these occurrences are in fault blocks however, and provide no information as to the thickness and relative age of the basaltic rocks.

Both Kelly's Knob and Carlton Range are on fault lines, and at these localities volcanic agglomerate can be seen abutting on silicified sandstones belonging to the Cockatoo Series of Upper Devonian age.

PLATE XI



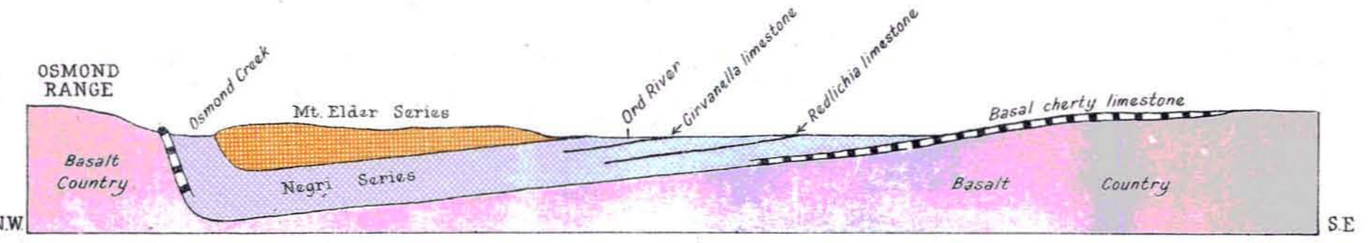
— SECTION THROUGH Mt PANTON —



— SECTION ALONG BEHN RIVER —

— SECTION THROUGH Mt CECIL —

Horizontal Scale : 1 inch = 4 miles
Vertical Scale : 1 inch = 2344 ft. approx



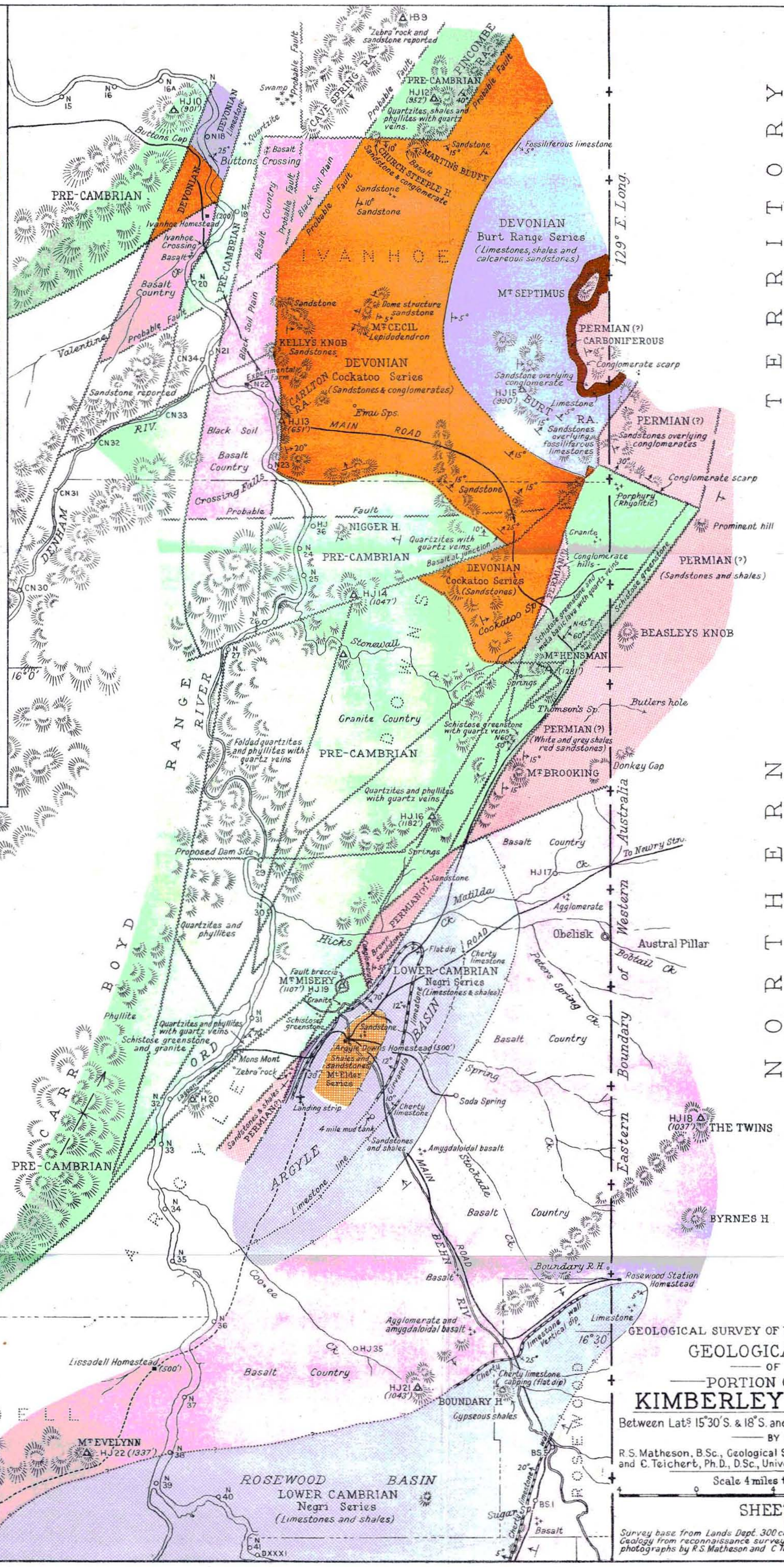
— SECTION 2½ MILES SOUTHWEST OF ORD RIVER HOMESTEAD —

— LEGEND —

UPPER TERTIARY	White Mountain Series	Lacustrine sediments consisting of fossiliferous cherts, siltstones & marls	
PERMIAN (?)	Mt. Brooking Series	White and grey shales, red sandstones and "zebra" rock. Probably also includes unsorted conglomerates (glacial?) and sandstones of central and southern Burt Range and elsewhere.	
CARBONIFEROUS		Fossiliferous limestone occurring between Permian(?) and Devonian sediments in the central part of the Burt Range.	
UPPER DEVONIAN	Burt Range Series	Fossiliferous, limestones, shales and calcareous sandstones conformably overlying the Cockatoo Series.	
	Cockatoo Series	Sandstones, grits and conglomerates. Lepidodendron impressions from Mt. Cecil. Series embraces Cockatoo Sands.	
MIDDLE & (?) UPPER CAMBRIAN	Mt. Elder Series	Red shales and red and white sandstones of the Hardman Basin conformably overlying the Negri Series. Remants of this series may also occur in the Rosewood and Argyle Basins.	
LOWER CAMBRIAN	Negri Series	Fossiliferous limestones and shales of the Hardman, Rosewood and Argyle Basins.	
	Basaltic Rocks	Amygdaloidal, and fine to medium grained basalt flows, interbedded with which are layers of volcanic agglomerate. Some tuffs may possibly occur.	
PRE-CAMBRIAN	Intrusive	Porphyritic granite and allied rocks.	
	Mosquito Creek Series	Quartzites and phyllites of the Carr Boyd Ranges which are intruded by quartz veins.	
	Greenstone Series (?)	Greenstone schists, metamorphosed basic lavas and felspar-quartz porphyry (rhyolitic?), intruded by quartz veins. This belt extends northeast from Mt. Hensman to the Burt Range.	

REFERENCE TO SIGNS

- Observed geological boundaries
- Geological boundaries from aerial photographs
- Inferred geological boundaries
- Faults
- Probable faults
- Outcrops showing direction of dip (15°)
- Outcrops with no observable strike or dip
- Strike and dip of schistosity (N45°E, 60°)
- Roads and tracks
- Limestone horizons
- Axis and direction of pitch of synclinal fold
- Station names and boundaries (IVANHOE)



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP
— OF —
— PORTION OF THE —
KIMBERLEY DIVISION

Between Lats 15°30'S. & 18°S. and Longs 128°15'E. & 129°E.

— BY —

R.S. Matheson, B.Sc., Geological Survey of Western Australia
and C. Teichert, Ph.D., D.Sc., University of Western Australia

Scale 4 miles to an inch

4 0 4 8 12

SHEET 1

Survey base from Lands Dept. 300 chain lithos.
Geology from reconnaissance survey and interpretation of aerial photographs by R.S. Matheson and C. Teichert. June to August 1945.

The occurrence of volcanic agglomerate overlying vesicular basalt on the Western side of Martin's Bluff, and occurring in association with silicified sandstones and conglomerate of Upper Devonian age, can probably also be accounted for by faulting, which at present is unmapped.

The basaltic rocks at Ivanhoe Crossing have received some attention from previous investigators, and very good exposures occur at the crossing, and for a distance of about two miles upstream. The basaltic rocks have a flat downstream dip, and the uppermost layer, which outcrops near the Eastern bank of the Ord River, is a porphyritic felspar basalt. Fine to medium grained basalt, containing vesicular and amygdaloidal seams, occur immediately below the porphyritic felspathic layer and extends for about half a mile upstream. Beyond this point a lower very vesicular layer of basalt appears, and this changes upstream into fine to medium grained basalt which continues to one mile from the crossing, where it begins to show spheroidal weathering and contains a few thin basaltic dykes in joints. A layer of volcanic agglomerate also occurs in this vicinity. Throughout the section the basaltic rocks are intersected by steep and flatly dipping joints. The joints and vesicles are in places filled by silica, calcite and/or greenish *prehnite** [$H_2Ca_2Al_2(SiO_4)_3$].

As has already been mentioned in the section dealing with the Pre-Cambrian rocks, an apparent unconformity, between the Mosquito Creek Series and volcanic agglomerate, occurs in the hills about three and a half miles North-West of Cockatoo Spring. The volcanic agglomerate overlying the Mosquito Creek Series has a thickness of about 80 feet, and is itself flatly overlain by silicified sandstones, which appear to belong to the Cockatoo Series of Upper Devonian age. Unfortunately observations in this critical area were limited to one short visit, and, until further investigations are made, the geology is open to different interpretations. The section may indicate the presence of a second and younger age of basaltic rocks, or may only be (and in the authors' opinion this is more likely) another exposure of the Lower Cambrian basaltic rocks complicated by faulting, and perhaps also by erosion prior to the deposition of the Cockatoo Series. If a second and younger age of basaltic rocks does occur however, it will be restricted to the Northern part of the area mapped.

Numerous specimens of basaltic rocks from both the Northern and Southern parts of the area have been added to the Departmental collection, and a petrological comparison of the types from the two areas may satisfactorily solve the problem of whether or not there are two different ages. Detailed petrological investigations have already been made by Edwards (Edwards and Clarke, 1940, pp. 77-94) on a comprehensive suite of basaltic rocks collected by Clarke in the East Kimberleys in 1927, but unfortunately none of the specimens examined were from the Northern part of the area under consideration. It is of interest to note however, that as a result of this petrological work there is "no suggestion that basalts of two ages are represented—rather the reverse."

Sediments.

Cambrian rocks were discovered by Hardman (1885) who however classified them as Carboniferous (together with the limestone series of the West Kimberley which later turned out to be Devonian.) After Hardman's fossil collections had been taken to England, Foord, in 1890, recognised among them some fossils of Cambrian age which he described as *Olenellus forresti* and *Salterella hardmani*. Unfortunately the localities from which these fossils were derived were not very well fixed, and in 1906, Jack dismissed the fossil evidence as unsatisfactory, mapping the limestone and associated sediments as Carboniferous. Although Glauert, in 1912, succeeded in fixing the exact position of Hardman's localities the Carboniferous age of the sediments in question was upheld as late as 1922 by Blatchford, and in 1923 by Farquharson.

In 1924 the area was re-investigated by Wade and from his collections Chapman (1924) concluded that the beds were mostly Upper Cambrian in age.

*Determination made at W.A. Chemical Laboratories, Lab. Nos. 5425, 5426

In the meantime it had been realised that "Olenellus" *forresti* was a member of the genus *Redlichia* (Etheridge 1917), and as Cambrian trilobite faunas from Asia became better known, it was shown that this genus was characteristic of a stratigraphical zone which was either high in the Lower or low in the Middle Cambrian. Stubblefield (1942) concluded that the beds with *Redlichia forresti* must be Lower Cambrian and this age classification was also accepted by Clarke, Prider, and Teichert in 1944.

The Cambrian rocks of the East Kimberleys form the Western end of a major belt of rocks of this age which may extend intermittently right across the Northern Territory into Western Queensland. On Western Australian territory the Cambrian forms a narrow belt along the boundary between approximately 18° 30′ and 16° 15′ S. lat., reaching Westward from the boundary for 15 to 75 miles.

This entire area is covered by a sheet of basalt, a few thousand feet thick, which has an irregular surface forming ridges, domes, and depressions. In the depressions sediments which once covered the basalt everywhere have been preserved. These sediment-filled depressions have now generally been eroded down to a level below that of the basalt rises. Their margins are sometimes steep monoclinal flexures and the basal limestones of the sedimentary series occupy in many places a steeply dipping, sometimes vertical, position. Since they are more resistant to erosion than both the overlying shales and the underlying top layers of the basalt (which are mostly agglomerates and vesicular flows) they form in many places almost vertical "limestone walls," sometimes thirty to fifty feet high. These striking physiographical features have puzzled many earlier observers.

The Cambrian sediments are arranged in a number of major structural basins in the basalt. These are from North to South:—

(a) The Argyle Basin, about 25 miles long and 7 miles wide, with its long axis striking N.E.-S.W., and faulted along its N.W. side against Pre-Cambrian and other rocks.

(b) The Rosewood Basin, about 40 miles long and 11 miles wide, roughly parallel to the former.

(c) A large basin, 75 miles long and 35 miles wide, which has generally been known as the "Ord River Basin," but for which the name Hardman Basin is here proposed. This basin is subdivided by a shallow anticline situated in the vicinity of Kelly Creek into a smaller basin in the North (Mt. Elder Basin) and a larger basin in the South (Dixon Range Basin). The Mt. Elder Basin continues Eastward into the Northern Territory in the direction of and beyond Mt. Panton. The Dixon Range Basin is truncated near its South-Western end by a major N.W.-S.E. trending fault zone, the Hardman Fault, which has already been described.

In the Hardman Basin the section of Cambrian sediments is thickest and the stratigraphy most complete. It is therefore advisable to describe the succession of this basin first. Places studied in greater detail include the vicinity of Ord River Homestead, the valley of the Forrest River, the country along the track from Mistake Creek Homestead via Ord River to Turner River Homestead, the Hardman Range and the small sedimentary area to the South of it, the vicinity of the Elvire River West of Turner River Homestead, the country along the track from Ord River Homestead to Nicholson Homestead as far as the basalt boundary, Mt. Elder and the White Mountain Range and the country between the latter and the Ord River, largely occupied by the Kelly Creek anticline, and finally the vicinity of the junction of the Negri and the Ord. In addition, to gain further stratigraphical information, our investigations were extended a short distance into the Northern Territory, where the Mt. Panton section was measured and a survey was made of the country between Mt. Panton and Mt. Napier.

(a) *Hardman Basin.*—As mentioned above this basin falls into two parts, the Mt. Elder Basin and the Dixon Range Basin, separated by the Kelly Creek anticline. The Mt. Elder Basin is oblong, with its longer axis tending N.W.-S.E., and is situated in a sub-rectangular area formed by the lower course of the Negri River and by the Ord River upward from its junction with the Negri.

Along the South-Western side of the basin the strata are steeply dipping (up to 40°), but around the other sides lower dips are encountered.

The Dixon Range Basin is elongated (about 65 miles long and 30 miles wide) with the Ord River flowing almost along the middle line. The axis of greatest depression of this basin is, however, to the West of the Ord, so that the transverse section is asymmetrical, with a gently sloping South-Eastern side and a steeply dipping North-Western side. The part of the basin West of the Ord River was not visited and is only known from some traverses by Wade (1924).

On the South-East side of the basin the basalt emerges from below the sediments and rises to the heights of the Antrim Plateau. Between the edge of the basalt and the Ord River the country is entirely underlain by rocks of the Negri Series whose limestone beds form low escarpments and extensive dip slopes.

The Cambrian sediments may be divided into two series:—

(i) *Mt. Elder Series**.—Red shales, overlain by brick-red sandstones changing into white sandstones, cross-bedded near the top. Thickness (approx.) 2,000 feet.

(ii) *Negri Series**—Shales and limestones. Thickness 850-1,000 feet.

(i) *Negri Series**—This series is well exposed on the flat South-West of Mt. Elder and the White Mountain (Kelly Creek Anticline), and in the country between the Ord River above its junction with the Forrest River and the South-Eastern edge of the basin; furthermore, along the lower course of the Negri River and South of the junction of the Ord and the Negri.

In general the sequence of strata in the Negri series is fairly constant over the entire area and a generalised section is as follows:—

Negri Series.

		feet.
7.	Limestone, unfossiliferous. often laminated ...	10
6.	Calcareous shale	70–235
5.	Limestone with *Girvanella* and *Biconulites hardmani*	10–20
4.	Calcareous shale	120
3.	Limestone, lower part cherty, unfossiliferous, upper part pure, with *Redlichia forresti* ...	55
2.	Calcareous shale	240–525
1.	Limestone, massive, cherty	40–50

The thickness of the Negri Series may vary between 850 and 1,000 feet. Whereas the thickness of the limestone beds remains rather constant, that of the shales is more variable. Thus, N.W. of Mt. Napier the lower shale horizon (2) was found to be 240 feet thick, while South of the junction of the Ord and the Negri its thickness was measured as 525 feet. Similarly, the thickness of the upper shales (6) seems to decrease South-Eastward; their thickness is about 235 feet South of White Mountain and not more than 90 feet in the section West of Mt. Napier.

The basal limestone is massive and very resistant to weathering and forms conspicuous outcrops all along the boundary of the sediments and the basalt. In places it occupies a steeply dipping almost vertical position (e.g. West of Mt. Napier); elsewhere it may rest on the basalt with a moderate dip as may be seen on the South side of the Negri near its junction with the Ord; in other places, probably all along the South-Eastern side of the Dixon Range Basin and South and South-West of the Hardman Range as well as along the Elvire River, it lies almost flat on the basalt foundation. This limestone is characterised by an abundance of chert nodules.

The next-following limestone bed shows slight variations in lithology. In general, its lower 25 to 30 feet are well-bedded and rich in chert nodules, but in places there is a more gradual transition from the shales below to the upper limestone with *Redlichia forresti*, which is underlain by 20 to 30 feet of alternating shale and limestone bands. This can be well observed in outcrops on the Forrest River, about two miles upstream from Ord River Homestead.

*Names proposed by Mahony in manuscript. See R. A. Hobson, 1936, p. 25.

The upper part of this limestone, mostly about 20 feet, though sometimes more, contains abundant remains of *Redlichia forresti* and *Biconulites hardmani*, but no other fossils. The trilobites are usually fragmentary, entire carapaces being quite rare. An interesting exposure is seen at the place where the road from Ord River Homestead to the Turner River crosses the Linacre River. A series of limestones and calcareous shales, striking N. 70° W. and dipping 3-4° N., occurs here. Trilobites are found throughout this series and at one horizon well marked ripple marks are seen. These are ridges, striking N. 15° E., about 40 cm. apart and 5 cm. high, formed entirely of shells of *Biconulites hardmani*, washed together by the action of the waves. This is a strong indication of a shallow water origin of these limestones.

The next following limestone horizon is characterised by an abundance of *Girvanella**. In most places this limestone may be characterised as a *Girvanella* biostrome. In addition to *Girvanella, Biconulites hardmani* is very common throughout. This horizon is very uniformly developed in the entire basin. Excellent and easily accessible outcrops are found in the vicinity of Ord River Homestead which is built on a platform of this limestone; furthermore, South of White Mountain and at the crossing of the main road over the Negri River near Mistake Creek Homestead.

The uppermost limestone horizon is characterised by its laminated appearance. On the Western Australian side of the boundary it is everywhere unfossiliferous, but at Mt. Panton, in the Northern Territory, the upper part of the Negri Series is more fossiliferous than in Western Australia and a study of the section here was made, because it gives a clue to the age of that part of the Negri Series in Western Australia.

Mt. Panton rises as an island hill from a wide undulating plain, which in the vicinity of Mt. Panton is underlain by shales. Some distance to the North the shales are seen to rest on limestone believed to be an extension of the limestone with *Redlichia forresti* of Western Australia. A detailed section (measured at the South-West corner of Mt. Panton) is as follows:—

Upper Part of Negri Series at Mt. Panton.

		Thickness feet.
n.	Hard, massive limestone with *Girvanella* and *Biconulites hardmani*	10
m.	Grey shale, unfossiliferous	16
l.	Flaggy limestone with rich trilobite layers (*Redlichia* cf. *nobilis* Walcott and *Xystridura* cf. *saint-smithi* Whitehouse)	12
k.	Grey shale	12
j.	Flaggy limestone with abundant *Xystridura* cf. *saint-smithi* Whitehouse	6
i.	Grey shale with *Redlichia* cf. *nobilis* and *Xystridura* cf. *saint-smithi*	19
h.	Flaggy limestone	5
g.	Grey shale	24
f.	Limestone with *Biconulites hardmani* and *Wimanella* sp.	1
e.	Grey shale	9
d.	Limestone with *Biconulites hardmani* and *Wimanella* sp.	1
c.	Grey shale with *Redlichia* sp.	20
b.	Hard, massive limestone with *Girvanella* and *Biconulites hardmani*	10
a.	Red and grey shales, unfossiliferous	135+
	Total	280+

It should perhaps be mentioned that there is a marked discrepancy between the above section and that given by Wade, which is not understood, but which may be due to some confusion of localities.

It seems likely that the lower limestone with *Girvanella* and *Biconulites* (b) corresponds to the *Girvanella* limestone of Western Australia (horizon 5 of the generalised section) and that the sequence of fossiliferous shales and limestones (c - m) is equivalent to the unfossiliferous calcareous shales (6). Somewhat puzzling is the associa-

*See R. Etheridge, jnr. (1917),

tion of *Redlichia* and *Xystridura* in these beds, two genera which in Queensland are stratigraphically well separated, *Xystridura* being restricted to the Middle Cambrian, namely the upper part of the Templeton Series. Since, however, *Redlichia* is the more widely distributed and better known genus it should carry greater weight in correlation and the entire Negri Series must, therefore, be regarded as belonging to the *Redlichia* zone. For the present the following sub-zones may be distinguished:—

Upper *Girvanella* sub-zone.

Sub-zone with *Xystridura* and *Redlichia c.f. nobilis.*

Lower *Girvanella* sub-zone.

Sub-zone with *Redlichia forresti.*

(ii) *Mt. Elder Series.*—There was little opportunity to study this series, except at Mt. Elder and White Mountain, and in the bed of the Ord West of Mt. Elder. The Mt. Elder series occupies the centre of the Mt. Elder Basin. South-Westward its outcrops extend across the Ord River between its junctions with Kelly Creek and Osmond Creek and are thus continuous with an extensive outcrop area of sandstones West of the Ord River which includes Mt. Buchanan, Glass Mountain, and the Dixon Range.

As can be seen in the vicinity of Mt. Elder and White Mountain, the transition between the Negri Series and the Mt. Elder Series is gradual and the boundary between the two is here drawn arbitrarily at the top of the uppermost limestone horizon. Near White Mountain this limestone is overlain by another series of reddish shales, about 650 feet thick, which are similar to some shales of the Negri series. Towards the top sandstone layers are intercalated in the shales and there is a fairly rapid transition to pure sandstones. This transition zone is well exposed at Mt. Elder itself. The sandstones are medium-grained and brick-red, and are strongly cross-bedded throughout. At White Mountain a thickness of about 1,300 feet of these sandstones is exposed below the Tertiary lacustrine beds. About 100 feet below the top of the Mt. Elder Series in this place, there is a change from brick-red to pinkish and then to pure white sandstone, which is very friable but also strongly cross-bedded. The fresh outcrops of this sandstone near the top of the hill are visible from afar and have suggested the name White Mountain.

In the vicinity of Trig. Station J40 and to the South-East of it this entire shale-sandstones series is dipping 40° N.E., but to the N.W. and W. the beds flatten out around the plunging axis of the Kelly Creek anticline and good outcrops of massive, cross-bedded red sandstones, with a flat North-Westerly dip, are seen in the bed of the Ord and West of the river in the vicinity of and downstream from a stockyard, situated about three miles West of Mt. Elder.

The maximum thickness of the Mt. Elder series in this general area is in the vicinity of 2,000 feet. Since, however, as stated in the section dealing with the Tertiary lacustrine beds, the tilted Cambrian beds are truncated by an erosion surface, the true thickness of the Mt. Elder Series is almost certainly greater.

Wade (1924, p. 29) has examined part of the sandstone area West of the Ord. Glass Hill and Mt. Buchanan are described as large isolated masses of massive sandstones showing very pronounced current bedding. These rocks seem to be very similar to the upper sandstones at White Mountain and Wade compared them to the "Upper Carboniferous" sandstones of the West Kimberleys (now regarded as of Permian age), but the extremely gradual transition from the Negri Series to the Mt. Elder Series suggests that this entire sequence was laid down without any break during one and the same cycle of sedimentation. Sedimentation of the Mt. Elder Series, therefore, began in the Middle Cambrian. In the absence of fossil evidence it is as yet impossible to say, when sedimentation ceased—probably this happened either at the end of the Middle Cambrian or some time during the Upper Cambrian.

(b) *Rosewood Basin.*—Only the North-Eastern end of this basin has been examined, but its extent can be fairly accurately plotted from available aerial photographs. Sections studied on the ground were along the main road from Argyle to Ord River Station, which traverses the basin between the "limestone wall" and Sugar Spring. Other localities visited were Boundary Hill and the "limestone wall" along the track leading to Rosewood Homestead, and elsewhere on Rosewood Station.

The lowest member of the sedimentary series of the Rosewood Basin is a massive cherty limestone which is well exposed on the North-West side of the basin in the bed of Behn Creek, where it strikes N. 22° E. and dips 25° S.E. North of the creek, approximately at the turn-off of the Rosewood track the limestone assumes an almost vertical position, forming a "limestone wall," about 40 to 50 feet high, and rising quite abruptly from the plain. Near its South-Western termination this wall is built of limestones dipping 20° to 25° S.E., but farther along the dip steepens and in places the limestone is even slightly overturned.

The maximum thickness of this limestone may be up to about 50 feet and in thickness and lithology it resembles closely the basal limestone member of the Hardman Basin with which it must no doubt be correlated.

East and North-East of Rosewood Homestead the limestone flattens out and it seems that the end of the Rosewood Basin is reached here.

The same limestone bed comes to the surface on the opposite (South-Eastern) side of the basin, in the vicinity of Sugar Spring, where it is 30 to 40 feet thick, strikes approximately N.-S., and dips 20° W. The road follows the outcrop for a distance of six miles. Because of the low dip the limestone does not form such a striking feature as the "wall" on the other side of the basin, though the outcrops are conspicuous enough.

The centre of the basin between the two limestone belts seems to be occupied by shales lying in almost horizontal position. A good section can be seen near Boundary Hill on the West side of Behn Creek, about two miles South of the "limestone wall." Here recent soil erosion has uncovered a large area of sandy red shales. The flat top of the hill itself is formed by a five feet layer of thin-bedded cherty limestone and intraformational conglomerate. It seems that this horizon must correspond to the cherty limestone associated with the *Redlichia forresti* zone in the Hardman Basin. Unfortunately it is impossible to give a figure for the thickness of the shale series.

It should be noted that the shale is in most places overlain by alluvial deposits, up to 20 feet thick, of densely packed basalt pebbles and boulders. The presence of an abundance of basalt boulders everywhere on the surface has led geologists to map the centre of the Rosewood Basin previously as basalt.

From the study of aerial photographs it appears that the basin widens and probably also deepens towards the South-West and that the greatest thickness of sediments may be found in an area South of the Junction of the Bow and Ord Rivers.

(c) *Argyle Basin.*—The Argyle Basin is the smallest of the Cambrian basins in Western Australia, being faulted down along its North-Western side against Pre-Cambrian and other, possibly Permian, rocks. A fairly extensive reconnaissance was made of the central and Northern parts of the basin, but the South-Western part, towards Cooee Creek, was not visited. The sediments of the basin belong to the Negri and Mt. Elder series, but the development of the Negri series is somewhat different from that in the other basins, and the Mt. Elder series is only incompletely represented.

Along the Eastern and South-Eastern edge of the basin the sediments rest on basalt with dips generally below 5°. The main feature of this contact is that there is no basal limestone as in the Rosewood and Hardman Basins. The basalt is overlain by a thick series of mostly reddish shales which are well exposed in the Behn River for a distance of two miles below the basalt contact. Near the contact the shales dip 5° N.W. and this dip persists for some distance downstream, increasing to 12° at the contact with the first limestone horizon exposed in the bed of the river and on the banks, half a mile South of the 4-mile mud tank. On the basis of the assumption of a uniform dip of 5° this shale series should be about 1,600 feet thick. Since the entire section has not been seen it is possible that a flattening out takes place somewhere, but even then a minimum thickness of not less than 1,000 feet might be expected.

PLATE XI

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL MAP OF PORTION OF THE KIMBERLEY DIVISION

Between Lats 15°30'S. & 18°S. and Longs 128°15'E. & 129°E.

BY

R.S. Matheson, B.Sc., Geological Survey of Western Australia
and C. Teichert, Ph.D., D.Sc., University of Western Australia

Scale 4 miles to an inch

4 0 4 8 12

SHEET 2.

Survey base from Lands Dept. 300 chain lithos.
Geology from reconnaissance survey and interpretation of aerial photographs by R.S. Matheson and C. Teichert. June to August 1945.

TERRITORY OF NORTHERN Australia

Eastern Boundary

Western Boundary

129° E. Long.

128°30'

17°0'

17°30'

18°0'

ROSEWOOD BASIN

LOWER CAMBRIAN
Negri Series
(Limestones and shales)

LISSADELL

Basalt Country

SPRINGS CREEK

MAIN ROAD

Wild Dog Sp

BS.2

BS.3

MT PITT

MT NYULASY

WILSON RIV.

TRACK

BOW RIVER

Basalt (specimen)

HJ32 (1086')

HJ33

HJ34

Springs

ORD RIVER

HJ24 (865')

HJ25

HJ26 (1428')

HJ29

HJ30

HJ31

HJ28

HJ29

J41 (885')

Dips steepen

MT BEHN

J42 (1391')

HJ23 (1241')

MT CLOSE

Basalt with limestone outliers

Basal cherty limestone along boundary

Cherty + redlichia limestone

Girvanella limestone

Mistake Creek Homestead

NEGRI

Basalt and agglomerate

Sandstone

Top limestone

TEXAS DOWNS

FROG HOLLOW

MT JOHN

RANGE

MT PARKER

TICKALARA

DUNGLE BUNGLE

OSMOND

Osmond Boundary after Wade

Red Rock Ck.

LOWER CAMBRIAN
Negri Series
(Limestones and shales)

GLASS HILL
Sandstone
(Hardman & Wade)

MT BUCHANAN
Sandstone
(Hardman & Wade)

BASIN

Sandstones

MT ELDER

TERTIARY
Lacustrine sediments

Kelly Ck

Okes' Durack Bore

Sandstone

Shady Camp

Bioconulites and brachiopod limestone

Mistake Ck - Inverway Rd

Trilobite limestone

Girvanella limestone

Limestone plateau and scarps

Top laminated limestone (Flat dip)

Bioconulites limestone with malachite

MT PANTON (1098')

Upper part of Negri Series (Flat dip)
Fossiliferous (redlichia etc.)

MIDDLE AND (?) UPPER CAMBRIAN
Mt Elder Series
(Red and white sandstones and red shales)

Ord River Homestead (700')

TRACK

Base of top cherty limestone

Base of cherty plus redlichia limestone

Lee Ck.

Forrest R.

LOWER CAMBRIAN
Negri Series
(Limestones and shales)

Shales

Limestone Country
(Reported Border Survey)

Top laminated limestone

Biconulites limestone with malachite

Girvanella + biconulites limestone

Cherty + redlichia limestone

Basal cherty limestone

Agglomerate and basalt

MT NAPIER (1570')

Basalt Country

Possibly with limestone outliers

(1597')
J39

Sandstone Hills

DOUGHBOY HILL

HARDMAN RANGE

TURNER RANGE

MT RANFORD

DIXON

(1295')
J37

Trilobite remains and biconulites

Brook Ck.

Linacre Ck.

Red Top Cherty

Agglomerate and basalt

To Nicholson Stn.

NICHOLSON RIV.

Bottom Mountain Ck.

PANTON RIVER

Palm Pool

LOWER CAMBRIAN
Negri Series
(Limestones and shales)

J34 (1654')

Fault breccia

Turner River Homestead

Agglomerate and amygdaloidal basalt

J36 (1326')

Red sandstone & conglomerate

Fault zone

Bottom shales

Basalt Country

ELVIRE R.

MT FORSTER

Negri Series
Basal cherty limestone

J33

Agglomerate and amygdaloidal basalt

J32 (1598')

Basalt with limestone outliers

TREE HILL

Basalt Country

NICHOLSON

Higher up follows a succession of limestone and shales which bears some resemblance to the typical Negri Series farther South. There are three clearly defined limestone beds which form good outcrops over the entire basin and which, once recognised on the ground, can be mapped easily from aerial photographs.

The lowest of these limestone horizons is a flaggy limestone about 25 feet thick with occasional chert nodules and chert bands. No fossils were found in it. The second horizon is the only fossiliferous one in the district. Its thickness is hardly more than 10 feet, but it is crowded with nodules of *Girvanella* and with shells of *Biconulites hardmani*. In many places where the limestone is exposed on the surface the *Girvanella* nodules have been leached out, leaving spherical cavities which give the rock a peculiarly pitted appearance. Towards the North the limestone flattens and more or less horizontal outcrops are seen along the main road to Ivanhoe, about six miles North of Argyle. From there the outcrops turn back in a South-Westerly direction along the North-Western edge of the basin, and steeply dipping (70°) outcrops can be seen East of Mt. Misery, and in the bed of Stockade Creek. In the bed of the Behn River and in the general region of the junction of the Behn River and Stockade Creek its continuity is interrupted by faulting, but good and continuous outcrops are again found further South just West of the road leading from Argyle Homestead to the airstrip. Here the limestone contains some very fragmentary trilobite remains among which a small species of *Redlichia* could be recognised. Also, in this vicinity the *Girvanella* limestone is associated with a thin layer of "edgewise conglomerate" which gives evidence of the shallow water conditions under which these rocks were formed.

The third and highest limestone layer is a thin bed of cherty limestone which, owing to its small thickness (probably generally not more than one or two feet) does not form a continuous belt of outcrops, but is nevertheless recognisable in many places.

The three limestone horizons are separated by grey shales which are generally poorly exposed. Mainly owing to the scarcity of outcrops in the shales the thickness of the entire series is very hard to estimate. On the North-West side of the basin the thickness of the series from the base of the lowest to the top of the highest limestone bed is probably not more than 360 feet. This same series is almost certainly thicker along the South-East side of the basin where it may be as much as 1,000 feet thick.

A doubtful point is the distribution of the basal shales above the basalt, so well exposed in the Behn River. There is no evidence of the presence of these shales on the North-West side of the basin. In the country West of the road to the airstrip there is a belt, up to half a mile wide, between the lowest limestone horizon and the North-Western boundary fault of the basin, which is covered with angular basalt boulders, and which, since such boulders are entirely absent from the limestone belt as well as from the country beyond the fault, may indicate that basalt is present here at a low depth. This being so it is necessary to assume that the basal shale series lenses out in this direction.

Based on lithological grounds and on the presence of *Redlichia* in the *Girvanella* limestone, it is suggested to regard the entire series between the top of the basalt and the top of the uppermost limestone layers, for the present, as the equivalent of the Negri Series of Lower Cambrian age.

The entire centre of the basin is taken up by red sandstones which are well exposed in places in the beds of the Behn River and Stockade Creek. The sandstones are medium-grained, interbedded with shales, and in places ripple-marks occur on the bedding planes. In one outcrop in the Behn River near the boundary fault obscure worm tracks were seen on the bedding planes.

Outside the river beds the presence of the sandstone series is indicated by blocks of red sandstone lying about on the surface. The blocks and boulders are in many places the result of *in situ* weathering, and, where the beds are tilted, the original bedding shows up well on vertical aerial photographs. Between the highest limestone horizon of the Negri Series and the lowest sandstone beds, there is probably a shale series as may be concluded from the absence of outcrops, so that the transition from the Negri Series to the upper beds is here just as gradual as in the Mt. Elder Basin. In spite of lithological differences, in particular the absence of cross-bedding, it may be concluded that the shales and sandstones in the centre of the Argyle Basin represent the Mt. Elder Series.

No estimates of the thickness can be given, except that in the Behn River section the thickness probably does not exceed a few hundred feet.

Devonian.

Devonian rocks occur in the East Kimberleys in the Burt Range Basin, and in a narrow down-faulted area, which can be conveniently referred to as the Ivanhoe Graben. Since the sequences show slight differences, the succession of rocks in these two structural units are described separately in the following pages.

(a) *Burt Range Basin.*—The general stratigraphy of this basin has already been described. That part of it which lies in Western Australian territory is almost wholly made up of Devonian rocks.

(i) *Cockatoo Series.*

Wade (1924, p. 33) first called attention to the occurrence of knobs and patches of much-weathered, soft, cross-bedded sandstone with pebble beds along the road about five and a half miles North of Cockatoo Spring. This sandstone disintegrates very easily and weathers into a soft, loose sand, locally known as the "Cockatoo sands." Wade found some similarities between this sandstone and that farther South near Glass Hill and Mt. Buchanan in the Dixon Range Basin.

Similar sandstones to those observed along the track North of Cockatoo Spring, cover a considerable area between Mt. Hensman in the South, and Martin's Gap and the Pincombe Range in the North. What appeared to be the lowest beds of this series were seen in the upper part of Eight-Mile Creek where this water course cuts its way through N.W.-S.E. striking ridges of steeply dipping sandstones and conglomerates. This locality is about three and a half miles N.W. of Cockatoo Spring. On the North side of the creek the edge of the sediments is reached about one mile upstream from the main road. From here on the creek runs along a fault, and on the South side of the creek the sediments seem to continue Westward for approximately four miles.

North of the fault the sediments strike N.W.-S.E. and dip 20° to 25° N.E. Coarse-grained, cross-bedded sandstones predominate, with frequent intercalations of conglomeratic layers These conglomerates and sandstones form a conspicuous ridge, clearly visible on aerial photographs, extending in a straight line for over six miles in a North-Westerly direction A second ridge, parallel to the first is situated somewhat farther North and North-East. It is somewhat more eroded, but consists of essentially the same type of rocks: coarse-grained sandstones and conglomerates, but in some places along the road layers of breccia-like sediments occur, with very angular quartzite fragments, and intraformational conglomerates. Towards the N.E. the dips flatten somewhat to about 15°.

This entire series of coarse-grained rocks is very thick and can hardly measure less than 4,000 feet in this particular section, unless there is some strike faulting which has escaped attention. The relations at the bottom of this series are not clear. Basalt resting on pre-Cambrian quartzites occurs immediately to the West of the sandstones. The basalt is agglomeratic and not more than about 80 feet thick. Although no exposures of the actual contact between the basalt and the sandstone were seen, field observations seemed to suggest a normal stratigraphical overlap. Study of aerial photographs, however, suggests that the contact might be a faulted one, so that a clear decision cannot be given, before additional field observations have been made.

Good outcrops of the lower, coarse-grained part of the Cockatoo sandstones were also seen in the Carlton Range which bears Trig. Station HJ13. This is a perfectly straight, sharp-crested ridge, about 200 feet high and one and a half miles long, running N. and S. Its Eastern slope consists of coarse-grained, cross-bedded Cockatoo sandstone, its Western slope of basaltic rocks. Both

rocks are separated by a fault. The sandstone along the fault are hardened by deposition of secondary siliceous matter forming a zone, 20 to 30 feet wide which is more resistant to weathering, thus forming the sharp crest of the ridge. A Northern continuation of this fault is found in Kelly's Knob. From this vicinity a series of low hills of Cockatoo sandstones trends in a general Northerly direction, for 8 to 10 miles, but this belt has not been visited.

At Church Steeple Hill, about one and a half miles West of Martin's Bluff, a thickness of about 300 feet of sediments are exposed, consisting chiefly of medium-grained, dark-red sandstones, with cross-bedding in only a few layers A well marked conglomerate layer, 15 feet thick, occurs here, which consists of densely packed pebbles and boulders with hardly any matrix. Many boulders measure up to 1 foot in diameter, but occasional boulders up to two and a half feet were seen. Most of the boulders are quartzite, but about 5 per cent, of them are basalt.

Martin's Bluff consists of quartzitic sandstone, probably silicified in the usual way along two intersecting faults. East of Martin's Bluff a low sandstone ridge extends for three miles, gradually decreasing in height. This sandstone is again much coarser, slightly conglomeratic and strongly cross-bedded. The Cockatoo sandstone abuts on an E.-W. fault by which it is separated from the Pre-Cambrian rocks of the Pincombe Range farther North.

Higher up in the sequence the sandstone becomes more fine-grained, and there are increasingly numerous intercalations of shale. Outcrops, therefore, become poorer and it is not yet possible to give a very detailed description of this part of the succession. Probably the best picture of these sandstones can be gained at Mt. Cecil which forms a peculiar dome structure in the Western part of the basin where the strata generally flatten out. Mt. Cecil is composed of medium-grained sandstones with occasional pebble bands, sometimes cross-bedded. These sandstones are thrown into a dome-shaped structure so that the slopes of Mt. Cecil on all sides are dip slopes. This structural feature alone would probably not have been sufficient to protect the sandstones from erosion, but it seems that the entire hill is traversed by a number of minor faults along which silification has taken place. These more or less parallel hardened belts provided a stiffening for the whole structure which was thus preserved as a topographic feature.

Near the South-West corner of Mt. Cecil remains of *Leptophlocum* (''*Lepidodendron*'') *australe* were found in some of these hardened silicified sandstones.

It appears likely that before Eight-Mile Creek is reached these sandstones grade into shales, because the bed of Eight-Mile Creek follows, in a somewhat meandering way, the general strike of the sediments in a broad semicircular sweep, and is probably carved out of the shales between the sandstones in the West and the lowest limestone horizons which are found a few hundred yards East of the bed of the creek.

The question of the upper boundary of the Cockatoo sandstone series and the transition to the fossiliferous limestone series above will require some further field investigations.

Leptophloeum australe occurs in Eastern Australia in rocks of Middle and Upper Devonian age. Considering the fact that the overlying fossiliferous limestone series is of late Upper Devonian age, it is reasonable to suppose that the Cockatoo series is either wholly or at least partly Upper Devonian.

(ii) *Burt Range Series.*

This series will have to be studied in greater detail. It consists of generally rather fossiliferous beds among which limestones are conspicuous, but which include a considerable thickness of calcareous shales and fine-grained calcareous sandstones, and which grade upwards into pure sandstones. Its lower boundary may be drawn at the base of the lowest limestone bed which outcrops about a quarter to half a mile East of Eight-Mile Creek and whose Northern continuation was found two miles South-East of the Eastern end of Martin's Gap. This lowest limestone seems to be unfossiliferous and fossils are also absent or scarce in the next two or three limestone horizons, only occasional crinoid stems and indeterminable brachiopod remains having been found.

About 600 to 800 feet above the base of the series fossils begin to appear in greater numbers and the remainder of the series contains many highly fossiliferous beds. The fossils both in the limestones and in the calcareous shales are almost all brachiopods, with some types of gastropods very subordinate in numbers. The number of species seems to be limited but successive horizons are usually well distinguished by different associations of fossils.

Owing to their relative inaccessibility these beds were only studied superficially. A complete traverse was made in one place only, viz., in the flat country between Eight-Mile Creek and the Burt Range, about two miles N.W of the Northern end of the Cockatoo fault. In this section the first unfossiliferous limestone horizon is found 0·2 miles, and the first richly fossiliferous limestone one mile, N.E. of Eight-Mile Creek. The lowest fossiliferous bed contains *Camarotoechia, Straparollus,* and ostracodes. This is followed by several additional very fossiliferous horizons which are rich in specimens of *Strophonella* and *Productella. Syringopora* is common in one bed. These outcrops extend as far as one and a quarter miles N.E. of the creek. Dips are mostly between 15° and 25° N.E., so that the thickness of this part of the series may be estimated at over 2,200 feet. Farther to the N.E. there were no outcrops until the foot of the Burt Range was reached, but in the vicinity of the first major tributary to Eight-Mile Creek, two and a half miles N.W. of the North end of the Cockatoo fault, there is a belt of fossiliferous shales about half a mile wide, and limestones outcropping in front of the range. The lower limestones in this series are rich in *Athyris.* Higher up, not far from the foot of the range there is an important horizon of calcareous sandstone with a large flanged species of *Productella,* associated with *Fenestella, Strophonella,* and *Parastrophia* (?).

Above this bed a very large species of *Productella* becomes very common and is usually associated with numbers of *Chonetes.* Other associated genera are *Camarotoechia* cf. *pleurodon,* a small species of *Camaratoechia, Spirifer, Meristella,* and *Athyris.* Good outcrops of this very fossiliferous series are found all along the deep valley one and a half miles S.S.E. of HJ15. Near the top of this gorge the facies becomes more sandy by intercalations of quartzose and calcareous sandstones which are mostly unfossiliferous. Fossiliferous limestone beds are, however, found as high as 200 feet above the bottom of the valley, near the head of the gorge, but are less fossiliferous containing only a few species, mostly of *Camarotocchia* and *Chonetes.* The upper boundary of this series is best drawn at the top of the uppermost limestone horizon.

The total thickness of beds exposed along this tributary of Eight-Mile Creek is in the vicinity of 1,300 feet and, since there is a gap between this section and the lower part of the section described above, the total thickness of the fossiliferous limestone series may be estimated at about 4,000 feet.

The lower part of the series was also traversed about 12 miles farther North along a line from two to four miles S.E. of the East end of Martin's Gap. The lowest limestone horizons here are either unfossiliferous or contain only a few indeterminable shell and crinoid fragments. Higher up follow limestones with *Productella, Camarotoechia* cf. *pleurodon, Meristella,* and *Strophonella.* The highest limestone horizons reached along this traverse, about four miles S.E. of Martin's Gap, contained corals (*Michelinia* sp. and *Syringopora* sp.) and a rich ostracode fauna of *Primitia, Haploprimitia, Bythocypris,* and *Macrocypris. Camarotoechia* cf. *pleurodon* and *Productella* persists and *Straparollus* is common.

The correlation of this entire fossiliferous limestone series rests on analogies with the Upper Devonian of the West Kimberley, particularly as developed in the upper Fitzroy and Margaret River regions. The fossil assemblages of the lower limestone horizons is quite typical of the *Productella* limestone of the West Kimberley, although possibly less fossiliferous. This is particularly true of the association of *Camarotoechia* cf. *pleurodon* with a certain undescribed species of *Productella.* The

Productella limestone of the West Kimberley has been correlated with Upper Devonian Stage IV (Teichert, 1943, p. 90) and this would also be the age of the lower part of the fossiliferous limestone series of the Burt Range. The remainder of the series is therefore of very young Devonian age, corresponding to Stages V and VI. This conclusion is also supported by the appearance of large productids in this part of the section, heralding the approach of the Carboniferous faunas.

As noted above sandstone layers are intercalated between the fossiliferous limestones so that there is a gradual transition to the sandstone series which forms the top of the Devonian sequence in the Burt Range. These higher sandstones crop out along the higher part of the Western ridge of the Burt Range (that on which Trig. Station HJ15 is situated) and they form the Eastern slope of this ridge. They are usually fine-grained, well-bedded, rarely cross-bedded and ripple-marked, and many horizons are characterized by vertical burrows which may be 1-2 inches in diameter and 10-15 inches long. The entire series which may be about 1,000 feet thick is remarkably uniform. It is obviously a shallow-water deposit which represents the closing stage of the Devonian cycle of sedimentation.

(b) *Ivanhoe Graben.*—A fine series of sedimentary rocks is exposed in the bed and along the banks of the Ord River beginning about one and a half miles North of Ivanhoe Homestead and extending downstream to the vicinity of the main Western bend of the river. The lowest series is a succession of thick-bedded, massive, cross-bedded sandstones, striking N.W.-S.E. and dipping 20° N.E. The rock is medium-grained containing occasional pebbles and pebble bands, but otherwise very uniform in character. It resembles strongly some parts of the Cockatoo sandstone, where the latter is not so conglomeratic. The exposed thickness in the river bed is about 900 feet.

Downstream the river follows a belt with no outcrops, less than half a mile wide when measured across the strike of the rocks, and at Button's Crossing an area of calcareous shales and limestones is entered which extends downstream for almost two miles, the river partly following the strike of the rocks. The best outcrops are on the East bank. The strike of this series is parallel to that of the sandstone series farther upstream (N.W.-S.E.), but the dip has increased to 25° to 26° N.E. The total exposed thickness of limestones and shales in this series is about 1,000 feet.

The series begins with flaggy, somewhat sandy limestones interbedded with calcareous shales. In some limestones beds there are traces of cross-bedding and thin grit bands. The only fossils are ostracodes which occur rarely in the shales as well as in the limestones.

The series becomes more fossiliferous about three-quarters of a mile downstream from Button's Crossing, where the limestones, still interbedded with shales, are very rich in ostracodes. Higher up shales disappear and the limestones become more massive and macro-fossils being to appear. At first layers with stromatoporoids (of the *Actinostroma* type) are found interbedded with layers with poorly preserved gastropods, probably mostly *Straparollus*. The facies now becomes more shelly and, still higher up, coralliferous and the top of the limestone series is characterised by an alternation of richly fossiliferous coral, brachiopod, and gastropod limestones.

Above the stromatoporoid limestone follows a layer crowded with *Spirifer* cf. *disjunctus* followed by a layer rich in *Bellerophon*. At this stage *Syringopora* begins to appear in great numbers in certain horizons and a recurrent stromatoporoid facies was noticed. Also, other brachiopods such as *Productella, Meristella, Rhipidomella* and *Athyris* make their appearance. Of cephalopods *Conostichoceras hardmani* and a poorly preserved *Spyroceras*-like type were noticed. In the highest horizons *Syringopora* is associated with several species of rugose corals and a specimen of *Leptophloeum australe* (McCoy) was also found at this level.

Ostracodes occur throughout the series, although they are most plentiful in the middle part. The fauna consists mostly of rather featureless Leperditellidae and Primitiidae such as *Aparchites, Primitia, Haploprimitia Euprimitia* and possibly two or three undescribed genera. In view of our almost complete lack of knowledge of Devonian ostracode faunas of Australia this microfauna is at present of little use for correlation.

The association of *Spirifer* cf. *disjunctus, Productella,* and *Conostichoceras hardmani* is quite typical of the Productella limestone of the upper Fitzroy and Margaret River area of the West Kimberleys (Teichert 1943, pp. 89-90). These limestones must therefore be referred to the middle part of the Upper Devonian. A noticeable difference from the West Kimberleys is the appearance of a coral fauna in the East Kimberleys.

There are additional outcrops of sediments farther downstream. On the west bank of the river a small area of crossbedded brown sandstone occurs, which strikes N. 65° W. and dips 35° N.E. These sandstones show a lithological resemblance to the sandstones farther up stream below the limestone series, which are exposed over a thickness of not more than 200 to 300 feet. There are no outcrops for the next mile down the river until a small occurrence of limestone with Syringopora, rugose corals, and ostracodes is met with on the East bank. From here it is about one-third of a mile to outcrops of jointed sandstone in the river bed.

The sedimentary area described above is bounded on both sides by Pre-Cambrian quartzites from which it is separated by N.N.E.-S.S.W. trending faults. This graben is probably traversed by several cross faults, but at least the sequence from the base of the lower sandstones, about one mile South of Button's Crossing to the top of the limestone series two miles North of the crossing must be continuous, representing a thickness of about 2,650 feet, and corresponding to the upper part of the Cockatoo Series and to the lower part of the fossiliferous limestones of the Burt Range Series.

Carboniferous.

Carboniferous limestone occurs in the central Burt Range and probably also at Mount Septimus. Its contact with the underlying Upper Devonian sandstones was not observed but from the general attitude of the beds it was concluded that the two series are more or less conformable. There is only a very narrow belt of the limestone exposed on the Western Australian side of the boundary. This was visited in one place only, namely about two and a quarter to two and a half miles due East of Trig. Station HJ 15. When the Westernmost ridge of the Burt Range with its Upper Devonian limestones and sandstones is crossed one descends into a valley occupied by a watercourse which probably empties into Milligan's Lagoon. On the East side of this valley there are excellent outcrops of fossiliferous limestone to a height of 235 feet above the valley. These beds strike N. 25° W. and dip 15° to 18° N.E. Their thickness is 350 feet.

Most of the limestone is a very hard, crystalline rock which is extremely fossiliferous. Unfortunately, our collections are very fragmentary, because this locality was a long way from our base and no suitable tools were available to break the fossils out of the hard rock. The following list may give an idea of the most predominant fossil types:—

Rugose corals, several species.
Bryozoa, several species.
Rhipidomella australis (McCoy).
Orthothetes nov. spec.
Productus sp.
Spirifer nov. sp.
Spirifer sp.
Athyris sp.
Camarotoechia cf. *pleurodon* (Phill.).
Dielasma nov. sp.
Platyceras nov. spec.

The most common fossils are *Dielasma* and *Camarotoechia*. The assemblage, although in a general way resembling that of the Upper Devonian limestones, is yet distinctly different. However, the interval of time between the deposition of the two is probably not very great.

In view of the poor state of our knowledge of the Carboniferous faunas of Eastern Australia the evidence of the age of these limestones rests on indirect evidence. The presence of *Rhipidomella, Orthothetes, Athyris,* and *Camarotoechia* cf. *pleurodon* indicates that the fauna is definitely older than Permian. On the other hand, as

has been shown above, the top part of the Devonian limestones is very young Devonian, and is moreover separated from the limestone under discussion by an unfossiliferous sandstone series. The Carboniferous age of the limestone described above can therefore not be questioned. It is, however, at present impossible to say for certain what part of the Carboniferous it represents.

Above the limestone follow about 150 to 200 feet of soft rocks in which, however, there were no outcrops. The slope above the limestone outcrops was completely covered with talus, mostly pebbles from the overlying conglomerate, so that it is impossible to say whether this part of the section belongs to the Carboniferous or to a younger period.

Permian (?)

Beds in the Burt Range.

The Carboniferous series in the central Burt Range is overlain, probably with a very slight angular unconformity, by 30 feet of conglomerate with well rounded quartzite pebbles, followed by 50 feet of coarse quartzose sandstone. From aerial photographs it is evident that these beds form the base of another, higher series of sediments in the unexamined interior of the Burt Range.

Near the Southern end of the Burt Range occurs a thick unstratified conglomerate of which only a small area is exposed in Western Australia just West of the Northern Territory boundary and West of the 25 and 26 mile pegs. Towards the West and North-West this conglomerate is separated by a major fault from the Devono-Carboniferous section of the central Burt Range. Towards the South-West it is cut off by another fault from an area of rhyolitic porphyry of Pre-Cambrian age. The base of the conglomerate was not seen, but its maximum exposed thickness was estimated to be between 400 and 500 feet. The conglomerate is strongly reminiscent of a moraine deposit. It is almost unstratified, except for occasional intercalated sandy lenses which may give the rock an appearance of being stratified in places. Furthermore, the deposit is quite unsorted, with large blocks, a foot and more in diameter, and small pebbles mixed up together. The boulders also show an uneven degree of wearing. However, a quick search failed to disclose the presence of any facetted or scratched boulders. Judging from aerial photographs this conglomerate is overlain by sandstone, but the outcrops were not visited.

These rock series continue North-Eastward into the Northern Territory, where they cover a considerable area and it is only here that their stratigraphy could be satisfactorily worked out. On the Western Australian side of the boundary outcrops of equivalent rocks probably occur in many places, but they are mostly in scattered and disconnected fault blocks which are described briefly below.

Mt. Brooking Series.

Mt. Brooking consists of light grey, purplish weathering shales which are overlain by purple sandstone with many spheroidal cavities. In spite of intense search in good exposures in a creek bed on the Western slope of Mt. Brooking no fossils were found in the shale. Aerial photographs show that this shale series continues far into the Northern Territory towards the North-East, where it possibly links up with the conglomerate of the Burt Range. Towards the South the Mt. Brooking Series is cut off by a fault which runs approximately N.E.-S.W., and separates it from the Argyle Basin of Cambrian basalts and sediments in the South.

Other Permian (?) Rocks.

About one mile North of Cockatoo Spring, just East of the Cockatoo fault, are some conspicuous hills which consist of a conglomerate which is similar to the one described above from the Southern end of the Burt Range. From the distance, particularly when viewed from the North-East or East side it may be seen that the conglomerate dips to the South-West. Its thickness probably exceeds 500 feet and may be nearer 1,000 feet. It is bounded by faults on all sides and the area occupied by it is small.

As mentioned in a previous section the Argyle Basin is bounded by a fault along its entire North-West side. The rocks on the other side of the fault are mainly Pre-Cambrian quartzites, but in between there is a narrow zone of disconnected outcrops of shales, sandstones, and conglomerates, obviously small fault blocks which form part of a major fault zone in the Southern continuation of the Cockatoo fault which cuts off part of the Southern end of the Burt Range Basin. One of these occurrences is a sharp-crested slightly curved, but generally N.-S. trending ridge East of Mt. Misery, consisting of brown, medium-grained sandstone, dipping 55° E. and E.N.E. In a depression on the West side of this ridge the ground is strewn with large boulders of irregular size, and although no outcrops are visible it is probable that the sandstone is underlain by a conglomerate which seems to be similar to that of the Southern Burt Range. These rocks are therefore tentatively referred to the Permian.

Rocks which outcrop similarly, and which are probably part of the same series can be seen five miles farther to the North-East. This resemblance also shows up clearly on the aerial photographs.

About six miles farther along the fault zone in the opposite direction, towards the South-West, the famous "Zebra" rock occurs in a similar fault block wedged in between the Pre-Cambrian on the West and the Cambrian on the East. The "Zebra" rock forms part of a series of mostly brown to purple shales and sandstones which are steeply dipping to vertical in position (E. deC. Clarke in Hobson 1936). At the Northern end of the occurrence there are vertical thick-bedded brown sandstones quite similar to those in the sharp-crested hill east of Mt. Misery. The shales resemble those of the Mt. Brooking Series which, however, are generally lighter in colour.

A similar occurrence of steeply dipping brown rocks was seen from the distance several miles farther to the South-West.

On the Western side of the Ord River, approximately 12 miles due West of the occurrence of the "Zebra" rock, occurs the Conglomerate or Ragged Range, which has been described by Blatchford (1928). From the description, the range appears to be lithologically similar to the conglomerate hills near Cockatoo Spring, and it is probably also a downfaulted block of Permian (?) age.

Tertiary.

Lacustrine sediments of probable Pliocene age occur in a low range, of which some hills known as White Mountain form part. Trigonometrical Station J40 is situated on this range*. The thickest section of these rocks is found in the low ridge South-East of J40 where the lacustrine beds overlie the Cambrian sandstones with a distinct angular disconformity. The sediments may be known as the *White Mountain Series.*

At the foot of the South-West slope of this ridge dark purple sandstones are exposed striking N.W. and dipping 40° N.E. These are overlain by a series of chert, siltstones, and marl striking N. 50° W. and dipping 25° N.E. Details of this section are as follows (from above):—

Chert with *Planorbis hardmani* ..	5 ft.
Siltstone	10 „
Chert, unfossiliferous	30 „
Siltstone	55 „
Marl	215 „
Siltstone with basal chert layers ..	55 „
Total	370 ft.

The top chert layer outcrops on the North-Eastern slope of the ridge and is highly fossiliferous. The more important fossils have already been described by Chapman (1937) who found in it *Planorbis hardmani, Planorbis* cf. *essingtonensis, Bullinus* sp. as well as algae, foraminifera, sponges, ostracodes and insect fragments.

A somewhat smaller area of these rocks occurs in the vicinity of J40, where they were first discovered by Hardman and later revisited by Wade. The thickness of the lacustrine beds here is, however, considerably less. The hill bearing the Trig. Station rises to a height of about 340 feet above the plain, but it consists mostly of Cambrian sandstones, striking N. 50° W. and dipping 40° N.E. Near the top of this series strongly cross-bedded white sandstones occur, which are overlain with

*Wade (1924) and Chapman (1937) refer to this range as "Mt. Elder Range." However, Mt. Elder is a residual hill on the South-East side of the range to which White Mountain belongs and it seems, therefore, preferable to refer to this range as "White Mountain Range."

an angular disconformity by almost horizontal sediments of the lacustrine series. The complete section of the sediments in this locality is as follows (from above):—

Chert with *Planorbis hardmani* ..	10 ft.
Siltstone	35 „
Glauconitic and quartzose sandstones with siliceous bands and nodules, pisolitic chert, etc., poorly exposed	50 „
Total	95 ft.

The fauna of the *Planorbis* chert is identical with that described on page 74.

The great variation in thickness and lithology of the beds below the *Planorbis* chert indicates that these sediments were deposited on a deeply eroded surface of tilted Cambrian sandstones. After the deposition of the sediments further earth movements took place and the lacustrine series itself was slightly folded. It thus appears that these lake sediments were formed during a quiet period, probably of short duration, between two orogenetic phases. Later considerable erosion took place and the sediments are now perched above the surrounding plain, about 600 feet above the bed of the Ord River.

As may be expected from lacustrine deposits in such an isolated geographical position, the fossils of the *Planorbis* chert do not furnish any conclusive evidence as to the age of the series. McCoy suggested an Upper Tertiary age (see Hardman 1885, p. 7). Chapman (1937) compared the *Planorbis* chert to the "*Helix* sandstone" of Bass Strait and the "*Helix* limestone" of the Cloncurry district of Queensland. However, the former, better known as Helicidæ Sandstone, is an æolian deposit of Pleistocene age* and is therefore not directly comparable to the White Mountain series of the East Kimberleys. The Helicidæ Limestone of Northern Queensland in the basin of the Gregory River is, according to Whitehouse† a spring deposit of most probably late Pliocene age and is thus likewise different in origin.

In the absence of reliable fossil evidence for the correlation of the White Mountain series, suggestions may be based on general geological observations. Considering the nature of the tectonic movements which affected the beds and the amount of erosion which has taken place since the last folding, it would be difficult to assume that the sediments are younger than Pliocene. In a general way, an Upper Tertiary age, as originally advocated by McCoy seems to be most likely.

ECONOMIC POSSIBILITIES.

Although prospecting and detailed examinations of mineral deposits were not carried out, from the observations that were made concerning the occurrence of certain rock formations and minerals, conclusions can be drawn as to the mineral possibilities of the area. These can be conveniently described under the headings Oil Possibilities, Water Supplies and Mineral Possibilities.

OIL POSSIBILITIES.

With regard to the oil possibilities the previous unmapped Burt Range Basin, which extends in a North-Easterly direction into the Northern Territory, is of considerable importance. An approximately conformable sequence of several thousand feet of Palaeozoic sedimentary rocks, consisting of conglomerates, sandstones, shales and highly fossiliferous limestones, which vary from Upper Devonian to Permian (?) in age, occur in the Basin, and they may, at least in part, be underlain by Cambrian sediments. Sediments which may be regarded as potential sources of oil, and as potential reservoir and cover rocks, occur in the sequence, but it yet remains to be proved whether or not suitable structures for the concentration of oil exist. The only indication of folding seen in the Basin during the investigations was some local folding in the Burt Range on the Northern side of the Cockatoo fault, and the dome structure of Mt. Cecil.

The presence of major faulting in the Basin may be an unfavourable feature, and should be closely studied when detailed investigations are undertaken. In some respects it may have been advantageous however, and have caused the down-faulting and preservation of thick sections of strata, and the concentration of oil. The block of Permian rocks occurring at the South end of the Burt Range, and which is bounded by three major faults, may be a fault block of this type.

The presence of fault blocks of Upper Devonian and Permian rocks in the Pre-Cambrian complex away from the Burt Range Basin show that the Palaeozoic rocks originally extended over a much wider area, and it is possible that they have been the source of the asphaltum (or mineral pitch) occurring in the vesicular Cambrian basalt on Texas Station and near the junction of the Ord and Negri rivers at the Northern end of the Hardman Basin. These observations are in agreement with those of Wade (1924) that the asphaltum was derived from rocks younger in age than the basalt, but the writers consider that the source rocks were younger than Cambrian in age. The discovery of asphaltum in the Burt Range would put the matter beyond doubt.

WATER SUPPLIES.

The natural water supplies are generally situated in low-lying areas, and consist of pools in river channels and their tributaries, isolated lagoons and springs, which in most cases are closely associated with the faulting.

Some of the pools are only accumulations of surface water in depressions, but many of them are on fault lines or near fault intersections, and are probably fed by springs issuing from these lines of weakness. The isolated lagoons, occurring near Ivanhoe Homestead and near H 20 South-West of Argyle Homestead, and very likely Milligan's Lagoons, are situated on fault lines, and are probably also fed by springs.

Springs situated on fault lines, good examples of which are Cockatoo Spring and Thompson's Spring, were seen in several places in the area, and many others were recognised on the aerial photographs from the patches of dense vegetation occurring in their proximity.

Besides the fissure springs, there are springs, such as Soda Spring and Sugar Spring, issuing from fragmental and vesicular basaltic rocks immediately below the basal cherty limestone, on the flatly dipping, South-Eastern limbs of the Argyle and Rosewood Basins. The occurrence of these springs is more likely controlled by folding than by faulting.

There is good scope for the development of these natural water supplies.

There are also good prospects for the development of underground water supplies, including sub-artesian and possibly artesian water.

The Cambrian structural basins, particularly the Rosewood and Hardman Basins which have steeply dipping and elevated North-Western limbs, offer possibilities for artesian water, provided due regard is paid to geological structure and topography in the selection of bore sites. The horizon most likely to serve as an aquifer is the fragmental and vesicular upper layer of the basaltic rocks, occurring immediately below the basal limestone of the Negri Series. Deeper fragmental and vesicular layers may also prove to be aquifers.

The Burt Range Basin has not yet been proved a structural basin, but the available information suggests it has possibilities of yielding artesian water, in addition to ordinary ground water, provided attention is paid to the attitude of the strata, the lithology and the topography, when selecting sites for boring.

MINERAL POSSIBILITIES.

Both the Greenstone and Mosquito Creek Series of the pre-Cambrian complex, which are older than the intrusive granite, and which contain gold, silver-lead and copper deposits in other parts of the East Kimberleys, are represented in the area mapped, and may contain similar metalliferous deposits.

*E. S. Hills, The Age and Physiographic Relationships of the Cainozoic Volcanic Rocks of Victoria. *Proc. Roy. Soc. Vic.*, Vol. 51 Pt. 1 (N.S.), 1939 p. 127.

†F. W. Whitehouse, Studies in the Late Geological History of Queensland. 2. Late Tertiary Limestones in Queensland and their significance. *Univ. Queensl. Papers, Dep. Geol.*, Vol. 2 (N.S.), No. 1 1940, p. 24.

The granitic areas themselves also have mineral possibilities, as the granite is probably of the same age as that intruding the Lower Proterozoic rocks of the Northern Territory, and may also contain economic mineral-bearing pegmatites and quartz reefs. If they do occur it is possible hat the pegmatites and quartz reefs may contain metallic minerals, such as cassiterite, tantalite or columbite, and non-metallic minerals, such as beryl and mica.

There is a possibility that useful replacement copper deposits of secondary origin may occur in isolated places in the basal cherty limestone of the Negri Series, as evidence of the deposition of secondary copper minerals in the limestone was noted at the Rosewood Limestone Wall, and near View Hill and Mt. Napier in the Hardman Basin. The source of the copper minerals appears to have been the basaltic rocks underlying the limestone, and the fact that the rocks are steeply dipping at these localities, suggests that the steeply dipping limbs of the Cambrian Basins may have been the most favorable for the circulation of the secondary solutions.

The area may also contain useful deposits of non-metallic minerals, such as barytes, fluorite, chrysotile asbestos, quartz crystals and ochres, and prospects for their discovery are best in the rocks of pre-Cambrian and Lower Cambrian age. Both barytes and fluorite are recorded from other localities in the East Kimberleys.

Samples of chrysotile asbestos and red ochre were seen, proving their existence in the area. The sample of chrysotile asbestos (Lab. No. 5428) is reported to have been obtained about nine miles South-West of the 9-Mile Homestead, near Mt. Close, and is apparently from the Pre-Cambrian complex. The sample of red oxide was obtained from North-East of Wyndham, and determinations since carried out at the Government Chemical Laboratories have proved it to be a high grade red oxide resembling commercial Spanish Red.

Idiomorphic and hypiodiomorphic quartz crystals were seen in vugs in the Lower Cambrian basaltic rocks in several places, but they were too small in size to be of commercial use. It is possible that larger crystals may occur in the basaltic rocks at other localities however.

In addition to the above it is possible that the well known "Zebra" rock of Permian (?) age could be commercialised as an ornamental stone.

SUMMARY OF RESULTS.

From the preceding pages it has been seen that the investigations have led to a much better understanding of the geology, and much better appreciation of the mineral possibilities of the area.

A large unsuspected basin of Palaeozoic rocks (the Burt Range Basin), which extends in a North-Easterly direction far into the Northern Territory and has oil-bearing potentialities, was discovered. The basin is composed of a sequence several thousand feet of approximately conformable strata varying from Upper Devonian to Permian (?) in age.

The stratigraphy of the Cambrian sedimentary rocks has been worked out in much more detail than previously and it has been proved that they are folded with, and occupy asymmetrical structural basins in, the underlying basaltic rocks. The basaltic rocks, are considered to be of Lower Cambrian age, and are composed of successive basalt flows interbedded with which are layers of volcanic agglomerates, and possibly also tuffs. The fact that the Cambrian sediments occur in structural basins suggests the possibility of artesian or sub-artesian water.

A system of major faults of fairly young geological age (possibly Tertiary to Recent), and which can be subdivided into two main sets of intersecting faults, has been recognised in the area. The distribution of the different rock formations in the Northern part of the area mapped is governed largely by the fault system, and in places graben structures have been produced between parallel faults belonging to the different sets. The drainage and the occurrence of natural water supplies are also controlled to a large extent by the faulting.

The investigations have also disclosed the presence in the area of the potentially metalliferous Mosquito Creek and Greenstone (?) Series of the Pre-Cambrian complex. In addition, new belts of granitic rocks, which may possibly contain mineral-bearing pegmatites and quartz reefs, were discovered.

REPORT ON THE HILL 60 LODE, MT. MAGNET GOLD MINES LTD., MT. MAGNET.

By K. R. Miles, D.Sc., F.G.S.

From August 2nd to 8th, 1941, I was engaged in an examination of the underground workings of the Hill 60 Mine, Mt. Magnet, in order to determine the nature, origin, mineralisation and any structural features, etc., of the ore body such as might provide indications of its future prospects at depth.

At the time of inspection no ore was being mined from Hill 60 itself and the only developmental work in progress was some driving Northwards on the No. 5 (500ft.) level towards the point at which a diamond drill from the surface (No. 4 bore) is calculated to have intersected the lode. This work has been authorised by the Government under the terms of a recent loan agreement. On Monday, August 4th, acting under instructions of the managing director, the manager published the announcement that the Hill 60 Mine was to be closed down at the end of the month.

The Hill 60 lode appears to consist of a mineralised and carbonated banded chert—an original fine-grained siliceous sedimentary bed containing abundant thin interbedded ferruginous and shaley layers which are now represented by bands of magnetite and magnetite-chlorite schist. Country rocks include interbedded white sericite—(some chloritoid-bearing) schists (phyllites?) sheared and carbonated basaltic lavas and tuffs (now green chloritic schists), intersected by tongues of felspar porphyry and occasional veinlets of white quartz. The general strike of both lode and country is approximately North and South, and the dip is to the West at a steep angle. In places this banded chert bed grades longitudinally into magnetite chlorite schist and I am informed that, particularly in the upper levels (oxidised zone) rich shoots of ore have been found in these schistose lenses which have provided easy access for mineralising solutions.

Probably secondary redistribution and concentration of gold by solution, downward transportation and redeposition has taken place in the zone of oxidation, resulting in a considerable enrichment of the lode in the upper levels. The upper levels above the No. 2 (200ft.) level have been almost completely stoped out, leaving little to be observed in an examination. From the semi-sulphide zone above the No. 3 (300ft.) level a considerable amount of ore has been stoped but the erratic distribution of values in this zone has necessitated selective mining. Below the No. 3 level in the sulphide zone, only one small block of ore has been stoped at between 50 feet and 130 feet South of the main crosscut above the 380ft. sublevel.

As the future prospects of the mine depend entirely upon the possibility of location and developing payable ore bodies in the primary (sulphide) zone, the present investigation was confined principally to the lode formation within the zone of primary sulphides.

Structure.

No evidence of major deformation of the lode formation by folding such as might be expected to provide localised channels (shoots) for the passage and deposition of primary auriferous solutions, was observed.

