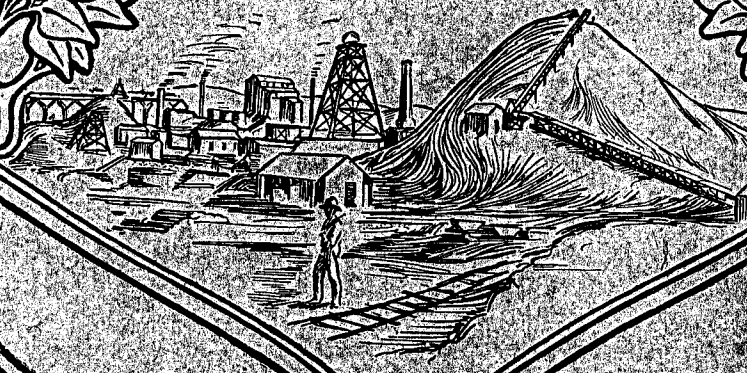




REPORT
OF THE
DEPARTMENT OF MINES
FOR THE YEAR
WESTERN · 1921 · AUSTRALIA



PRESENTED TO BOTH HOUSES OF PARLIAMENT

BY HIS EXCELLENCY'S COMMAND



1922.

WESTERN AUSTRALIA.

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FOR THE YEAR

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[SECOND SESSION OF THE ELEVENTH PARLIAMENT.]

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1922.

ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1921.

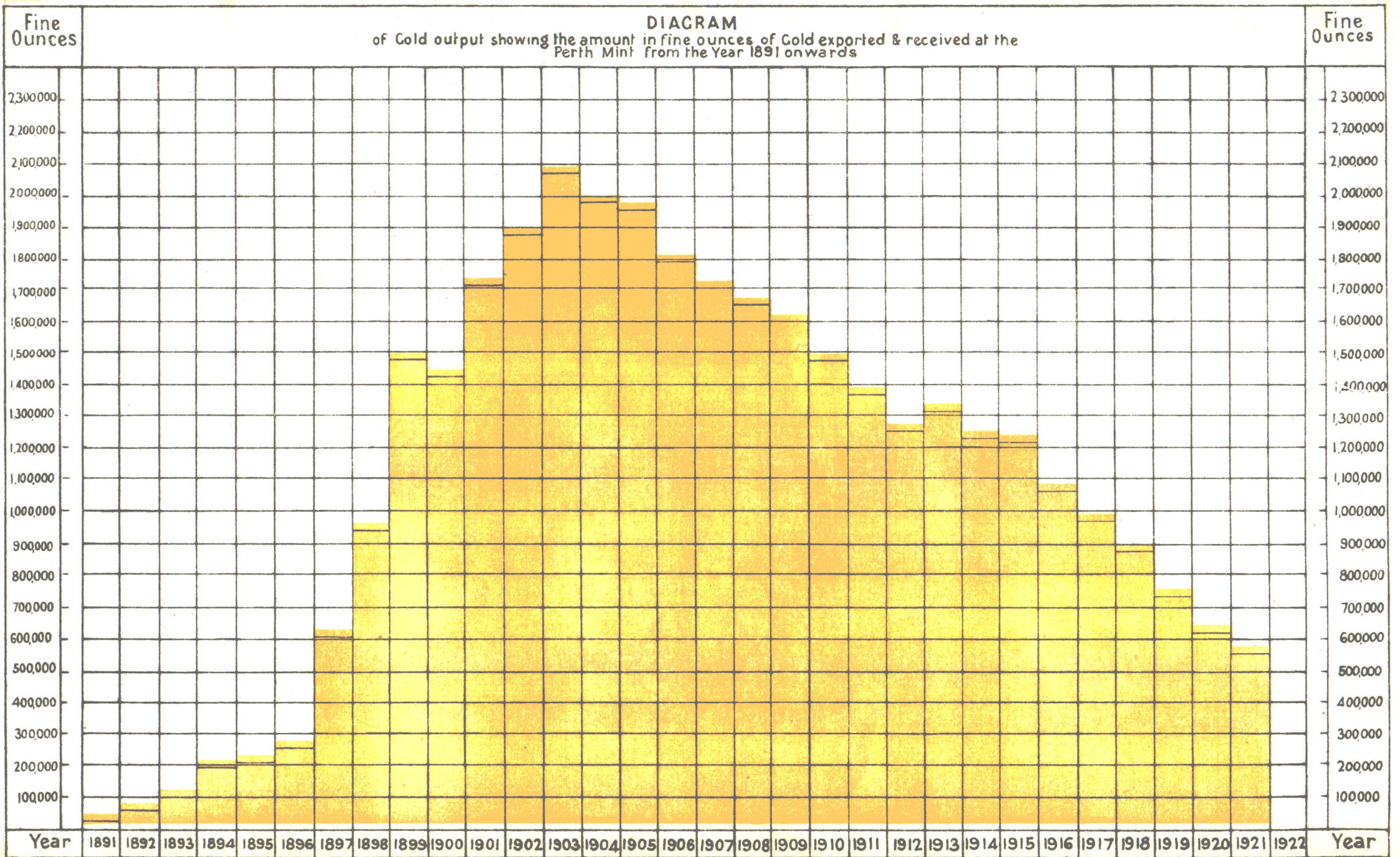
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STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines for the State of Western Australia,
for the Year 1921.

To the Hon. the Minister for Mines.

Sir,—

I have the honour to submit the Annual Report of the Department for the year 1921, with summaries of reports from the Wardens and other officers, together with various comparative tables furnishing statistics relating to the Mining Industry of the State.

Reports from the officers controlling the various sub-Departments are also submitted.

I have, etc.,

M. J. CALANCHINI,
Under Secretary for Mines.

Department of Mines, Perth, 31st March, 1922.

DIVISION I.

Summary by the Under Secretary for Mines.

PART I.—GENERAL REMARKS.

II.—MINERALS RAISED.

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

IV.—MEN EMPLOYED.

V.—ACCIDENTS.

VI.—STATE AID TO MINING.

VII.—REMARKS ON THE GOLDFIELDS AND
MINERAL DISTRICTS, AND SUM-
MARIES OF WARDENS' AND OTHER
OFFICERS' REPORTS.

VIII.—EXISTING LEGISLATION.

IX.—INSPECTION OF MACHINERY.

X.—SCHOOL OF MINES.

PART I.—GENERAL REMARKS.

The value of the mineral output of the State for the year 1921 was £2,880,169, being £379,242 less than that for the previous year.

Copper ore exported showed a decrease of 471 tons, and copper ingot, matte, etc., an increase of 69 tons.

Coal showed an increase, but Silver and Tin decreases.

The value of the gold yield was £2,352,098, being 81.87 per cent. of the total output.

The value of the coal output was £407,117, Copper £24,601, Silver £18,658, and Tin £6,485.

The dividends paid by Mining Companies amounted to £306,958, and in the preceding year £384,083, a decrease of £77,125.

The total dividends paid to the end of 1921 were £28,115,705. To the same date the total mineral production was £153,872,213, and the total gold production £145,706,152.

GOLD.

The gold yield again shows a decline, being 64,111 fine ounces less than in 1920, which was 116,224 fine ounces less than in 1919.

The average value per ton of ore treated in the State as a whole has risen from 42.22 shillings in 1920 to 51.56 shillings in 1921, and in the East Coolgardie Goldfield, which produced over 72 per cent. of the State's reported yield, from 47.02 shillings to 50.37 shillings.

Comparing the tonnage of ore treated in 1920 and 1921, there was a decrease of 392,097 tons in the latter year, during which 857,510 tons were treated.

There were decreases in all the fields excepting Broad Arrow, North-East Coolgardie, and Phillips River, where there were increases of 3,796, 2,284, and 415 tons respectively. The greatest decreases were in Yilgarn and Mount Margaret, viz., 70,956 and 193,075 tons, respectively.

Working costs show an increase, the average cost per ton of 2,000lbs. being, as furnished by the Chamber of Mines, 38s. 7d. For the last few years the costs have been:—In 1914, 20s. 6d.; in 1915, 19s. 9d.; in 1916, 22s. 3d.; in 1917, 23s. 7d.; in 1918, 24s. 8d.; in 1919, 26s. 2d. to 35s. 10d.; in 1920, 29s. 6d. to 37s. 3d.

There were increases in the outputs of Broad Arrow, Coolgardie, North-East Coolgardie, and Yalgoo; all the others recorded decreases.

The acreage held under mining lease for all minerals is 53,736, being a decrease of 12,647 acres when compared with 1920.

The area leased for gold mining is less by 12,647 acres, but for minerals greater by 62 acres.

The area held under prospecting areas is 70,801 acres, including 49,462 acres for coal and oil.

This is an increase of 6,381 acres on the area held in 1920, and does not include the acreage held under Oil Licenses, which cover practically the whole State.

The number of men engaged in all classes of mining was 7,084; a decrease of 1,412 on the figures for 1920.

The number of men engaged in mining for minerals other than gold decreased by 344, the principal falling off being in Lead and Tin. In Coal and Asbestos mining there were increases.

In gold mining there was a decrease of 1,068 men.

The average value of gold produced per man employed on gold mines has fallen from £381.26 in 1920 to £378.30 in 1921.

The average tonnage raised per man was 146.76 tons, and in the previous year 180.61 tons.

In the East Murchison field there was a falling off, but prospects at Lawlers continue to be promising, several shows giving encouraging returns.

In the Wiluna centre there was no improvement, the expected capital for development of the large ore bodies there not having materialised.

The Black Range district continued exceedingly quiet, the bulk of the output coming from Youanmi.

The Murchison field had a decreased output.

In the Meekatharra district there was little change in any of the mines.

The Cue district recorded a falling off, and no developments of note transpired.

In the Day Dawn district matters are exceedingly quiet. In the Mt. Magnet district there is a lot of prospecting going on, and although the production was smaller than in the preceding year prospects are good.

The Mount Margaret field recorded a large decrease.

In the Mount Margaret district the cessation of operations at the Lancefield Mine, besides affecting the output, had a most depressing effect on the industry generally.

The Mount Morgans district had two good producers in the Westralia Mount Morgans Mine and the Bindah Mine at Linden, and recorded an increase.

In the Mount Malcolm district there was a considerable reduction, due to a cessation of operations at the Sons of Gwalia Mine, where in the early part of the year the greater portion of the surface plant was destroyed by fire.

The Government came to the assistance of the men thrown out of work in consequence of this by rendering them considerable financial assistance to undertake prospecting, but, unfortunately, the results were very disappointing. It is hoped the mine will be in full operation again at an early date.

The Coolgardie field had an increase.

In the Gibraltar district one or two mines are looking promising. The water scheme has been extended to them in the hope that it will materially aid their development. One has also been assisted in the erection of a treatment plant.

In the Kununalling district there was little change. The Carbine Mine continued to be a steady producer.

At Widgiemooltha prospecting has been active and results encouraging. At St. Ives the State battery has been completed, and a few months should prove some of the mines.

The North Coolgardie field had a decrease.

In the Menzies district there was a falling off owing to the temporary closing down of the Menzies Consolidated Mine at Yunndaga.

At Comet Vale and Mt. Ida mining was practically at a standstill. In the Ularring district the Riverina South Mine was producing and promises well. In the Niagara and Yerilla districts mining was very quiet.

The North-East Coolgardie goldfield had an increase, but notwithstanding this there is little to report.

Alunite mining was still at a standstill pending the results of certain experiments as to its value as a fertiliser. Nothing sensational has, so far, been revealed by the boring for deep alluvial at Kanowna. The outside centres remained quiet.

The Broad Arrow field had a small increase, but although a good many prospectors were out, nothing of note was reported.