The banded chert bed dips (between the Nos. 3, 4 and 5 levels near the main crosscuts) at a fairly constant angle from 70-75° to the West. Longitudinally this bed apparently varies considerably in width, it being approximately 15-20 feet wide on the Nos. 3 and 4 levels, while at the main crosscut on No. 5 level it has been opened up over a width of 43 feet and so far the hanging wall has not been exposed. In the upper levels the ore body is said to vary in width from as low as 8 feet up to

about 40 feet, forming lenticular bulges. It has been claimed (R. W. Fletcher, Consulting Geologist) that these wider portions of the lode or bulges usually yield the best values. This may be so in the zone of oxidation, but does not necessarily follow in the sulphide zone as the very wide zone of lode formation in the No. 5 level has so far (i.e. to August 8th) failed to yield any payable values.

Minor fracturing, faulting and even minute crinkling and dragfolding is occasionally abundant within the lode formation. A considerable amount of this fracturing is probably pre gold in age, as fine joint planes and seams are often filled by the sulphide mineral pyrite and occasionally also by quartz—minerals which when present in conjunction usually indicate the presence of gold. However, the lode is also intersected by many small faults which may contain recemented (silicified) gouge but which show no sign of mineralisation and contain no appreciable increase in values. These are thus probably post gold faults.

Mineralisation.

I have been credibly informed that wherever good values have been obtained the lode formation has always been highly mineralised. The converse does not, however, necessarily hold true, and some portions of the lode which show abundant mineral have been found quite barren of gold. The common sulphide mineral found throughout the Hill 60 lode formation is pyrite (FeS_2) and this occurs distributed either in connected localised seams and veinlets, or as scattered individual crystals. Pyrrhotite or magnetic pyrites $Fe_{11}S_{12}$, has been reported to occur in a few localities—as streaky masses or bands of crystals. It has been suggested that pyrrhotite is the primary sulphide and that pyrite is a "secondary" sulphide which may be expected to give place to pyrrhotite in depth. This idea was probably originally developed from the discovery of pyrrhotite in the material obtained from a winze sunk to a depth of 40 feet at a point 90 feet South of the main crosscut, No. 4 level, and close to the hanging wall, and engendered by the desire to show an analogy with the Hill 50 lode, Boogardie, in which pyrrhotite is said to be the predominant sulphide.

Pyrrhotite is said to be a good indicator of gold in the Hill 60 lode but unfortunately I was unable to obtain any record of the assay values of the winze mentioned above though they are reported to be fair. The presence of scattered pyrite in the No. 5 level and the very limited occurrence of pyrrhotite rather scouts the idea of a gradation from pyrite to pyrrhotite at depth, however.

In places in the upper levels, narrow tongues of felspar porphyry were found either upon the walls of or enclosed within the lode formation, and it has been reported that good values in the lode are invariably found in the immediate vicinity of these porphyry dykes. Although a small tongue of porphyry is said to have existed on the wall of the stope above the No. 4 level, no porphyry has been seen on either the No. 4 or No. 5 levels.

A mineral which is said to be unfavourable to the deposition of gold at Hill 60 is carbonate. This may be due to the fact that grey carbonates frequently constitute a considerable fraction of the denser, harder and more blocky portions of the cherty lode material—"bars" as they are locally called.

Distribution of Values.

It appears a basic principle that auriferous solutions or vapours have been able to use only the softer and schistose or more highly fractured and easily penetrable zones in the original formation for their passage, and consequently all inherently dense and compact or tightly cemented portions of the original banded chert bed which have been difficult of penetration may be considered as unfavourable.

It seems that with increasing depth the relative amount of poorly mineralised hard bar material to the softer and well mineralised portions of lode in the sulphide zone is gradually increasing with consequent decrease in the number and size of payable ore shoots. Whereas with, probably, the superimposed secondary concentration of gold on the primary ore shoots, the upper levels provided fairly large volumes of payable ore, as shown by the continuous stoping above the No. 2 level, the semi-sulphide zone between the No. 2 and No. 3 levels contained only limited portions of the ore body which could profitably be stoped. Within these stopes values were also frequently rather erratic.

Assay values on and below the No. 3 level, as shown on a longitudinal section, are extremely variable, whilst there appears to be a distinct falling off of values with increasing depth. No workable quantity of payable ore was obtained in the North drives of either the No. 4 level or the 380ft. sub-level over a distance of about 160 feet North of the main crosscut. Further North of this again is virgin ground, but values on the No. 3 level from 160 feet North to 400 feet North were mostly very low and did not offer much encouragement for development underfoot.

South of the main crosscut on No. 4 level and in the 380ft. sub-level values were payable, as already stated between 60 feet South and 130 feet South but beyond that they dropped again, whilst on the No. 3 level from 130 feet South to the face of the South drive at 240 feet South values were unpayable. A point dealing with the erratic nature of the gold distribution of the lode which may be noted here is the fact that even within those portions of the lode itself which contain good bulk averages, the values are seldom evenly distributed. It is reported that values often follow either the foot or hanging wall, sometimes jumping across from one side to the other.

Bores From Surface.

Two diamond drill bores from the surface which were put down to intersect the lode at a depth of about 500 feet may be mentioned here. They are bore No. 4 and bore No. 3 respectively.

Details of the localities of these bores are as follow:—

No. 4 Bore:
Co-ordinates 504 ft. S., 769 ft. W.
Bearing 77°, Depressed 50°.
Length 643 ft. 7 in.

No. 3 Bore:
Co-ordinates 810 ft. S., 715 ft. W.
Bearing 86°, Depressed 50°.
Length, 667 ft. 4 in.

The positions of these two bores relative to the underground workings are shown on an underground plan. They intersect the lode at approximately 170 feet North and 210 feet South respectively, of the main crosscuts.

No. 4 bore intersected the lode between 578 feet 2 inches and 613 feet 9 in. (giving true width about 31 feet). The centre of the lode is at approximately 450 feet vertically below the surface.

Assays of Lode.

ft.	in.		ft.	in.		dwt. per ton	gr.
578	2	—	582	0	.. .. ..	0	11
582	0	—	585	0	.. .. ..	nil	
585	0	—	588	0	.. .. ..	nil	
588	0	—	591	0	.. .. ..	Trace	
591	0	—	594	0	.. .. ..	10	12
594	0	—	597	0	.. .. ..	nil	
597	0	—	600	0	.. .. ..	nil	
600	0	—	603	0	.. .. ..	2	4
603	0	—	606	0	.. .. ..	0	15
606	0	—	609	0	.. .. ..	0	15
609	0	—	612	0	.. .. ..	0	11
612	0	—	613	9	.. .. ..	9	21

Average grade between 591 feet and 613 feet 9 inches (true width 16 feet) is 2 dwt. 16 gr. per ton.

Bore No. 3 intersected the lode channel between 543 feet 2 in. and 577 ft. 6 in. (true width about 24 feet). The centre of the lode was at approximately 450 feet vertical depth, though it is possible that the borehole has flattened somewhat and may be nearer 400 feet V.D.

Assays.

ft.	in.		ft.	in.	dwt. gr. per ton
543	2	—	546	2	nil
546	0	—	549	0	Trace
549	0	—	552	0	6 19
552	0	—	555	0	Trace
555	0	—	558	0	Trace
558	0	—	561	0	0 15
561	0	—	564	0	Trace
564	0	—	567	0	Trace
567	0	—	570	0	Trace
570	0	—	573	0	6 4
573	0	—	575	0	nil
575	2	—	577	6	nil

Average grade between 549 feet and 573 feet (true width 16 feet) is approximately 1¾ dwt. per ton.

It can be seen from the assays of these bore cores that the values are very unevenly distributed but both bores show some better values near the footwalls.

Also it should be noted that though these bore cores both indicate small concentrations of payable ore the average value over about half the lode in each case is distinctly unpayable.

Diamond drill cores of a lode so erratic in gold distribution as is the Hill 60, have, however, very little quantitative value. Their chief importance is a qualitative one—as indicators of the presence or absence of the lode formation itself.

Recent Development.

Developmental work recently carried out by the company with the assistance of money loaned by the Government, and according to an agreement with the Government, included sinking of the main shaft from No. 4 to No. 5 (500ft.) level, sinking a winze from No. 4 level to a depth of 30 feet, crosscutting to the lode at No. 5 level, and driving North and South on the lode. The original plan provided for the completion of the winze to the No. 5 level and driving on the No. 5 level for 100 feet both North and South of the crosscut, but rapidly diminishing funds caused this plan to be abandoned. At the time of final inspection (August 8th) about 205 feet of crosscutting had been completed cutting a width of 43 feet of lode but *not exposing the hanging wall.* The lode had been driven on Southwards for a distance of 28 feet, and a North drive had been completed for a distance of 64 feet starting from a point 22 feet West of the footwall, i.e. *along the centre of the lode.* At the time of inspection the South drive had been abandoned and the North drive was being continued apparently with the object of driving North as far as the intersection of the surface bore No. 4 with the lode. This would require a further 108 to 110 feet of driving.

Values both in the crosscut and in the North and South drives have proved exceptionally low—seldom showing more than 1 or 2 dwt. per ton. In fact most samples taken over the first 60 feet of the North drive —whether grab samples, truck samples, or borings, have shown only a trace of gold. At a distance of about 62 feet from the crosscut the North drive has exposed on its Eastern wall what appears to be the footwall country rock, whilst on the Western side of the drive the lode appears somewhat darker and more heavily mineralised.

The exposure of the footwall in the drive indicates that it has swung rather sharply to the North-West. From this point the direction of the drive was changed slightly so as to swing Westward away from the footwall. The last two cuts have exposed a fairly dark (chloritic) and rather better mineralised ore than hitherto. Assay of a sample of borings into the face of the drive at about 62 feet yielded 2 dwt. gold per ton. At the time of final inspection the face of the drive at approximately 66 feet North was seen to be intersected by a vertical diagonal fracture, which strikes at approximately N. 50° E. In the vicinity of this fracture the ore appears well mineralised with both pyrite and pyrrhotite and some quartz. A bore sample into this face assayed 4 dwt. 12 gr. per ton—easily the best assay value obtained on the No. 5 level, so far. It should be remembered, however, that a bore hole sample into the face of a drive gives no indication of the value of the ore over the face as a whole such as should be obtained by a careful grab sample taken over the entire face, A sample of 5 feet of borings into the Western wall of the drive at about 64 feet assayed about 1 dwt. per ton.

General Remarks and Conclusions.

At the time of final inspection of the Hill 60 Mine, the position appears to have been as follows:—

1. The bulk of available payable ore in the upper levels (above No. 3 (300ft.) level) has been completely worked out and it is considered that the cost of development work required for the mining (separately) of the small blocks of remaining ore would make such mining uneconomic and unprofitable.

2. Development work below the No. 3 level includes (a) about 330 feet of driving on the No. 4 (400ft.) level, (b) 270 feet of sublevel driving at 380 feet, (c) two winzes from the No. 3 to the No. 4 levels, (d) short lengths of driving at 345 ft. sublevel, (e) two half completed winzes below the No. 4 level (south end), and (f) about 90 feet of driving on the No. 5 level.

3. The result of this development has been to expose only one small block of ore which the Company has seen fit to mine, despite the fact that the rather low treatment costs of the Hill 60 plant have in the past made it possible to treat, at a profit, ore of an extremely low grade.

4. Development work in progress at the time of inspection consisted of driving Northwards on the lode at the No. 5 level with the aim of reaching that portion which was intersected by a diamond drill borehole (No. 4) portions of the core of which yielded two payable assays but which indicated that over any workable width, the lode was unpayable.

5. The fact that no payable *quantities* of ore whatsoever have so far been found in the lode North of the main shaft and below the No. 3 level, indicates that the present North driving on the No. 5 level must be accepted as very much of a blind stab, the result of which it is impossible to prophesy but for which little hope and no optimism is justified. The evidence of the existence of payable ore above and on the No. 4 level South of the shaft suggests the possibility that driving further South on the No. 5 level may have disclosed the downward continuation of an ore shoot. Further development in the South drive would have been of more definite and immediate value than a continuation of the North drive, and the available geological evidence is, I consider, rather more favourable to development Southwards than Northwards.

6. It seems very unfortunate that the main crosscut on the No. 5 level was not continued so as to expose the hanging wall as well as the footwall, particularly since the values in the Hill 60 lode have frequently been found to be higher near a wall than in the centre of the lode.

7. Since the management of the Hill 60 Mine seems determined to close the mine down at the end of the month (August 26th) and in view of the almost total lack of any ore reserves as shown above, and of the rather unpromising prospects of the North drive at present in progress, unless a considerable and sustained increase in values has been obtained since my final inspection (August 8th), further expenditure on a continuation of this drive appears unwarranted.

GEOLOGICAL NOTES ON BORING IN THE MT. PALMER DISTRICT, YILGARN GOLDFIELD.

By K. R. Miles, D.Sc., F.G.S.

In order to assist in the selection of sites for boring to be carried out on two temporary reserves held by Yellowdine Gold Development Limited, the writer spent three weeks in the Mt. Palmer District, Yilgarn Goldfield, during August, 1940. The temporary reserves, Nos. 1087H and 1088H, were situated at Meier's Find, approximately two and a half miles due South, and at Heaney's Find, approximately three and a quarter miles N.N.E., respectively, of Mt. Palmer townsite.

Each reserve included an area of about 300 acres, made up of highly metamorphosed older pre-Cambrian rocks of the Yilgarn System (Greenstone Series) intruded by later granite, pegmatite and quartz.

Detailed mapping of critical areas in these reserves was carried out by the writer by means of tape and compass traverses added to survey data supplied by the Mines Department, and plotted on a scale of 100 feet to an inch. Transport to and from the bore sites was provided by the management of Yellowdine Gold Development Ltd., to whom the writer is also much indebted for the provision of a field assistant.

A. HEANEY'S FIND.

GEOLOGY.

The rocks of the Heaney's Find area consist of interbedded recrystallised schistose basic lavas (including pillow lavas), ultrabasic rocks, and thin banded sedimentary beds (banded ferruginous quartzites or jaspilites, and quartzites), cut by later quartz and pegmatite dykes, and in places covered by recent superficial deposits of soil and alluvium.

In the area mapped (see Plate XII) the country strikes approximately North-West and South-East. There are three horizons of recrystallised jaspilites, the principal bed having an average width of about 30-40 feet and being folded into a large S shaped drag fold pitching S.S.E. at about 70° in the centre of the area. It was this bed which forms a fairly continuous ridge of high ground, whose underground continuation it was proposed to explore by drilling. It dips at a very high angle (about 85-88°) to the South-West and is enclosed by basic schists. Under fairly high temperature and pressure conditions the whole rock has been completely recrystallised from an original banded ferruginous quartzite or jaspilite to a banded magnetite-grunerite quartzite containing layers locally rich in other iron rich silicate minerals such as hedenbergite and fayalite.

There are two other narrow sedimentary horizons to the West of the main bed. The first of these is a very thin discontinuous lens of impure sugary textured quartzite (usually decomposed) seldom more than 4-5 feet wide. Further West again is a parallel bed of ferruginous quartzite which is siuated in a "granitised" zone on the Eastern edge of an area of granite. This is a rather discontinuous bed up to 30 feet wide in places and is for the most part bleached to white quartzite by the action of the granitic solutions. The rock surrounding and immediately to the West of this bed is usually a white altered kaolinitic schistose rock often containing pegmatitic quartz with here and there residual lenses of fresh schistose greenstone. At the approximate boundary between the "granitised" rock and the greenstones (basic schists) part of the country is covered by a deposit of limonitic duricrust.

The recrystallised ultrabasic rocks occur in two distinct horizons probably representing original sills or flows. The first, about 550 feet thick, lies East and North of the main meta-jaspilite horizon. Its Western boundary with the basic schists swings in a broad S shaped fold roughly parallel to the meta-jaspilite bed. The rock, which was probably originally a pyroxene-rich ultrabasic type, has been recrystallised into an anthophyllite-tremolite schist. It is not particularly schistose in appearance but has a characteristic blocky jointing. Nodules of magnesite are plentifully scattered about the surface within and close to the boundaries of this rock. A narrow seam of vermiculite is exposed in this ultrabasic on the lake shore in the extreme South-East of the area mapped. (See Plate I.)

The second horizon of ultrabasic rocks lies to the West of the main meta-jaspilite bed. It averages about 200 feet in thickness and runs parallel to the Western sedimentary horizons. The rock is mostly rather decomposed—consisting essentially of tremolite, anthophyllite and talc with some scattered iron ore (magnetite). It is characterised by an abundance of secondary (opaline) silica scattered about its surface. It is cut by dykes of recrystallised basic rock—now black amphibolite schists.

The fine grained basic schists represent original lavas interbedded with the sediments and the ultrabasic rocks. They have been mostly recrystallised and usually contain abundant diopsidic augite and well oriented amphibole (green hornblende) laths. They range from pyroxene-plagioclase amphibolite gneisses and schists, to recrystallised pillow lavas consisting of pyroxene-plagioclase rocks with selvages of hornblende schist. These rocks at the surface are usually highly schistose and jointed, and frequently outcrop in pointed spearheads which often have a marked pitch.

No undoubtedly intrusive granite occurs within the confines of the area mapped, but the Westernmost side of the area is occupied by a belt of coarse schistose acid (granitic and pegmatitic) rocks covered by a sparse mulga type of vegetation. This is believed to represent a hybrid or granitised zone. To the immediate West of this area are seen flat sloping floors of massive biotite granite surrounded by yellowish sandy soil.

Intrusive pegmatite dykes are abundant in the centre of the area mapped, where there is a belt of parallel pegmatite lenses running at about N. 20° W. apparently intruded along an old zone of weakness. They here and there cut through the main meta-jaspilite belt.

White quartz reefs are widely scattered throughout the area, but are usually short and narrow except in the North-East corner where two large masses of quartz associated with some pegmatites form a prominent knoll or 'blow.'' The quartz appears to be barren of gold.

STRUCTURE.

The main meta-jaspilite bed in this area dips at a steep angle to the South-West (70°-88°). At the nose of the major dragfold already described the dip (pitch) is to the South-East at 70°. Minor dragfolds within the bed indicate a change in pitch from steep Northerly at the South end to steep Southerly from the centre of the area Northwards. The regional pitch of spearheads of basic schist in various parts of the area is Southerly. Recognisable pillows on the Eastern side of the main meta-jaspilite bed face South-West and dip steeply in the same direction and hence are in their normal position. Dragfolds in the Westernmost quartzite horizon are few and owing to the broken natures of the outcrops readings of these are unreliable.

BORING.

Six bore holes were put down to intersect the main meta-jaspilite bed in the area described. The first was drilled from the North-Eastern side of the outcrop. This confirmed the South-Westerly dip of the country and subsequent bore sites were located on the South-Western side of the outcrop. Bores Nos. 5 and 6 were drilled from the same site to intersect different parts of the meta-jaspilite bed beneath the shallow workings in a prospecting area which at the time of inspection was held by two prospectors, Messrs. McDonald and Ward, and covered the North-Western section of the area mapped. The position, direction and projected length of each bore has been plotted upon the accompanying plan (Plate ?). Each bore hole was depressed at an angle of 45°.

The following are brief logs of the bores:—

Bore No. 1.

ft.	in.	ft.	in.	
0	0	257	0	Med. fine grained actinolitic amphibolite schist with scattered veinlets of quartz and pegmatite up to 6 in. thick *usually rimmed by narrow brown biotitic zones.*
257	0	265	6	Banded magnetite-grunerite quartzite with local layers rich in coarse crystal line pyroxene, or dark green hornblende, and intersected by stringers of quartz.
(256	9	258	10	Mineralised quartz veinlet. Assay Tr.)
265	6	268	3	Clear glassy quartz. Assay Tr.
268	3	271	6	Clear glassy quartz slightly mineralised. Assay 0·5 dwts. per ton.
271	6	291	2	Banded magnetite-grunerite quartzite with localised dark bands rich in coarse crystalline pyroxene.
291	2			End of bore.

PLATE XII

GEOLOGICAL SUBSURFACE MAP
— OF —
PORTION OF
HEANEY'S FIND BORE SITE AREA
TEMPORARY RESERVE 1088H
MT PALMER, YILGARN GOLDFIELD

Scale 200 feet to an inch

200 0 200 400

Survey data supplied by Mines Dept.
Tape and compass traverses, and geology by K.R. Miles, Aug. 1940

LEGEND

RECENT

- Soil
- Alluvium
- Ironstone (Lateritic)

PRE-CAMBRIAN

YILGARN SYSTEM GREENSTONE SERIES

- Greenstone — Medium and fine-grained amphibolite schists (original basic-pillow-lavas and tuffs).
- Greenstone — Blocky recrystallised ultrabasic rocks (tremolite-anthophyllite rocks, probably sills).
- Meta-jaspilites — Metamorphosed banded ferruginous quartzites containing interbanded layers of quartz magnetite, grunerite, fayalite hedenbergite with local bands of garnet and hornblende. In places, in "granitised zone, is bleached to white quartzite.

INTRUSIVES

- "Granitised" Zone – Granitic schist with relicts of basic schist
- Pegmatite Dykes
- Quartz Reefs
- Basic Dykes (Recrystallised to amphibolite-cutting rocks of Greenstone Series, probably pre-granite).

REFERENCE TO SIGNS

- Geological boundaries doubtful or assumed
- Strike and dip of bedding
- Strike and dip of schistosity
- Strike of schistosity with no observed dip
- Strike of foliation in Granite
- Strike and plunge of dragfold
- Direction and dip of pillow lava tops
- Regional pitch of minor fold
- Outcrops with no observed strike and dip
- Cliffs
- Shafts – accessible and inaccessible
- Prospecting Area — P.A.

Bore No. 2.

ft.	in.	ft.	in.	
0	0	180	11	Amphibolite schist with scattered quartz veinlets rimmed by brown biotite schist.
180	11	182	6	Coarse pegmatite.
182	6	183	0	Pyritised basic schist with quartz. Assay Tr.
183	0	188	0	Micaceous amphibolite schist.
188	0	189	0	Coarse pegmatite.
189	0	189	6	Amphibolite schist.
189	6	194	6	Pegmatite.
194	6	201	6	Soft micaceous amphibolite schist.
201	6	203	6	Pegmatite.
203	6	212	0	Quartzose micaceous amphibolite schist grading into black chlorite schist (containing (?) chloritoid).
212	0	215	8	Pegmatite.
215	8	224	1	Quartzose amphibolite schist.
224	1			End of Bore.

Bore No. 3.

ft.	in.	ft.	in.	
0	0	101	6	Decomposed basic schist with occasional thin stringers of pegmatite.
101	6	110	0	Pegmatite.
110	0	190	3	Fine grained amphibolite schist with localised micaceous bands and stringers of pegmatite.
190	3	216	6	Banded magnetite-grunerite-hedenbergite quartzite (Meta-jaspilite) highly pyrrhotitic at the contact (Assay 0·4 dwts. per ton). Contains narrow layers rich in dark green hornblende and red garnet. Assays—210′ 5″—211′ 0″ Tr. 214′ 0″—216′ 9″ Tr.
216	6			Grades imperceptibly from banded garnetiferous magnetite-grunerite quartzite to a sandy micaceous amphibolite schist.
216	6	228	2	Sandy micaceous amphibolitic schist.
228	2			End of Bore.

Bore No. 4.

ft.	in.	ft.	in.	
0	0	20	0	Decomposed basic schist.
20	0	30	0	Coarse pegmatite.
30	0	165	11	Amphibolite schist with localised micaceous zones and stringers of quartz.
165	11	166	3	Pegmatitic quartz. Assay Tr.
167	0	168	2	Quartz vein. Assay Tr.
168	2	193	0	Amphibolite schist.
193	0	200	0	Quartz with about 9in. of basic schist.
200	0	203	3	Banded magnetite-grunerite quartzite.
203	3			End of Bore.

Bore No. 5.

ft.	in.	ft.	in.	
0	0	47	0	Decomposed basic schist.
47	0	47	6	Quartz. Assay Tr.
47	6	133	6	Amphibolite schist with local micaceous zones.
133	6	136	0	Meta jaspilite (banded magnetite-grunerite quartzite) with quartz veinlets.
136	0	142	0	Quartz. Assay Tr.
142	0	187	0	Amphibolite schist.
187	0			End of Bore.

Bore No. 6.

ft.	in.	ft.	in.	
0	0	108	0	Amphibolite schist with localised micaceous zones and quartz stringers.
108	0	138	0	Banded magnetite-grunerite quartzite with localised layers rich in hedenbergite or garnet and dark green hornblende.
120	0			Quartz veinlet (2 in.). Assay Tr.
116	6	117	0	Quartz veinlet (2 in.). Assay Tr.
132	9	136	9	Quartz veinlets. Assay Tr.
138	0	185	0	Amphibolite schist.
185	0			End of Bore.

B. MEIER'S FIND.

GEOLOGY.

The rocks of this area are very similar to those exposed at Heaney's Find except that no definite horizon of ultrabasic rocks was noticed. Two horizons of metamorphosed jaspilite occur at Meier's Find, the beds striking approximately N. 50° E. and dipping from 50° to 80° to the South-East. The main meta-jaspilite bed occupies the centre of the area mapped (see Plate XIII) and averages about 55 feet in width. It is enclosed on both sides by schistose recrystallised greenstones (basic lavas) and is cut by numerous pegmatite dykes and quartz reefs whilst in the North-Eastern corner of the area mapped the entire bed appears to have been cut off and engulfed by a larg intrusive body of massive granite. A pegmatite tongue, offshoot from this granite body, has also broken across the bed near the centre of the area, stoping off a fragment of the meta-jaspilite and leaving a break some 80 feet wide. These intrusive granite bodies have probably been largely responsible for the contact metamorphism of the adjacent basic schists and jaspilite, recrystallising the latter into a banded magnetite-grunerite quartzite locally rich in hedenbergite and with garnetiferous amphibole-rich zones.

Quartz reefs appear to have been the last intruded bodies in the area. They are for the most part short, narrow and rather sporadically distributed, and run in various directions at random, but most of them appear quite barren of gold. One very large white "buck" quartz reef occupies a fissure over 2,000 feet long running in the direction N. 30° E. and cutting through granite, greenstone and meta-jaspilite alike.

In the North-Western corner of the area mapped outcrops are few, and the country is covered with a light reddish soil containing a mixture of chips of fresh greenstone and decomposed schistose granitic rocks. This soil-covered area probably represents a marginal (granitised) contact zone between granite and greenstone. Further to the South-West this marginal zone is covered by a small knoll of ferruginous laterite. The actual contact between the massive granite outcropping in the North-Eastern corner and the adjacent basic schist is also masked by a zone of reddish semi-alluvial soil which has been mapped as soil (see Plate XIII).

The second meta-jaspilite horizon is situated in the inderterminate soil-covered granitised zone in the North-West of the area and is represented by a few small scattered outcrops, the line of strike btween them being marked by occasional rubble floaters only. These indicate that the bed strikes North-East, approximately parallel to the main bed.

STRUCTURE.

Dragfolds in the main meta-jaspilite bed are not plentiful, but where recognisable they indicate that there in a change in pitch in the centre of the area from steep North-Easterly to equally steep South-Westerly, suggesting a possible synclinal crossfold with axis running at right angles to the strike of the bed. Just South-West of this point the meta-jaspilite bed has been broken and displaced Northwards in such a manner as to suggest the presence of a compound or forked fault cutting the horizon in an approximate North-South line. No quartz or pegmatite occurs in the fault planes, suggesting that they are either of post quartz age or that they represent the planes of a tightly over-thrust fold. The meta-jaspilite bed has also been displaced by the long "buck" quartz fissure reef, which cuts through the area a little further East, as described above.

BORING.

Four bore holes were sunk to investigate the downward continuation of portions of the main meta-jaspilite in the vicinity of certain old workings on the late G.M.L. 3590 at Meier's Find. All bore holes were drilled from the South-Eastern side of the bed and directed approximately North-North-East. Their exact positions, directions and projected lengths are shown in Plate XIII. Bores Nos. 1, 2 and 4 were depressed at 45° and bore no 3 at 51°.

The following are the geological logs of the core from each bore hole:—

Bore No. 1.

0	0— 32	0	Decomposed basic schist.
32	0— 37	4	Pegmatite.
37	4— 72	0	Decomposed basic (amphibolite) schist with narrow micaceous layers.
72	0— 73	0	Pegmatite.
73	0—175	2	Fine grained basic schist with local coarsely crystalline layers, micaceous bands and stringers of quart.
175	2—190	6	Coarse pegmatite.
190	6—202	0	Banded magnetite-grunerite quartzite containing layers rich in pyroxene (hedenbergite) and with streaks and patches of pyrrhotite and occasional veinlets of quartz. Assays 190′ 9″—194′ Tr. 194′ 0″—202′ 0·6 dwts./ton.
202	0—207	0	Coarse pegmatite.
207	0—217	6	Banded magnetite-grunerite quartzite alternately fine and coarse banded with numerous veinlets of quartz rich in pyrrhotite. Coarse crystalline pyroxene developed at contact with quartz veins. Also contains bands rich in garnet and dark green hornblende. Assays— 207′ 0″—208′ 10″ 0·5 dwts./ton. 211′ 0″—212′ 10″ 0·8 dwts./ton. 214′ 0″—215′ 5″ Tr. 216′ 5″—217′ 3″ 0·8 dwts./ton.
217	6—230	0	Banded magnetite-grunerite quartzite grading into rather sandy and micaceous basic schist.
230	0—235	0	Chloritic amphibolite schist.
235	0—		End of Bore.

Bore No. 2.

0	0— 55	9	Core not seen.
55	9— 57	0	Pegmatite.
57	0—112	0	Decomposed schistose amphibolite.
112	0—119	0	Decomposed schistose amphibolite with numerous quartz stringers. Assays 112′—115′ Tr. 117′—119′ 0·4 dwts./ton.
119	0—127	0	Quartzose amphibolite schist grading into meta-jaspilite.
127	0—146	0	Meta-jaspilite—Banded magnetite-grunerite quartzite—medium-coarse grained containing some pyroxene and veinlets of quartz mineralised with pyrrhotite. Assay 127′—129′ Tr.
146	0—163	0	Fine banded (varve structure) magnetite-grunerite quartzite with narrow garnet-rich layers. Scattered veinlets of mineralised quartz. Assays 152′ 9″—154′ 6″ Tr. 160′ 9″—162′ 10″ Tr.
163	0—165	0	Fine micaceous bands developed and meta-jaspilite grades into a sandy fine banded micaceous amphibolite (sediment).
165	0—186	0	Banded micaceous amphibolite.
186	0—194	3	Pegmatite.
194	3—197	0	Quartzose and micaceous amphibolite schist.
197	0—269	4	Medium-coarse grained massive biotite granite.
269	4—		End of Bore.

Bore No. 3.

0	0— 28	0	Not seen.
28	0— 76	0	White quartz.
76	0—128	0	Amphibolite schist with micaceous bands and quartz veinlets.
128	0—137	6	Banded magnetite-grunerite quartzite with layers of pyroxene and quartz veinlets. 136′ 4″—137′ (No assay).
137	6—141	0	Amphibolite schist.
141	0—161	4	Granite.
161	4—		End of Bore.

Bore No. 4.

ft.	in.	ft.	in.	
0	0—	69	0	Not seen.
69	0—	107	6	Basic amphibolite schist.
107	6—	109	6	Pegmatite.
109	6—	115	6	Quartz.
115	6—	120	0	Pegmatite.
120	0—	204	9	Granite—contains a little pyrite in places with pyrite and quartz veinlet at 203′ 3″.
204	9—	213	0	Dense fine grained acid rock (? felsite).
213	0—	225	0	Quartz.
225	0—	248	6	Gneissic granite.
248	6—	250	0	Quartz.
250	0—	259	0	Gneissic granite.
259	0—	259	5	Quartz.
259	5—	269	3	Granite.
269	3—			End of Bore.

REPORT ON THE GEOLOGY OF TINDALS, COOLGARDIE GOLDFIELD.

By K. R. Miles, D.Sc., F.G.S.

CONTENTS.

INTRODUCTION.

The Tindals Gold Mine, property of Consolidated Gold Mines of Coolgardie Ltd., is situated some two and a half miles by road South of Coolgardie townsite and lies just East of the railway line running from Coolgardie to Norseman and Esperance. The mine is on gently sloping, fairly low lying ground flanked both to East and West by ridges of undulating high ground.

The area held by the present Company embraces some 265 acres, and extends over a length of more than two miles of country. It is comprised of 25 Gold Mining Leases and one Tailings Area. These are G.M.L.'s 5245, 5246, 5247, 5248, 5253, 5259, 5295, 5296, 5308, 5317, 5328, 5330, 5333, 5334, 5466, 5481, 5482, 5484, 5486, 5488, 5502, 5504, 5505, 5532, 5548, and T.A. 103*. These leases include a number of old workings which, though now abandoned were of considerable importance in the past. They are the Griffiths leases, the Empress of Coolgardie, the Dreadnought, Perseverence, Flagstaff, Lady Carmen, Lady Charlotte and the Big Blow. Active mining operations are at present being carried on solely upon the Tindals line of lode enclosed in part by G.M.L.'s 5245 and 5259 respectively.

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*Since the writer's examination, the management has acquired two more leases—G.ML.'s 5656 and 5657, occupying ground covered by the late G.M.L.'s 5318 and 5343 respectively—now (Sept. 1941) making a total of 27 G.M.L.'s held by the Company.

PLATE XIII

GEOLOGICAL SUBSURFACE MAP
OF
PORTION OF
MEIER'S FIND BORE SITE AREA
(TEMPORARY RESERVE 1087H)
Mt PALMER, YILGARN GOLDFIELD

Scale 100 feet to an inch

100 0 100 200 300 400

Survey data supplied by Mines Dept.
Tape and compass traverses, and geology by K.R. Miles, Aug. 1940

LEGEND

RECENT

- Soil
- Alluvium
- Ferruginous Laterite

PRE-CAMBRIAN

YILGARN SYSTEM, GREENSTONE SERIES

- Greenstone — Medium and fine-grained amphibolite schists (original basic lavas and tuffs).
- Meta-jaspilites — Metamorphosed banded ferruginous quartzites containing interbanded layers of quartz, magnetite, grunerite, hedenbergite with local bands of garnet and hornblende.

INTRUSIVES

- Gneiss and Granite (Overlain by light sandy soil)
- Massive Granite
- Marginal zones of Granitised Greenstone
- Pegmatite Dykes
- Quartz Reefs — Q

REFERENCE TO SIGNS

- Geological boundaries doubtful or assumed
- Strike and dip of bedding — 65°
- Strike of vertical bedding
- Strike of vertical schistosity
- Strike of schistosity with no observed dip — N60°E
- Strike of foliation in Granite or Gneiss — N57°E
- Strike and plunge of dragfold — N70°E, 60°
- Outcrops with no observed strike and dip
- Fault
- Shafts
- Costeans
- Gold Mining Leases (void) — G.M.L. 3591

FERRUGINOUS LATERITE

Gently sloping plateau covered with low scrub

Low Scrub

Probable zone of partially Granitised Greenstone

No outcrops

Chips of Granite and Greenstone

Red Soil

Red Soil probably overlies Greenstone

Granitic Schist N40°E

Line of Qfe Rubble

Schistose Basic Lava

Granitic Schist N43°E

Granite QFe

Occasional chips of Qfe only

Line of Qfe Rubble — Accurate measurement impossible

Schistose Basic Lava N50°E

Shallow Water-course

Outcrops and Rubble of Schistose Basic Lava

Schistose Greenstone Outcrops and Rubble

Lateritised Granitic Schist 70°

Schistose Basic Lava

Basic Schist

Abundant Quartz Rubble

Red Soil

No outcrops

Abundant Quartz and Pegmatite Rubble

Scattered Qfe and Quartz Rubble

Track

Track to Mt Palmer

Light coloured sandy soil probably overlying Granite or Gneiss

Pothole

Red Sandy Soil

Schistose Basic Lava

Massive Granite outcrops

G.M.L. 3644

Costean N34°E

Light yellow sandy soil

Massive Granite

Abundant Quartz Rubble

G.M.L. 3590

Granitised Basic Lava

Greenstone Schist

Schistose Greenstone

QFe

Decomposed Schist

Abundant Qfe Rubble

Basic Schist

Schistose Greenstone (Granitised Basic Lava)

Costean

Highly dragfolded

Heavy Quartz Rubble on steep slope

Numerous outcrops of Blocky Schistose Basic Lava N64°E

Soil and Rubble

Blocky Greenstone

Deep Gully

Bore No 4

Bore No 3

Bore No 2

Bore No 1

Numerous outcrops of Blocky Greenstone

Outcrops and Rubble Schistose Greenstone

Outcrops of blocky, dense, fine-grained Basic Lava

Quartz Rubble

Outcrops of Schistose Basic Lava

G.M.L. 3647

Numerous outcrops of Blocky Greenstone (Basic Lava)

Abundant Quartz Rubble

Blocky Schistose Greenstone

Blocky Greenstone outcrops Schistose to Gneissic Basic Lava

Steep Cliffs

Blocky Greenstone

Numerous outcrops of Blocky Greenstone Schist

LAKE

Numerous outcrops and rubble of Schistose Basic Lava

Blocky Greenstone

Deep Gully

Blocky Schistose Basic Lava

Abundant outcrops of Blocky Schistose Greenstone with scattered Magnesite nodules

Blocky Schistose Greenstone (Lava)

Numerous outcrops of Schistose Basic Lava

Blocky Schistose Greenstone with scattered nodules of Magnesite

Greenstone Schist and Rubble Outcrops

Coarse Pegmatitic Granite

Numerous outcrops of Schistose Basic Lava

Sloping floors of Massive Granite

LAKE

Heavy Talus

Very thick quartz and pegmatite talus obscuring geology

Geology obscured

Heavy Quartz Rubble and scattered chips

Quartz Rubble

G.M.L. 3758

Blocky Greenstone Schist

Few outcrops Gently sloping ground Soil and Greenstone Rubble

Open Country covered with numerous outcrops of Schistose Greenstone

G.M.L. 3646

Numerous outcrops and rubble of Schistose Basic Lava

Soil and Rubble

Coarse Amphibolite Rock

Basic Lava

Basic Schistose Lava

Costean Decomposed Schist

Numerous outcrops of dense, fine-grained Schistose Basic Lava

Coarse band Greenstone N50°E

Probable fault movement

Light yellow sandy soil with Costean chips of Granite and Pegmatite

Numerous outcrops Schistose Basic Lava

Numerous outcrops of Schistose Basic Lava

Soil

Few outcrops Quartz and Greenstone Rubble

Gently sloping ground

Costean

Decomposed Schistose ? Greenstone in dumps

Shallow Water-course

Decomposed red Schistose ? Greenstone Lava

Soil and Rubble No outcrops

Few outcrops

Soil and Rubble and scattered outcrops of decomposed Greenstone

Abundant scattered outcrops of Schistose Basic Lava

Costean

Numerous outcrops of Schistose Basic Lava N75°E N62°E

Pegmatite

Pegmatitic Granite

Basic Lava

Schistose Basic Lava N60°E

Schistose Basic Lava N57°E

Schistose Basic Lava N43°E

Abundant Quartz Rubble

Schistose Basic Lava N57°E

Costean Decomposed Kaolinitic Schist in dump

Schistose Basic Lava N60°E

Few outcrops Quartz and Greenstone Rubble

Outcrops of decomposed (lateritised) Greenstone and thick Quartz Rubble

Schistose Basic Lava

Basic Schist

Sandy Laterite Soil No outcrops Thick Scrub

Numerous outcrops of Schistose Basic Lava

Sandy Soil

Schistose Basic Lava N70°E N82°E Spearheads pitch W at 45°-50°

Light Sandy Soil with scattered chips of Granite or Gneiss

Costeans with Quartz in dumps

Schistose Basic Lava N56°E

G.M.L. 3647

Basic Schist

Blocky Schistose Basic Lava

Pothole

Coarse Gneissic Granite

Previous to the present examination, the only recorded geological surveys of the Tindals area by Departmental officers appear to have been carried out by Blatchford and Allhusen in 1898* and by Blatchford in 1912**.

The present survey was conducted by the writer during the period April 17th to May 29th, 1941. This work included the preparation of a surface geological map on a scale of 5 chains to an inch, which embraced an area containing all the leases held by the Company. (See Plate XIV.) Mapping was carried out by means of a plane table and alidade, with the addition of compass traverses. For assistance in this surface mapping, and in the underground work, a field hand was made available by the management.

The writer's underground examination was greatly facilitated by the use of up-to-date survey plans and sections provided by the management, for whose ready co-operation and assistance both in this, and in the provision of a field assistant, he is much indebted. Geological plans were made of each main level, and longitudinal and cross sections of the workings were drawn from these† For the most part the underground mapping resolved itself into a checking up of geological boundaries as delineated upon the Company's plans. For information concerning the now inaccessible portions of the mine, the writer relied solely upon these plans.

GENERAL GEOLOGY.

The Tindals Gold Mine is located in an area of schistose greenstones—probably representing the recrystallised and metamorphosed remains of original basic tuffs, lava flows, and some interbedded basic sediments, believed to be of pre-Cambrian age—probably part of the Older Greenstone or restricted Kalgoorlie Series.

To the immediate East of the mine these schists are bounded by a belt of hard, blocky greenstones—fine grained recrystallised basic lavas and (?) sills of recrystallised medium grained gabbro amphibolite, with interbedded thin bands of laminated black graphitic slates. The rocks of this belt are more resistant to erosion than the adjacent schists, and consequently they stand out as a belt of broken, hilly country. The contact between the schists and this belt of blocky lavas is a sharp one. In the Southern part of the area mapped, this boundary strikes North and South, but further Northward it swings away to the North-East.

Further North again, and outside the area mapped, the blocky lava belt swings back to a North-Westerly strike and extends towards Coolgardie. Thus the whole belt describes a sharply curved horseshoe fold or arc with an East-West axis at approximately one mile North-East of Tindals. Examination of structure lines plotted from a series of air photographs of this area indicates that the country has been folded in an East-facing arc at some distance to the North-East of Tindals, the bedding planes of the whole belt of greenstones then swinging from a North-Westerly strike to East and West in a gentle arc to the North of Coolgardie townsite.

Just South of the main Coolgardie-Norseman road at about one and three-quarter miles South-East of Coolgardie, are some excellent exposures of pillow lavas in a cutting near an old dam. These pillow lavas lie within the Northward continuation of the belt of blocky lavas mapped at Tindals as already described. The pillows face Eastward, strike a little West of North, and dip steeply to the East. This orientation of the pillows tends to confirm the impression that they here form portion of the Northern limb of either a normal anticlinal or an overturned synclinal fold whose axial plane runs approximately East and West at some half mile North of Tindals.

At about one and a quarter miles due North of Coolgardie railway station is a prominent ridge on which is located the reservoir for the town water supply. This ridge consists of blocky fine grained amphibolite (lava) whose bedding planes apparently strike about East and West and dip Northward at moderate angles. Good exposures are found in a cutting made for the pipe line, where can be seen rounded forms strongly suggestive of pillow structures. In all probability the rocks of this ridge represent a continuation of the same belt of lavas which cross the Coolgardie-Norseman road and then swing round to the South-East of Tindals as described above.

In travelling Westward from Tindals it is seen that schistose basic lava flows interbedded with the schists, become progressively more and more numerous, and they constitute a line of prominent ridges running in a direction approximately N. 10° E. at about half a mile West of Tindals. Vesicular and amygdaloidal structures are well preserved in these flows. In this series there is also a belt of fine grained basic porphyrite believed to represent a flow lava.

Further Westward of these ridges the country gradually flattens out into a featureless plain covered by red soil or yellowish sand, and a uniform low mulga-mallee and spinifex vegetation believed to overlie either granite or gneiss.

Within the area mapped are numerous scattered occurrences of later acid intrusives—aplite and quartz reefs. Dykes of aplite, which constitute the principal lode formations in the area are almost entirely confined to the belt of basic schists. The quartz reefs are more liberally scattered, but although some small reefs and veins are found cutting through the blocky and schistose lava belts to the East and West of Tindals, they are most abundant within the basic schist belt. Several of these quartz reefs or "blows" situated in the Tindals leases, form prominent knolls surrounded by flat or gently undulating country covered over considerable areas by milk white quartz rubble derived from these knolls.

Although many of these quartz reefs have obviously been prospected and tested with costeans, pits and shafts. it is evident from the lack of any extensive mining within them, that few of them carry gold in payable quantities. *The ore bodies of the TINDALS MINE are aplitic lodes.*

Recent superficial deposits consist of red soil and alluvium derived from the weathering, decomposition and transportation of pre-existing rock formations during the present cycle of erosion. Soil covered areas are more abundant overlying the softer and more easily decomposed basic schists than the adjacent blocky and more resistant basic lavas. Alluvium is confined to the beds of several of the main drainage channels, the principal one swinging away in a South-Easterly direction in the South-Western portion of the area mapped.

THE COUNTRY ROCKS.

(a) *The Schistose Greenstones or Basic Schists.*

The rocks in the basic schist belt vary in grain size from medium fine to relatively coarse, though the coarse grained schists predominate. These rocks usually have a strongly laminated or platy structure, foliation planes varying in strike from about N. 20° W. to N. 60° E. in different parts of the area, and dipping vertically or at steep angles either to the East or the West. Some portions of these schists are intersected by a series of cross joints which result in the exposed surfaces being weathered into sharply pointed, steeply pitching spears. In other places the schists have weathered into rounded or oval shaped boulders whose long axes often show a parallel alignment. These may possibly represent the schistose relicts of original pillows in interbedded thin lava flows. Good exposures of these rounded bouldery structures and pitching spears in the schists can be seen on the Western flanks of a prominent ridge between 30 and 40 chains due South of Tindals Main Shaft, and also at about 30 chains East-North-East of the Main Shaft on the late Great Hope and Lady Charlotte leases (G.M.L.'s 5548 and 5549, see Plate XIV.)

Microscopic examination of typical specimens of these schists reveals that they are made up almost entirely of oriented fibrous masses of pale green tremolite—actinolite plates and needles. The only other minerals present are usually microscopic quantities of interstitial quartz, felspar, carbonate (calcite) and scattered granules of magnetite. The textures are characteristic of complete recrystallisation under moderately high shear-

*Geol. Surv. W.A. Bull. 3. 1899.
†Not published—available for perusal at Geo. Sur. Office.
**Geo. Sur. W.A. Bull. 53, 1913 pp. 46-7.

ing pressures. Dinstinct banding is seen in some specimens due to variations in the grain size of the amphibole in certain layers. The uniform composition and coarse crystallinity of these amphibolite schists suggests a thorough mixing and diffusion of an original limited number of constituents with a consequent ease of recrystallisation under moderate temperatures and pressures, such as might be expected from a basic tuff, and it is therefore considered that a great deal of this basic schist material was originally present in the form of basic (probably andesitic) tuffs, interbedded with thin beds of basic lavas and sediments.

(b) *The Blocky Basic Lavas.*

The fine grained blocky greenstones found associated with coaser grained gabbro amphibolites and forming, as already described, a distinct horizon at some 50-60 chains East of Tindals Mine, have a remarkable uniform mineralogical composition. They consist almost entirely of laths of pale green amphibole occasionally enclosing tiny clustered aggregates of magnetite, with clear interstitial spaces filled with granular quartz or felspar. The only other mineral noticed under the microscope was pale yellow epidote in a few scattered grains. These rocks have obviously been completely recrystallised. Thin sections frequently reveal the amphibole laths (which usually show well defined prism faces and cleavage but no distinct terminations) to be arranged in spiral shaped groups suggestive of rotation of the centres of recrystallisation and progressive deformation during or towards the close of the recrystallisation period. The amphibole is a weakly pleochroic blue-green variety of actinolitic hornblende.

These rocks are now fine grained blocky amphibolites formed from the complete recrystallisation at fairly high temperatures and moderate pressures, of original fine grained basic lava—doleritic or basaltic. It is possible that they frequently contain pillow structures, but the highly jointed and blocky fractured state of the surface exposures makes the recognition of such features well nigh impossible. Some portions of the outcrops appear much denser and finer grained than others and are usually fractured into thin spear-shaped slivers. These probably represent the chilled margins of individual flows.

(c) *The Schistose and Amygdaloidal Basic Lavas.*

The schistose basic lava flows occurring to the West of Tindals are generally finer grained, darker and more dense, though distinctly more schistose than the blocky lavas on the Eastern side of the area mapped. Individual flows ranging from less than 20 feet up to many hundreds of feet thick have been recognised in the field. These frequently show well preserved vesicular and amygdaloidal structures, the vesicles being stretched and elongated parallel to the boundaries of the flows. This orientation may represent the direction of original flow or it may be principally due to later directed pressure.

The vesicles are commonly filled with quartz or, though to a lesser extent, calcite. Thin sections of these rocks show that they have been recrystallised into fine grained aggregates of shredded pale green amphibole intergrown with the relicts of tiny needles, laths and plates, of plagioclase felspar, and enclosing scattered grains of iron ore (magnetite). Some fine grained specimens were found to contain amygdales formed by the oozing of residual magma into the vesicles, producing small rounded patches of minute amphibole and felspar crystallites. These rocks were probably original dolerites or basaltic dolerites.

Numerous outcrops of basic porphyrite occur to the West of Tindals and associated with the schistose basic lavas. No attempt was made to map the porphyrite in detail. From its general distribution however, it appears to occur as elongated tabular bodies lying concordant with the above mentioned lava flows, though in several places these bodies may be cutting through the flows. The porphyrite is a dense dark coloured rock usually having a very fine grained ground mass enclosing abundant idiomorphic white crystals of felspar which range from less than 1mm. up to more than 25 mm. in diameter. The larger phenocrysts are generally crowded with inclusions of amphibole needles often showing a zonal arrangement.

Thin sections show the ground mass to consist of interlocking fine grained, recrystallised shredded amphibole and needle relicts of felspar not dissimilar from the schistose basic lavas described above. Other minerals recognised are sphene, with cores of ilmenite. The felspar needles in the ground mass, especially where they are adjacent to phenocrysts, are usually oriented to give a fluxional arrangement. The phenocrysts are of plagioclase felspar (var. labradorite) crowded with inclusions of blue green hornblende needles and showing replacement by quartz and epidote.

This rock is very possibly a basic volcanic extrusive more or less contemporaneous in age and co-magmatic with the other schistose basic lavas.

(d) *Gabbro Amphibolite.*

This rock is confined mainly to the Eastern side of the area mapped. It forms a fairly continuous narrow belt, averaging less than 100 feet wide, along the boundary between the blocky basic lava belt and the basic schists, and also as apparently parallel bodies intermingled with the blocky lavas, though no attempt was made to map the rock within the blocky lava belt.

It is dark green, medium to medium coarse grained, and though usually blocky may sometimes be distinctly schistose. It consists of interlocking plates of amphibole which in thin section are pale brownish green to blue-green, with ragged terminations and which are occasionally grouped in spiral shaped clusters. Interstitial material is clear, colourless granulated plagioclase felspar and a little quartz. Other minerals present are granular epidote and magnetite. The texture is characteristic of partial recrystallisation, and the mineralogical composition of the rock generally is very similar to that of the blocky lavas as described above.

This rock probably represents pre-metamorphism (and folding) sills of doleritic gabbro intruded into the blocky basic lavas and neighbouring tuffs, and was probably derived from the same magma which produced the blocky lavas themselves.

(e) *The Sediments.*

In the extreme South-East corner of the area mapped, and within the blocky basic lava belt is a series of thin, discontinuous and apparently highly folded beds of laminated black graphitic slates, which sometimes grade across the strike into felspathic sandy beds. The slates are usually somewhat silicified at the surface and the rare outcrops are generally characterised by the presence of abundant yellowish white travertine. These beds are partly enclosed by the late G.M.L.'s 5269 (''Master-key'') and 5465, and in the former lease highly mineralised portions of the graphitic slate have yielded payable ore bodies.

At one point where the sediments have apparently been intruded by a body of gabbro amphibolite, near the contact, a band of felspathic sandy slate has been metamorphosed to pinkish coloured felspathic quartz-muscovite schist containing flakes of fresh muscovite scattered through a matrix of fine granular quartz and cloudy decomposed felspar Another abundant mineral is deep yellowish semi-opaque and granular epidote

THE ORE BODIES.

Surface observations of the various leases in the Tindals Group indicate that the ore bodies within them consist principally of either mineralised aplite lodes or quartz reefs, although one or two compound lode formations consisting of mineralised schist with stringers of quartz, have also been mined in the past.

As has already been stated, the main ore body of the Tindals Mine at present being worked is an aplite lode, but before proceeding with a detailed description of this, it is proposed to give a few notes on the principal lodes in the other leases of the group. No underground examination of any of these was made by the present writer, however, as in most cases these old workings had long been abandoned and were inaccessible.

PLATE XIV

GEOLOGICAL SUBSURFACF MAP OF TINDALS GROUP

COOLGARDIE

COOLGARDIE GOLDFIELD

Scale: 5 chains to an inch

5 4 3 2 1 0 5 10 15 20

LEGEND

RECENT

Alluvium

PRE-CAMBRIAN

OLDER GREENSTONE SERIES

- Laminated Graphitic Slate.
- Recrystallised blocky Basic Lavas, with sills and dykes of Gabbro Amphibolite
- Basic (Amphibolite) Schists: Original Basic Tuffs and ? Pillow Lavas, with interbedded flows of Schistose, often Amygdaloidal Basic Lava, & Porphyrite.
- Medium to coarse grained Gabbro Amphibolite.

INTRUSIVES

- Quartz Reefs
- Aplite Dykes (Lodes)

REFERENCE TO SIGNS

- Gold Mining Leases (Existing) — G.M.L 5246
- Gold Mining Leases (Void) — G.M.L 5337
- Tailings Area — T.A 103
- Leases held by Consolidated Gold Mines of Coolgardie, Ltd.
- Tailings and mullock dumps
- Open Cuts
- Costeane
- Shafts (accessible)
- Shafts (inaccessible)
- Buildings
- Railway lines
- Formed road
- Tracks
- Drainage channels
- Form lines
- Geological boundaries (doubtful)
- Outcrops with no observed strike or dip
- Strike and dip of schistosity
- Strike of schistosity, dip steep but not measurable
- Strike and plunge of dragfold
- Pitch of spears or ? pillows in Basic Schist
- Locality and direction of Surface Diamond Drill Holes — BORE No 15

Survey data supplied by Mines Dept.
Plane Table and Telescopic Alidade surveys,
Compass traverses and Geology by K.R. Miles, May 1941.

JMPL 14-10-41

(a) *The "Empress of Coolgardie" G.M.L.* 5295 *and "Alicia," late G.M.L.* 5318.

The lode formation of the Empress of Coolgardie is an aplitic dyke in basic schists—all highly weathered and traceable over a length of some 400 feet. At the Southern end of the workings is a prominent quartz blow running parallel to the lode. This does not carry payable quantities of gold.

Directly East of the Empress of Coolgardie is the late Alicia lease which carries an 80-100 feet wide belt of aplite running approximately North and South and traceable for a length of over 800 feet. Traces of gold can be found throughout the dyke but usually in quantities insufficient to repay treatment.

(b) *The "Dreadnought" Lode G.M.L.'s* 5328, 5253.

The old Dreadnought lode appears to have been a mineralised quartz reef averaging 3 to 4 feet in width, and dipping vertically. Shafts along the line of strike (N. 30° E.) extend over a length of 500 feet. The sulphide mineral appears to be pyrite with possibly some pyrrhotite. Blue copper carbonate stains on some weathered fragments from old ore paddocks indicate the presence of some original chalcopyrite in addition to the iron sulphide minerals. The country rock is soft, foliated amphibolite schist. In G.M.L. 5253 there are also numerous dykes of aplite, some forming an intersecting network, well exposed in a group of shallow workings.

(c) *"Tindals No. 2" (late "Perseverance"), "Flagstaff" and "Lady Carmen" G.M.L.'s* 5246, 5502 *and* 5486.

The lines of old workings in these three leases which lie to the North and North-East of Tindals indicate three lines of quartz reefs running in the general direction North-East—South-West, enclosed in decomposed amphibolite schists and occasionally associated with thin bands of graphitic schist. It is reported that some aplite lode material has also been found in the Flagstaff workings.

(d) *The "Big Blow" and "Little Blow" lodes G.M.L.'s* 5248, 5481, 5484.

These two leases lie some 80-100 chains North of the main Tindals workings. The Big Blow lode from surface observations appears to represent a band of decomposed ferruginous schist (probably sediment) which has been penetrated by stringers of quartz. Two large barren, iron stained quartz reefs are situated to the immediate East and to the South-West of the big open cut by which this lode has been worked, and other reefs evidently equally as barren lie further North. The Little Blow line of lode has been traced discontinuously over a length of more than 22 chains with a Southerly continuation at some 8 chains further south. This lode material apparently consists of mineralised quartz in a belt of granitic aplite enclosed in basic schist (doubtful lava). Surface exposures are mostly highly decomposed. This line lies to the East of the Big Blow line and runs almost due North and South.

As regards the production from the various lodes described above, a search of official records has been made, and the official production figures have been rearranged so as to give, wherever possible, a complete analysis of the production from each principal lode. This is set out in the Production Table attached at the close of this report.

The Tindals Lodes G.M.L.'s 5245, 5247, 5259.

In these leases there are four lines of lode formation which have been opened up at the surface and worked to varying depths in the past. These are:—the Tindals Main Lode, the Bird in Hand lode, the Griffiths lode and the Cyanide lode.

The line of the Main Lode runs almost due North and South and has been traced at the surface over a length of nearly 1,800 feet, over about 1,200 feet of which payable ore has been mined in the surface zone. The Bird in Hand line lies about 500 feet East of the Northern part of the Main Lode and strikes about N. 15° E. It consists of a narrow dyke of decomposed aplite and quartz in decomposed greenstone schist, and has been traced at the surface over a length of about 400 feet.

The Griffiths line consists of an aplite dyke of unknown width running parallel to the Bird in Hand line but at some 300-400 feet East of the Southern end of the Main Lode. It is traceable over about 600 feet but the bulk of the surface outcrops in this vicinity are now hidden under sand, tailings and mullock dumps.

The Cyanide lode is not well exposed at the surface. It consists of a very fine grained siliceous dyke or series of dykes ("Silicified lode"), in platy amphibolite schist, running approximately North and South at about 980 feet due east of Tindals Main Shaft. Just South and East of where the lode has been opened up is the outcrop of a large white iron-stained quartz reef which is, however, barren of gold.

Tindals Main Lode.

At the time of inspection (May 1941) active mining was being carried out on the Tindals Main Lode only. This lode had been opened up to a depth of 600 feet, while the main shaft had been sunk to 700 feet, and crosscutting was in progress to expose the lode at this depth. From the No. 2 level (200 feet) to the surface the greater part of the lode has been stoped out but below this, though many large blocks of ore have been stoped and occasionally filled, geological boundaries may be delineated with fair accuracy along the walls of the main drives. No stoping had been done below the No. 5 (500ft.) level.

The country rock lying to the west of the Main Lode has been exposed in a crosscut which runs West for about 160 feet from the Main Shaft, on the No. 3 (310ft.) level. The country to the East of the Main Lode has been explored on the No. 4 (385ft.) level by a cross cut which links the Main Shaft with the Cyanide Shaft, a distance of nearly 1000 feet.

(a) *Structure.*

The ore body forming the Tindals Main Lode channel is a compound formation and is not a continuous body, but consists of a discontinuous series of overlapping lenses of acid intrusive material separated by thin walls of amphibolite schist country which pinch and swell, coalesce and lens out longitudinally, in both the horizontal and the vertical planes. The form of the ore body represents what might be expected as the result of the penetration, fracturing and partial absorption of a series of thinly laminated and foliated schists in a narrow zone of weakness, by a fairly fluid intrusive magma.

The lode channel as a whole is by no means regular in thickness and varies continuously, ranging from less than 5 feet up to probably 90-100 feet thick in places. It follows a rather sinuous line running approximately North and South for about 500 feet North of the Main Shaft. Further North of this point it swings to the West. This swing is visible in the plans of levels Nos. 1 to 5, but in the No. 6 (600ft.) level driving had not been continued far enough North to expose it. It has been exposed most fully in the No. 3 level where, at about 750 feet North of the Main Shaft the lode channel appears to be running approximately East and West and thence curving back to the South. Here, in the vicinity of co-ordinates 120′ E. and 455′ S. (see underground plans) the strike of the schistosity in adjoining amphibolite schist on the North side of the drive is N. 55° W., indicating that the lode material is here cutting across the country.

The exact course of the lode here in the Northern extremity of the mine has not yet been fully defined. It appears to swing back on itself, producing a fairly sharp North-facing fold which pitches steeply to the South. A horizontal diamond drill bore hole put out almost due West from co-ordinates 250′ E., 580′ S. on

the writer's knowledge no shoots of payable gold ore have been located in the subsidiary parallel lenses of "silicified' material below the zone of oxidation.

Thirdly, although the gold is distributed rather erratically throughout the aplite, in general it may be said that values are highest where the ore is light coloured aplite, fairly heavily mineralised and intersected by abundant stringers or veinlets of quartz. Dark coloured granitic or dioritic lode, little mineralised, is generally regarded as poor or unfavourable ore. Of the sulphide minerals pyrrhotite is probably a more favourable indicator than pyrite. It is not known definitely what effect the presence of scheelite in quartz has upon the gold content of the lode at Tindals, but apparently scheelite does not necessarily indicate improved values. Scheelite bearing auriferous quartz reefs have been found in a number of other goldfields in Western Australia and in at least one of these, viz., the late Fraser's G.M., Southern Cross, scheelite is said to occur in association with ore richest in gold.

Probably the best and most consistent values in the sulphide zone have been obtained from that portion of the lode channel which lies between co-ordinates 550 feet S. and 850 feet S. This is the part in which the lode channel is swinging from almost due North to about 30° W., and at 550 feet S. from No. 2 level down to No. 5 level it is of good payable width though tapering from about 50 feet to 25 feet (true width) with increasing depth. Further North of 550 feet S. the lode maintains its width, but the ore becomes more granitic and values drop. Between No. 3 and No. 5 levels payable values were encountered between co-ordinates 1,050 feet S. and 1,200 feet S., just North of the main shaft, and also South of the main shaft between co-ordinates 1,300 feet S. and 1,400 feet S. In the Southern end of the mine, however, the lenticular nature of the aplitic ore and the presence of numerous blocks of unpayable material —basic schist and "silicified" lode—provide serious complications to economical mining.

Griffiths Extension and Cyanide Lodes.

As a result of the discovery of good values in a bore (No. 10) drilled from the surface by the present company to intersect the Cyanide Lode at about 500 feet V.D., a considerable amount of money was spent in development work designed to open up the lode at depth. A crosscut was driven from opposite the Tindals Main Shaft on the No. 4 (386ft.) level for about 1,000 feet Eastwards to cut the Cyanide Lode and an old prospecting shaft was reamed out and timbered into a three-compartment shaft, and sunk to the crosscut. From the Cyanide Shaft at this level the crosscut was continued Eastward for nearly 80 feet and then a winding drive was carried Northwards for about 400 feet. West crosscuts were driven for about 80 feet from points on this drive at co-ordinates 1,270 E., 1,060 S., and at 1,315 E., 870 S., and a subsidiary drive was cut Northwards for about 100 feet from 1,200 E., 1,030 S.

During the course of this development work innumerable thin lenses of "silicified" lode were exposed in the amphibolite schist country but evidently none of these proved sufficiently valuable to merit the cost of additional development. Few of the lenses examined by the writer contained much sulphide mineral, and none showed any resemblance to the typical aplite ore of the Tindals Main Lode.

The main crosscut linking the Tindals and the Cyanide shafts intersected several bands of "silicified" lode material. One of these on assay showed traces of gold and accordingly was opened up by short drives for 60 feet North and 40 feet South of the crosscut. The results proved disappointing however, and the work was discontinued. This lens was here about 30 feet wide. Because of its supposed correlation with the Griffiths line of lode to the South this has been called the Griffiths Extension. No trace was found in this crosscut of a Southward extension of the Bird in Hand line of lode, but so discontinuous and lenticular are these "silicified" lodes, especially those revealed in the Cyanide workings, that little value can be attached to their apparent absence at any particular point. This fact is particularly demonstrated in any attempt to correlate information derived from the logs of adjacent bore holes drilled through this country.

The Iron Duke G.M.L. 5577.

This lease lies immediately west of the Empress of Coolgardie lease, and outside the property held by Consolidated Gold Mines of Coolgardie, Ltd. The ore body is a narrow quartz reef on the West side of an ironstone knoll. The reef cannot be traced for more than about 30 feet on the surface but at the time of inspection had been opened up to a vertical depth of about 150 feet. It averaged about 2 feet wide but was somewhat irregular, often pinching to less than six inches. At the time of inspection (May, 1941) this property was under option to New Golconda Gold Mines N.L. Some rich stone has been obtained from this reef, the official production up to July, 1941, (given below) being 571 tons of ore treated for 481.24 fine ounces of gold, or a yield of 16.8 dwt. per ton.

BORING.

Nineteen diamond drill holes have been sunk from the surface to intersect the various lodes of the Tindals Group. Bores Nos. 1 to 4 were drilled by the Government, Nos. 5-7 by the Western Mining Corporation during the period of an option held by them over the property, and Nos. 8-19 were drilled by the present Company. Two surface bores were also drilled by the Western Mining Corporation into the Big Blow Lode on G.M.L. 5248. The localities and directions of all these bores have been plotted on the surface geological map (Plate XIV). All existing information and detailed logs of these bores were kindly made available to the writer by the management, but no descriptions of these will be included here.

A noticeable feature of this boring is the fact that no attempt has been made to drill into the Tindals Main Lode from the surface on the Western side. This is particularly surprising in that the lode is known to dip at a steep angle to the West, whilst two lines of aplitic dyke rock, the Alicia and the Empress of Coolgardie, appear to be converging to the West of the Main Lode. The only exploration of the West wall country rock is confined to three horizontal bores (300S, 300E and 300T) drilled from the No. 3 level. These have investigated the country North of the Main Shaft, but no bores have penetrated any distance into the West wall country South of the Main Shaft.

Many of these surface bores have confirmed the presence of numerous subsidiary parallel lenses of "silicified" lode material in the country between the Main Lode and the Cyanide Lode, but evidently none of these have proved sufficiently rich in gold to warrant development at the present time. It may be noted here that no trace of the Tindals Main Lode formation was found in bores No. 7 and No. 11 put down North of F Shaft to test the possible Northern continuation of the lode at depth. This tends to confirm the evidence that the lode channel folds back on itself just West of F Shaft. Apparently no attempt has so far been made to explore the possibilities of the lines of aplitic lode further West of Tindals, viz., the Alicia line on G.M.L's. 5318 and 5317 and the Empress of Coolgardie line on G.M.L. 5295, as mentioned above.

MINING AND TREATMENT.

Although the question of the mining and treatment of the ore at Tindals G.M. is outside the scope of the present report and was not investigated by the writer, a few notes may not be inappropriate here, especially as the whole subject is inevitably bound up with considerations of geological occurrence and association.

On the whole, the ore and country in the Tindals Main Lode channel is strong, and, assisted by the high angle of dip, is fairly good holding ground. There are, however, certain thin seams usually of amphibolite schist in the basic schist walls of the lode which on exposure to air seem to lose the power of coherence. These bands fret away, and on being touched, disintegrate at the surface into a running powder. In a few places the fretting of such seams has weakened walls and necessitated some timbering.

The aplite lode itself is a rather brittle rock and usually breaks out well. Blocks of ore in wide stopes occasionally become seriously fractured and weakened by

(a) *The "Empress of Coolgardie" G.M.L.* 5295 *and "Alicia," late G.M.L.* 5318.

The lode formation of the Empress of Coolgardie is an aplitic dyke in basic schists—all highly weathered and traceable over a length of some 400 feet. At the Southern end of the workings is a prominent quartz blow running parallel to the lode. This does not carry payable quantities of gold.

Directly East of the Empress of Coolgardie is the late Alicia lease which carries an 80-100 feet wide belt of aplite running approximately North and South and traceable for a length of over 800 feet. Traces of gold can be found throughout the dyke but usually in quantities insufficient to repay treatment.

(b) *The "Dreadnought" Lode G.M.L.'s* 5328, 5253.

The old Dreadnought lode appears to have been a mineralised quartz reef averaging 3 to 4 feet in width, and dipping vertically. Shafts along the line of strike (N. 30° E.) extend over a length of 500 feet. The sulphide mineral appears to be pyrite with possibly some pyrrhotite. Blue copper carbonate stains on some weathered fragments from old ore paddocks indicate the presence of some original chalcopyrite in addition to the iron sulphide minerals. The country rock is soft, foliated amphibolite schist. In G.M.L. 5253 there are also numerous dykes of aplite, some forming an intersecting network, well exposed in a group of shallow workings.

(c) *"Tindals No. 2" (late "Perseverance"), "Flagstaff" and "Lady Carmen" G.M.L.'s* 5246, 5502 *and* 5486.

The lines of old workings in these three leases which lie to the North and North-East of Tindals indicate three lines of quartz reefs running in the general direction North-East—South-West, enclosed in decomposed amphibolite schists and occasionally associated with thin bands of graphitic schist. It is reported that some aplite lode material has also been found in the Flagstaff workings.

(d) *The "Big Blow" and "Little Blow" lodes G.M.L.'s* 5248, 5481, 5484.

These two leases lie some 80-100 chains North of the main Tindals workings. The Big Blow lode from surface observations appears to represent a band of decomposed ferruginous schist (probably sediment) which has been penetrated by stringers of quartz. Two large barren, iron stained quartz reefs are situated to the immediate East and to the South-West of the big open cut by which this lode has been worked, and other reefs evidently equally as barren lie further North. The Little Blow line of lode has been traced discontinuously over a length of more than 22 chains with a Southerly continuation at some 8 chains further south. This lode material apparently consists of mineralised quartz in a belt of granitic aplite enclosed in basic schist (doubtful lava). Surface exposures are mostly highly decomposed. This line lies to the East of the Big Blow line and runs almost due North and South.

As regards the production from the various lodes described above, a search of official records has been made, and the official production figures have been rearranged so as to give, wherever possible, a complete analysis of the production from each principal lode. This is set out in the Production Table attached at the close of this report.

The Tindals Lodes G.M.L.'s 5245, 5247, 5259.

In these leases there are four lines of lode formation which have been opened up at the surface and worked to varying depths in the past. These are:—the Tindals Main Lode, the Bird in Hand lode, the Griffiths lode and the Cyanide lode.

The line of the Main Lode runs almost due North and South and has been traced at the surface over a length of nearly 1,800 feet, over about 1,200 feet of which payable ore has been mined in the surface zone. The Bird in Hand line lies about 500 feet East of the Northern part of the Main Lode and strikes about N. 15° E. It consists of a narrow dyke of decomposed aplite and quartz in decomposed greenstone schist, and has been traced at the surface over a length of about 400 feet.

The Griffiths line consists of an aplite dyke of unknown width running parallel to the Bird in Hand line but at some 300-400 feet East of the Southern end of the Main Lode. It is traceable over about 600 feet but the bulk of the surface outcrops in this vicinity are now hidden under sand, tailings and mullock dumps.

The Cyanide lode is not well exposed at the surface. It consists of a very fine grained siliceous dyke or series of dykes ("Silicified lode"), in platy amphibolite schist, running approximately North and South at about 980 feet due east of Tindals Main Shaft. Just South and East of where the lode has been opened up is the outcrop of a large white iron-stained quartz reef which is, however, barren of gold.

Tindals Main Lode.

At the time of inspection (May 1941) active mining was being carried out on the Tindals Main Lode only. This lode had been opened up to a depth of 600 feet, while the main shaft had been sunk to 700 feet, and crosscutting was in progress to expose the lode at this depth. From the No. 2 level (200 feet) to the surface the greater part of the lode has been stoped out but below this, though many large blocks of ore have been stoped and occasionally filled, geological boundaries may be delineated with fair accuracy along the walls of the main drives. No stoping had been done below the No. 5 (500ft.) level.

The country rock lying to the west of the Main Lode has been exposed in a crosscut which runs West for about 160 feet from the Main Shaft, on the No. 3 (310ft.) level. The country to the East of the Main Lode has been explored on the No. 4 (385ft.) level by a cross cut which links the Main Shaft with the Cyanide Shaft, a distance of nearly 1000 feet.

(a) *Structure.*

The ore body forming the Tindals Main Lode channel is a compound formation and is not a continuous body, but consists of a discontinuous series of overlapping lenses of acid intrusive material separated by thin walls of amphibolite schist country which pinch and swell, coalesce and lens out longitudinally, in both the horizontal and the vertical planes. The form of the ore body represents what might be expected as the result of the penetration, fracturing and partial absorption of a series of thinly laminated and foliated schists in a narrow zone of weakness, by a fairly fluid intrusive magma.

The lode channel as a whole is by no means regular in thickness and varies continuously, ranging from less than 5 feet up to probably 90-100 feet thick in places. It follows a rather sinuous line running approximately North and South for about 500 feet North of the Main Shaft. Further North of this point it swings to the West. This swing is visible in the plans of levels Nos. 1 to 5, but in the No. 6 (600ft.) level driving had not been continued far enough North to expose it. It has been exposed most fully in the No. 3 level where, at about 750 feet North of the Main Shaft the lode channel appears to be running approximately East and West and thence curving back to the South. Here, in the vicinity of co-ordinates 120′ E. and 455′ S. (see underground plans) the strike of the schistosity in adjoining amphibolite schist on the North side of the drive is N. 55° W., indicating that the lode material is here cutting across the country.

The exact course of the lode here in the Northern extremity of the mine has not yet been fully defined. It appears to swing back on itself, producing a fairly sharp North-facing fold which pitches steeply to the South. A horizontal diamond drill bore hole put out almost due West from co-ordinates 250′ E., 580′ S. on

No 3 level revealed a lode formation about 30 feet wide whose Eastern wall was intersected at approximately 80′ E., 580′ S. This is probably the Southerly extension of the Western arm of the Main Lode channel but in order to prove this connection beyond doubt it will be necessary to continue driving along the path of the Main Lode.

It may be noted here that it was found impossible to delineate the boundaries of the lode channel on the surface at the North end. The outlines of the main lode shown in the surface plan* represents a projection of the boundaries as mapped on the No. 3 level.

Southward of the Main Shaft the lode channel appears far more broken and divided than in the Northern workings. Lenticular horses of mullock (amphibolite schist) become numerous and the lode is split into several lenticular shaped ore bodies which overlap laterally. In the Nos. 2 and 3 levels these form two distinct legs separated by schist. At No. 2 level the Eastern lens only has been mined, but on the No. 3 level both lenses have been worked. On the No. 3 level at about co-ordinates 300′ E., 1,480′ S., these two lenses coalesce to form a bulge of ore more than 70 feet wide. On the No. 4 level only the Western lens has been opened up and mined while on No. 5 level a small bulge of ore which probably represents the Eastern lens, has been opened up at about 320′ E., 1,330′ S. No further driving has been attempted to determine the course of the Western lens on the No. 5 level. On the No. 6 level also only the Eastern lens appears to have been exposed.

The lode zone over the length of the channel which has been mined, dips almost vertically at the surface, but below the No. 2 level swings to a steep Westerly dip (about 85°). At the Northern end of the lode where it shows the pronounced swing to the West, the lode is practically vertical down to the No. 3 level, below which it rolls to the South-West. The boundaries of individual lenses of lode material show no steady dip however, but vary continuously from steep angles either to the East or the West according to the changing width of the lenses at different depths.

No sign of dragfolding was seen in the amphibolite schist walls of the aplitic lode formations, nor was there any conclusive evidence of the replacement of dragfolds by the lode material. The lode material itself shows little sign of having been subjected to any appreciable shearing stresses. The presence of the sharp Westerly swing of the lode channel in the North end of the mine and the fact that at the surface the Main Lode aplite appears to branch or fold back on itself at its Southern extremity as illustrated by the surface mapping (see Plate XIV) might be, and in fact has been mistakenly interpreted that the Tindals lode forms the central limb of a major dragfold in the amphibolite schist series.

It is possible that the lode does represent the *replacement* of a major dragfold in the schists by a concordant intrusive aplite, but no evidence to support this was seen underground in the mine workings. There is no doubt that the aplite intrusion is post folding in age and it appears most likely that the intrusive acid magma was injected between the planes of foliation or pressure cleavage of the already metamorphosed and foliated amphibolite schists. The so-called ''folds'' in the Northern and Southern ends of the line of lode have probably been formed where the intrusive fluid magma has broken across the foliation planes of the schists and linked up with other concordant veins along adjacent planes. As will be shown below it is considered that this lode material is really made up of two phases of intrusion, the first a type of metasomatic or hydrothermal alteration and replacement by acid (granitic) fluids at fairly high temperatures, along planes of lamination, forming the so-called ''silicified'' lodes, and the second being an intrusion of typical aplitic material at decreasing temperatures. The period of injection probably followed in quick succession upon the period of replacement, the material for both phases being derived from the same magma reservoir. Later pressure has been responsible for minor deformations—small faults and joints, many of which were probably sealed by still later quartz intrusions.

Apart from the lode formations of the Tindals Main Lode channel there are numerous small parallel lenses of fine grained ''silicified'' lode material in both the East and the West wall country rock. These have been revealed in various underground diamond drill holes put out to explore the country at all levels; in the main crosscuts; and in the East crosscut on the No. 4 level. These subsidiary lenses range in width from mere stringers up to more than 30 feet wide. Like many of the lenses in the main ore channel they vary rapidly in thickness along the strike, and it is often difficult to correlate individual bands of this rock exposed in any one bore hole, with those found in an adjacent bore.

In most cases these parallel lenses of ''silicified'' lode contain very little sulphide mineral and are more or less barren of gold. It is probable that some of these lenses are merely tongues from the main channel.

(b) *The ''Silicified'' Lode Material.*

The fine grained dense, dark coloured rock which commonly forms a marginal zone separating the typical aplitic ore of the main ore channel from the adjacent amphibolite schist country, and which also occurs in numerous subsidiary parallel lenses in the country on both sides of the main ore channel, is known locally by the term ''silicified'' lode. It seldom carries payable quantities of gold, though in several isolated localities in the mine thin strips of fairly well mineralised ''silicified'' lode have yielded payable values. Compared with the aplitic ore however, it contains very little sulphide mineral, and quartz stringers are seldom seen cutting through the ''silicified'' ore though they are abundant in the aplite.

The contact line between the ''silicified'' lode material and adjacent amphibolite schist country rock is usually sharp and well defined, and the amphibole at the contact is frequently well crystallised in fresh tightly packed needles. Occasionally the actual contact is marked by a narrow zone 1 to 2 inches wide, in which amphibolite schist is partially absorbed and digested or replaced by the ''silicified'' ore. On one side of this zone is usually a sharply defined wall of schist whilst on the other it grades out imperceptibly into the normal ''silicified'' ore.

Contact between the ''silicified'' and the aplitic ore is in some places sharply defined and in others is quite indefinite, the former feathering out into the latter in irregular dark streaks. Typical examples of this gradational type of contact were seen at various points in the back of the main North drive on the No. 4 level.

Microscopic examination of typical specimens of ''silicified'' lode reveal that it consists essentially of a structureless aggregate of yellow to brown pleochroic biotite flakes and rounded granules of carbonate (-?? calcite), in what is usually a fine granular ground mass of tiny quartz and felspar grains. A common and usually abundant accessory is apatite in short needles. The biotite is sometimes intergrown with and replacing the remnants of original pale green to colourless, shredded, fibrous amphibole. In the finer grained specimens it usually occurs in separate scales and flakes often showing some parallel orientation, but in some specimens it appears to be segregated into clusters. Dark brown pleochroic haloes about zircon inclusions in biotite are very common.

of the ground mass are often indistinguishable but in the coarse grained types separate irregular shaped grains of quartz are clearly recognisable while it is often possible to distinguish the ghost form of incipient phenocrystal grains of plagioclase felspar (probably albite). Sulphide minerals were rarely seen in thin slice and were confined to an occasional minute grain of pyrrhotite.

The development of biotite, evidently derived at least in part from original amphibole, and its association with carbonate, quartz and felspar, suggests that this fine grained siliceous rock was formed as a result of the addition of potash, silica, alumina, water, carbon dioxide, etc., to the original amphibolite schist, and of the replacement of some of this schist along narrow well marked zones. This added material may have been injected partly in the fluid and partly in the gaseous state, resulting in a type of hydrothermal alteration of the schist by the volatile constituents. The abundant accessory apatite indicates the presence of fluorine and phosphate.

* Unpublished.

These volatile constituents were probably the forerunners of a less highly fluid acid magma which, at a slightly later stage was injected along certain of the same zones of alteration or lines of weakness and solidified into the typical aplitic ore of the Tindals Main Lode channel.

(c) *The Aplitic Lode Material.*

As already stated the boundaries of typical aplitic lode with the "silicified" lode are sometimes sharply defined but are more often indefinite and gradational. In places aplitic ore abuts directly upon amphibolite schist walls, where the contact is almost invariably sharp and clear cut. More frequently however, the aplite is separated from the schistose country rock by a zone of varying width, of "silicified" ore. Lenticular horses of "silicified" lode are also occasionally to be found with in the main aplite lode channel.

During the course of underground mapping it was frequently found impossible to delineate the boundary between "silicified" and aplitic ore on the main level, owing to the highness of the backs, or because the geology was obscured by the timbering of "Chinaman Chutes," etc,. whilst it was not possible at the time of inspection to enter certain of the stopes. Consequently it was in such places found necessary to depend on the company's geological plans for this information.

Taken as a whole, the general distribution of the aplitic ore gave the writer the impression of an intrusive relationship between the aplite and both the "silicified" lode and the amphibolite schist. The aplite was probably injected into the cooling, though in places probably still plastic, "silicified" lode material in the Main Lode. Marginal absorption of this "silicified" lode has probably resulted in the obliteration of the exact boundary with the aplite in places, whilst in other places fragments of the "silicified" lode have been stoped off and surrounded by aplite, being left as lenticular horses of unpayable lode material in the Main Lode Channel. In places the aplite has cut across the "silicified" lode material and entered the amphibolite schist wall rock. Darker coloured phases of the typical aplitic ore indicate that it has in some places probably absorbed and digested limited quantities of basic schist.

Typical aplitic ore is light coloured and of medium-fine, even grain. It is brittle, and underground is usually traversed by a series of irregular vertical or steeply inclined, and horizontal joints; the latter often forming flat or gently sloping heads. These joint seams are sometimes filled with later sulphide mineral—usually pyrite. The ore breaks easily with an irregular blocky fracture. Typical ore is usually fairly evenly bespattered with small grains of dark bronze coloured pyrrhotite. Often the pyrrhotite grains are clustered into massive crystalline aggregates. Pyrite may also be present in tiny scattered cubes. In places the sulphide minerals are so distributed as to give the appearance of an irregular banding, but for the most part the ore is typically massive and homogeneous. In one specimen from near the North end of the No. 2 level were seen numerous yellowish granules of a brittle heavy mineral, probably siderite.

In thin section the typical light coloured aplitic ore is seen to consist essentially of interlocking, rather irregular shaped crystals of intermediate acid plagioclase and some doubtful orthoclase, and minor interstitial quartz with usually small quantities of shredded pale green chloritic hornblende. Apatite is an abundant accessory. Some calcite is occasionally present in proximity to crystals of pyrrhotite. A few flakes of brown biotite occasionally take the place of the amphibole.

The aplite of the Main Lode Channel is not uniform in character however, but in places grades into a medium fine grained granite intermediate between the typical coarse, light-coloured aplite and the fine grained dark "silicified" rock. This granite is characterised by a far greater quantity of dark coloured minerals (horneblende or biotite. or both) than the aplite, and by a less definite structure of the felspar —quartz groundmass.

In an even darker coloured phase, the granitic ore grades into a hornblende diorite in which blue-green, highly pleochroic hornblende phenocrysts become as abundant as the felspar. These phenocrysts are crowded with inclusions of granular quartz and felspar, some biotite, apatite and (probable) magnetite. Brown biotite is often abundant in clusters intergrown with the amphibole which in proximity to biotite is usually very pale coloured. Accessory apatite is abundant while carbonate and sulphide minerals are rare.

This dark dioritic lode material has probably been formed by the direct absorption and digestion of basic schist country and "silicified" lode by the aplite, the blue green amphibole being the recrystallised product of this basic material. Specimens for examination were collected from the extreme north end of the main North drive, No. 3 level.

(d) *Mineralisation and Distribution of Gold.*

Mineralisation of the ore bodies in the Main Lode Channel appears to have been confined principally to the aplitic lode. The principal sulphide minerals are, as has already been described, pyrrhotite and pyrite. These minerals have probably been introduced at a late stage in the intrusion of the aplite and as an end product of the aplitic magma. Another end phase mineral is quartz, which occurs frequently in small stringers and veinlets sealing up cross fractures in the aplitic lode. These quartz stringers usually remain within the aplite and are seldom seen to pass out into adjoining "silicified" lode or basic schist wall rock, and they have probably been formed principally as the result of injection of highly siliceous liquid into cracks formed during the cooling of the aplite magma itself. Sulphide minerals, pyrrhotite and to a lesser extent pyrite, are frequently intimately associated with the quartz in these stringers. Pyrrhotite is the most abundant sulphide mineral but it was found impossible to determine its age relationship to the pyrite. Minute fragments of doubtfully determined chalcopyrite were also discerned.

Another mineral which is of limited occurrence in the Tindals Main Lode channel is scheelite. This mineral was noticed in two places, one near J. winze on the South drive of the 600ft. level, and the other just South of K. winze, South drive No. 3 level. The scheelite occurs in irregular kidney-shaped lumps in narrow veins of clear glassy quartz which cut through "silicified" ore and pass out into basic schist. Small quantities of pyrrhotite are usually to be found associated with the quartz in these veins.

Calcite is another gangue mineral found in the Main Lode channel. It usually occurs in white or pink crystalline veinlets cutting quartz, aplite, or "silicified" ore.

As regards the gold content of, and the distribution of values within the Tindals Main Lode, the following are generalised observations gleaned principally from information supplied by the management. The writer undertook no check sampling, and relied entirely upon assay plans prepared by the Company.

Firstly, although some rich ore was originally obtained from some of the surface outcrops of the Tindals Main Lode, and within the zone of oxidation, the ore within the sulphide zone and throughout the mine as a whole is essentially low in grade. (Official production figures indicate an average yield of 3.76 pennyweights of gold per ton from 1939 to July 1941.) No rich shoots have been found within the sulphide zone, and values in this zone are consistently lower than those in the oxidised zone. This suggests that there has been some secondary enrichment of gold in the surface zone above the water table. No well defined shoots of ore can be traced through the mine, and although the distribution of the stoping as illustrated in the longitudinal section through the lode channel suggests that payable values in the Northern end of the mine pitch steeply South and in the Southern end pitch steeply North, it should be remembered that the stoping is dependent not only upon the grade of the ore but also upon the continuity and width of the aplite lode formations.

Secondly, in general gold in payable amounts is confined to the aplitic ore and is seldom found in the "silicified" lode material of the main lode channel. To

the writer's knowledge no shoots of payable gold ore have been located in the subsidiary parallel lenses of "silicified' material below the zone of oxidation.

Thirdly, although the gold is distributed rather erratically throughout the aplite, in general it may be said that values are highest where the ore is light coloured aplite, fairly heavily mineralised and intersected by abundant stringers or veinlets of quartz. Dark coloured granitic or dioritic lode, little mineralised, is generally regarded as poor or unfavourable ore. Of the sulphide minerals pyrrhotite is probably a more favourable indicator than pyrite. It is not known definitely what effect the presence of scheelite in quartz has upon the gold content of the lode at Tindals, but apparently scheelite does not necessarily indicate improved values. Scheelite bearing auriferous quartz reefs have been found in a number of other goldfields in Western Australia and in at least one of these, viz., the late Fraser's G.M., Southern Cross, scheelite is said to occur in association with ore richest in gold.

Probably the best and most consistent values in the sulphide zone have been obtained from that portion of the lode channel which lies between co-ordinates 550 feet S. and 850 feet S. This is the part in which the lode channel is swinging from almost due North to about 30° W., and at 550 feet S. from No. 2 level down to No. 5 level it is of good payable width though tapering from about 50 feet to 25 feet (true width) with increasing depth. Further North of 550 feet S. the lode maintains its width, but the ore becomes more granitic and values drop. Between No. 3 and No. 5 levels payable values were encountered between co-ordinates 1,050 feet S. and 1,200 feet S., just North of the main shaft, and also South of the main shaft between co-ordinates 1,300 feet S. and 1,400 feet S. In the Southern end of the mine, however, the lenticular nature of the aplitic ore and the presence of numerous blocks of unpayable material —basic schist and "silicified" lode—provide serious complications to economical mining.

Griffiths Extension and Cyanide Lodes.

As a result of the discovery of good values in a bore (No. 10) drilled from the surface by the present company to intersect the Cyanide Lode at about 500 feet V.D., a considerable amount of money was spent in development work designed to open up the lode at depth. A crosscut was driven from opposite the Tindals Main Shaft on the No. 4 (386ft.) level for about 1,000 feet Eastwards to cut the Cyanide Lode and an old prospecting shaft was reamed out and timbered into a three-compartment shaft, and sunk to the crosscut. From the Cyanide Shaft at this level the crosscut was continued Eastward for nearly 80 feet and then a winding drive was carried Northwards for about 400 feet. West crosscuts were driven for about 80 feet from points on this drive at co-ordinates 1,270 E., 1,060 S., and at 1,315 E., 870 S., and a subsidiary drive was cut Northwards for about 100 feet from 1,200 E., 1,030 S.

During the course of this development work innumerable thin lenses of "silicified" lode were exposed in the amphibolite schist country but evidently none of these proved sufficiently valuable to merit the cost of additional development. Few of the lenses examined by the writer contained much sulphide mineral, and none showed any resemblance to the typical aplite ore of the Tindals Main Lode.

The main crosscut linking the Tindals and the Cyanide shafts intersected several bands of "silicified" lode material. One of these on assay showed traces of gold and accordingly was opened up by short drives for 60 feet North and 40 feet South of the crosscut. The results proved disappointing however, and the work was discontinued. This lens was here about 30 feet wide. Because of its supposed correlation with the Griffiths line of lode to the South this has been called the Griffiths Extension. No trace was found in this crosscut of a Southward extension of the Bird in Hand line of lode; but so discontinuous and lenticular are these "silicified" lodes, especially those revealed in the Cyanide workings, that little value can be attached to their apparent absence at any particular point. This fact is particularly demonstrated in any attempt to correlate information derived from the logs of adjacent bore holes drilled through this country.

The Iron Duke G.M.L. 5577.

This lease lies immediately west of the Empress of Coolgardie lease, and outside the property held by Consolidated Gold Mines of Coolgardie, Ltd. The ore body is a narrow quartz reef on the West side of an ironstone knoll. The reef cannot be traced for more than about 30 feet on the surface but at the time of inspection had been opened up to a vertical depth of about 150 feet. It averaged about 2 feet wide but was somewhat irregular, often pinching to less than six inches. At the time of inspection (May, 1941) this property was under option to New Golconda Gold Mines N.L. Some rich stone has been obtained from this reef, the official production up to July, 1941, (given below) being 571 tons of ore treated for 481.24 fine ounces of gold, or a yield of 16.8 dwt. per ton.

BORING.

Nineteen diamond drill holes have been sunk from the surface to intersect the various lodes of the Tindals Group. Bores Nos. 1 to 4 were drilled by the Government, Nos. 5-7 by the Western Mining Corporation during the period of an option held by them over the property, and Nos. 8-19 were drilled by the present Company. Two surface bores were also drilled by the Western Mining Corporation into the Big Blow Lode on G.M.L. 5248. The localities and directions of all these bores have been plotted on the surface geological map (Plate XIV). All existing information and detailed logs of these bores were kindly made available to the writer by the management, but no descriptions of these will be included here.

A noticeable feature of this boring is the fact that no attempt has been made to drill into the Tindals Main Lode from the surface on the Western side. This is particularly surprising in that the lode is known to dip at a steep angle to the West, whilst two lines of aplitic dyke rock, the Alicia and the Empress of Coolgardie, appear to be converging to the West of the Main Lode. The only exploration of the West wall country rock is confined to three horizontal bores (300S, 300E and 300T) drilled from the No. 3 level. These have investigated the country North of the Main Shaft, but no bores have penetrated any distance into the West wall country South of the Main Shaft.

Many of these surface bores have confirmed the presence of numerous subsidiary parallel lenses of "silicified" lode material in the country between the Main Lode and the Cyanide Lode, but evidently none of these have proved sufficiently rich in gold to warrant development at the present time. It may be noted here that no trace of the Tindals Main Lode formation was found in bores No. 7 and No. 11 put down North of F Shaft to test the possible Northern continuation of the lode at depth. This tends to confirm the evidence that the lode channel folds back on itself just West of F Shaft. Apparently no attempt has so far been made to explore the possibilities of the lines of aplitic lode further West of Tindals, viz., the Alicia line on G.M.L's. 5318 and 5317 and the Empress of Coolgardie line on G.M.L. 5295, as mentioned above.

MINING AND TREATMENT.

Although the question of the mining and treatment of the ore at Tindals G.M. is outside the scope of the present report and was not investigated by the writer, a few notes may not be inappropriate here, especially as the whole subject is inevitably bound up with considerations of geological occurrence and association.

On the whole, the ore and country in the Tindals Main Lode channel is strong, and, assisted by the high angle of dip, is fairly good holding ground. There are, however, certain thin seams usually of amphibolite schist in the basic schist walls of the lode which on exposure to air seem to lose the power of coherence. These bands fret away, and on being touched, disintegrate at the surface into a running powder. In a few places the fretting of such seams has weakened walls and necessitated some timbering.

The aplite lode itself is a rather brittle rock and usually breaks out well. Blocks of ore in wide stopes occasionally become seriously fractured and weakened by

heavy firing however, and if in addition they happen to be traversed by abundant horizontal joints, as is frequently the case, dangerous falls may occur.

In the past a great deal of oxidised ore was mined by open cut methods and at the present time an open cut is being worked just South of F Shaft in the North end of the lode. The bulk of the ore now comes from underground in the sulphide zone. This is being mined principally by various methods of overhand stoping—shrink stoping and cut and fill stoping, while some benching was attempted at 402D.

No serious metallurgical difficulties have been encountered in the treatment of Tindals ore. Despite the apparent close association of gold with the sulphides, it is evidently not present in solid solution with them nor in any way isolated by them, as the ore is free milling and the gold is easily recoverable by ordinary methods of crushing, amalgamation and cyanidation. The chief concern regarding treatment appears to be adjustment of the plant to obtain maximum recovery from properly balanced quantities of both oxidised and sulphide ore.

SUMMARY AND CONCLUSIONS.

The Tindals Gold Mine lies within a belt of recrystallised basic schists probably representing original interbedded basic tuffs and lavas, enclosed on both sides by belts of basic lava. To the East of the mine is a prominent horizon of blocky lavas which form undulating ridges and which can be traced from South of Tindals up to the outskirts of Coolgardie Townsite.

The whole area is folded along a major East-West axis and Tindals lies on the Southern limb of the fold.

The Tindals Main Lode is a compound, post folding acid intrusive body. It consists of fine grained, siliceous acid material (''silicified'' ore) which contains little sulphide mineral and is usually non-auriferous; and of medium to coarse grained auriferous aplite which is usually well mineralised.

These two varieties of rock are considered to be comagmatic. The former probably represents an early phase injection of very fluid and volatile acidic material at fairly high temperatures along planes of lamination in the basic schists. This material has probably metasomatically replaced and absorbed basic schist material, thus altering its original composition. The latter rock, the aplite, is considered to have followed after the ''silicified'' ore as a later phase of injection at lower temperatures. The mineralisation of the aplite with concomitant introduction of gold was probably an end phase process carried out at falling temperatures.

The Tindals Lode is essentially low grade, particularly in the sulphide zone, though there is evidence of some secondary enrichment in the zone of oxidation. The gold is rather irregularly distributed in the lode channel and this distribution is controlled by lithological rather than structural factors.

Geologically there appears to be no reason to anticipate any immediate or appreciable diminution in the dimensions of the lode channel with increasing depth nor is there any evidence to suggest either enrichment or impoverishment at depth. Giving account to the past history of the mine, however, it is unlikely that the ore will show any material improvement in grade with increasing depth.

PRODUCTION.

The following table gives as complete as possible an analysis of the recorded production for the Tindals area, the bulk of which is at present being held by Consolidated Gold Mines of Coolgardie Ltd. These production figures date from the time of first official records up to July, 1941. Existing leases are typed in capital letters and voided leases which have occupied approximately the same block or blocks of ground have been bracketed together.

It has been found possible to subdivide the production of the Tindals Group of leases into the seven main subgroups:—Tindals, Empress of Coolgardie, Dreadnought, Flagstaff, Lady Carmen, Undaunted-Lady Charlotte, Big Blow, and Little Blow. The production of Tindals sub-group has been further subdivided into that of the principal lodes which have been worked in the central block, viz., Central (Tindals Main Lode), Bird in Hand, Griffiths, Perseverance and South-West.

Official production figures for the Coolgardie Centre of the Coolgardie District, which are listed under the heading of Sundry Claims give (up to 1940) the following figures:—

Alluvial, 201·82 fine oz.; dollied and specimens, 2,591·89 fine ozs.; ore treated, 61,016·28 tons; gold therefrom, 22,809·66 fine ozs.; total gold, 25,603·37 fine ozs. These figures represent the production from voided prospecting areas and other sources not recorded elsewhere, and no doubt a considerable portion came from the Tindals area but beyond recording this fact, little can be done to identify this source of production further. Furthermore, up to the end of 1941 an amount of 15,347·59 fine ozs. of gold has been reported by Banks and Dealers from the Coolgardie District generally. This was mainly in the form of alluvial and specimen gold, of which a certain proportion could no doubt be allocated to the Tindals area.

The production for the Master-key Group to the South-East of Tindals, but within the area examined and mapped, has also been included in the following table on pages 100, 101 and 102.

TABLE SHOWING PRODUCTION FROM TINDALS GROUP, COOLGARDIE, TO JULY, 1941.

Existing Leases are shown in Capital Letters. Leases bracketed occupy approximately the same block or blocks of ground.

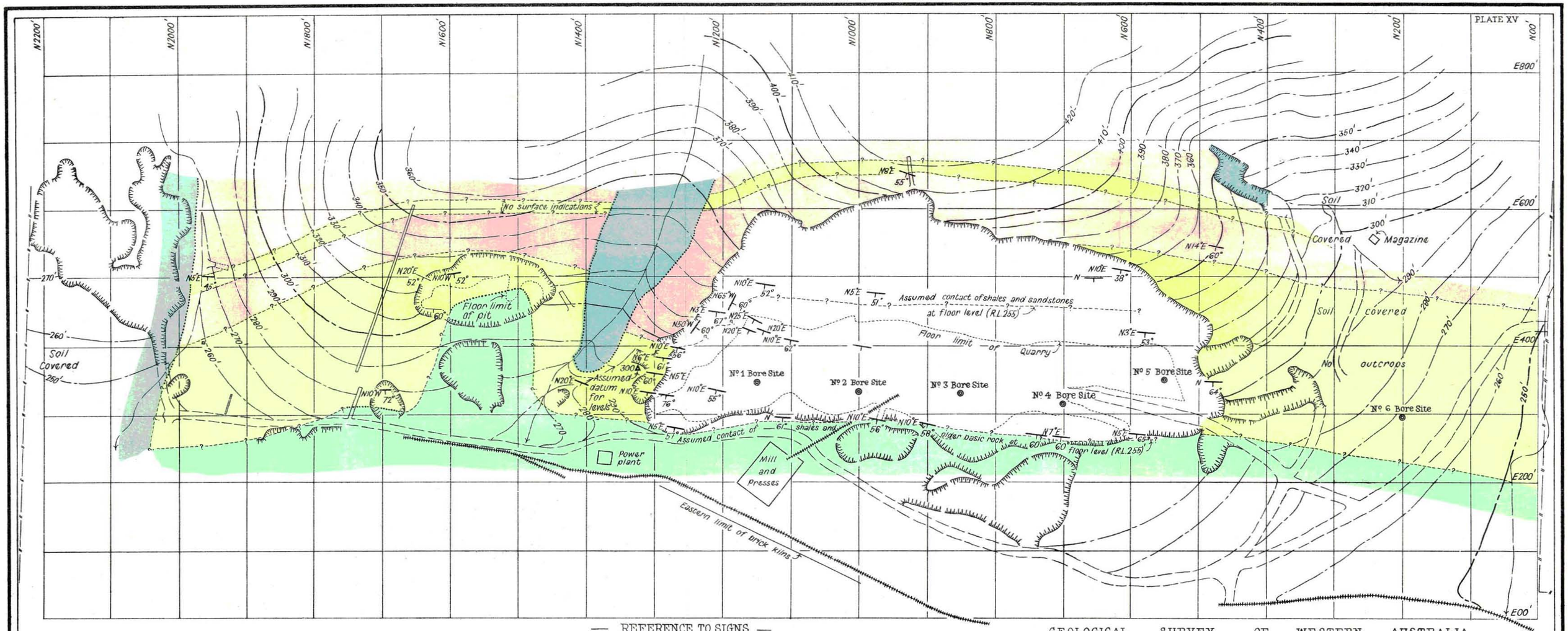
Group.	Sub-Group.	Registered Name of Company or Lease.	No. of Lease.	Period.	Dollied and Specimens.	Ore Treated.	Gold Therefrom.	Total Gold.	Grade.	Silver.
					fine ozs.	tons (2,240 lb.)	fine ozs.	fine ozs.	fine ozs. per ton.	fine ozs.
TINDALS	Tindals (Central)	CONSOLIDATED GOLD MINES OF COOLGARDIE, LTD.	5245, 5246, 5247, 5248, 5259, 5295, 5296, 5297, 5317, 5328, 5330, 5333, 5334, 5466, 5481, 5482, 5483, 5484, 5486, 5488, 5502, 5504, 5505, 5532, 5548	1936 1939 1940 1941 (to July)	... ...	75·00 43,106·00 69,085·70 42,772·00	22·92 8,764·39 12,857·28 7,544·38	22·92 8,764·39 12,857·28 7,544·38	0·305 0·203 0·186 0·176	... 878·66 1,213·71 595·53
		TINDALS No. 1, etc.	5245 (5246, 5247)	1935	...	40·00	20·27	20·27	0·507	...
		FRANK	5317	1935	1·14	...	...	1·14	...	...
		Collins Cyanide Plant	TL's 439H, 566H	1935–39	...	(32,550·00 tons sands)	1,905·45	1,905·45	0·058	...
		Tindals Coolgardie G.M. Co. ...	3824, 3830, 4227, 4323, 4326, 4544	1906–16	...	102,051·10	26,457·27	26,457·27	0·259	...
		Tindals Coolgardie G.M. Co. ...	2033, 3718, 3756, 3824, 3830	1897–1905	...	41,019·25	8,713·74	8,713·74	0·212	...
		Tindals Extended	1641, 1835,	1897	...	18·00	2·00	2·00	0·111	...
		Total	...	...	1·14	298,167·05	66,287·70	66,288·84	0·222	2,687·90
	(Bird in Hand)	Bird in Hand	4577	1917–19	...	576·50	79·36	79·36	0·138	...
			= 3674	1899–1900	...	104·60	29·15	29·15	0·279	...
		Total	...	...	...	685·10	108·51	108·51	0·158	...
	(Griffiths) ...	TINDALS CENTRAL	5259	1932–33	...	141·00	20·02	20·02	0·142	...
		Griffiths G.M.	4567	1917–25	4·16	17,782·50	2,043·31	2,047·47	0·115	...
			= 4448	1913–15	...	675·25	79·40	79·40	0·118	...
		Griffiths Leases	73, 1902, 3556, 3701, 3811, 3813, 3998	1900–12	...	35,024·00	13,909·83	13,909·83	0·397	...
		Morning Star	1902	1897–99	...	357·00	523·63	523·63	1·467	...
		Lily	3555	1898–1900	...	342·75	217·64	217·64	0·635	...
		Morning Star South	3701	1899	...	250·00	30·63	30·63	0·122	...
		Star of the South	73	1897–1904	...	975·00	819·75	819·75	0·840	...
		King's Lynn	3536	1897–98	...	45·00	40·86	40·86	0·908	...
			= 3619	1899–1901	...	77·00	36·40	36·40	0·472	...
		Total	...	...	4·16	55,669·50	17,721·47	17,725·63	0·318	...

Tindals (Perseverance)	Perseverance G.M's., Ltd. ...	3415, 3416,	1905–07	...	2,268·00	1,430·89	1,430·89	0·631	...
		3415, 3416, 3968	1903–04	...	1,849·00	1,836·73	1,836·73	0·993	...
	Sherlaws G.M. Co., Ltd. ...	3415, 3416, 3968	1897–1903	...	13,305·00	5,977·05	5,977·05	0·449	...
	Sherlaws No. 1 South	3695 (3510)	1899	...	10·00	1·79	1·79	0·179	...
	Perseverance Extended	3252	1897	...	55·00	5·32	5·32	0·096	...
	Total	...	...	...	17,487·00	9,251·78	9,251·78	0·529	...
(Southwest) ...	Tindals South	4328	1908	...	20·00	4·75	4·75	0·237	...
	Tindals Consols	3659	1899	...	6·00	1·49	1·49	0·248	...
		= 3561	1898	...	172·00	37·83	37·83	0·222	...
	Tindals Central	1835	1897–98	...	175·80	69·08	69·08	0·393	...
	H. ROBARTSON	PA5417	1941	...	26·00	5·38	5·38	0·207	...
	H. Robartson	PA5297	1940	...	92·00	24·54	24·54	0·266	...
	Total	...	...	...	491·80	143·07	143·07	0·299	...
	Sub-Group Total... ...	...	...	5·30	372,500·45	93,512·53	93,517·83	0·251	2,687·90
Empress of Coolgardie	EMPRESS OF COOLGARDIE ...	5295	1934–36	...	429·51	103·84	103·84	0·241	3·22
	Great Empress of Coolgardie	5197	1924–26	...	82·00	29·84	29·84	0·363	...
	Empress of Coolgardie ...	1865	1906–13	...	2,321·50	859·46	859·46	0·370	...
	Empress of Coolgardie—Phoenix G.M's., Ltd.	1865 (1111)	1899–1906	...	12,028·50	4,524·96	4,524·96	0·376	...
	Empress of Coolgardie (1896) G.M's., Ltd.	1865	1897–99	...	2,868·00	950·53	950·53	0·331	...
	Sub-Group Total ...	...	...	...	17,729·51	6,468·63	6,468·63	0·365	3·22
Tindals Dreadnought	Dreadnought Leases	4555, 4561,	1923	...	124·04	70·79	70·79	0·570	...
		4555, 4561, 5065 (4563)	1918–22	...	838·14	957·45	957·45	1·142	...
	Dreadnought	4555	1916–17	...	86·85	870·10	870·10	10·018	...
	Cosmopolitan	4106	1905	...	5·00	1·91	1·91	0·382	...
	Edwenia	3997	1903	...	150·00	6·81	6·81	0·045	...
	Just in Time	1491	1897–98	...	235·00	91·05	91·05	0·387	...
	DREADNOUGHT EXTENDED ...	5297	1933–34	...	379·69	215·43	215·43	0·560	...
	Derry Ormond	5253	1933	...	60·00	11·34	11·34	0·189	...
		= 5199	1924	...	58·00	4·27	4·27	0·073	...
	Sub-Group Total ...	...	...	...	1,936·72	2,229·15	2,229·15	1·151	...
Flagstaff—Lady Carmen	Flagstaff	5398	1935	...	52·00	7·03	7·03	0·154	...
	Flagstaff G.M's.	1604, 1605, 2753, 3810, 3955	1902–05	...	1,311·00	463·20	463·20	0·355	...
		1604, 1605, 2753, 3810, (3658, 3672)	1895–1901	...	9,535·50	4,102·36	4,102·36	0·430	...
	Rio Tinto	4479	1915–19	...	428·30	130·12	130·12	0·303	...
	Victor	4377	1910	...	173·50	53·60	53·60	0·309	...
	Gladys	4391	1910	...	184·00	13·92	13·92	0·076	...
	Homeward Bound	4262	1906	...	84·00	16·68	16·68	0·197	...
	Thistle	4354	1908	...	20·00	17·99	17·99	0·899	...
	Star	4303	1908	...	126·00	38·23	38·23	0·311	...
	LADY CARMEN	5486	1936	...	88·00	20·86	20·86	0·237	...
	Lady Carmen	4556	1916–24	74·83	1,077·99	506·90	581·73	0·539	...
	Sub-Group Total ...	...	...	74·83	13,080·29	5,370·89	5,445·72	0·416	...

TABLE SHOWING PRODUCTION FROM TINDALS GROUP, COOLGARDIE, TO JULY, 1941—*continued.*

Group.	Sub-Group.	Registered Name of Company or Lease.	No. of Lease.	Period.	Dollied and Specimens.	Ore Treated.	Gold Therefrom.	Total Gold.	Grade.	Silver.
					fine ozs.	ton (2240 lb.)	fine ozs.	fine ozs.	fine ozs. per ton.	fine ozs.
TINDALS—*contd.*	Undaunted Lady Charlotte	UNDAUNTED	5330	1934–36	...	495·00	90·98	90·98	0·183	...
		Coolgardie Prospecting, Development and Mining Co.	4093, 4117	1910	...	97·00	18·73	18·73	0·193	...
			4093, 4117, 4345, 4347	1908–09	...	818·00	275·48	275·48	0·336	...
		Undaunted Leases	4093, 4117	1905–07	...	1,737·00	462·21	462·21	0·266	...
		Undaunted	4093	1904–05	...	565·81	156·39	156·39	0·276	...
		Nelson	5449	1935–36	...	102·00	15·75	15·75	0·154	...
		Iron Duke	4486	1915–16	...	197·00	48·13	48·13	0·244	...
		Charlotte	4542	1915	...	5·00	15·14	15·14	3·028	...
			666, 1384, 2419, 3549, 3818	1902–03	...	193·00	1,214·36	1,214·36	6·280	...
		Lady Charlotte G.M's., Ltd.	666, 1384, 2216, 2357, 2419, 2826, 3549, 3818	1899–1901	...	9,511·00	5,174·63	5,174·63	0·544	...
		Sub-Group Total ...	...	...	...	13,720·81	7,461·80	7,461·80	0·543	...
	Big Blow ...	Big Blow	4261	1906–10	45·18	1,186·50	496·25	541·43	0·457	...
		Big Blow Flagstaff G.M's., Ltd. ...	4091	1904–05	1·98	589·00	155·45	157·43	0·267	...
		Big Blow Flagstaff G.M's., Ltd. ...	3590	1899–1904	...	5,111·00	2,065·24	2,065·24	0·404	...
		Big Blow, Ltd.	35, 3590	1898	...	2,674·00	598·58	598·58	0·227	...
		Big Blow, Ltd.	35	1893–97	...	429·00	122·11	122·11	0·208	...
		Golden West	4137	1905	...	19·00	3·01	3·01	0·158	...
		Sub-Group	...	...	47·16	10,008·50	3,440·69	3,487·85	0·348	...
	Little Blow ...	Resource	4384	1909	...	40·00	6·76	6·76	0·169	...
		Little Blow and Golden Ridge Extended	2596, 2392	1897	...	9·00	7·98	7·98	0·886	...
		Coonong	3524	1898	...	39·00	9·63	9·63	0·247	...
		Coolgardie Enterprise	4363	1909–10	...	365·00	116·07	116·07	0·318	...
		Albert	4186	1905	...	29·00	25·09	25·09	0·865	...
		Sub-Group Total ...	...	...	...	482·00	165·53	165·53	0·343	...
		IRON DUKE	5577	1937–41	...	571·00	481·24	481·24	0·842	...
		Wallaby	5531	1938	...	13·00	3·49	3·49	0·268	...
		Group Total	...	...	127·29	429,242·28	119,133·95	119,261·24	0·277	2,691·12
MASTER-KEY	... ...	Masterkey	5269	1932–38	...	476·00	65·39	65·39	0·137	...
		H. O. ALLOM	PA5442	1941	...	38·00	5·38	5·38	0·141	...
		H. O. Allom	PA5145	1940	...	54·00	6·70	6·70	0·124	...
		Total	...	...	...	568·00	77·47	77·47	0·136	...
		Keystone	5465	1935–37	...	125·50	17·66	17·66	0·140	...
		E. A. GUNNING	PA5402	1941	...	60·00	7·14	7·14	0·119	...
		E. A. Gunning	PA5310	1940	...	31·50	2·19	2·19	0·069	...
			PA5175	1939	...	28·00	5·93	5·93	0·211	...
			PA4970	1938	...	51·00	9·44	9·44	0·185	...
		Total	...	...	...	296·00	42·36	42·36	0·143	...
		Group Total	...	...	...	864·00	119·83	119·83	0·138	...

PLATE XV



LEGEND

CARDUP SERIES
- Shales
- Sandstones
- Older basic rock
- Younger basic rock

REFERENCE TO SIGNS

- Geological boundaries — Observed / Doubtful or assumed
- Strike and dip of bedding
- Quarries and pits
- Costeans
- Roads and tracks
- Railways
- Fences
- Creeks
- Contours

Plane Table and Telescopic Alidade Survey and Geology by H.J Ward Oct-Nov 1945

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

GEOLOGICAL PLAN OF SHALE DEPOSIT
STATE BRICKWORKS HOLDING, BYFORD

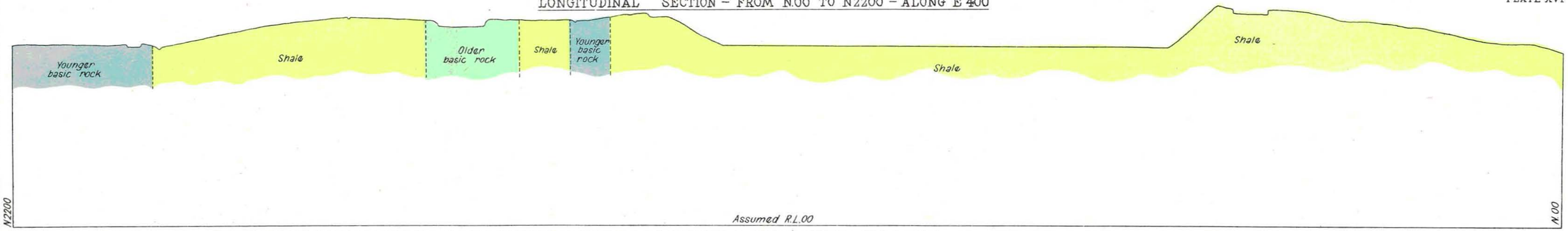
LOCATION 462, COCKBURN SOUND
SOUTH WEST DIVISION

Scale 100ft = 1inch

100 75 50 25 0 100 200 300 400

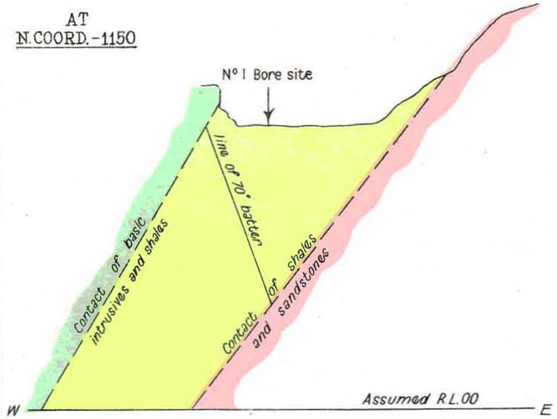
PLATE XVI

LONGITUDINAL SECTION - FROM N.00 TO N2200 - ALONG E 400

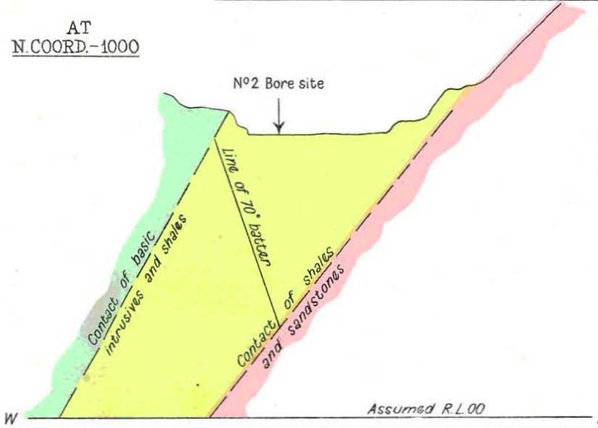


TRANSVERSE SECTIONS - THROUGH MAIN QUARRY LOOKING NORTH

AT N.COORD.-1150



AT N.COORD.-1000



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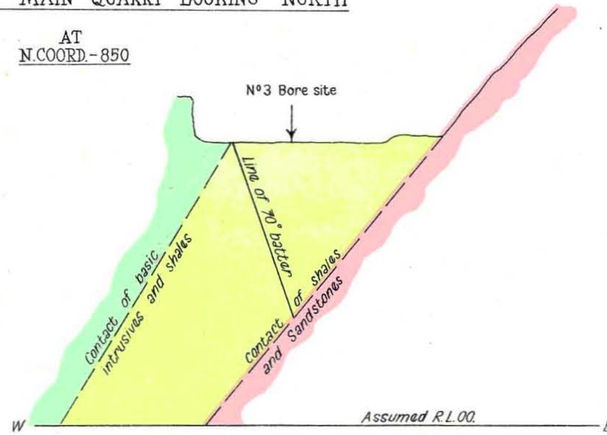
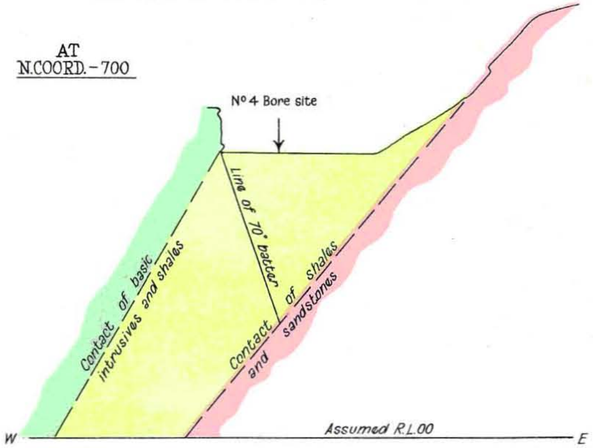
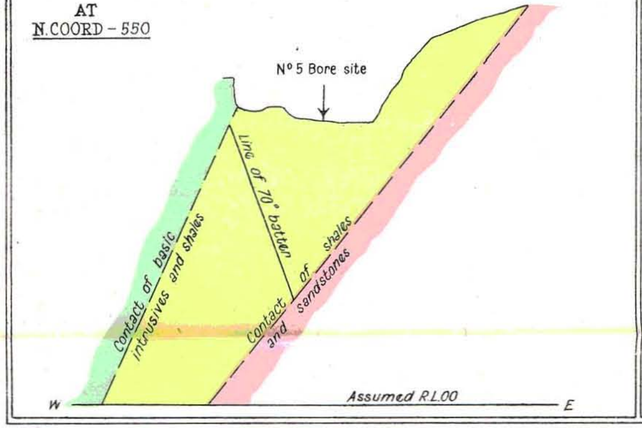


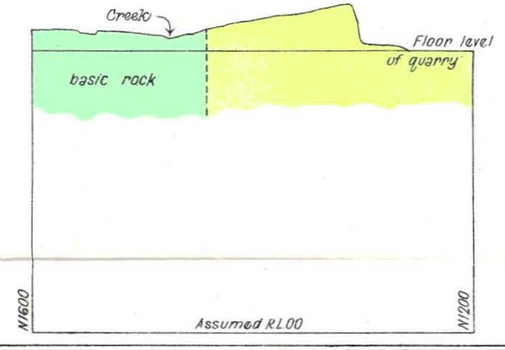
AT N.COORD.-700



AT N.COORD - 550



LONGITUDINAL SECTION - FROM N1200 TO N1600 ALONG E300



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

TRANSVERSE AND LONGITUDINAL SECTIONS THROUGH STATE BRICKWORKS HOLDING, BYFORD

LOCATION 462, COCKBURN SOUND
SOUTH WEST DIVISION

Scale 100ft = 1inch

100 75 50 25 0 100 200 300 400

Plane Table and Telescopic Alidade Survey and Geology by H.J. Ward Oct Nov 1945.

REPORT ON THE AVAILABILITY OF SHALE AT THE STATE BRICK WORKS, BYFORD.

By H. J. Ward, B.Sc.

Location.

The State Brick Works are at the end of Parr road, Byford, which is in Cockburn Sound Location 462, South-Western Division. Parr road branches off the Perth-Bunbury road in a South-Easterly direction approximately 23 miles from Perth.

Means of Access.

By road and rail.

Activity.

At present the only activity is in the main quarry which is almost in the centre of the holding. The depth of the quarry varies from 153 feet on the Eastern side to 40 feet on the Western side. The quarry is roughly 800 feet long by 180 feet wide.

Water Supplies.

The State Brick Works are supplied by the water from two soaks, about one and a half miles East of the quarry.

Production.

Operations were started in 1914. Table I shows the number of bricks sold since 1927 and gives some idea of the production.

TABLE I.

Period.	Number of Bricks Sold.
1927-28	14,902,138
1928-29	14,795,668
1929-30	12,066,754
1930-31	3,027,013
1931-32	3,063,734
1932-33	3,104,355
1933-34	4,222,216
1934-35	6,769,580
1935-36	8,433,751
1936-37	7,984,220
1937-38	10,303,748
1938-39	12,738,098
1939-40	9,685,061
1940-41	10,489,992
1941-42	12,766,302
1942-43	5,535,807
1943-44	6,502,752
1944-45	7,943,748

General Geology.

The quarry is in the upper shales of the Cardup series. The shales are bounded on the Western side of the quarry by a concordant basic intrusive. The contact between the shales and concordant basic intrusive has a dip of 60° W. and an approximate North-South strike. On the Eastern side of the quarry the shales lie conformably on sandstone of the Cardup Series. The contact between the sandstones and shales has a dip of 51° W. and an approximate North-South strike.

In the North-Eastern corner of the quarry there is a flexuring of the beds. The strike changes from N. 10° E. to N. 65° W. but resumes its normal direction in 120 feet.

North of the quarry the continuity of the shales is interrupted by the discordant intrusion of a younger basic rock which has a Westerly trend. The width of the beds is restricted to about 50 feet at 120 feet from the North-Western corner of the quarry.

Further on there is a local bulging of the concordant basic intrusive This bulging also causes a reduction in the thickness of the shales.

At approximately 350 feet from the Northern end of the quarry the beds resume their normal trend for a further 370 feet; then the shales are cut off by another discordant intrusion.

South of the quarry there is no surface indication of any interruptions in the continuity of the shales within the boundaries of the holding.

Amount of Shale Available.

The amount of shale available outside the present limits of the quarry and to the same depth as the floor level of the quarry is as follows:—

North of the quarry ..	83,734	cubic yards
South of the quarry ..	122,756	cubic yards
Total	206,490	cubic yards

Recommendations.

Sites for six boreholes have been located. Five sites are inside the quarry and one is to the South of the quarry. The boreholes will test the depth at which the shale will become too hard for brickmaking. The boreholes are so placed that they will test the shale available if a 70° batter and a minimum working width of a 100 feet is used.

Plans and Sections.

A geological plan together with transverse and longitudinal sections accompany the report. (Plates XV., XVI.)

Index to Geological Survey Annual Progress Report for 1945.

INDEX TO GEOLOGICAL SURVEY ANNUAL PROGRESS REPORT FOR 1945—*continued.*

Division V.

School of Mines, W.A.

The Under Secretary for Mines.

I forward herewith, for the information of the Hon. Minister for Mines, my Annual Report for 1945.

1. KALGOORLIE SCHOOL OF MINES.

Enrolments.

The total number of individual students enrolled during the year was 421, made up as follows:

	Class Enrolments.	Individual Enrolments.
First Term	754	349
Second Term	618	372
Third Term	522	367

Correspondence Course Enrolments.

Civilian	15
Service and Ex-Service	70

Commonwealth Reconstruction Trainees.

Full-time	6
Part-time	20

These students are discharged service personnel who have been considered eligible and suitable for either full-time or part-time training under the Commonwealth Reconstruction Training Scheme. The former are assisted by weekly payments while the latter have all fees paid by the Commonwealth, and, in addition, receive annual allowances for the purchase of books and instruments, as also do the full-time trainees.

R.A.A.F. Personnel.

These were R.A.A.F. personnel from the Kalgoorlie station of the R.A.A.F. who were admitted to classes at special concession fees approved by the then Hon. Minister for Mines in 1943. The majority of these men have taken full advantage of the concession as long as they remained in Kalgoorlie but, unfortunately, many of them have been posted to other stations before completing a year's course.

Revenue.

The revenue from fees, not including Correspondence Course and Metallurgical Laboratory fees, has been £472 13s. 3d.

Fees received for investigations conducted in the Metallurgical Laboratory have amounted to £27.

These fees have been paid into special trust funds which are used to defray the cost of conducting the former and of purchasing supplies, etc. for the Metallurgical Laboratory.

Public Assays and Mineral Determinations.

The number of free assays and mineral determinations carried out by members of the Staff for prospectors during the year was as follows:—

Assays for gold and other metals ..	152
Mineral determinations	49

In addition to the information furnished in this way, members of the Staff are called upon to give information and advice about the occurrence, value and exploitation of many minerals of commercial importance.

Staff.

At the end of the first term Mr. C. C. Meredyth, Lecturer in Engineering, found it necessary through continued ill health to tender his resignation and the classes under his control have since been successfully carried on by part-time instructors, Messrs. W. G. Gobbart and H. D. Golding, to whom the thanks of the school are due for their valuable assistance.

The resignation of Mr. Meredyth is greatly regretted and it is fitting that I should here pay a tribute to the value of his work at the school, which was often carried out under serious difficulties due to ill health.

In May, Mr. A. C. McDonald, Senior Research Metallurgist in the Kalgoorlie Metallurgical Laboratory, resigned in order to accept a similar position with the Broken Hill Associated Smelters Pty. Ltd., at Port Pirie. Mr. McDonald, who had occupied the position for three years had done good work in the laboratory, particularly in the field of pyrometallurgy in which he had had a long training.

The position of Senior Research Metallurgist was filled by the appointment of Mr. R. W. Wilson, who had held the position of Assayer and Assistant Research Metallurgist for 11 years and had done excellent work in that position.

Mr. M. A. Moore, assistant in the laboratory for nearly two years was appointed to the position vacated by Mr. Wilson and he in turn, was succeeded by Mr. E. E. Hughes, a returned serviceman of the last war who had had excellent training at Perth Technical College and the University of W.A.

Late in October, Mr. E. H. Illidge, Lecturer in Mathematics and Physics who had been on special war service in the R.A.A.F. for four and a half years, returned to duty and in consequence Mr. S. Edelman, Assistant Lecturer in Mathematics and Physics, who had taken charge of this department during Mr. Illidge's absence, returned to his former position, while Mr. C. Cockram, who had very capably carried on Mr. Edelman's work, retired from the service of the school. Mr. Cockram's work has been excellent and he has gained the approval of the students and the other members of the Staff, all of whom regret that it should be necessary for him to sever his official connection with the School of Mines.

All members of the Staff have carried out their work capably and have continued to give excellent service to the school.

Correspondence Courses.

The total number of students who enrolled for these classes during the year has been as follows:—

	Service and Ex-Service Personnel	Civilians
Mining I	34	6
Mining II	1	1
Metallurgy I	23	0
Assaying I	2	2
Ore Dressing	10	6

These courses have been of very great value to those who by reason of distance from Kalgoorlie have been unable to attend classes in person and have in many cases led to the students finally coming to Kalgoorlie in order to obtain the benefit of personal instruction.

Commonwealth Reconstruction Training Scheme.

Under this scheme by which ex-service personnel are assisted to take up full-time or part-time professional or vocational training the following students enrolled during the past year:—

Full-time	6
Part-time	20

As the servicemen are being demobilised more and more are applying for training under this scheme either to continue courses of instruction commenced before enlistment or to enter upon new courses connected with the mining industry and it is quite probable that during the next few years the number of ex-service personnel taking up such courses will increase very considerably.

Metallurgical Laboratory.

During the year 19 applications for investigations were received and reports have been issued on all these to the interested parties.

Up to the present time the majority of applications have been for investigations into the treatment of gold ores and problems connected therewith and although some attention has already been paid to the treatment of non-metallic minerals it is expected that as the gold mining industry begins to expand as it naturally will do after the end of the war, further demands will be made on the staff of the laboratory for investigations into the treatment of these ores.

The classes of investigations conducted or applied for have been as follows:—

Gold ore and tailings treatment ..	17
Tin-Tantalum ore	1
Tin-Gold ore	1

A very interesting and comprehensive investigation has been carried out for Blue Spec Gold Mines, N.L., which had for its object the determination of a method of not only producing an antimony concentrate but also of extracting the maximum amount of gold as bullion and the reduction of the gold content of the antimony concentrate below the maximum value agreeable to the purchasers of these concentrates. This work was highly successful and showed an actual extraction and recovery as bullion of 92 per cent. of the gold and the production of an antimony concentrate of gold content well below the allowance maximum, together with a low grade final residue, from a high grade gold-antimony ore.

In addition to the work in the laboratory the operating staff and the director spent six weeks at Ravensthorpe operating a small flotation plant and blast furnace smelting plant erected to determine the possibility of recovering the gold and copper from the ores of the Phillips River goldfield. The work of the staff showed that, with certain necessary improvements and additions to the existing plant or with the erection of an up-to-date plant and careful and exact metallurgical control it is possible to recover a high percentage of both the gold and copper in the form of copper bullion from the oxidised and sulphide ores directly instead of by first producing matte as an intermediate product.

In consequence of the resignation of Mr. A. C. McDonald and the promotion of Messrs. R. W. Wilson and M. A. Moore, the former to the position of Senior Research Metallurgist and the latter to the position of Assistant Research Metallurgist, it became necessary to fill Mr. M. A. Moore's position as assistant. Mr. E. E. Hughes, a discharged serviceman and senior student of the school has been appointed to the vacant position, the cost of which is borne by the Council for Scientific and Industrial Research.

The Commonwealth vote for the assistance of the three laboratories at Melbourne, Adelaide and Kalgoorlie, expires in June, 1946, but the Council for Scientific and Industrial Research has applied for a continuance of the vote, the amount now asked for being £4,500 per annum for a period of five years. The Council appears to be quite satisfied with the work of these laboratories and at a conference held in Melbourne in December, 1945 appreciation of the valuable work of these laboratories was expressed by the executive officers of the Council.

The extension to the laboratory buildings has now been completed and has filled a long-felt want by enabling some of the equipment to be set up in more suitable positions, thus relieving the congestion previously existing in the laboratory.

The provision of means for abating and removing the dust produced in the dry sampling and dry crushing of ores has not yet been put in hand, but should be made during the annual vacation so that the operating staff may work under more healthy and less unpleasant conditions.

In connection with the work of the laboratory 647 assays for gold, 112 chemical analyses and 46 grading tests have been carried out, apart from routine cyanide control analyses and analyses carried out at Ravensthorpe.

Buildings.

Tenders have again been called for external and internal painting and repairs to the school buildings which have been asked for for many years.

The necessity for this work has been stressed so often that it should now be apparent to the authorities concerned that the requests so frequently put forward were justified and that it is only by carrying out such work at reasonably short intervals that the buildings can be preserved from decay

Advisory Committee.

During the year Mr. A. Beange retired by effluxion of time and Mr. W. R. Matthews was nominated by the Amalgamated Workers' Union and approved by the Hon. Minister for Mines as Mr. Beange's successor on the committee. The other members of the committee were re-nominated by the respective bodies which they represent and were again appointed by the Hon. Minister.

Meetings have been well attended and one important result of the committee's activities has been the broadening of the scope of the affiliation existing between the School of Mines and the University of W.A. so that students proceeding to a degree in Mining Engineering of the University may now do so by taking two years' work at each institution.

The committee has at all times taken a very live interest in the school and I personally have to thank its members for very valuable assistance not only during the past year, but also ever since its appointment.

The Registrar, Mr. G. M. Lumb, has efficiently carried out the duties of secretary to the Advisory Committee throughout the year.

Diplomas and Certificates.

Diplomas and Certificates have been issued during the year, as follows:—

Diplomas	7
Mines Surveyor's Certificates	2
Industrial Chemist's Certificates	2
Assayer's Certificates	1
Electrician's Certificates	2
Draughtman's Certificate	1

Scholarships.

The Junior Scholarship has for many years not attracted the entries that its value warrants and it has been realised that one contributory factor has been the lack of instruction in mathematics provided by the State Primary and central schools. This has restricted the field of eligible candidates to boys attending either the State High Schools or other secondary schools.

In an endeavour to effect an improvement the scholarship regulations have now been amended so that boys who are unable to obtain the necessary instruction in mathematics at the State Primary schools may now attend the School of Mines classes in Elementary Mathematics without being disqualified from entering for this Scholarship.

A notification of this amendment to the regulations has been conveyed to all the schools on the goldfields and it is hoped that this will result in an increased entry in future for this Scholarship.

Other scholarships and prizes previously enumerated have again been open for competition and the thanks of the school are due to the donors of scholarships and prizes who have in this way shown their practical interest in the work of the school and the advancement of its students.

General.

In consequence of my retirement on account of my having passed the statutory retiring age, it becomes necessary to appoint a successor and I hope that the Mines Department will be able to obtain a well qualified man who will gain the confidence not only of the Department, but also of the mining industry, the staff, and the students generally, that is so necessary for success.

It is with great regret that I sever my official connection with the school, extending over a period of 38 years, and in doing so I am happy to express my sincere appreciation of the cordial relations that have existed between the Mines Department and myself and of the assistance that has always been freely given to me and to the school by all officers of the Department with whom my relations have been always most happy.

To the members of the staff of the School of Mines, to the members of the Chamber of Mines of W.A., and to the general public of the goldfields, I also tender my sincere thanks for their valuable co-operation and support and confidently rely on the same assistance being given to my successor and to the school.

CLASS ENROLMENTS, 1945.

Subject.	1st. Term.	2nd. Term.	3rd. Term.
Elementary Mathematics ..	60	51	36
Preparatory Chemistry ..	70	41	32
Preparatory Physics	64	39	28
Preparatory Drawing	65	47	37
Preparatory Mathematics ..	65	45	44
Preparatory Geology	17	18	19
Mathematics I.	35	29	28
Applied Mathematics	18	15	14
Mathematics II.	8	7	8
Physics I.	28	26	24
Chemistry I.	13	9	7
Engineering Chemistry I. ..	8	8	8
Engineering Chemistry II. ..	1	1	1
Assaying I.	13	13	12
Assaying II.	2	2	1
Metallurgy I.	3	4	5
Metallurgy II.	1	1	1
Geology	9	7	7
Mining & Economic Geology	1	1	1
Mineralogy	4	5	5
Petrology	3	2	2
Mining I.	12	10	7
Mining II.	2	2	2
Ore Dressing	5	6	3
Surveying I.	7	6	7
Surveying II.	2	2	4
Mechanical Drawing I. ..	43	37	25
Mechanical Drawing II. ..	12	12	13
Applied Mechanics	8	9	9
Mechanical Engineering I. ..	8	6	6
Mechanical Engineering II. ..	3	3	3
Internal Combustion Engines	29	25	22
Building Construction ..	9	10	11
Machine Design	5	5	5
Electrical Engineering I. ..	8	10	6
Electrical Engineering II. ..	4	4	4
Engine Driving I.	16	17	12
Engine Driving II.	8	6	6
Workshop Practice I. ..	46	45	38
Workshop Practice II. ..	39	32	19
Total Class Enrolments, 1945	754	618	522
Total Class Enrolments, 1944	747	604	506
Individual Students, 1945 ..	349	372	367
Individual Students, 1944 ..	351	313	308

2. WILUNA SCHOOL OF MINES.

Enrolments:

The enrolments for 1945 were as follows:—

	Individual Enrolments	Class Enrolments
First Term	45	74
Second Term	38	62
Third Term	35	54

Classes have been conducted in Elementary Mathematics, Preparatory Mathematics, Applied Mathematics, Preparatory Mechanical Drawing, Mechanical Drawing I., Mechanical Drawing II., Preparatory Chemistry, Workshop Practice I. and II., Preparatory Geology, Geology, Mineralogy, and Mining I.

Fees collected during the year amounted to £51.

Staff:

In consequence of the uncertainty regarding the continuance of full scale operations on Wiluna Gold Mines Ltd., and the resulting departure of technical officers, some changes in staff have been necessary but all officers have carried on their classes satisfactorily.

Attendances, however, fell off towards the end of the year owing to the departure of some of the students from the town.

General:

The Advisory Committee has continued to function to the advantage of the School and the Registrar, Mr. G. M. Hickey, has carried out his duties energetically and enthusiastically in the face of difficulties caused by the uncertainty regarding the life of the mines.

Whether the Department will be justified in continuing the School will depend on the population and the possible support to be given to the School by the residents of Wiluna although it appears that the number of employees on the mines will so diminish that insufficient students will present themselves.

To the staff and the Advisory Committee my thanks are due for their valuable assistance during the whole of the life of the School.

3. NORSEMAN SCHOOL OF MINES.

Class work at the Norseman School of Mines has been carried on continuously during the year and the results of the Annual Examinations have been satisfactory and reflect credit on the Instructors who have given up their spare time to conduct the classes.

Classes in operation have been as follows:—

Elementary Mathematics
Preparatory Mathematics
Preparatory Chemistry
Preparatory Physics
Workshop Practice I. and II.
Practical Electricity
Preparatory Mechanical Drawing
Mechanical Drawing I. and II.
Chemistry I.
Mathematics I.
Applied Mathematics.

Attendance at classes has been satisfactory despite the uncertain conditions brought about by the war but with the cessation of hostilities and the gradual discharge of servicemen it is expected that there will for the next few years be an increase in enrolments.

During the year the Registrar, Mr. K. H. Hogg, retired on account of his transfer to another part of the State and his duties have been undertaken by his successor as Mining Registrar, Mr. A. C. W. Manning.

My thanks are due to the members of the Advisory Committee, the Staff of Instructors and to the Registrar for their valuable assistance during the period since the establishment of the branch School and in taking leave of them owing to my impending retirement I wish the School and all connected with it success in the future.

B. H. MOORE,
Director, School of Mines.

12/12/45.

SCHOOL OF MINES OF W.A.

ANNUAL EXAMINATIONS, 1945.

PASS LIST.

(T) denotes Terminal Pass Only.
Names are in order of merit.
* Denotes equal.

ELEMENTARY MATHEMATICS.

Arithmetic Section.

Credit—
Reid, B.
Lamb, W. E.
Hunter, C.
Reeves, C. A.
Annear, R. J.*
Beck, A. J.*
Taaffe, J. M.*

Pass—
Rymer, R.
Sullivan, L. J.
Gaynor, R. E.
Hamilton, J. H.
Stewart, D.
McNally, Miss S.
Scott, J. F.
Still, W. L.
Douglas, R. D.*
Camilleri, O. J.*
Sharp, R. C.*

Algebra Section.

Credit—
Lamb, W. E.
Beck, A. J.
Hamilton, J. H.

Pass—
Reid, B.
Torpy, J.
Garlick, A. J.
Sommer, R.
Smith, E. H.
Annear, R. J.
Brown, D. E.
Douglas, R. D.
Grey, J. A.
Hunter, C.

Geometry Section.

Credit—
Taaffe, J. M.

Pass—
Lamb, W. E.
Beck, A. J.
Edgar, K. R.
Annear, R. J.
Hamilton, J. H.
Sommer, R.
Reid, B.
Bassett, R. J.*
Brown, D. E.*
Douglas, R. D.*
Hunter, C.*
McCahon, H. A.*
Smith, E. H.*

PREPARATORY MATHEMATICS.

Algebra Section.

Credit—
Jamieson, P. H.
Quadrio, J. S.
Collin, A.
Gard, L. A.
Lazberger, A.
Bawden, C. L.

Pass—
Crowley, P. J.
Long, W.
Jacobsen, W. G.
Chapman, G. M.
Still, J. D.
Wallis, F. A.*
Braithwaite, A.*

Geometry Section.

Credit—
Collin, A.
Quadrio, J. S. } *
Jamieson, P. H. }
Henderson, P. B. } *
Wallis, F. A. }

Pass—
Pearce, C. J.
Gard, L. A.
Canning, D. G.
Lazberger, A.
Lawford, D. J.*
Long, W.*
Madin, R. J.
Ion, C. E.*
Rogers, C. I.*
Jacobsen, W. G.

Trigonometry Section.

Credit—
Jamieson, P. H.
Collin, A.
Quadrio, J. S.
Lazberger, A.
Gard, L. A.
Ion, C. E.
Wallis, F. A.

Pass—
Long, W.
Madin, R. J.
Stronach, B. J.
Bawden, C. L.
Toms, A. J.
Braithwaite, A.

PREPARATORY CHEMISTRY.

Credit—
Quadrio, J. S.
Collin, A.
Walker, H. R.
Henderson, D. C.

Pass—
Clayton, J. L.
Lazberger, A.
McCombe, W. P.
Stronach, B. J.
Brennan, Miss R. C.
Bain, M. A.
Gray, F. E.
Ion, C. E.
Wheeler, B. H.
Quan, L. E.
Smith, W. B.*
Braithwaite, A.*

PREPARATORY PHYSICS.

Credit—
Collin, A.
Quadrio, J. S.
Jamieson, P. H.

Pass—
Thomas, R. P.
Canning, D. G.
Harris, J. E.*
Hill, J. C.*
Madin, R. J. (T)
Lazberger, A.

Pass in Practical only—
Braithwaite, A.
Busch, E. H.
Herbert, S. G.
Litchfield, A. G.
Newman, F. L.
Quan, L. E.
Teague, M. G.
Wheeler, B. H.

PREPARATORY GEOLOGY.

Credit—
Collin, A.

Pass—
Brockway, Miss D. J.
Clayton, J. L.
Long, W.
Edlington, W. B.
Stronach, B. J.
Hooker, L. F.
Brennan, Miss R. C.
McCombe, W. P.

Pass in Practical only—
Browne, G.
Reid, B.
Quan, L. E.

PREPARATORY MECHANICAL DRAWING.

Credit—
Lazberger, A.
Reid, B. (T)
Clayton, J. L. (T)
Jones, K. D.

Pass—
Edgar, K. R.
Gard, R. F.
Canning, D. G.
Quan, L. E. (T)
Douglas, R. D.
Wheeler, B. H.
Newman, F. L.
Tinetti, E. G.
Roberts, J. T.*
Brune, S. R.*
Harper, D. G.
Litchfield, A. G.
Brockway, Miss D. J.
Teague, M. G.
Herbert, S. G.*
Johnston, D. W.*

MATHEMATICS.
(First Course)
Algebra Section.

Credit—
Smith, Miss V.
Edlington, W. B.

Pass—
Martin, D. H.
Brockway, Miss D. J.
Inman, E. G.
Lambert, K. C.
Darrow, Miss B. M.
Ford, T. H.
Carew-Reid, D. M.*
McDonald, A. J.*

MATHEMATICS.
(First Course)
Geometry Section.

Credit—
Crowley, P. J.
Inman, E. G.

Pass—
Edlington, W. B.
Brockway, Miss D. J.
Cockram, C. C.
Darrow, Miss B. M.
Taylor, R. J.*
Kelly, K. W.*

Trigonometry Section.

Credit—
Edlington, W. B.
Brockway, Miss D. J.

Pass—
Cockram, C. C.
Lambert, K. C.
Crowley, P. J.
Martin, D. H.
Darrow, Miss B. M.
Carew-Reid, D. M.
James-Wallace, W.
Ford, T. H.
Henderson, D. C.
Inman, E. G.

MATHEMATICS.
(Second Course)

Credit—
Wilson, R. G.

Pass—
Fisher, E. W.
McCombe, W. P.
Turner, J. L.
Paterson, J. R.

APPLIED MATHEMATICS.

Credit—
Cockram, C. C.
Chilvers, J. E.*
Thomas, W. W.*

Pass—
Lambert, K. C.
Erbe, J. W.
Ibbotson, G. R.
James-Wallace, W.

PHYSICS I.

Credit—
Lambert K. C.
Tasker, E.

Pass—
Cockram, C. C.*
Inman, E. G.*
Walton, A. H.
Edlington, W. B.
Chadd, W. R.
Erbe, W. V.

Pass in Practical only—
Armstrong, L. H.
Crowley, P. J.
Ford, T. H.
Gray, F. E.
Henderson, D. C.
Hooker, L. F.
Kelly, K. W.
Ritchie, H. G.
Carew-Reid, D. M.
Warren, R. E.
Peek, K.

CHEMISTRY.
(First Course)

Pass—
Carew-Reid, D.
Crowley, P. J.
Brockway, Miss D. J.
Ryder, K. N.
Hooker, L. F.
Cockram, C. C.

ASSAYING.
(First Course)

Credit—
Hughes, E. E.
Wilson, R. G.

Pass—
Ryder, K. N.
Thomas, R. P.
Crowe, I. F.
Chapman, G. M.
Crowley, P. J.
Thomas, W. W.
Cockram, C. C.
Ibbotson, G. R.

Pass in Theory only—
Lee, G. S.
Weight, F. J.

Pass in Practical only—
Brennan, Miss R. C.

ASSAYING.
(Second Course)

Credit—
Cockram, C.
Chilvers, J. E.

ENGINEERING CHEMISTRY.
(First Course)

Credit—
Hamilton. F. G.
Cackett, W. S.

Pass—
Chilvers, J. E.
Erbe, J. W.
Canning, D. G.
Thomas, W. W.
Ibbotson, G. R.

ENGINEERING CHEMISTRY.
(Second Course)

Credit—
Cockram, C.

Pass—
Barr, J. C.

METALLURGY.
(Second Course)
(Provisional pending Thesis)

Pass—
Green, K. C. B.

Thesis Accepted—
Walton, L. H.
Muskett, G.
Hoffman, W.
Westaway, J. W.
Illidge, E. H.

METALLURGY.
(First Course)

Credit—
Cockram, C.

Pass—
Olive, L. C.
Anderson, J. F.
Robinson, F. L
Thomas, W. W.

GEOLOGY.

Pass—
Taylor, R. J.
Wilson, R. G.
Tasker, E.
Paterson, J. R.
Boyd, J. P.
Crowley, P. J.
Melville, R. J.