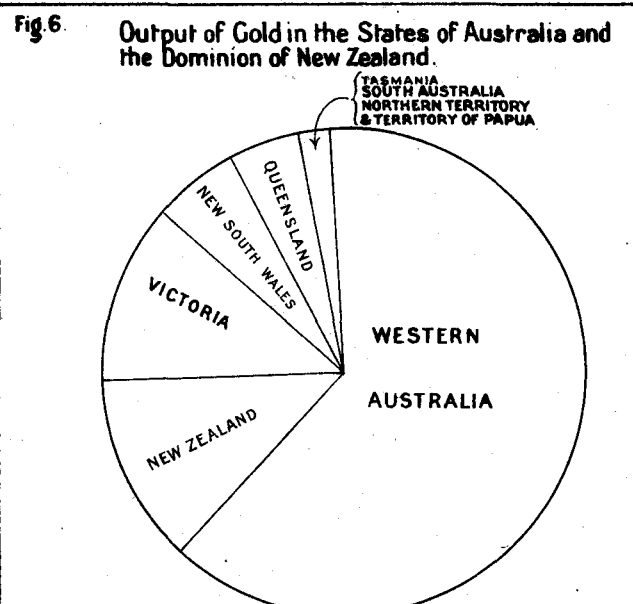
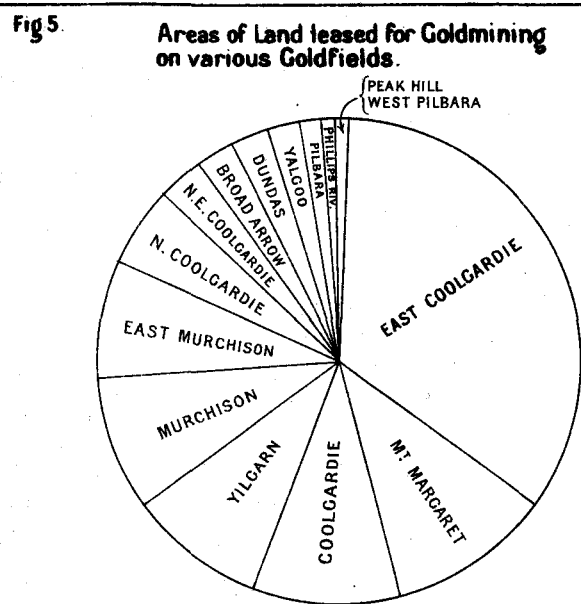
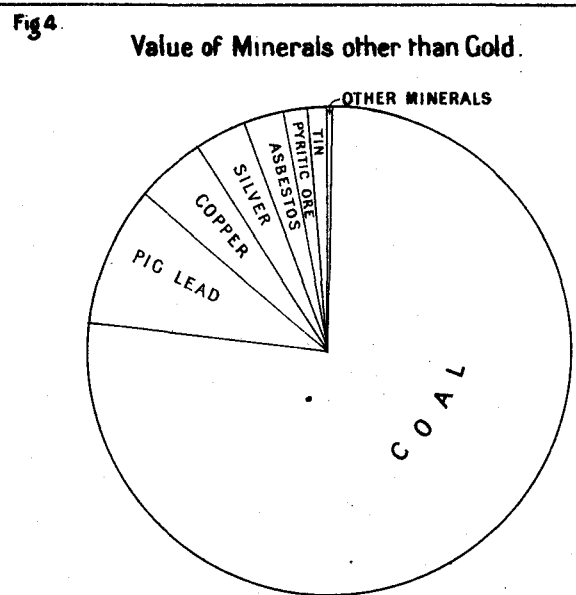
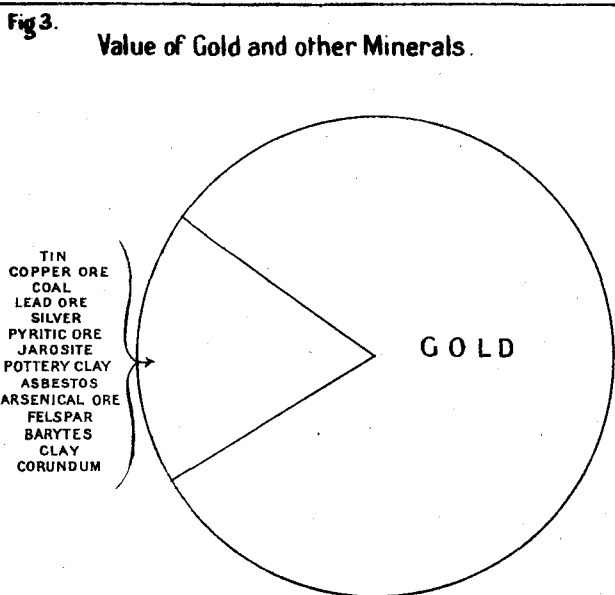
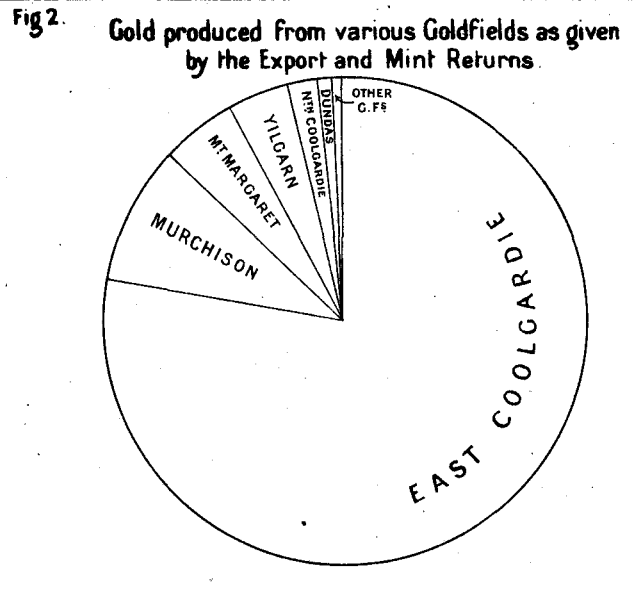
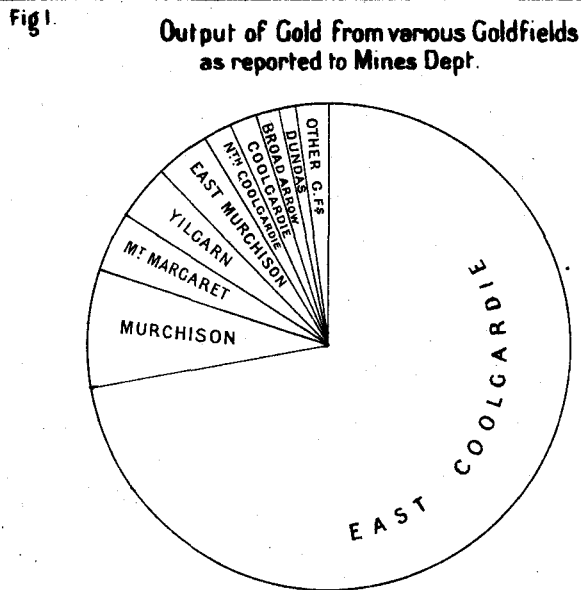
In the East Coolgardie Goldfield the number of men engaged in mining was 2,776, and in 1920, 3,374; a decrease of 598. This goldfield gave employment to over 46 per cent. of the number of men engaged in gold mining, and the reported production during the year was 378,430 fine ounces, over 72 per cent. of the total reported yield. The tonnage treated was 635,816 tons, being less than in 1920 by 88,752 tons. The yield showed a decrease on the preceding year of 23,066 fine ounces.

The average grade of the ore per ton appreciated from 47.02 shillings in 1920 to 50.37 shillings in 1921.

In the Yilgarn Field there was a decrease.

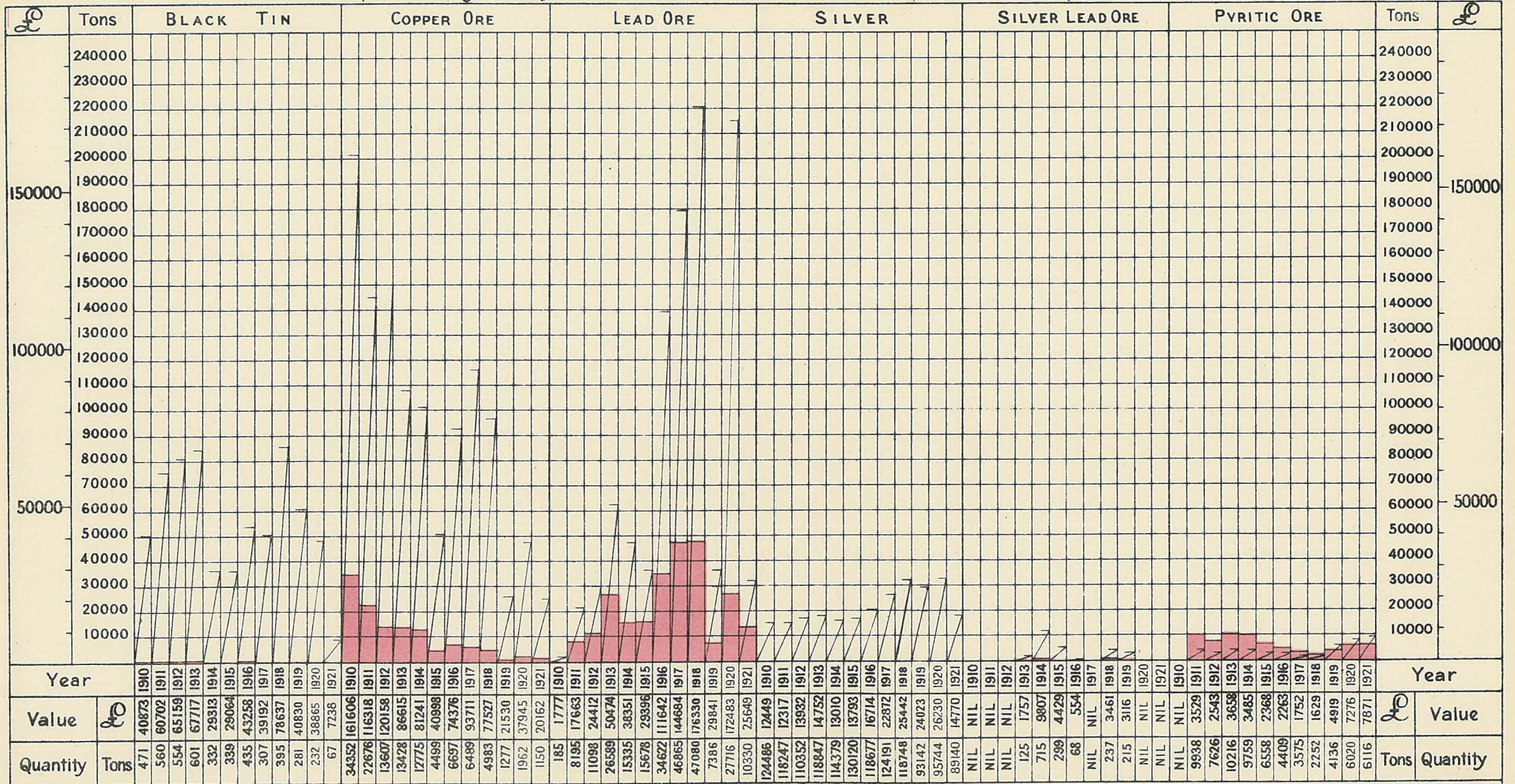
At Westonia there has not been any change, and no improvement is anticipated.

COMPARATIVE STATISTICAL DIAGRAMS
 RELATING TO
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 1921.**



DIAGRAM

of the Mineral Output - showing Quantity & Value of Minerals other than Gold & Coal reported to the Mines Dept from the Year 1910 onwards



NOTE. The Pink denotes Quantities produced and Diagonal lines Values thereof

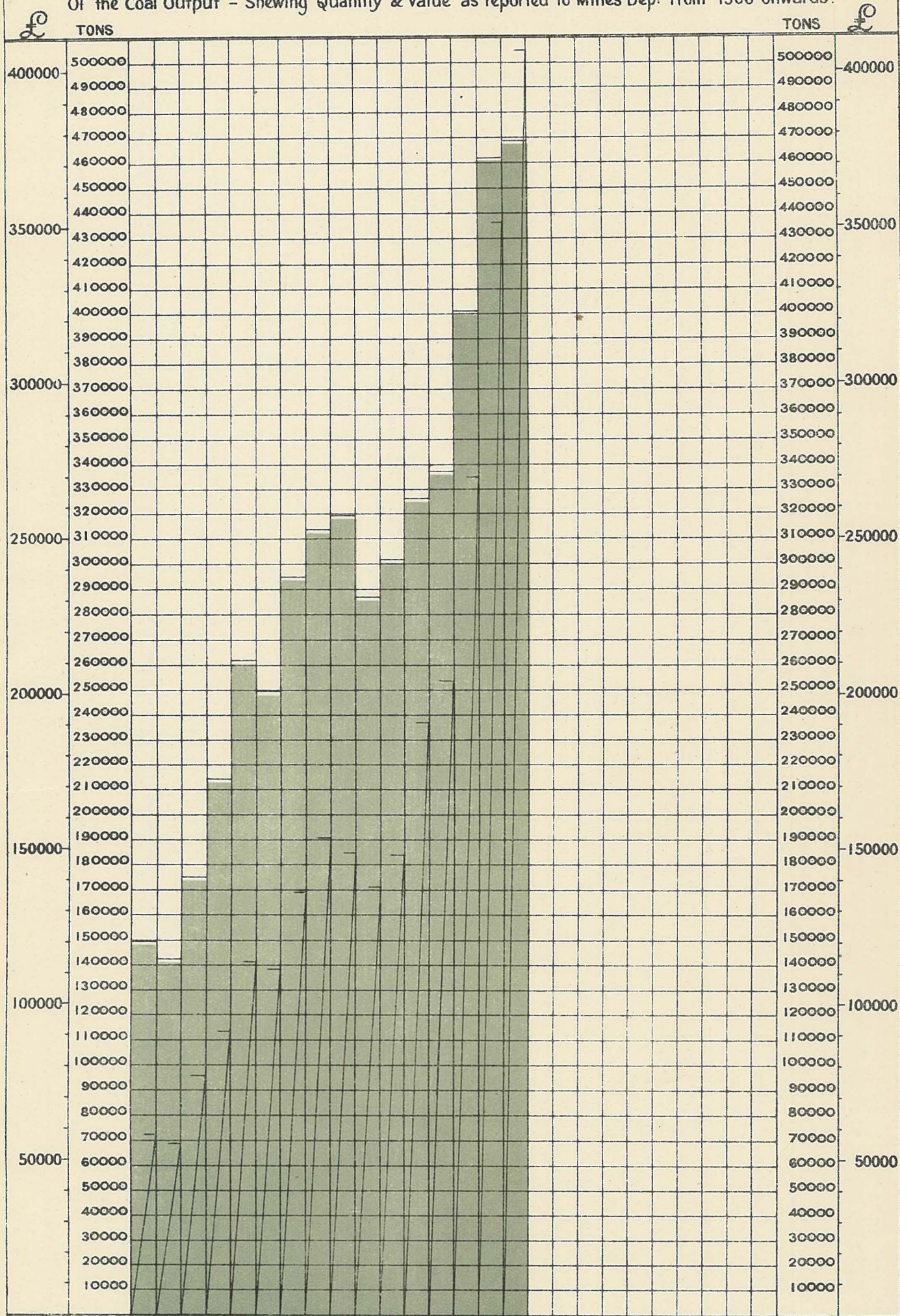
Other Minerals not shown above,
Viz: Asbestos 235 Tons, Value £13,581,
Fireclay 678 " " £646,
Gypsum 665 " " £622,
also reported in the Year 1921.

Previous to 1910 the Quantity & Value of various Minerals reported amounted to

Black Tin 11781 Tons Copper 105041 Ironstone 57820 Lead 418 Asbestos 43	Tons £ 879138 688360 36695 2034 1754
Silver Lead 1224 Tons Tantalite 89 Limestone 93706 Silver 951624	Tons £ 10863 13486 18290 114386 <u>1765006</u>

D I A G R A M

Of the Coal Output - Shewing Quantity & Value as reported to Mines Dept from 1906 onwards.



Year		1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	Year	
Value	£	57998	55158	75694	90965	113699	111154	135857	153614	148684	137589	147823	191822	204319	270355	350346	407117	£	Value
Quantity	Tons	149765	142373	175248	214302	262166	249890	295079	313818	319210	286666	301526	326550	337039	401713	462021	468817	Tons	Quantity

At Forrestania the water supply is the chief difficulty, but this, it is hoped, will soon be surmounted.

Elsewhere prospecting has been vigorous, and results are decidedly encouraging.

In the Dundas Goldfield there was a small decrease. Apart from the closing down of the Mararoa, which for many years has been the principal mine, there was little change in this field.

The Phillips River Field recorded a small decrease. Apart from the smaller mines, some of which were being actively worked, many with Government assistance, there was little doing. Until sufficient capital is available for the proper development of the large mines, no considerable improvement can be expected.

In the Northern Goldfields, Kimberley, West Kimberley, West Pilbara, Ashburton, and Gascoyne no developments worth noting were recorded. In the Pilbara Field there was a decrease, but, generally speaking, the position was well maintained, and practically the same number of men were employed as in the previous year.

TIN.

The quantity of Tin exported was 67 tons, valued at £6,485; a decrease in tonnage of 176 tons, and in value of £42,964.

The Greenbushes Tinfield produced 52.87 tons, valued at £5,778; a decrease in tonnage of 137.22 tons, and in value of £25,471; the Pilbara Field 14.50 tons, valued at £1,460; a decrease in tonnage of 27 tons, and in value of £6,156. None was produced in any other field.

TANTALITE.

None of this mineral was exported or reported.

COPPER.

The value of the copper exported was £24,601, being £564 less than in 1920. The ore raised in the West Pilbara Field was 1,055 tons, valued at £18,955; a decrease on the preceding year in tonnage of 645.50 tons, and in value of £13,104. The Whim Well Mine was the principal producer, but consequent on the low price ruling for this metal, operations have been practically suspended.

In the Phillips River Field the production was 95.34 tons, valued at £1,207; a decrease in tonnage of 121.93 tons, and in value of £2,918.

As stated elsewhere, the necessity of capital to properly open up the mines on this field is paramount. No other field produced any ore.

The number of men engaged in copper mining was 36, and in 1920, 116.

COAL.

The output of Coal was 468,817 tons, being 6,796 tons more than in 1920.

There were five collieries producing, all situated at Collie.

Boring operations carried out by the Government at Wilga and Irwin River have revealed the existence of coal measures at each place, and it now remains for private enterprise to open them up.

The number of men employed, 870, is greater by 40 than in 1920, and the output per man was, in 1920, 557 tons, and in 1921, 539 tons.

OIL.

At the end of the year practically the whole of the Crown lands in the State had been taken up under licenses to prospect for Oil. The holders of licenses for areas in the north of the State have arrangements well in hand to commence active operations at the

close of the summer. They are all sanguine of success.

In the Annual Report of the Geological Survey will be found reports on reported occurrences of oil in the Kimberley Division, also in the valley of the Fitzgerald River on the South coast.

ASBESTOS.

In the Pilbara Field 235.35 tons, valued at £13,581, were produced, and in the preceding year 156.50 tons, valued at £7,286; an increase in tonnage of 78.85 tons, and in value of £6,295.

Large deposits exist at Nullagine and other centres on this field, also in the West Pilbara Field. The Department has been investigating the question of how best to assist in the development of this industry, but, so far, no conclusion has been reached.

GRAPHITE.

None of this mineral was exported or reported.

OTHER MINERALS.

The quantity of Silver obtained as a by-product and exported was 116,151 ounces, valued at £18,658, and in the preceding year 130,692 ounces, valued at £36,605; a decrease of 14,541 ounces, and in value of £17,947.

Pig Lead to the amount of 2,156 tons, valued at £48,863, was exported, and in the preceding year 1,930 tons, valued at £69,136.

Pyritic Ore, amounting to 6,117 tons, valued at £7,871, was reported, and in the preceding year 6,020 tons, valued at £7,276; also 664 tons of Gypsum, valued at £622.

Small quantities of Arsenical Ore, Barytes, Corundum, Felspar, Jarosite, and Manganese were reported.

MINING GENERALLY.

The States of New South Wales and South Australia had small increases in the gold output, but Queensland and Victoria decreases of 74,854 and 64,467 fine ounces, respectively, both greater than Western Australia. Tasmania had a small decrease. New Zealand, as in the previous year, again recorded an increase.

The Western Australian production was 63.01 per cent. of the total of Australasia, and in the previous year 58.99 per cent. The alarming decrease in the output is almost wholly attributable to the increased cost of production. Although some mines have come to the end of their resources, there is little doubt that many others have been compelled to suspend operations until some relief from the high cost of production is afforded them to enable their ore to be treated at a profit.

In mining for base metals there has been the additional burden of the low market prices ruling throughout the year.

The assistance to prospectors by way of sustenance, loans of equipment, and transport facilities has been continued, but the control of this has now been placed under a Board comprised of departmental officers and representatives of various organisations interested in the mining industry. During the year the Board recommended the granting of assistance to 156 parties comprising 285 men, at a cost of £5,570, and all were approved. It has also recommended, and the Minister has approved, the sending out of a large party early in the New Year to systematically prospect a defined area where little prospecting has hitherto been done, but geological re-

ports indicate the possibility of the existence of minerals. The cost will be approximately £2,500.

The area held under prospecting areas for gold and minerals other than Coal and Oil, viz., 21,339 acres, although 3,441 acres less than in the preceding year, is nevertheless an indication that prospecting is still being actively pursued.

A very considerable amount of financial assistance under the provisions of the Mining Development Act was also rendered to mine owners; details regarding this will be found in the report of the State Mining Engineer, Division II. of this Report. Every application that had a reasonable hope of success was granted.

PART II.—MINERALS RAISED.

TABLE 1.
Quantity and Value of all the Minerals produced during 1920 and 1921.

Description of Minerals.	1920.		1921.		Increase or Decrease for Year compared with 1920.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		£		£		£
1. Antimony (exported), statute tons	2½	45	...	...	—	2½ — 45
2. Arsenical ore (exported), statute tons	1,765	4,260	7	16	—	1,758 — 4,244
3. Asbestos (reported), statute tons	156	7,286	235	13,581	+	79 + 6,295
4. Barytes (exported), cwts. ... ..	...	...	2	18	+	2 + 18
5. Clay (exported), statute tons	½	6	3½	40	+	3 + 34
6. Coal (raised), statute tons	462,021	350,346	468,817	407,117	+	6,796 + 56,771
7. Copper { Ore (exported), statute tons	1,511	22,467	1,040	16,153	—	471 — 6,314
{ Ingot, Matte, etc. (exported), statute tons	137	2,698	206	8,448	+	69 + 5,750
8. Corundum (exported), cwts. ... ..	...	...	½	2	+	½ + 2
9. Felspar (exported), statute tons ... ..	...	...	1	47	+	1 + 47
10. Gold (exported and minted), fine ounces	617,842	2,624,427	553,731	2,352,098	—	64,111 — 272,329
11. Graphite (exported), statute tons... ..	13	130	...	...	—	13 — 130
12. Gypsum (reported), statute tons ... ..	...	...	664	622	+	664 + 622
13. Iron Concentrates (exported), statute tons	1	17	...	...	—	1 — 17
14. Jarosite (exported), cwts. ... ..	...	...	12	5	+	12 + 5
15. Lead and silver lead (ore and concentrates exported), statute tons	3,427	84,743	...	...	—	3,427 — 84,743
16. Lead, Pig (exported), statute tons	1,930	69,136	2,156	48,863	+	226 — 20,273
17. Manganese (exported), statute tons ... ..	...	...	16	145	+	16 + 145
18. Mica (exported), statute tons	*	120	...	...	...	... — 120
19. Molybdenite (exported), statute tons	½	5	...	...	—	½ — 5
20. Pyritic Ore (reported), statute tons	6,020	7,276	6,117	7,871	+	97 + 595
21. Silver (exported), fine ounces	130,692	36,605	116,151	18,658	—	14,541 — 17,947
22. Tin (exported), statute tons	243	49,449	67	6,485	—	176 — 42,964
23. Tungsten Ore { Scheelite (exported), statute tons	2½	395	...	...	—	2½ — 395
{ Wolfram (exported), statute tons	...	...	...	...	...	...
Total Values ... ..	...	3,259,411	...	2,880,169	...	— 379,242

* Weight not stated.

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.
	£	£	
1901	8,515,623	6,920,118	81.27
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
Total since 1900	204,717,833	121,361,559	59.28

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 Gold per ton of ore treated.