MINERALOGY.

Pass—
Hewett, M. H.
Paterson, J. R.

PETROLOGY.

Pass—
Moore, M. A.

MINING AND ECONOMIC GEOLOGY.

Thesis Accepted—
Crocos, A. J.

MINING.
(First Course)

Pass—
Hosie, A.
Ion, C. E.
Crowley, P. J.
McCombe, W. P.*
Worcester, N. C.*
Morrell, C. C.*

MINING.
(Second Course)

Pass—
Ryder, K. N.
Ibbotson, G. R.

ORE DRESSING.

Pass—
Anderson, J. F.
Robinson, F.L.

SURVEYING.
(First Course)

Credit—
Cox, E. J.
Weedon, P. H.

Pass—
McCombe, W. P.
Christopher, L. F.* (T)
Ion, C. E.*
Chapman, G. M.

SURVEYING.
(Second Course)
(Provisional pending Thesis)

Pass—
Peek, K.
Livingstone, J. A.
Taylor, R. J.
Busch, E. H.

Plan Accepted—
Gobbart, W. G.

MECHANICAL DRAWING.
(First Course)

Credit—
Jamieson, P. H.
Walton, A. H.
Wilson, R. G.
Crowley, P. J.

Pass—
McCombe, W. P.
Cockram, C. C.
Watson, F. G.
Scott, J. F.
Lambert, K. C.
Morey, D. V. } *
Way, I. E. }
Edlington, W. B.
Henderson, D. C.
Armstrong, L. H. } *
McDonald, M. W. }
Ford, T. H.
Hudson, H. R.
Hamilton, J. H.
D'Esterre, J. V. (T)
Hunter, C.
Williams, C. K.
Annear, R. J.
DeCampi, R.

MECHANICAL DRAWING.
(Second Course)

Credit—
Collin, A.
Thomas, R. P.
Martin, D. H.
Hughes, E. E.
Madin, R. J.

Pass—
James-Wallace, W.
Ritchie, H. G.
Tamblyn, L. F.
Andrijasevich, A. (T)
Henderson, P. B.

APPLIED MECHANICS.

Credit—
Hughes, E. E.
Cox, E. J.
Weedon, P. H.
Thomson, A. W.

Pass—
Moore, M. A.
Turner, J. L.
Ryder, K. N.

BUILDING CONSTRUCTION.

Credit—
Crowe, I. F.
Thomson, A. W.
Fisher, E. W. } *
Olive, L. C. }
Hughes, E. E. } *
Cackett, W. S. }

Pass—
Hamilton, F. G.
Cox, E. J.
Dainton, R.
Watson, F. G.*
Dowson, R. C.*

WORKSHOP PRACTICE.
(First Course)

Credit—
Lambert, K. C.
Thomson, A. W.
Collins, S. J.
Watson, F. G.
James-Wallace, W.
Thomas, W. W.
Henderson, D. C.*
Wishart, A. R.*

Pass—
McCarthy, R. L.*
Bain, M. A.*
Davey, F. G.
Gard, R. F.
Griffiths, C. G.
Johnston, D. W.
Sarich, J. W.
Camilleri, O. J.
Angwin, E. T.
Bonser, I. L.
Pearson, D.
Eaton, R. E.
Stevens, F. J.

Pass in Theory only—
Conway, J. S.
Lathlain, W. B.
Hall, W. H.
Torpy. J.

Pass in Practical only—
Koops, B.
Martin, R.

WORKSHOP PRACTICE.
(Second Course)

Credit—
Wittber, C. A.
Mountstephen, A. V.*
Parin, J.*
Fisher, E. W.
Turner, J. L.

Pass—
McKean, R. F.
O'Brien, A. R.
DeCampi, R.
Hunter, C. A.
Mitchell, A. J.
Taaffe, J. M.

Pass in Theory only—
Slee, A. P.

MECHANICAL ENGINEERING.
(First Course)

Credit—
Wilson, R. G.

Pass—
Hughes, E. E.
Crowe, I. F.*
Moore, M. A.*
Watson, F. G.
James-Wallace, W.

MECHANICAL ENGINEERING.
(Second Course)

Credit—
Parker, S. C.
Cox, E. J.
Weedon, P. H.

Pass—
Dainton, R.
Slee, A. P.

ELECTRICAL ENGINEERING.
(First Course)

Credit—
Hamilton, F. G.
Harris, G. D.
Olive, L. C.
Watson, F. G.

Pass—
Moore, M. A.
Scholey, J. W.

ELECTRICAL ENGINEERING.
(Second Course)
(Provisional pending Thesis)

Credit—
Turner, J. L.
Cox, E. J.
Weedon, P. H.
Dainton, R.

Theses Accepted—
Slee, A. P.
Weedon, R. P. J.
Morphet, J. P.
Parker, S. C.
Walker, G. A.
Turner, J. L.

MACHINE DESIGN.
(Provisional pending Thesis)

Credit—
Fisher, E. W.
Cox, E. J.*
Weedon, P. H.*
Dainton, R.

Pass—
Thomson, A. W.

Theses Accepted—
Weedon, R. P. J.
Turner, J. L.
Parker, S. C.

INTERNAL COMBUSTION ENGINES.

Credit—
Rogers, J. I.
Logan, R. B.
Plant, C. A. } *
Lamb, W. E. }
Daws, C. P. } *
Fyfe, H. L. }
Wallis, F. A.
Kelly, W. J. } *
McNally, F. J. }
Williams, L.

Pass—
Tamblyn, L. F.
McDonald, M. W.
Hammer, H. R.
Hayes, W. R.*
Kluge, C. G.*
Lonsdale, C. T.*
McDonald, K. J.
Wilson, M. G.
Carr, J. G.
Mitchell, K. R.
Conway, J. S.

ENGINE DRIVING.
(First Course)

Credit—
Gard, L. A.
Wallace, R. H.
McKean, R. F.

Pass.—
Eiffler, F. J.
Parin, J.
Brown, D. E. (T)
Jones, K. D.
Lamotte, J. A.

ENGINE DRIVING.
(Second Course)

Credit—
Merritt, H. G.

Pass—
McNally, F. J.
Eiffler, F. J.
Burley, E. J.*
Tooth, J.*

SUPPLEMENTARY EXAMINATIONS, 1945.

PREPARATORY MATHEMATICS.
Trigonometry Section.

Pass—
Brennan, Miss R. C.

Algebra Section.

Pass—
Canning, D. G.
Wheeler, B. H.

MATHEMATICS.
(First Course)
Algebra Section.

Pass—
Cockram, C. C.
Hooker, L. F.
Erbe, W. V.
Gray, F. E.

ENGINEERING CHEMISTRY.
(First Course)

Pass—
Crowe, I. F.

GEOLOGY.

Pass—
Gobbart, W. G.

PETROLOGY.

Pass—
Ibbotson, G. R.

YEAR'S FREE FEE SCHOLARSHIPS.

PREPARATORY MATHEMATICS.
Jamieson, P. H.

PREPARATORY CHEMISTRY.
Quadrio, J. S.

PREPARATORY PHYSICS.
Collin, A.

PREPARATORY GEOLOGY.
Collin, A.

PREPARATORY DRAWING.
Lazberger, A.

MATHEMATICS II.
Wilson, R. G.

APPLIED MATHEMATICS
Cockram, C. C.

PHYSICS I.
Lambert, K. C.

ASSAYING I.
Hughes, E. E.

ASSAYING II.
Cockram, C.

ENGINEERING CHEMISTRY I.
Hamilton, F. G.

ENGINEERING CHEMISTRY II.
Cockram, C.

METALLURGY I.
Cockram, C.

SURVEYING I.
Cox, E. J.

MECHANICAL DRAWING I.
Jamieson, P. H.

MECHANICAL DRAWING II.
Collin, A.

APPLIED MECHANICS.
Hughes, E. E.

BUILDING CONSTRUCTION.
Crowe, I. F.

WORKSHOP PRACTICE I.
Lambert, K. C.

WORKSHOP PRACTICE II.
Wittber, C. A.

MECHANICAL ENGINEERING I.
Wilson, R. G.

MECHANICAL ENGINEERING II.
Parker, S. C.

ELECTRICAL ENGINEERING I.
Hamilton, F. G.

ELECTRICAL ENGINEERING II.
Turner, J. L.

MACHINE DESIGN.
Fisher, E. W.

INTERNAL COMBUSTION ENGINES.
Rogers, J. I.

ENGINE DRIVING I.
Gard, L. A.

ENGINE DRIVING II.
Merritt, H. G.

NORSEMAN SCHOOL OF MINES.

ELEMENTARY MATHEMATICS.

Arithmetic Section.

Pass—
Meacock, W. G.
Hawkins, W. J.

Algebra Section.

Pass—
Meacock, W. G.
Hawkins, W. J.
Kerr, P. H.

Geometry Section.

Credit—
Kerr, P. H.

Pass—
Meacock, W. G.
Perkin, E. J.

PREPARATORY MATHEMATICS.

Algebra Section.

Pass—
Pugh, D. D.

Geometry Section.

Pass—
Horsham, J. F.
Radosevich, J. D.
Stubbs, J. R.

PREPARATORY PHYSICS.

Pass—
Dehring, H.

PREPARATORY MECHANICAL DRAWING.

Credit—
Cottrell, R. H.

Pass—
Meacock, W.
Kerr, W.
Kerr, P.
Stubbs, J. R.
Mahoney, J.

PREPARATORY CHEMISTRY.

Pass—
Morton, J. L.
Scholey, J. W.
Joplin, W.

PRACTICAL ELECTRICITY.

Credit—
Sweet, E.

Pass—
Guest, A. I.
Carey, L. J.
Bach, D. J.*
Dehring, F. A.*

CHEMISTRY.

(First Course)

Pass—
Dodd, K. C.
Cox, J. A.
Walker, J. M.
McKenna, D. M.

APPLIED MATHEMATICS.

Credit—
Dodd, K. C.

Pass—
Peek, D.

MECHANICAL DRAWING.

(First Course)

Pass—
Mitchell, B. A.
Joplin, W.
Horsham, J.
Lord, S. J.

MECHANICAL DRAWING.

(Second Course)

Credit—
Dodd, L.
Carey, L.

Pass—
Morton, J.
Trotter, E. J.

WORKSHOP PRACTICE.

(First Course)

Pass—
Pugh, D.

WORKSHOP PRACTICE.

(Second Course)

Credit—
Dodd, L. C.

Pass—
Trotter, E.
Benson, A. D.
Forgan, F.
Dehring, F.

Pass in Practical only—
Lord, S.

YEAR'S FREE FEE SCHOLARSHIPS.

PREPARATORY MECHANICAL DRAWING.
Cottrell, R. H.

PRACTICAL ELECTRICITY.
Sweet, E.

APPLIED MATHEMATICS.
Dodd, K. C.

MECHANICAL DRAWING II.
Dodd, L. C.

WORKSHOP PRACTICE II.
Dodd, L. C.

WILUNA SCHOOL OF MINES.

ELEMENTARY MATHEMATICS.

Arithmetic Section

Credit—
Payne, H. J.
Speirs, M.

Algebra Section.

Credit—
Toussaint, F. F.
O'Brien, M.

Pass—
Dawson F. A.

Geometry Section

Credit—
Toussaint, F. F.

Pass—
Robinson, W. A.
Dawson, F. A.

PREPARATORY MATHEMATICS.

Algebra Section.

Credit—
Sims, A. J.

Pass—
D'Alton, A. J.

Geometry Section.

Pass—
Hille, T. S.
Sims, A. J.

Trigonometry Section.

Pass—
Sims, A. J.
D'Alton, A. J.

PREPARATORY MECHANICAL DRAWING.

Pass—
D'Alton, A. J.
O'Brien, M.

PREPARATORY GEOLOGY.

Pass—
Henley, E. K.
McCarthy, R. J.
Hille, R. W.

APPLIED MATHEMATICS.

Pass—
Smith, A. D.

MECHANICAL DRAWING.

(First Course)

Pass—
Toussaint, F. F.

MECHANICAL DRAWING.

(Second Course)

Credit—
Smith, A. D.
Sims, A. J.

WORKSHOP PRACTICE.

(First Course)

Credit—
Dawson, F. A.

Pass—
O'Brien. M.

Pass in Practical only—
Moiler, R.
Giltrap, C.

WORKSHOP PRACTICE.

(Second Course)

Credit—
Turner, A.

Pass—
Groessler, G. H.
Satchell, J. H.

MINING.

(First Course)

Pass—
Muskett, G. H.
O'Dea, W. J.

GEOLOGY.

(First Course)

Pass—
Taylor, E.

Pass in Theory only—
Smith, A. D.

MINERALOGY.

Pass—
Hudson, E. F.
Taylor, E.
Sims, A. J.
Smith, A. D.

YEAR'S FREE SCHOLARSHIPS.

MECHANICAL DRAWING II.
Smith, A. D.

WORKSHOP PRACTICE I.
Dawson, F. A.

WORKSHOP PRACTICE II.
Turner, A.

SCHOLARSHIPS, PRIZES, ETC.

The following have been recommended.

JUNIOR SCHOLARSHIP (£40 per annum).
Barclay, V.

SENIOR SCHOLARSHIP (£75 per annum).
Cockram, C. C.

CHAMBER OF MINES SCHOLAR SHIP (£15 per annum). (Metallurgy).
Jamieson, P. H.

CHAMBER OF MINES SCHOLARSHIP (£20 per annum). (Mining).
Edlington, W. B.

W.A. SCHOOL OF MINES STUDENTS' ASSOCIATION SCHOLARSHIP.
Lambert, K. C.

INSTITUTE OF MINING SURVEYORS' SCHOLARSHIP (£10 per annum).
Crowley, P. J.

C. A. HENDRY PRIZE.
Collin, A.

CRITCHLEY PARKER PRIZES
Taylor, R. J.
McCombe, W. P.

WESLEY LADIES' GUILD PRIZES.
Hughes, E. E.
Crowe, I. F.

Division VI.

Annual Report of the Inspection of Machinery Branch of the Mines Department for Year 1945.

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, 1945, 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, 1945.

JOHN L. FOXALL,
Chief Inspector of Machinery.

SECTION I.

Inspection of Boilers, Maintenance, 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 purpose, also unfired pressure vessels, such as steam jacketed pans, stills, sterilisers, digesters, vulcanisers, air or gas receivers, montejus, etc.

Return No. 1 gives the types of the 145 boilers registered during the year, also the country of origin, and from return No. 3, it will be seen that three second-hand boilers from the Eastern States and five transferred from other departments in this State were also added to the register, making a total of 153. The deductions were as follows:—Two converted to uses not subject to the provisions of the Act, 21 permanently condemned or cut up, and 11 sent out of this State, leaving a net increase of 119 registered boilers and pressure vessels.

The number of thorough inspections made during 1945 was 155 more than in the previous year, but the number of inspections made under working conditions for which separate reports were submitted was 13 less. The number of certificates issued was 158 more and 16 more repair notices were sent to owners.

New Construction.

Return No. 1 shows that 99 new boilers and pressure vessels were built in this State; of these 17 were power boilers, but the other steam boilers were of small size designed for the use of dairy farmers, etc.

The spherical gas holder is 40 feet diameter; it is constructed of mild steel plates half an inch thick, all seams are electrically welded, the working pressure is 50 lbs. per square inch. There are seven horizontal belts of plates each approximately 8 feet deep. The equatorial belt and the two above and below it each contain 22 plates, but the top and bottom belt have each only 11 plates. There is a circular plate 8 feet diameter at the extreme top and bottom.

The plates were all cut to shape and pressed to 20 feet radius at the Melbourne works of the firm who made and erected the gas holder, the actual erection and welding was undertaken by the local branch of this firm.

Before placing the plates in position for final welding, they were welded together on jigs in sections of three and two plates. The eleven plate belts had three sections of three plates and one of two plates and the other belts six of three plates and two of two plates.

As far as was possible overhead welding was avoided, the plate edges of all seams welded in the jigs were bevelled on the inside and welded while in a horizontal position, the sections of two or three plates were then turned over and the seams were sealed by a light weld on the outside.

When these sections were assembled in position in the sphere, the seams in the top half were welded from the outside and sealed on the inside, and vice versa for the bottom half.

A central tubular mast was first erected. This carried a jib for lifting the plates, etc. As the work progressed the foot of the jib was raised on the mast. When the holder was completed with the exception of the top and bottom circular plates, the mast and jib were dismantled and removed through the bottom manhole.

The bottom belt of plates was first assembled round the mast and when all seams had been welded, it was trued up and levelled by means of wire rope slings; these can clearly be seen in the first photograph. The four concrete foundation blocks, one of which can be seen in this photograph, were then constructed.

The second belt of plates when completed was held to the mast by temporary radial angle iron stays which can be seen in the second photograph. The permanent supporting legs were then placed in position on the foundation blocks and welded to the shell.

The remaining belts of plates were then assembled, the sections being held in place by triangular clamping plates. These can be seen in the third and fourth photographs. As each belt was assembled, it was trued up and stayed to the mast by temporary radial stays. When the sphere was completed with the exception of the top and bottom plates, the welding of the vertical and horizontal seams between the plate sections was completed from the top downwards. This work can be seen in progress in the fourth photograph.

The fifth photograph shows the holder completed and painted, while in the background of both these photographs, portion of a similar size gas holder can be seen, which was constructed with riveted seams and completed early in 1934.

When the holder was completed it was tested by air pressure to 75 lbs. per square inch. All the seams were hammer tested under this pressure with a two pound hammer, and tested for leaks by means of soapy water. At the time of writing the holder has been in use for twelve months and so far no leaks have appeared in any of the seams.

A Perth firm, one of whose activities is the manufacture and repair of steam jacketed vessels, recently built three stainless steel steam jacketed tilting pans for a working pressure of 80 lbs. per square inch. The design, workmanship and finish of these pans was excellent and superior to that of any which have previously been seen in this State.

Two steam jacketed pans were imported by a firm of manufacturing chemists for use in their local laboratory. Both pans were constructed with a stainless steel inner shell and a mild steel outer shell, joined at the top of the steam space by welding to a half inch round stainless steel rod. One pan was 24.5 inch radius of .25 inch Staybrite stainless steel, designed for 50 lbs. working pressure, the other was 20 inch radius of .1875 inch Silver Fox stainless steel, designed for 40 lbs. working pressure. The thickness of metal in each case would have been sufficient had the vessels been constructed of copper, but appears to be most uneconomically thick, when one takes into consideration the fact that the strength of stainless steel is about three times that of copper and its thermal conductivity only about 1/18 to 1/28.

Some boilers and other vessels which were built for the military during the war, are now coming on to the market through the Disposals Board. In some cases these vessels were not built in accordance with the S.A.A. Code or any other recognised code, and the purchasers find that they cannot obtain a certificate for as high a working pressure as they expected.

While an all welded air receiver 8 feet by 3 feet by 9¼ inches by ⅜ inch shell was under hydraulic test to a pressure of 200 lbs. per square inch, an apprentice came along with a joint for the manhole door and asked the fitter did he not want it. It was then discovered that the door for the 15 inch by 11 inch manhole had been put in without any jointing material whatsoever, yet it only showed slight weeps under the full 200 lbs. hydraulic pressure. The manhole door was made of two thicknesses of boiler plate riveted together. The inspector's comment was, "Good workmanship indeed, and a truly memorable fluke."

Maintenance.

Maintenance is not yet up to pre-war standard but conditions are improving both in respect to manpower and materials.

Return No. 1. Showing the Number of Boilers of each Type, and Country of Origin of New Registrations for the Year ended 31st December, 1945.

Type.	Country of Origin.					Total
	United Kingdom.	Sweden.	Eastern States.	Western Australia.	Unknown Sources.	
Cornish	....	....	....	1	....	1
Vertical Stationary	....	....	....	9	....	9
Vertical Multitubular Stationary	....	1	....	....	....	1
Return Multi. Stat. Underfired	....	....	1	13	....	14
Return Multi. Stat. Int. Fired	....	....	....	2	....	2
Water Tube	....	....	4	....	....	4
Locomotive	....	....	....	2	....	2
Saddle Back	....	....	....	24	....	24
Digester	....	....	2	13	1	16
Vulcaniser	1	....	3	1	....	5
Steam Jacketed Vessel	1	....	6	8	8	23
Steriliser	....	1	2	4	....	7
Air Receiver	3	....	7	20	4	34
Vertical Cylindrical Multi-tubular Stat. (waste heat)	....	....	1	....	....	1
Spherical Gas holder	....	....	....	1	....	1
	....	....	....	1	....	1
	5	2	26	99	13	145

Return No. 2.—Showing Classification of Various Types of Useful Boile « in Proclaimed Districts on 31st December, 1945.

Types of Boilers.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Unproclaimed Areas.	Totals.	
				1945.	1944.
Lancashire	41	57	....	98	99
Cornish	99	472	....	571	570
Semi-Cornish	11	37	....	48	48
Vert. Stat.	310	354	....	664	650
Vert. Port.	73	15	....	88	86
Vert. Mult. Stat.	42	25	....	67	67
Vert. Mult. Port.	17	3	....	20	20
Vert. Pat. Tubular	49	....	....	49	49
Loco. Rect. Firebox Stat.	85	65	....	150	146
Loco. Rect. Firebox Port.	255	69	....	324	318
Loco. Cerc. Firebox Port.	136	9	....	145	143
Locomotive	79	43	....	122	116
Water Tube	212	119	....	331	331
Return Mult. Underfired Stat.	189	61	....	250	239
Return Mult. Underfired Port.	....	8	....	8	8
Return Mult. Int. Fired Stat.	44	12	....	56	54
Return Mult. Int. Fired Port	2	....	....	2	2
Egg ended and other types not elsewhere specified	261	26	....	287	323
Digesters	164	5	....	169	154
Air Receivers	604	445	....	1,049	990
Gas Receivers	7	....	....	7	7
Vulcanisers	290	10	....	300	295
Steam Jacketed Vessels	365	13	....	378	349
Total Registrations useful boilers	3,335	1,848	....	5,183	5,064
Total Boilers out of use 31st December, 1945	1,617	1,503	....	3,120	3,088

Return No. 3.—Showing Operations in Proclaimed Districts during Yea ended 31st December, 1945.

(BOILERS ONLY.)

Types of Boilers.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Unproclaimed Areas.	Totals.	
				1945.	1944.
Total number of useful boilers registered	3,335	1,848	....	5,183	5,064
New boilers registered during year	140	5	....	145	114
Boilers reinstated	....	....	....	....	....
Boilers converted	2	....	....	2	1
Boilers inspected—					
Thorough	1,731	335	....	2,066	1,911
Working	194	8	....	202	215
Boilers condemned during year—					
Temporarily	16	....	....	16	13
Permanently	17	1	3	21	13
Boilers sent to other States during year	11	....	....	11	3
Boilers sent from other States during year	3	....	....	3	3
Transferred to other Departments	....	....	....	....	2
Transferred from other Departments	4	1	....	5	3
Number of Notices for Repairs issued during year	492	8	....	500	484
No. of Certificates issued, including those issued under Section 30 during the year	1,718	345	....	2,063	1,905

SECTION II.

Explosions and Interesting Defects.

A copper steam jacketed pan which had been in constant use for twenty years at a working pressure of 80 lbs. per square inch, slowly turned inside out soon after the product had reached boiling point, which makes it unlikely that the collapse was due to water hammer. The thickness of the inner shell was found to be very uniform and was apparently originally 8-gauge, giving a working stress of 3,840 lbs. per square inch. A new inner shell of 6-gauge was made and the pan was re-riveted. The working stress is now 3,125 lbs. per square inch at the maximum working pressure.

Electro plating can cover a multitude of defects. This was found to be so in the case of a drum steriliser which was built to the order of a good customer by a firm not used to this class of work. As a rule the lugs which

carry the swivel bolts for attaching the lid, are cast solid with the top ring, which is usually made of gun-metal or other good quality non-ferrous alloy, but in this case the ring was made of mild steel and the mild steel lugs were only fillet welded to it. In the process of grinding and polishing preparatory to nickel plating, most of the weld metal was ground off. At the first inspection, no particulars of construction were available, and it was assumed that the lugs had been vee-d before welding. The defective workmanship was not discovered until one lug broke off after two years' service. As the owners would not go to the expense of fitting a new ring, the vessel was discarded.

An unregistered small boiler, 16 inches by 42 inches, designed for dairy purposes, was found by an inspector to be working without a pressure gauge. The owner informed the inspector that he was trying to get a gauge to replace the original one, which was out of order, and in the meantime, he continued to use the boiler. The safety valve was also defective. The owner said that while the original gauge was operating the safety valve did not blow at 110 lbs. per square inch. The authorised working pressure was only 25 lbs., but luckily the factor of safety was sufficient to cover this excessive overload. This is just one instance of many similar ones that proves the necessity for the inspection of these small boilers.

The experience of the local gas works has proved that liquid fuel firing can cause severe damage to Cornish boilers. Owing to increased demand for gas, this firm has had to force their boilers for some years past, the fuel used being coke and liquid tar fired through a burner of the type used for oil firing. In 1938 they had to discard one Cornish boiler and in 1939 another owing to cracks developing in the flue at the back-end. A Cornish boiler which was installed in December, 1939, to take the place of one of the discarded boilers, recently developed a crack in the heel of the flange of the fourth section of the flue. When the boiler was opened up for inspection, it was found that the crack extended for about 18 inches over the top of the flue, also that the front section was grooved in the heel of the flange to the front plate over the top half, the bottom of the shell at the back end was bulged downwards ¾ in., the plate was sprung away from the flange of the back end plate up to the line of rivets, and the toe rivets of the gusset angle on the front plate were sprung, two rivets' heads were forced off. The boiler was repaired and before it was again put under steam the burner was deflected downwards on to the coke fire bed in this and the adjacent boiler. An additional boiler was installed, which removed the necessity for forcing these boilers and so far no further trouble has been experienced.

SECTION III.

Inspection of Machinery. See Returns 4, 5 *and* 6.

Although the number of groups of machinery registered increased by 695, the number of groups inspected during 1945 was 48 less than during the previous year.

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 31*st December*, 1945.

Classification.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals. 1945.	Totals. 1944.
No. of Groups driven by steam engines	457	526	983	1,012
No. of Groups driven by oil engines	1,377	813	2,190	2,132
No. of Groups driven by gas engines	70	189	259	256
No. of Groups driven by compressed air	....	60	60	60
No. of Groups driven by electric motors	11,842	3,569	15,411	14,748
No. of Groups driven by hydraulic pressure	5	....	5	5
	13,751	5,157	18,908	18,213

Return No. 5.—Showing Operations in Proclaimed Districts during Year ended 31*st December*, 1945.

(MACHINERY ONLY.)

Classification.	Districts worked from Perth.	Districts worked from Kalgoorlie.	Totals. 1945.	Totals. 1944.
Total registrations useful machinery	13,751	5,157	18,908	18,213
Total inspections made	8,848	2,385	11,233	11,281
Certificates (bearing fees)	2,757	385	3,142	3,257
Certificates (steam without fees)	50	5	55	45
No. of extension certificates issued under Section 42 of Act	....	....	....	....
Notices issued (Machinery Dangerous)	368	1	369	331

Return No. 6.—Showing Classification of Lifts on 31*st December*, 1945.

Types.	How Driven.	Totals. 1945.	Totals. 1944.
Passenger	Electrically driven	188	188
	Hydraulically driven	1	1
Goods	Electrically driven	95	96
	Hydraulically driven	3	3
	Belt driven	4	4
Service	Electrically driven	31	29
		322	321

Accidents to Machinery.

A rather peculiar accident happened to a horizontal single cylinder 100 horsepower suction gas engine. The outer half of the crank pin bearing broke in two, the piston hit the cylinder head and fractured it, it then flew out of the cylinder and was badly smashed up through fouling the crank balance weights.

The crank shaft of a horizontal single cylinder 125 h.p. gas engine fractured through one crank web. From the appearance of the fracture the web had been cracked more than half way through for a long time. This engine was running continuously except at the week-end. It is rather extraordinary that neither the engine drivers nor the maintenance staff noticed the crack before the final fracture took place.

The necessity for working according to the maker's instructions was demonstrated in the case of an electric jib crane, which was supplied to a Government Department about 1919. This crane was designed by a very well known firm of English engineers to lift a load of three tons at 30 feet radius, but on the drawing supplied with the crane, there was a warning that the crane should not be used at a lesser radius than 21 feet 6 inches. Apparently in the course of time, this stipulation was forgotten, because a man was seriously injured when the crane was being used at a radius of only 15 feet. This crane is mounted on a railway truck, and as the hoisting machinery is placed well back from the bottom of the jib, under certain conditions of load and radius, the resultant of the forces due to the load on the hook, and those in the derricking and hoisting rope, comes sufficiently above the jib to make the jib self derricking. This occurred when the crane was loading coal and by a peculiar series of coincidences an unfortunate man was crushed between the coal box and the base of the jib, sustaining a crushed pelvis and fractured jaw. After the accident, a substantial stop was fitted to the frame of the machinery house, which prevents the jib being raised above the position corresponding to a radius of 21 feet 6 inches.

On a double drum electric winding engine the brake path on each drum was found to be badly cracked. They were made of mild steel 7 inches wide by ⅝ inch thick, four sections making up the complete path, which was 8 feet diameter. The brake paths were bolted on to the drum cheeks by 1 inch counter-sunk headed bolts and rested on bearing strips about three inches wide at approximately 12 inch pitch. There were two bolts to each bearing strip at 4¼ pitch, an air gap being left between the bearing strips. Each section of the brake paths

showed cracks starting from the bolt holes, and generally extending from hole to hole, a few also had started from the hole outwards, but in some cases the crack was midway between the supports running practically the full width of the path. The original brake paths have been replaced by cast iron sections eight inches wide by one and one quarter inches thick. The company intends to instal dynamic braking, as soon as the necessary electrical equipment becomes available.

A by-pass valve which was fitted on a 125-ton ammonia compressor burst under peculiar circumstances, causing severe injuries to one man through inhaling the gas; another man was slightly blistered on his right arm. The valve was a cast iron one of 3-inch bore. It was fitted as a by-pass between the delivery and suction side of the compressor, in a vertical position, and in parallel with it there was a spring loaded relief valve. At the time the accident happened the coils in one of the large meat rooms were being defrosted by hot gas, and apparently there was an accumulation of liquid ammonia in the coils, in excess of the capacity of the separator on the main suction line in the engine room. Two compressors were running at the time, and both started to knock badly. The driver had closed in the main suction valve on one machine, and was in the act of closing in the suction valve on the other machine when the by-pass valve burst. The bottom of the valve casting which was in connection with the delivery main, was blown out; this apparently was caused by liquid hammer analogous to water hammer in a steam pipe.

The car of a passenger lift took a lady passenger to the top floor when she intended to descend to the ground floor. On investigation it was found that the worm wheel had split through rolling on the key, thus leaving the pinch wheel free to rotate. As there was only one passenger in the car the balance weight brought it to the top floor, and the car came to rest when the balance weight grounded at the bottom. This emphasises the value of the modern practice of making the worm wheel spider and pinch wheel in one casting.

A mishap that might easily have caused a serious accident occurred when a lift was being improperly used to move a trestle table top to the top floor of the building. This table top was placed on end on top of the lift car, and held in place by two men standing on the car top. The lift attendant unfortunately did not stop the car soon enough and the table top was forced through the roof of the lift car. Luckily no one was seriously injured, one or both of the men on the car roof might easily have been thrown off, and killed.

SECTION IV.

There were no prosecutions for breaches of the Act.

SECTION V.

Accidents to Persons.

Return No. 7 includes only those accidents in which the period of disablement was not less than two weeks, and the injury was caused by working machinery subject to the provisions of the Act. Accidents on timber mills which are subject to the Timber Industries Regulation Act, 1926, are not recorded. Accidents on mines are also included in the report of the State Mining Engineer.

The number of accidents recorded was six less than for 1944 and those which caused the death of the injured person were two less.

The circular saw accident which proved fatal was caused by a face cut fouling the back of the saw, when being passed across the back of the saw. It was picked up by the saw and hit the sawyer in the abdomen, causing severe internal injuries from which he died. This accident was caused through faulty procedure and an uneven bench top, but could have been avoided had the tailer-out exercised more care.

Both of the fatal accidents caused by belts and shafting occurred on gold mines. In one case the deceased was gathering sawdust, and went into the belt race to obtain some which was dry, he was hit on the head by a Jackson belt fastener. In the other case the deceased who was employed as an oiler, received injuries which proved fatal, when his clothing became entangled in a shaft which revolved at only 20 revolutions a minute. All his clothing was torn off and his right foot was severed above the ankle. He also received severe internal injuries.

An engine driver with long years of experience, dislocated the elbow and fractured the radius and ulna of his right arm under peculiar circumstances. The motor driving a number of laundry machines had been switched off, but before the shafting came to rest his right arm was caught between a belt and pulley while he was endeavouring to throw the belt off, his arm was pulled to the top of the pulley, raising him on to his toes. His injuries occurred while he was attempting to pull his arm out, after the shaft had come to rest.

A boy aged 18 lost his right hand in a chaffcutter; as he was cutting green feed, grass and clover, the usual guard was removed. It is impossible to feed the rollers with the guard in position except when cutting wheaten hay or similar material.

The remaining accidents do not call for special comment.

Return No. 7.—Showing Number of Accidents, both Fatal and Non-Fatal, which occurred in Proclaimed Districts during the Year ended 31st December, 1945.

Numbers within brackets denote Fatal Accidents.

—	Woodworking.	Engineering and Metalworking.	Printing and Stationery, etc.	Glass Manufacturing.	Leather Working.	Ice Making.	Firewood Cutting.	Building Contracting.	Baking and Confectionery.	Laundry.	Dairying.	Refrigeration.	Brickmaking.	Asbestos Manufacturing	Harbour Works.	Mining.	TOTAL (Machines).
Circular Saw	3 (1)	....	....	....	1	1	1	....	....	....	....	....	....	....	....	....	6 (1)
Buzzer	5	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	6
Spindle Moulder	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Press	2	....	1	....	1	....	....	....	....	....	....	....	....	....	....	....	4
Guillotine	....	1	....	....	1	....	....	....	....	....	....	....	....	1	....	....	3
Drilling	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Emery Wheel	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Belting and Shafting	....	1	1	....	....	....	....	....	....	1	....	....	....	....	....	2 (2)	5 (2)
Mixing	....	....	....	....	....	....	....	....	2	....	....	....	1	....	....	....	3
Steam Mangle	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	1
Chaffcutter	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
Burst NH_3 Valve	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	1
Sleeve Making	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Cornering Machine	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Envelope Machine	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Crane	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1
Water Gauge Bursting Boiler	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Total (Industries)	11	4	4	1	3	1	1	1	2	2	1	1	1	1	1	3	38 (3)

SECTION VI.

Examination of Engine Drivers.

Examinations were held as follows:—Perth 4, Kalgoorlie 4, Bunbury 2.

Examinations occupied 15 days, dealing with applications for certificates, marking examination papers and inquiries, etc., took 32 days, and 13 days were spent in travelling.

Applications received 286, certificates granted 237.

Return No. 8.—Showing Total of Engine Drivers' and Boiler Attendants' Certificates (all Classes) Granted in 1945 compared with 1944.

	Number Granted.	
	1945.	1944.
Winding Competency, including certificates issued under Regulation 40 and Section 60 of the Act	5	2
First Class Competency, including certificates issued under Regulation 40 and 45 and Sections 60 and 63 of the Act	31	5
Second Class Competency, including certificates issued under Regulation 40 and Section 60 of the Act	19	15
Third Class Competency, including certificates issued under Regulation 40 and 45 and Sections 60 and 63 of the Act	32	26
Locomotive Competency, including certificates issued under Regulation 40 and Section 60 of the Act	9	5
Traction Competency, including certificates issued under Regulation 40 and Section 69 of the Act	1	....
Internal Combustion Competency, including certificates issued under Regulation 40 and Section 60 of the Act	49	46
Crane and Hoist Competency, including certificates issued under Regulation 40 and Section 60 of the Act	10	6
Boiler Attendant Competency, including certificates issued under Regulation 40 and Section 60 of the Act	71	70
Interim	....	....
Copies	9	13
Transfer	1	4
	237	192

SECTION VII.

General, Staff, Revenue and Expenditure, Mileage, etc.

Staff.—The Senior Inspector returned to duty on 12th November, 1945, after an absence of nearly four and a half years in control of a Munitions Annexe. Two inspectors on the permanent staff received promotion in the Royal Australian Naval Reserve during the year; one who has been an Engineer Officer since war was declared, was promoted to Engineer Commander, and the other who obtained leave to join up in December, 1941, was promoted to Engineer Lieutenant-Commander.

Revenue and Expenditure.—Return No. 9: The financial position improved, as the loss on the year's working was only £1 19s. 10d. compared with a loss of £399 1s. 8d. for 1944.

Return No. 10 shows the particulars of miles travelled in making inspections. Air transport was used on two occasions in making inspections in the Kimberley Division, resulting in a great saving in time as compared with travelling by boat.

I wish to thank all those who helped in carrying out the work of this Branch, and to record my appreciation of the co-operation received from the officers of other departments both in this State and the Commonwealth. In particular, I desire 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 ending 31st December, 1945.

REVENUE.

	1945.	1944.
	£ s. d.	£ s. d.
Fees for Boiler Inspections	2,734 19 4	2,532 0 2
Fees for Machinery Inspections	5,115 12 3	5,055 19 10
Engine Drivers' Fees	291 2 0	236 4 6
Incidentals	65 11 10	70 13 8
Increase—£312 7s. 3d.	8,207 5 5	7,894 18 2

EXPENDITURE.

	1945.	1944.
	£ s. d.	£ s. d.
Salaries	6,683 9 7	6,689 7 8
Incidentals	1,430 15 4	1,507 19 10
Engine Drivers	94 15 4	96 12 4
Decrease—£84 19s. 7d.	8,209 0 3	8,293 19 10

Loss—£1 19s. 10d.

Return No. 10 Showing Distances Travelled, Number of Inspections Made and Average Miles Travelled per Inspection for the Year ended 31/12/1945.

AREAS TRAVERSED.	RAIL MILES.			ROAD MILES.			AIR MILES			TOTAL MILES			TOTAL NUMBER OF INSPECTIONS			AVERAGE MILES PER INSPECTION		
	1945	As Compared with 1944		1945	As Compared with 1944		1945	As Compared with 1944		1945	As Compared with 1944		1945	As Compared with 1944		1945	As Compared with 1944	
		Increase	Decrease		Increase	Decrease		Increase	Decrease		Increase	Decrease		Increase	Decrease		Increase	Decrease
Districts worked from Perth	178	....	184	37,320	....	358	6,707	6,707	....	44,205	6,129	....	10,773	103	....	4·10	·54	....
Districts worked from Kalgoorlie	150	....	1,666	14,194	697	....	....	....	....	14,344	....	969	2,729	....	8	5·25	....	·34
Totals	328	....	1,850	51,514	697	358	6,707	6,707	....	58,549	6,129	969	13,502	103	8	4·33	=Average All Districts 1945	
																3·98	=Average all Districts 1944	
Increases *or* Decreases	Decrease 1,850			Increase 339			Increase 6,707			Increase 5,160			Increase 95			=Average Increase ·35 miles per inspection.		

ANNUAL REPORT OF THE GOVERNMENT MINERALOGIST, ANALYST AND CHEMIST FOR THE YEAR 1945.

Table of Contents.

Division VII.

Annual Report of the Government Mineralogist, Analyst and Chemist for the Year 1945.

The Under Secretary for Mines:

I have the honour to present for the information of the Hon. the Minister for Mines, my report on the operations of the Government Chemical Laboratories for the year ending 31st December, 1945.

STAFF.

The staff of the Laboratories now numbers 40, made up as follows:—Professional, 29; Clerical, 6; Laboratory Assistants, 5.

Mr. H. E. Hill, F.A.C.I., A.R.I.C., Supervising Chemist of the Food, Drug and Toxicology Section, who was seconded in 1943 for the duration of the war as second in charge of the Defence Foodstuffs Organisation in Melbourne, resigned during the year to take the position of Government Analyst of Tasmania.

Mr. Hill joined the Laboratory as a cadet analyst and later served as a munition chemist during the First World War. During his long association with the Laboratory Mr. Hill gained many distinctions and was responsible for a number of contributions to the knowledge of the natural products of Western Australia, food technology and toxicology.

He takes to his new position a reputation as a painstaking investigator, mostly in the sphere of organic chemistry, and as one of the foremost food analysts in Australia, and has left behind a tradition on which to model the future activities of his section.

Mr. J. C. Hood, who had been acting as Supervising Chemist of the Food, Drug and Toxicology Section during Mr. H. E. Hill's absence, was appointed permanently to that position on 10th August, 1945.

The temporary staff was increased during the year by the appointment of the following chemists:—Misses J. M. Johnston, B.Sc., and R. L. Selby, B.Sc., A.A.C.I., Messrs. R. A. Broadbent, B.Sc., D. Burns, B.Sc., N. K. Jones, B.Sc. (Hons.), D. J. Simper, B.Sc., and V. N. Young, B.Sc.

A recommendation to reorganise the staff, supported by a scheme designed to meet the expanded activities of the Laboratories and to relieve the head of some of his present duties so that he may be free to devote more attention to his very important responsibilities as consultant and adviser to the Government in matters involving chemistry and mineralogy, was submitted during the latter part of the year. Finality had not been reached in this matter at the end of this year.

ACCOMMODATION.

Although the new laboratories were planned to give some space for expansion the work has increased so rapidly since the transfer from Wellington Street, that additional chemists have been appointed and no further working spaces are available. In order to adequately meet the present requirements, the following additional accommodation is necessary:—

Administration.

Main office to be enlarged to accommodate three additional clerks; record rooms, two required; scientific secretary, one room.

Stores.

Space of about 30 feet by 40 feet is required for the normal storage of soil and mineral samples—this is additional to the present mineral store. It is necessary to have adequate storage for samples because further work often has to be done on old samples and mineral samples are kept to supply prospectors and others interested, in addition to acting as a small museum of local minerals.

Refectory.

The present refectory is too small and of the wrong shape to accommodate all members of the staff. It should be enlarged to accommodate 50 officers and be suitable for showing 16 m.m. cinema films, which are of a high educational value and would serve to remove some of the scientific isolation under which the staff has to work.

Conference Room.

Such a room is necessary for holding interdepartmental technical committee meetings and for addresses by visiting scientists. It should have facilities for hanging maps and plans and for displaying specimens and exhibits. This part of the activities of the Laboratory, considered to be absolutely essential in all modern laboratories, has had to be very severely curtailed.

Female Staff.

Adequate accommodation including a retiring room is necessary in any establishment where women are employed. The present accommodation is quite unsuitable and inadequate.

Soil Mineralogy Laboratory.

The Soil Mineralogy Section, established in 1943, has not had sufficient laboratory accommodation and a new block approximately 30 feet by 60 feet should be provided.

Metallurgy Laboratory.

A laboratory 30 feet by 40 feet with walls 20 feet high is urgently required to house the special metallurgical equipment ordered and now coming forward.

Fuel Technology Laboratory.

The final design for the Fuel Technology Laboratory was prepared early in the year and the erection by private contract, at a cost of approximately £4,000 allotted by the Coal Panel, began early in June, but numerous delays caused by material shortages have hindered its completion.

(Note:—This building was not available for occupation at the 28th May, 1946.)

Industrial Chemistry Laboratory.

Provision should also be made in any building scheme to house the proposed Industrial Chemistry Section. Tentative plans for a laboratory block 90 feet by 40 feet to include a pilot plant section 60 feet by 40 feet with 20 feet walls have been prepared in anticipation of the Government's approval to establish this special section to deal with problems associated with the development of secondary industries in this State. When this proposed building scheme is completed, the State Government will have a group of buildings in which all problems within the State can be investigated with assurance. Such a plan is necessary for Western Australia as it has to be self-contained so far as chemical work is concerned. These laboratories will then be second to none within the Commonwealth and an achievement of which the State Government may well be proud.

LIBRARY.

The library is far from adequate to meet the demands of the various sections and additional books and periodicals are required, particularly for Soil Mineralogy, Fuel Technology and Industrial Chemistry. It cannot be stressed too strongly that an efficient and comprehensive library is just as essential as laboratory equipment to the chemist and mineralogist; especially as the investigations now required by this Laboratory are often in the nature of research problems where a perusal of the relevant literature is both necessary and important.

EQUIPMENT.

During the year a Fagergren laboratory model flotation cell was installed and is proving useful in many ways. It is intended to investigate the possibilities of concentrating non-metallic minerals such as sillimanite and mica and to beneficiate local bauxites by eliminating the associated quartz. In furtherance of our mineralogical work and to place this Laboratory in the position to advise prospectors and others as to the advisability of developing newly discovered deposits of economic minerals, for which there is likely to be a demand, it is essential that we should be equipped to carry out experiments on ore beneficiation and extraction. For this purpose it will be necessary to instal, as soon as possible, (a) Haultain Superpanner; (b) Magnetic Separator; (c) Laboratory type of concentrating tables; (d) Fine grinding air separating unit.

A set of Tyler Standard Sieves was added to the Laboratory equipment during the year, and with the Ro-tap Shaker expected early in the new year will very considerably enlarge the facilities for the mechanical analysis of various materials. The immediate use which suggests itself is for work in connection with soil erosion.

Extra petrological microscopes are urgently required, especially for work in soil mineralogy, and for the additional examinations of minerals asked for by the Geological Survey. Although numerous enquiries have been made, manufacturers cannot guarantee any early return to pre-war conditions. It is intended ultimately, to instal a Federov Universal Stage in the Mineral Section. This is a standard piece of equipment designed for the accurate determination of the optical constants of minerals. Work in connection with the examination of opaque minerals involving the preparation of polished sections has increased during the year. Owing to the lack of a suitable microscope for work with polarised reflected light improvisations have had to be made necessitating the use of parts of two microscopes. Accurate work obviously cannot be undertaken in this way and the provision of suitable microscope and accessories is essential if the Laboratory is to continue to undertake this type of work.

A suitable furnace for testing various types of refractory minerals and materials at high temperatures has not yet been obtained. Enquiries are in progress with several Australian manufacturers.

A more modern type of Quartz Spectograph, suitable for the spectroscopic determination of trace elements in minerals, and other products, is still urgently needed. The present spectograph is obsolete for this work.

The housing of some of this equipment will have to be provided as facilities are not available in the present building.

RECENT EXPANSIONS IN LABORATORY FUNCTIONS.

Soil Mineralogy and Sedimentary Petrology.

The newer science of soils presents a picture of the processes whereby rock becomes soil or solubles and contemporaneously contributes the elements serving to nourish plants for animal or human sustenance. The entire mineral composition, from the very finest to the largest particles, is brought into prominence as fundamental to plant production and agriculture itself, by investigations which are occupying soil scientists in many parts of the world today and it is with this end in view that a section of Soil Mineralogy has been established in this Laboratory.

Soil mineralogy is expected to provide fundamental information in connection with the relationship of soils to rocks in our agricultural areas and to fill in the gap between the chemistry of soils and their mineralogical composition.

For an understanding of the roles of parent rock in the incident of minor element deficiencies in soils alone, the creation of the Soil Mineralogy Section was fully justified, and from now on useful contributions to this knowledge will be made.

It is hoped, in time, by the acquisition of modern equipment and the introduction of new techniques peculiar to soil science itself, that this section will be able to play a very important part in the utilisation of the soils of this State.

In addition suitable equipment will be provided for work on clay minerals and on the changes between rock and soil.

The study of dusts in industry, and their effects on the health of workers, will constitute an important activity of this section.

Sedimentary Petrology is a firmly established branch of science which deals with sedimentary rocks, that is, rocks of non-igneous origin. It includes something more than the mere description of rocks based on microscopical analysis, and in its wider sense embraces comprehensive investigations of their nature, origin, mode of deposition, inherent structures, mineralogical composition, mechanical constitution, textural analysis, various chemical and physical properties, and in short, all data leading to an understanding of the natural history of such rocks.

Sedimentary petrology, more specifically, deals with beds of sediments deposited by water or by wind, such as sandstones, sand dunes, sand accumulations, etc. Some of its most important applications are in the correlation of oil-bearing sands in petroleum producing areas, the differentiation of marker-beds in coalfields, the effect of wind and water erosion on soils, etc. As the first stage in the formation of sedimentary petrology, and as indicated above, there are many contributions which can be made to our knowledge of soils by such methods of study. Other investigations which lend themselves particularly to these methods are:—Refractories, ceramics, building materials, water supplies, dust hazards (silicosis, etc.). These came within the scope of this section's activities.

Fuel Technology.

Following on a recommendation of the Coal Panel under the Department of Industrial Development, the Government agreed in July, 1944, to finance the establishment of a Fuel Technology Laboratory and to provide funds for its maintenance over a period of four years. It was decided to bring this Laboratory under the direction of the Government Chemist as a new section of the Government Chemical Laboratories.

The object of the establishment is to improve and extend the utilisation of Western Australian native fuels, first attention being directed to coals, and, more particularly, to productive seams of the Collie coalfield.

As knowledge of our coals is incomplete in many respects, it is expected that much of the early work undertaken will involve a more complete study of the chemical and physical properties than has hitherto been possible.

The scope of work on coals envisaged includes the following:—

Proximate and ultimate analysis.
Calorific values.
Carbonisation characteristics, including the nature of by-products yielded thereby.
Coking properties.
Microscopical characteristics.
Specific gravities.
Simple solvent extraction.
Weathering characteristics.
Coal-moisture equilibria.
Storage properties, including liability to spontaneous ignition.
Friability.
Grindability.

Bulk densities under various conditions.
Ash properties, including fusibility and analysis.
Size distribution in commercial grades.
Quality survey within seams.
Beneficiation, including such problems as: Drying, Cleaning, Upgrading, Blending.
Special studies of utilisation problems such as total gasification, hydrogenation, etc.
Investigation of specific problems that may be suggested by producers or consumers.

Dr. C. R. Kent, Chief Chemist of the Railways Department, was seconded for a year to supervise the establishment and work of the new laboratory and began these duties on 23rd April, 1945.

In addition to delay in erecting the building much delay has been experienced also in locating suitable equipment, some of which is specialised in nature and unobtainable in Australia.

As a result of these unavoidable delays, little work of a permanent quality has yet been possible; and the appointment of staff has been postponed until facilities for useful employment are ready.

Some work of an advisory nature has been done, including evidence given before the South Australian Parliamentary Standing Committee on Public Works, and the Davidson Commission on the Coal Mining Industry. Data was collected for a wartime revision of the Australian Standards Association's publications on the Coal Resources of Australia. A report was submitted on the results of trials made by the Railways Department with the Fox gasification plant.

During a recent visit to the Eastern States, I availed myself of the opportunity to examine the "Broadhead" Complete Gasification plant that is operating successfully at the Metropolitan Gas Company's Works in Melbourne. It is claimed that this plant, although founded upon the simple intermittent procedure of alternate "blow" and "run," embraces two desirable features of the more recent German plants, namely, continuity of production and reduction of CO_2 in the fuel bed. It also possesses a further advantage of permitting of carburetting in the generator itself without any auxiliary construction for that purpose.

The calorific value of the gas produced by this plant from brown coal is 310 B.T.Us. and from Maitland coal 375 B.T.Us. This gas is carburetted with oil up to a further 100 B.T.Us.

The Power Gas Corporation (Australia) Pty. Ltd., which owns the patent rights of the process has expressed interest in its possibilities for the gasification of Collie coal and is prepared to make a complete survey of the gasification characteristics of Collie coal at no cost other than providing 150 tons of coal for the test.

Disposal of Trade Wastes.

A committee consisting of the Engineer for Metropolitan Water Supply and Sewerage, the Commissioner of Public Health, and the Government Analyst was constituted some years ago to advise the Hon. Minister for Works on matters related to the purity of the metropolitan water supply. This committee, at its meetings, has dealt with problems associated with sewerage treatment in the metropolitan area, but has not received any official appointment for that purpose and consequently has very little standing. Latterly the committee has been asked to advise on the treatment and disposal of trade wastes.

The committee has no official status in such matters and as these important responsibilities will increase with the growth of population and the development of secondary industries in this State it is recommended that consideration be given to the appointment of a technical committee with the necessary authority to advise the Government on the purity of water supplies, sewerage treatment and disposal of trade wastes.

The establishment of a committee representative of the Water Supply and Sewerage Department, the Department of Public Health, and the Government Chemical Laboratories would bring together the departments, interests concerned in these matters and would obviate the possibility of the Laboratories duplicating any chemical work in regard to them.

INTER-DEPARTMENTAL TECHNICAL COMMITTEES.

The Inter-departmental Soils Technical Committee, Dairy Products Technical Committee, Fruit Technical Committee, and the Vegetable Research Committee, continued to function during the year.

GENERAL.

Mr. C. R. LeMesurier spent several weeks in Sydney, Melbourne and Adelaide on behalf of the Committee on Fibrolite Pipes and Cement-Lined Pipes studying the manufacture and causes of failure of fibrolite and cement-lined pipes.

Dr. D. Carroll spent a week at Chandler, collecting samples of grits from below the Alunite in Lake Chandler with a view to ascertaining whether the grits represented the rock floor of the lake.

In connection with the investigation of rocks and soils from areas affected with sheep-breeding problems, Dr. Carroll made a collection in the Boyup Brook-Muradup district in order to make a comparison with material collected in the Kojonup-Beverley districts during the previous year.

In August, Messrs. B. L. Southern and A. G. Turton, as representatives of these Laboratories, attended the Winter School in Soil Science which was held in Adelaide.

Mr. H. Bowley continues to act as a member of the Boards of Management appointed by the Government to establish and conduct the State (W.A.) Alunite Industry at Chandler, and The Charcoal Iron and Wood Distillation Industry at Wundowie. He continued also to be a member of the Alumina Pilot-Plant Committee and the Committee on Fibrolite Pipes and Cement-Lined Pipes. He is also a member of the Coal Panel and other Panels established under the Department of Industrial Development. As Government Analyst, Mr. Bowley is a member of the Foods Advisory Committee under the Health Act and a member of the Advisory Committee on the Purity of Water Supplies.

Publications.

D. Carroll:
Mineralogy of Some Soils from the Margaret River District, *Jour. Dept. Agriculture*, W.A. XXI., No. 4.
Mineralogy of Some Soils from Denmark, Western Australia, *Soil Science* 60, No. 6.
Heavy Minerals in the Irwin River Coal Measures, *Geological Magazine*, 82, No. 2.
Census of Western Australian Minerals. *Mineral Resources of W.A.*, Bull. No. 1.

D. Carroll and H. P. Rowledge, with K. R. Miles:
Tantalum and Niobium, *Mineral Resources of W.A.*, Bull. No. 3.

The revised fifth edition of the pamphlet on the "Mineral Resources of Western Australia" is in the press.

ADMINISTRATION.

A perusal of this report shows the great variety of work now carried out in these Laboratories. This fact, together with the rapid growth in all branches, suggests that the time is fast approaching when consideration will have to be given to the desirability of increasing the status of this Institution.

There has been a considerable expansion during the past eight years in the demand for chemical work by the Departments of Agriculture and Industrial Development, due, mainly, to the Government's decision to concentrate its chemical work under these Laboratories. A steady increase in the laboratory requirements of the Departments of Mines, Works and Health has also been noted during that period.

An indication of this expansion is given by the recent establishment of the three new divisions, (1) Soil Mineralogy and Sedimentary Petrology; (2) Fuel Technology; (3) Industrial Chemistry. The staffs of the three original divisions, Mineralogy and Mineral Technology; Foods, Drugs and Toxicology; Agricul-

ture, Forestry and Water Supplies; were considerably increased in order to meet the additional work forthcoming.

Laboratories which are called upon to deal with such a variety of work cannot be expected to function satisfactorily unless given freedom of action that will permit a decision as to the relative merits of the various requests for priority received from the many Government Departments that are compelled to utilise the facilities of a combined laboratory.

I feel therefore, that the time has now arrived when the status of this Institution should be changed from a Branch to a Department of Chemistry.

Such an arrangement would allow the claims by various Departments on the services of these Laboratories, to be dealt with to the best advantage in respect to the laboratory facilities available and would grant to the Head of the Department the necessary powers to implement the Government policy to obviate any duplication and overlapping of its chemical work. It would also eliminate the possibility of any one Government authority gaining an advantage at the expense of other Government Departments and would therefore increase the efficiency of this Institution.

TABLE SHOWING SOURCES OF SAMPLES FOR 1945.

Mines—	No. of Samples.
Chemical Laboratories	356
Under Secretary for Mines	35
State Mining Engineer	91
State Batteries	45
Government Geologist	80
Explosives Branch	1
Health Department	91
Hospitals	21
Agriculture Department	1,068
Police—	
Coroners	68
Criminal Investigation Branch	30
Liquor Inspection Branch	36
Government Stores and Tender Board	13
Metropolitan Water Supply	1,321
Works and Labour	236
Industrial Development Department	17
Chief Inspector of Factories	4
Prisons Department	3
Fisheries Department	10
Education Department	2
Treasury	1
Forests Department	34
Pipe Investigation Committee	516
Free	169
Pay—	
Public	659
State Insurance Department	1
Repatriation Department	1
Children's Hospital	1
Royal Society for Prevention of Cruelty to Animals	3
State Sawmills	2
Railway Department	32
Aeronautical Inspection Directorate	31
United States Navy	490
Royal Navy	7
Royal Australian Navy	8
Royal Australian Air Force	2
Department of the Army	34
Allied Works Council	8
University of Western Australia	4
Main Roads Board	8
Commonwealth Minerals Production	6
Ministry of Munitions	4
Local Governing Bodies	5
Total	5,554

NATURE OF WORK DONE.

DRUGS AND MEDICINES.

Twenty-six samples of anaesthetic ether were received from the Government Stores Department and Public Hospitals. These were examined for compliance with the British Pharmacopoeia tests for purity. Only two failed to comply with the requirements for peroxides and four showed the presence of aldehydes.

Impounded anaesthetics sent by direction of District Coroners in suspected cases of death under anaesthesia numbered seven, consisting mainly of ether and ethyl chloride. In no cases did the ether or ethyl chloride show any indication of deterioration. A sample of spinal anaesthetic submitted contained only sufficient material to confirm the identity of the constituents and to show that the concentration was substantially in the concentration inscribed.

A preparation submitted for analysis by the Department of Public Health was labelled Dr. Schuesslers cell salts—Kali Phos. In the accompanying literature supporting the theory of cell salts it was stated that potassium phosphate constituted a mineral requirement of the brain, a deficiency being indicated by such complaints as fatigue, nervous prostration, etc. This deficiency could be made good by cell salts such as Dr. Schuesslers Kali Phos. Analysis showed the tablets to consist of 99·7 per cent lactose and 0·14 per cent, potassium dihydrogen phosphate. The adult dose recommended on the box was six tablets which would contain 0·00064 grammes of the phosphate and consequently it would require approximately 9,380 tablets to obtain the minimum medicinal dose of the British Pharmacopoeia Codex.

TOXICOLOGY.

Human Poisoning Cases.

The human poisoning cases numbered 30. The common poisons found were strychnine three, cyanides three, arsenic three, carbon monoxide one, barbiturates one, alcohol five. In five cases either no poisons were detected or the recovered material was innocuous in character.

An aqueous solution of atropine sulphate used as eye drops was submitted in connection with the death of a child following its use. The solution was correctly dispensed but the post mortem findings indicated a hypersensitivity to the drug.

An unusual mixture, diacetone alcohol and castor oil, the composition of a proprietary brand of hydraulic brake fluid, was held to be responsible for the death of a married woman. A large quantity was taken with suicidal intent immediately after discharge from hospital following treatment for attempted poisoning with spirits of salts.

A case of considerable interest arose as the result of the death of a native at Wyndham following symptoms suggestive of acute arsenical poisoning. Exhibits were received which were examined for arsenic with negative results. Subsequently on information received from other natives the young leaves of ironwood tree, allegedly administered by a police boy, were suspected. Aqueous infusions were stated to be extremely toxic but on examination of some ironwood leaves submitted from the locality, no poisonous principles were isolated, whilst prepared extracts were found by the Government Pathologist to be innocuous to rabbits and guinea pigs. Exhumed viscera which, owing to lapse of time and difficulty of transport, showed gross putrefactive change when received, failed to give any indication of chemical poison. There appeared to be some evidence of the deceased having consumed "blown" tinned fish discarded by a local storekeeper but the condition of the exhibits precluded any possibility of the confirmation of pathogenic bacteria.

A fatality occurred in Perth in which two occupants of the cab of a truck lost their lives from carbon monoxide poisoning as the result of fumes from a producer with which the truck was fitted. An investigation, carried out in weather conditions similar to those prevailing on the morning of the fatality, showed that toxic concentrations of gas were quickly attained as the result of the blower outlet being directed towards the scuttle of the cab into which the gas could find access by a number of

holes. The concentrations of carbon monoxide found at head level in the driver's and passenger's positions were 0·50 per cent. and 0·38 per cent respectively, amounts which would prove fatal in a short space of time.

As the result of the post mortem findings on an Allied serviceman found drowned in the harbour, an examination of the gastric juice for alcohol content was made to establish whether the deceased had partaken alcoholic liquor prior to the fatality.

Most of these analyses were made in connection with Coroners' Inquests and evidence in these and other courts were given by Messrs. J. C. Hood, H. Sedgman or N. R. Houghton.

Animal Poisoning Cases.

Twenty specimens of viscera, baits and materials were received in connection with real or supposed animal poisoning. Ten specimens were the subject of investigation and prosecutions by the police and Criminal Investigation Branch as being of malicious intent. Prosecutions were also launched in the case of specimens received from the Royal Society for Prevention of Cruelty to Animals.

High mortality amongst poultry in a country district was thought to be due to wheat treated with materials to control weevil infestation. Dust from the wheat was examined for the known control agents and other poisons with negative results.

CRIMINAL INVESTIGATION CASES.

A number of exhibits were examined for the Criminal Investigation Branch in connection with a charge of administering poison which had been laid against one of two brothers living together on a farm.

The other brother was taken suddenly ill after partaking of a meal prepared by the accused. Strychnine was found in the vomit and in the residual food left on the plate.

The fact that no strychnine was found on the accused's plate and as the result of other corroborative evidence at the Lower Court the accused was committed for trial. At subsequent criminal proceedings the accused however, was discharged.

A further occurrence of scarlet-coloured flesh due to chromogenic bacteria was submitted during the year in circumstances thought to indicate poisoning. The colouration was confirmed by the Government Bacteriologist as being produced by Bacillus prodigiosus. The bacillus which may occur in air, water or soil, grows best at a temperature of 68° F., which is commonly maintained in the canvas type of cooler. Bacillus prodigiosus is not considered to be pathogenic when cultured on meat but the resultant colouration is naturally, somewhat alarming.

The examination of some remnants of material left after an explosion in a tunnel at North Fremantle showed these substances to consist of the several constituents of gunpowder. The explosion was initiated by some boys, one of whom was injured fatally, from discarded materials which had been obtained from an old military dump. The explosive material had been enclosed in a tin and ignited.

The examination of two samples from petrol suspected of having been maliciously tampered with, showed the petrol to be free from foreign matter. A deposit however, consisted largely of cane sugar with a small amount of powdered glass

Mr. J. C. Hood was subpoenaed as an expert witness to give evidence at the Commonwealth Public Service Board of Appeal in the matter of an appeal against wrongful dismissal of two employees of the Taxation Department. The evidence was a recapitulation of that previously tendered in a conspiracy charge at the Criminal Court in respect to bleaching of cancellation marks on taxation stamps.

INDUSTRIAL HYGIENE.

Lead Hazard.

For the purpose of supporting diagnosis of "leaded" subjects, 11 samples of urine were received from private practitioners, Repatriation Department, State Insurance Office, and Department of Public Health.

Thirty-one samples of urine were also examined for lead periodically from workers exposed to a lead hazard at the Western Australian Government Railways.

Factory Sanitation.

As the result of a complaint following the use of a proprietary wood preserving fluid, the material was forwarded for analysis by the Factories Department. Analysis and distillation showed the fluid to be of a creosote nature. A report was submitted covering the hazards of this material, which would be, mainly, from the small amount of low boiling fraction it contained. These were reported as likely to be slightly irritating to the cornea and respiratory tract but as the operations were conducted in the open air, it was considered these would only be transitory.

Dust.

A mineralogical and chemical examination was made of dust from a factory which was engaged in crushing calcareous beach sand as a source of lime. The dust submitted was found to contain less than 5 per cent. quartz, of which less than 2 per cent. occurred in the material passing a 200 mesh I.M.M. sieve, the upper limit of dangerous particle size with respect to industrial hazards. This fact, coupled with the large amount of calcium carbonate present, indicated that the dust would be relatively harmless.

Air from Coal Mines.

Six samples of air collected by the Inspector of Mines at Collie in the Proprietary and Co-operative Mines, Collie, were submitted for analysis.

The analyses did not indicate any serious vitiation of the air.

CHEMICAL SEWERAGE CONTROL.

Weekly.

Routine control consisted of weekly inspections together with samples taken for reaction (pH) solids in suspension and combustible matter in sludge. The Fremantle works, which is on the septic tank principle with no controlled sludge digestion, was not visited except when taking the influent and effluent samples for complete analysis.

Subiaco plant, is in general, the best of the three sewerage treatment plants giving satisfactory sedimentation and yielding an effluent containing between 50-100 parts per million suspended solids. Digestion is also consistently good with substantially no difference between digesters 3-4 (to which pan nightsoil is added) and the remainder. From the digesters a supernatant liquor containing 0·1 to 0·4 per cent, suspended solids is obtained and a sludge containing 5 per cent. suspended solids. No advantage appears to come from longer retention with a view to increasing the solid matter. The ratio of combustibles to total remains steady at from 68-75 per cent.

The Swanbourne plant while functioning satisfactorily as regards sedimentation, showed some inconsistency in the digesters performance in regard to segregation of supernatant liquor, much suspended matter being carried over. Considerable improvement occurred during November and December, but the supernatant liquor is still too variable for disposal as effluent. This is largely the fault of overloading and again stresses the necessity for additional digester capacity.

The fly nuisance which was exceptionally bad in 1944 showed considerable abatement after the addition of borax to sludge, thereby successfully suppressing breeding in the drying beds. The use of D.D.T. preparations has since reduced the nuisance to negligible proportions.

Complete Analysis.

In addition to the weekly control samples taken, periodic samples were taken for complete analysis of influent and effluent at the two treatment plants at Subiaco and Swanbourne. The result of these analyses indicated that generally the best reduction in solids, biological oxygen demand and McGowan's factor is achieved at the Subiaco plant.

Ocean Outfall Survey.

The survey, aimed at determining the extent of ocean pollution by sewage effluent, was conducted along the usual lines except that the surf boat was replaced by a launch with the added advantage of providing more room and permitting better sampling technique. Dissolved oxygen determinations could also be commenced on board without fear of loss in transferring samples. No remarkable results were encountered, the ocean pollution only extending to a few hundred feet radius of the outfall.

Beach Surveys.

Two surveys were made, the first being on May 1st. This was originally intended to be an ocean survey but this phase had to be abandoned on account of inclement weather conditions. The ocean at various beaches from Southwards of Robb's Jetty to Wembley was sampled. High values for absorbed oxygen and ammonia were encountered on the beaches adjacent to Florence and Howard streets, Fremantle, which are in close proximity to the discharge of storm water drains. The influence of a strong North-East wind also showed in the high values for absorbed oxygen and ammonia obtained in a short stretch of beach South of the outfall.

A reference sample taken in the clear ocean half a mile off shore and one mile North of the Fremantle Harbour entrance (before abandoning the ocean survey) was above the average in chlorides, but not the lowest in absorbed oxygen, ammonia or phosphorus. This sample and previous experience with "reference" samples again directs attention to what constitutes (in a chemical sense) a normal seawater and one on which to base effects of pollution.

The second survey was made on September 11th and 13th when beaches from Marmion Beach to Naval Base were covered, the breeze on both days being North-West.

The effect of the record winter rains was noticeable in a decided muddiness of the ocean South of the harbour mouth extending almost to Coogee, undoubtedly due to the large volumes of mud brought down by the flooded river.

The effect of this fresh water was also noticeable in analyses, chlorides throughout being lower than usual, falling to below 14,100 parts per million at the beach adjacent to Howard street, South Fremantle.

The usual range of figures for chlorides range from 20,000 to 21,000 parts per million.

Investigational.

Investigational work on the use of ferric chloride to suppress the formation of hyrogen sulphide in sewage was continued.

Ferric chloride to give a concentration of 20 parts per million was introduced into sewage at the foot of a rising main at Victoria Park and samples collected and examined at Claisebrook after traversing the river—a distance of one and a half miles. Composite samples representing pumpings from 8 a.m. to 9 a.m., 9 a.m. to 11 a.m., 11 a.m. to 2 p.m. and 2 p.m. to 4 p.m. were received at the laboratory and colour, odour and sediment noted.

Dissolved sulphur compounds were determined and prepared lead papers introduced into the free space above the liquid. The papers were examined 15 minutes later (designated immediate hydrogen sulphide) and fresh papers 24 hours later. Exact quantitative evaluation is difficult but papers when mounted and compared, showed that in nearly all cases 20 parts per million of ferric chloride practically eliminated hydrogen sulphide formation over 24 hours—a period greater by several hours than the average time of transit from Victoria Park to Subiaco outfall. For the purpose of comparison a similar series of papers was prepared from composite samples of pumpings over the same range of time. This and previous chemical work has thrown some doubt on the value of the determination of dissolved sulphur compounds but gave strong evidence that hydrogen sulphide evolved from a sample most closely approximates to the harmful sulphur metamorphosis of sewage.

TRADE WASTES.

On account of representations made to the Hon. Minister in Charge of Local Government by the Bassendean Road Board, an investigation was made of a drain, receiving waste liquors from Messrs. Cuming Smith's Acid and Superphosphate Works, which traverses the district of Bassendean and ultimately discharges into the Swan River. It was claimed that these waste liquors were acid and had a deleterious effect on concrete and on adjacent vegetation. The drain which during the winter months is the outflow for a large lake and swamp area was tested from its source and the reactions and composition of each influent examined and the combined stream sampled throughout its length. The sources of the wastes from the works were chiefly from the pyrites washers, which were not neutralised, and scrubber liquors from the superphosphate reaction pots which are given a treatment with lime. A large number of samples taken continuously over some months however, showed the combined wastes were almost invariably acid. A comprehensive report was submitted and certain recommendations made to ensure complete neutralisation of the acid wastes.

An enquiry from the Fisheries Department as to what effect effluents from the Denmark Butter Factory would have on fish life in the Denmark River were referred to and made the subject of some investigation by the Inter-departmental Committee on Dairy Products. Samples were obtained of typical factory effluents and also from the river up stream and down stream from the factory discharge and subsequently examined for reactions, suspended matter and biochemical oxygen demand. The opinion was expressed as the result of observations and analysis, that the factory effluents would constitute little danger to fish life.

The opportunity was taken whilst obtaining the above information of extending the enquiry to all butter factories and to obtain details of quantities, treatment and disposal of wastes.

Further samples of waste discharges were obtained following the survey made last year of aerated water plants generating their own carbon dioxide from the reaction of sodium bicarbonate and sulphuric acid. Samples taken up stream in a stormwater drain receiving a factory discharge gave a reaction pH 6·60 and SO_4^- – 50 p.p.m., and downstream after receiving discharge, reaction pH 6·47 and SO_4^- – 128 p.p.m.

Other trade wastes were two reputedly neutralised effluents from an acid pickling bath at a wire netting company. The first of these was strongly acid but considerable improvement was shown in the later sample by more extensive liming.

At the request of the Principal Architect, long-run experiments were conducted on galvanised pipes lined with a bituminous composition, which it was proposed to use for waste pipes to carry spent photographic solutions. The bituminous coating showed no deterioration over a long period with various solutions but it was considered to have too low a softening point for safe use in a vertical pipe 60 feet in length housed in a shaft with other services.

FOOD.

Milk Inspection Samples.

As the result of a number of periodic checks on the composition of milk supplied to the metropolitan area, 48 official samples were received from the Department of Public Health. In all, 23 samples did not comply with the Food and Drug Regulations with respect to composition, being mostly deficient in total solids or solids not fat. Successful prosecutions against the vendors were lodged in a number of cases.

Three samples of milk from a country town were all of sub-standard quality.

Milk Investigations.

Samples of milk from a herd on a State farm fed on a ration which, whilst ample in bulk, was deficient in protein, disclosed variations in composition which was made the subject of further investigations by the Superintendent of Dairying. It was planned to ascertain the effect of alternating rations fed to selected cows by a more detailed analysis of milk solids.

Two series of analyses were made, but, owing to the difficulty of procuring samples and the difficulty of providing each group with the ration desired, the work was discontinued.

During the year a small investigation was initiated by the laboratory with the co-operation of Mr. A. Mitchell, of Oldbury via Mundijong, with the purpose of securing data from authentic samples of factors governing the composition of milk and freezing point. The samples were collected weekly from the morning milking of three cows selected from good stock representing Jersey, Friesian and Shorthorn breeds. The work is continuing and has yielded valuable information which will be of assistance when a more comprehensive survey is made.

Human Milks.