Goldfield.	Reported Yield.					
	1920.	1921.	Percentage for each Goldfield.		Average Value of Gold per ton of Ore treated.	
			1920.	1921.	1920.	1921.
	fine ozs.	fine ozs.			shillings.	shillings.
1. Kimberley ... ..	...	49	...	.01	...	...
2. West Kimberley ... ..	...	...	...	...	...	...
3. Pilbara	4,052	2,627	.65	.50	130.31	113.22
4. West Pilbara	134	67	.02	.01	109.03	55.82
5. Ashburton ... ..	...	22	...	.01	...	...
6. Gascoyne ... ..	...	7	...	.01	...	...
7. Peak Hill	1,656	1,079	.26	.20	12.30	23.03
8. East Murchison	19,600	18,762	3.13	3.57	43.32	53.94
9. Murchison	46,604	41,257	7.44	7.85	49.03	53.50
10. Yalgoo	2,965	3,579	.47	.68	74.58	128.89
11. Mt. Margaret	77,336	20,803	12.34	3.96	28.90	53.80
12. North Coolgardie	12,024	10,640	1.92	2.02	48.86	52.68
13. Broad Arrow	7,445	8,875	1.19	1.69	47.94	42.20
14. North-East Coolgardie	1,739	4,148	.28	.79	40.10	60.23
15. East Coolgardie	401,496	378,430	64.07	72.00	47.02	50.37
16. Coolgardie	5,986	9,548	.95	1.82	28.99	69.21
17. Yilgarn	37,637	19,241	6.00	3.66	30.65	48.85
18. Dundas	6,541	5,456	1.04	1.04	50.50	131.09
19. Phillips River	1,423	866	.23	.16	183.69	68.60
State generally	21	100	.01	.02	...	...
Totals and averages	626,659	525,556	100.00	100.00	42.22	51.56

The total gold yield of the State is as shown in Table 1, being the amount of gold exported, and also that lodged at the Royal Mint, which total includes alluvial gold and gold not reported to the 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.

Number of Gold-producing Mines in the several Goldfields and Districts during 1920 and 1921.

Goldfield.	District.	1920.		1921.		Increase or Decrease.
		District.	Goldfield.	District.	Goldfield.	
Kimberley ... ..	...	...	...	...	...	...
West Kimberley ... ..	...	...	...	...	...	...
Pilbara	Marble Bar	13	15	11	11	4
	Nullagine	2				
West Pilbara ... ..	...	...	1	...	1	...
Ashburton ... ..	...	...	...	...	...	...
Gascoyne ... ..	...	...	...	...	...	...
Peak Hill ... ..	...	...	3	...	8	5
East Murchison	Lawlers	7	27	8	25	2
	Wiluna	11		9		
	Black Range	9		8		
	Cue	11		13		
Murchison	Meekatharra	15	43	10	33	10
	Day Dawn	4		2		
	Mt. Magnet	13		8		
Yalgoo ... ..	...	...	10	...	10	...
Mt. Margaret	Mt. Morgans	8	26	10	31	5
	Mt. Malcolm	9		7		
	Mt. Margaret	9		14		
	Menzies	8		8		
North Coolgardie	Ularring	1	14	3	20	6
	Niagara	2		3		
	Yerilla	3		6		
Broad Arrow ... ..	...	...	5	...	13	8
North-East Coolgardie	Kanowna	6	10	12	16	6
	Kurnalpi	4		4		
East Coolgardie	East Coolgardie	59	60	58	60	...
	Bulong	1		2		
Coolgardie	Coolgardie	24	30	31	36	6
	Kunanalling	6		5		
Yilgarn ... ..	...	...	32	...	29	3
Dundas ... ..	...	...	14	...	17	3
Phillips River ... ..	...	...	11	...	6	5
State generally ... ..	...	...	1	...	...	1
Totals ... ..	...	...	302	...	316	14

TABLE 5.

Gold Yield from Registered Gold Mining Companies and Gold Mining Leases for the Years 1918, 1919, 1920, and 1921.

Goldfield	REGISTERED COMPANIES PRODUCING OVER 12,000 OZS.								REGISTERED COMPANIES PRODUCING UNDER 12,000 OZS.								LEASES, EXCLUSIVE OF SUNDRY CLAIMS AND TREATMENT.							
	1918.		1919.		1920.		1921.		1918.		1919.		1920.		1921.		1918.		1919.		1920.		1921.	
	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.	No.	Fine ozs.
Kimberley ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Kimberley ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pilbara ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	2,264	15	2,449	15	3,478	11	1,902
West Pilbara ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	81	3	57	1	90	1	25
Ashburton ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gascoyne ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Peak Hill ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	921	8	683	3	523	8	735
East Murchison ... ..	...	...	1	13,468	...	...	...	...	6	19,967	3	7,346	6	14,229	6	13,462	25	6,676	20	5,154	21	3,289	19	3,264
Murchison ... ..	...	...	1	14,500	...	...	...	...	5	3,751	3	1,734	2	6,669	2	5,193	55	55,565	46	28,928	41	35,200	31	32,059
Yalgoo ... ..	...	...	...	...	...	...	...	...	1	311	1	715	1	889	1	1,214	15	3,718	14	3,737	9	1,846	9	914
Mt. Margaret	2	71,006	2	77,265	2	67,436	...	...	7	8,109	6	6,918	5	4,544	5	13,443	32	4,284	23	2,357	19	4,236	26	5,705
N. Coolgardie	1	12,845	...	...	...	...	...	...	7	13,502	7	14,612	3	9,499	3	7,502	22	7,449	16	5,739	11	900	17	1,690
Broad Arrow ... ..	...	...	...	...	...	...	...	...	1	287	2	8,622	1	5,174	2	6,048	14	2,739	7	2,000	4	1,664	11	1,373
N.E. Coolgardie ... ..	...	...	...	...	...	...	...	...	1	1,119	1	60	...	...	2	44	12	1,734	7	4,874	10	1,578	14	3,584
E. Coolgardie	10	482,906	10	361,151	9	363,254	8	337,097	11	4,019	8	3,308	14	15,422	14	19,889	27	28,532	24	24,685	37	14,732	38	15,465
Coolgardie ... ..	...	...	...	...	...	...	...	...	4	655	2	679	1	43	...	...	33	4,925	30	3,507	29	4,889	36	6,665
Yilgarn	2	34,203	2	27,297	1	13,826	...	...	8	24,739	3	16,017	8	17,234	11	15,513	81	7,884	29	9,321	23	5,623	18	2,531
Dundas ... ..	...	...	...	...	...	...	...	...	2	8,569	1	5,466	1	2,647	2	1,425	16	6,388	16	6,034	13	3,196	15	1,786
Phillips River ... ..	...	...	...	...	...	...	...	...	1	52	1	37	1	50	1	30	15	4,045	12	1,579	10	1,300	5	770
State generally ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	46	1	7	...	...	...
Total	15	600,960	16	493,681	12	444,516	8	337,097	54	85,130	38	66,014	43	76,400	49	83,768	317	137,565	271	101,200	247	82,551	259	78,468

TABLE 6.

Increase or Decrease in Output of certain producing Gold Mines in 1921 as compared with 1920.

Goldfield.	District.	Name of Mine.	Gold Production.		Increase or Decrease for Year compared with 1920.	
			1920.	1921.		
			Fine ozs.	Fine ozs.	Fine ozs.	
Pilbara ...	Marble Bar ...	1. Haig	693.28	445.75	— 247.53	
		2. Kitchener	921.16	572.45	— 348.71	
East Murchison ...	Nullagine ...	3. Doherty Reward	559.18	...	— 559.18	
		4. Queen : Daisy-Queen G.M. Co., N.L.	206.47	500.87	+ 294.40	
	Lawlers ...	5. Waroonga G.M. Co., Ltd.	1,146.95	859.72	— 287.23	
		6. Moonlight leases	810.45	572.37	— 238.08	
	Wiluna ...	7. Western Machinery Co., Ltd.	3,347.41	2,763.92	— 583.49	
		8. Red, White and Blue	512.71	...	— 512.71	
		9. United	110.28	1,207.51	+ 1,097.23	
Murchison... ..	Cue	10. Yuanmi G.M's., Ltd.	9,303.09	9,222.88	— 80.21	
		11. Big Bell	1,676.38	193.51	— 1,482.87	
	Meekatharra ...	12. Mararoa G.M. Co., N.L.	4,823.20	4,927.84	+ 104.64	
		13. Turn of the Tide	840.66	73.67	— 766.99	
		14. Fenian leases	11,960.50	13,026.23	+ 1,065.73	
	Day Dawn ...	15. Ingliston Consols Extended leases	11,889.29	13,968.71	+ 2,079.42	
		16. Ingliston leases	1,722.91	833.98	— 888.93	
		17. Marmont... ..	234.88	529.25	+ 294.37	
		18. Waterloo... ..	553.31	594.16	+ 40.85	
		19. Eureka	1,912.63	...	— 1,912.63	
20. Great Fingall Consolidated, Ltd.		1,846.11	264.78	— 1,581.33		
Mt. Magnet ...	Mt. Magnet ...	21. Mount Zion	1,219.88	...	— 1,219.88	
		22. Moyagee	593.15	1,140.18	+ 547.03	
	Yalgoo	23. Carnation	1,018.62	395.70	— 622.92	
		24. Lake View : Payne's Find Development Co., N.L.	889.46	1,214.33	+ 324.87	
Mt. Margaret ...	Mt. Morgans ...	25. Bindah	1,807.91	2,237.91	+ 430.00	
		26. Murrin Queen	20.20	523.10	+ 502.90	
		27. Torquay leases	160.95	681.90	+ 520.95	
		28. Westralia Mt. Morgans Mines, N.L.	2,766.55	3,259.02	+ 492.47	
	Mt. Malcolm ...	29. Sons of Gwalia, Ltd.	41,870.00	7,078.05	— 34,791.95	
		30. Lancefield G.Ms., Ltd.	25,565.79	2,981.77	— 22,584.02	
	Mt. Margaret ...	31. Nil Desperandum	1,259.94	277.49	— 982.45	
		32. Mary Mac G.M. Co., N.L.	1,089.91	47.71	— 1,042.20	
	North Coolgardie	Menzies	33. Menzies Consolidated G.Ms., Ltd.	8,325.15	5,993.80	— 2,331.35
			34. Riverina South G.M. Co., N.L.	1,353.20	+ 1,353.20
Broad Arrow ...	... ..	35. Slippery Gimlet : Associated Northern Blocks (W.A.), Ltd. ... ..	...	753.58	+ 753.58
		36. Victorious : Associated Northern Blocks (W.A.), Ltd.	5,174.11	5,294.46	+ 120.35	
North-East Coolgardie	Kanowna	37. Oversight	1,054.48	223.42	— 831.06	
		38. Golden Valley	188.64	1,467.49	+ 1,278.85	
East Coolgardie ...	East Coolgardie... ..	39. Kanowna	472.03	722.89	+ 250.86	
		40. Associated G.Ms. of W.A., Ltd.	24,277.05	23,862.24	— 414.81	
		41. Associated Northern Blocks (W.A.), Ltd.	11,023.06	6,092.70	— 4,930.36	
		42. Central and West Boulder G.Ms., Ltd.	1,925.16	417.02	— 1,508.14	
		43. Creswick leases.	607.00	523.55	— 83.45	
		44. Croesus South	334.30	810.40	+ 476.10	
		45. Eureka	46.94	576.13	+ 529.19	
		46. Golden Horseshoe Estates Co., Ltd.	54,697.44	55,289.80	+ 592.36	
		47. Great Boulder Perseverance G.M. Co., Ltd.	51,414.56	48,192.95	— 3,221.61	
		48. Great Boulder Proprietary G.Ms., Ltd.	71,535.70	73,713.16	+ 2,177.46	
Coolgardie ...	Coolgardie ...	49. Great Hope ... ..	...	3,063.47	+ 3,063.47
		50. Great Hope North	837.09	628.31	— 208.78	
		51. Hopeful ... ..	...	571.32	+ 571.32
		52. Idaho leases	6,620.93	3,406.20	— 3,214.73	
		53. Ironsides North leases	3,672.05	947.66	— 2,724.39	
		54. Ivanhoe Gold Corporation, Ltd.	56,456.63	60,601.54	+ 4,144.91	
		55. Kalgurli G.Ms., Ltd.	17,198.01	12,182.15	— 5,015.86	
		56. Lake View and Star, Ltd.	40,172.24	31,391.17	— 8,781.07	
		57. Mutooroo	630.86	1,361.80	+ 730.94	
		58. North Kalgurli (1912), Ltd.	937.67	1,075.57	+ 137.90	
Coolgardie ...	Coolgardie ...	59. Oroya Links, Ltd.	17,892.76	9,620.38	— 8,272.38	
		60. South Kalgurli Consolidated, Ltd.	29,609.89	31,863.49	+ 2,253.60	
		61. Union Jack	294.16	1,645.80	+ 1,351.64	
		62. Griffith's Gold Mine	1,240.88	299.06	— 941.82	
		63. Carbine leases	1,593.22	3,562.05	+ 1,968.83	
		64. Turn of the Tide	462.72	757.95	+ 295.23	
		Yilgarn	65. Bullfinch Proprietary (W.A.), Ltd.	13,826.06	3,042.72	— 10,783.34
			66. Edna May Battler G.M. Co., N.L.	100.77	1,195.61	+ 1,094.84
		Dundas	67. Edna May Central G.Ms., N.L.	7,025.69	3,102.07	— 3,923.62
			68. Edna May Deep Levels G.M. Co., N.L.	8,975.07	5,278.10	— 3,696.97
Phillips River ...	... ..	69. Edna May Golden Point, N.L.	587.48	241.88	— 345.60
		70. Golden Butterfly G.M. Co., N.L. ... ..	...	2,044.82	+ 2,044.82
Phillips River ...	... ..	71. Great Victoria leases	2,444.61	...	— 2,444.61
		72. Radio	1,254.11	991.73	— 262.38	
Phillips River ...	... ..	73. Mararoa G.M. Co., N.L.	2,647.19	1,156.27	— 1,490.92
		74. Viking No. 1 leases	1,582.41	416.79	— 1,165.62	
Phillips River ...	... ..	75. Fair Play leases	1,014.42	...	— 1,014.42

TABLE 7.

Averages of Gold Ore raised and treated, and Gold produced therefrom, per man employed on the several Goldfields of the State, during 1920 and 1921.

Goldfield.	1920.				1921.			
	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 ... ..	...	...	...	...	...	...	...	...
2. West Kimberley ... ..	...	...	...	...	...	...	...	...
3. Pilbara	67.41	38.14	106.26	56.98	50.91	28.20	67.85	34.92
4. West Pilbara	17.50	10.00	22.46	12.83	11.40	6.33	7.49	4.16
5. Ashburton ... ..	...	...	...	...	...	...	...	...
6. Gascoyne ... ..	...	...	...	...	...	...	...	...
7. Peak Hill	1,375.38	323.62	199.10	46.85	355.00	108.47	96.25	29.41
8. East Murchison	253.55	104.90	129.29	53.49	225.04	89.19	142.87	56.63
9. Murchison	254.45	140.99	146.84	81.37	195.76	108.43	123.28	68.28
10. Yalgoo	70.39	36.33	61.78	31.89	60.33	28.00	91.53	41.31
11. Mt. Margaret	471.56	263.94	160.43	89.79	190.17	75.71	120.43	47.95
12. North Coolgardie	144.91	73.74	83.35	42.41	148.54	67.25	92.11	41.70
13. Broad Arrow	167.02	100.74	94.26	56.85	261.73	136.28	130.00	67.69
14. North-East Coolgardie	70.99	38.45	33.51	18.15	157.89	84.21	111.94	59.70
15. East Coolgardie	379.55	215.71	210.07	119.39	401.15	222.96	237.83	136.48
16. Coolgardie	71.50	36.83	24.40	12.57	43.04	22.20	35.06	18.09
17. Yilgarn	404.26	195.32	145.85	70.47	164.25	72.01	94.45	41.41
18. Dundas	194.96	104.24	115.90	61.97	62.91	34.69	97.06	51.96
19. Phillips River	65.76	36.53	142.28	79.04	67.01	36.97	54.11	29.85
Total Averages	333.05	180.61	165.52	89.76	281.43	146.76	170.79	89.06

The average value of Gold produced per man employed above and under ground was £381.26 in 1920, and £378.30 in 1921. The average tonnage of ore raised shows a decrease from 180.61 tons to 146.76 tons. The average tonnage raised per man is highest in the East Coolgardie Goldfield, viz., 222.96 tons, average value £579.73, the next being Broad Arrow Goldfield, with 136.28 tons, average value £287.53.

TABLE 8.

Output of Gold from the several States of Australia, the Northern Territory, the Territory of Papua, and the Dominion of New Zealand during 1921.

State.	Output of Gold.	Value.	Percentage of total Output of Australasia.
1. Western Australia	Fine ozs. 553,731	£ 2,352,098	63.01
2. Victoria	104,512	443,938	11.89
3. New South Wales	51,173	217,370	5.82
4. Queensland	40,376	171,504	4.59
5. Tasmania	5,340	22,683	.61
6. South Australia	2,628	11,163	.30
7. Northern Territory	145	618	.02
8. Territory of Papua	9,289	39,458	1.06
9. New Zealand	111,627	474,160	12.70
Total	878,821	3,732,992	100.00

TABLE 9.

Dividends paid by Western Australian Gold Mining Companies during 1921 and Total to date.

(Compiled from information supplied by the Government Statistician's Office and the Chamber of Mines of W.A., Kalgoorlie.)

Goldfield.	Name of Company.	Capital.				Dividends.		
		Authorised	No. of Shares.	Par Value Shares.	Paid up to.	Paid in 1921.		Grand Total paid to end of 1921.
						No.	Total Amount.	
		£		£ s. d.	£ s. d.		£	£
Peak Hill ...	Various Companies ...	...	...	...	...	...	...	160,666
East Murchison	Various Companies ...	...	...	...	...	...	...	437,968
Murchison ...	Mararoa G.M. Co., N.L. ...	48,000	{ 100,000 10,000	0 8 0 0 8 0	0 4 0 0 8 0	1	2,500	76,875
Do. ...	Other Companies ...	...	...	...	...	...	...	1,835,170
Mt. Margaret ...	Various Companies ...	...	...	...	...	...	...	1,504,701
North Coolgardie	Various Companies ...	...	...	...	...	...	...	575,032
North-East Coolgardie	Various Companies ...	...	...	...	...	...	...	82,971
East Coolgardie...	Golden Horseshoe Estates Co., Ltd.	1,500,000	300,000	5 0 0	5 0 0	1	37,500	3,510,000
Do. ...	Great Boulder Proprietary, G.Ms., Ltd.	175,000	1,750,000	0 2 0	0 2 0	3	131,250	5,925,550
Do. ...	Ivanhoe Gold Corporation, Ltd.	1,000,000	200,000	5 0 0	5 0 0	4	65,000	3,933,750
Do. ...	Kalgurli G.Ms., Ltd. ...	120,000	120,000	1 0 0	1 0 0	1	24,000	1,681,500
Do. ...	Lake View and Star, Ltd. ...	200,000	1,000,000	0 4 0	0 4 0	1	12,500	148,500
Do. ...	South Kalgurli Consolidated, Ltd.	150,000	250,007	0 10 0	0 10 0	1	31,250	221,250
Do. ...	Other Companies ...	...	...	...	...	...	...	6,951,453
Coolgardie ...	Various Companies ...	...	...	...	...	...	...	339,495
Yilgarn ...	Edna May Central Gold Mines, N.L.	45,000	60,000	0 15 0	0 12 6	1	2,958	14,790
Do. ...	Other Companies ...	...	...	...	...	...	...	493,409
Dundas ...	Various Companies ...	...	...	...	...	...	...	222,625
	Total Dividends paid during 1921 ...	...	...	...	...	...	306,958	...
	Total Dividends paid to end of 1921 ...	...	...	...	...	...	...	28,115,705

TABLE 10.

Value of Gold Production and Percentage of Dividends paid.

Year.	Value of Gold Production.	Dividends paid by Gold Mining Companies.	Dividends % of Total Production.	Value of Gold Production by Gold Mining Companies only.	Dividends % upon Production by Gold Mining Companies.
Prior to 1912 ...	£ 103,850,487	£ 22,178,259	% 21.36	£ ...	% ...
1912 ...	5,448,385	814,092	14.94	4,304,161	18.91
1913 ...	5,581,701	910,326	16.30	4,528,106	20.10
1914 ...	5,237,353	799,392	15.26	4,094,336	19.52
1915 ...	5,140,228	792,317	15.41	4,109,254	19.28
1916 ...	4,508,532	632,883	14.04	3,518,531	17.90
1917 ...	4,121,645	590,856	14.34	3,310,536	17.85
1918 ...	3,723,183	368,295	9.81	2,914,325	12.64
1919 ...	3,118,113	388,244	10.85	2,337,433	14.23
1920 ...	2,624,427	384,083	14.63	2,212,711	17.36
1921 ...	2,352,098	306,958	13.05	1,787,721	17.17
Total ...	145,706,152	28,115,705	19.30	*33,117,114	*17.93

* Ten last years only.

TABLE 11.

Quantity and Value of Minerals, other than Gold and Coal, reported to the Mines Department during 1921.

Goldfield, District, or Mineral Field.	1921.		Increase or Decrease for Year compared with 1920.	
	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£
BLACK TIN.				
Pilbara Goldfield (Marble Bar District)	14.50	1,460	— 27.00	— 6,156
Greenbushes Mineral Field	52.87	5,778	— 137.22	— 25,471
Total	67.37	7,238	— 164.22	— 31,627
PYRITIC ORE.				
Mt. Margaret Goldfield (Mt. Morgans District)	6,116.66	7,871	+ 96.68	+ 595
COPPER ORE.				
West Pilbara Goldfield	1,055.00	18,955	— 645.50	— 13,104
Pilbara Goldfield (Nullagine District) ... ..	...	...	— 9.00	— 360
Peak Hill Goldfield ... ..	...	...	— 35.39	— 1,401
Phillips River Goldfield	95.34	1,207	— 121.93	— 2,918
Total	1,150.34	20,162	— 811.82	— 17,783
LEAD ORE.				
Northampton Mineral Field	10,330.43	25,649	— 17,385.97	— 146,834
ASBESTOS.				
Pilbara Goldfield (Marble Bar District)	32.60	1,360	+ .60	— 540
Pilbara Goldfield (Nullagine District)	202.75	12,221	+ 78.25	+ 6,835
Total	235.35	13,581	+ 78.85	+ 6,295
GYPSUM.				
State Generally (Koorda)	664.50	622	+ 664.50	+ 622

The output of black tin shows decreases in tonnage of 164.22 tons, and in value of £31,627. In pyritic ore there were increases in tonnage of 96.68 tons, and in value of £595. In copper ore there were decreases in tonnage of 811.82 tons, and in value of £17,783. Lead ore shows a decrease in tonnage of 17,385.97 tons, and in value of £146,834. The output of asbestos increased by 78.85 tons, and in value by £6,295, and there were 664.50 tons of gypsum produced of a value of £622, there not being any in the previous year.

The production of tin was again confined to Pilbara and Greenbushes Fields, and pyritic ore to the

Mount Margaret Goldfield. Copper ore came from West Pilbara Goldfield and Phillips River Goldfield. The production of lead ore was confined to Northampton Mineral Field. Asbestos came from Pilbara Goldfield, while gypsum was obtained at Koorda outside any proclaimed goldfield or mineral field.

It will be observed that the figures in this table differ from those in Table 1. The figures above are those reported to the Department, and this table is published as an index to the amount of mining in each field named.

TABLE 12.

Quantity of Coal raised during 1920 and 1921, and estimated Value thereof, with 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	1920	462,021	350,346	218	612	755	557
	1921	468,817	407,117	198	672	698	539

The number of men employed at collieries has increased by 40, and the output increased by 6,796 tons.

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

TABLE 13.

Total Number and Acreage of Leases held for Mining on 31st December, 1920 and 1921.

Description of Leases.	1920.		1921.	
	No.	Acreage.	No.	Acreage.
Gold mining leases on Crown land	1,347	24,540	735	11,831
„ „ „ private property ... ..	...	...	...	...
Mineral leases on Crown land	313	41,438	275	41,534
„ „ private property	13	405	11	371
	1,673	66,383	1,021	53,736

The total number of leases held for mining purposes decreased by 652 and the area by 12,647 acres, as compared with the year 1920. The number of leases for gold mining decreased by 612 and the area by 12,709 acres. The number of mineral leases decreased by 40 and an increase of the area by 62 acres.

TABLE 14.

Number and Acreage of Gold Mining Leases in force each year for the Five Years ending the 31st December, 1921.