To assist Infant Health Centres and Clinics in the diagnosis of abnormal conditions thought to be due to the composition of mother's milk, partial analyses of 20 samples were made. This work is given a high priority in order that early corrective measures may be taken.

Frequently the quantity of samples received is too small to carry out the usual methods of analysis. By the application of micro or semi-micro methods an early diagnosis can be made for verification with a more representative sample later.

Liquors, Beverages, Etc.

A survey of a certain class of locally manufactured wine for the Liquor Inspection Branch showed an appreciable proportion to contain salicylic acid, undoubtedly added as a preservative for the purpose of dispensing with the purchase of fortifying spirit. The addition of salicylic acid, which is a prohibited addition under the Food and Drug Regulations, varied in amount from 0.9 grain to 125 grains per gallon. Successful prosecutions were obtained in each case.

A successful prosecution was also obtained against the vendor of a whisky which was adulterated by the addition of water.

A sample of rum of high spirit strength submitted for examination, when broken down with water to prescribed limits showed a copious milky separate. This was found to be resinous, the nature of which suggested that the rum had been stored in a cask prepared for beer or liquor of low alcoholic strength.

Interdepartmental Committee on Dairy Products.

The work of this committee includes consideration of some problems of waste disposal from butter factories with particular reference to the Denmark factory following an enquiry as to the effect of factory effluents on fish life in the Denmark River. This is commented upon elsewhere.

In extension of the knowledge of the composition of milk, particularly solids not fat, the records of the Department of Agriculture from various districts were studied by the committee. It was resolved that information should be obtained by regular samples of milk produced in the sandy country adjacent to Perth under commercial conditions.

The co-operation of Mr. Bradley, who was hand milking a herd in the Osborne Park district, was obtained and 10 cows were selected for the tests.

The records of breeding of the cows were obtained by an Agricultural Adviser who also collected the necessary information on feeding, yields, etc., and personally sampled the evening and morning milking each week. Analyses were made for total solids, fat, solid not fat, ash, protein and lactose and freezing point determination on composite samples. It is proposed to continue the tests as long as the cows remain in milk.

Interdepartmental Fruit Technical Committee.

The programme of work on apples proposed for the 1945 season was carried out during the year. The aim of the investigation was to determine the spread of the periods for processing for juice and dehydration of apples collected from a South-West and hills locality.

Other points brought out by the analyses were the relatively low figures for acidity of W.A. Granny Smith apples. The quantities of juice, astringency and relationship between sugar and acidity in other varieties of apples vary appreciably from data recorded elsewhere. These factors were of value in connection with dehydrating processes, and emphasised the necessity of obtaining our own figures for West Australian fruits.

The analyses of 54 samples of apples grown at Donnybrook and Karragullen during the 1945 season are given in Appendix II.

It is proposed to continue analyses of Granny Smith and Yates during the 1946 season.

Interdepartmental Vegetable Research Committee.

The work of this committee at the outset had largely been dictated by wartime requirements, for example, in connection with the carotene content of carrots. This could now be considered satisfactory and the future work of the committee should tend to concentrate on composition and quality, as determined by flavour and palatability, of the principle vegetables. Consideration would be given to variety, district, maturity and soil type and fertiliser applications.

Carrots.—Seventeen samples of carrots were examined as a continuation of the survey of the carotene content of carrots grown in the State. These analyses are given in Appendix III.

Tomatoes.—Nine samples of tomatoes were examined for moisture, reaction pH, titratable acidity and vitamin C from fruit grown in a fertiliser experiment at Balcatta. The carotene, fibre and pectin on a bulked sample were also examined. Observations on the ripening, keeping qualities and flavour were made for correlation with fertiliser applications.

Other vegetables.—Future programmes of work on potatoes and cabbages were planned.

AGRICULTURAL PRODUCTS.

Linseed.

The linseed grown in experimental plots at Merredin and Avondale Experimental Stations during the current season was submitted for the determination of moisture and oil content.

The oil contents of the samples on the moisture-free basis, ranged from 33.2% to 45.1% with an average of 38.0%. These figures are somewhat lower than the results obtained from similar varieties grown in the previous season.

Insecticides.

Five insecticides of varied types and ingredients were submitted by a private firm for the purpose of obtaining registration under the Plant Diseases Act. Under the provisions of this Act all insecticides lodged for registration must be accompanied by a certificate of analysis by a competent analyst within the State or the Government Analyst.

With the increasing use of new and more complex organic compounds these preparations are frequently submitted for registration before proved methods have been worked out for their analysis and their toxic properties thoroughly understood. The difficulty of analyses is most marked in composite preparations and as a result considerable investigation is necessary before analyses can be completed.

The field of synthetic organic insecticides has grown immeasurably since the Plant Diseases Act was formed and some consideration may have to be given to meet the altered conditions.

Pyrethrum flowers grown at the Mental Hospital, Claremont, and a kerosene extract made from immature flowers were submitted for determination of the pyrethrin content.

No pyrethrin was found in the extract but the flowers were found to contain 0.36% of pyrethrin I.

In the classification correlating pyrethrin content with observed toxicity, the flowers would fall within the group of medium toxicity containing 0.26% to 0.36% of pyrethrin I.

Sheep Infertility Investigation.

In connection wth this investigation, three samples of wethers' milk were examined for the Veterinary Pathologist. Partial analysis only could be carried out owing to the small quantity of samples available. The composition showed certain abnormal features.

Lab. No.	4190.	4544.	4545.
Marks	V. Clune. New Norcia.	Morrell Bros. Geraldton No. 1.	Morrell Bros. Geraldton No. 2.
	Per cent.	Per cent.	Per cent.
Total Solids	19·0	19·01	17·76
Fat	5·3	5·19	5·54
Ash	1·0	0·82	0·81
Total Protein (Nx6·38)	10·2	6·15	6·40
Albumin	9·4	3·88	4·4
Casein	0·8	2·27	1·9
Ratio Albumin/Casein	11·8	1·7	2·3
Lactose (by difference)	2·5	6·85	5·01

GASIFICATION OF COLLIE COAL.

The gas generated at a pilot plant erected at the Railway Workshops, Midland Junction, for the gasification of Collie coal was tested for calorific value and chemical composition for the Department of Industrial Development.

The unit, which was designed to produce an "industrial gas" and a "domestic gas" suitable for use in small towns, was given a number of trial runs under the control of the professional staff of the workshop.

The average figure for the calorific value of the "industrial gas" (which was essentially a producer gas) was 160B. Th. U. per cubic foot gross and the "domestic gas" (essentially a slightly enriched water gas) was 289 B. Th. U. per cubic foot gross.

WORK FOR AUSTRALIAN AND ALLIED SERVICES.

Department of the Army.

Nineteen samples of tea and sugar, representing composite samples of supplies which had come from enemy sources, were comprehensively examined for poisons with negative results.

A number of samples of oil which were taken from drums without identifying marks, were identified as hydraulic buffer oils by analysis.

Six petrols were examined for the detection of indicator fluid and expert evidence tendered at subsequent Courts Martial of personnel concerned with possession of same. Advice was also sought on chemical means which might be adopted to mask the official test.

Royal Navy.

A sample of locally grown pine to be used for packing pieces was analysed for moisture.

United States Navy.

Prior to the cessation of hostilities, 164 samples of used lubricating oils from submarines were examined to determine if the dilution figures and oil deterioration approached the replacement limits.

Aeronautical Inspection Directorate.

Twenty samples were received covering a variety of materials such as sitka spruce and wood wool, amyl acetate, casein glue for compliance with specifications, identification of material found in the fuel tank of an aircraft.

Samples of blue cloth used for R.A.A.F. uniforms were submitted for analysis. It is well known that some individuals exhibit an allergy to chromium salts used as a mordant in khaki dyeing. The only blue material containing chromium was a heavy material used for overcoats and consequently unlikely to be in contact with bare skin.

It has been suggested that a dispensation be granted to chromium-sensitive personnel to wear blue uniforms on all occasions.

WATER.

Goldfields Water Supply.

Analyses of samples of waters taken from the Mundaring and Mt. Charlotte Reservoirs and from the Kalgoorlie reticulation were made at intervals during the year.

Hygienic Analyses.

Date	25-6-45.			18-9-45.			28-9-45.	17-12-45.	
	Parts per million								
Source*	A.	B.	C.	B.	C.	A.	A.	B.	C.
Free Ammonia	n.d.	n.d.	n.d.	trace	trace	trace	·05	·09	·01
Albuminoid Ammonia	n.d.	n.d.	n.d.	·12	·14	·2	·2	·07	·07
Nitrite	*nil*	*nil*	*nil*	*nil*	*nil*	*nil*	·01	·01	·01
Nitrate	n.d.	n.d.	n.d.	trace	trace	trace	....	·20	·28
Oxygen absorbed in 4 hours from $KMnO_4$	1·53	·29	·29	2·19	2·19	2·32	1·7	1·3	1·4
Chlorine	190	216	218	62	64	69	98	86	85
Chloride (calculated as sodium choride)	313	357	360	102	105	113	162	142	141
Total solids	408	460	488	164	168	160	204	232	228
Reaction, pH	6·5	9·3	9·3	9·1	9·1	7·2	7·3	9·2	9·2

*A. Mundaring Reservoir, B. Kalgoorlie Reticulation, C. Mt. Charlotte Reservoir.

Mineral Analysis

The following are the results of a complete mineral analysis of a sample of water from the Mundaring Reservoir taken on 30th August, 1945:—

	Parts per Million.
Carbonate, CO_3	10
Sulphate, SO_4	7
Nitrate, NO_3	Trace
Chloride, Cl	35
Calcium, Ca	2
Magnesium, Mg	3
Sodium, Na	36
Potassium, K	2
Iron and aluminium oxides Fe_2O_3 & Al_2O_3	1
Silica, SiO_2	Trace
	96

Assumed Combination.

Calcium carbonate, $CaCO_3$	5
Magnesium carbonate, $MgCO_3$	10
Sodium sulphate, Na_2SO_4	22
Sodium nitrate, $NaNO_3$	Trace
Potassium chloride, KCl	4
Sodium chloride, NaCl	54
Iron and aluminium oxides Fe_2O_3 & Al_2O_3	1
Silica, SiO_2	Trace
	96

Reaction, pH 6.54	Faintly acid
Total hardness (calc. as $CaCO_3$)	17

Salinity Tests.

The seasonal variations in the salinity of the Mundaring Reservoir water during 1945 are indicated by the following figures obtained on samples taken alongside the valve tower, one foot below the surface:—

Date.	Sodium Chloride NaCl p.p.m.	Reaction, pH.
5/1/45	377	—
31/1/45	386	7.1
27/2/45	414	7.2
4/4/45	414	7.45
4/5/45	414	6.8
1/6/45	414	7.68
21/6/45	300	6.6
22/6/45	300	6.5
23/6/45	271	6.9
25/6/45	171	6.8
27/6/45	114	6.7
28/6/45	114	6.7
29/6/45	114	6.7
30/6/45	86	6.7
2/7/45	86	6.7
3/7/45	86	6.7
4/7/45	86	6.6
5/7/45	86	6.6
6/7/45	86	6.6
7/7/45	91	6.6
9/7/45	91	6.6
12/7/45	91	6.6
16/7/45	91	6.6
17/7/45	91	6.6
20/7/45	93	6.61
23/7/45	94	6.76
24/7/45	97	6.76
26/7/45	101	6.86
27/7/45	103	6.98
28/7/45	103	6.85
30/7/45	114	6.82
31/7/45	113	6.89
1/8/45	114	6.95
2/8/45	123	6.90
4/8/45	120	6.97
6/8/45	129	6.94
7/8/45	126	6.84
8/8/45	129	6.86
20/8/45	86	6.6
21/8/45	77	6.6
22/8/45	74	7.0
23/8/45	81	7.0
24/8/45	71	7.0
25/8/45	67	7.1
27/8/45	60	6.9
28/8/45	69	6.9
12/9/45	86	6.7
5/10/45	118	7.54
6/10/45	120	7.13
8/10/45	121	7.38
10/10/45	122	7.24
11/10/45	124	7.24
13/10/45	126	7.13
15/10/45	127	7.34
16/10/45	128	7.13
18/10/45	129	7.16
4/12/45	157	6.9

Metropolitan Water Supply.

The Metropolitan area receives its supply of hills water from the Canning, Churchman's Brook and Victoria Reservoirs, of 20,550, 357 and 189 million gallons storage capacity respectively, and from a pipe head dam at Wongong Brook.

These supplies are augmented when required during the summer months, by artesian bores situated in the vicinity of Perth.

The following are analyses of waters made during the year:—

Hills Supplies.

Mineral Analyses.

Date	20-4-45.	23-4-45.		20-7-45.	25-7-45.	30-7-45	
Source	E.	G.	F.	D.	E.	G.	F.
	Parts per Million.						
Calcium, Ca	6	5	10	4	2·5	3·5	4
Magnesium, Mg	7	7	17	6	4	4·5	7
Sodium, Na	42	50	133	56	41	47	66
Potassium, K	11	5	7	2	2	2	2
Iron oxide and alumina	trace	trace	trace	trace	trace	trace	trace
Silica, SiO_2	1	1	5	trace	trace	trace	trace
Sulphate, SO_4	8	8	19	17	16	17	24
Bicarbonate as CO_3	11	9	15	12	12	10·5	10·5
Chloride, Cl	86	96	246	86	56	69	101
Nitrate, NO_3	slight trace	slight trace	trace	trace	trace	trace	trace
Total hardness (as $CaCO_3$)	40	42	92	35	23	28	39
Assumed Combination.							
Calcium bicarbonate, $Ca(HCO_3)_2$	25	20	40	16	10	15	17
Magnesium bicarbonate, $Mg(HCO_3)_2$	3	4	....	15	20	13	10
Magnesium sulphate, $MgSO_4$	10	10	24	17	4·5	13	26
Sodium sulphate, Na_2SO_4	....	....	....	5	18	9	5
Sodium nitrate, $NaNO_3$	1	1	1	....	....	....	....
Magnesium chloride, $MgCl_2$	16	19	46	*nil*	*nil*	*nil*	*nil*
Sodium chloride, NaCl	106	127	339	138	89	111	162
Potassium chloride, KCl	21	10	15	4	4	3	5
Total	181	190	464	195	145·5	164	225
Reaction, pH	7·82	7·70	7·62	6·62	6·83	6·96	6·93

D. Canning Reservoir.
E. Churchman's Brook.
F. Victoria Reservoir.
G. Wongong Brook pipe head dam.

Perth Water Storage.

The composition of the inlet and outlet waters at the Mt. Eliza Reservoir supplying Perth is given below:—

Date	23-4-45.		23-7-45.	
Source	Inlet.	Outlet.	Inlet.	Outlet.
	Parts per Million.			
Calcium, Ca	7	6	5·5	5
Magnesium, Mg	10	9	6	5
Sodium, Na	65	69	46	50
Potassium, K	8	5	2	2
Iron oxide, silica, and alumina	1	1	trace	trace
Sulphate, SO_4	12	9	16	19
Bicarbonate as CO_3	11	14	12	10·5
Chloride, Cl	126	126	73·5	77
Nitrate, NO_3	slight trace	slight trace	trace	trace
Total hardness as $CaCO_3$	60	53	39	33
Assumed Combination.				
Calcium bicarbonate, $Ca(HCO_3)_2$	27	23	22	22
Magnesium bicarbonate, $Mg(HCO_3)_2$	1	12	10	6
Magnesium sulphate, $MgSO_4$	15	12	20	21
Sodium sulphate, Na_2SO_4	....	....	*nil*	3
Sodium nitrate, $NaNO_3$	1	1	....	....
Magnesium chloride, $MgCl_2$	26	9	trace	*nil*
Sodium chloride, NaCl	165	176	117	123
Potassium chloride, KCl	15	11	4	4
Total	249	253	173	179
Reaction, pH	7·44	7·33	6·90	6·89

Country Water Supplies.

Numerous samples of waters from dams, wells, bores and streams extending over a wide area in the South-West portion of the State were examined for the Department of Works in connection with their search for supplies suitable for domestic and stock purposes.

The waters examined were classified as follows:—

	Per cent.
Suitable for town supplies	32
Suitable for stock purposes only ..	45
Too saline for watering any stock ..	23
	100

In addition to the examination of these waters, the survey of rivers and streams in the South-West portion of the State was continued during the year on similar lines to those dealt with in my report for 1944.

A large number of waters representing supplies available to farmers, graziers, etc., from private sources, were examined, for the suitability for domestic, irrigation and stock purposes. The uses of these waters for watering various classes of stock were as shown hereunder:—

	Per cent.
Suitable for pigs, horses, cattle & sheep	15.5
Not suitable for pigs	15.0
Not suitable for pigs or horses ..	20.0
Not suitable for pigs, horses or cattle	15.5
Not suitable for any stock	34.0
	100.0

Waters—General.

Included with the waters submitted for examination by Commonwealth and State Departments was a sample from a soak in Goddard's Creek, 18 miles north of Zanthus. It was proposed to use this water for treating runway at the Zanthus Aerodrome. It contained Total soluble salts, 16.8%; Sodium chloride, calculated from chlorine, 15.0%; with a reaction pH, 4.6.

In connection with the cement lining of a 12 inch main, 11 samples of water were taken at intervals to check the alkalinity by analyses and reaction as the work progressed. It was found that the alkalinity persisted for an appreciable period after the cement had set.

The large amount of work involved in the examination of waters, etc., for the Fighting Services ceased during the year, and practically ceased at the termination of the war and the departure of the United States Navy from Western Australia.

COPPER STATUS OF SUBTERRANEAN CLOVER

The Department of Agriculture has for many years been interested in the copper, manganese, and zinc status of the subterranean clover from different types of soil in the Southern part of the State. This laboratory has supplied the figures on which our knowledge of the distribution of these elements are based, and of which a summary was prepared in 1943 by Teakle and Turton (Journal Dept. Agriculture, W.A. XX., No. 3, p. 238). Further figures obtained this year are as follows:—

Locality.	Soil.	On dry basis. Parts per Million. Copper, Cu.	Manganese, Mn.	Zinc, Zn.
Waroona	Grey sandy	8·3	172	42
Cookernup	Red-brown sandy loam	18·0	323	26
Yarloop	Chocolate loam	18·9	141	21
Benger	Brownish sandy loam	14·7	428	32
Wokalup (State Farm No. 2)	Reddish	15·5	113	24
Wokalup (State Farm No. 1)	Sandy loam	16·8	307	32
Cookernup	Gravelly sandy loam	5·6	75	22
West Harvey	Heavy chocolate loam	11·8	132	26
West Harvey	Red to yellow-brown clay	8·9	119	11
Wokalup	Brown sandy loam	16·7	209	30
Boyup Brook (north)	Grey sand over gravelly sand and clay	13·0	....	17
Boyup Brook (north)	Grey sand over clay	13·3	....	19
Boyup Brook (Mayanup)	Grey sand over clay	13·3*	....	30
West Dale		3·7	113	29
West Dale	Grey sandy loam	11·1*	94	25
West Dale		2·6	72	13
West Dale	Dark gravelly	10·3*	53	21

* Copper sulphate added as fertiliser.

The figures are interesting in that the soils from the Waroona to Wokalup area and southwards to Brunswick are considered to be some of the best soils in the State for dairying, fruit and intense cultivation, and they are, moreover, those benefiting from the irrigation scheme whereby pastures are kept green throughout the summer.

PASTURE FERTILISER EXPERIMENT, MANJIMUP.

A number of samples of subterranean clover leaves and petioles were collected from fertiliser experiments in the Manjimup district and were analysed for nitrogen, potassium and phosphorus and for the copper and zinc status. There appeared to be little variation in the three former elements and in zinc under the treatment given, but the copper status, which in this district as far as examined is subnormal to high normal (Teakle and Turton, 1943) was increased by the addition of bluestone from one to two parts per million in the experimental plots. It is noteworthy that the increase in copper is of approximately the same order in each pair of samples.

IRRIGATED PASTURE.

A large number of samples of pasture cut from fertiliser trials at Waroona and Harvey were analysed for nitrogen, phosphorus and calcium. The samples represent spring and autumn cuts from plots with the addition of up to 6 cwt. of fertiliser per acre. The samples receiving no fertiliser were in general slightly lower in phosphorus than the fertilised pasture but there was little significant difference in the nitrogen content. Calcium was somewhat more variable, with a seasonal variation being noticeable.

MOLYBDENUM TRIALS.

The Department of Agriculture carried out some experiments with pasture on the rate of superphosphate dressing and molybdenum at the Denmark Research Station. The pasture receiving superphosphate only contained 0.3 parts per million molybdenum, but the addition of molybdenum to the adjacent plot raised the figure to 1.3 parts per million. Little is known of the molybdenum status of Western Australian soils, but molybdenum sulphide is a fairly common constituent of the granite and gneiss in the South-Western portion of the State and further surveys may yield interesting results.

OAT VARIETY TRIAL.

Samples of grain from the oat variety trial experiment conducted at the Merredin Research Station were analysed for their feeding value. The varieties were: Fulghum, Mulga, Ballidu and Wongan.

OTHER PASTURES.

A large number of pasture samples was examined for the Department of Agriculture. These included oat and barley (green growth) samples from the Growth Curve Studies Experiment; pasture samples from the local and sub-acid phosphate experiments carried out in various parts of the State; samples of wheaten and oaten hay, straw and "cocky" chaff from various Research Stations.

WIMMERA RYE GRASS.

Samples from the Wimmera Rye Grass maintenance experiment at Merredin were analysed and gave:—

Sample.	A.	B.	C.	D.	E.
Ash	6·09	6·59	6·26	5·86	6·06
Crude protein	5·38	6·18	6·07	6·18	5·82
Petroleum ether extract	1·46	1·74	1·52	1·36	1·49
Crude Fibre	30·93	29·79	29·55	30·05	31·26
Nitrogen free extract	56·14	55·70	56·60	56·55	55·37
	Percentages on dry basis.				
Calcium	0·35	0·32	0·41	0·30	0·32
Magnesium	0·20	0·20	0·15	0·21	0·21
Phosphorus	0·138	0·116	0·114	0·150	0·271
Potassium	1·04	1·20	1·04	0·98	1·01

KIMBERLEY NATIVE GRASSES.

In connection with the investigations being carried out in the lower Ord River Valley with a view to irrigating certain areas, samples representing 12 varieties of native grasses collected at different stages of growth were sent in for analysis.

Samples of Para Grass (*Brachiaria mutica*) from the Carlton Reach Experiment Plots on the Ord River gave the following analyses:—

	Percentages on Moisture-free Basis		
	A	B	C
Nitrogen ..	1.95	0.97	0.56
Phosphorus ..	0.291	0.300	0.290
Potassium ..	4.01	2.74	1.69
Calcium ..	0.27	0.18	0.30
Crude Fibre ..	30.83	32.31	33.31

A. From an irrigated pasture of para grass and lucerne. Grass six months old.

B. Para grass from a pure stand irrigated and planted the same time as A.

C. Para grass from a pure stand 25 months old. Irrigated.

CORROSION OF WATER MAINS IN COUNTRY AREAS.

Plans are being made to increase the reticulation scheme whereby water from catchments in the Darling Ranges will be supplied to considerable areas of country East of the ranges. One of the aspects that is being investigated is the soil reaction so that some knowledge of the conditions to which the water pipes will be submitted is obtained. During the year the reaction, pH, of 265 samples of soil from the Southern Brook, South Meckering and Seabrook pipe-lines was determined. The whole of the investigation is a co-operative effort by officers of the Mines Department, Water Supply Department and Department of Agriculture.

FERTILISERS.

No official samples taken under the Fertiliser Act were received during the year, but several samples for use as fertilisers were examined. These included old Army boots which were to be treated and mixed with other fertilising material; rape-seed meal, fowl manure, and muriate of potash.

FLAX.

Five samples of flax grown in 1945 from properties at Boyup and Muradup, in the principal flax-growing area of the State, were analysed for the presence of zinc, copper, manganese, calcium and magnesium in connection with possible zinc deficiency. The figures obtained are:—

	On dry basis.				
Sample No.	Calcium Ca. %	Magnesium Mg. %	Copper Cu. p.p.m.	Manganese Mn. p.p.m.	Zinc Zn. p.p.m.
1	1·82	0·76	5·6	86	17
2	1·00	0·55	5·5	57	22
3	1·26	0·49	9·3	56	20
4	1·29	0·61	8·8	171	16
5	0·97	0·27	3·3	167	15

The field notes with regard to these samples are:—

1. Boyup Brook, zinc deficient and stunted.
2. Boyup Brook, very mild zinc deficiency, some leaves spotted.
3. Boyup Brook, healthy.
4. Muradup, zinc deficient and stunted.
5. Muradup, zinc deficient, severely spotted.

Nos. 1, 2 and 3 were from one property; Nos. 4 and 5, from one property.

It is considered that the normal zinc content is 20-30 parts per million, and with smaller amounts zinc deficiency symptoms appear.

TANNIN.

Locally manufactured tannin is exported to England and has to comply with certain standards for iron and copper content. A number of samples was submitted for check with the results of the firm's analyses.

LEAVES.

A considerable amount of analytical work has been done on various plant leaves for the Department of Agriculture in order to give definite information for certain investigational work that is being undertaken by that Department.

In connection with the study of nutrition of vines in the Upper Swan District certain symptoms of unthriftiness are suggestive of zinc deficiency. The Department of Agriculture's Plant Nutrition Officer with Mr. A. G. Turton of this Laboratory made plans to sample vines under treatment at three periods, October, December, and the following March. The results for the October sampling are:—

Locality.	Sample No.	Zinc treatment.	On dry basis. Copper, Cu. p.p.m.	Zinc, Zn. p.p.m.
Caversham (Bailey)	1	—	16·1	30
,, ,, ...	2	+	n.d.	27
,, ,, ...	3	—	18·4	20
,, ,, ...	4	+	n.d.	23
,, ,, ...	5	—	n.d.	21
,, ,, ...	6	—	n.d.	29
Caversham (Duff)	7	+	n.d.	22
,, ,, ...	8	—	17·4	22
,, ,, ...	9	+	n.d.	27
,, ,, ...	10	—	n.d.	25
Upper Swan (Howard)	11	—	24·2	27
,, ,, ...	12	+	n.d.	31
,, ,, ...	13	—	n.d.	29
,, ,, ...	14	+	n.d.	31
,, ,, ...	15	—	28·8	23
,, ,, ...	16	+	n.d.	22
,, ,, ...	17	—	27·0	26
,, ,, ...	18	+	n.d.	23
Muchea (Fewsters)	19	—	18·0	23
,, ,, ...	20	—	17·4	31
,, ,, ...	21	—	14·1	15
,, ,, ...	22	—	20·6	34
Upper Swan (St. Alban's)	23	+	n.d.	18
,, ,,	24	—	8·8	15
,, ,,	25	+	n.d.	15
,, ,,	26	—	n.d.	16
Upper Swan (Cook)	27	—	12·8	14
,, ,, ...	28	+	n.d.	17
,, ,, ...	29	—	12·4	15
,, ,, ...	30	+	n.d.	20

n.d. signifies not determined.

The zinc treatment was a swab of 20% zinc sulphate on the cut surface of pruning. These figures, though interesting, will prove of more value when the two further lots of samples have been examined For the Muchea samples there is a very considerable increase in zinc content of leaves of the healthy vines when compared with those of unhealthy plants.

In connection with a fertiliser experiment with potatoes at Pickering Brook, 10 samples of leaves were sampled from various treatments which included blood and bone, superphosphate, sulphate of ammonia, muriate of potash, and a side dressing of sulphate of ammonia. The nitrogen, potassium, phosphorus and magnesium were estimated on the dry basis, and copper, manganese and zinc figures obtained for some samples. The copper figures were in the range 9-12 parts per million; zinc, 59-84 parts per million; and manganese, 103-313 parts per million.

Tomato leaves from a fertiliser experiment at Balcatta and from an experiment to determine the difference in appearance of leaves using muriate of potash and potassium sulphate as a fertiliser were analysed. The figures obtained for the latter are:—

			On dry basis.	
Sample No.	KCl treatment.	K_2SO_4 treatment.	Chlorine, Cl. %	Potassium, K. %
1	+	—	2·05	4·07
2	—	+	1·72	3·63
3	+	—	1·80	3·70
4	—	+	1·57	3·68
5	+	—	1·99	4·24
6	—	+	1·59	3·87

Apple leaves included a number of samples from Kendenup where manganese deficiency occurs. The varieties of apples were Dunns, Granny Smith, Jonathan, Yates, and Democrat. The manganese figures range from 5-9 parts per million. Considerable difficulty was encountered in obtaining the manganese figures and the trouble may be connected with the very high ratio of calcium to manganese encountered. The figures reported are for samples containing approximately 5-7% moisture. Leaves from apparently unhealthy and healthy Rokewood and Yates apple trees were analysed spectrographically for copper and manganese. The lines given by these elements were somewhat less intense in the unhealthy trees and potassium was definitely so. A number of whole cauliflower plants, cut just below the lowest leaves, were collected from a fertiliser experiment in the Osborne Park area. There were eight fertiliser treatments involving blood and bone, sulphate of potash, with nitrate of soda (the normal fertiliser application), variations in the amounts of the normal application, treatments minus potash, and a treatment plus a minor element mixture consist-

ing of epsom salts, manganese sulphate, copper sulphate, zinc sulphate, borax and molybdenum. The analytical results are as follows:—

Sample No.	Net dry weight (grams.)	Percentages on Dry Basis. Ca.	Mg.	K.	P.	N.	Parts per Million. Cu.	Mn.	Zn.
A	231	2·26	0·40	0·97	0·69	4·18	3·5	73	64
B	291	1·68	0·27	1·63	0·65	4·02	3·6	55	51
C	225	2·25	0·36	2·02	0·61	4·13	....	....	....
D	239	1·76	0·35	1·30	0·68	4·31	3·2	65	71
E	236	2·13	0·34	1·79	0·57	4·16	....	....	....
F	154	2·24	0·37	0·83	0·64	4·30	2·7	62	61
G	200	1·34	0·30	0·65	0·84	4·58	2·6	65	66
H	220	2·17	0·43	1·39	0·62	4·28	3·5	74	92

Sample H., which received the minor element mixture is noticeably higher in manganese and zinc. The micro-element work revealed that the samples were grossly contaminated with lead, presumably from spraying operations.

FLOUR AND WHEAT.

An interstate investigation on the analysis of flour, resulted in flour samples from each States being distributed to the various States for analysis. The protein content of samples from South Australia and Victoria were determined in this laboratory.

The f.a.q. sample of wheat for the 1944-1945 season, and the flour milled from it gave the following figures:

	Wheat. %	Flour. %
Moisture	13·40	14·65
Protein	9·59 (Nx 5·83)	8·18 (Nx 5·7)
Ash	1·23	0·48
Wet Gluten	....	18·5
Dry Gluten	....	6·9
Maltose (Kent Jones)	....	1·86

SHEEP BREEDING PROBLEMS.

One hundred and twenty-six samples of soils and rocks were examined from an area between Kojonup and Beverley, west of the Great Southern. The following conclusions appear to be justified: The soils are mostly granitic or gneissic in origin and can be regarded as sedentary, the minerals present in the soils reflecting those in the parent rocks. Laterite is a factor on some properties. The country is generally regarded as "light," as there are few basic dykes producing heavy clay soils. It should be noted, however, that samples were collected mainly from properties on which the sheep have been affected, and it will be necessary to sample unaffected properties in the same areas before the full significance of the observed facts can be used to the best advantage. It appears clear that the granite of the areas all belongs to the one type and is intrusive into older gneisses. In order to provide some information on the chemical elements being supplied to the soils by the rock minerals, biotite was carefully separated and examined spectrographically. This examination cannot be done satisfactorily with the spectrograph in the Laboratory, and as a special technique for dealing with silicate powders has to be evolved, this part of the work was abandoned for the time being. There is a large and untouched field for research in this aspect of mineralogy and one which it would well repay this Laboratory to consider. Complete analyses of three samples of biotite were made (reported elsewhere). The chief contribution of soil mineralogy in problems of this nature is to give the mineralogical background of the area examined, and so in time similarities and differences will be found. It is planned to carry out similar work in other areas for comparative purposes.

GRITS FROM CHANDLER LAKE.

During the year a number of grits were examined from beneath the alunitic clay filling the bed of Chandler Lake. The samples were obtained in co-operation with Chandler Alunite Industries as part of their sampling scheme. The grits are probably partially due to the disintegration *in situ* of the underlying gneissic granite and partly to transported material, a definite channel being apparent in parts of Chandler and Red Lakes. Mineralogical examination showed that the grits are largely quartz and felspar, the former predominating. Heavy mineral suites were obtained from the finest sandy material and these contained a fair variety of minerals. It is interesting to note that although the granite at the Northern end of the Lake contains approximately 4% of biotite, practically no biotite is present in the samples examined, although felspar is plentiful. This indicates that the acid environment has caused the removal of biotite, the potash from which would go to form alunite. The whole question of the origin of alunite as a lake deposit is under consideration and it is hoped that some useful facts about this interesting deposit will come to light.

LATERITE.

It is important from the soil point of view that further mineralogical and chemical information be obtained concerning the changes that take place between the solid parent rock and the overlying laterite. One almost complete profile of the Forest Grove gravelly sandy loam down to 23 feet, and one from near Wongan Hills down to 10 feet, have been examined. Interesting facts have been found regarding the distribution and form of the iron-bearing minerals and titania in the Forest profile, while both showed a silicified zone just below the massive laterite layer and above the kaolinised layer lower down in the profile. This silicified zone has been recognised in the Queensland laterite and is probably common to all laterites which developed under the same conditions, for laterite is a fossil soil and is not forming in this part of Australia at the present time.

INTERDEPARTMENTAL SOILS TECHNICAL COMMITTEE.

Monthly meetings of this committee have been held throughout the year and have been found particularly valuable in correlating field and laboratory work in special investigations and in straightening out apparent anomalies in chemical results. Close touch has been kept with the Council for Scientific and Industrial Research Soil Surveys in the Margaret River, Rocky Gully and Blackwood River areas and information exchanged particularly with the Forests Department.

Manganese deficient soils in the Kendenup area have been examined and the committee is of the opinion that, except in the case of inherently poor soils, sufficient manganese is present in the soils but in a condition unavailable to plants. The committee suggests that further experimental work be done on the physical properties of the soils, methods of cultivation and manuring as well as comparative studies in unaffected areas growing similar products under the same rainfall conditions. Mineralogical examination of the soils formed *in situ* indicated two rock types—garnet bearing and granite gneisses.

Descriptions and impressions gained by field officers of the following areas:—Ord River, Kendenup, Lake Pinjar, Wongan Hills, Pingrup, Margaret and Blackwood Rivers and Rocky Gully, have been made available to members of the committee.

Further work in hand and projected deals with sheep fertility, salinity of Lake Grace soils, rotational experiments at Merredin and Wongan Hills research stations, Wongan Hills survey, vegetable soils and research work on phosphate fixation and soil organic matter.

A catalogue of Western Australian soils series as used in soil classifications is being prepared.

ORD RIVER VALLEY SOILS.

During the year work continued on the type samples of soil collected in the Ord River Valley the previous year by the Department of Agriculture. There were nearly 90 samples of these soils representing 18 type profiles. The information asked for was:—Mechanical analysis; Reaction, pH; Exchangeable cations (Ca, Mg;

K, Na); Per cent. of total cations; Organic carbon; Nitrogen; C/N, K_2O, P_2O_5, exchangeable K_2O and Acid soluble K_2O which were determined on 46 of these samples. It is expected that this work will be completed early in 1946.

Additional samples of soils from the areas mapped by the Department of Agriculture were examined and the mineralogy of a number of soil types has been described. A paper has been prepared for publication in collaboration with Mr. G. H. Burvill. The principal features are the mineralogical evidence of the mixture of source material in the alluvial soils and the sedentary character of the sand derived from the weathering *in situ* of Devonian sandstones. Conclusive evidence is given of the banded nature of the alluvial material forming the principal soil type, the Cununurra Clay, and also of the mixture of soil types in what is mapped as the Junction Complex.

SOIL SURVEYS.

The State Department of Agriculture is collaborating in Soil Surveys of areas to be used for post-war land settlement, and in opening up new areas. Mineralogical examinations were asked for for type samples from an area between Margaret River and Nannup, and these were done so that the information was available before the soil mapping was completed. Some additional knowledge is thereby gained of parentage, similarity or dissimiliarity while the field work is in progress. The mineralogical examination indicated that the soils were largely of sedimentary origin with fairly high concentrations of zircon, ilmenite, and rutile. Such sand when further concentrated by wave action on a beach would give a typical black beach concentrate.

"Pituri" Soils.

A reconnaissance of the areas in which Pituri (*Duboisia Hopwoodii*) is growing resulted in a mineralogical examination of 15 samples of soil for the Department of Agriculture. The examination showed that the soils are of gneissic origin. A partial chemical analysis was made of siliceous hardpan associated with one of these soils. This contained:—47 per cent. SiO_2; 13.5 per cent. Al_2O_3; 11 per cent. CaO; and 5 per cent. Fe_2O_3, as the principal constituents.

SOIL EROSION.

The mechanical analysis of all types of sediments is an established practice in sedimentary laboratories in the United States of America, and it is pleasing to record that the addition of a standard set of Tyler sieves to the equipment of this laboratory will enable similar investigations to be made here. One of the most pressing and interesting problems is that of the effect of wind action on loose sand. Fifteen samples of windblown sand from Wongan Hills, Tammin and Mukinbudin were analysed mechanically. The sorting action of the wind is clearly shown by the reduction of the very fine and very coarse sand giving an increase in the +60 grade of about 20 per cent. over that in the natural sandy soil. The sands blown into drifts in the vicinity of a sandplain soil being actively eroded by wind are not nearly as well sorted as those of the coastal sand dunes. The fact that wind of a certain velocity will move grains of a definite size is of importance and much could be done on the liability to wind erosion to be expected in areas of high winds.

ECONOMIC MINERALOGY.

Information both written and oral was given to a large number of enquirers, and considerable time was spent in interviews.

The mineral collections were increased and the Simpson collection was checked; it was found that about 2,000 specimens had not been catalogued, and this was done, as well as the numbering and card-indexing of all specimens. This collection is now in good order. Interesting and unique specimens were added to the new collection; these included simpsonite from Brazil. Beryl, columbite, and tantalite have been prepared for exchanges which will be made with mineralogists abroad when time permits. The "Mineral Resources of Western Australia," a folder dealing briefly with various economic minerals, was revised. This entailed a considerable amount of work as the previous edition was published in 1935, and new sections on the non-metallic minerals which had come into prominence during this time had to be written, and all the information brought up to date.

With regard to mineral information which is forwarded to the Eastern States for inclusion in publications dealing with the Mineral Resources of Australia, I wish once again to draw your attention to the fact that this laboratory, where supposedly all mineral investigations are made for the State Government, is never consulted, although the Geological Survey and the State Mining Engineer's Branch are regularly asked to contribute. I resent this attitude on the part of the Mines Department and would urge that something be done to effect a change of policy on its part.

ABRASIVES.

Light coloured, very fine grained silt from Woodanilling was found to consist of quartz with fragments of sponge spicules and diatoms, halloysite and plagioclase felspar. This material would make an excellent base for sand and similar types of abrasive soaps.

A sample of rock from Scotts Brook consisted of a dark green schistose matrix of biotite mica with numerous red-brown crystals of spessartite garnet. The garnet crystals were mostly about three-quarters of an inch in diameter, fresh and unaltered, and showed little intergrown biotite. Suitable processing of this rock should produce a good abrasive product if the hardness and other physical properties proved suitable.

ALLOYS AND METALS.

A wide range of alloys and metals was submitted for analysis and examination. Work for the Aeronautical Inspection Directorate included the preliminary examinaton by spot test to differentiate between aluminium, aluminium alloys, and steel. These tests were carried out in accordance with the methods supplied, and in a general way were satisfactory. A section of ring land of a Cheetah piston was examined for abrasive particles. A few deeply embedded grains were noted but these showed no sign of drag or other movement and were not thought to be responsible for the excessive wear experienced in use. Test pieces of copper, cadmium and chromium plated mild steel plate were tested for thickness and porosity of coating. A polished section was prepared and examined of a test sample of Stellite welded to the edge of a mild steel plate. No porosity or shrinkage cracks were detected at the junction of the two metals and there was very little solution of the mild steel in the Stellite or modification of the crystalline structure near the junction.

Samples of cartridge cases from the Gun Ammunition Factory at Welshpool consisted of fired and unfired cartridges. Analyses were made to detect possible variation in chemical composition that may have been causing elongation.

Selected portions of columbium-stabilised stainless steel tubing and welding rod, for use in the new Perth Hospital hot water system were analysed. Tube and welding rod are required to be of the same composition to minimise corrosion effects. Good agreement in composition was found. The analytical figures obtained were:—

	Stainless steel tubing.					Welding Rod.
Size of tube.	1¼ in.	1 in.	¾ in.	⅝ in.	½ in.	
	%	%	%	%	%	%
Chromium, Cr	18·47	18·74	18·28	18·79	18·22	19·00
Nickel, Ni	10·69	11·35	11·33	11·71	11·06	11·34
Niobium, Nb	0·81	0·91	0·81	0·85	0·84	0·78
Silicon, Si	0·51	0·59	0·52	0·44	0·33	0·41
Manganese, Mn	1·16	1·30	1·01	1·61	1·33	1·36
Carbon, C	0·10	0·10	0·08	0·11	0·08	0·08

Molybdenum, vanadium, tungsten, titanium, tantalum and zirconium were not recognised by a spectrographic examination. It is proposed later to examine and analyse welded sections of pipes. Analysis of the flux was also made to ensure that no metallic contamination would be derived from its use.

Samples of white metal were analysed for the Department of the Australian Navy. This alloy consisted of tin and zinc with a little copper. Total impurities were required not to exceed 0·05 per cent.

A block of metal found in the store at Barton's Mill Prison was found to consist of zinc with approximately three per cent. of tin. It was suggested that it may possibly have been intended for use in galvanising iron by the molten dip process.

The Government Printer forwarded a sample of linotype metal for analysis.

CERAMICS INCLUDING REFRACTORIES.

Two samples of a clay from Marchagee sold as Bentonite were forwarded by the Geological Survey Branch for testing in accordance with the procedure set out in U.S. Department of the Interior Technical Paper 609. The clay occurs in a clay-pan, material from the surface layer giving 70 per cent. gel. with Sadler's test and a dehydration curve which indicates it to be mainly halloysite. Clay from the lower layer of the clay-pan gives 97 per cent. gel. or higher and has a dehydration curve indicating the presence of montmorillonite with some halloysite and probably other clay minerals. According to the above mentioned technical paper this clay would be classified as a low-grade alkali sub-bentonite.

A soft light grey coloured clay containing small limonitic fragments was examined for possible value. It proved to be a fine grained semi-ball clay burning to an off-white colour due to the presence of limonite, and would only be of use in the manufacture of coloured ware. The clay comes from one mile North of Nannup.

Preliminary examination of a clay from 20 miles South of Bruce Rock showed it to be plastic ball clay with an Ashley figure for plasticity of 149/200.

Several samples of sillimanite bearing clays from Clackline were examined to determine the approximate percentage of sillimanite, quartz, clay, and mica present. Briquettes were prepared and burnt at a temperature of 1350° C.

NATIVE FUEL.

Coal.

A seam of coal about six feet thick outcropping in the Irwin River Valley and explored by a tunnel driven through the seam for some 180 feet was systematically sampled, about 70 samples being forwarded for analysis. The samples were taken from top to bottom across the seam. The results obtained at a distance of 90 feet and 180 feet from the tunnel mouth are given below:

Irwin River Coal at 90 feet from Tunnel Mouth.

Proximate Analysis.	Top 12 in. %	12 in. %	10 in. %	14 in. %	Bottom 24 in. %
Moisture	5·84	4·87	6·91	5·68	5·51
Volatile matter	28·74	22·83	31·49	32·83	30·81
Fixed carbon	41·41	28·95	48·19	42·71	46·23
Ash	24·01	43·35	13·41	18·78	17·45
	100·00	100·00	100·00	100·00	100·00
Calorific Value B.T.U.	8287	5583	9629	9037	9326

Irwin River Coal at 180 feet from Tunnel Mouth.

Proximate Analysis.	Top 12 in. %	12 in. %	10 in. %	14 in. %	Bottom 24 in. %
Moisture	12·55	10·08	12·70	12·54	13·49
Volatile matter	26·88	21·01	28·94	27·98	28·46
Fixed carbon	40·61	28·29	42·92	37·62	43·27
Ash	19·96	40·62	15·44	21·86	14·78
	100·00	100·00	100·00	100·00	100·00
Calorific Value B.T.U.	8083	5467	8765	7698	8740

The coal is of the hydrous bituminous non-coking type, too high in ash for most commercial uses.

Collie Coal.

By invitation of the South Australian Government, samples each of approximately one ton of coal from Proprietary and Griffin Collieries were sent in sealed containers to South Australia for drying tests in the experimental Fleissner steam-drying plant at Osborne. This process aims to improve the keeping qualities of the coal as well as achieving a high degree of drying. The coals of these tests were taken from large (screened) deliveries from the two mines in August, 1945.

The results of these tests that were personally observed by me were:—

"Drying Tests at 320 pounds per square inch steam pressure."

Average Results.	Proprietary Coal. Raw Coal.	Proprietary Coal. Dried Coal.	Griffin Coal. Raw Coal.	Griffin Coal. Dried Coal.
Moisture, %	21·0	7·05	19·85	4·5
Ash, %	6·9	8·1*	3·65	4·35*
Heating value B.T.U./pound gross	9380	11030*	9840	11720*
Range of Results.				
Moisture, %	21·0	5·9 to 8·9	19·85	3·4 to 5·9
Heating value B.T.U./pound gross	9380	11170 to 10820*	9840	11860 to 11550*

* Calculated figures, experimental figures yet to be determined.

The drying tests were done on coal sizes up to four inches and with slight variations in the experimental procedure.

Seventeen separate tests were done on each coal and in all a substantial reduction in moisture content was achieved.

Samples of the dried products have been returned to Perth for further examination.

Proximate analyses and calorific value were determined on six samples of coal from the Westralia Dump at Collie. The ratio of fixed carbon to volatile matter varied from 1.3: 1 to 6.8: 1, and the ash on the coal as received which contained from 24 to 30 per cent. moisture, ranged from 9.5 to 29.8 per cent.

A seven foot seam of coal 28 feet below the Cardiff seam at Collie sampled at the face and forwarded in an air tight container gave the following results:—

Coal from a 7-foot seam 28 feet below the Cardiff seam.

Proximate Analysis	%
Moisture	24.84
Volatile Matter	27.87
Fixed carbon	41.98
Ash	5.31
	100.00
Ratio Fixed Carbon to Volatile Matter ..	1·51:1
Calorific Value B.T.U.	8759

Oil Shale.

A bed of inferior quality oil shale was penetrated by bores South of Coolgardie about the year 1900. Two samples from the Coolgardie district, probably originally from this area, were sent in for determination during the year.

BERYL.

Production of beryl declined sharply during the year due to the easing of this mineral from its high priority position among the minerals urgently required for war purposes. Western Australian supplies were mainly shipped to the United States of America. That little associated quartz, felspar, or other gangue minerals were included in these parcels is shown by the following assays:—

Beryl for Export	Beryllium Oxide BeO %
Sample from Yinnietharra representing 155 bags	13.40
Sample from Wodgina representing 241 bags	13.07
60 bags of Beryl from Wodgina, crushed and sampled at the Laboratory	12.48

It was realised that this laboratory should possess more knowledge of the optical characteristics and chemical constitution of beryl, and the variation of these properties in the mineral occurring at Yinnietharra, Wodgina, Londonderry and other localities. Considerable work was successfully completed during the previous year to improve the accuracy of the analytical separation

of beryllium from aluminium. During the year research was commenced on the chemical composition and optical properties of beryl from various localities. A number of specimens of beryl from Yinnietharra were selected and examined. Dr. R. T. Prider, Geology Department of the University of W.A., collaborated by determining the refractive index of the different types, and selecting and preparing pure minerals for analysis.

Clear transparent aquamarine mineral of gem quality, and pale green to white material was hand-picked for analysis by Dr. Prider, the selected clear and white mineral being analysed in this laboratory with the following results:—

	Clear transparent aquamarine beryl from Yinnietharra.	White Beryl from same specimen.
	%	%
Silica, SiO_2	64·85	64·88
Alumina, Al_2O_3	17·52	17·49
Ferric oxide, Fe_2O_3	0·37	0·46
Manganous oxide, MnO	0·01	n.d.
Magnesia, MgO	0·14	*nil*
Lime, CaO	*nil*	*nil*
Beryllia, BeO	13·15	12·97
Lithia, Li_2O	0·52	0·24
Soda, Na_2O	0·94	0·94
Potash, K_2O	0·16	0·08
Rubidia and Caesia, (Rb, $Cs)_2O$	0·08	0·23
Water, H_2O, combined	2·19	2·35
Titanium dioxide, TiO_2	*nil*	n.d.
Phosphoric oxide, P_2O_5	*nil*	n.d.
Chromic oxide, Cr_2O_3	*nil*	n.d.
Fluorine, F	*nil*	n.d.
Chlorine, Cl	*nil*	n.d.
	99·93	99·64
Analyst	H. P. Rowledge.	J. D. Hayton.
Specific Gravity	2·73	2·73
Refractive Index "ω"	1·5825	1·5825

(Refractive Index determined by Dr. R. T. Prider on a Pulfrich Refractometer.)

From the above figures it would appear that the opacity of the white material is due mainly to fracturing.

The second specimen selected for analysis contained areas of clear greyish beryl. Clean transparent mineral was selected by careful hand-picking. The analytical figures obtained were:—

	Clear greyish beryl from Yinnietharra.
	%
Silica, SiO_2	64·80
Alumina, Al_2O_3	17·78
Ferric oxide, Fe_2O_3	0·16
Ferrous oxide, FeO	0·03
Manganous oxide, MnO	*nil*
Magnesia, MgO	*nil*
Lime, CaO	*nil*
Beryllia, BeO	13·72
Lithia, Li_2O	0·36
Soda, Na_2O	0·52
Potash, K_2O	0·10
Rubidia, Rb_2O	trace
Caesia, Cs_2O	0·07
Water, H_2O, combined	2·07
Titanium dioxide, TiO_2	trace
Barium oxide, BaO	*nil*
Chromic oxide, Cr_2O_3	slight trace
Vanadous oxide, V_2O_3	*nil*
Phosphoric oxide, P_2O_5	0·01
	99·62

Analyst: C. E. S. Davis.

Specific Gravity	2.72
Refractive Index "ω"	1.5820

(Refractive Index determined by Dr. R. T. Prider on a Pulfrich Refractometer.)

Beryl from 18 miles South of Wodgina Mines contained 12.70 per cent. BeO. This is a new locality for this mineral.

A sample from about 20 miles north-east of Wodgina Tantalite Mines contained 13.15 per cent. of BeO.

Two samples of massive cream-coloured beryl intergrown with small amounts of muscovite mica and quartz were received from the Central Emerald Fields at Poona. A fine specimen of rose-coloured beryl from this district was donated for the mineral collection by A. S. Giles.

Several specimens of beryl with a surface staining of oxides of iron and manganese came from pegmatite dykes 11 miles south of Coolgardie.

COPPER.

Prospecting copper ores were received from 3 miles south of Arrino, 10 miles west of Fields Find, and 20 miles east of Marble Bar. Two samples were forwarded by farmers, the ore being required as a copper dressing for soils deficient in this metal.

GOLD AND OTHER PRECIOUS METALS.

An indication of the increasing activity in gold mining was the receipt of samples of tailings from ore treated at 14 of the State Batteries. The samples were mainly for umpire gold assay.

The gold bearing material assayed during the year included flotation tailings and gold bearing slags, one sample containing 167ozs. 18dwts. of gold per ton.

Prospecting ores were received from widely different localities which included Carey Downs Homestead, Delaney's Well, and Lake Cowcowing. Ore from the latter locality contained no gold.

Platinum has not been recorded from Western Australia and latterly platinum assays have seldom been made. However, during the year, two samples of basic rock from the vicinity of Mt. Brown (York) and one from the Yilgarn district were assayed for platinum with negative results.

A small heavy white metal button found in a private collection was identified as osmiridium. It probably came from Tasmania.

TELLURIUM.

The tellurium content in samples of mill feed and concentrate were determined for one of the Kalgoorlie mining companies. The figures obtained were:—

Mill feed Tellurium, Te, Trace (under 0.002%)

Concentrate Tellurium, Te, 0.006%

TANTALUM, NIOBIUM AND TIN.

With the closing of the Commonwealth plant at Wodgina following the non-renewal of the purchasing contracts with the United States of America work on these fields practically ceased. Tantalite from this project remaining at this laboratory consisted of four lots, which were crushed, sampled and bagged for shipment. Details of these parcels were as follows:—

Lot No.	Nett weight. lbs.	Tantalic oxide. Ta_2O_5. %	Niobic oxide. Nb_2O_5. %	Tin dioxide. SnO_2. %	Titanium dioxide. TiO_2. %
29	734	56·8	7·1	7·3	1·8
32	2998	65·9	11·7	4·3	0·7
36	1728	65·4	13·1	4·1	0·5
33	2370	51·3	23·4	7·0	0·6

During the war years little mineralogical research could be carried out owing to other more pressing needs of urgent war work. Its value however, is apparent when dealing with the difficult problems presented in the examination and analyses of the strategic minerals such as the presence of considerable amounts of tin dioxide not present as cassiterite in the tantalite from the Pilbara, and the recognition of zirconium in the mixed oxides of tantalum and niobium prepared from tantalite from the same locality. Another example is the presence of a small percentage of lime found during the analysis of some concentrates from Greenbushes which could not be readily allotted to any of the minerals known from there. Stibiotantalite was found to be more plentiful at Greenbushes than was known before. Examination of typical stibiotantalite in the Simpson Mineral Collection showed some small fragments of golden yellow colour to differ in optical properties from stibiotantalite.

Analyses were made of selected grains and these proved to be stibiomicrolite, a mineral not previously recorded in Western Australia and only known from Varutrask in Sweden. The analytical figures obtained

on stibiomicrolite and stibiotantalite were as follows. An analysis of stibiomicrolite from Varutrask is included for comparison:—

	Stibiomicrolite, Greenbushes. "A." %	Stibiotantalite, Greenbushes. "B." %	Impure Stibiotantalite, Greenbushes. "C." %	Stibiomicrolite, Varutrask. * %
Tantalic oxide, Ta_2O_5	72·52	56·28	57·22	52·3
Niobic oxide, Nb_2O_5	2·90	1·40		11·8
Tin dioxide, SnO_2	0·50	0·20	0·20	n.d.
Ferrous oxide, FeO	0·23	1·22	....	....
Manganous oxide, MnO	0·40	trace	trace	0·08
Lime, CaO	9·92	*nil*	*nil*	5·32
Magnesia, MgO	0·22	0·16	*nil*	*nil*
Ferric oxide, Fe_2O_3	....	....	2·88†	0·26
Alumina, Al_2O_3	0·62	0·50	....	0·50
Antimony trioxide, Sb_2O_3	7·96	39·12	37·84	25·3
Bismuth trioxide, Bi_2O_3	0·30	0·58	0·56	0·10
Potash, K_2O	0·20	*nil*	n.d.	*nil*
Soda, Na_2O	2·70	*nil*	n.d.	1·50
Fluorine, F	1·30	*nil*	*nil*	n.d.
Water, H_2O, hygroscopic	*nil*	*nil*	n.d.	0·16
Water, H_2O, combined	0·06	0·19	0·18	1·11
Silica, SiO_2	0·22	0·28	0·74	1·38
Titanium dioxide, TiO_2	0·12	trace	0·56	*nil*
Arsenious oxide, As_2O_3				
Zirconium oxide, ZrO				
Lead, Pb				
Copper, Cu				
Rare Earths: U	n.d.	n.d.	n.d.	*nil*
Y				
Th				
Ce				
	100·17			
F_2 = O	·55			
	99·62	99·93	100·18	99·81
Analyst	H. P. Rowledge	H. P. Rowledge	H. P. Rowledge	Th. Berghgren
Specific Gravity	6·34	7·41	7·08	5·735

* Meddelanden Fran Stockholms Miner. Inst. No. 100.
† Total 3A.

Remarks:

"B" appeared to be a mixture and was carefully hand-picked before analysis. The light grey pebbles were analysed, the darker grey and black being rejected.

"C" appeared to be a mixed lot of "A" and "B" with black patches occasionally seen. The most uniform pieces were taken for analysis but even these were impure. All yellow pieces were rejected.

Tin-tantalum concentrates from Greenbushes obtained from D.C. 97 and 99, and M.C. 1 were examined at the laboratory before being sent to the Eastern States for treatment. The presence of antimony tantalates in these concentrates created difficulties in obtaining a clean separation of cassiterite and tantalite fractions, tantalum being lost to the cassiterite fraction with a corresponding impure cassiterite resulting.

Mangano-columbite containing Nb_2O_5 48 per cent. and Ta_2O_5 34 per cent., was received from two and a half miles West of Gibraltar, and also from five miles from Pilgangoora on Tabba Station, containing Nb_2O_5 45 per cent., Ta_2O_5 37 per cent.

Assays were made of "tin concentrate" and "middlings," products of a parcel of tin ore from Kathleen Valley crushed at the Coolgardie State Battery.

NATURAL MINERAL PIGMENTS.

The marketing of prepared oxide pigments appears to be based mainly on the maintenance of an agreed standard of colour within fairly narrow limits, the pigments being sold under trade names such as "Flemish Red" and "Spanish Red." Oxide mined at Wilga Mia is mainly of a "Flemish Red" colour in its natural state. Some of the oxide mined in the Ophthalmia Ranges is of a true "Spanish Red," while some is browner, or more purplish, these latter being regarded as second grade oxides even though the chemical composition may be satisfactory. High iron oxide, low silica content and very fine grinding are other essential requirements.

A soft red rock was received from 65 miles North-East of Wyndham and West of Ninbing Station. It consisted of haematite with a little kaolin and limonite. Scattered through the rock were surface areas of micaceous haematite with a bright metallic lustre. The sample contained 80·63 per cent. of ferric oxide, Fe_2O_3 and 16·08 per cent. insoluble in acids. By suitable treatment to remove the small amount of micaceous haematite it should be possible to prepare an excellent grade of pigment of the "Spanish Red" type.

The high grade and bright red colour of the local red oxides from the Ophthalmia Range and elsewhere is such that there is likely to be little call for imported oxides and ochres in the future.

OTHER ECONOMIC MINERALS.

Asbestos.

A sample of crocidolite (blue asbestos) was submitted for heat treatment in an endeavour to determine its fusion point. Pieces of the fibrous portion of the rock and also separated fibre were slowly heated taking four hours to reach 900° C. and an additional half hour for each subsequent 50° C. No sharp fusion point was noted, some fibres showing vitrification at 900° C. much of it being fused at 950° C.

Actinolite asbestos of unusually soft and silky texture for this species was received from Bardoc.

Calcite.

Pieces of crystalline calcite from 35 miles South of Hammersley Homestead were too cloudy and flawed to be of any value for optical use, although further prospecting of this area for better quality material seems warranted.

Chalk and Marl.

Samples of chalk from Gingin and marl from Muchea and Bullsbrook forwarded by the Geological Survey Branch were analysed for lime, magnesia and siliceous material insoluble in acids.

Western Australia is the only State in the Commonwealth which possesses beds of chalk similar to the English chalk. The manufacture of whiting from certain deposits of chalk is an ancient occupation of the Southern counties of England, the whiting being greatly in demand because of its purity and freedom from gritty particles. Recently whiting made on a laboratory scale from Gingin chalk was compared with English whiting. Except for its darker colour, the putty made from the local chalk compared very favourably with the English product.

Beds of marl that have previously given encouraging results occur at Cannington and Rockingham. The Rockingham marl is said to give a very white and plastic putty. Both these deposits require further investigation.

Diatomaceous Earth.

A light grey powdery deposit from a lake near the coast South of Dongarra, received for examination from the Department of Agriculture, was found to be a diatomaceous earth of poor grade.

Dolomite.

Small tonnages of dolomite have been produced from the Mt. Magnet district for use in local foundries. Analysis of a representative sample from this area showed:—

	Dolomite Mt. Magnet P.A. 3048M. ½ mile South of townsite. %
Silica, SiO_2	2.87
Alumina, Al_2O_3	0.76
Ferric oxide, Fe_2O_3	0.57
Magnesia, MgO	19.46
Lime, CaO	30.36
Soda, Na_2O	0.19
Potash, K_2O	0.01
Water, H_2O, hygroscopic ..	0.43
Water, H_2O, combined ..	0.68
Titanium dioxide, TiO_2 ..	0.01
Carbon dioxide, CO_2 ..	44.95
Phosphoric oxide, P_2O_5 ..	trace
	100.29

Analyst: V. N. Young.

Fluorite.

A mineral specimen from 10 miles South of Yinnietharra consisted of fluorite with a thin coating of limonite.

Gypsum.

Gypsum crystals from Perenjori were dark coloured and intergrown with patches of clay soil. The soil could not be completely removed by crushing and washing, and the Plaster of Paris formed by calcining the washed material was far from the pure white required, and therefore valueless.

Heavy Sands.

Beach concentrates from Cheyne Beach East of Albany consisted of varying proportions of ilmenite, zircon, rutile and garnet. The ilmenite varied from 45 to 65 per cent., and the zircon from 15 to 35 per cent. Rutile was present in smaller quantities but one sample contained 15 per cent. It should be possible to prepare both zircon and ilmenite-rutile products from this deposit.

Limestone.

Samples of ground limestone for use as agricultural lime, and lime for stock and poultry purposes were received for analysis. The former contained 83.5 per cent. and the latter 83.3 per cent. of calcium carbonate. Dark grey material thought to be guano proved to be a siliceous limestone of no value.

Magnesite.

A sample of whitish material representing a sub-soil horizon on an ultra basic dyke about three miles East of Northam was forwarded by the Department of Agriculture. It was found to consist of earthy magnesite with a little opal.

Talc.

Talc samples were received from Bejoording via Toodyay and from one mile South of P.A. 1295, Kathleen Valley.

MICA.

Lepidolite.

Following its policy of amassing information on the State's mineral resources, a survey was made by the Mineral Laboratory of the lithium deposits in the Pilbara Goldfield. The lithium content of the Wodgina lepidolite, is rather low, the individual samples containing up to 2½ per cent. lithia. Lepidolite is found elsewhere in the Pilbara Goldfield, as also is spodumene, another lithium bearing mineral. The latter occurs in fair quantities in the vicinity of Pilgangoora and is of a grade similar to that at Ravensthorpe, the principal deposit in this State.

Appendix I gives a detailed account of the work.

Biotite.

Some work has already been done in Western Australia on the correlation of known mineral deficiencies with the soil developed on certain types of rocks, and during the year analyses were made of biotite mica from granite in three areas where sheep-breeding problems occur. More knowledge is required of the chemical composition of many of the common rock-forming minerals of the State. These analyses may assist in indicating what clay minerals may be expected as a result of weathering and some of the minor elements that may be expected to be present. The results of the three analyses are given below.

	Rosedale" near Williams. Loc. 1603.	Dattening, paddock south-west of homestead A. Watts.	Avondale Research Station, about 40 chs. south-west of homestead
	%	%	%
Silica, SiO_2	37·80	36·19	36·33
Alumina, Al_2O_3	15·26	16·67	14·86
Ferric oxide, Fe_2O_3	5·80	4·64	3·90
Ferrous oxide, FeO	14·92	15·86	17·40
Manganous oxide, MnO	0·18	0·36	1·10
Magnesia, MgO	8·18	8·70	9·29
Lime, CaO	1·70	1·14	1·00
Lithia, Li_2O	n.d.	n.d.	n.d.
Soda, Na_2O	0·76	1·08	0·30
Potash, K_2O	7·44	7·47	8·08
Titanium dioxide, TiO_2	3·08	2·70	2·45
Phosphoric oxide, P_2O_5	0·58	0·62	0·46
Carbon dioxide, CO_2	*nil*	*nil*	n.d.
Chromic oxide, Cr_2O_3	0·03	n.d.	n.d.
Vanadous oxide, V_2O_3	0·03	n.d.	n.d.
Iron sulphide, FeS_2	0·02	n.d.	n.d.
Barium oxide, BaO	*nil*	0·25	*nil*
Fluorine, F	0·31	0·27	0·21
Water, H_2O, hygroscopic	0·35	0·66	4·07
Water, H_2O, combined	3·54	3·76	
	99·98	100·37	99·45
$F_2 = O$	0·13	0·11	0·10
	99·85	100·26	99·35
Analyst	J. D. Hayton	V. N. Young	V. N. Young

GRANITE.

A sample of granitic rock (consisting of a mixture of gneissic granite and younger granite), outcropping at the Gnamma Hole, just north of the lake at Chandler was analysed in connection with an investigation of the origin of alunite at Chandler. The analytical results obtained were:—

	Granite Gnamma Hole North of Lake Chandler.
	%
Silica, SiO_2	74.00
Alumina, Al_2O_3	13.62
Ferric oxide, Fe_2O_3	0.65
Ferrous oxide, FeO	1.24
Manganous oxide, MnO	0.04
Magnesia, MgO	0.41
Lime, CaO	1.60
Titanium dioxide, TiO_2	0.32
Soda, Na_2O	3.88
Potash, K_2O	4.04
Phosphoric oxide, P_2O_5	0.02
Carbon dioxide, CO_2	0.01
Chromic oxide, Cr_2O_3	nil
Vanadic oxide, V_2O_5	nil
Water, H_2O, hygroscopic	0.05
Water, H_2O, combined	0.22
Total	100.10

Analyst: N. K. Jones.

INVESTIGATION INTO THE CAUSES OF THE DETERIORATION OF FIBROLITE PRESSURE PIPE.

Throughout the year investigation was carried on into the causes of failure of fibrolite pressure pipe in the Metropolitan Area.

About 150 samples of turnings were taken from pipes and 64 complete analyses and 67 partial analyses made. A technique for the visual detection of signs of incipient failure of pipe was developed, whereby a section of pipe was subjected to a solution of fluorescent dye under a pressure of approximately 100 lb. per square inch for several hours. After drying, sections were cut and the penetration of the dye noted under ultra-violet light.

Results of this investigation show that failure, except in isolated cases, is accompanied by loss of lime and gain in sulphate in the inner zone and by the appearance of radial cracks in the outer zone of the pipe.

Nineteen samples of pipe lifted from streets in which no bursts have occurred were examined by the dye penetration method and eight (42 per cent.) showed incipient failure. Analyses of turnings taken from the inner zone of three of the latter showed an increase of

sulphate in each case. Partial analyses were also made on samples of plant water and samples of fibrolite from Messrs. James Hardie's works at Rivervale.

In October Mr. C. R. LeMesurier, Research Chemist carrying out the investigation, visited the Eastern States in order to discuss the results so far obtained with cement authorities in Melbourne and Sydney and to study the behaviour of fibrolite pipe in service in these cities.

The opportunity was also taken to visit the works of the Southern Portland Cement Coy. at Berrina, New South Wales and the Australian Cement Coy., Geelong, Victoria, to study methods of plant control.

CLAY FROM BORES AT SITE OF PROPOSED NEW GOVERNMENT BUILDINGS.

During the year 1944, two bores were drilled for the Principal Architect's Branch to test the foundations on the proposed site of the new Government buildings.

Representative samples of clay beds encountered in the two bores were collected at approximately 2 feet intervals and forwarded to this laboratory by the Geological Survey Branch for physical tests and mineralogical examination. Work on these samples commenced during that year and has now been completed. All samples were dried at approximately 80°F, and the loss in weight determined. Samples from various depths in both bores were selected as representing the various types of clay encountered during the drilling. These samples were prepared for physical tests in accordance with A.S.T.M. Tentative Standard Methods D 421—38 T. The following tabulation gives the results obtained from those tests:—

Clay from No. 1 Bore, Government House Grounds.

Depth of Sample.	Discarded +40 mesh* material	On air-dry sample. Loss at 110°C.	Absolute specific gravity.	Lower Plastic Limit.	Lower Liquid Limit.	Shrinkage Limit.
ft. in. ft. in.	%	%				
16 0—17 0	14·99	0·69	2·617	15·69	20·82	14·34
19 0—19 6	5·05	6·67	2·688	23·34	85·01	8·17
25 6—26 0	0·46	2·10	2·684	17·25	54·38	14·02
58 3—59 0	0·22	5·02	2·637	26·51	95·17	8·50
95 0—95 6	*nil*	5·44	2·670	41·23	64·76	17·53

Clay from No. 2 Bore, Government House Grounds.

11 0—11 6	0·78	4·03	2·725	18·40	58·11	9·51
12 9—13 0	1·09	4·76	2·677	22·12	64·01	15·37
16 9—17 0	7·02	3·14	2·872	15·33	42·68	14·25
28 9—29 0	*nil*	6·87	2·703	28·48	108·87	16·06
36 6—36 9	*nil*	4·93	2·721	20·74	79·61	10·40
53 6—53 9	*nil*	6·36	2·662	29·50	99·16	10·19
58 9—59 0	*nil*	7·09	2·564	33·41	94·59	9·03
64 9—65 0	*nil*	5·61	2·701	35·88	64·43	17·40

* Size of screen opening 0·448m.m.

Determinations of grit and plasticity were also made on clay from the several beds encountered in sinking the No. 2 bore by the methods in use at this laboratory for the testing of clay for ceramic uses.

RESULTS OF TESTS.

	Depth of Sample.	Colour of Clay.	Grit. %	Plasticity (Ashley Figure).
Top Bed—				
Upper Portion	13 ft.	grey	42	152/200
	20 ft.	grey	21	239/300
Lower Portion	34 ft.	mottled red and grey	21	160/200
Middle Bed	49 ft.	grey	19	260/300
	54 ft.	grey	9	275/300
Bottom Bed	65 ft.	black, with shell fragments	2	173/200
	82 ft.	do.	0·5	
	100 ft	do.	20	

The grit consists mainly of quartz and felspar with some muscovite and chlorite. Both series of physical tests show these clays to be highly plastic. The main clay mineral present appears to be halloysite.

A small concentrate of heavy minerals was obtained from all samples. Mineralogical examination of these concentrates is set out in the following table, which lists the minerals recognised and their relative abundance:—

Clay Bed	Top Upper.		Top Lower.	Middle.		Bottom	
Depth of sample from surface (in feet)	13	20	34	49	54	65	100
Actinolite	s	s	s	s	s	p	p
Barite	–	–	s	–	–	–	–
Biotite	–	–	–	r	–	–	s
Chlorite	–	s	–	r	s	r	r
Clinozoisite	r	r	r	p	p	a	a
Corundum	r	–	–	–	–	–	–
Epidote	s	s	r	s	s	r	r
Glauconite	–	–	–	–	–	r	r
Hornblende	r	r	r	r	s	s	p
Hypersthene	r	–	–	–	–	–	–
Ilmenite	a	a	a	p	p	p	p
Kyanite	p	p	p	s	s	s	s
Leucoxene	p	p	p	s	s	–	–
Limonite	a	a	f	p	f	r	r
Magnetite	s	s	s	s	s	s	s
Muscovite	r	s	r	s	s	p	s
Pyrite	–	–	–	–	–	p	p
Rutile	s	s	r	r	r	r	r
Sillimanite	a	p	p	s	p	s	s
Spinel	r	r	–	–	–	–	–
Staurolite	r	r	s	r	r	–	r
Titanite	r	r	r	r	r	r	r
Tourmaline	r	r	s	r	s	–	r
Zircon	a	p	p	s	p	s	s
Diatoms	a	s	r	–	–	–	–
Foraminifera	–	–	–	–	–	p	p
Shell fragments	–	–	–	–	–	p	p
Sponge spicules	p	s	r	–	–	–	–

f = flood
a = abundant
p = plentiful
s = scarce
r = rare
– = not detected

NEW MINERAL RECORDS.

The following is a list of new localities for various minerals recorded at the laboratory during the year:—

Beryl, Londonderry, from a different locality; six miles West of McPhee's Government Well. BeO, 13.15%.

Clay, one mile North of Nannup, semi-ball clay.

Diatomaceous earth, South of Dongarra.

Fluorite, North-East of Nullagine.

Fuller's earth, Lake Biddy.

Graphite, graphitic rock from 23 miles North-East of Katanning on Nyabing Road, containing 6-7% graphite.

Ilmenite, North Greenbushes.

Limonite, lepidocrocite and maghemite, Broome Hill District.

Magnesite, earthy in soil, 4-5 miles east of Northam.

Ochre, West River, South-West of Ravensthorpe; 65 miles North-East of Wyndham, West of Ninbing Station.

Scheelite, Williams River, about seven miles from Hakea.

Stibiomicrolite, Greenbushes. In alluvial stibiotantalite concentrates from the Simpson collection. There is reason to suppose that this mineral may be present in concentrates from the vicinity of M.C.1, about a mile and a half South of Greenbushes.

Tantalite, on Tabba Station, five miles from Pilgangoora. Alluvial.

Tourmaline, 100 miles North of Hall's Creek; in quartz from near Deep River Bridge on Manjimup-Nornalup Road.

MISCELLANEOUS SAMPLES.