Goldfield.		District.		1917.		1918.		1919.		1920.		1921.		Percentage of Total Acreage.		Increase or Decrease in Acreage for 1921 compared with 1920.		Goldfield.
Name.	Proclaimed.	Name.	Proclaimed.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	1920.	1921.	Increase.	Decrease.	
West Kimberley ...	19-3-20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	West Kimberley
Kimberley ...	20-5-86	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Kimberley.
Yilgarn ...	1-10-88	...	...	144	2,702	98	1,742	94	1,697	91	1,584	65	1,080	6.46	9.13	...	504	Yilgarn.
Pilbara ...	1-10-88	Marble Bar ...	6-11-96	17	169	13	115	15	125	20	227	14	126	1.02	1.27	...	101	Pilbara.
Ashburton ...	11-12-90	Nullagine ...	6-11-96	8	78	5	48	5	42	3	24	3	24	...	...	...	...	Ashburton.
Murchison... ..	24-9-91	Cue ...	7-12-94	46	539	30	378	37	471	33	474	22	248	...	...	...	...	Ashburton.
		Meekatharra ...	7-12-94	60	819	56	713	36	468	33	451	40	581	4.83	8.87	...	136	Murchison.
		Day Dawn ...	10-1-96	38	398	36	377	19	215	11	116	8	82	...	...	...	...	Murchison.
		Mount Magnet ...	7-12-94	28	274	21	189	16	169	14	144	14	138	...	...	...	...	Murchison.
Dundas	31-8-93	...	...	47	521	41	423	37	416	34	451	23	284	1.84	2.40	...	167	Dundas.
Coolgardie ...	6-4-94	Coolgardie ...	7-12-94	40	519	41	594	43	723	338	7,233	57	1,029	30.30	9.90	...	6,264	Coolgardie.
		Kunanalling ...	1-9-97	20	256	15	179	13	155	15	203	12	143	...	...	...	...	Coolgardie.
		East Coolgardie ...	7-12-94	157	2,269	129	1,836	168	2,689	380	7,173	233	4,112	30.55	34.76	...	3,384	East Coolgardie.
		Bulong ...	15-4-96	2	30	5	95	3	53	15	323	...	...	...	...	...	...	East Coolgardie.
Yalgoo	23-1-95	...	...	34	506	32	484	26	375	25	364	15	259	1.48	2.17	...	105	Yalgoo.
		Menzies ...	15-4-96	42	582	37	522	30	450	26	417	16	293	...	...	...	...	Yalgoo.
		Ularring ...	15-4-96	18	198	16	167	15	183	16	221	13	161	3.28	5.30	...	178	North Coolgardie.
		Yerilla ...	15-4-96	5	84	4	72	5	78	6	108	9	138	...	...	...	...	North Coolgardie.
		Niagara ...	1-4-97	7	108	5	72	5	72	4	60	2	36	...	...	...	...	North Coolgardie.
		Lawlers ...	1-7-04	24	283	16	193	14	169	18	297	14	213	...	...	...	...	North Coolgardie.
		Black Range ...	1-7-04	36	493	22	365	18	296	19	326	16	292	4.64	7.72	...	227	East Murchison.
		Wiluna ...	1-3-10	31	524	24	401	23	400	29	517	22	408	...	...	...	...	East Murchison.
		Kanowna ...	15-4-96	20	275	19	268	14	207	29	434	19	315	1.96	3.00	...	126	N.E. Coolgardie
		Kurnalpi ...	15-4-96	3	32	2	20	3	23	6	47	6	40	...	...	...	...	N.E. Coolgardie
Broad Arrow ...	20-11-96	...	...	30	453	23	507	47	829	25	415	21	314	1.69	2.65	...	101	Broad Arrow.
Peak Hill ...	1-4-97	...	...	13	123	11	87	11	90	13	137	14	116	.56	.98	...	21	Peak Hill.
		Mount Margaret ...	1-4-97	52	941	47	815	38	712	50	965	20	348	...	...	...	...	Peak Hill.
		Mount Malcolm...	1-4-97	66	1,311	64	1,265	57	1,232	59	1,276	32	668	10.68	10.79	...	1,345	Mount Margaret.
		Mount Morgans...	2-4-02	24	384	19	315	17	283	22	379	16	259	...	...	...	...	Mount Margaret.
West Pilbara ...	1-11-95	...	...	3	36	2	12	1	6	3	36	1	6	.15	.05	...	30	West Pilbara.
Phillips River ...	14-9-00	...	...	11	176	13	182	8	118	10	138	8	118	.56	1.01	...	20	Phillips River.
Other Localities ...	...	...	...	...	...	1	12	1	12	...	...	...	...	...	...	...	...	Other Localities.
Gascoyne ...	15-4-97	...	...	1	6	...	...	...	...	...	...	...	...	...	...	...	...	Gascoyne.
Totals ... ..	...	...	...	1,027	15,089	847	12,448	819	12,758	1,347	24,540	735	11,831	100.00	100.00	...	12,709	

Decrease for the year 1921 : Leases 612, acres 12,709. The largest percentage of the area leased for gold mining purposes is in the respective order :—East Coolgardie, 34.76; Mt. Margaret, 10.79 ; Coolgardie, 9.90 ; Yilgarn, 9.13 ; Murchison, 8.87 ; East Murchison, 7.72.

TABLE 15.

Number and Acreage of Mineral Leases in force 31st December each year, for the Five Years ending 31st December, 1921.

Mining District.		Sub District.		1917.		1918.		1919.		1920.		1921.		Increase or Decrease in Acreage for 1921, compared with 1920.		Mining District.		
Name.	Proclaimed.	Name.	Proclaimed.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Increase.	Decrease.			
Ashburton ...	11-12-90	...	...	6	79	5	69	4	45	3	44	1	10	...	34	Ashburton.	
Murchison ...	24-9-91	Cue ...	7-12-94	...	...	2	63	7	222	4	135	2	63	...	...	78	Murchison.
		Meekatharra ...	7-12-94	...	1	24
		Day Dawn ...	10-1-96	...	1	6	...	6	1	6	2	54	1	48
Greenbushes ...	7-4-92	Mt. Magnet ...	7-12-94	...	...	...	...	...	...	...	...	...	...	...	...	134	Greenbushes.
		...	...	33	492	51	644	27	409	29	421	18	287	...	...	
Pilbara ...	16-6-92	Marble Bar ...	16-6-92	8	145	11	259	8	145	11	247	15	415	199	...	Pilbara.		
		Nullagine ...	6-11-96	...	...	2	54	6	120	10	144	14	175				
Yalgoo ...	23-1-95	...	...	11	318	11	282	13	284	14	320	10	238	...	...	82	Yalgoo.
Yilgarn ...	22-3-95	...	...	1	48	...	...	...	...	1	48	1	48	...	...	...	Yilgarn.
		Coolgardie ...	22-3-95	...	1	9	1	10	2	28	2	28	3	76	...			48
East Coolgardie ...	22-3-95	Kunanalling ...	1-9-97	...	...	...	...	...	...	...	...	...	...	...	...	26	East Coolgardie.
		East Coolgardie ...	22-3-95	...	3	13	3	13	8	120	2	3	1	1
East Murchison ...	28-6-95	Bulong ...	15-4-96	...	...	...	...	...	...	1	24	...	...	...	...	...	East Murchison.
		Lawlers ...	17-4-04	1	10	1	10	...	...	...	...	...	...	...	...
North Coolgardie ...	16-8-95	Black Range ...	1-7-04	...	...	1	6	1	6	1	6	1	6	...	...	48	North Coolgardie.
		Wiluna ...	1-3-10	...	...	...	...	...	...	...	...	...	...	...	...
		Menzies ...	15-4-96	1	48
		Ularring ...	15-4-96	...	...	...	...	...	...	...	...	...	...	...	...
West Pilbara ...	1-11-95	Yerilla ...	15-4-96	...	...	...	...	...	...	...	...	...	...	...	...	47	West Pilbara.
		Niagara ...	1-3-97	...	...	...	...	...	...	...	...	...	...	...	...
Dundas ...	27-12-95	...	...	17	606	15	550	14	540	26	751	21	798	...	...	...	Dundas.
Collie ...	21-2-96	...	...	113	34,647	114	34,661	115	34,981	115	34,979	117	35,621	642	...	...	Collie.
North-East Coolgardie ...	15-4-96	Kanowna ...	15-4-96	...	...	7	145	6	125	4	71	3	47	...	...	24	North-East Coolgardie.
Broad Arrow ...	20-11-96	Kurnalpi ...	15-4-96	...	...	...	...	...	...	...	...	...	...	...	...	...	Broad Arrow.
		...	...	1	20	...	...	...	...	...	...	...	...	...
Northampton ...	1-1-97	(Private Property) ...	...	2	72	3	84	3	75	8	297	4	167	...	...	481	Northampton
		...	...	6	124	14	315	17	365	28	637	14	286	...	...	
Peak Hill ...	1-4-97	...	...	15	351	9	225	8	183	12	375	8	261	...	...	114	Peak Hill.
Mt. Margaret ...	1-4-97	Mt. Margaret ...	1-4-97	...	...	...	...	...	...	...	...	...	...	...	...	...	Mt. Margaret.
		Mt. Malcolm ...	1-4-97	...	...	1	48	...	...	...	...	...	...	...
		Mt. Morgans ...	2-4-02	4	74	4	74	3	69	3	69	3	69	...	...	
Gascoyne ...	15-4-97	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Gascoyne.
Yandanooka ...	1-12-97	...	...	...	...	1	10	1	10	1	10	...	...	...	...	10	Yandanooka.
Phillips River ...	1-7-99	...	...	18	443	18	447	15	397	16	437	16	446	9	...	...	Phillips River.
Other localities ...	...	...	...	16	572	12	391	29	2,728	18	2,187	15	2,151	...	...	60	Other localities.
		(Private Property) ...	...	1	48	1	48	2	72	5	108	7	204	...	...	
West Kimberley ...	19-3-20	...	...	...	...	...	...	...	...	10	448	10	440	...	8	West Kimberley.	
Totals ...	...	...	...	259	38,101	288	38,414	290	40,930	326	41,843	286	41,905	Decrease of 40 leases and an increase of 62 acres.	...	...

In the Collie Mineral Field the largest area is held, viz., 35,621 acres, worked entirely for Coal; then follow West Pilbara, 798 acres, for Copper, Silver-lead, Asbestos; Pilbara, 590 acres, for Tin, Copper, Asbestos; Northampton, 453 acres, for Coal, Copper, Lead; Phillips River, 446 acres, for Copper, Manganese; West Kimberley, 440 acres, for Tin, Iron.

TABLE 16.

Number and Acreage of Mineral Leases in force on 31st December, 1921, showing Minerals for which they are worked.

Goldfield or Mineral Field.	District.	MINERAL.																					
		Coal.		Tin.		Copper.		Iron.		Potash.		Limestone.		Ochre.		Silver and Lead.		Asbestos.		Magnesite.		Clay.	
		Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.
Pilbara	Marble Bar ... ..	...	...	8	227	1	24	...	...	...	...	...	...	...	...	...	...	4	144	...	...	...	...
	Nullagine ... ..	...	...	...	...	1	48	...	...	...	...	...	...	...	...	1	24	13	127	...	...	...	...
West Pilbara ... ..	...	...	...	...	...	14	492	...	...	...	...	...	...	...	...	...	...	6	282	...	...	...	...
Ashburton ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Peak Hill ... ..	...	...	...	...	...	4	69	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Yilgarn ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
East Murchison	Black Range ... ..	...	...	...	...	...	...	...	...	...	...	...	...	1	6	...	...	...	...	...	...	...	...
Murchison	Day Dawn ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Cue ... ..	...	...	...	...	2	63	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
North Coolgardie ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	48	...
Yalgoo ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mt. Margaret	Mt. Morgans ... ..	...	...	...	...	3	69	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
East Coolgardie ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...
Coolgardie ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
North-East Coolgardie	Kanowna ... ..	...	...	...	...	...	...	...	...	2	37	...	...	...	...	...	...	...	...	...	...	...	...
Phillips River ... ..	...	...	...	...	...	13	368	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Collie ... ..	...	117	35,621	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Greenbushes ... ..	...	...	...	18	287	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Northampton ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	(Private Property)	1	100	...	...	1	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Outside Proclaimed Fields	(Private Property)	6	1,920	...	...	2	36	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Kimberley ... ..	...	...	...	2	58	...	...	8	382	...	...	...	...	...	...	1	48	...	...	...	...	...	1
	Totals	124	37,641	28	572	41	1,193	9	430	2	37	1	6	2	49	1	24	23	553	1	48	1	24

Goldfield or Mineral Field.	District.	MINERAL.																		Total.			
		Phosphatic Rock.		Alunite.		Tantalite.		Lead.		Gypsum.		Graphite.		Molybdenite.		Mica.		Manganese.					
		Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.		
Pilbara	Marble Bar ... ..	...	...	...	...	2	20	...	...	...	...	...	...	...	...	...	...	...	...	15	415
	Nullagine ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	175
West Pilbara ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	21	798
Ashburton ... ..	...	...	...	...	...	...	...	1	10	...	...	...	...	...	...	...	...	...	...	1	10
Peak Hill ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	261
Yilgarn ... ..	...	...	...	...	...	...	...	...	...	1	48	...	...	...	...	...	...	...	...	1	48
East Murchison	Black Range ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	6
Murchison	Day Dawn ... ..	...	...	...	...	...	...	...	...	1	48	...	...	...	...	...	...	...	...	1	48
	Cue ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	63
North Coolgardie ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	48
Yalgoo ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	238	...	...	10	238
Mt. Margaret	Mt. Morgans ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	69
East Coolgardie ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Coolgardie	2	28	1	48	
North-East Coolgardie	Kanowna ... ..	...	...	1	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	76
Phillips River ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	47
Collie ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	446
Greenbushes ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	117	35,621
Northampton ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18	287
	(Private Property) ... ..	...	...	...	...	...	...	14	286	2	43	...	...	...	...	...	...	...	...	14	286
Outside Proclaimed Fields	(Private Property)	1	6	1	40	2	81	2	20	1	48	15	2,151
West Kimberley ... ..	...	2	12	...	...	...	...	...	...	1	48	1	24	...	...	...	...	...	...	7	204
	Totals	3	18	1	10	2	20	17	339	4	184	3	105	10	238	4	48	9	366	286	41,905		

TABLE 17.
Number and Acreage of Miscellaneous Leases in force on 31st December, 1921.