These included glauconite used by the American Navy for water treatment to be examined for trace metals; an efflorescence occurring on the ground at Carlton Station, Wyndham, which contained 47% of water soluble salts consisting mainly of carbonate and bicarbonate of sodium; meatmeals from Albany and Kalgoorlie; a clay soil from the bottom of a dam at Pingrup, which contained 1·27% of water soluble salts and had a reaction, pH of 2·35.

Other samples included chalk from Dandaragan greensand from Gingin, sillimanitic clays from the firebrick quarry at Clackline, sand from Crawley, copper deficient soil from Pardelup, and rocks from the Boyup Brook district.

Several rounded metallic looking nodules and irregular fragments of lateritic material were received from the Denmark district. It appeared that pyrite had partially replaced the original limonite producing an external bronzy appearance.

Black glassy fragments of Australites showing pits and depressions on their original surfaces were received from 200 miles North-East of Wiluna. These small lenticular bodies are composed of volcanic glass. Their origin is not quite clear but they are found all over Australia, and are thought to be meteorites.

Two pieces of black mineral submitted from Cooglegong proved to be rare earth minerals, one being gadolinite and the other hydroallanite.

The Allied Works Council forwarded three samples of concrete for determination of the cement content, determination to be made according to supplied specifications. Incomplete mixing of materials was thought to be causing unsatisfactory results.

Clear, pale green, glassy fragments found 20 miles East of Dongara, were received for examination as possible gem quality beryl or other gem mineral. These fragments were noted to have in many cases two parallel polished faces. The material proved to be a hard crown glass.

A sample of coarse grit from the bed of the Murchison River at Galena was forwarded by the Main Roads Department for examination for deleterious material which would affect its use in cement aggregate. It was proposed to use this grit in concrete for the construction of the new Geraldton-Northampton-Carnarvon Road Bridge over the Murchison River.

Sand from the Avon River at Northam was examined for salinity as it was proposed to use this sand in concrete.

Eight samples of galvanised iron pipe and two samples of corrosion products were submitted and examined in connection with the investigation of the extent of soil corrosion of buried pipe lines.

Also included amongst the miscellaneous samples examined were caustic limes for use at the State Batteries for compliance with specifications; beeswax for coating trays used in apple dehydration; deposits in vacreator at butter factory; leather; disinfectant; rabbit poisons; arsenical cattle dips; paints used in harbour extensions, pseudo-ambergris; identification of substance from shark; powellising solutions and a karri railway sleeper, which proved on analysis to have been treated with arsenic.

H. BOWLEY,
Government Mineralogist, Analyst and Chemist.
1st July, 1946.

APPENDIX I.

THE LITHIUM MINERALS OF THE WEST PILBARA GOLDFIELD.

By H. P. Rowledge, A.W.A.S.M., A.A.C.I.

The occurrence of the lithium minerals of the West Pilbara has been described briefly in the preliminary report published in the Annual Report of the Government Mineralogist, Analyst and Chemist, 1943, app. 1, pp. 16-17. The specimens collected have now been examined in detail and the results furnish and complete the information available with regard to the lithium minerals of this area.

LEPIDOLITE.

Wodgina.

Lepidolite occurs in several places in the Wodgina Hills namely, the North end of the main tantalite lode, the North extension of this lode and at West Wodgina. The chief of these from the point of view of size is the substantial deposit occurring at the North end of the main tantalite lode.

North End of Main Lode.—Specimens Nos. 1-5 were collected from an exposure in the North wall of an open cut on the East slope of a ridge over an area of 20 x 5 feet, No. 6 from a surface outcrop at the top of the rise 45 yards away and No. 7 from a surface outcrop on the West slope 35 yards further on. The whole body is interspersed irregularly with muscovite albite and quartz. The lepidolite is a dense compact fine scaly variety varying in colour from lilac, mottled dark grey and lilac to light violet. Some specimens are more compact and waxy looking than others with generally a lower lithia content.

No. 1.—A dense compact form, lilac in colour, collected from the top of the exposure in the opencut.

Lithia, Li_2O. 1.77%.
Optical Properties: Refractive Indices, Ng 1.57-1.58.
Np 1.53-1.54.
Biaxial, Negative, 2E. 65°40′.

No. 2.—A compact finely crystalline form, greyish lilac in colour, collected at centre of exposure.

Lithia, Li_2O: 2.60%.
Optical Properties: Refractive Indices, Ng 1.57-1.58.
Np 1.53-1.54.
Biaxial, Negative, 2E. 65°40′.

A microscopic examination of a section showed it to consist of finely crystallised plates and sheaves of uniform texture. No albite was seen and only one or two grains of quartz.

No. 3.—Soft crumbly finely crystalline material pale lilac in colour collected at the bottom near the junction with albite.

Lithia, Li_2O: 0.42%.

This specimen was largely contaminated with kaolinised albite and some greenish muscovite.

No. 4.—This specimen was more finely crystalline and compact than No. 2 and inclined to the waxy appearance of agalmatolite. It was pale lilac to grey in colour.

Lithia, Li_2O: 0.63%.

No. 5.—Similar to No. 4 and collected 8 feet away from Nos. 1-3 towards the entrance of the cut.

Lithia, Li_2O: 0.51%.

No. 6.—A compact finely crystalline form, lilac to greenish grey in colour collected from surface outcrop at top of rise.

Lithia, Li_2O: 2.47%.
Potash, K_2O: 8.04%.
Soda, Na_2O: 1.70%.
Optical Properties: Refractive Indices, Ng 1.58-1.59.
Np 1.54-1.55.
Biaxial, Negative.

A microscopic examination of a section showed it to be similar to No. 2 in its main mass but enclosing some larger plates and sheaves and occasional fragments of albite.

No. 7.—Similar in appearance and texture to No. 2 and collected from a surface outcrop on West slope of the rise.

Lithia, Li_2O: 1.22%.
Potash, K_2O: 8.62%.
Soda, Na_2O: 2.57%.

The lithia content of this deposit varies considerably. The highest values 2·60 per cent. and 2·47 per cent. were obtained on the lilac and more scaly varieties. The more compact pale lilac ones all contained less than 0·7 per cent. and were shown to be contaminated with altering albite and muscovite. There appeared to be considerable amounts of this material. Interspersed throughout the deposit is partly altered albite, muscovite and quartz. The soda values indicate the presence of albite intimately associated with the mica and this was confirmed in an optical examination of a section prepared from No. 6. The determination of the maximum and minimum refractive indices show that Ng is that of the highest figure given for muscovite and Np the lowest figure given for lepidolite. It would thus seem that the whole deposit consists of a mixture of muscovite and lepidolite in varying proportions interspersed with albite quartz and muscovite.

The lithia content is too low and the composition of the whole deposit too variable to be of much value.

The maximum molecular ratio of $Li_2O : K_2O$ in the cleanest specimen No. 6 is 1 : 1·03.

North Extension.

An outcrop of lepidolite occurs on the West slope of a ridge underneath a bold quartz escarpment a mile or two North of the main lode. A specimen, No. 36, collected from this outcrop consisted of an intimate mixture of about equal quantities of greenish quartz and small flakes of lilac coloured lepidolite. A determination of the alkalies in this rock gave the following results:—

Lithia, Li_2O 2.17%
Potash, K_2O 6.74%
Soda, Na_2O 0.75%

Optical properties of the lepidolite—
Refractive Indices, Ng 1·58—1·59.
Np 1·55—1·56.
Biaxial, Negative, 2E approx. 70°.

The molecular ratio of $Li_2O : K_2O$ is 1 : 0·98 which is slightly higher but close to that of the best specimen from the main Wodgina lode.

West Wodgina.

Specimens No. 69 of well crystallised lilac tinted mica in long slender prismatic books in quartz were collected on the West slopes of the Wodgina Hills near the Government well and an old peg M.C. 143. It was in the form of slightly tapered radiating individuals and aggregates of rough six sided prisms up to half an inch in diameter and one inch in length.

Lithia, Li_2O 0.38%
Potash, K_2O 10.31%
Soda, Na_2O 0.94%

Optical properties—
Refractive Indices, Ng 1·58—1·59.
Np 1·54—1·55.
Biaxial, Negative, 2E 69° 12′.

The molecular ratio of $Li_2O : K_2O$ was extremely low in this specimen and it could not be classed as a lepidolite.

Pilgangoora.

Specimen No. 20. The lepidolite referred to in the preliminary report proved, on further examination, to be lilac tinted muscovite carrying small amounts of lithia intimately associated with kaolinised albite.

Lithia, Li_2O 0.18%

Optical properties—
Refractive Indices, Ng 1·58—1·59.
Np 1·55—1·56.
Biaxial, Negative, 2E approx. 70°.

Tabba Tabba.

Specimen No. 52 of curved lepidolite was obtained from a dump at the top of the rise of the tantalite workings. It occurred as slender radiating crystals intergrown with quartz and albite, lilac tinted and pearly grey in colour with curved basal plates.

Lithia, Li_2O 2.18%
Potash, K_2O 9.36%
Soda, Na_2O 1.04%

Optical properties—
Refractive Indices, Ng 1·58—1·59.
Np 1·55—1·56.
Biaxial, Negative, 2E 70° 38′.

The molecular ratio of $Li_2O : K_2O$ is 1: 1.36 which is lower than that of the cleanest specimen from the Wodgina district.

Specimen No. 67 was obtained from the dump at the tin workings on the S.E. slope on the other side of the hill from the tantalite workings. It occurred as pale lilac radiating slender prismatic crystals up to three-quarters of an inch in cross section intergrown with albite and quartz. Some of the plates are distinctly curved and occur in botryoidal masses.

Lithia, Li_2O 2.50%
Potash, K_2O 10.08%
Soda, Na_2O 0.94%

Optical properties—
Refractive Indices, Ng 1·58—1·59.
Np 1·55—1·56.
Biaxial, Negative, 2E 70° 38′.

The molecular ratio of $Li_2O : K_2O$ is 1 : 1·27 which is close to specimen No. 52.

There did not appear to be any considerable amounts of lepidolite at either of these occurrences.

Strelley.

Specimen No. 60 was collected from dense hard compact lilac tinted rock outcropping intermittently along the lode at the tantalite workings. It contained only traces of lithia with 4·31 per cent. potash, K_2O, and 0·23 per cent. soda, Na_2O.

A microscopic examination of a section showed it to be silicified consisting of sub-angular fragments of quartz in more or less parallel bands interspersed with muscovite.

SPODUMENE.

Wodgina.

No specimens of spodumene were collected at the main tantalite workings. Specimens however, were collected from the Terra Nova lease No. 93, in the hills South of the main workings and No. 80, in very rugged country further South and just South of the Mt. Cassiterite tin mine.

No. 80 occurred as very thin broad grey coloured plates showing two distinct cleavages lying and frozen to the quartz at all angles. A little tantalite was associated with it.

Lithia, Li_2O 6.50%
Potash, K_2O 0.43%
Soda, Na_2O 0.58%

Optical properties—
Refractive Indices, Ng 1.67.
Np 1.65 close.
Maximum Extinction angle 38.5°.

No. 93 occurred as grey coloured broad plates thicker than No. 80 up to half an inch associated with and frozen to the quartz. It was partly altered.

Lithia, Li_2O 7.46%
Potash, K_2O 0.31%
Soda, Na_2O 0.33%

Optical properties—
Refractive Indices, Ng 1.67 close.
Np 1.65 close.
Maximum Extinction angle 39°.

Both these specimens differ from the spodumene described later from Pilgangoora inasmuch that they have a much larger Maximum Extinction Angle and lower Refractive Indices.

Pilgangoora.

Specimen No 23 was collected from beneath the surface in a pot hole at Gilbert and Houston's show. It occurred as pearly grey well cleaved columnar bands ⅜" x 1" in cross section associated with tantalite in partly altered albite.

Lithia, Li_2O 6.52%
Potash, K_2O 0.04%
Soda, Na_2O 0.59%

Optical Properties—

Refractive Indices, Ng 1.680 close.
Np 1.662.

It showed signs of alteration along the cleavage planes. Maximum Extinction angle 25°.

Specimen No. 26 was collected from the dump at the entrance of the Mt. York tin mine. It occurred as large broad plates of varying thickness up to half an inch associated with albite quartz and cassiterite. The largest plate observed was 4" x 3" x ½". It is pearly grey in colour with two pronounced cleavages. Well developed crystals of cassiterite were seen in the spodumene and at the junction of the spodumene and albite.

Lithia, Li_2O 7.35%
Potash, K_2O 0.24%
Soda, Na_2O 0.94%

Optical properties—

Refractive Indices, Ng 1.67—1.68.
Np 1.65—1.67.
Maximum Extinction angle 26°.

A miscroscopic examination of the crushed grains showed considerable alteration with lower Refractive Indices.

Surface indications point to the fact that the distribution of spodumene may be considerable in this area.

APPENDIX II.—APPLE SURVEY.

H. PRICE, KARRAGULLEN.

Variety	Dunns Seedlings.									
Lab. No.	993	996	1178	1323	1335	1409	1670	1688	1753	1851
Date of picking	19–2–45	26–2–45	5–3–45	12–3–45	19–3–45	26–3–45	2–4–45	9–4–45	16–4–45	23–4–45
Quantity of juice % Vol./weight	39	37	42·8	58·8	43	43	44	45	45	47·3
Specific Gravity °Brix	12·3	14·2	15·4	9·9	16·5	15·6	18·1	17·1	16·5	16·6
Sugar (as invert sugar) % w/w	9·8	11·5	11·4	11·3	14·0	12·9	15·7	14·4	14·5	14·5
Acidity. Titratable acidity. As malic acid % w/w	0·9	0·9	0·86	0·86	0·8	0·7	0·67	0·73	0·70	0·6
Reaction. pH	3·33	3·33	3·38	3·34	3·48	3·47	3·44	3·39	3·49	3·40
Astringency (tannin) % w/w	0·048	0·058	0·05	0·06	0·077	0·073	0·095	0·097	0·091	0·078
Starch (qualitative)	Much	Much (1 fruit trace)	Moderate to much	Trace	Medium amount	Medium amount	Trace to medium	Trace to medium	Trace to medium	Trace

PARKE BROS., DONNYBROOK.

Variety	Dunns Seedlings.				Cleopatra.			
Lab. No.	999	1093	1199	1326	1001	1094	1201	1328
Date of picking	19–2–45	26–2–45	5–3–45	12–3–45	19–2–45	26–2–45	5–3–45	12–3–45
Quantity of juice % Vol./weight	46	44·1	43·3	42·8	54	54·5	55·9	56·2
Specific Gravity °Brix	13·3	13·3	14·0	12·1	13·5	14·2	12·1	12·3
Sugar (as invert sugar) % w/w	11·4	10·8	12·2	9·9	11·6	11·3	11·2	11·0
Acidity. Titratable acidity. As malic acid % w/w	0·8	0·71	0·60	0·74	0·6	0·56	0·56	0·59
Reaction. pH	3·30	3·79	3·44	3·31	3·27	3·57	3·34	3·30
Astringency (tannin) % w/w	0·043	0·04	0·05	0·05	0·049	0·04	0·05	0·05
Starch (qualitative)	Much	Moderate	Medium	Medium	Medium to much	Moderate	Trace	Medium

H. PRICE, KARRAGULLEN.

Variety	Cleopatra.									
Lab. No.	995	998	1179	1325	1337	1410	1671	1689	1754	1852
Date of picking	19–2–45	26–2–45	5–3–45	12–3–45	19–3–45	26–3–45	2–4–45	9–4–45	16–4–45	23–4–45
Quantity of juice % Vol./weight	52	58	58·2	42·5	50	59	57	60	56	75·8
Specific Gravity °Brix	10·9	11·2	11·9	13·5	12·3	12·3	12·7	12·4	12·7	12·2
Sugar (as invert sugar) % w/w	9·2	9·8	9·2	8·9	11·0	11·2	11·7	10·9	11·5	11·5
Acidity. Titratable acidity. As malic acid % w/w	0·6	0·6	0·55	0·55	0·5	0·5	0·40	0·47	0·37	0·4
Reaction. pH	3·21	3·21	3·22	3·26	3·46	3·40	3·43	3·46	3·54	3·46
Astringency (tannin) % w/w	0·042	0·045	0·03	0·03	0·044	0·053	0·061	0·039	0·067	0·057
Starch (qualitative)	Medium to much	Medium to much	Moderate	Medium	Trace	Trace	Trace	Trace	Trace	Faint trace

H. PRICE, KARRAGULLEN. PARKE BROS., DONNYBROOK.

Variety	Jonathan.					Jonathan.			
Lab. No.	994	997	1180	1324	1336	1000	1095	1200	1327
Date of picking	19-2-45	26-2-45	5-3-45	12-3-45	19-3-45	19-2-45	26-2-45	5-3-45	12-3-45
Quantity of juice % Vol./weight	53	45	58·8	55·5	56	50	52·9	49·5	54·6
Specific Gravity °Brix	12·3	13·0	12·6	11·2	12·6	14·7	15·4	14·2	13·0
Sugar (as invert sugar) % w/w	10·8	11·6	10·1	10·2	11·3	13·6	12·8	12·2	12·5
Acidity. Titratable acidity. As malic acid % w/w	0·6	0·5	0·59	0·55	0·4	0·6	0·52	0·53	0·53
Reaction, pH	3·33	3 43	3·25	3·35	3·62	3·40	4·02	3·45	3·37
Astringency (tannin) % w/w	0·032	0·039	0·02	0·04	0·051	0·043	0·04	0·06	0·05
Starch (qualitative)	Trace to medium amount	Trace	Trace	Trace	Very faint trace	Medium amount	Trace	Nil	Trace

H. PRICE, KARRAGULLEN.

Variety	Granny Smith.									
Lab. No.	1672	1690	1755	1853	2002	2343	2345	2599	2601	2672
Date of picking	2-4-45	9-4-45	16-4-45	23-4-45	30-4-45	7-5-45	14-5-45	21-5-45	28-5-45	4-6-45
Quantity of juice % Vol./weight	59	63	63	66·4	65	63	64	68	65	61
Specific Gravity °Brix	11·0	11·3	10·5	11·2	11·2	11·0	11·0	10·2	10·8	14·2
Sugar (as invert sugar) % w/w	9·8	9·6	9·4	9·9	10·0	9·9	9·8	10·1	9·8	13·1
Acidity. Titratable acidity. As malic acid % w/w	0·53	0·51	0·45	0·4	0·4	0·4	0·4	0·4	0·4	0·4
Reaction, pH	3·37	3·36	3·51	3·44	3·54	3·47	3·54	3·54	3·46	3·68
Astringency (tannin) % w/w	0·040	0·050	0·055	0·047	0·052	0·039	0·042	0·039	0·044	0·064
Starch (qualitative)	Trace	Trace	Trace	Very faint trace	Very faint trace	Faint trace	Very faint trace	Nil	Very faint trace	Nil

H. PRICE, KARRAGULLEN.

Variety	Yates.						
Lab. No.	1860	2003	2344	2346	2600	2602	2673
Date of picking	23-4-45	30-4-45	7-5-45	14-5-45	21-5-45	28-5-45	4-6-45
Quantity of juice % Vol./weight	61·1	60	61	61	59	60	58
Specific Gravity °Brix	13·6	13·0	14·3	13·8	13·0	14·5	14·4
Sugar (as invert sugar) % w/w	12·1	12·4	12·4	12·1	11·9	12·9	12·8
Acidity. Titratable acidity. As malic acid % w/w	0·5	0·5	0·5	0·5	0·5	0·5	0·4
Reaction, pH	3·46	3·67	3·52	3·52	3·58	3·50	3·67
Astringency (tannin) % w/w	0·036	0·024	0·031	0·031	0·014	0·020	0·025
Starch (qualitative)	Trace to medium	Trace	Trace to medium	Trace to medium	Trace	Trace	Trace

APPENDIX III.—CARROT SURVEY.

Variety	Early Nantes.		Nantes.	Sutton's Champion Scarlet Horn.			Sutton's Favourite.			Johnson's Maincrop Stunted Rooted.			Champion Type Own Selection.		Champion Red Inter-mediate	Impera-tor.	Red Cored Chantenay.
Grower	E. J. Gibbs	K. Lulich.	J. Arbuckle	E. J. Gibbs	K. Lulich.	J. Arbuckle	E. J. Gibbs	K. Lulich.	J. Arbuckle	E. J. Gibbs	K. Lulich.	J. Arbuckle	E. J. Gibbs	K. Lulich.	....	J. Arbuckle	....
District	Wanneroo	Osborne Park	Balcatta	Wanneroo	Osborne Park	Balcatta	Wanneroo	Osborne Park	Balcatta	Wanneroo	Osborne Park	Balcatta	Wanneroo	Osborne Park	....	Balcatta	....
Date Received	29-6-45	29-6-45	5-9-45	29-6-45	29-6-45	5-9-45	29-6-45	29-6-45	5-9-45	29-6-45	29-6-45	5-9-45	29-6-45	29-6-45	....	5-9-45	....
Number of Carrots	8	6	10	5	6	10	7	7	10	6	6	10	5	6	10	10	10
Weight of tubers (ounces avoirdupois)	46	27	27	43	28	24	50	20	27	52	28	29	68	33	74	75	48
Average weight per tuber (ounces avoirdupois)	5·8	4·5	2·7	8·6	4·7	2·4	7·1	2·9	2·7	8·7	4·7	2·9	13·6	5·5	7·4	7·5	4·8
Visual Examination of Cores (approx. per cent.)—																	
Deep	65	10	....	80	70	30	70	40	50	70	50	30	20	50	....	40	....
Medium	35	90	40	20	30	70	20	40	50	30	50	50	40	35	50	40	70
Pale	....	....	60	....	....	....	10	20	....	....	....	20	40	15	50	20	30
Moisture, per cent. (5 hours with sand at 98–100°C.)	88·7	88·2	91·3	87·9	88·0	90·5	88·3	87·3	89·6	89·2	88·4	90·5	90·6	89·6	90·2	90·7	91·3
Carotene—																	
Parts per million	96	86	54	91	93	72	101	99	76	83	103	101	107	70	93	45	84
Mgm. per 100 gram.	9·6	8·6	5·4	9·1	9·3	7·2	10·1	9·9	7·6	8·3	10·3	10·1	10·7	7·0	9·3	4·5	8·4
Carotene—																	
On Moisture Free Sample :																	
Parts per million	850	729	621	752	775	758	863	780	731	769	888	1,063	1,138	673	949	484	966
Mgm. per 100 gram	85·0	72·9	62·1	75·2	77·5	75·8	86·3	78·0	73·1	76·9	88·8	106·3	113·8	67·3	94·9	48·4	96·6

TABLE 1.

AGRICULTURE, FORESTRY, AND WATER SUPPLIES SECTION.

Source and Description of Samples Received during 1945.

	Department of Agriculture.	Department of Works and Labour.	Public Health Department.	Department of Industrial Development.	Departmental (Government Mineralogist and Analyst).	Fisheries Department.	Education Department.	Prisons Department.	Government Geologist.	Free.	Pipe Investigation Committee.	Pay Public.	Royal Australian Air Force.	Allied Works Council.	United States Navy.	Royal Navy.	Royal Australian Navy.	Department of the Army.	Forests Department.	University of Western Australia.	Main Roads Board.	Local Government Bodies.	Total.
Samples Received	610	224	4	1	2	9	2	1	2	3	302	581	2	5	323	5	3	1	33	4	7	2	2,126
Water	29	219	4	1	1	9	2	1	2	3	10	534	2	5	2	4	3	1	2	4	7	2	847
Electrolyte	....	....	....	....	....	....	....	....	....	....	....	....	....	....	182	....	....	....	....	....	....	....	182
Battery Water	....	....	....	....	....	....	....	....	....	....	....	....	....	....	137	1	....	....	....	....	....	....	138
Fodders—																							
Pastures	359	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	359
Sub-clover	33	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	33
Meatmeal	1	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	3
Soils—																							
Farm Soils	35	....	....	....	....	....	....	....	....	....	....	12	....	....	....	....	....	....	31	....	....	....	78
Soil from Excavated Tank	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Mud	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Soils from Pipelines	....	....	....	....	....	....	....	....	....	....	292	....	....	....	....	....	....	....	....	....	....	....	292
Grain and Cereals—																							
Wheat	19	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	19
Flour	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Oats	9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9
Field Peas	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fruits—																							
Vine Leaves	32	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	32
Pear Tree Leaves	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Apple Leaves	18	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18
Vegetables—																							
Tomato Leaves	38	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	38
Cauliflower Plants	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8
Potato Leaves	10	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Fertilisers—																							
Fertiliser	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Rape Seed Meal	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Fowl Manure	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Army Boots	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Flax	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Salt (natural)	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tannin Extract	....	....	....	....	....	....	....	....	....	....	....	31	....	....	....	....	....	....	....	....	....	....	31
Outcrop Material	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Efflorescence	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Glauconite	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Silver Nitrate Solution	....	1	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	1
Solution	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1

TABLE 2.

FOODS, DRUGS AND TOXICOLOGY SECTION.

Source and Description of Samples received during 1945.

	Department of Public Health.	Police and Coroner.	Police—Criminal Investigation Branch.	Police—Liquor Inspection Branch.	Government Stores Department and Tender Board.	Department of Agriculture.	Department of Industrial Development	Hospital.	Chief Inspector of Factories.	Metropolitan Water Supply, Sewerage and Drainage Department.	State Mining Engineer.	Under Secretary for Mines.	Superintendent of State Batteries.	Department of Works and Labour.	Prisons Department.	Fisheries Department.	Departmental (Government Mineralogist, Analyst and Chemist.	Free.	Pay—Public.	Pay—Forests Department.	Pay—Under Treasurer.	Pay—State Insurance Department.	Pay—Repatriation Department.	Pay—Childrens' Hospital.	Pay—Local Governing Bodies.	Pay—State Sawmills.	Pay—Western Australian Government Railways.	Pay—Aeronautical Inspection Directorate.	Pay—United States Navy.	Pay—Royal Navy.	Pay.—Department of the Army	Total.
Samples received	87	68	30	36	13	246	12	21	3	1321	6	33	4	3	1	1	264	7	23	1	1	1	1	1	3	2	32	20	167	2	33	2,443
Foods—																																
Cows' Milk—Inspectional	48	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	51
Butter	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Honey	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Shelled Peas	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Sausage Casings	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Raisins	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Cabbage	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Tinned Rabbit	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Human Milk	20	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Liquors, Beverages, etc.	....	....	....	36	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	20
Cows' Milk—Investigational	....	....	....	....	....	40	....	....	....	....	....	....	....	....	....	....	264	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36
Vegetables—Investigational	....	....	....	....	....	26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	304
Fruit—Investigational	....	....	....	....	....	54	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26
Miscellaneous Work on Agricultural Products—																																54
Linseed	....	....	....	....	....	89	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	89
Insecticides	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	5
D.D.T. Preparations	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Pyrethrum Flowers and Extract	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Sheep Infertility Investigation	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Drugs and Medicines—																																
Ether and Anaesthetics	....	5	2	....	10	....	....	15	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	33
"Kali Phos"	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Toxicology—																																
Human Poisoning Cases	4	63	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1	....	....	71
Animal Poisoning	....	....	10	....	....	7	....	....	....	....	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	20
Cattle Dip	....	....	....	....	....	13	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13
Criminal Investigations	....	....	18	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18
Tea and Sugar	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	19	19
Industrial Hygiene and Products—																																
Urine	7	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	1	1	....	....	....	31	....	....	....	....	42
Wood and Preserving Fluid	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Can Lacquer	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Respirator Canister	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Air from Coal Mines	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
Gas from Collie Coal	....	....	....	....	....	....	9	....	....	....	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
																																9

Sewage—																																
Treatment Control—Weekly	....	....	....	....	....	....	....	....	....	1026	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,026
Treatment Control—Quarterly	....	....	....	....	....	....	....	....	....	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Beach Surveys	....	....	....	....	....	....	....	....	....	96	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	96
Investigational	....	....	....	....	....	....	....	....	....	120	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	120
Trade Wastes	....	....	....	....	....	....	2	....	....	9	....	33	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44
Effluent	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	1
Water—																																
Partial and Complete Mineral Analyses	....	....	....	....	....	....	....	4	....	64	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	68
Poisoned	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Oils—																																
Lubricating	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	5	....	....	....	....	....	....	....	....	....	164	....	8	178
Putative Petroleum	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	1	....	....	....	....	....	....	....	....	....	....	....	....	6
Petrol	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Wood and Wood Products—																																
Karri Sleeper	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1
Powellising Fluid	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	2
Karri Extract	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Work for Australian and Allied Services—																																
Army Petrol	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6	6
Wood Wool	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Sitka Spruce	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	....	....	....	7
Wood and Borings	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	2
Amyl Acetate	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Casein Glue	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	2
Material from Fuel Tank	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Solution and Alloy	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	2
Powder Residue	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	1
Blue Cloth	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5	....	....	....	5
Miscellaneous—																																
Lime	....	....	....	....	3	....	....	....	....	....	....	....	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7
Leather	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	2
Tallow	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Beeswax	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Deposits—Vacreator	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Deposits—Ship's Condenser	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Substance from Shark's Stomach	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Pseudo Ambergris	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Disinfectant	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Apple Juice Can	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Rabbit Poison	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Bitulynd Pipe	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Paint	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Hydrometers	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	2

TABLE 3.

MINERALOGY, MINERAL TECHNOLOGY, AND GEOCHEMISTRY SECTION.

Source and description of samples received during 1945.

	Pay.	Free.	Department of Mines.						Department of Industrial Development.	Department of Agriculture.	Department of Works and Labour.	Pipe Investigation Committee.	Prisons Department.	Pay—Commonwealth Minerals Production.	Ministry of Munitions.	Aeronautical Inspection Directorate.	Department of the Navy.	Main Roads Department.	Allied Works Council.	Total.
			State Batteries.	Government Chemical Laboratories.	Under Secretary for Mines.	State Mining Engineer.	Geological Survey.	Explosives.												
Samples Received	58	158	41	23	2	85	78	1	4	3	9	214	1	6	4	11	5	1	3	707
Abrasives—																				
Clay		1														1				1
Garnet		1																		1
Silt (siliceous)		1																		1
Alloys and Metals—																				
Brass Cartridge Cases															4					4
Chromium Plated Steel																1				1
Metal Coated Steel																3				3
Metal for Spot Test																3				3
Metallic Iron		1																		1
Metal Piston Part																1				1
Osmiridium					1															1
Stellite Surfaced Metal																1				1
Steel Tube																1				1
Stainless Steel Tube											5									5
Welding Rod											1									1
Flux for Stainless Steel											1									1
White Metal	1												1				5			7
Ceramics (including Refractories)—																				
Clay		1					1	1			1									4
Clays—Miscellaneous		4																		4
Yellow Clay		1																		1
Fuels—																				
Brown Coal	1																			1
Charcoal	4																			4
Coal						76														76
Hydrous Oil Shale		1			1															2
Metallic Ores—																				
Bismuth		1																		1
Beryllium	5	4					5							2						16
Copper	3	6																		9
Gold Ore	12	39																		51
Gold Tailings	1		12																	13
Gold Tailings—Umpire	3		27																	30
Gold Slag	2																			2
Gold Concentrate							1													1
Gibbsite		1																		1
Iron Ore		13						1												14
Iron Sulphide Ore							11													11
Lithium				17		1														18
Niobium	1	3				1														5
Platinum		1																		1
Silver		2																		2
Tellurium	2																			2
Tantalite concentrate	1													4						5
Tantalum Ore		2																		2
Tin/Tantalum Ore	3																			3
Tin Ore	2		1																	3
Tin/Columbite Concentrate		2																		2
Titanium/Iron Ore		3																		3
Tin/Tantalite Concentrate	2	1				4														7
Tin Concentrate			1																	1
Tungsten		3																		3
Minerals and Rocks for Complete Analysis—																				
Rock				1																1
Biotite				3																3
Natural Mineral Pigments—																				
Iron Oxide	1																			1
Red Oxides and Ochres	3	2																		5
Other Economic Minerals—																				
Asbestos		1				1														2
Barite		1																		1
Calcite (Crystalline)		1																		1
Chalk and Marl							28													28
Clay—Bentonitic		1					2													3
Dolomite		4																		4
Diatomaceous Earth										1										1
Felspar	1	2				1														4
Fluorite	1																			1
Gypsum	1	1																		2
Graphite		3					1													4
Heavy Sand		8																		8
Kyanite				1																1
Limestone	3	1																		4
Magnesite										1										1
Mica		3					1													4
Opal		1																		1
Petalite							1													1
Rare Earth Minerals		1																		1
Talc		4																		4
Tourmaline		8					1													9
Vermiculite	2	1																		3
Miscellaneous—																				
Galvanised Pipe												8								8
Pipe Corrosion Products												2								2
Fibrolite Pipes												177								177
Cement and Concrete												3							3	6
Fibrolite												10								10
Fibrolite Briquettes												4								4
Plant Water												10								10
Salt Crust	1																			1
Quartz and Chalcedony		8				1	16			1										26
Efflorescence		1																		1
Sand		2							3		1							1		7
Rocks—Miscellaneous		4																		4
Glass Fragments		1																		1
Whiting				1																1
Australite		1																		1
Unclassified Determinations	2	7					10													19

TABLE 4.

SOIL MINERALOGY SECTION.

Source and description of samples received during 1945.

	Government Mineralogist, Analyst and Chemist.	Department of Agriculture.	Chief Inspector of Factories.	Free.	Total.
Samples received	65	209	1	1	276
Soils—					
Kimberley	...	21	...	...	21
Pardelup	1	...	...	...	1
Blackwood River District	...	25	...	...	25
Sheep Breeding Problems	...	126	...	...	126
Pituri Sites	...	15	...	...	15
Grits—					
Chandler	32	...	...	...	32
Laterite—	8	10	...	...	18
Sands—					
Factory Sand	...	...	1	...	1
Soil Erosion	3	12	...	...	15
Crawley	1	...	...	...	1
Rocks—					
Sandstone—Kimberley	9	...	...	...	9
Sandstone—Collie	2	...	...	...	2
Chalk—Dandaragan	2	...	...	...	2
Greensand—Gingin	1	...	...	...	1
Granite, etc., ...	3	...	...	...	3
Clay, sillimanitic	3	...	...	1	4

Division VIII.

Annual Report of the Chief Inspector of Explosives For the Year 1945.

The Under Secretary for Mines:

I have the honour to submit for the information of the Honourable Minister for Mines, in compliance with Section 45 of The Explosives Act, 1895, my report on the working of the Branch for the year 1945.

The quantity of explosives imported into the State during the year is shown in Table No. 1, and Table No. 2 gives a comparison of the quantities imported during the past five years.

TABLE No. 1.

Importation of explosives into Western Australia during 1945.

		lbs.
Gelignite	.. .. ..	1,634,850
Gelatine Dynamite	.. ..	235,300
Permitted Explosives	..	945,250
Blasting Powder	.. ..	15,000
Total	.. .. ..	2,830,400
Detonators:	Number ..	1,814,000
Fuse:	Yards ..	3,864,800

TABLE No. 2.

Explosives.	1941.	1942.	1943.	1944.	1945.
	lb.	lb.	lb.	lb.	lb.
Gelignite	5,131,650	2,219,900	2,230,800	1,481,500	1,634,850
Gelatine Dynamite	902,540	60,750	139,850	154,800	235,300
Permitted Explosives	239,800	115,500	265,900	160,000	945,250
Powder (Blasting and Pellet)	32,450	23,950	67,500	11,150	15,000
Detonators No.	2,970,000	1,740,000	1,933,000	1,300,000	1,814,000
Fuse .... Yards	7,044,000	2,822,400	3,861,600	1,864,800	3,768,000

The quantity of explosives used in the different classes of industry during the years 1944 and 1945 is given hereunder:—

	1944 lbs. used	1945 lbs. used
Gold Mining	2,044,150	2,212,550
Coal Mining	175,750	226,300
Agriculture	7,750	8,500
Quarrying	50,200	62,550
Mining and base metals	46,050	142,250
Government Departments	39,700	40,000
Miscellaneous	17,850	11,800
	2,381,450	2,703,950

The following tests were made during the year for the purpose of determining the suitability for use, and the chemical stability of explosives:—

Explosives	1,124
Fuse	255

The following table shows the number of Licenses issued during the year:—

Magazines on Government Reserves	16
Magazines used by Government Departments and on private property	89
Store Licenses, Mode A	70
Fireworks Licenses	nil
Importation Licenses	2

During the year inspections were made of licensed premises and inquiries made with a view of ascertaining whether the requirements of the Act and Regulations were being complied with. As a result of these inspections and inquiries it was found necessary to have the undermentioned explosives destroyed:—

Date.	Place.	Kind and Quantity.	Reason for destruction.
1–6–45	Rockingham	Gelignite—15 lbs.	Owing to having absorbed moisture.
6–45	Wodgina	Monobel—875 lbs. Gelignite—285 lbs.	Owing to having been damaged by water.
29–7–45	Bayswater	Gelignite—4 lbs.	Owing to chemical deterioration.
7–45	Rockingham	Gelignite—5 lbs. .... Detonators—100	Confiscated by Security Service under conviction.
6–8–45	Canning Bridge	Detonators—3	Found in rubbish tip.
7–45	South Perth	Detonators No. 6—16	Found on foreshore near Mends Street.

During the period the Empire was at war, mining activities throughout the State diminished considerably with the result that the importation of explosives was very much reduced to what it was in pre-war years. With the cessation of hostilities, which will lead to the rehabilitation of mining, importation should go up very considerably and it will not be at all surprising if, in a year or two's time the quantity of explosives required in this State will be even greater than the peak period of 1940.

During the war period a very large part of the time of the entire staff of the branch was taken up in connection with the administration of the National Security Regulations governing explosives. With the cancellation of these Regulations, which, I think, will be in the near future, we will return to normal activity. These Regulations placed restrictions on everyone connected with storage, sale and use of explosives, but it is very gratifying to note the whole-hearted co-operation the Department received from everybody concerned. This co-operation made the control efficient, and administration simple and my thanks are due to everybody concerned for the consideration and help they gave.

T. N. KIRTON,
Chief Inspector of Explosives.

27th March, 1946.

Division IX.

Report of the Chairman, Miner's Phthisis Board, and Superintendent, Mine Workers' Relief Act.

Under Secretary for Mines:

I have the honour to submit, for the information of the Hon. Minister for Mines, my report on this Branch of the Mines Department for the Year, 1945.

Under arrangements similar to previous years, the Commonwealth Health Department continued the periodical examination of mine workers, the work being continuously carried on 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, Phillips River and West Kimberley, which are all remote and contain very few mine workers.

MINE WORKERS' RELIEF ACT.

Examinations under the Mine Workers' Relief Act during the year totalled 3,334 compared with 4,468 for the previous year, the reduced number being mainly due to the fact that the Mobile Unit did not visit any centre more than once during the year.

The results of the examinations for 1945 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 explanation of these figures, I desire to make the following comments:—

Normal, etc.—These number 3,071 or 92.16 per cent. of the men examined, and include men having first class lives or suffering from pneumoconiosis only—the figure for the previous year was 91.51 per cent.

Early Silicosis.—These number 220, a decrease of 120 compared with the previous year. Of these 54 were new cases and 166 were reported previously, the figures for 1944 being 70 and 270 respectively. Early silicotics represent 6.60 per cent. of the men examined, the percentage for the previous year being 7.45.

Advanced Silicosis.—Of the 36 cases reported 26 were men who advanced from early silicosis during the year, the other 10 had been reported previously but continued in their employment. Advanced silicotics represent 1.08 per cent. of the men examined, compared with 0.76 for the previous year.

Silicosis Plus Tuberculosis.—Five cases were reported, compared with eight for the previous year, and represent 0.15 of the men examined.

Tuberculosis Only.—Two cases only were reported compared with six for the previous year, and represent 0.06 of the men examined.

General.—The Mobile X-Ray Unit, feeling the effects of its age, had a major breakdown whilst in the Pilbara Goldfield, and it was necessary for some essential equipment to be borrowed and flown to the locality to enable the tour to be completed. It would appear, therefore, that the time has arrived when the entire unit should be replaced.

MINES REGULATION ACT.

Examinations under the Mines Regulation Act totalled 1,108. This was in addition to the 3,334 examined under the Mine Workers' Relief Act. These examinations show an increase of 258 over the previous year.

The 1,108 men comprise 513 new applicants and 595 re-examinees for the Initial Certificate.

Particulars of the examinations are as follows:—

NEW APPLICANTS.

Normal	460
Pneumoconiosis	25
Silicosis Early	—
Silicosis Advanced	—
Query Tuberculosis	11
Tuberculosis	1
Pneumoconiosis plus Query Tuberculosis	1
Pneumoconiosis plus Tuberculosis	—
Silicosis Early, plus Query Tuberculosis	1
Silicosis Early, plus Tuberculosis	—
Silicosis Advanced, plus Query Tuberculosis	—
Silicosis Advanced, plus Tuberculosis	—
Other Conditions	14
	513

Of the above applications for admission to the industry 460 received the Initial Certificate (Form 2), 11 received Re-Admission Certificates (Form 6), 40 received Special Certificates (Form 9), one received a temporary Rejection Certificate (Form 3), and one received a Rejection Certificate (Form 4). Thus, of 513 applicants, 460 were eligible for employment anywhere on a mine, 51 were eligible for surface employment, and two were not eligible for any employment on a mine. There is, however, no information available as to the number of these new applicants who actually entered the industry.

RE-EXAMINATIONS.

Normal	370
Pneumoconiosis	144
Silicosis Early	24
Silicosis Advanced	1
Query Tuberculosis	17
Tuberculosis	1
Pneumoconiosis, plus Query Tuberculosis	6
Pneumoconiosis, plus Tuberculosis	—
Silicosis Early, plus Query Tuberculosis	8
Silicosis Early, plus Tuberculosis	1
Silicosis Advanced, plus Query Tuberculosis	1
Silicosis Advanced, plus Tuberculosis	—
Other Conditions	22
	595

These men had previously been examined and some were engaged in the industry prior to this examination —370 received the Initial Certificate (Form 2), two received temporary Rejection Certificates (Form 3), three received Rejection Certificates (Form 4), 81 received Re-admission Certificates (Form 6), 138 received Special Certificates (Form 9), and one received a Prohibition Certificate (Form 10).

Thus of the 595 men re-examined 370 were eligible for employment anywhere on a mine, 219 were eligible for surface employment, and six 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 Certificates (Form 2)	830
Temporary Rejection Certificates (Form 3)	3
Rejection Certificates (Form 4)	4
Re-admission Certificates (Form 6)	92
Special Certificates (Form 9)	178
Prohibition Certificates (Form 10)	1
	1108

The percentage of men of normal health to the number examined was 74·90 compared with 68·35 for the previous year.

MINER'S PHTHISIS BOARD.

The amount of compensation paid during the year totalled £33,190 9s. 7d., compared with £35,455 16s. 5d. for the previous year, the reduction being due to the deaths of beneficiaries and 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, 1945, totalled 272, being 58 ex-miners and 214 widows.

J. THOMAS,

Acting Chairman Miner's Phthisis Board and Superintendent Mine Workers' Relief Act.

13th February, 1946.

TABLE SHOWING RESULTS OF PERIODICAL EXAMINATION OF MINE WORKERS FROM INCEPTION OF EXAMINATIONS (1925) TO 31st DECEMBER, 1945.

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

PERIODICAL 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—			
Previously 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		
Previously 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 =	·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 =	·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 =	·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 =	·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 =	·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 =	·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 =	·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 =	·055
Total number of men examined		7,299 =	100·000

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

PERIODICAL EXAMINATION OF MINE WORKERS—*continued.*

Eighteenth Examination (1943)—*continued.*

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	= 100·0

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

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		
Previouly 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	2	= 0·06
Total number of men examined		3,334	= 100 00

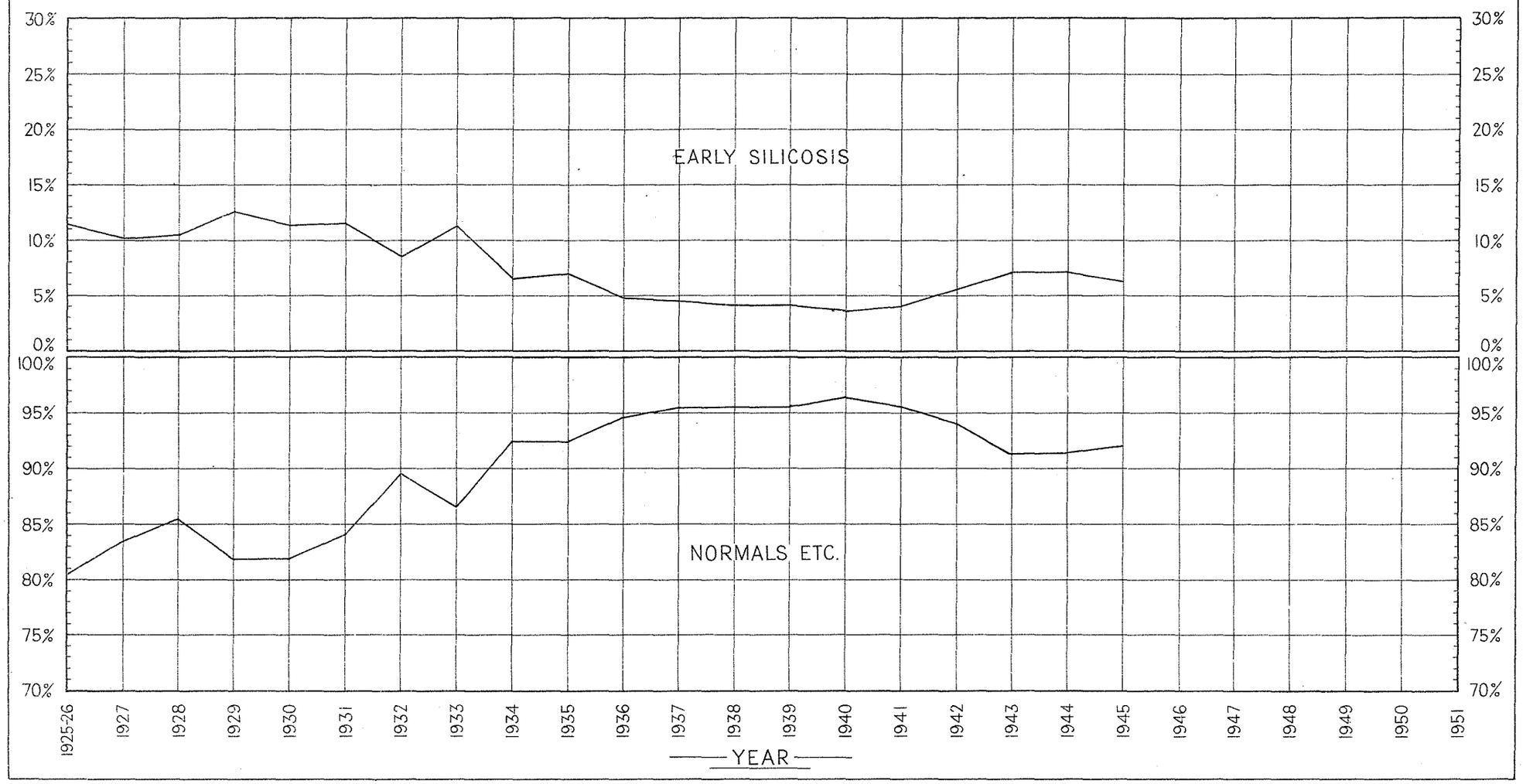
Men employed in the outlying districts were not examined during 1929 or 1931 ; only those employed in Kalgoorlie and surrounding districts being examined. The increase in numbers diagnosed as Early Silicosis and Tuberculosis in 1930 was due to the improved plant and radiographic technique.

Only new miners and those whose previous diagnosis warranted review were examined in the outlying districts during 1933.

PERIODICAL EXAMINATION OF MINE WORKERS

GRAPH No.1

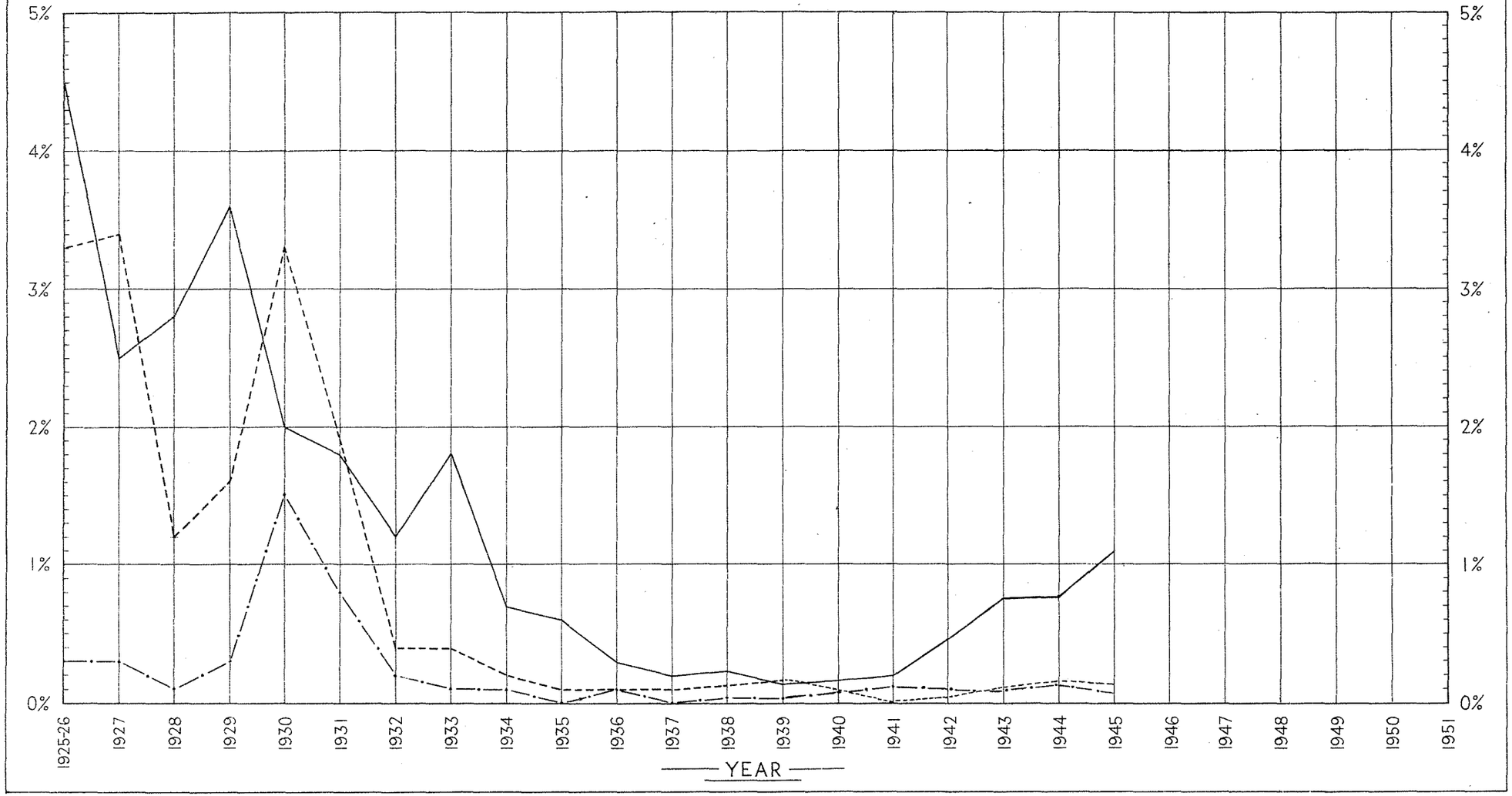
Showing Percentages of Normals and Early Silicotics, from 1925-26 onwards



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* ---·---·---·---

Mining Statistics to 31st December, 1945.

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 1945, 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 1945.					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	...
Hall's Creek ...	...	Voided leases	...	...	...	...	...	...	...	423·00	477·76	...
		Sundry claims	...	...	...	...	...	27·73	...	204·55	159·68	...
Mt. Dockrell ...	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	...
Ruby Creek ...	98	Goliath	...	...	...	...	...	...	...	120·70	103·72	...
	97	Ruby Queen	...	...	...	...	...	...	...	2,799·25	1,556·85	...
	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	...	...	...	...	...	...	...	273·25	177·27	...
The Mary ...	...	Voided leases	...	...	...	...	...	...	...	399·00	210·03	...
		Sundry claims	...	...	...	...	...	...	...	46·85	53·66	...
The Panton ...	...	Voided leases	...	...	...	...	...	...	...	34·70	138·70	...
		Sundry claims	...	...	...	...	...	...	...	6·15	18·01	...
		From Goldfield generally :— Reported by Banks and Gold Dealers	107·38	...	...	...	...	7,888·06	85·07	·75	1·54	...
		Totals	**107·38**	...	...	...	...	**7,932·58**	**142·43**	**22,453·15**	**17,036·31**	**93·00**
Pilbara Goldfield. MARBLE BAR DISTRICT.												
Bamboo Creek ...	856	Bulletin	...	...	...	...	...	...	8·36	3,072·00	964·31	...
	850	Federation	...	...	...	·62	...	...	...	1,280·50	836·27	...
	866, 901 ...	Greater Bonnie Doon (1935) Ltd. ...	...	...	...	...	...	...	...	2,530·00	1,043·86	...
	866	(Bonnie Doon)	...	...	...	...	...	...	...	204·00	78·03	...
	707	Kitchener	...	...	140·00	60·35	...	...	...	9,681·50	13,632·67	...

	1010	Mickey	...	...	...	...	...	...	...	1,300·00	351·99	...
	740, 794, 878 ...	Mt. Prophecy Leases	...	...	...	...	...	...	...	8,090·50	8,262·79	...
	740	(Mt. Prophecy)	...	...	...	...	...	...	1·11	1,040·50	1,898·07	...
	794	(Perseverance)	...	...	...	...	...	...	...	290·50	584·21	...
	817	Prince Charlie	...	...	101·50	63·99	...	...	3·68	2,062·50	3,086·22	...
	924	True Blue	...	...	283·50	3·59	...	...	...	1,821·75	81·83	...
		Voided leases	...	...	...	...	...	13·54	550·72	18,375·85	25,744·37	...
		Sundry claims	...	...	106·00	15·68	...	8·97	307·83	4,875·85	2,925·06	...
Boodalyerrie ...	...	Voided leases	...	...	...	...	...	...	292·07	120·25	587·86	...
		Sundry claims	...	...	...	...	...	...	7·16	...	...	...
Lalla Rookh ...	...	Voided leases	...	...	...	...	...	...	4·78	3,612·00	4,696·33	574·01
		Sundry claims	...	...	...	...	...	...	...	7,943·00	7,675·09	...
Marble Bar ...	927, etc. ...	Comet Gold Mines, Ltd.	...	...	10,515·00	6,370·33	...	...	...	91,768·19	85,280·51	...
	1019	(Alethia)	...	...	...	...	...	...	...	586·75	23·70	...
	930, etc. ...	Prior to transfer to present holders	...	...	...	...	...	...	...	1,609·00	1,211·72	...
	1063	General	...	...	...	...	...	...	...	144·75	351·46	...
	912	Homeward Bound	...	...	656·25	222·94	...	...	...	5,308·00	2,572·57	...
	929 (1023), (1034)	Ora Banda South Mines, N.L. ...	...	...	234·50	59·18	...	...	...	1,528·25	653·50	...
	929	(Tassie Queen)	...	...	...	...	...	...	...	2,323·50	1,534·75	...
	(1062)	Outward Bound East	...	...	55·75	22·33	...	...	...	137·00	59·36	...
	1050	Stray Shot	...	...	...	...	...	...	...	85·25	73·83	...
		Voided leases	...	...	...	...	...	...	199·09	35,935·25	37,849·78	...
		Sundry claims	...	...	39·00	17·33	...	67·08	251·77	19,217·39	12,128·06	...
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	1057	Edelweis	...	...	...	...	...	...	...	195·50	139·38	...
	868	Mt. Ada	...	...	...	...	...	1·43	...	1,447·25	1,589·68	...
		Voided leases	...	...	...	...	...	...	...	78·00	222·02	...
		Sundry claims	...	...	10·50	15·66	...	162·10	41·42	1,077·00	1,598·67	...
Talga	...	Voided leases	...	...	...	...	...	...	93·15	1,799·00	1,760·68	...
		Sundry claims	...	...	...	...	...	64·70	85·18	1,967·90	1,498·10	...
Tambourah ...	...	Voided leases	...	...	...	...	...	...	73·90	1,576·50	1,882·29	...
		Sundry claims	...	...	...	...	...	89·52	294·75	3,742·25	2,689·78	...
Warrawoona ...	(1046)	Klondyke Queen	...	...	74·00	137·32	...	...	...	2,040·00	577·18	...
		Voided leases	...	...	...	...	...	...	16·99	10,708·80	18,253·32	...
		Sundry claims	...	...	...	...	...	70·98	623·67	6,143·04	4,195·34	...
Western Shaw ...	...	Voided leases	...	...	...	...	...	...	...	1,222·50	957·80	...
		Sundry claims	...	...	...	...	...	22·34	67·47	71·50	81·49	...
Wyman's Well ...	1002, 1003 ...	Copenhagen Leases	...	...	...	...	...	...	...	785·75	39·29	...
	1002	(Copenhagen)	...	...	...	...	...	...	...	1,046·75	42·87	...
	1013	Trump	...	...	422·75	86·19	...	...	...	2,182·25	400·55	...
		Voided leases	...	...	...	...	...	...	42·86	1,144·79	1,176·28	...
		Sundry claims	...	...	...	...	...	1·14	51·52	2,371·11	1,193·65	...

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 1945.					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.
Yandicoogina ...	...	Voided leases	...	...	...	...	...	...	140·76	3,159·20	6,218·83	...
		Sundry claims	...	...	...	...	...	4·32	239·89	565·75	630·87	...
		From District generally :—										
		Sundry Parcels treated at :										
		Bamboo Creek State Battery	...	...	...	...	...	...	...	40·00	*9,588·84	*181·04
		Marble Bar State Battery	...	...	...	...	...	...	...	12·00	*9,203·82	...
		Ironclad Battery	...	...	...	...	...	...	...	...	*237·71	...
		The Great North-Western Gold Co., Ltd. ...	...	...	...	*22·77	...	...	...	...	*267·07	...
		Various Works	...	...	...	...	...	...	...	237·95	*1,391·56	...
		Reported by Banks and Gold Dealers	48·41	...	...	...	...	14,051·53	436·76	...	·90	...
		Totals	**48·41**	...	**12,638·75**	**7,098·28**	...	**14,745·75**	**4,410·08**	**273,714·37**	**282,412·14**	**755·05**
		NULLAGINE DISTRICT.										
Eastern Creek ...	(268L)	Doherty's Reward	...	...	40·00	29·26	...	...	...	482·50	419·04	...
	276L	Rose	...	...	19·00	28·54	...	...	...	45·50	60·95	...
	(253L)	Shamrock	...	...	5·00	3·20	...	8·96	...	82·50	78·35	...
		Voided leases	...	...	...	...	...	...	8·19	4,696·00	9,069·61	11·77
		Sundry claims	...	...	...	...	...	...	12·74	1,403·60	1,593·97	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	...	...	165·50	67·02	...	...	...	440·50	146·18	...
	229L	Barton	...	...	...	...	...	1·22	...	1,343·50	215·96	...
	231L, etc. ...	Blue Spec Leases	...	...	4,722·00	1,375·08	...	...	...	8,257·50	3,354·51	...
	247L	Hopetoun North	...	...	...	...	...	...	...	213·00	51·43	...
	267L	Little Wonder	...	...	...	...	...	...	...	3,226·00	869·72	...
		Voided leases	...	...	...	...	...	...	...	11,683·15	9,896·69	...
		Sundry claims	...	...	28·00	16·45	...	...	...	4,494·60	2,018·19	...
Mosquito Creek ...	...	Voided leases	...	...	...	...	...	1·07	30·12	8,232·30	12,814·22	...
		Sundry claims	...	...	19·00	11·95	...	...	168·71	3,620·94	3,752·60	...
Nullagine	270L	Valentine	...	...	4·00	2·40	...	...	...	139·00	66·74	...
		Voided leases	...	...	...	...	...	...	32·79	8,646·25	12,306·39	...
		Sundry claims	...	151·43	15·00	14·81	...	313·02	400·91	5,758·05	10,061·99	...

Twenty Mile Sandy	256L	Bill Jim	...	...	34·00	9·69	...	...	...	1,618·00	943·43	...
		Voided leases	...	...	...	...	...	...	3·20	5,221·20	7,971·21	...
		Sundry claims	...	...	54·00	67·63	...	33·10	30·50	7,135·35	5,895·89	...
	From District generally :—											
	Sundry Parcels treated at :											
	Simpson's Cyanide Plant (Twenty Mile Sandy)		...	...	...	*70·96	...	...	...	...	*1,286·28	...
	Various Works		...	...	...	...	...	...	...	112·50	*6,340·55	...
	Reported by Banks and Gold Dealers		68·39	...	...	2·40	...	9,298·67	97·45	...	27·17	...
	Totals		**68·39**	**151·43**	**5,105·50**	**1,699·39**	**...**	**9,656·04**	**792·89**	**77,743·19**	**91,440·07**	**28·67**

Ashburton Goldfield.

Belvedere ...	...	Voided leases	...	...	...	...	...	...	9·88	1,560·00	435·86	176·48
	47	Star of the West	...	...	...	...	...	...	...	448·50	293·64	...
		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 :—											
	Reported by Banks and Gold Dealers		16·66	22·21	...	...	...	8,878·10	69·31	...	7·12	...
	Totals		**16·66**	**22·21**	**...**	**...**	**...**	**9,255·14**	**428·60**	**5,684·25**	**2,398·70**	**8,183·68**

Gascoyne Goldfield.

Bangemall ...	...	Voided leases	...	...	...	...	...	...	6·22	350·70	313·82	...
		Sundry claims	...	...	...	...	...	88·97	33·55	36·30	203·47	...
	From Goldfield generally :—											
	Reported by Banks and Gold Dealers		...	...	...	...	...	588·55	1·80	...	...	...
	Totals		**...**	**...**	**...**	**...**	**...**	**677·52**	**41·57**	**387·00**	**517·29**	**...**

Peak Hill Goldfield.

Egerton	556P	Pegasus	...	...	100·00	186·44	...	...	84·84	1,118·00	2,479·47	...
		Voided leases	...	...	...	...	...	60·86	30·91	5,077·25	2,842·45	...
		Sundry claims	...	...	...	...	...	235·35	23·51	1,431·77	765·74	...
Horseshoe ...	564P	Labourchere Main Load	...	12·71	105·00	18·65	...	...	12·71	105·00	18·65	...
	565P	Nathan Bitter	...	...	196·00	50·46	...	...	...	196·00	50·46	...
		Voided leases	...	...	...	...	...	15·57	1,962·66	2,051·88	2,240·09	2·00
		Sundry claims	...	...	...	...	...	20·12	829·58	1,794·55	673·36	...
Jimblebar ...	...	Voided leases	...	...	...	...	...	...	172·75	7,526·25	2,561·95	·58
		Sundry claims	...	...	...	...	...	13·79	65·95	1,048·05	574·16	...

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

PEAK HILL GOLDFIELD—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1945.					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.
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	...	...	...	...	...	...	...	1,038·10	791·51	...
Peak Hill ...	(562P)	Anti Axis	...	...	...	...	...	...	...	279·00	144·93	...
	512P	Atlantic	...	...	...	...	...	1·69	2·87	4,128·75	515·53	...
	552P	Bobby Dazzler	...	...	...	...	...	·63	...	505·50	258·87	...
	511P	Commercial	...	...	...	...	...	...	...	2,702·75	470·23	...
	448P	Evening Star	...	...	...	...	...	...	70·17	6,933·00	4,865·94	...
	567P	Miner Bird	...	...	61·00	42·97	...	...	...	61·00	42·97	...
	553P	Morning Star	...	...	...	...	...	...	4·43	2,474·25	308·83	...
	506P	No. 1 North	...	40·56	8·00	23·24	...	...	86·47	5,747·20	1,316·59	...
	492P	North Star	...	...	...	...	...	23·20	69·63	12,354·50	1,867·56	...
		Voided leases	...	...	...	...	...	6·76	850·04	512,763·83	241,638·21	2,285·63
		Sundry claims	...	...	29·00	13·20	...	61·51	275·61	33,792·85	8,862·71	...
Ravelstone ...	...	Voided leases	...	...	...	...	...	...	101·64	4,219·85	3,117·68	...
		Sundry claims	...	...	...	...	...	...	...	553·60	283·17	...
Wilgeena	...	Voided leases	...	...	...	...	...	...	23·54	128·50	146·79	...
Wilthorpe ...	...	Voided leases	...	...	...	...	...	...	...	47·00	20·93	...
		Sundry claims	...	...	...	...	...	...	...	89·00	25·71	...
Yowereena ...	...	Voided leases	...	...	...	...	...	...	...	19·50	36·46	...
		Sundry claims	...	...	...	...	...	...	...	117·25	203·16	...
	From Goldfield generally :—											
	Sundry Parcels treated at :											
		State Battery, Peak Hill	...	...	...	...	...	...	3·05	15·00	*6,431·91	...
		Australian Machinery and Investment Co. ...	...	...	...	*153·12	...	...	...	...	*1,404·37	...
		Various Works	...	...	...	...	...	...	...	30·00	*5,661·37	*23·12
		Reported by Banks and Gold Dealers	...	...	...	...	...	2,846·65	444·36	...	11·43	...
		Totals	...	53·27	499·00	488·08	...	3,374·41	5,160·38	609,759·68	291,723·55	2,311·33

East Murchison Goldfield.

LAWLERS DISTRICT.

Kathleen Valley ...	1330	Beth-Heno	...	...	45·00	6·33	...	...	...	548·00	222·80	...
		Voided leases	...	...	...	...	...	...	144·85	78,824·00	48,174·48	...
		Sundry Claims	...	...	59·50	66·83	...	14·37	526·03	5,192·50	2,187·77	...

Lawlers	1341	Boomer	...	...	120·00	16·52	...	...	...	438·00	234·39	...
	1336	Caroline East	...	...	...	...	...	...	...	117·00	65·95	...
	1236, 1240, etc.	Emu Gold Mines, Limited ...	...	...	27,541·00	7,017·34	...	...	...	277,908·68	68,334·07	452·00
	1236, 1240, 1249	Prior to transfer to present holders	...	...	...	...	...	13·02	...	168·50	1,216·93	...
	1340	Never-can-Tell	...	...	35·00	17·25	...	...	...	47·50	22·92	...
		Voided leases	...	...	...	...	...	...	690·66	1,284,499·72	491,020·56	14,350·93
		Sundry claims	...	...	8·00	2·36	...	399·86	388·51	16,406·48	9,031·76	268·34
Sir Samuel ...	1333	Vanguard	...	...	...	...	...	...	...	1,462·00	190·98	...
		Voided leases	...	...	...	...	...	...	359·03	273,477·55	141,386·56	10,227·52
		Sundry claims	...	...	7·00	4·71	...	53·89	64·96	7,057·75	4,388·53	...
	From District generally :—											
	Sundry parcels treated at :											
	State Battery, Sir Samuel		...	...	...	*43·79	...	...	...	53·50	*2,311·25	...
	Australian Machinery and Investment Co. ...		...	...	...	*16·63	...	...	...	5·00	*4,288·78	*29·00
	Prior to transfer to present holders		...	...	...	...	...	...	...	...	*1,371·33	*15·64
	Australian Machinery and Investment Co., Limited (McPherson's Cyanide Plant) ...		...	...	...	...	...	2·12	...	12·03	*4,265·25	...
	Norwood, Vickery, and Lewis		...	...	...	...	...	...	...	...	*352·19	*·12
	Tallon Doon Battery		...	...	...	*83·56	...	...	...	...	*83·56	...
	Vanguard Cyanide Plant		...	...	...	...	...	...	...	4·00	*700·47	...
	Various Works		...	...	...	...	...	...	2·35	1,699·50	*26,067·02	*936·09
	Reported by Banks and Gold Dealers		2·81	...	...	...	...	6,375·60	101·09	·05	9·84	...
	Totals		**2·81**	...	**27,815·50**	**7,275·32**	...	**6,858·86**	**2,277·48**	**1,947,921·76**	**805,927·39**	**26,279·64**

WILUNA DISTRICT.

Coles	662J	Black Adder	...	...	...	...	...	...	...	1,108·50	520·33	...
	665J	New Venture	...	...	14·25	1·41	...	...	...	63·25	7·71	...
		Voided leases	...	...	...	...	...	...	...	767·25	149·14	...
		Sundry claims	...	7·40	38·00	22·61	...	...	20·17	3,844·50	1,500·05	...
Corboy's	435J	Old Toscana	...	...	69·50	35·02	...	5·24	...	929·50	633·78	...
	669J	Vinaurum	...	...	224·00	101·45	...	...	...	536·00	361·05	...
	433J	Waratah	...	...	...	...	...	...	...	38·00	58·89	...
	433J (434J) ...	(Waratah leases)	...	...	...	...	...	...	...	1,188·04	568·94	...
	433J, 434J ...	(Waratah Gold Mines Limited, N.L.) ...	...	...	...	...	...	...	...	359·00	587·92	...
		Voided leases	...	...	...	...	...	...	1·25	10,593·25	7,403·59	5·00
		Sundry claims	...	...	581·50	204·87	...	21·58	...	7,843·35	4,593·95	...
Gum Creek ...	...	Voided leases	...	...	...	...	...	20·75	...	1,380·00	595·73	...
		Sundry claims	...	...	...	...	...	...	1·36	379·25	120·89	...
Mt. Eureka ...	...	Voided leases	...	...	...	...	...	...	...	142·25	96·36	...
		Sundry claims	...	...	...	...	...	...	...	783·75	548·56	...
Mt. Keith ...	...	Voided leases	...	...	...	...	...	...	44·54	20,259·50	13,551·08	...
		Sundry claims	...	...	...	...	...	4·81	227·29	3,862·50	2,480·03	...
New England ...	...	Voided leases	...	...	...	...	...	5·74	95·70	5,336·25	3,471·17	...
		Sundry claims	...	...	72·00	154·10	...	9·31	5·78	4,534·75	3,111·97	...
Wiluna	631J	Brilliant Reduced	...	...	...	...	...	...	...	1,756·75	243·35	...
	552J, 664J ...	Coolgardie Brilliant, N.L.	...	...	...	*145·14	...	...	...	21,267·00	7,291·20	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	7,257·00	2,202·75	12·40
	607J	Coolgardie Brilliant, N.L.	...	...	...	...	...	...	...	1,140·00	1,152·53	...
	607J (663J) ...	Linden (W.A.) Gold, N.L.	...	...	...	...	...	...	...	21,619·00	6,024·02	...
	607J	Prior to transfer to present holders	...	...	...	...	...	...	...	1,156·75	655·83	...

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 1945.					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.
Wiluna—*contd.*												
	(10J, 37J, etc.)	Moonlight Wiluna Gold Mines, Ltd. ...	...	...	19,117·00	5,834·00	...	...	...	848,151·83	203,633·40	1,213·00
		Prior to transfer to present holders	...	...	...	...	...	...	...	36,975·50	14,174·75	...
	194, etc. ...	Wiluna Gold Mines, Limited	...	...	334,638·00	35,016·00	...	...	...	7,192,416·00	1,282,266·48	1,213·99
		Prior to transfer to present holders	...	...	...	...	...	...	...	341,730·57	133,457·92	89·32
		Voided leases	...	...	...	...	...	...	574·76	140,807·75	79,753·12	124·00
		Sundry claims	...	...	570·50	56·82	...	105·39	219·08	24,700·05	10,056·05	·33
		From District generally :—										
		Sundry parcels treated at :										
		State Battery, Wiluna	...	...	...	...	...	...	...	592·00	*22,158·18	*218·70
		Black Adder Battery	...	...	...	*8·45	...	...	...	...	*94·38	...
		Toscana Cyanide Plant	...	...	...	...	...	...	...	...	*2,445·85	...
		Waratah Cyanide Plant	...	...	...	*102·50	...	...	...	...	*629·72	...
		Various Works	...	...	...	...	...	...	...	...	*1,237·68	12·68
		Reported by Banks and Gold Dealers	...	...	...	...	...	49·54	56·58	...	51·48	...
		Totals	...	**7·40**	**355,324·75**	**41,682·37**	...	**222·36**	**1,246·51**	**8,703,519·09**	**1,807,889·83**	**2,889·42**
		BLACK RANGE DISTRICT.										
Barrambie ...	972B, 976B ...	Sheelite leases	...	...	...	...	...	...	...	616·50	698·11	...
	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	168·10	833·55	915·51	...
Bellchambers ...	...	Voided leases	...	...	...	...	...	...	111·80	3,437·27	1,758·90	...
		Sundry claims	...	...	...	6·43	...	...	...	619·80	392·51	...
Berrigrin	...	Voided leases	...	...	...	...	...	...	820·68	12,042·93	15,086·09	...
		Sundry claims	...	...	...	...	...	...	179·92	2,487·55	1,238·22	...
Curran's Find ...	...	Voided leases	...	...	...	...	...	18·24	222·89	7,252·25	3,116·68	...
		Sundry claims	...	...	...	...	...	...	29·38	2,158·75	827·18	...
Erroll's	...	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	...	...	...	...	...	...	443·79	599·75	651·16	...
	1050B	Duke of Windsor	...	...	...	...	...	...	·78	649·25	334·39	...
		Voided leases	...	...	...	...	...	...	6,523·59	31,975·25	33,098·94	55·72
		Sundry claims	...	...	37·75	2·26	...	4·21	142·89	8,326·35	3,152·07	...

Maninga Marley ...	...	Voided leases	...	...	...	...	...	...	195·20	60,833·48	48,494·40	22·55
		Sundry claims	...	...	...	...	...	...	158·16	3,071·40	1,764·28	...
Montague ...	967B, 998B ...	North End leases	...	...	...	...	...	...	...	35,372·95	4,871·16	...
		Voided leases	...	...	...	...	...	...	100·17	39,672·65	16,888·02	...
		Sundry claims	...	...	...	...	...	...	71·09	5,018·60	3,147·93	...
Nungarra	...	Voided leases	...	...	...	...	...	25·94	952·34	10,395·75	5,015·04	...
		Sundry claims	...	...	...	...	...	50·27	1,458·06	7,494·15	2,930·91	...
Sandstone ...	959B, etc. ...	Atlas Gold Mines, Limited	...	...	...	...	...	...	...	959·00	168·60	...
		Prior to transfer to present holders	...	...	...	...	...	...	136·06	537·75	686·59	...
	1076B, 1080B...	Black Range Gold Mines, Limited ...	...	...	...	...	...	...	...	84·00	14·34	...
	1075B	Doolette South	...	...	136·00	357·66	...	...	217·54	903·00	1,325·59	...
	958B	Lady Mary	...	...	595·50	835·02	...	...	...	6,177·00	5,813·89	2·28
	(1069B) ...	Sonny Boy	...	...	...	7·34	...	...	394·38	326·00	540·22	...
		Voided leases	...	...	...	...	...	4·75	3,615·71	692,204·07	443,769·55	11,754·22
		Sundry claims	...	...	50·75	22·33	...	44·95	1,421·07	14,742·45	6,649·42	...
Youanme	1046B	Camberra	...	...	...	...	...	...	...	1,501 00	443·13	...
	960B, etc. ...	Youanmi Gold Mines, Limited ...	...	...	...	...	...	...	...	370,977·77	96,279·42	5,865 55
	960B, etc. ...	(Youanmi)	...	...	...	...	...	...	...	38·50	3·91	...
		Voided leases	...	...	...	...	...	·36	126·92	358,978·78	176,882·54	4,608·55
		Sundry claims	...	...	...	...	...	1·07	18·79	6,258·55	1,814·66	...
	From District generally :—											
	Sundry parcels treated at :											
	State Battery, Sandstone	...	...	...	*180·63	...	...	...	...	266·00	*22,499·88	*59·53
	State Battery, Youanmi	...	...	...	...	...	...	...	...	40·00	*5,461·83	...
	North End Cyanide Plant	...	...	...	...	...	...	...	...	...	*4,911·99	...
	Various Works	...	...	...	...	...	...	...	...	37·00	*6,505·69	...
	Reported by Banks and Gold Dealers	...	...	...	...	...	...	1,441·81	50·84	...	20·38	...
	Totals	...	...	**820·00**	**1,411·67**	...	**1,617·37**	**18,134·04**	**1,719,581·97**	**944,499·97**	**22,494·00**

Murchison Goldfield.

CUE DISTRICT.

Big Bell	2050, etc. ...	Big Bell Gold Mines, Limited	...	...	...	...	...	...	...	...	2,226,219·00	290,615·52	93,153·35
	2050	(Little Bell)	...	...	...	...	...	...	4·49	579·75	60·95	...
	2219	Pindar	...	...	...	...	...	...	...	65·00	79·35	...
		Voided leases	...	...	...	...	...	...	...	274·75	278·83	...
		Sundry claims	...	...	...	...	...	·39	6·32	359·50	339·41	...
Cuddingwarra ...	...	Voided leases	...	...	...	...	...	10·59	132·46	102,020·41	56,131·93	100·71
		Sundry claims	...	10·99	136·25	67·10	...	18·46	365·56	8,220·89	4,805·35	9·00
Cue	2242	Dunedin	...	32·62	...	...	...	...	32·62	...	...	...
	2236	Hill View	...	242·49	97·00	59·76	...	95·96	298·39	668·00	886·46	2·48
		Voided leases	...	...	...	...	...	106·75	580·59	287,720·44	220,011·47	66·63
		Sundry claims	...	...	132·25	31·03	...	243·45	894·70	41,297·24	18,370·98	...
Eelya	...	Voided leases	...	...	...	...	...	...	8·78	1,039·00	1,811·26	...
		Sundry claims	...	...	112·00	19·77	...	6·20	101·86	954·90	759·70	...
Mindoolah ...	...	Voided leases	...	...	...	...	...	3·07	2·54	9,380·28	5,672·31	42·97
		Sundry claims	...	...	...	...	...	...	29·30	3,002·10	2,180·55	...

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MURCHISON GOLDFIELD—*continued.*

CUE DISTRICT.—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1945.					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.
Reedy	1977, etc. ...	Triton Gold Mines, N.L.	...	...	...	...	...	...	...	604,070·00	191,041·46	17,791·92
		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	...	...	...	...	...	170·71	120·73	4,940·05	2,252·12	...
Tuckabianna ...	2130	Garibaldi	...	...	...	...	...	...	45·22	298·88	544·36	...
	2237	Gidgie	...	...	350·40	185·50	...	...	...	2,037·40	782·14	...
	2244	Winston	...	76·32	...	...	...	...	76·32	...	...	...
	(2234)	Winston	...	...	...	...	...	649·70	75·91	110·75	190·56	...
		Voided leases	...	...	...	...	...	...	176·55	12,480·10	6,573·64	...
		Sundry claims	5·83	...	121·75	40·49	...	143·17	480·56	4,222·60	2,489·81	...
Tuckanarra ...	2079	Batchelor	...	...	...	...	...	70·72	75·39	450·25	381·43	...
	2238	Last Chance	...	...	...	...	...	...	85·94	10·25	18·44	...
		Voided leases	...	...	...	...	...	14·65	3,349·77	19,023·75	22,418·32	172·77
		Sundry claims	...	...	...	...	...	115·23	769·93	9,829·55	10,189·33	...
Weld Range ...	2183	Joy Long	...	...	37·75	13·31	...	...	...	1,048·00	347·94	...
		Voided leases	...	...	...	...	...	...	23·64	545·75	486·41	...
		Sundry claims	...	...	...	...	...	...	3·90	1,203·75	766·13	...
	From District generally :—											
	Sundry parcels treated at :											
	State Battery, Cue		...	...	...	*500·10	...	...	...	53·50	*20,353·05	*91·93
	State Battery, Tuckanarra		...	...	...	...	...	...	...	518·50	*5,523·88	...
	Various Works		...	...	...	...	...	...	...	7,158·52	*29,387·81	*1,147·77
	Reported by Banks and Gold Dealers		23·09	4·07	...	...	...	3,310·33	98·06	...	22·62	...
		Totals	**28·92**	**366·49**	**987·40**	**917·06**	...	**4,960·84**	**8,054·18**	**3,372,724·29**	**913,873·92**	**118,589·05**

MEEKATHARRA DISTRICT.

Abbott's	...	Voided leases	...	...	...	...	...	...	26·45	36,841·35	38,775·28	...
		Sundry claims	...	...	...	...	...	...	5·29	3,661·27	2,237·83	...
Burnakura ...	1849N	New Alliance	...	...	...	...	...	...	...	132·25	114·39	...
		Voided leases	...	...	...	...	...	...	3,247·59	39,040·45	30,775·77	26·90
		Sundry claims	...	...	17·75	10·90	...	17·03	129·24	2,010·30	1,082·87	1·54
Chesterfield ...	...	Voided leases	...	...	...	...	...	29·02	420·32	6,869·26	7,483·76	·80
		Sundry claims	...	...	...	...	...	...	42·19	888·55	714·20	...
Gabanintha ...	1854N	Golden Star	...	...	...	...	...	...	...	203·25	251·06	...

	1725N	New Brew	...	...	484·50	1,160·35	...	...	...	1,685·60	2,672·40	...
		Voided leases	...	...	...	...	...	11·79	28·82	23,826·75	14,039·87	815·57
		Sundry claims	...	...	...	...	...	16·78	147·72	3,497·00	2,200·74	...
Garden Gully ...	...	Voided leases	...	...	...	...	...	26·36	74·91	30,238·32	21,847·71	1,102·59
		Sundry claims	...	...	...	...	...	...	7·51	2,843·69	1,677·23	...
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 claims	...	...	...	...	...	164·95	49·07	425·15	279·25	...
Jillawarra ...	1871N	Werribie	...	...	12·50	18·82	...	...	128·85	310·75	617·28	...
		Voided leases	...	...	...	...	...	...	1,134·68	1,499·55	2,801·53	...
		Sundry claims	...	...	7·50	13·11	...	173·02	150·04	374·00	359·59	...
Meeka Pools ...	...	Voided leases	...	...	...	...	...	...	...	111·58	82·27	...
		Sundry claims	...	...	...	...	...	...	2·84	233·57	205·38	...
Meekatharra ...	1861N	Adele May	...	...	...	...	...	...	...	9·00	4·37	...
	1883N	Coffee Pot	...	...	...	...	...	...	...	99·00	45·92	...
	1855N	Commodore	...	...	...	...	...	...	...	575·75	181·96	...
	1553N	Consols North	...	...	...	...	...	...	...	581·00	1,241·10	...
	1894N (477N), 814N	Fenian Leases	...	...	188·75	227·59	...	...	...	329,077·44	260,527·54	...
	(477N) ...	Fenian	...	...	...	...	...	...	...	8,831·75	18,289·22	...
	1884N	Fortune Teller	...	...	...	...	...	...	7·09	794·00	102·63	...
	1893N	Halcyon	...	...	601·75	116·33	...	...	·78	601·75	116·33	...
	1888N	Haveluck	...	...	207·25	48·97	...	...	...	207·25	48·97	...
	1559N	Ingliston	...	4·35	...	...	...	...	481·11	1,705·05	1,519·62	...
	1542N	Ingliston Alberts	...	...	...	...	...	...	...	279·50	416·89	...
	1542N (1566N)	Ingliston Alberts Leases	...	...	...	...	...	...	...	2,983·70	1,283·06	...
	(475N) (515N) 729N, etc.	Ingliston Consols Extended Syndicate	...	...	64·00	116·00	...	...	...	873,719·47	357,046·42	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	1,536·25	4,248·25	·30
	(1539N) (1863N)	Ingliston South Gold Development, N.L.	...	...	7·00	8·75	...	...	...	1,244·00	1,999·14	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	16,274·61	12,815·17	...
	1547N	Lady Central	...	...	...	...	...	...	...	32·75	26·05	...
	1889N	Little Mary	...	...	24·75	16·32	...	...	...	47·75	52·18	...
	(533N) ...	Marmont	...	...	85·50	62·98	...	...	89·33	60,345·20	43,122·06	...
	580N	Marmont Extended	...	...	...	...	...	...	...	1,667·95	1,562·40	...
	580N (888N) ...	Marmont Extended Leases ...	...	...	...	...	...	...	...	152·00	129·61	...
	1547N (1576N)	Meekatharra Central Gold, N.L. ...	...	...	...	...	...	...	5·29	4,842·25	2,463·30	...
		Prior to transfer to present holders	...	...	...	...	...	...	11·06	2,951·42	5,198·33	...
	1577N	Mopoke	...	...	...	...	...	...	12·47	1,338·25	820·16	...
	1860N	New Gwalia	...	...	...	4·84	...	...	...	421·75	61·28	...
	1571N	Pharlap	...	...	433·50	314·34	...	...	...	6,645·75	4,376·02	...
	1529N, etc. ...	Prohibition Gold Mining Co., N.L. (in liquidation)	...	...	...	97·71	...	...	...	24,844·25	4,631·56	11·83
	1529N	Prior to transfer to present holders	...	...	...	...	...	...	...	29,422·00	4,971·30	...
		Voided leases	...	...	...	...	...	3·88	1,316·68	375,358·37	203,085·23	2,454·74
		Sundry claims	...	3·14	42·25	43·53	...	229·71	577·31	22,415·20	9,004·75	...
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	...

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 1945.					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.
Munara Gully ...	...	Voided leases	...	...	...	...	...	...	...	13,283·50	6,559·93	...
		Sundry claims	...	...	...	...	...	...	34·23	1,009·75	373·74	...
Nannine	1872N	Blue Pedro	...	...	...	...	...	...	...	7,003·75	1,650·12	...
	1580N	Caledonian	...	...	...	...	...	...	...	1,025·10	492·72	...
	1879N	Called Back	...	...	...	...	...	...	29·96	4·25	34·36	...
		Voided leases	...	...	...	...	...	37·25	796·62	113,287·32	72,331·89	167·45
		Sundry claims	...	...	...	...	...	116·99	1,248·76	6,007·68	4,647·29	...
Quinn's	...	Voided leases	...	...	...	...	...	7·30	1,186·50	33,356·91	13,464·37	**90·70**
		Sundry claims	...	...	...	...	...	15·07	1,289·65	3,829·17	2,716·66	...
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	...	...	...	...	...	...	...	4,002·00	1,219·21	...
	(1892N) ...	Rocklee	...	...	36·50	26·19	...	...	...	36·50	26·19	...
	1898N	Rocklee	...	...	43·25	18·90	...	...	...	43·25	18·90	...
		Voided leases	...	...	...	...	...	19·03	1,972·23	28,067·04	14,541·80	8·68
		Sundry claims	...	...	135·25	102·79	...	61·89	647·51	9,994·17	4,603·27	...
	From District generally :—											
	Sundry Parcels treated at :											
	State Battery, Meekatharra		...	...	...	*90·79	...	...	...	68·50	*23,164·15	*19·00
	Various Works		...	...	...	...	...	...	...	172·75	*6,729·60	342·17
	Reported by Banks and Gold Dealers		7·49	2·44	...	...	...	12,104·74	178·80	13·50	22·00	...
		Totals	**7·49**	**9·93**	**2,392·00**	**2,499·21**	...	**14,235·52**	**17,436·50**	**2,226,247·49**	**1,268,019·21**	**5,042·27**
		DAY DAWN DISTRICT.										
Day Dawn ...	652D	Creme D'or	...	...	12·75	13·74	...	...	...	205·75	139·57	...
	661D	Klondyke West	...	20·56	...	...	...	...	20·56	...	...	...
	573D	Mountain View	...	...	1,495·00	7,745·40	...	...	94·05	6,715·53	14,945·48	...
	576D	New Fingall	...	...	...	...	...	6·12	6·84	2,961·50	1,058·07	...
		Voided leases	...	...	...	...	...	160·64	806·09	1,921,658·86	1,225,373·29	169,210·44
		Sundry claims	...	98·54	139·75	47·51	...	96·42	508·85	12,431·01	6,157·08	...

Lake Austin ...	(656D) ...	Eureka	...	...	...	...	...	11·08	12·31	264·25	124·57	...
		Voided leases	...	...	...	...	...	601·92	3,067·31	36,607·95	50,925·92	...
		Sundry claims	...	27·79	19·75	6·49	...	59·07	943·06	3,123·44	1,234·72	...
Mainland	...	Voided leases	...	...	...	...	...	·41	3,296·77	7,575·62	25,026·07	...
		Sundry claims	...	...	...	...	...	16·57	746·58	1,337·95	701·31	...
Pinnacles	...	Voided leases	...	...	...	...	...	4·90	1,213·68	18,117·00	9,869·29	...
		Sundry claims	...	...	62·25	34·58	...	62·93	446·50	4,266·17	1,641·77	...
	From District generally :—											
	Sundry Parcels treated at ;											
	Various Works		...	...	...	...	...	...	16·61	962·75	1,985·65	...
	Reported by Banks and Gold Dealers		1·82	...	...	11·80	...	1,970·84	33·97	...	12·57	...
		Totals	**1·82**	**146·89**	**1,729·50**	**7,859·52**	...	**2,990·90**	**11,213·18**	**2,016,227·78**	**1,339,195·36**	**169,210·44**

MOUNT MAGNET DISTRICT.

Jumbulyer ...	1410M	Gold Bug	...	...	...	...	...	...	...	67·75	119·79	...
	1406M	Granites	...	...	...	...	...	...	...	12·25	26·45	...
		Voided leases	...	...	...	...	...	...	13·37	660·35	328·81	...
		Sundry claims	...	...	...	...	...	18·45	116·27	1,043·45	767·37	...
Lennonville ...	1405M	Banker	...	·73	...	...	...	...	8·58	205·25	197·16	...
	1308M	Empress	...	...	...	...	...	...	...	405·00	116·61	...
	1379M... ...	Galtee Moore	...	...	232·00	59·34	...	...	...	5,526·00	1,457·77	...
	1378M	Gambier Lass	...	...	...	...	...	...	5·85	419·00	101·26	...
		Voided leases	...	...	...	...	...	...	3,212·48	143,890·05	125,864·21	458·82
		Sundry claims	...	...	60·00	6·46	...	19·14	108·82	13,622·77	5,171·09	...
Mt. Magnet ...	1432M	Chum	...	...	102·00	124·97	...	...	...	102·00	124·97	...
	1382M	Corona	...	...	...	...	...	...	...	3,472·65	2,722·09	...
	1255M (1367M)	Edward Carson Leases	...	...	...	4·82	...	...	...	17,740·50	12,601·58	7·00
	1286M	Evening Star	...	...	66·00	13·91	...	...	36·37	2,782·32	1,180·69	...
	1431M	Good Hope	...	...	324·50	75·07	...	...	...	324·50	75·07	...
	1287M	Havelock	...	...	...	...	...	...	11·05	4,318·75	837·12	...
	1424M	Havilah	...	...	...	...	...	...	...	9·25	9·23	...
	1282M, etc. ...	Hill 50 Gold Mine, N.L.	...	...	31,108·00	8,430·43	132·67	...	...	273,051·90	81,518·27	474·12
	1361M	Jupiter	...	...	...	...	...	...	·83	307·00	102·98	...
	1411M	Leap Year	...	6·54	107·50	59·15	...	...	6·54	634·75	467·24	...
	1416M	Myra Lydia	...	...	...	...	...	...	...	45·25	2·83	...
	1246M	Neptune	...	...	...	...	...	...	829·41	8,787·65	4,094·37	...
	1281M, etc. ...	Saturn Leases	...	...	...	...	...	...	101·24	37,413·00	5,741·32	...
	1251M, etc. ...	Swan Bitter Gold Mine Co., N.L. ...	...	...	79·50	21·93	...	...	15·25	13,838·75	5,228·87	...
		Prior to transfer to present holders	...	...	...	...	...	...	320·12	6,081·25	3,180·61	...
	1322M	Three Boys	...	...	...	...	...	...	229·73	480·28	664·00	...
	1426M	Zenith	...	...	...	...	...	...	...	41·00	40·30	...
		Voided leases	...	...	...	...	...	29·26	9,098·14	766,496·01	292,591·15	851·37
		Sundry claims	...	...	416·25	117·32	...	122·21	2,543·52	56,210·10	27,943·38	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 (1398M)	Moyagee Leases	...	...	...	*435·58	*55·72	...	...	4,641·00	5,489·13	382·52
	1355M	(Moyagee)	...	...	...	...	...	...	...	2,547·50	4,198·30	347·04
		Voided leases	...	...	...	...	...	...	23·59	5,107·60	7,575·88	...
		Sundry claims	11·61	...	...	...	...	14·44	168·99	1,484·00	1,677·51	...

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 1945.					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.
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	...	...	39·50	10·77	...	...	223·32	202·28	66·27	...
		From District generally :—										
		Sundry Parcels treated at :										
		State Battery, Boogardie	...	...	...	*146·92	4·20	...	...	125·26	*33,100·90	4·20
		Empress Battery	...	...	...	...	...	...	...	...	*36·98	...
		Welcome Cyanide Works	...	...	...	...	...	...	...	10·00	*941·39	...
		Various Works	...	...	...	...	...	...	...	43·06	*17,428·06	1·00
		Reported by Banks and Gold Dealers	14·40	1·02	...	...	...	2,220·44	81·55	8·00	64·95	...
		Totals	**26·01**	**8·29**	**32,535·25**	**9,506·67**	**192·59**	**2,491·58**	**20,302·20**	**1,379,502·35**	**649,654·13**	**2,530·56**
		Yalgoo Goldfield.										
Bilberatha ...	1139	Blaney's Gold Mine	...	...	78·50	43·11	...	1·27	90·94	2,058·50	1,336·43	...
		Voided leases	...	...	...	...	...	...	...	1,263·00	491·84	...
		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	...
Fields Find ...	907	Brown's Reward	...	...	...	...	...	...	...	300·00	75·91	...
	907, etc. ...	Brown's Reward Leases	...	...	...	...	...	...	...	4,540·55	3,800·16	...
	1119	Fields' Find Central West ...	...	...	25·00	6·67	...	...	...	25·00	6·67	...
	1119 (1114) ...	Fields' Find Central West ...	...	...	...	...	...	...	...	4,625·00	1,074·53	56·69
	1207	Rose Marie	...	...	35·50	48·27	...	...	...	35·50	48·27	...
		Voided leases	...	...	...	...	...	...	226·72	40,635·41	28,671·03	...
		Sundry claims	...	...	...	...	...	5·77	179·54	5,415·25	1,759·04	...
Goodingnow ...	1063	Ark	...	...	...	...	...	...	1·23	841·50	379·57	...
	1102	Aster	...	...	...	...	...	...	...	5,442·75	2,925·64	...
	1198	Aster South	...	...	...	...	...	...	...	498·50	114·17	...
	1025	Carnation	...	...	...	...	...	...	...	16,146·55	11,765·96	...
	(1175)	Marigold	...	4·26	499·00	253·86	...	...	4·26	3,878·75	1,615·49	...
	1206	Orchid	...	...	...	...	...	...	...	157·50	33·74	...
	1145	Oversight	...	...	608·00	204·67	...	...	...	1,660·85	521·17	...
	1208	Oversight	...	...	85·00	18·87	...	...	...	85·00	18·87	...
	1085	Sweet William	...	...	...	...	...	...	2·97	792·00	249·45	...
		Voided leases	...	...	...	...	...	146·70	273·40	45,490·31	44,910·49	...
		Sundry claims	...	...	...	...	...	152·96	169·70	9,863·25	5,048·30	...

Gullewa	1189	King Solomon's Mine	...	...	...	...	...	...	...	315·00	135·89	5·79
	1189, etc. ...	(King Solomon's Mine, Ltd.)	...	...	...	...	...	...	...	5,130·10	2,101·25	26·49
	1047	Mugga King	...	...	49·00	21·23	...	...	7·76	8,698·50	2,816·33	81·38
		Voided leases	...	...	...	...	...	...	11·29	25,536·00	15,882·93	·04
		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	5·43	...	59·00	64·30	...	5·43	...	65·00	235·66	...
		Voided leases	...	...	...	...	...	...	349·71	39,721·51	28,314·92	1,083·01
		Sundry claims	...	...	...	...	...	463·12	333·98	1,585·35	583·39	...
Mt. Farmer ...	...	Voided leases	...	...	...	...	...	...	...	64·00	40·19	...
		Sundry claims	...	...	...	...	...	...	...	462·90	145·06	...
Mt. Gibson ...	...	Voided leases	...	...	...	...	...	...	6·44	526·50	888·70	...
		Sundry claims	...	...	14·00	8·00	...	1·03	44·72	987·10	417·48	1·00
Ningham	...	Voided leases	...	...	...	...	...	...	...	10·00	1·41	...
		Sundry claims	...	...	...	...	...	...	...	324·75	123·28	...
Noongal	1137	City of Melbourne	...	...	...	...	...	...	...	2,046·50	860·05	...
	1201	Hard to Find	...	...	...	...	...	...	...	74·00	107·77	...
	1203	Revival	...	...	...	*67·61	1·07	...	...	...	*114·58	4·04
		Voided leases	...	...	...	...	...	7·88	31·96	9,023·25	4,666·85	...
		Sundry claims	...	...	...	...	...	36·16	310·31	8,497·30	3,556·78	...
Nyounda	...	Voided leases	...	...	...	...	...	...	217·63	416·00	183·91	...
		Sundry claims	...	4·29	13·00	2·17	...	...	30·88	714·00	179·36	...
Pinyalling ...	...	Voided leases	...	...	...	...	...	...	93·80	2,296·35	959·50	...
		Sundry claims	...	...	...	...	...	3·13	134·09	1,405·50	621·23	...
Retaliation ...	1046	Alma May	...	...	...	...	...	...	...	1,623·75	684·72	...
		Voided leases	...	...	...	...	...	...	...	3,220·00	1,110·85	...
		Sundry claims	...	...	...	...	...	...	...	778·25	304·71	...
Rothsay	1204	Exchange	...	24·06	...	...	...	...	24·06	...	...	...
		Voided leases	...	...	...	...	...	...	...	40,490·75	10,729·58	...
		Sundry claims	...	...	...	...	...	...	·73	6,469·50	2,562·03	...
Wadgingarra ...	...	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	...	...	...	...	...	...	23·56	2,615·25	998·46	...
Yuin	...	Voided leases	...	...	...	...	...	...	127·12	68,139·50	27,908·57	130·13
		Sundry claims	...	...	...	...	...	...	4·70	335·50	67·53	...

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 1945.					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.
Yuin—*continued.*												
		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. Nevills, Rothsay Cyanide Plant ...	...	...	...	*97·14	...	...	...	...	*144·59	72·23
		Various Works	...	...	...	...	...	9·42	...	664·00	*2,958·99	26·67
		Reported by Banks and Gold Dealers	2·70	...	...	...	...	914·92	49·86	...	34·44	...
		Totals	**8·13**	**32·61**	**1,466·00**	**835·90**	**1·07**	**1,749·07**	**2,955·70**	**430,515·21**	**256,376·66**	**1,498·07**

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	...	...	18·00	16·34	...	...	588·28	1,994·30	1,925·38	...
Linden	522F	Ailsa	...	...	...	...	...	...	...	894·50	323·11	...
	(528F)	Blue Peter	...	...	100·00	63·94	...	...	...	241·00	100·98	...
	(508F)	Coronation	...	...	...	...	...	...	...	306·75	2,320·32	...
	539F	Democrat	...	...	483·00	1,748·06	...	...	...	1,462·50	2,463·28	...
	494F	Local Lady	...	...	216·00	275·53	...	...	1·65	1,586·50	1,515·80	...
	521F	North Democrat	...	...	383·00	719·81	...	...	...	2,182·75	4,616·85	...
	529F	Second Fortune	...	...	19·00	9·06	...	...	...	446·50	242·52	...
		Voided leases	...	...	...	...	...	7·53	564·13	57,387·06	43,298·59	·68
		Sundry claims	...	...	86·00	49·43	...	132·11	234·81	18,135·60	13,177·80	...
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	...	...	...	...	...	25·22	102·12	1,701·35	652·62	...
Mt. Morgans ...	399F, etc. ...	Morgans Gold Mines, Limited	...	...	24·75	20·84	...	...	...	4,466·80	13,776·04	...
	...	Prior to transfer to present holders	...	...	...	...	...	...	16·66	779,578·43	354,225·86	5,552·63
	547F	Vodice	...	...	...	...	...	...	...	433·25	94·95	...
		Voided leases	...	...	...	...	...	17·95	148·79	60,503·25	34,541·15	77·86
		Sundry claims	...	...	...	...	...	34·47	360·33	4,653·82	3,153·57	...
Murrin	395F	Arthur Rymer	...	...	...	...	...	...	8·42	3,848·25	744·25	...
	482F	Hill End	...	...	...	...	...	...	...	3,666·75	1,570·74	...
		Voided leases	...	...	...	...	...	10·43	222·93	129,376·47	101,692·22	29·60
		Sundry claims	...	2·27	48·35	34·11	...	51·15	557·24	6,305·08	4,401·44	...

Redcastle	...	Voided leases	...	...	...	...	...	4·49	436·54	4,107·20	4,043·41	...
		Sundry claims	...	...	28·50	7·01	...	...	113·84	834·57	569·30	...
Yundamindera ...	510F	Landed at Last	...	...	...	...	...	...	...	4,332·00	683·02	...
	548F	Mulga Rose	...	...	180·00	110·72	...	...	...	230·00	188·66	...
	(509F)	New Golden Treasure	...	...	24·00	26·39	...	...	22·83	1,003·00	412·85	...
	(549F)	Sunny Boy	...	...	139·00	48·05	...	...	...	139·00	48·05	...
	540F	Vera	...	...	...	...	...	...	...	80·00	22·02	...
		Voided leases	...	...	...	...	...	...	88·10	72,413·85	48,461·93	5·82
		Sundry claims	...	...	...	...	...	3·01	271·93	6,409·35	4,694·45	...
	M.A. 14F ...	Crocker's Plant	...	...	...	...	...	...	...	10·00	16·40	...
	From District generally :—											
		Sundry Parcels treated at :										
		State Battery, Linden	...	...	...	*820·62	...	...	9·16	275·29	*11,972·04	...
		Hill End Cyanide Plant	...	...	...	...	...	...	...	...	*556·95	...
		Rymer's Cyanide Plant	...	...	...	...	...	...	...	...	*1,159·90	...
		Turbett's Cyanide Plant	...	...	...	*202·92	...	...	...	...	*1,232·20	...
		A. E. Smith (Stack of Ore)	...	...	...	...	...	...	...	7·25	1·39	...
		Various Works	...	...	...	...	...	...	...	1,257·81	*5,587·24	99·97
		Reported by Banks and Gold Dealers	12·31	17·22	...	1·61	...	2,901·77	141·84	10·30	95·75	·68
		Totals	**12·31**	**19·49**	**1,749·60**	**4,154·44**	...	**3,313·34**	**9,281·53**	**1,198,408·96**	**698,802·10**	**5,781·64**

MOUNT MALCOLM DISTRICT.

Cardinia	1795c	Rangoon	...	...	...	...	...	...	...	250·00	106·64	...
		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	...	...	275·00	370·41	...	...	...	1,527·00	1,691·89	...
		Voided leases	...	...	...	...	...	...	945·65	36,103·03	32,335·98	33·18
		Sundry claims	...	...	...	...	...	11·21	329·32	4,597·30	4,405·51	...
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 ...	1784c	British King West	...	...	26·50	30·10	...	...	...	329·50	335·75	...
		Voided leases	...	...	...	...	...	...	4,482·18	68,013·46	49,993·88	...
		Sundry claims	...	...	84·00	27·24	...	67·68	557·70	7,228·34	4,814·23	2·60
Leonora	1754c	Gold Blocks	...	...	...	*152·23	16·61	...	...	1,410·00	1,433·08	83·86
	1594c	Leonora Central Gold Mines Co., N.L.	...	...	...	...	...	...	...	8,621·00	853·23	...
	1788c	Little Gwalia	...	...	...	...	...	...	...	635·00	15·62	...
	(980c) 1341c, etc.	Sons of Gwalia, Ltd.	...	...	67,871·00	20,791·80	1,853·47	...	...	5,084,844·53	2,097,344·40	146,783·62
		Prior to transfer to present holders	...	...	...	...	...	...	...	109,081·00	55,989·21	8·66
	1557c	Tower Hill	...	...	...	...	...	...	·58	526·55	120·73	...
		Voided leases	...	...	...	...	...	...	1,866·28	164,241·45	88,210·02	10·71
		Sundry claims	...	...	...	...	...	30·31	333·89	17,639·55	11,393·05	...
Malcolm	...	Voided leases	...	...	...	...	...	...	47·07	62,656·53	47,560·70	...
		Sundry claims	...	...	6·50	2·14	...	5·75	33·39	4,280·97	2,633·51	...
Mertondale ...	...	Voided leases	...	...	...	...	...	...	...	89,024·75	60,935·32	1,497·58
		Sundry claims	...	...	...	...	...	1·82	85·74	3,112·16	2,249·39	...
Mt. Clifford ...	...	Voided leases	...	...	...	...	...	...	1,623·35	9,556·96	16,492·17	...
		Sundry claims	...	...	...	...	...	53·98	351·65	5,511·70	3,471·95	...

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

MT. MARGARET GOLDFIELD— *continued.*

MOUNT MALCOLM DISTRICT—*continued.*

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1945.					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.
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	...	...	95·00	5·93	...	...	7·27	759·00	77·09	...
		Voided leases	...	...	...	...	...	...	239·49	10,141·65	9,653·78	...
		Sundry claims	...	...	...	...	...	66·57	164·02	2,464·64	1,299·14	...
Webster's Find ...	...	Voided leases	...	...	...	...	...	30·30	...	22,167·50	14,377·65	...
		Sundry claims	...	...	...	...	...	36·84	695·68	2,227·40	1,499·81	...
Wilsons' Creek ...	...	Voided leases	...	...	...	...	...	...	...	333·50	168·27	...
		Sundry claims	...	...	...	...	...	·70	4·24	316·00	261·12	...
Wilson's Patch ...	...	Voided leases	...	...	...	...	...	...	99·38	28,863·35	13,050·19	1·05
		Sundry claims	...	...	9·25	6·74	...	4·68	50·57	1,498·16	1,364·51	...
	From District generally :—											
	Sundry Parcels treated at :											
	State Battery Reserve, Darlot		...	...	...	*31·32	...	...	...	10·00	*277·30	...
	H. J. Maund (L.T.T. 1012H)		...	...	...	*82·37	...	...	...	...	*82·37	...
	Parks and Hunt's Cyanide Plant		...	...	...	...	...	...	...	...	*951·64	...
	Reefer Cyanide Plant		...	...	...	*30·60	...	...	...	20·00	*2,744·15	22·38
	Various Works		...	...	...	...	...	...	...	789·50	*20,984·71	123·15
	Reported by Banks and Gold Dealers		3·17	1·24	...	...	...	3,405·47	249·87	21·50	45·17	...
	Totals		**3·17**	**1·24**	**68,367·25**	**21,530·88**	**1,870·08**	**3,734·38**	**13,999·64**	**5,774,565·99**	**2,572,520·11**	**148,631·13**

MOUNT MARGARET DISTRICT.

Burtville	2446T	Boomerang	...	...	43·00	361·18	...	...	...	423·00	3,361·32	21·54
	2476T	Happy Find	...	...	...	...	...	...	...	73·00	316·95	...
	2485T	Karridale	...	...	15·00	12·90	...	...	...	15·00	12·90	...
	2480T	Mocking Bird	...	...	20·50	26·73	...	...	...	45·00	93·62	...
	2138T	Nil Desperandum	...	...	17·00	62·37	...	...	5·30	1,402·12	3,096·36	...
	2412T	Sailor Prince	...	...	...	...	...	...	...	467·25	89·16	...
		Voided leases	...	...	...	...	...	2·29	413·80	68,523·68	104,615·47	275·27
		Sundry claims	...	...	...	...	...	2·65	208·27	7,165·91	5,332·85	...
Duketon	(2483T) ...	Mulga King	...	...	12·00	37·48	...	...	...	32·00	58·14	...
		Voided leases	...	...	...	...	...	5·35	3,216·10	31,857·42	22,484·49	...
		Sundry claims	...	...	39·65	19·82	...	...	528·26	2,310·65	2,088·71	29·76
Eagle's Nest ...	...	Voided leases	...	...	...	...	...	...	145·34	534·50	1,238·22	...
		Sundry claims	9·14	...	57·00	29·69	...	23·23	472·38	1,000·00	346·69	...

Erlistoun	(2482T) ...	Marloo	...	...	...	1·83	...	...	...	...	118·46	...
	2141T	King of Creation Gold Mines, Ltd. ...	...	...	...	...	...	...	...	6,358·00	1,288·92	11·00
		Prior to transfer to present holders	...	...	...	...	...	...	...	13,723·00	3,199·66	...
	2345T	Western Mining Corporation, Ltd. ...	...	...	...	11·78	...	...	...	106,009·00	75,828·03	4,316·81
		Prior to transfer to present holders	...	...	...	...	...	...	...	119·25	140·97	...
	2458T	Westralia	...	...	55·00	51·21	...	...	...	192·00	171·69	...
		Voided leases	...	...	...	...	...	10·07	393·41	29,693·15	20,119·23	...
		Sundry claims	...	...	10·00	10·70	...	1,181·65	148·23	5,434·59	3,702·17	...
Euro	...	Voided leases	...	...	...	...	...	...	65·14	91,821·50	37,678·25	...
		Sundry claims	...	...	...	...	...	4·87	73·04	1,270·25	785·52	...
Laverton	2216T	Beria Main Lode	...	...	...	*24·07	...	...	...	6,550·35	1,506·69	...
	2408T	Gladiator Gold Mines, Ltd.	...	...	...	...	...	...	...	103,538·00	25,965·35	...
	(2433T) ...	Ida H. Extended	...	...	...	...	...	8·30	...	25·50	26·96	...
	2229T	Ida H.	...	...	...	...	...	...	...	531·50	469·46	...
	2229T (2230T)	(Ida H. Leases)	...	...	...	...	...	...	...	2,683·75	379·62	...
	2245T	Lancefield Extended West ...	...	...	409·25	60·31	...	...	...	881·25	846·77	...
	2478T	Lancefield North	...	...	...	...	...	...	...	17·25	88·96	...
		Voided leases	...	...	...	...	...	20·29	2,024·11	1,961,643·52	784,754·06	56,923·16
		Sundry claims	...	...	63·00	15·20	...	210·18	1,475·35	16,746·75	8,960·43	...
Mt. Barnicoat ...	2254T	Ulalla	...	...	...	...	...	...	...	392·50	92·44	...
		Voided leases	...	...	...	...	...	...	23·08	1,376·25	558·94	...
		Sundry claims	...	...	19·00	27·72	...	...	·68	1,077·00	824·29	...
Mt. Shenton ...	...	Voided leases	...	...	...	...	...	...	...	15·00	26·65	...
		Sundry claims	...	...	...	...	...	...	...	279·25	209·67	...
	From District generally :—											
	Sundry Parcels treated at :											
	State Battery, Laverton		...	...	...	...	...	...	...	97·50	*7,211·05	15·64
	G. E. Grey (Cyanide Works) L.T.T. 966H, L.T.T. 1029H		...	...	...	*14·85	...	...	...	...	*5,536·47	...
	D. Cable (Cyanide Works) L.T.T. 978H, L.T.T. 979H		...	...	...	*216·16	...	...	...	...	*1,008·69	...
	J. Shepherd (Cyanide Works M.A.) 23T ...		...	...	...	*24·63	...	...	...	...	*61·64	...
	Various Works		...	...	...	...	...	...	...	159·50	*12,339·53	...
	Reported by Banks and Gold Dealers		7·39	...	...	...	...	2,480·26	105·90	...	26·76	...
	Totals		16·53	...	760·40	1,008·63	...	3,949·14	9,298·39	2,464,485·14	1,137,062·21	61,593·18

North Coolgardie Goldfield.

MENZIES DISTRICT.

Comet Vale ...	5719Z	Coonega	...	...	...	...	...	...	...	8·00	5·21	...
	5476Z	Sand Queen Gladsome Mines, N.L. ...	...	...	...	...	...	...	...	42,096·75	14,583·85	6·45
		Prior to transfer to present holders	...	...	...	...	...	...	...	75,754·50	59,007·25	1,505·65
		Voided leases	...	...	...	...	...	...	419·74	148,635·97	119,408·22	3,839·28
		Sundry claims	...	...	...	...	...	...	40·19	1,696·91	885·75	...
Goongarrie ...	5726Z	Pretty Easy	...	1·54	27·25	48·87	...	...	1·54	27·25	48·87	...
		Voided leases	...	...	...	...	...	·94	1,378·20	29,771·54	17,966·00	...
		Sundry claims	...	...	23·00	6·11	...	46·46	1,954·08	2,349·27	2,854·69	...
enzies	5703Z	Aspacia	...	...	10·00	11·58	...	...	18·46	980·50	887·69	5·24
	5543Z	Black Swan	...	...	...	...	...	...	...	967·63	1,486·32	9·08
	5694Z	Dark Horse	...	...	...	...	...	...	...	83·00	293·76	...

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

NORTH COOLGARDIE GOLDFIELD—*continued.*

MENZIES DISTRICT—*continued.*

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1945.					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.
Menzies—*contd.*												
	5720, etc. ...	First Hit Gold Mines (1934), Ltd. ...	...	...	4,410·00	2,738·79	...	...	...	65,435·20	46,486·92	6,608·73
		Prior to transfer to present holders	...	...	...	...	...	...	...	1,672·75	4,687·69	...
	5542z	Good Block Lease	...	...	30·00	476·39	...	...	7·32	1,455·00	2,235·62	...
	5549z	Lady Harriet	...	...	...	...	...	...	...	548·00	164·46	...
	5520z	Mignonette	...	...	...	...	...	...	...	168·50	209·47	...
	5697z	New Florence	...	...	27·00	10·76	...	...	6·56	999·50	369·39	...
	5663z	Springfield	...	...	10·00	3·68	...	...	...	142·00	51·66	...
	5671z	Woolgar Gold Mines, Limited	...	...	...	...	...	...	...	42·00	8·85	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	151·50	174·25	...
		Voided leases	...	...	...	...	...	45·42	1,095·38	931,186·50	723,638·24	13,581·15
		Sundry claims	...	...	10·00	8·65	...	49·50	590·32	30,710·94	23,654·83	776·49
Mt. Ida	5658z	Carida	...	...	...	...	...	...	...	277·95	361·69	...
	5668z	Federation	...	...	...	...	...	...	...	389·50	425·20	...
	5551z, etc. ...	Goldfields Australian Development Co., Limited	...	...	...	...	...	...	...	6,881·00	4,014·98	250·15
	5551z, etc. ...	(Mt. Ida Gold Mines, Limited) ...	...	...	...	...	...	...	...	17,638·50	8,075·96	558·74
		Prior to transfer to Mt. Ida G.M.	...	...	...	...	...	...	...	1,512·75	737·95	...
	5707z	Quinn Hills	...	...	...	...	...	...	12·52	809·00	181·19	...
		Voided leases	...	...	...	...	...	...	79·69	67,254·72	71,711·06	106·63
		Sundry claims	...	5·74	3·50	21·05	...	48·14	321·01	15,565·41	7,919·83	·12
Twin Hills ...	...	Voided leases	...	...	...	...	...	...	...	552·30	568·87	...
		Sundry claims	...	...	...	...	...	...	...	97·80	86·69	...
	From District generally :—											
	Sundry parcels treated at :											
	State Battery, Mt. Ida		...	...	...	...	...	...	...	1,866·25	*6,829·04	...
	Gold Tailings, Limited Cyanide Plant		...	...	...	...	...	...	...	...	*345·87	5·84
	Lady Harriet Cyanide Plant		...	...	...	*229·50	...	...	...	279·50	*15,703·89	30·00
	Menzies Consolidated Cyanide Plant		...	...	...	*36·40	...	...	...	...	*3,277·45	...
	E. C. Robinson (L.T.T. 1024H)		...	...	...	*15·83	...	...	...	...	*15·83	...
	Various Works		...	...	...	...	...	...	...	2,512·30	*34,654·69	2,453·31
	Reported by Banks and Gold Dealers		3·60	...	...	...	...	1,426·35	382·80	35·00	7·72	...
	Totals		**3·60**	**7·28**	**4,550·75**	**3,607·61**	...	**1,616·81**	**6,307·81**	**1,450,555·19**	**1,174,026·90**	**29,736·86**
						ULARRING DISTRICT.						
Davyhurst ...	1102U	Lights of Israel	...	...	...	...	...	...	...	1,075·00	176·42	...
	1016U, 1085U...	New Callion	...	...	...	...	...	...	...	5,293·30	2,002·37	119·67
		Voided leases	...	...	...	...	...	2·93	144·62	164,253·32	125,596·63	5,408·47
		Sundry claims	...	65·13	228·00	110·24	...	...	103·11	12,877·44	5,412·41	...

Morley's	1101U	Emerald	...	...	55·00	177·75	...	...	26·03	399·50	989·98	...
	1094U	First Hit	...	...	51·00	111·93	...	...	...	669·75	2,324·59	...
	1081U	Mabel Gertrude	...	...	...	...	...	...	...	348·00	426·55	...
	1089U	Paramount	...	...	30·00	81·06	...	...	...	690·50	982·39	...
	1078U	Rabbit	...	...	...	...	...	...	2656·6	277·50	687·47	...
	1074U	Two Chinamen	...	2·29	10·00	2·92	...	...	3,411·83	794·50	2,884·37	...
		Voided leases	...	...	...	...	...	...	121·96	443·50	754·84	...
		Sundry claims	...	...	61·00	41·26	...	2·16	932·23	1,354·25	2,300·18	...
Mulline	1107U	Ajax West	...	...	55·50	54·60	...	...	1·37	338·25	602·49	...
	1069U, etc. ...	Riverina Gold Mines, Ltd.	...	...	...	...	...	...	...	32,058·00	11,662·42	...
		Voided leases	...	...	...	...	...	...	274·09	102,556·22	103,327·32	530·75
		Sundry claims	...	5·57	93·50	39·27	...	10·82	197·72	10,411·39	8,522·00	1·10
Mulwarrie ...	1113U	Oakley	...	...	...	...	...	...	...	151·00	191·83	...
		Voided leases	...	...	...	...	...	...	165·29	19,480·68	26,369·21	38·47
		Sundry claims	...	...	42·00	15·12	...	·80	282·29	3,023·33	2,589·71	...
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. 13)	...	...	...	...	...	...	...	...	...	*21·65	...
	Waihi Battery and Cyanide Plant	...	...	...	*159·15	...	...	...	...	5·00	*492·96	...
	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	2·92	...	...	...	...	...	105·97	63·08	100·00	22·67	...
	Totals	**2·92**	**72·99**	**626·00**	**793·30**	...	**122·68**	**6,568·44**	**368,529·35**	**343,335·24**	**6,093·46**

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	(918G)	Altona South	...	...	30·00	6·10	...	...	...	30·00	6·10	...
	911G	Cosmopolitan South	...	...	...	...	...	...	...	600·00	293·91	...
	916G	Ruby	...	...	70·00	28·86	...	...	...	70·00	28·86	...
		Voided leases	...	...	...	...	...	3·35	347·30	744,223·21	393,923·63	5,375·97
		Sundry claims	...	...	93·50	52·05	·18	56·74	99·84	7,847·30	6,058·08	·18
Niagara	913G	New Gladstone	...	...	...	...	...	...	...	639·00	269·99	...
		Voided leases	...	...	...	...	...	...	104·54	85,237·50	52,095·06	...
		Sundry claims	...	...	70·50	23·34	...	28·10	97·22	14,205·66	8,019·92	...
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	8,016·33	4,100·19	...
	From District generally :—											
	Sundry parcels treated at :											
	Grafter Battery	...	...	...	...	...	...	...	...	...	*137·63	...
	P. J. Ward (Permit)	...	...	...	...	...	...	...	...	...	*10·08	...
	Various Works	...	...	...	...	...	...	...	...	1,220·50	16,226·67	41·17
	Reported by Banks and Gold Dealers	...	...	...	...	...	1,583·86	823·66	...	63·53	...	
	Totals	...	...	**264·00**	**110·35**	**·18**	**1,704·65**	**1,813·65**	**924,601·52**	**512,969·65**	**5,603·60**

TABLE 1.—*Production of Gold and Silver from all sources, etc.*—continued.

NORTH COOLGARDIE GOLDFIELD—*continued.*

YERILLA DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1945.					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.
Edjudina	1011R, 1022R, 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	...	...	...	...	...	...	26·89	6,807·58	4,761·31	...
Patricia	...	Voided leases	...	...	...	...	...	...	...	4,158·50	5,396·40	25·40
		Sundry claims	...	...	...	...	...	...	...	35·00	17·76	...
Pingin	...	Voided leases	...	...	...	...	...	...	48·34	17,463·30	10,742·77	...
		Sundry claims	...	...	...	...	...	...	154·86	5,623·59	3,466·70	...
Yarri	1211R	Margaret	...	...	...	...	...	...	...	590·00	131·18	...
	1126R, etc. ...	Porphyry (1939) G.M., N.L. ...	...	...	...	...	...	...	...	66,648·00	9,855·05	261·86
	1126R	Edjudina Gold Mining Co., N.L. ...	...	...	...	...	...	...	...	30,220·00	5,409·93	507·51
		Prior to transfer to present holders	...	...	...	...	...	...	...	124·50	38·89	...
		Voided leases	...	...	...	...	...	6·30	87·08	43,095·25	20,835·58	2·00
		Sundry claims	...	...	45·00	21·44	...	·87	5·93	13,714·80	5,229·67	...
Yerilla	...	Voided leases	...	...	...	...	...	...	3,107·25	16,161·93	12,733·54	13·93
		Sundry claims	...	...	...	·75	...	19·30	34·30	2,695·58	1,538·94	...
Yilgangie	1221R	Golden Hill	...	...	247·00	180·44	...	...	...	367·00	246·57	...
	1176R, etc. ...	Western Mining Corporation, Ltd. ...	...	...	...	...	...	...	...	646·75	446·89	...
		Prior to transfer to present holders	...	...	...	...	...	...	·85	1,244·75	1,830·28	...
		Voided leases	...	...	...	...	...	...	9·94	1,342·75	949·08	...
		Sundry claims	...	7·72	34·00	27·62	...	121·67	98·20	2,875·30	1,694·18	...
		From District generally :—										
		Sundry parcels treated at :										
		State Battery, Yarri	...	...	...	...	...	...	...	271·50	*7,496·64	3·50
		State Battery, Yerilla	...	...	...	...	...	...	...	...	*43·52	...
		Various Works	...	...	...	...	...	2·17	...	642·25	*6,049·24	...
		Reported by Banks and Gold Dealers	...	...	...	...	...	1,161·08	160·08	...	4·11	...
		Totals	...	**7·72**	**326·00**	**230·25**	...	**1,311·39**	**3,752·16**	**250,252·03**	**142,293·02**	**851·99**
Broad Arrow Goldfield.												
Bardoc	2102W ...	Despatch	...	...	...	...	...	...	...	432·00	140·60	...
	2198W ...	Ellen Pearce	...	...	...	...	...	...	...	1,040·75	743·72	...
	2219W ...	Gippslander	...	...	...	...	...	...	...	26·00	26·76	...
	2199W ...	Zoroastrian	...	...	...	...	...	...	...	936·25	149·31	...
		Voided leases	...	...	...	...	...	...	2,335·41	82,272·09	54,441·19	203·60
		Sundry claims	...	...	84·25	42·25	...	54·95	1,193·45	14,241·53	7,408·03	...

Black Flag ...	2190w, 2191w	Bell Bird	...	...	...	...	...	...	1·55	149·25	44·00	...
		Voided leases	...	...	...	...	...	27·81	404·35	48,058·54	28,105·53	...
		Sundry claims	...	...	...	...	...	712·92	250·76	7,205·71	4,513·31	...
Broad Arrow ...	2217w ...	Dreamer	...	...	22·75	13·50	...	...	74·34	76·75	94·71	...
	2039w ...	Golden Arrow	...	...	...	...	...	...	...	4,023·50	622·96	...
	1952w ...	Grace Darling	...	...	49·50	22·41	...	...	1·67	3,626·00	2,562·73	...
	2215w ...	Hagland's Hill	...	...	...	...	...	...	10·11	...	...	...
	2216w ...	Kimra	...	...	174·25	221·50	...	...	...	975·25	1,257·93	...
	2148w ...	Lady Betty	...	...	...	...	...	...	...	390·80	79·43	...
	2206w ...	Lady Betty Extended	...	...	...	...	...	...	...	155·00	37·48	...
	2218w ...	Lady Betty North	...	...	...	...	...	...	...	101·00	20·20	...
	2223w ...	North Bulletin	...	...	254·75	134·33	...	...	...	502·75	420·86	...
	1771w ...	North Duke	...	...	...	...	...	...	1,670·51	192·80	628·42	...
	1933w ...	Oversight Tara United	...	...	...	...	...	...	1,147·01	837·29	909·72	...
	(2233w) ...	Rising Sun	...	...	14·75	10·28	...	...	...	14·75	10·28	...
	2221w ...	Undersight	...	...	...	...	...	...	...	95·00	15·82	...
		Voided leases	...	...	...	...	...	70·32	7,405·47	139,084·35	111,384·10	20·23
		Sundry claims	1·90	14·73	180·50	117·88	...	1,007·72	2,620·38	30,160·89	15,661·06	·11
Canegrass ...	...	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	...	...	16·75	7·45	...	...	6·61	1,791·33	869·06	...
Cashman's ...	...	Voided leases	...	...	...	...	...	67·51	813·76	8,172·15	7,090·91	...
		Sundry claims	...	...	...	...	...	...	39·55	997·27	313·75	...
Christmas Reef ...	2175w ...	New Mexico	...	...	100·50	275·53	...	...	...	382·00	790·88	...
	2211w ...	New Year Gift	...	...	...	...	...	...	...	11·25	9·03	...
		Voided leases	...	...	...	...	...	...	29·68	783·52	207·21	...
		Sundry claims	...	...	47·50	8·89	...	...	307·15	2,730·89	2,534·62	...
Fenbark	2236w ...	Fenbark	...	...	28·00	3·90	...	...	...	28·00	3·90	...
	2188w ...	Golden Penny	...	...	97·50	7·82	...	...	...	2,221·50	365·40	...
	2228w ...	New Fenbark	...	...	...	...	...	...	...	75·75	23·16	...
		Voided leases	...	...	...	...	...	...	4·42	3,291·50	1,955·85	...
		Sundry claims	...	...	...	...	...	...	51·96	2,525·52	935·75	...
Grant's Patch ...	2227w ...	Magpie	...	...	104·50	138·69	...	...	...	140·25	239·81	...
	1962w ...	Ora Banda Amalgamated Mines, N.L. ...	...	...	...	...	...	...	...	153,483·00	57,765·88	175·00
		Prior to transfer to present holders	...	...	...	...	...	...	...	12,424·50	9,540·07	...
	2208w ...	Wentworth	...	...	...	...	...	...	...	453·25	110·69	...
		Voided leases	...	...	...	...	...	...	258·52	14,501·60	4,560·62	...
		Sundry claims	...	...	299·00	172·99	...	...	356·66	4,859·29	2,496·85	...
Ora Banda ...	1336w, etc. ...	Associated Northern Ora Banda, N.L. ...	...	...	...	...	...	...	...	2,727·50	406·53	4·87
		Prior to transfer to present holders	...	...	...	...	...	...	...	315,958·95	123,252·22	1,664·70
	2232w ...	Cave Hill North	...	15·97	9·50	22·43	...	...	15·97	21·50	58·99	...
	1943w ...	Ora Banda United Mines, Ltd.	...	...	...	...	...	...	...	2,182·25	74·80	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	76,612·22	14,630·93	...
		Voided leases	...	...	...	...	...	...	829·75	24,532·10	12,526·19	...
		Sundry claims	...	...	23·25	39·95	...	...	324·13	11,981·25	4,068·64	...
Paddington ...	2195w ...	New Lochinvar	...	...	...	...	...	...	...	218·50	130·35	...
	2195w ...	(Lochinvar Gold Mines, Ltd.)	...	...	...	...	...	...	...	572·00	54·54	...
	(2114w) ...	Lone Oak	...	...	22·00	14·08	...	8·58	...	509·00	369·11	...
	2105w ...	Minnie Palmer	...	...	16·00	5·80	...	...	...	9,738·50	809·95	...

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 1945.					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.
Paddington—*contd.*												
	2122W ...	Pakeha	...	...	...	...	...	...	...	1,901·90	633·49	...
		Voided leases	...	...	...	...	...	5,557·72	463·31	178,566·41	83,131·57	18·96
		Sundry claims	...	1·25	23·50	7·02	...	1,714·16	280·74	15,411·98	8,876·27	...
Riche's Find ...	...	Voided leases	...	...	...	...	...	...	7·01	7,357·09	5,283·87	71·36
		Sundry claims	...	...	...	...	...	...	212·26	1,460·55	1,660·28	·13
Siberia	2234W ...	Cat	...	67·97	...	...	...	...	67·97	...	...	...
		Voided leases	...	...	...	...	...	1·07	2,581·31	28,854·47	31,364·62	...
		Sundry claims	...	20·74	13·25	66·15	...	289·06	1,199·38	20,023·54	12,403·93	...
Smithfield ...	2193W ...	King of Kings	...	...	...	...	...	...	...	2,143·75	532·78	...
		Voided leases	...	...	...	...	...	...	...	2,091·96	590·34	...
		Sundry claims	...	...	...	...	...	...	123·37	2,393·09	910·21	...
	From Goldfield generally :—											
	Sundry parcels treated at :											
	State Battery, Ora Banda		...	...	...	*1·83	...	...	...	128·05	*16,258·05	...
	Brearley's Cyanide Plant		...	...	...	...	...	...	...	...	*2,374·39	1,227·68
	P. Doherty (L.T.T. 1026H)		...	...	71·00	2·79	...	...	...	71·00	2·79	...
	C. Floyd (L.T.T. 1011H)		...	...	...	*9·57	...	...	...	...	*9·57	...
	Golden Arrow Cyanide Plant		...	...	...	...	...	...	...	26·00	*2,617·13	...
	T. J. Henneberry (L.T.T. 1015H) ...		...	...	...	*·26	...	...	...	...	*·26	...
	Minnie Palmer Cyanide Plant		...	...	...	*94·47	...	...	...	...	*2,842·49	...
	R. G. Oliver (L.T.T. 1014H)		...	...	...	*12·69	...	...	...	...	*12·69	...
	Various Works		...	...	...	...	...	2,275·66	1·24	16,896·02	43,952·35	1,875·77
	Reported by Banks and Gold Dealers		8·71	·85	...	...	...	9,917·59	130·96	61·68	90·35	...
	Totals		**10·61**	**121·51**	**1,653·00**	**1,454·46**	...	**21,881·11**	**26,135·35**	**1,269,701·35**	**692,157·72**	**5,262·41**

North-East Coolgardie Goldfield.

KANOWNA DISTRICT.

Gindalbie	1540x	Lady Betty	...	...	...	...	...	...	301·95	197·00	432·46	...
		Voided leases	...	...	...	...	...	...	19·94	44,077·78	39,512·90	38·31
		Sundry claims	...	...	...	...	...	...	713·92	4,810·77	2,741·08	...
Gordon	1532x	Sirdar	...	10·43	·10	20·30	...	...	90·27	4,452·35	3,193·76	517·61
		Voided leases	...	...	...	...	...	...	589·88	48,723·78	16,562·53	...
		Sundry claims	...	...	...	...	...	...	177·38	1,918·20	1,130·74	...
Kalpini	...	Voided leases	...	...	...	...	...	...	38·73	13,463·50	6,739·57	·07
		Sundry claims	...	...	...	...	...	24·70	252·83	1,437·00	1,010·42	...

Kanowna	1541x	Three of Diamonds	...	...	...	...	...	...	...	174·00	22·80	...
		Voided leases	...	...	...	...	...	24·94	4,511·34	684,818·35	380,125·24	2,482·24
		Sundry claims	18·91	20·92	183·00	65·53	...	118·94	2,146·26	23,849·02	11,088·34	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 :											
	Maund's Cyanide Plant		...	...	...	...	...	...	...	...	*32·26	...
	Peat's Cyanide Plant		...	...	...	...	...	...	...	16·00	278·66	...
	Various Works		...	...	...	...	...	330·42	867·52	158,919·05	152,894·97	...
	Reported by Banks and Gold Dealers		28·54	...	...	...	...	105,947·98	35·68	·50	101·55	...
	Totals		**47·45**	**31·35**	**183·10**	**85·83**	**...**	**106,446·98**	**12,636·97**	**996,319·56**	**621,689·94**	**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	...	...	...	...	...	317·61	727·39	4,255·36	2,063·34	...
Mulgabbie ...	...	Voided leases	...	...	...	...	...	...	1,402·66	226·75	7,845·87	4·95
		Sundry claims	...	32·67	...	...	...	8·06	2,757·96	1,171·45	2,185·53	...
	From District generally :—											
	Sundry Parcels treated at :											
	Various Works		...	...	...	...	...	...	...	101·50	388·63	...
	Reported by Banks and Gold Dealers		·04	...	...	...	...	12,097·41	68·59	...	2·35	...
	Totals		**·04**	**32·67**	**...**	**...**	**...**	**12,819·83**	**8,282·05**	**13,149·32**	**18,420·22**	**11·22**

East Coolgardie Goldfield.

EAST COOLGARDIE DISTRICT.

Binduli	6025E	Red Star	...	...	161·25	16·27	...	...	...	289·25	30·37	...
		Voided leases	...	...	...	...	...	...	...	803·10	385·19	...
		Sundry claims	...	...	27·75	4·05	...	...	13·01	4,620·52	1,595·70	...
Boorara	5486E	Olympian	...	...	...	...	...	...	...	1,306·00	738·90	...
		Voided leases	...	...	...	...	...	...	459·07	306,930·82	171,842·83	408·36
		Sundry claims	...	...	...	...	...	·49	145·56	2,764·34	1,406·17	...
Boulder	5465E	Birthday Gift	...	...	...	...	...	...	...	5,244·89	1,366·30	...
	5690E	Boulder Perseverance, Limited ...	...	...	85,805·65	23,665·84	9,554·04	...	...	1,823,498·92	780,862·96	230,714·57
		Prior to transfer to present holders	...	...	...	...	...	...	...	3,306,942·88	1,841,159·00	203,821·43
	5964E	Croesus Extended	...	...	...	...	...	1·07	...	67·75	5·22	...
	5472E	Golden Key	...	...	...	...	...	18·27	19·72	415·00	158·96	...
	5692E, etc. ...	Gold Mines of Kalgoorlie, Ltd. ...	...	...	109,334·00	25,356·54	5,206·86	...	...	996,799·86	293,599·97	97,633·84
	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	...

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 1945.					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—*contd.*												
	5692E, etc. ...	Prior to transfer to present holders	...	...	...	...	...	...	545·23	527,790·53	568,643·05	4,844·50
	5696E, etc. ...	Great Boulder Proprietary G.Ms., Ltd.	...	...	276,778·00	71,560·31	40,832·66	...	1·53	7,737,952·97	4,699,131·76	805,986·05
	5845E	Happy Returns	...	...	...	...	...	...	...	186·50	45·78	...
	5345E, etc. ...	Kalgoorlie Enterprise Mines, Ltd. ...	...	...	40,888·73	11,860·81	1,443·30	...	...	438,584·92	135,655·79	13,572·51
		Prior to transfer to present holders	...	...	...	...	...	...	...	15,320·68	8,957·01	...
	5708E, etc. ...	Lake View and Star, Ltd.	...	...	279,579·00	88,340·34	9,644·17	...	...	6,779,397·30	2,310,238·88	167,153·93
		Prior to transfer to present holders	...	...	...	...	...	...	8·49	15,792,500·38	9,149,223·80	1,348,055·82
	5789E, etc. ...	North Kalgurli (1912), Ltd.	...	...	107,737·16	31,063·77	11,134·79	...	111·55	1,622,982·40	577,322·94	159,703·43
	5806E, 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 Leases	...	...	...	...	...	...	5·12	946·00	448·72	...
	5853E	(Paringa Junction)	...	...	...	...	...	...	...	123·75	17·77	...
	5854E	(Paringa Junction North) ...	...	...	...	...	...	...	...	60·50	10·64	...
	5855E	(Paringa Junction South) ...	...	...	...	...	...	...	...	1,473·25	228·42	...
	5456E, etc. ...	Paringa Mining and Exploration Co., Ltd.	...	...	81,378·09	20,550·32	1,496·66	...	...	623,245·06	157,499·12	10,697·91
		Prior to transfer to present holders	...	...	...	...	...	...	·79	57,400·53	24,432·83	...
	5808E, etc. ...	South Kalgurlie Consolidated, Ltd. ...	...	...	63,253·35	18,527·79	3,228·89	...	...	2,408,188·90	962,228·55	23,069·44
		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	6·83
		Sundry claims	...	...	...	...	...	24·58	201·30	11,402·99	4,229·63	...
Cutter's Luck ...	6056E	New Black Cat	...	3·06	12·00	164·07	...	...	3·06	12·00	164·07	...
		Voided leases	...	...	...	...	...	...	20·83	12·25	9·13	...
		Sundry claims	·44	114·95	24·00	48·05	...	8·11	498·09	716·65	356·23	...
Feysville	...	Voided leases	...	...	...	...	...	...	110·93	561·30	394·24	...
		Sundry claims	...	...	...	...	...	...	199·00	1,096·35	618·03	...
Hampton Plains	P.P.L. 9 ...	Celebration Gold Mine, N.L.	...	...	...	...	...	...	...	61,399·75	15,206·00	...
	P.P.L. 1 ...	Consolidated Gold Areas	...	...	...	...	...	...	...	140,168·73	37,036·58	5,835·85
	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. 12 ...	Junction Extended	...	...	...	...	...	...	...	2,296·25	358·67	...
	P.P.L. 252, 289	Mount Martin	...	...	...	16·30	...	...	...	14,953·75	5,731·52	...
	P.P.L. 279 ...	Mutooroo	...	...	...	...	...	...	...	6,151·88	1,087·26	...
	P.P.L. 277 ...	New Hope	...	...	...	...	...	...	17·23	54,209·30	10,174·96	...
	P.P.L. 371 ...	Stearn and Thompson	...	...	25·50	6·34	...	...	...	25·50	6·34	...
	P.P.L. 81 ...	Villers Brettaneaux	...	...	...	...	...	...	...	3,562·02	1,435·55	...
		Voided leases	...	...	...	...	...	4,565·62	203·94	49,092·69	20,871·27	69·60
		Sundry claims	...	...	...	...	...	2·68	70·85	46,300·91	8,470·77	...

Kalgoorlie ...	6048E	Auld Acquaintance	...	...	7·50	2·36	...	...	...	7·50	2·36	...		
	5519E, etc. ...	Barbuan Corporation Ltd. (Hannan's Enterprise)	...	...	...	...	...	...	...	362·00	79·80	...		
	5735E	Bonnie Lass	...	...	...	...	...	...	...	250·50	74·67	...		
	5449E, etc. ...	Broken Hill Proprietary Co., Ltd. ...	...	...	...	...	...	...	3·99	272,314·01	113,598·98	1,843·28		
		Prior to transfer to present holders	...	...	...	...	...	...	...	1,558·49	316·58	...		
	6030E	Churchill	...	...	95·00	8·07	...	...	...	149·75	14·78	...		
	6046E	Colleen Bawn	...	...	...	...	...	...	...	142·25	38·30	...		
	5867E	Concord	...	...	...	...	...	...	8·64	169·25	65·54	...		
	5839E	Coronation	...	...	...	...	...	...	...	40·00	9·03	...		
	5913E	Devon Consuls	...	7·30	...	...	...	...	89·77	844·21	356·72	...		
	5924E	Federal	...	...	...	...	...	...	...	36·25	4·51	...		
	5737E	Golden Mile Channel	...	...	...	...	...	...	·97	2,534·50	199·41	...		
	6020E	Golden Mile North	...	...	...	...	...	...	...	106·25	23·77	...		
	6019E	Golden Seam	...	...	...	...	...	...	...	201·00	161·16	...		
	5904E	Great Patience	...	...	...	...	...	...	1·07	204·75	62·02	...		
	5878E	Lady May	...	62·05	120·00	48·42	...	...	62·05	2,039·00	553·65	...		
	6057E	Little Ray	...	...	52·50	10·21	...	...	...	52·50	10·21	...		
	4547E, etc. ...	Mount Charlotte (Kalgoorlie) G.Ms., Ltd.	...	...	...	...	...	...	...	1,234·00	252·17	...		
		Prior to transfer to present holders	...	...	...	...	...	...	5·72	48,292·60	13,930·79	...		
	5437E	North End Extended	...	112·93	67·25	50·92	...	...	986·40	350·60	503·26	...		
	5852E	Pedestal	...	...	...	...	...	...	...	1,608·75	444·93	...		
	5468E	Phar Lap	...	...	28·25	8·87	...	...	...	465·25	347·22	...		
	5415E, 5803E	Return Leases	...	...	...	...	...	...	5·64	3,670·50	638·42	...		
	5934E, 5933E ...	Sceptre Leases	...	...	...	...	...	...	...	28·00	4·63	...		
	6024E	Trident	...	...	...	...	...	...	...	58·75	36·67	...		
		Voided leases	...	...	...	...	...	242·48	9,558·67	963,254·45	397,399·16	44,017·12		
		Sundry claims	...	12·67	78·00	19·83	...	232·41	1,065·70	59,008·29	22,906·17	...		
Wombola	6051E	Big Bull	...	...	40·00	25·04	...	...	...	40·00	25·04	...		
	5688E	Caledonian	...	...	296·50	275·15	...	...	...	3,488·00	2,836·85	...		
	5497E	Daisy	...	...	689·50	483·20	...	...	...	4,605·75	3,975·65	...		
	6032E	Dry Mount	...	...	31·00	100·55	...	...	...	70·00	154·33	...		
	5872E	Everly	...	...	32·00	52·30	...	...	...	76·00	95·68	...		
	5962E	G.D.N.	...	...	...	...	...	...	68·71	47·00	179·45	...		
	5689E, 5525E ...	Haoma Leases	...	...	1,402·50	816·86	...	...	...	5,181·50	3,187·02	...		
	5689E	(Haoma)	...	...	...	...	...	...	...	2,168·00	1,948·36	...		
	5525E	(Xmas Flat)	...	...	...	...	...	...	...	330·25	264·74	...		
	5500E	Happy-Go-Lucky	...	...	...	...	...	...	...	2,075·25	1,675·85	...		
	6043E	Launa Doone	...	...	...	...	...	...	...	62·50	34·51	...		
	5961E	Loganberry	...	...	...	...	...	...	...	288·25	101·02	...		
	5829E	Lurgan	...	...	...	...	...	...	·69	854·75	476·59	...		
	5798E	Maranoa	...	...	59·50	19·68	...	...	32·17	2,105·00	1,066·46	...		
	5493E etc., ...	New Milano, No Liability	...	...	...	...	...	...	·25	17,030·75	10,548·97	479·00		
	5493E	(Milano)	...	...	...	...	...	...	...	4,012·75	11,676·72	...		
	5616E	(Leslie)	...	...	...	...	...	...	...	602·00	939·10	...		
	5967E	North Caledonian	...	1·27	...	...	...	...	1·27	10·75	4·16	...		
	5850E	Pauline	...	...	...	...	...	...	...	237·00	287·95	...		
	4766E	Pericles Gold Mines, Limited	...	...	...	...	...	...	358·11	4,728·03	19,305·86	...		
	6022E	Proprietary	...	...	...	...	...	...	...	357·25	388·02	...		
	6018E	Reggio	...	...	...	...	...	...	·43	68·00	30·43	...		
	5866E	Rosemary	...	...	...	...	...	...	...	32·50	67·19	...		
	5925E	Tangney	...	...	...	...	...	...	...	12·00	4·46	...		
	5795E	Transvaal	...	...	...	...	...	...	...	504·75	102·14	...		
	6052	Vanenter	...	...	17·50	50·23	...	...	...	17·50	50·23	...		
		Voided leases	...	...	...	...	...	...	2,003·68	19,037·31	18,386·22	...		
		Sundry claims	...	...	111·75	210·44	...	...	698·05	20,389·68	12,893·71	...		
	From District generally :—													
	Sundry claims		...	...	...	...	...	11,014·57	465·61	5,440·46	2,541·10	...		

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 1945.					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.
Wombola—*contd.*												
		Sundry Parcels treated at:										
		State Battery, Kalgoorlie	...	...	...	*747·94	...	...	...	287·45	*20,622·82	...
		Cavalier Treatment Works	...	...	...	...	...	...	...	10·50	*31·43	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	...	*1,538·16	1,507·65
		Golden Horseshoe (New), Ltd.	...	...	...	*8,079·44	15,747·56	...	...	...	*256,954·49	222,927·21
		Pericles Cyanide Plant	...	...	...	*257·37	...	...	...	...	*2,182·32	...
		Polkinghorne's Cyanide Plant	...	...	...	...	...	...	...	...	*149·38	...
		J. F. Poynton (M.A. 1)	...	...	...	...	...	...	...	9·50	6·06	...
		Various Works	...	...	...	...	...	384·36	64·70	41,115·02	*264,204·51	12,606·81
		Reported by Banks and Gold Dealers	40·49	242·45	...	254·11	...	16,582·56	9,950·01	355·63	2,957·46	...
		Totals	**40·93**	**556·68**	**1,048,133·14**	**302,701·80**	**98,288·93**	**33,231·09**	**40,355·73**	**50506172·16**	**26853873·07**	**3,470,536·07**
		BULONG DISTRICT.										
Balagundi ...	...	Voided leases	...	...	...	...	...	...	2,408·98	1,110·68	1,473·73	12·92
		Sundry claims	...	2·27	93·25	10·90	...	3·51	282·80	761·51	476·54	...
Bulong	1311Y	Blue Quartz	...	...	...	...	...	...	...	571·50	159·49	...
	1315Y	Lady Gwen	...	30·56	73·75	20·63	...	...	30·56	377·75	91·65	...
	1308Y	Southern Cross	...	...	...	...	...	...	1·30	1,144·75	161·40	...
		Voided leases	...	...	...	...	...	107·54	8,490·35	104,142·55	85,090·08	...
		Sundry claims	...	...	42·00	7·72	...	1,655·86	1,592·19	14,635·23	17,401·17	...
Majestic	...	Voided leases	...	...	...	...	...	19·45	63·91	1,317·94	647·62	...
		Sundry claims	...	...	...	...	...	42·88	150·67	1,899·05	940·62	...
Morelands ...	...	Sundry claims	...	...	...	...	...	...	·13	183·00	58·51	...
Mt. Monger ...	...	Voided leases	...	...	...	...	...	...	2,771·39	1,437·85	1,256·10	...
		Sundry claims	...	...	...	...	...	215·60	...	379·05	308·48	...
Randall's	...	Voided leases	...	...	...	...	...	...	60·04	33,099·85	11,089·30	...
		Sundry claims	...	...	...	...	...	20·70	8·11	4,691·56	1,188·34	...
Taurus	...	Voided leases	...	...	...	...	...	2·06	3·70	1,765·10	909·84	...
		Sundry claims	...	...	...	...	...	112·69	51·88	2,597·35	1,036·33	...
Trans Find ...	P.P.L. 308A ...	Dawn of Hope	...	...	...	...	...	...	2·87	792·25	286·93	...
		Voided leases	...	...	...	...	...	...	...	983·92	865·71	...
		Sundry claims	...	...	...	...	...	...	5·93	699·25	312·08	...