Goldfield.	District.	LEASES.										Total.	
		Tailings.		Tramway.		Water.		Machinery.		Residence.			
		No.	Acre.	No.	Acre.	No.	Acre.	No.	Acre.	No.	Acre.	No.	Acre.
Yalgoo ... ..		...	...	...	...	...	...	1	24	...	...	1	24
West Pilbara ... ..		...	...	2	25	...	...	...	...	...	...	2	25
East Murchison	Black Range	2	36	...	...	...	...	...	...	...	...	2	36
Mt. Margaret	Mt. Margaret	1	22	...	...	...	...	...	...	...	...	1	22
North Coolgardie	Menzies	1	12	...	...	1	5	...	...	...	...	2	17
East Coolgardie	East Coolgardie	18	374	...	...	1	34	3	21	...	...	22	429
Coolgardie	Coolgardie	2	12	...	...	1	13	...	...	...	...	3	25
Phillips River ... ..		...	...	2	3	...	...	...	...	...	...	2	3
	Total	24	456	4	28	3	52	4	45	...	...	35	581

TABLE 18.

Claims and Authorised Holdings, under "The Mining Act, 1904," and Regulations, existing on 31st December, 1920 and 1921.

Goldfield or Mineral Field.	District.	Prospecting Areas.				Water Rights.				Lode Claims.	Alluvial Claims.	Mineral Claims.	Dredging Claims.	Residence Areas.	Business Areas.	Machinery Areas.	Tailings Areas.	Garden Areas.	Washing Areas.	Quarrying Areas.											
		Number.		Acreage.		Number.		Acreage.																							
		1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.				
West Kimberley	...	...	1	...	3,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Northampton	...	12	4	209	139	1	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pilbara	Marble Bar	16	12	304	141	2	2	2	2	2	2	3	2	3	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Nullagine	8	12	111	142	1	3	1	3	3	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Pilbara	...	9	5	150	140	1	1	5	5	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ashburton	...	3	...	57	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Peak Hill	...	11	4	141	51	5	3	18	16	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
East Murchison	Lawlers	8	10	146	155	12	11	17	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Wiluna	14	11	276	191	6	6	12	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Black Range	18	14	219	219	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Murchison	Cue	17	23	224	289	5	5	18	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Meekatharra	13	22	153	442	2	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Day Dawn	10	12	147	127	4	3	5	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Mt. Magnet	22	36	284	442	2	1	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Yalgoo	...	14	22	181	375	1	1	4	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mt. Margaret	Mt. Morgans	10	17	159	230	9	5	14	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Mt. Malcolm	16	33	270	599	24	18	183	173	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Mt. Margaret	15	16	256	297	19	18	44	34	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
North Coolgardie	Menzies	24	29	363	452	3	3	15	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Ularring	2	8	36	105	4	4	4	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Niagara	6	9	61	129	1	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Yerilla	2	10	21	125	6	5	8	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Broad Arrow	...	30	37	541	628	9	8	25	21	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
N.E. Coolgardie	Kanowna	23	13	438	261	1	1	3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Kurnalpi	3	6	66	72	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
East Coolgardie	...	135	95	2,677	1,738	9	9	30	31	3	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Bulong	18	15	372	305	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Coolgardie	...	135	68	3,049	1,185	9	10	29	30	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Kunanalling	10	14	174	225	6	6	40	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Yilgarn	...	50	46	915	782	3	5	4	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dundas	...	29	15	466	193	12	12	69	69	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Phillips River	...	2	4	36	63	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Collie	...	5	3	11,400	5,840	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Greenbushes	...	1	1	3	3	9	5	12	4	1	...	14	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gascoyne	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Outside Proclaimed Fields	...	35	36	40,515	51,716	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	...	726	663	64,420	70,801	166	147	574	536	12	6	18	12	7	13	15	4	414	399	141	122	54	38	41	46	108	100	2	...	1	...
Increase or Decrease for 1921 compared with 1920	...	= - 63	...	+ 6,331	...	- 19	...	- 38	...	- 6	...	- 6	...	+ 6	...	- 11	...	- 15	...	- 19	...	- 16	...	+ 5	...	- 8	

For the year 1920 the number of prospecting areas held was 726, the total acreage being 64,420, which included 14 areas of 39,640 acres for coal and oil. For the year 1921 the number held is 663 of a total acreage of 70,801, including 29 areas of 49,462 acres for coal and oil.

TABLE 19.

Miners' Rights issued during 1920 and 1921.

Place of Issue.	Miners' Rights.		Place of Issue.	Miners' Rights.	
	1920.	1921.		1920.	1921.
Albany ...	18	40	Mullewa ...	10	39
Boulder ...	66	26	Mulline ...	...	...
Bridgetown ...	1	16	Nannine ...	17	21
Broad Arrow ...	20	19	Narrogin ...	6	3
Broome ...	11	38	Norseman ...	99	67
Bullfinch ...	23	9	Northampton ...	43	36
Bunbury ...	24	5	Northam ...	1	3
Busselton ...	8	19	Nullagine ...	30	41
Carnarvon ...	28	17	Onslow ...	46	16
Collie ...	26	31	Ora Banda ...	14	44
Coolgardie ...	216	156	Payne's Find ...	15	16
Cue ...	133	134	Peak Hill ...	23	18
Derby ...	23	10	Perth ...	317	297
Esperance ...	1	1	Port Hedland ...	14	10
Geraldton ...	12	46	Ravensthorpe ...	32	21
Greenbushes ...	124	57	Roebourne ...	49	71
Hall's Creek ...	50	53	Sandstone ...	40	30
Kalgoorlie ...	898	762	Southern Cross ...	110	129
Kunanalling ...	...	...	St. Ives ...	5	7
Lake Dartot ...	2	15	Wagin ...	1	...
Laverton ...	134	123	Westonia ...	103	88
Lawlers ...	41	42	Wiluna ...	60	36
Leonora ...	84	148	Wyndham ...	10	18
Linden ...	16	8	Yalgoo ...	52	49
Marble Bar ...	89	78	Yarri ...	2	8
Marvel Loch ...	27	14	York ...	...	3
Meekatharra ...	81	102	Youanmi ...	43	38
Menzies ...	148	120			
Mount Magnet ...	102	115	Total ...	3,553	3,313

TABLE 20.

Number and Acreage of Miners' Homestead Leases in force on 31st December, 1920 and 1921.

Goldfield.	District.	1920.		1921.		Increase.		Decrease.	
		Leases.	Acre-age.	Leases.	Acre-age.	Leases.	Acre-age.	Leases.	Acre-age.
West Pilbara ...	...	...	...	...	...	...	...	...	...
Greenbushes ...	...	7	631	6	611	...	...	1	20
Pilbara ...	Marble Bar	...	...	...	...	...	...	...	...
	Nullagine ...	...	...	...	...	...	...	...	...
Dundas ...	...	27	1,345	27	1,345	...	...	...	...
Broad Arrow ...	...	2	40	2	40	...	...	...	...
Yilgarn ...	...	19	1,144	18	1,018	...	...	1	126
Mt. Margaret ...	Mt. Malcolm	5	1,239	5	1,239	...	...	...	...
	Mt. Margaret	17	421	18	911	1	490	...	...
	Cue ...	6	1,264	6	1,264	...	...	...	...
Murchison ...	Day Dawn	5	75	4	55	...	...	2	40
	Meekatharra	15	1,870	14	1,850	...	...	...	...
	Mt. Magnet	2	256	2	256	...	...	...	...
Yalgoo ...	...	2	680	2	680	...	...	...	...
Coolgardie ...	Coolgardie ...	25	992	28	1,111	...	...	...	...
	Kunanalling	3	540	3	540	3	119	...	...
East Coolgardie ...	...	89	2,388	88	2,735	...	347	1	...
Phillips River ...	...	147	20,363	142	19,740	...	...	5	623
Peak Hill ...	...	4	247	4	247	...	...	...	...
North-East Coolgardie ...	Kanowna	17	802	16	782	...	...	1	20
	Menzies	9	729	5	690	...	...	...	...
North Coolgardie	Yerilla	1	10	1	10	...	...	4	39
	Niagara	1	20	1	20	...	...	...	...
	Ularring	1	20	1	20	...	...	...	...
East Murchison...	Lawlers	6	1,115	5	1,110	...	...	3	26
	Black Range	8	171	5	120	...	...	...	...
	Wiluna	3	39	4	69	...	...	...	...
	Total ...	421	36,401	407	36,463	...	62	14	...

As compared with the year 1920, the number of leases held has decreased by 14 and the area increased by 62 acres.

PART IV.—MEN EMPLOYED.

TABLE 21.

Average number of Men engaged in Mining during 1920 and 1921.

Goldfield.	District.	Reef or Lode.		Alluvial.		Total.	
		1920.	1921.	1920.	1921.	1920.	1921.
1. Kimberley ...	...	...	...	5	6	5	6
2. West Kimberley ...	...	...	...	...	...	...	...
3. Pilbara ...	Marble Bar ...	50	49	17	21	67	70
	Nullagine ...	19	19	21	26	40	45
4. West Pilbara ...	...	7	9	10	10	17	19
5. Ashburton ...	...	...	...	...	1	...	1
6. Gascoyne ...	...	...	...	...	1	...	1
7. Peak Hill ...	...	34	36	3	3	37	39
	Lawlers ...	66	73	1	1	67	74
8. East Murchison ...	Wiluna ...	112	78	...	...	112	78
	Black Range ...	187	177	...	...	187	177
	Cue ...	121	125	6	7	127	132
9. Murchison ...	Meekatharra ...	290	350	11	10	301	360
	Day Dawn ...	32	41	7	3	39	44
	Mt. Magnet ...	93	78	1	1	94	79
10. Yalgoo ...	...	93	84	...	...	93	84
	Mt. Morgans ...	124	142	5	5	129	147
11. Mt. Margaret ...	Mt. Malcolm ...	449	210	2	...	451	210
	Mt. Margaret ...	281	75	4	5	285	80
	Menzies ...	194	137	1	...	195	137
12. North Coolgardie ...	Ularring ...	34	58	1	...	35	58
	Niagara ...	15	23	...	...	15	23
	Yerilla ...	40	36	1	...	41	36
13. Broad Arrow ...	...	126	121	9	3	135	124
14. North-East Coolgardie ...	Kanowna ...	62	52	6	2	68	54
	Kurnalpi ...	10	8	3	2	13	10
15. East Coolgardie ...	East Coolgardie ...	3,335	2,735	9	10	3,344	2,745
	Bulong ...	24	27	6	4	30	31
16. Coolgardie ...	Coolgardie ...	384	437	26	44	410	481
	Kunanalling ...	78	69	13	10	91	79
17. Yilgarn ...	...	534	463	...	...	534	463
18. Dundas ...	...	101	99	...	...	101	99
19. Phillips River ...	...	18	29	...	1	18	30
State generally ...	...	6	3	...	...	6	3
Total—Gold Mining ...		6,919	5,843	168	176	7,087	6,019
MINERALS OTHER THAN GOLD.							
Tin ...	Greenbushes ...	136	27	*8	...	144	27
	Marble Bar ...	2	20	*41	*12	43	32
	West Pilbara ...	91	21	...	...	91	21
Copper ...	Phillips River ...	21	12	...	...	21	12
	Peak Hill ...	4	3	...	...	4	3
Pyritic Ore ...	Mt. Morgans ...	17	16	...	...	17	16
Lead Ore ...	Northampton ...	238	41	...	...	238	41
Coal ...	Collie River ...	830	870	...	...	830	870
Asbestos ...	Marble Bar ...	...	5	...	...	...	5
	Nullagine ...	19	34	...	...	19	34
Gypsum ...	State Generally ...	...	4	...	...	...	4
Manganese ...	Peak Hill ...	2	...	...	...	2	...
Total—Other Minerals ...		1,360	1,053	49	12	1,409	1,065
GRAND TOTAL ...		8,279	6,896	217	188	8,496	7,084

*Classified elsewhere as employed at mines.