From District generally :—														
Sundry Parcels treated at :														
Various Works			...	...	...	...	...	...	...	...	6,102·15	6,675·38	...	
Reported by Banks and Gold Dealers			1·82	...	...	...	...	25,195·25	70·15	·01	28·44	...		
Totals			**1·82**	**32·83**	**209·00**	**39·25**	...	**27,375·54**	**15,994·96**	**178,692·30**	**130,457·74**	**12·92**		

Coolgardie Goldfield.

COOLGARDIE DISTRICT.

Bonnivale ...	5596	Jenny Wren	...	...	...	69·73	...	...	141·17	575·00	673·05	**4·17**		
	4600	Melva Maie	...	...	162·00	16·36	...	...	...	1,623·65	3,145·11	...		
		Prior to transfer to present holders	...	...	...	...	...	...	...	614·50	1,099·21	**11·63**		
	5321	Westralia Extended	...	...	...	...	...	...	...	164·50	37·54	...		
		Voided leases	...	...	...	...	...	...	25·00	352,443·84	188,746·25	...		
		Sundry claims	...	...	34·00	18·65	...	...	158·69	5,962·93	4,504·03	...		
Bulla Bulling ...	...	Voided leases	...	...	...	...	...	...	...	776·81	668·19	...		
		Sundry claims	...	...	10·00	2·81	...	5·21	15·98	1,318·26	561·29	...		
Burbanks	5605	Burbanks Deeps	...	...	...	...	...	...	...	103·00	53·46	...		
	5706	Lord Bobs	...	...	91·50	31·53	...	...	...	91·50	31·53	...		
	5443	New Gift	...	...	...	...	...	...	2·00	601·00	206·10	...		
	5250	Vice Regal	...	...	...	...	...	...	1·91	3,966·00	1,250·21	...		
		Voided leases	...	...	...	...	...	14·90	372·17	415,584·71	304,569·63	**521·06**		
		Sundry claims	...	3·17	184·50	75·30	...	55·05	466·38	14,094·60	8,456·57	...		
Cave Rocks ...	5645	Goldcoin	...	...	...	...	...	...	...	242·75	39·30	...		
	5665	Nornadeen	...	...	...	...	...	...	...	260·75	76·45	...		
		Voided leases	...	...	...	...	...	...	...	2,302·05	588·18	...		
		Sundry claims	...	...	...	...	...	...	50·00	3,415·65	785·28	...		
Coolgardie ...	5679	Ada	...	...	418·25	31·98	...	...	...	800·25	80·33	...		
	5637	Caledonia	...	...	180·75	10·29	...	...	7·30	1,652·25	236·04	...		
	5297, etc. ...	Consolidated Gold Mines of Coolgardie, Ltd.	...	...	890·00	145·23	7·40	...	...	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	...		
	5680	Greenhills	...	...	...	...	...	...	...	16·00	8·48	...		
	5638	Grey's Hill	...	...	...	...	...	...	...	129·00	87·50	...		
	5686	Hillside	...	...	12·00	17·67	...	...	...	12·00	17·67	...		
	5577	Iron Duke	...	...	...	...	...	...	...	826·00	589·23	...		
	5598	King Solomon	...	...	...	...	...	2·69	...	615·00	92·66	...		
	5643	Lloyd George South	...	...	...	...	...	...	...	...	10·25	...		
	5622	Lucky Hit	...	...	67·75	44·70	...	...	...	703·25	297·46	...		
	5239, etc. ...	Phoenix Gold Mines, Limited	...	...	29,431·00	8,262·78	...	...	...	169,915·00	48,123·91	**2·54**		
		Prior to transfer to present holders	...	...	...	...	...	...	2·74	167·56	237·80	...		
		Voided leases	...	...	...	...	...	1,299·02	4,665·92	570,910·43	326,346·17	**·96**		
		Sundry claims	·39	...	479·25	134·14	...	203·72	2,673·45	63,897·53	23,581·12	...		
Eundynie ...	5624	Eundynie	...	...	...	...	...	...	...	54·00	71·56	...		
		Voided leases	...	...	...	...	...	·92	16·09	31,697·20	16,423·28	**1·75**		
		Sundry claims	...	...	...	...	...	...	10·18	630·19	311·52	...		
Gibralter	5217	Lloyd George	...	...	90·00	26·31	...	...	18·69	6,574·88	3,640·55	...		
		Voided leases	...	...	...	...	...	...	15·28	31,849·75	16,424·07	...		
		Sundry claims	...	...	68·50	13·81	...	1·39	50·76	2,891·70	1,273·56	...		

TABLE I.—*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 1945.					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.
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	...	...	1,569·25	1,047·94	...	...	...	1,971·75	1,451·31	...
	P.P.L. 119 ...	Golden Eagle	...	...	...	...	...	...	7·63	2,807·59	2,548·42	...
	P.P.L. 348 ...	Goldfields Australian Development Co., Ltd.	...	...	78·00	12·89	...	...	...	78·00	12·89	...
	P.P.L. 319 ...	Lady May	...	...	589·00	305·78	...	...	...	1,401·50	835·27	...
	P.P.L 315 ...	Malvern Star	...	...	...	...	...	...	...	16·00	10·14	...
	P.P.L. 316 ...	Surprise G.M.	...	...	587·00	133·98	...	...	...	6,084·50	2,985·02	...
	P.P.L. 355 ...	Lady Marie	...	...	65·50	25·13	...	...	...	65·50	25·13	...
		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	...	...	350·00	81·95	...	...	...	7,039·00	1,447·60	...
	5703	Milesi Deeps	...	...	70·75	33·40	...	...	...	70·75	33·40	...
	5662	Sons of Erin	...	...	...	...	...	...	...	68·05	139·85	...
	5293	Two Boys	...	...	...	*94·95	...	...	...	460·00	595·90	...
	5293 (5526) ...	(Two Boys)	...	...	...	...	...	...	...	6,888·00	3,193·95	...
	5666	War Time	...	...	...	...	...	...	26·28	40·00	61·97	...
		Voided leases	...	...	...	...	...	...	347·65	37,829·55	17,159·23	159·44
		Sundry claims	...	...	11·50	2·45	...	...	149·47	3,606·23	1,910·24	...
Larkinville ...	5667	Ground Lark	...	7·96	59·50	18·92	...	...	7·96	59·50	18·92	...
		Voided leases	...	...	...	...	...	22·77	46·48	2,098·91	3,198·09	...
		Sundry claims	...	...	8·50	3·26	...	...	147·20	448·53	1,029·03	...
Logan's	5324	Spargo's Reward Gold Mine (1935), N.L.	...	...	...	...	...	...	...	105,397·50	26,318·11	...
	5681	Twenty Grand	...	...	63·50	33·17	...	...	...	81·00	75·93	...
		Voided leases	...	...	...	...	...	...	...	1,182·31	531·33	...
		Sundry claims	...	...	...	...	...	...	128·95	1,539·10	843·44	...
Londonderry ...	...	Voided leases	...	...	...	...	...	...	93·13	29,817·35	20,886·19	...
		Sundry claims	...	...	19·75	14·67	...	16·68	38·72	3,015·42	2,421·57	22·42
Mungari	...	Voided leases	...	...	...	...	...	...	17·71	735·00	331·78	...
		Sundry claims	...	...	...	...	...	1·77	151·34	1,104·44	433·74	...
Paris	5311, 5500 ...	Lister's Gold Mine	...	...	1,080·00	585·41	...	...	...	3,331·00	2,116·73	...
	5311, 5500, 5530	(Lister's Gold Mine)	...	...	...	...	...	...	...	8,582·00	4,423·84	...
	5500	(Paris Central)	...	...	...	...	...	...	...	113·00	24·16	...
	5514	Paris	...	...	...	...	...	...	...	696·00	337·87	3·24
		Voided leases	...	...	...	...	...	...	4·30	463·00	209·47	...
		Sundry claims	...	...	...	...	...	...	...	2,037·25	501·81	...

Red Hill	...	Voided leases	...	...	...	...	...	14·87	1,551·81	40,797·40	31,070·65	...
		Sundry claims	...	...	...	...	...	15·29	90·11	1,306·52	704·47	...
Ryan's Find ...	...	Voided leases	...	...	...	...	...	...	...	54·16	151·69	...
		Sundry claims	...	...	...	...	...	...	·44	101·69	228·66	...
St. Ive's	5682	Alice May	...	...	40·00	124·66	...	...	...	60·00	130·47	...
	(5617), 5628/9	Ive's Reward Leases	...	...	...	...	...	...	...	1,617·00	450·47	...
		Voided leases	...	...	...	...	...	61·90	146·87	37,600·46	15,603·59	...
		Sundry claims	...	...	...	...	...	211·25	944·85	4,078·56	1,441·72	...
Wannaway ...	...	Voided leases	...	...	...	...	...	...	19·10	1,813·35	1,047·89	...
		Sundry claims	...	...	...	...	...	...	175·11	1,101·42	1,150·43	...
Widgiemooltha ...	5451	Host Group	...	...	...	...	...	...	...	1,601·00	434·38	...
	5658	Iron Knob	...	...	...	...	...	...	6·02	145·00	52·19	...
		Voided leases	...	...	...	...	...	9·42	1,108·92	20,362·70	11,292·64	·17
		Sundry claims	...	3·11	75·00	16·33	...	46·49	418·92	15,246·21	6,552·73	...
	From District generally :—											
	Sundry parcels treated at :											
	State Battery, Coolgardie	...	...	...	*583·27	...	...	...	...	771·01	*31,533·53	9·65
	Australian Machinery and Investment Company's Cyanide Plant	...	...	...	*27·05	...	...	...	...	...	*2,932·84	86·31
	Frank's Cyanide Plant	...	...	...	...	...	...	...	...	...	*1,343·17	...
	Imperial Cyanide Plant	...	...	...	...	...	...	...	...	26·00	*340·76	...
	Lister's 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	33·86	·16	...	...	...	14,675·10	715·18	48·25	64·91	...
	Totals	**34·25**	**14·40**	**36,786·75**	**12,046·50**	**7·40**	**16,667·82**	**15,596·37**	**2,347,819·96**	**1,246,509·99**	**5,861·74**

KUNANALLING DISTRICT.

Carbine	970s	Carbine	...	...	...	...	...	...	...	13,820·00	7,047·96	...
	970s, etc. ...	Carbine leases	...	...	...	...	...	...	687·98	51,991·86	39,862·25	...
		Voided leases	...	...	...	...	...	...	...	20,116·00	5,470·81	...
		Sundry claims	...	...	...	...	...	136·08	93·96	5,851·53	1,946·07	...
Chadwin	1014s	Magdala	...	...	...	4·94	...	...	...	285·50	121·78	...
	1020s	Question Mark	...	...	140·00	137·17	...	...	...	547·00	700·63	...
		Voided leases	...	...	...	...	...	...	...	3,578·55	3,691·68	2·50
		Sundry claims	...	23·05	58·00	65·39	...	14·28	78·02	4,508·55	2,530·10	...
Dunnsville ...	...	Voided leases	...	...	...	...	...	...	828·58	17,489·60	8,642·30	...
		Sundry claims	·53	...	145·25	61·98	...	3·35	1,020·90	2,461·56	1,778·23	...
Jourdie Hills ...	...	Voided leases	...	...	...	...	...	...	18·00	28,009·74	19,401·09	28·45
		Sundry claims	...	...	...	...	...	1·86	49·81	1,648·75	811·80	1·05
Kintore	...	Voided leases	...	...	...	...	...	18·70	169·33	54,044·64	39,197·31	677·88
		Sundry claims	...	...	83·75	54·61	...	111·91	102·70	2,876·13	2,053·88	...
Kunanalling ...	987s	Premier	...	...	230·00	325·61	...	·23	...	4,071·00	2,284·36	...
	919s, 920s, 921s	(Kunanalling Gold, N.L.)	...	...	...	...	...	...	...	6,482·50	5,440·77	...

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

COOLGARDIE GOLDFIELD—*continued.*

KUNUNALLING DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1945.					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.
Kunanalling—*contd.*		Prior to transfer to present holders	...	...	...	...	...	...	...	690·00	847·30	12·78
	988s	Premier North	...	...	...	...	...	...	...	410·00	288·08	...
		Voided leases	...	...	...	...	...	85·90	1,734·92	117,678·66	91,323·50	27·99
		Sundry claims	...	...	149·00	52·66	...	216·53	808·12	12,859·32	8,916·32	...
Kundana	...	Voided leases	...	...	...	...	...	...	...	465·00	68·12	...
		Sundry claims	...	...	...	...	...	...	...	305·25	34·63	...
	From District generally :—											
	Sundry parcels treated at :											
	Goldfields Australian Development Treatment Works		...	...	...	*63·25	...	...	...	...	*548·07	...
	Various Works		...	...	...	...	...	42·23	...	1,782·26	*5,061·33	...
	Reported by Banks and Gold Dealers		1·82	...	...	...	...	857·98	17·93	...	5·85	·49
		Totals	**2·35**	**23·05**	**806·00**	**765·61**	**...**	**1,489·05**	**5,610·25**	**351,973·40**	**248,074·22**	**751·14**

Yilgarn Goldfield.

Blackborne's ...	...	Voided leases	...	...	...	...	...	...	...	1,282·50	341·37	...
		Sundry claims	...	...	...	...	...	...	...	340·50	74·59	...
Bullfinch	4020	Birthday	...	...	...	...	...	...	·95	8·00	60·05	...
	4042	Birthday South	...	...	...	...	...	...	1·03	15·00	50·50	...
	3345	Copperhead	...	...	...	...	...	...	...	7,427·32	2,076·32	...
	3378	Copperhead Deeps	...	...	...	...	...	...	...	13,554·65	4,102·83	...
	3337, 3458 ...	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	...	...	...	...	...	...	6·73	6,456·03	2,634·10	...
	4009	Reynold's Find	...	...	...	...	...	...	...	241·00	114·95	...
	3350	Rising Sun	...	...	...	...	...	...	2·30	37,059·53	10,837·80	...
	4076	Two Boys	...	...	191·00	40·40	...	...	...	191·00	40·40	...
		Voided leases	...	...	...	...	...	...	10·14	489,929·07	185,333·68	27,958·41
		Sundry claims	...	...	...	...	...	8·47	37·04	7,284·75	3,949·16	...
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	...
	3415	Deliverance	...	...	...	...	...	...	...	3,019·40	3,173·07	...
		Voided leases	...	...	...	...	...	...	...	135,095·00	30,011·76	...
		Sundry claims	...	...	66·00	82·98	...	...	·68	1,088·35	640·61	...

Eenuin	4067	Lone Pine	...	...	...	...	...	...	...	...	106·75	29·41	...
	4060	Star of Eenuin	...	...	...	...	...	...	2·33	390·25	279·33	...
	3937, 4008, 4016	Yellowdine Gold Areas, N.L.	...	...	...	...	...	...	...	7,341·50	7,605·06	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	281·00	418·04	...
		Voided leases	...	...	...	...	...	...	176·13	1,359·56	1,562·42	...
		Sundry claims	...	...	...	...	...	·60	73·97	2,291·60	1,602·46	...
Evanston	3895	Blue Peter	...	...	...	...	...	...	...	1,288·00	285·84	...
	3868	Evanston	...	...	...	...	...	...	...	48,125·30	25,848·30	10·14
	3870	Evanston East	...	...	...	...	...	...	...	34·00	13·59	...
	3869	Evanston North	...	...	...	...	...	...	...	1,598·76	1,079·93	...
	3888	Goldie's	...	...	...	...	...	...	...	200·00	43·15	...
	3997	Gravel Pit	...	...	...	...	...	...	79·27	238·80	160·25	...
		Voided leases	...	...	...	...	...	...	...	649·00	230·70	...
		Sundry claims	...	...	...	...	...	4·98	...	503·35	133·66	...
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	...
	3248	Radio Deeps	...	...	178·00	20·62	...	...	...	5,710·58	6,291·15	...
	2994, etc. ...	Radio leases	...	...	768·50	626·95	...	...	2·70	17,497·80	38,593·97	7·43
	3993	Stumpy Doodle	...	...	...	...	...	...	·58	2,280·00	824·22	8·99
		Voided leases	...	...	...	...	...	...	35·76	10,802·84	10,584·40	2·00
		Sundry claims	...	...	79·00	15·94	...	4·58	57·83	6,155·77	4,527·78	1·02
Greenmount ...	...	Voided leases	...	...	...	...	...	45·99	21·62	125,022·64	31,575·09	944·50
		Sundry claims	...	...	...	...	...	·46	4·27	2,856·58	779·67	...
Holleton	3788	Brittania	...	...	...	...	...	...	...	278·00	423·91	...
	3923	Holleton East	...	...	520·00	40·68	...	...	...	4,764·00	465·89	2·74
	(4071)	Lovelly Lady	...	...	127·50	17·05	...	...	...	127·50	17·05	...
		Voided leases	...	...	...	...	...	...	9·33	39,808·75	12,554·58	31·79
		Sundry claims	...	...	...	...	...	...	3·75	3,464·05	923·78	·20
Hope's Hill ...	3414	Pilot	...	...	...	...	...	...	...	19,446·12	2,948·68	...
	4033	Queen Elizabeth	...	...	...	...	...	...	...	113·00	46·22	...
		Voided leases	...	...	...	...	...	...	74·78	132,361·55	36,369·69	1·00
		Sundry claims	...	...	...	...	...	18·67	33·36	4,151·02	1,301·77	...
Kennyville ...	3875	Victoria	...	...	...	...	...	...	...	3,592·00	841·55	·63
		Voided leases	...	...	...	...	...	...	18·76	55,581·63	21,520·61	·59
		Sundry claims	...	...	...	...	...	...	5·06	8,237·50	2,137·54	...
Koolyanobbing ...	...	Voided leases	...	...	...	...	...	...	...	1,707·05	884·28	...
		Sundry claims	...	...	...	...	...	·26	...	580·00	225·46	...
Marvel Loch ...	4046	Banker	...	...	...	...	...	...	...	50·00	19·67	...
	3897, etc. ...	Burbidge Gold Mines, N.L.	...	...	...	...	...	...	...	72,785·00	7,404·15	...
	3987	(Grand National)	...	...	...	...	...	...	...	19,739·00	2,647·30	...
	4003	Christmas Gift	...	...	...	...	...	...	1·40	90·00	46·58	...
	3957	Comet	...	...	...	...	...	...	...	1,067·00	639·66	6·85
	13P.P. ...	Cricket	...	...	...	...	...	...	...	1,616·00	921·75	...
	3966	Donovan's Find	...	...	...	...	...	...	...	200·05	56·02	...
	3942, 3943 ...	Edward's Reward Leases ...	...	...	1,220·00	491·99	...	...	...	19,007·50	9,663·59	...
	3942	(Edward's Reward)	...	...	...	...	...	...	...	2,080·00	2,016·32	...
	3943	(Sunshine)	...	...	...	...	...	...	...	3,866·00	2,384·79	...

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 1945.					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.
Marvel Loch—*contd.*												
	4034	Firelight	...	...	...	...	...	...	...	645·00	117·54	...
	3724	Frances Firness	...	...	...	...	...	...	...	8,012·00	3,731·76	...
	3941	Geelong	...	...	...	...	...	...	1·95	413·50	73·37	...
	3683	Golden Cube	...	...	...	...	...	...	20·27	1,310·00	653·54	...
	4074	Greenbird	...	...	10·00	4·80	...	...	...	50·00	98·62	...
	3718	Karrajong	...	...	...	...	...	...	...	9,106·00	3,231·11	...
	4047	Lenneberg's Reward	...	...	...	...	...	...	...	341·00	32·40	...
	3431, 3781	Lenodo Leases	...	...	...	...	...	...	...	5,006·00	1,032·14	·36
		Prior to transfer to present holders	...	...	...	...	...	...	...	1,056·00	177·67	...
	3914	May	...	...	...	...	...	...	...	145·00	45·86	...
	3459	May Queen	...	...	...	...	...	...	...	3,738·00	6,922·23	...
	4073	Mountain King	...	...	...	...	...	...	...	17·00	8·75	...
	3970	Mountain Queen	...	...	165·00	17·47	...	...	...	661·00	382·37	...
	3390, etc.	N.G.M., Ltd.	...	...	...	...	...	...	...	4,067·50	351·36	·50
		Prior to transfer to present holders	...	...	...	...	...	...	...	2,675·00	459·60	...
	4068	Try Again	...	...	370·00	106·68	...	...	...	760·00	281·96	...
	4035	Undaunted	...	...	...	...	...	...	...	742·00	92·19	...
	4006	Union Jack	...	...	...	...	...	...	...	907·00	177·74	1·04
		Voided leases	...	...	...	...	...	...	385·60	626.945·16	176,930·88	2,464·70
		Sundry claims	...	...	78·00	13·71	...	11·35	215·63	33,282·84	12,847·20	...
Mt. Jackson	3449	Die Hardy	...	...	...	...	...	...	...	365·50	343·86	...
	3859	Great Unknown	...	...	...	...	...	...	14·71	708·50	650·97	...
	3418	Clamp's Central	...	...	...	...	...	...	...	1,232·50	665·35	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	7,224·00	6,457·63	6·34
		Voided leases	...	...	...	...	...	...	164·60	44,202·28	30,726·43	2,307·43
		Sundry claims	...	...	...	...	...	6·44	52·87	9,841·85	4,463·45	70·74
Mt. Palmer	3544, etc.	Yellowdine Gold Development, Ltd.	...	...	...	17·80	...	...	...	304,234·50	155,392·62	...
		Prior to transfer to present holders	...	...	...	...	...	...	...	1,564·65	2,540·71	...
		Voided leases	...	...	...	...	...	...	...	67·25	22·90	...
		Sundry claims	...	...	...	...	...	1,643·48	18·19	385·25	356·07	...
Mt. Rankin	3555	No Trumps	...	...	...	...	...	...	...	5,205·37	819·29	...
		Voided leases	...	...	...	...	...	3·84	5·20	496·00	122·17	...
		Sundry claims	...	...	...	...	...	...	...	491·00	117·59	...
Parker's Range	3520	Centenary	...	...	...	...	...	...	...	1,671·00	440·00	...
	4064	Groper	...	1·65	...	...	...	...	32·03	41·00	157·18	...
	4052	McIntosh	...	...	40·00	43·53	...	...	...	332·00	234·03	...
	4000	Olga	...	...	...	...	...	...	...	96·00	114·14	...
	4062	Victory	...	...	...	...	...	...	...	719·00	518·49	...
	3969	White Horseshoe	...	...	329·00	252·01	...	...	...	2,354·60	1,420·09	25·95
		Voided leases	...	...	...	...	...	·42	117·30	53,185·75	25,965·05	·45
		Sundry claims	...	...	15·00	10·45	...	6·59	51·73	10,005·75	4,381·83	·8

Southern Cross ...	4004	Excelsior	...	...	...	...	...	...	...	866·00	261·16	...
	4018	Fraser's	...	...	...	...	...	...	...	1,211·50	152·41	...
	4010	Lord Cardigan	...	...	...	...	...	...	...	280·00	36·13	...
	3944	Nil Desperandum	...	...	...	...	...	...	...	1,297·00	189·83	...
	4032	Queen Ann	...	...	20·00	1·98	...	...	...	345·00	39·92	...
	3444, etc. ...	Three Boys Gold Mines, Limited ...	...	...	...	...	...	...	...	9,947·00	1,376·56	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	452,851·68	214,952·47	364·41
		Sundry claims	...	...	...	...	...	95·90	642·09	8,099·66	2,609·39	...
Westonia	3308, etc. ...	Edna May (W.A.) Amalgamated G.Ms., N.L.	...	...	10,861·00	3,779·27	238·15	...	...	113,190·00	48,773·85	4,234·06
		Prior to transfer to present holders	...	...	...	...	...	...	...	4,092·00	2,867·26	...
	4023	Greenfinch	...	...	...	...	...	...	...	479·65	432·13	...
		Voided leases	...	...	...	...	...	...	4·06	445,495·49	314,459·63	21·78
		Sundry claims	...	...	...	...	...	9·51	64·96	3,853·41	2,487·34	...
	From Goldfield generally :—											
	Sundry Parcels treated at :											
	Centenary Cyanide Plant	...	...	...	*5·18	...	...	...	...	...	*455·52	...
	Copperhead Cyanide Plant	...	...	...	*194·15	...	...	...	...	...	*16,165·08	...
	Holleton Cyanide Plant	...	...	...	*13·96	...	...	...	...	...	*691·34	47·50
	Howlett's Battery	...	...	...	*61·39	...	...	...	...	110·00	*13,392·98	...
	Howlett's Cyanide Plant (Banker Sands) ...	...	...	...	*56·92	...	...	...	...	...	*56·92	...
	Invermay Cyanide Plant	...	...	...	...	...	...	...	...	...	*608·49	3·57
	Kurrajong Cyanide Plant	...	...	...	...	...	...	...	...	...	*409·57	...
	Pilot Cyanide Plant	...	...	...	...	...	...	...	...	...	*3,745·95	...
	Queen Ann Treatment Works	...	...	...	...	...	...	...	...	...	*169·05	...
	Radio Deeps Cyanide Plant	...	...	...	*7·67	...	...	...	...	...	*1,488·89	...
	Three Boys Cyanide Plant	...	...	...	...	...	...	...	...	7·00	*2,249·37	...
	E. C. and L. C. Wesley's Cyanide Plant ...	...	...	...	*5·37	...	...	...	...	...	*1,220·67	...
	Various Works	...	...	...	...	...	...	...	...	161·28	*61,553·57	36·54
	Reported by Banks and Gold Dealers	·60	4·96	...	1·54	...	313·91	67·10	...	9·54	...	
	Totals	**·60**	**6·61**	**15,038·00**	**5,930·49**	**238·15**	**2,180·34**	**2,835·18**	**3,579,035·46**	**1,641,974·81**	**38,563·00**

Dundas Goldfield.

Buldania	...	Voided leases	...	...	...	...	...	...	3·02	846·05	708·99	...
		Sundry claims	...	...	...	...	...	...	36·53	1,281·02	837·20	·12
Dundas	...	Voided leases	...	...	...	...	...	1·88	28·02	6,103·48	2,545·38	155·02
		Sundry claims	...	...	...	...	...	·76	413·85	1,761·75	1,019·19	17·81
Norseman ...	1596	Abbotshall	...	...	26·00	16·82	·68	...	...	2,473·20	1,068·63	752·33
	(1656)	Black Cat	...	...	10·00	14·70	1·16	...	...	35·50	60·96	5·11
	1468	Bronzewing	...	...	158·00	155·22	16·44	...	33·89	1,708·50	1,356·25	86·50
	1617	Caesar	...	...	...	...	...	...	...	54·00	42·72	...
	1319, etc. ...	Central Norseman Gold Corporation, N.L.	...	...	73,488·00	24,668·52	17,041·01	...	...	759,599·20	281,537·31	266,944·61
		Prior to transfer to present holders	...	...	...	...	...	...	1,663·32	69,436·58	47,782·56	16,508·66
	1452	Cumberland Central	...	...	...	...	...	...	...	265·25	72·77	·19
	1462	Cumberland Central West ...	...	...	...	...	...	...	...	118·00	36·75	...
	1619	Dunkerque	...	...	6·00	5·48	·47	...	...	246·75	240·07	4·86
	1637	Ellen Terry	...	...	79·50	120·04	12·90	...	...	505·25	770·34	73·74
	1421, (1534) ...	Empress Gold Mines, N.L.	...	...	...	...	...	...	...	567·50	516·08	54·61

TABLE I.—*Production of Gold and Silver from all sources, etc.*—continued.

DUNDAS GOLDFIELD—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1945.					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.
Norseman—*contd.*												
	(1668)	Hopetoun	...	...	40·00	68·59	1·96	...	...	40·00	68·59	1·96
	(1653)	Houghton	...	2·52	...	...	·28	...	11·52	35·00	27·56	4·18
	1665	Lady Eunice	...	...	47·75	46·37	4·04	...	...	47·75	46·37	4·04
	1364	Lady Mary	...	...	...	...	...	...	...	99·00	15·45	...
	(1666)	Lake View	...	...	24·00	32·74	2·73	...	...	24·00	32·74	2·73
	1490, etc. ...	Norseman Associated G.Ms., N.L. ...	...	...	...	...	...	...	...	17,917·00	3,216·75	4,981·00
		Prior to transfer to present holders	...	...	...	...	...	...	...	83·25	23·47	...
	1315, etc. ...	Norseman Gold Mines, N.L.	...	...	40,580·00	5,626·00	8,814·00	...	...	916,142·00	234,454·95	342,347·54
		Prior to transfer to present holders	...	...	...	...	...	...	...	2,656·75	669·38	...
	1588	O.K.	...	...	...	...	...	...	...	288·00	133·72	2·37
	1661	O.K. South	...	...	26·00	34·73	3·69	...	...	64·00	58·13	5·65
	1422	Onkaparinga	...	...	194·00	331·36	26·12	...	...	591·75	1,131·79	105·66
	1468, 1422 ...	Bronzewing and Onkaparinga (prior to cancellation of amalgamation)	...	...	...	...	...	...	...	843·00	1,396·98	3·62
	1660	Second Front	...	...	...	...	...	...	...	24·00	5·78	·33
	1530	Second Try	...	...	720·00	470·16	50·49	...	4·37	1,536·75	843·93	101·30
	1667	Sun	...	...	22·00	29·38	3·65	...	...	22·00	29·38	3·65
	1657	Trump	...	...	83·00	31·62	3·05	...	...	257·25	111·37	11·39
	1624	Valhalla	...	...	118·50	74·94	5·14	...	...	334·00	251·62	12·74
		Voided leases	...	...	...	...	...	9·31	10,551·37	891,402·47	585,967·60	36,638·93
		Sundry claims	...	...	202·50	159·25	13·27	1,041·31	3,377·55	44,026·91	21,244·36	161·48
Peninsula	1616	Day Dawn	...	...	...	...	...	...	...	364·75	414·21	3·60
	1597	Peninsula North	...	...	...	...	...	...	...	191·75	231·07	7·54
		Voided leases	...	...	...	...	...	...	24·29	8,817·14	5,373·87	...
		Sundry claims	...	...	...	...	...	...	...	203·00	108·18	·97
	From Goldfield generally :—											
	Sundry Parcels treated at :											
	State Battery, Norseman		...	...	...	...	...	...	...	405·39	*24,094·06	1,023·65
	Princess Royal Cyanide Plant		...	...	...	...	...	...	...	...	*1,949·04	1,571·78
	Various Works		...	...	...	...	...	...	54·52	483·14	*12,857·24	844·36
	Reported by Banks and Gold Dealers		·90	1·96	...	...	...	1,181·77	42·99	47·50	18·62	·43
		Totals	**·90**	**4·48**	**115,825·25**	**31,855·92**	**26,001·08**	**2,235·03**	**16,245·24**	**2,731,949·58**	**1,233,371·41**	**672,444·46**

Phillips River Goldfield.

Hatter's 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, etc. ...	Beryl Gold Mines, Limited	...	...	...	...	...	...	...	2,365·00	2,330·52	197·78
	261	Gem Restored	...	...	...	...	...	...	...	68·00	10·29	...
		Voided leases	...	...	...	...	...	113·28	556·17	82,109·58	58,196·98	3,811·03
		Sundry claims	...	·18	...	...	...	90·27	73·02	6,404·18	1,939·25	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	7,251·57	3,194·41	41·12
West River ...	...	Voided leases	...	...	...	...	...	...	...	...	10·34	31·06
		Sundry claims	...	...	...	...	...	...	...	...	6·60	3·44
	From Goldfield generally :—												
	Sundry Parcels treated at :												
	Cordingup Cyanide Plant	...	...	...	...	...	...	...	...	...	*909·37	4·36
	Floater Cyanide Plant	...	...	...	3·45	...	...	...	...	12·00	*245·95	...
	Daw and Toleman Cyanide Plant	...	...	...	...	...	...	...	...	...	*342·19	...
	J. T. Hunt's Smelter Reserve	...	...	...	4·67	...	...	...	...	...	4·67	...
	Kundip Cyanide Plant	...	...	...	...	...	...	...	...	15·00	15·25	...
	Various Works	...	...	...	...	...	...	...	...	...	*1,927·99	496·46
	Reported by Banks and Gold Dealers	...	...	...	...	...	164·69	12·14	...	...	...
	TOTAL	...	·18	...	8·12	...	607·11	818·28	129,683·03	103,046·67	15,992·66

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	...	...	...	...	...	44·01	42·29	119·50	15·71	15·18
Jimperding ...	45P.P. ...	Hillsdale	...	...	...	...	...	...	...	1,261·75	298·05	...
Roebourne ...	68H, 70H ...	Corderoy Mines, Limited	...	...	...	...	...	...	...	1,954·50	451·44	10·79
		Voided leases	...	...	...	...	...	177·74	93·21	19,975·11	22,105·90	1,258·16
		Sundry claims	...	...	...	...	...	46·39	88·97	1,074·35	845·13	99·11
	Reported by Banks and Gold Dealers	...	...	...	...	...	6,063·75	170·45	103·50	228·32	...
	From State generally :—												
	Sundry Parcels treated at :												
	Fremantle Smelter, Limited	...	...	...	...	...	...	...	...	...	*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	...	...	...	...	...	245·45	14·13	201·60	43·58	...
	Reported by Banks and Gold Dealers	38·78	16·29	...	...	...	1,019·33	845·80	...	240·14	59·99
	TOTAL	38·78	16·29	...	...	...	7,624·15	1,311·70	27,414·21	35,076·99	32,969·86

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 1945.

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 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240 lbs.).	Fine ozs.	Fine ozs.	Fine ozs.
Kimberley	... ...	...	...	...	...	...	...	107·38	...	...	...	107·38	...
Pilbara	Marble Bar ...	48·41	...	12,638·75	7,098·28	7,146·69	...	116·80	151·43	17,744·25	8,797·67	9,065·90	...
	Nullagine ...	68·39	151·43	5,105·50	1,699·39	1,919·21	...						
Ashburton	... ...	...	...	...	...	...	...	16·66	22·21	...	...	38·87	...
Gascoyne	... ...	...	...	...	...	...	...	...	...	...	...	...	...
Peak Hill	... ...	...	...	...	...	...	...	...	53·27	499·00	488·08	541·35	...
East Murchison ...	Lawlers ...	2·81	...	27,815·50	7,275·32	7,278·13	...	2·81	7·40	383,960·25	50,369·36	50,379·57	...
	Wiluna ...	...	7·40	355,324·75	41,682·37	41,689·77	...						
	Black Range ...	...	...	820·00	1,411·67	1,411·67	...						
Murchison	Cue	28·92	366·49	987·40	917·06	1,312·47	...	64·24	531·60	37,644·15	20,782·46	21,378·30	192·59
	Meekatharra ...	7·49	9·93	2,392·00	2,499·21	2,516·63	...						
	Day Dawn ...	1·82	146·89	1,729·50	7,859·52	8,008·23	...						
	Mt. Magnet ...	26·01	8·29	32,535·25	9,506·67	9,540·97	192·59						
Yalgoo	... ...	...	...	...	...	...	...	8·13	32·61	1,466·00	835·90	876·64	1·07
Mt. Margaret ...	Mt. Morgans ...	12·31	19·49	1,749·60	4,154·44	4,186·24	...	32·01	20·73	70,877·25	26,693·95	26,746·69	1,870·08
	Mt. Malcolm ...	3·17	1·24	68,367·25	21,530·88	21,535·29	1,870·08						
	Mt. Margaret...	16·53	...	760·40	1,008·63	1,025·16	...						
North Coolgardie ...	Menzies ...	3·60	7·28	4,550·75	3,607·61	3,618·49	...	6·52	87·99	5,766·75	4,741·51	4,836·02	·18
	Ularring ...	2·92	72·99	626·00	793·30	869·21	...						
	Niagara ...	...	...	264·00	110·35	110·35	·18						
	Yerilla ...	...	7·72	326·00	230·25	237·97	...						
Broad Arrow ...	... ...	...	...	...	...	...	...	10·61	121·51	1,653·00	1,454·46	1,586·58	...
N.E. Coolgardie ...	Kanowna ...	47·45	31·35	183·10	85·83	164·63	...	47·49	64·02	183·10	85·83	197·34	...
	Kurnalpi ...	·04	32·67	...	...	32·71	...						
East Coolgardie ...	East Coolgardie	40·93	556·68	1,048,133·14	302,701·80	303,299·41	98,288·93	42·75	589·51	1,048,342·14	302,741·05	303,373·31	98,288·93
	Bulong ...	1·82	32·83	209·00	39·25	73·90	...						
Coolgardie	Coolgardie ...	34·25	14·40	36,786·75	12,046·50	12,095·15	7·40	36·60	37·45	37,592·75	12,812·11	12,886·16	7·40
	Kunanalling ...	2·35	23·05	806·00	765·61	791·01	...						
Yilgarn	... ...	...	...	...	...	...	...	·60	6·61	15,038·00	5,930·49	5,937·70	238·15
Dundas	... ...	...	...	...	...	...	...	·90	4·48	115,825·25	31,885·92	31,891·30	26,001·08
Phillips River ...	... ...	...	...	...	...	...	...	...	·18	...	8·12	8·30	...
Outside Proclaimed Goldfields ...		...	...	...	...	...	...	38·78	16·29	...	...	55·07	...
		...	...	...	...	...	...	**532·28**	**1,747·29**	**1,736,591·89**	**467,626·91**	**469,906·48**	**126,599·48**

TABLE III.

RETURN SHOWING TOTAL PRODUCTION REPORTED TO THE MINES DEPARTMENT, AND RESPECTIVE DISTRICTS AND GOLDFIELDS FROM WHENCE DERIVED, TO 31ST DECEMBER, 1945.

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 (2,240lbs.).	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.).	Fine ozs.	Fine ozs.	Fine ozs.
Kimberley	... ...	...	...	...	...	...	...	7,932·58	142·43	22,453·15	17,036·31	25,111·32	93·00
Pilbara	Marble Bar ...	14,745·75	4,410·08	273,714·37	282,412·14	301,567·97	755·05	24,401·79	5,202·97	351,457·56	373,852·21	403,456·97	783·72
	Nullagine ...	9,656·04	792·89	77,743·19	91,440·07	101,889·00	28·67						
Ashburton	... ...	...	...	...	...	...	...	9,255·14	428·60	5,684·25	2,398·70	12,082·44	8,183·68
Gascoyne	... ...	...	...	...	...	...	...	677·52	41·57	387·00	517·29	1,236·38	...
Peak Hill	... ...	...	...	...	...	...	...	3,374·41	5,160·38	609,759·68	291,723·55	300,258·34	2,311·33
East Murchison ...	Lawlers ...	6,858·86	2,277·48	1,947,921·76	805,927·39	815,063·73	26,279·64	8,698·59	21,658·03	12,371,022·82	3,558,317·19	3,588,673·81	51,663·06
	Wiluna ...	222·36	1,246·51	8,703,519·09	1,807,889·83	1,809,358·70	2,889·42						
	Black Range ...	1,617·37	18,134·04	1,719,581·97	944,499·97	964,251·38	22,494·00						
Murchison	Cue	4,960·84	8,054·18	3,372,724·29	913,873·92	926,888·94	118,589·05	24,678·84	57,006·06	8,994,701·91	4,170,742·62	4,252,427·52	295,372·32
	Meekatharra ...	14,235·52	17,436·50	2,226,247·49	1,268,019·21	1,299,691·23	5,042·27						
	Day Dawn ...	2,990·90	11,213·18	2,016,227·78	1,339,195·36	1,353,399·44	169,210·44						
	Mt. Magnet ...	2,491·58	20,302·20	1,379,502·35	649,654·13	672,447·91	2,530·56						
Cashmere	... ...	...	...	...	...	...	...	1,749·07	2,955·70	430,515·21	256,376·66	261,081·43	1,498·07
Mt. Margaret ...	Mt. Morgans ...	3,313·34	9,281·53	1,198,408·96	698,802·10	711,396·97	5,781·64	10,996·86	32,579·56	9,437,460·09	4,408,384·42	4,451,960·84	216,005·95
	Mt. Malcolm ...	3,734·38	13,999·64	5,774,565·99	2,572,520·11	2,590,254·13	148,631·13						
	Mt. Margaret...	3,949·14	9,298·39	2,464,485·14	1,137,062·21	1,150,309·74	61,593·18						
North Coolgardie ...	Menzies ...	1,616·81	6,307·81	1,450,555·19	1,174,026·90	1,181,951·52	29,736·86	4,755·53	18,442·06	2,993,938·59	2,172,624·81	2,195,822·40	42,290·91
	Ularring ...	122·68	6,568·44	368,529·85	343,335·24	350,026·36	6,098·46						
	Niagara ...	1,704·65	1,813·65	924,601·52	512,969·65	516,487·95	5,603·60						
	Yerilla ...	1,311·39	3,752·16	250,252·03	142,293·02	147,356·57	851·99						
Broad Arrow ...	... ...	...	...	...	...	...	...	21,881·11	26,135·35	1,269,701·35	692,157·72	740,174·18	5,262·41
N.E. Coolgardie ...	Kanowna ...	106,446·98	12,636·97	996,319·56	621,689·94	740,773·89	3,039·73	119,266·81	20,919·02	1,009,468·88	640,110·16	780,295·99	3,050·95
	Kurnalpi ...	12,819·83	8,282·05	13,149·32	18,420·22	39,522·10	11·22						
East Coolgardie ...	East Coolgardie	33,231·09	40,355·73	50,506,172·16	26,853,873·07	26,927,459·89	3,470,536·07	60,606·63	56,350·69	50,684,864·46	26,984,330·81	27,101,288·13	3,470,548·99
	Bulong ...	27,375·54	15,994·96	178,692·30	130,457·74	173,828·24	12·92						
Coolgardie	Coolgardie ...	16,667·82	15,596·37	2,347,819·96	1,246,509·99	1,278,774·18	5,861·74	18,156·87	21,206·62	2,699,793·36	1,494,584·21	1,533,947·70	6,612·88
	Kunanalling ...	1,489·05	5,610·25	351,973·40	248,074·22	255,173·52	751·14						
Yilgarn	... ...	...	...	...	...	...	...	2,180·34	2,835·18	3,579,035·46	1,641,974·81	1,646,990·33	38,563·00
Dundas	... ...	...	...	...	...	...	...	2,235·03	16,245·24	2,731,949·58	1,233,371·41	1,251,851·68	672,444·46
Phillips River ...	... ...	...	...	...	...	...	...	607·11	818·28	129,683·03	103,046·67	104,472·06	15,992·66
Outside Proclaimed Goldfields ...		...	...	...	...	...	...	7,624·15	1,311·70	27,414·21	35,076·99	44,012·84	32,969·86
		...	...	...	...	...	...	**329,078·38**	**289,439·44**	**97,349,290·59**	**48,076,626·54**	**48,695,144·36**	**4,863,647·25**

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, 1945; 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 1942	22,422·06	12,496·15	34,918·21	147,484·65	280,307·59	427,792·24
1942	....	605·88	605·88	127·94	15,747·25	15,875·19
1943	....	249·60	249·60		16,222·38	16,222·38
1944	....	154·00	154·00	234·60	12,871·67	13,106·27
1945	....	113·81	113·81	....	8,203·99	8,203·99
Total	22,422·06	13,169·44	36,041·50	147,847·19	333,352·88	481,200·07
	(*a*) WEST PILBARA.			ASHBURTON.		
Prior to 1942	4,351·11	26,760·61	31,111·72	4,104·96	5,663·53	9,768·49
1942	....	....	....	....	95·42	95·42
1943	....	....	....	....	33·57	33·57
1944	....	....	....	....	69·21	69·21
1945	....	....	....	....	53·36	53·36
Total	4,351·11	26,760·61	31,111·72	4,104·96	5,915·09	10,020·05
	(*b*) GASCOYNE.			(*c*) PEAK HILL.		
Prior to 1942	304·55	1,063·89	1,368·44	41,102·76	201,959·34	243,062·10
1942	....	....	....	....	253·82	253·82
1943	....	....	....	....	388·52	388·52
1944	....	....	....	....	446·42	446·42
1945	....	....	....	....	389·95	389·95
Total	304·55	1,063·89	1,368·44	41,102·76	203,438·05	244,540·81
	EAST MURCHISON.			MURCHISON.		
Prior to 1942	248,242·17	2,708,605·19	2,956,847·36	1,572,292·46	2,805,423·00	4,377,715·46
1942	3,850·32	82,262·14	86,112·46	853·58	85,325·67	86,179·25
1943	3,025·25	63,725·90	66,751·15	568·11	25,431·99	26,000·10
1944	23·76	44,926·42	44,950·18	1·18	16,304·32	16,305·50
1945	3,723·82	43,178·04	46,901·86	....	18,498·50	18,498·50
Total	258,865·32	2,942,697·69	3,201,563·01	1,573,715·33	2,950,983·48	4,524,698·81
	(*d*) YALGOO.			(*e*) MT. MARGARET.		
Prior to 1942	13,543·93	184,894·73	198,438·66	689,577·54	3,519,858·74	4,209,436·28
1942	6·80	2,981·14	2,987·94	1,867·53	41,497·11	43,364·64
1943	22·42	1,272·93	1,295·35	411·87	24,666·82	25,078·69
1944	....	1,042·47	1,042·47	297·57	23,414·33	23,711·90
1945	....	788·86	788·86	413·27	20,755·71	21,168·98
Total	13,573·15	190,980·13	204,553·28	692,567·78	3,630,192·71	4,322,760·49
	(*f*) NORTH COOLGARDIE.			(*g*) BROAD ARROW.		
Prior to 1942	263,061·61	1,946,226·26	2,209,287·87	122,324·23	391,254·60	513,578·83
1942	12·82	19,339·58	19,352·40	69·14	8,950·04	9,019·18
1943	97·63	8,220·58	8,318·21	46·24	7,318·34	7,364·58
1944	3·08	5,937·46	5,940·54	8·56	2,398·22	2,406·78
1945	48·62	4,792·75	4,841·37	1·33	976·11	977·44
Total	263,223·76	1,984,516·63	2,247,740·39	122,449·50	410,897·31	533,346·81
	(*f*) NORTH-EAST COOLGARDIE.			(*f*) EAST COOLGARDIE.		
Prior to 1942	235,812·00	455,165·42	690,977·42	7,013,065·36	20,231,318·63	27,244,383·99
1942	19·42	494·60	514·02	7,246·74	443,509·94	450,756·68
1943	6·03	395·36	401·39	828·72	316,369·51	317,198·23
1944	38·71	492·21	530·92	488·24	293,919·88	294,408·12
1945	....	235·28	235·28	513·14	319,060·21	319,573·35
Total	235,876·16	456,782·87	692,659·03	7,022,142·20	21,604,178·17	28,626,320·37
	(*h*) COOLGARDIE.			YILGARN.		
Prior to 1942	662,573·28	1,095,879·04	1,758,452·32	217,424·97	1,427,697·70	1,645,122·67
1942	58·32	32,199·57	32,257·89	929·82	30,765·37	31,695·19
1943	172·36	16,897·52	17,069·88	600·83	14,505·05	15,105·88
1944	48·59	14,022·60	14,071·19	87·90	9,287·35	9,375·25
1945	55·55	11,590·78	11,646·33	12·47	5,160·98	5,173·45
Total	662,908·10	1,170,589·51	1,833,497·61	219,055·99	1,487,416·45	1,706,472·44
	(*i*) DUNDAS.			(*j*) PHILLIPS RIVER.		
Prior to 1942	168,814·53	1,010,051·80	1,178,866·33	40,571·16	61,364·67	101,935·83
1942	74·13	66,630·78	66,704·91	23·50	964·46	987·96
1943	40·35	44,115·34	44,155·69	1·88	80·80	82·68
1944	376·43	38,559·52	38,935·95	5·85	106·99	112·84
1945	55·81	29,157·22	29,213·03	....	109·98	109·98
Total	169,361·25	1,188,514·66	1,357,875·91	40,602·39	62,626·90	103,229·29
	¶ DONNYBROOK.			OUTSIDE PROCLAIMED GOLDFIELDS.		
Prior to 1942	282·21	557·53	839·74	20,077·90	34,394·25	54,472·15
1942	....	....	....	536·42	881·20	1,417·62
1943	....	....	....	586·65	172·87	759·52
1944	....	....	....	210·52	486·69	697·21
1945	....	....	....	205·37	455·81	661·18
Total	282·21	557·53	839·74	21,616·86	36,390·82	58,007·68

(*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
Total	11,516,374·31	38,701,4731·14	50,217,847·45	276,296,675

	1944. £	1945. £
Estimated total par value of above production	211,321,534	213,311,810
Premiums received on sales of gold during 1920–1924 and 1930–1944 (approximate)	59,964,600	62,984,865
Estimated Total	£A271,286,134	£A276,296,675
Gross estimated value of gold won (including £161,448, bonus paid under the Commonwealth Bounty Act, 1930)	£A271,447,582	£A276,458,123

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 1945, AND PREVIOUS YEARS.

Period.	ALUNITE (POTASH).				ARSENIC.†	
	Yilgarn Goldfiled.		Total.		East Murchison Goldfield (Wiluna District).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£
Prior to 1942	....	....	....	....	26,308·70	483,691
1942	....	....	....	....	2,727·00	57,267
1943	....	....	....	....	2,283·00	47,943
1944	943·20	14 229	943·20	14,229	2,304·00	48,384
1945	1,358·80	23,902	1,358·80	23,902	1,989·00	41,771
Total	**2,302·00**	**38,131**	**2,302·00**	***38,326**	**35,611·70**	**679,056**

* Includes Alunite valued at £195 from State generally. † By-product from Wiluna Goldfields, Ltd.

Period.	ANTIMONY.*								
	East Murchison Goldfield.			Pilbara Goldfiled.			Total.		
	Conc.	Metal.	Value.	Conc.	Metal.	Value.	Conc.	Metal.	Value.
	tons.	tons.	£	tons.	tons.	£	tons.	tons.	£
Prior to 1942	3,869·06	1,837·39	37,202	27·29	10·13	252	†3,917·13	1,859·08	37,945
1942	1,670·77	879·24	22,820	12·65	5·58	207	1,683·42	884·23	43,027
1943	1,742·43	848·23	63,295	24·83	11·65	647	1,767·26	859·88	63,942
1944	....	....	....	5·92	3·60	252	5·92	3·60	252
1945	....	....	....	....	....	....	....	....	....
Total	**7,282·26**	**3,564·86**	**123,317**	**70·69**	**30·96**	**1,358**	**7,373·73**	**3,607·38**	**145,166**

* By product of Gold Mining. † Includes 20·78 tons Conc. containing 11·56 tons Metal valued at £491 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 1942	10·00	959	1,650·00	73,279	*1,301·98	32,417	*2,961·98	106,655
1942	....	....	....	....	119·03	5,788	119·03	5,788
1943	....	....	12·25	456	230·83	12,519	243·08	12,975
1944	....	....	2·00	200	306·53	10,656	308·53	10,856
1945	....	....	....	....	1,091·94	44,662	1,091·94	44,662
Total	**10·00**	**959**	**1,664·25**	**73,935**	**3,050·31**	**106,042**	**4,724·56**	**180,936**

* Includes 5 tons valued at £20 from East Coolgardie Goldfield.

Period.	BERYL ORE.									
	Pilbara Goldfield.		Murchison Goldfield.		Coolgardie Goldfield.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	....	....	....	....	....	....	9·55	83	9·55	83
1942	....	....	....	....	....	....	....	....	....	....
1943	476·75	13,560	....	....	....	....	38·74	1,004	515·49	14,564
1944	298·89	9,380	21·53	824	28·71	945	37·83	1,452	386·96	12,602
1945	11·13	324	3·00	104	19·23	519	·25	5	33·61	*952
Total	**786·77**	**23,264**	**24·53**	**928**	**47·94**	**1,464**	**86·37**	**2,544**	**945·61**	**28,201**

* Incomplete.

TABLE VI.—*Minerals other than Gold*—continued.

Period.	BENTONITE.		BISMUTH		CLAYS.					
	State Generally.		State Generally.		Collie Mineral Field.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity	Value.	Quantity.	Value.
	tons.	£	lbs.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	....	....	3,398·40	1,029	1,051·00	738	5,299·55	3,406	6,350·55	4,144
1942	15·70	33	....	....	....	....	797·50	449	797·50	449
1943	159·03	337	560·00	137	....	....	2,111·75	1,387	2,111·75	1,387
1944	290·90	660	*1,042·00	482	....	....	1,615·50	1,726	1,615·50	1,726
1945	50·00	120	506·00	152	....	....	2,363·00	1,424	2,363·00	1,424
Total	515·63	1,150	5,506·40	1,800	1,051·00	738	12,187·30	8,392	13,238·30	9,130

* Amended.

Period.	COAL.		COPPER ORE.									
	Collie Coalfield.		West Kimberley Goldfield.		Pilbara Goldfield. Marble Bar District.		Pilbara Goldfield. Nullagine District.		West Pilbara Goldfield.		Ashburton Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	15,530,828·02	10,259,323	109·83	1,702	32·87	386	14·00	480	82,745·45	748,482	353·07	6,431
1942	581,175·81	461,495	....	....	....	....	....	....	....	....	....	....
1943	531,546·38	489,721	....	....	....	....	....	....	....	....	....	....
1944	558,322·11	583,076	....	....	....	....	....	....	....	....	....	....
1945	543,362·55	572,895	....	....	....	....	....	....	....	....	....	....
Total	17,745,234·87	12,366,510	109·83	1,702	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 1942	1,030·10	32,364	238·56	4,525	1,024·02	11,236	38·40	413	24,026·25	119,497	171·55	1,889
1942	13·25	268	9·43	152	....	....	....	....	....	....	....	....
1943	....	....	·40	33	....	....	....	....	....	....	....	....
1944	....	....	26·80	183	18·00	54	....	....	....	....	....	....
1945	....	....	9·12	159	....	....	30·45	205	....	....	....	....
Total	1,043·35	32,632	283·75	5,052	1,042·02	11,290	68·85	618	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 1942	47,860·52	230,846	6·12	51	50·67	379	95,747·03	588,464	....	....
1942	....	....	....	....	....	....	9·40	241	16·00	77
1943	....	....	....	....	....	....	....	....	....	....
1944	....	....	....	....	....	....	†1·21	*130	....	....
1945	....	....	....	....	....	....	....	....	....	....
Total	47,860·52	230,846	6·12	51	†50·67	379	95,757·64	588,335	16·00	77

* Metallic value. † Incomplete.

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 1942	18·30	256	253,466·74	1,747,401	....	....	....	....	....	24	18,373·00	1,609
1942	....	....	48·08	738	....	....	....	....	....	....	....	....
1943	....	....	·40	33	40·00	640	....	....	....	....	....	....
1944	....	....	46·01	367	....	....	158·51	795	....	....	....	....
1945	....	....	39·57	364	*30·00	480	105·35	502	....	....	....	....
Total	18·30	256	253,600·80	1,748,903	70·00	1,120	263·86	1,297	....	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 1942	....	....	24,859·25	53,607	415·00	816	25,274·25	54,422	52·00	58
1942	13·00	130	3,240·50	9,712	11·00	22	3,251·50	9,734	111·00	141
1943	....	....	2,289·00	6,867	24·50	57	2,313·50	6,924	340·30	304
1944	....	....	1,881·00	10,376	77·50	155	1,958·50	10,531	157·50	204
1945	....	....	1,234·50	4,321	....	....	1,234·50	4,321	175·00	227
Total	13·00	130	33,504·25	84,883	528·00	1,050	34,032·25	85,931	835·55	934

Period.	GADOLINITE.		GLAUCONITE.		GRAPHITE.		LEAD ORE.			
	Pilbara Goldfield. (Marble Bar District).		State Generally.		State Generally.		Northampton Mineral Field.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	1·00	112	2,147·50	17,671	1·10	12	416,714·89	1,280,207	107·00	1,529
1942	....	....	260·00	6,500	6·00	30	....	....	....	....
1943	....	....	98·00	2,450	11·00	55	1,250·00	1,100	....	....
1944	....	....	144·00	3,600	....	....	....	....	....	....
1945	....	....	180·00	4,500	....	....	....	....	....	....
Total	1·00	112	2,829·50	34,721	18·10	97	417,964·89	1,281,307	107·00	1,529

Period.	LEAD ORE—*continued.*		*LIMESTONE.							
	Total.		Murchison Goldfield (Cue District.).		Yilgarn Goldfield.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons	£	tons.	£	tons.	£
Prior to 1942	416,821·89	1,281,736	298·00	772	2,548·00	1,607	90,859·00	15,911	93,705·00	18,290
1942	....	....	....	....	....	....	....	....	....	....
1943	1,250·00	1,100	....	....	....	....	....	....	....	....
1944	....	....	....	....	....	....	....	....	....	....
1945	....	....	....	....	....	....	....	....	....	....
Total	418,071·89	1,282,836	298·00	772	2,548·00	1,607	90,859·00	15,911	93,705·00	18,290

* Only reported to year 1907.

Period.	GYPSUM.						IRON ORE.	
	Yilgarn Goldfield.		State Generally.		Total.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	11,374·00	10,892	101,618·00	120,803	112,992·00	131,695	*57,830·00	36,695
1942	....	....	2,877·55	3,136	2,877·55	3,136	150·00	225
1943	....	....	935·30	880	935·30	880	84·35	12[illegible]
1944	....	....	3,604·45	3,723	3,604·45	3,722	....	....
1945	....	....	7,232·50	9,136	7,232·50	9,136	....	....
Total	11,374·00	10,892	116,267·80	137,678	127,641·80	148,570	58,064·35	37,048

* Includes 450 tons from East Coolgardie Goldfield.

Period.	MAGNESITE.						MANGANESE.		PHOSPHATIC GUANO.	
	East Coolgardie Goldfield (Bulong District).		Coolgardie Goldfield.		Total.		Peak Hill Goldfield.		State Generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	924·40	1,140	267·00	242	1,191·41	1,382	77·00	436	59·73	314
1942	....	....	25·00	100	25·00	100	....	....	....	....
1943	....	....	....	....	....	....	....	....	42·00	21
1944	....	....	....	....	....	....	....	....	2,215·00	12,183
1945	....	....	....	....	....	....	....	....	8,483·00	46,656
Total	924·40	1,140	292·00	342	1,216·41	1,482	77·00	436	10,799·73	59,174

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.
	lbs.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	*9,012·00	532	†74,047·56	45,496	....	....	....	....	693·40	6,730	693·40	6,730
1942	389·00	115	368·00	607	....	....	....	....	143·00	1,360	143·00	1,360
1943	13,907·75	715	13,942·00	19,078	15·35	46	....	....	382·00	3,820	397·00	3,866
1944	8,367·50	1,279	43,648·00	68,340	20·00	80	74·00	563	851·00	7,064	945·00	7,707
1945	....	....	66,504·00	102,053	....	....	50·00	320	600·00	2,766	650·00	3,086
Total	**31,676·25**	**2,641**	198,509·56	235,574	**35·35**	**126**	**124·00**	**883**	**2,002·00**	**15,088**	**2,828·75**	**22,749**

* Includes 78.68 lbs. Crude Mica. † Prior to 1942 from Mt. Margaret Goldfield.

Period.	Silver Lead Ore.						Soapstone.					
	Pilbara Goldfield (Marble Bar District).		Ashburton Goldfield.		Total.		Greenbushes 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 1942	195·00	3,658	2,974·00	35,796	3,169·00	39,454	....	....	....	....	....	....
1942	....	....	....	....	....	....	255·00	950	10·00	25	265·00	975
1943	....	....	....	....	....	....	....	....	....	....	....	....
1944	....	....	....	....	....	....	262·00	828	....	....	262·00	828
1945	....	....	....	....	....	....	....	....	....	....	....	....
Total	**195·00**	**3,658**	**2,974·00**	**35,796**	**3,169·00**	**39,454**	**517·00**	**1,778**	**10·00**	**25**	**527·00**	**1,803**

Period.	Talc.		Vermiculite.							
	East Coolgardie Goldfield.		East Coolgardie Goldfield. (Bulong District).		Yilgarn Goldfield.		State Generally.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Prior to 1942	....	....	95·40	677	....	....	204·35	1,292	299·75	1,969
1942	38·00	57	....	....	....	....	178·40	1,070	178·40	1,070
1943	72·55	170	....	....	20·00	60	342·80	2,057	362·80	2,117
1944	....	....	....	....	....	....	123·00	738	123·00	738
1945	....	....	....	....	....	....	59·00	254	59·00	254
Total	**110·55**	**227**	**95·40**	**677**	**20·00**	**60**	**907·55**	**5,411**	**1,022·95**	**6,148**

Period.	Tin.											
	Kimberley Goldfield.				Pilbara Goldfield (Marble Bar District).				East Murchison Goldfield.			
	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 1942	....	....	....	....	372·62	5,529·68	5,902·30	546,828	....	....	....	....
1942	....	....	....	....	....	10·70	10·70	2,265	....	....	....	....
1943	....	·60	·60	143	....	4·60	4·60	1,022	·14	....	·14	53
1944	....	....	....	....	9·87	....	9·87	2,175	....	....	....	....
1945	....	....	....	....	....	10·81	10·81	2,250	·25	....	·25	50
Total	....	·60	·60	143	382·49	5,555·79	5,938·28	554,540	·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 1942	477·31	10,834·58	11,311·89	992,371	844·83	16,363·63	*17,213·93	*1,539,620	51·87	201·45	253·32	116,428
1942	9·26	3·45	12·71	2,369	9·26	14·15	23·41	4,634	·66	....	·66	332
1943	5·69	·18	5·87	1,097	5·83	5·38	11·21	2,315	·87	....	·87	780
1944	·90	....	·90	176	10·77	....	10·77	2,351	9·86	....	9·86	12,851
1945	8·05	2·65	10·70	2,069	8·30	13·46	21·76	4,369	....	....	....	....
Total	496·11	10,840·23	11,336·34	998,082	879·59	16,401·49	17,281·08	1,553,289	63·26	201·45	264·71	130,391

* Includes 4·72 tons valued at £360 ; ·15 tons valued at £15 ; and ·60 tons valued at £46, the product of Cue, Coolgardie, and Yilgarn Goldfields respectively.

Period.	TANTALITE—*continued.*								TIN-TANTALUM.	
	Greenbushes Mineral Field.				Total.				Greenbushes Mineral Field.	
	Quantity.			Value.	Quantity.			Value.	Quantity.	Value. (Tin content only)
	Lode.	Stream.	Total.		Lode.	Stream.	Total.			
	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	£
Prior to 1942	....	3·94	3·94	2,009	*54·37	205·39	259·80	120,777	....	....
1942	....	·18	·18	118	·66	·18	·84	450	....	....
1943	....	7·38	7·38	6,952	·87	7·38	8·25	7,732	....	....
1944	....	....	....	....	†10·17	....	10·17	13,020	20·16	2,045
1945	....	....	....	....	....	....	....	....	6·17	915
Total	....	11·50	11·50	9,079	66·07	212·95	279·07	141,979	26·33	2,960

* Includes 2·50 tons valued at £2,340 from Coolgardie Goldfield.

† Includes ·31 tons valued at £169 from Coolgardie Goldfield.

Period.	WOLFRAM.								SCHEELITE.			
	Broad Arrow Goldfield.		Yalgoo Goldfield.		State Generally.		Total.		Murchison Goldfield.		Yalgoo Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	units.	£	units.	£	units.	£	units.	£	units.	£	units.	£
Prior to 1942	....	....	....	....	601	1,506	601	1,506	....	....	....	....
1942	16	88	1	8	....	....	17	96	....	....	....	....
1943	....	....	14	80	....	....	14	80	....	....	194	1,050
1944	....	....	....	....	....	....	....	....	11	59	....	....
1945	....	....	....	....	....	....	....	....	....	....	....	....
Total	16	88	15	88	601	1,506	632	1,682	11	59	194	1,050

Period.	SCHEELITE—*continued.*											
	Broad Arrow Goldfield.		Coolgardie Goldfield (Coolgardie District).		North Coolgardie Goldfield (Menzies District).		Yilgarn Goldfield.		Dundas Goldfield.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	units.	£	units.	£	units.	£	units.	£	units.	£	units.	£
Prior to 1942	70	175	723	2,216	388	970	....	....	4	10	1,185	3,371
1942	....	....	58	321	10	36	....	....	....	....	68	357
1943	....	....	281	1,540	7	24	8	41	2	9	492	2,664
1944	....	....	16	90	....	....	3,873	21,271	....	....	3,900	21,420
1945	....	....	....	....	....	....	1,638	8,946	....	....	1,638	8,946
Total	70	175	1,078	4,167	405	1,030	5,519	30,258	6	19	7,283	36,758

TABLE VII.

Quantity and Value of Minerals, other than Gold and Sil ver, reported during year, 1945.

Number of Lease, Claim, or Area.	Goldfield.	Registered Name of Company or Lease.	Quantity.		Value.
		ALUNITE.			
			tons.	Potash tons.	£A.
M.Ls. 41 and 43 ...	Yilgarn ...	State (W.A.) Alunite Industries ...	21,628·00	1,358·80	23,901·90
		ARSENIC.			
G.M.L. 667J	East Murchison	Wiluna G.Ms., Ltd.	1,989·00	...	41,771·00
		ASBESTOS—(Anthophyllite).			
Private Property (Bindi-Bindi)	State generally	Midland Mining & Development Synd.	81·00	...	870·00
		ASBESTOS—(Chrysotile).			
M.C. 263H (Nunyerri) ...	State generally	Stein, K.	19·64	...	918·00
		ASBESTOS—(Crocidolite).			
M.C. 269H, etc. (Yampire Gorge)	State generally	Australian Blue Asbestos, Ltd.	388·32	...	13,203·60
M.C. 249H (Wittenoom Gorge)	State generally	Walters, I.	4·10	...	305·00
M.C.s 164H, 221H, etc. (Wittenoom & Yampire Gorges)	State generally	W.A. Blue Asbestos Fibres Co., Ltd. ...	598·88	...	29,365·84
			1,091·94	...	44,662·54
		BENTONITE.			
M.Cs. 258H, etc. (Marchagee)	State generally	Fennell & Bryant	50·00	...	120·00
		BERYL ORE.			
Crown Lands	Pilbara ...	Lamont, G.	11·13	...	324·00
P.A. 3071	Murchison ...	Giles, A. S.	2·00	...	70·00
P.A. 3073	Murchison ...	Rule, G.	1·00	...	34·00
M.L. 80, etc.	Coolgardie ...	Australian Glass Manufactures Pty. ...	19·23	...	519·42
M.C. 111H (Balingup) ...	State generally	Oma, V. C.	·25	...	5·50
			33·61	...	952·92
		BISMUTH.			
				Metal lbs.	
M.L. 373H (Yinnietharra)	State generally	Burt, G. H.	...	328	98·70
Crown Lands (Yinnitharra)	State generally	Burt, G. H.	...	178	53·40
			...	506	152·10
		CLAYS.			
M.Cs. 150H, etc. (Clackline)	State generally	Clackline Firebrick Co.	1,533·00	...	771·30
M.C. 247H (Mt. Kokeby)	State generally	Linton, J. B.	54·00	...	270·00
M.L. 357H (Mt. Helena) ...	State generally	Swan Portland Cement, Ltd.	776·00	...	383·00
			2,363·00	...	1,424·30
		COAL.			
			tons.		
M.Ls. 314, etc.	Collie Mineral Field	Griffin Coal Mining Co., Ltd. ...	77,699·70	...	78,303·10
		Wyvern Colliery	13,477·50	...	13,857·20
M.Ls. 85, etc.	Collie Mineral Field	Amalgamated Collieries of W.A.—			
		Cardiff Mine	60,033·70	...	62,069·36
		Co-operative Mine	62,112·68	...	68,438·76
		Proprietary Mine	127,228·95	...	138,154·18
		Stockton Mine	90,028·83	...	97,854·08
		Stockton Open Cut	112,781·19	...	114,218·85
			543,362·55	...	572,895·53

TABLE VII—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1945.

Number of Lease, Claim, or Area.	Goldfield.	Registered Name of Company or Lease.	Quantity.		Value.
		COPPER ORE.			
				Metal—tons.	
P.A. 1329 (Lawlers) ...	East Murchison	E. Jessop	9·12	1·70	158·72
P.A. 2363 (Field's Find)	Yalgoo ...	M. P. Malone	30·45	4·07	205·16
			39·57	5·77	363·88
		DOLOMITE.			
M.Ls. 11M, etc. (Mt. Magnet)	Murchison ...	Atkinson & Giles	105·35	...	502·00
		FELSPAR.			
M.L. 80, etc.	Coolgardie ...	Australian Glass Mfs. Co. Pty., Ltd. ...	1,234·50	...	4,321·25
		GLASS SAND.			
M.Cs. 161H etc. (East Wanneroo)	State generally	W. M. Leach	175·00	...	227·00
		GLAUCONITE.			
			Greensand. tons.	Glauconite. tons.	
Private Property (Gingin)	State generally	G. E. Brook	900·00	180·00	4,500·00
		GYPSUM.			
M.Cs. 33H, etc. (Woolundra)	State generally	Ajax Plaster Co., Ltd.	1,427·50	...	1,962·81
M.Cs. 110H, etc. (Baandee)	State generally	Perth Modelling Works	3,406·00	...	3,725·15
M.C. 293H (Woolundra) ...	State generally	P. Ripper	229·00	...	257·87
M.C. 280H, etc. (Lake Brown)	State generally	G. R. Saunders	2,170·00	...	3,189·90
			7,232·50	...	9,135·73
		KYANITE.†			
Crown Land (Bridgetown)	State generally	Payne, H. E.	19·95	...	100·00
		PHOSPHATIC GUANO.			
Lands Dept. (Pelsart Island)	State generally	British Phosphate Commissioners ...	8,483·00	...	46,656·50
		PYRITES.			
G.MLs. 146o, etc. ...	Dundas ...	Norseman G.Ms., N.L.	66,504·00	...	102,053·00
		RED OCHRE.			
			tons.		
P.A. 3051 (Cue)	Murchison ...	J. E. Cassidy & W. Gregory	10·00	...	70·00
M.C. 26 (Cue)	Murchison ...	J. C. Zadow & J. E. Cassidy	40·00	...	250·00
M.L. 370H (Opthalmia Range)	State generally	Smith & Dodds	563·00	...	2,252·00
P.A. 840H (Opthalmia Range)	State generally	D. Nelley	37·00	...	514·00
			650·00	...	3,086·00
		TIN.			
				tons.	
P.A. 1295	East Murchison	R. M. Hinde	...	·25	50·33
M.C. 4, etc.	Greenbushes...	F. E. D. Freeman	...	8·05	1,635·00
M.C. 27, etc.	Greenbushes...	Collett & Freeman	...	1·30	160·00
D.Cs. 99, 100	Greenbushes...	Joice Bros.	...	·55	110·00
Sundry Claims	Greenbushes...	Sundry Claims	...	·80	164·00
D.C. 16 (Moolyella) ...	Pilbara ...	R. Brompton-Byrnes	...	6·35	1,364·90
Sundry Claims	Pilbara ...	Sundry Claims	...	4·46	885·70
			...	21·76	4,369·93

†Late reported for 1938.

TABLE VII.—*continued.*

Quantity and Value of Minerals, other than Gold and Silver, reported during year 1945.

Number of Lease, Claim, or Area.	Goldfield.	Registered Name of Company or Lease.	Quantity.			Value.
		TUNGSTEN ORES—(Scheelite).	Ore. tons.	Concentrates. tons.	Units.	Value £A.
T.L. 132, G.M.L. 3447 ...	Yilgarn ...	Edna May (W.A.) Amalgamated G.Ms., N.L.	36,132	26·08	1,638	8,945·72
		VERMICULITE.		Quantity. tons.		Value £A.
M.C. 187H, etc. (Young River)	State generally	Perth Modelling Works		59·00	...	254·00
		TIN TANTALUM.			tons.	
M.C. 4	Greenbushes...	F. E. D. Freeman		...	·42	Not known
D.Cs. 97, 99	Greenbushes...	J. M. and J. B. Joice		...	5·75	*915·00
				...	6·17	915·00

*Tin content value only

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