TABLE 22.
Average Number of Men employed at Mines during 1921.

Mineral.	Above ground.	Under ground.	Total.	Percentage of total men employed.	Increase or decrease compared with 1920.
Coal	198	672	870	12·60	+ 40
Copper	17	19	36	·52	— 80
Gold	2,796	3,047	5,843	84·58	— 1,076
Lead	13	28	41	·59	— 197
Pyritic Ore	4	12	16	·23	— 1
Tin	* 55	4	59	·85	— 128
Asbestos	28	11	39	·57	+ 20
Gypsum	4	...	4	·06	+ 4
Manganese ... ..	...	...	...	...	— 2
Total	3,115	3,798	6,908	100·00	— 1,420

*As the tin obtained is principally "stream tin" the average number of alluvial workers has been, in this case, included in the heading "above ground."

The above table deals with men working their own mines, or employed on wages, and is compiled from returns furnished to the Department by mine-owners.

TABLE 23.

Average Number of Men employed at Gold Mines during 1921, classified according to the several Goldfields and the proportion of Men employed in each Goldfield.

Goldfield.	Above Ground.	Under Ground.	Total.	Increase or Decrease compared with 1920.	Percentage of total men employed.	
					1920.	1921.
1. Kimberley ... ..	...	...	...	...	...	...
2. West Kimberley ... ..	...	...	...	...	...	...
3. Pilbara	33	35	68	— 1	1·00	1·16
4. West Pilbara	4	5	9	+ 2	·10	·15
5. Ashburton ... ..	...	...	...	...	...	...
6. Gascoyne ... ..	...	...	...	...	...	...
7. Peak Hill	25	11	36	+ 2	·49	·62
8. East Murchison	198	130	328	— 37	5·27	5·61
9. Murchison	265	329	594	+ 58	7·75	10·17
10. Yalgoo	45	39	84	— 9	1·34	1·44
11. Mt. Margaret	257	170	427	— 427	12·34	7·31
12. North Coolgardie	139	115	254	— 29	4·09	4·35
13. Broad Arrow	58	63	121	— 5	1·82	2·07
14. North-East Coolgardie	28	32	60	— 12	1·04	1·03
15. East Coolgardie	1,177	1,585	2,762	— 597	48·55	47·27
16. Coolgardie	245	261	506	+ 44	6·68	8·66
17. Yilgarn	260	203	463	— 71	7·72	7·92
18. Dundas	46	53	99	— 2	1·46	1·69
19. Phillips River	13	16	29	+ 11	·26	·50
State generally	3	...	3	— 3	·09	·05
Total	2,796	3,047	5,843	— 1,076	100·00	100·00

TABLE 24.

Alluvial Gold Workers.

Goldfield.	1920.	1921.	Increase or Decrease compared with 1920.
1. Kimberley	5	6	+ 1
2. West Kimberley ... ..	...	...	...
3. Pilbara	38	47	+ 9
4. West Pilbara	10	10	...
5. Ashburton ... ..	...	1	+ 1
6. Gascoyne ... ..	...	1	+ 1
7. Peak Hill	3	3	...
8. East Murchison	1	1	...
9. Murchison	25	21	— 4
10. Yalgoo ... ..	...	...	...
11. Mt. Margaret	11	10	— 1
12. North Coolgardie	3	...	— 3
13. Broad Arrow	9	3	— 6
14. North-East Coolgardie	9	4	— 5
15. East Coolgardie	15	14	— 1
16. Coolgardie	39	54	+ 15
17. Yilgarn ... ..	...	...	...
18. Dundas ... ..	...	...	...
19. Phillips River ... ..	...	1	+ 1
Total	168	176	+ 8

TABLE 25.

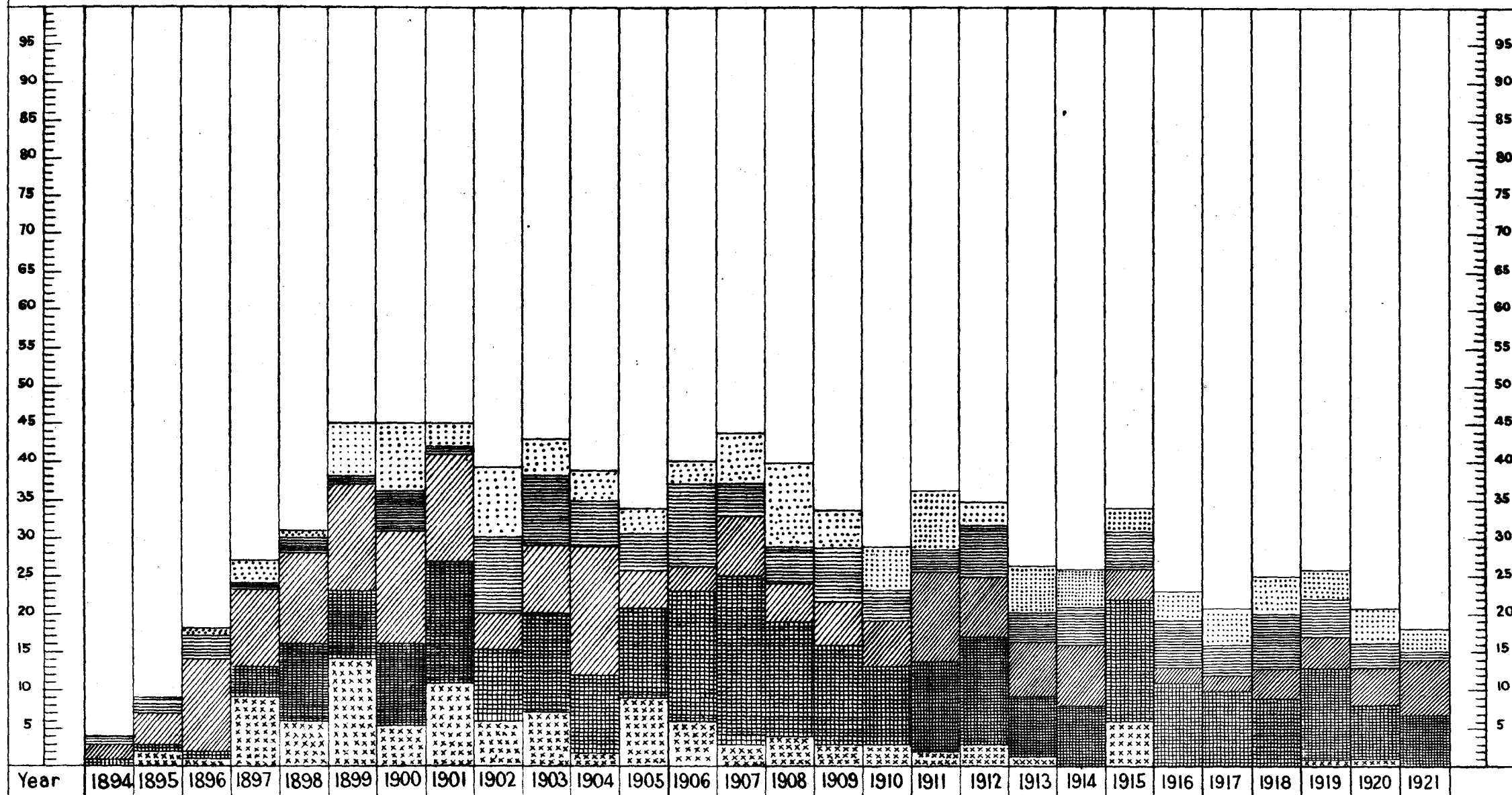
Table showing Rate of Wages Payable in the Mining Industry at the 31st December, 1921.

Class of Employee.	Districts.		
	Yilgarn, Coolgardie, Dundas, E. Coolgardie, N.E. Coolgardie, N. Coolgardie, Mt. Margaret, and East Murchison Goldfields.	Meekeaharra and Youanmi Districts.	Cue and Day Dawn Districts.
Rock Drill Men in Shafts	Rate per Shift. 19 4	Rate per Shift. 18 10	Rate per Shift. 18 1
Rock Drill Men in Rises	18 10	18 4	17 7
Rock Drill Men in Winzes	18 6	18 0	17 3
Rock Drill Men in Other places	18 2	17 8	16 11
Hand Miners in Shafts	18 6	18 0	17 3
Hand Miners in Rises	18 0	17 6	16 9
Hand Miners in Winzes	17 8	17 2	16 5
Hand Miners in Other places	17 4	16 10	16 1
Shaft Timberman	19 4	18 0	17 3
Timberman	18 6	18 0	17 3
Mullockers, Truckers, Shovellers, etc.	16 6	16 0	15 3
Bracemen, Platmen, and Skipmen	17 6	16 6	15 9
Man in charge Explosives Magazine	18 0	...	...
Platelayer (Underground)	17 6	...	...
Pipe Fitter	18 3	...	...
Scalers (Underground)	18 6	...	...
Sampler	17 8	...	...
Rock Breaker—Crackermen	17 0	16 6	15 9
Battery Feeders and Mill Hands	16 0	16 0	15 3
Mechanic's Labourer	16 6	16 0	15 3
Iron Furnacemen	18 0	...	...
Castings Dresser	16 6	...	...
Fireman, Leading	18 0	...	...
Fireman, Steam or Roaster	17 0	...	...
Wood Trimmer	16 6	...	...
Greaser, Cleaner, and Oiler	17 0	...	...
Motorman	17 10	...	...
Boiler Cleaners	18 6	...	...
Filterpress Filler	17 10	18 0	17 3
Cyanide and Filterpress Men	17 0	16 6	15 9
Amalgamator	17 8	...	...
Wilfley Tablemen	16 4	...	...
Vacuum Plant Hands (Top)	18 0	18 0	17 3
Vacuum Plant Hands (Bottom)	16 8	16 6	15 9
Timber Dresser, Sawyer, etc.	17 10	...	...
Tool Sharpeners	18 0	18 0	17 3
Blacksmith's Striker	16 6	16 4	15 7
Platelayer on Surface	17 0	...	...
Roper and Rigger	18 0	17 6	16 9
Sailor Gang Men	16 6	...	...
Conveyor Beltmen	16 0	...	...
Horse-driver	16 0	16 0	15 3
Sanitary Man	19 4	...	...
Watchman	17 6	...	...
General Labourer	16 0	16 0	15 3
Winding Engine Drivers	14 9	16 3*	15 0
Winch Drivers	13 9	15 3*	14 0
Other Engine Drivers	13 0	14 6*	13 3
Locomotive Drivers	14 3	15 9*	14 6

Forty-eight hours on surface and forty-four hours underground constitute a week's work.

* Engine Drivers at Youanmi receive threepence per day extra.

DIAGRAM SHEWING THE NUMBER OF DEATHS FROM ACCIDENTS ARRANGED IN FIVE CLASSES, IN THE MINES OF WESTERN AUSTRALIA DURING THE YEARS 1894 AND ONWARDS.



EXPLOSIONS



FALLS OF GROUND



IN SHAFTS



MISCELLANEOUS UNDERGROUND



ON SURFACE INCLUDING MACHINERY

1921.

PART V.—ACCIDENTS.

TABLE No. 26.

MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING 1920
AND 1921.

A.—According to Locality of Accident.

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1920.	1921.	1920.	1921.	1920.	1921.
1. Kimberley ... ..	...	...	...	...	...	...
2. West Kimberley ... ..	...	...	...	...	...	...
3. Pilbara ... ..	...	...	...	...	...	...
4. West Pilbara	1	...	...	...	1	...
5. Ashburton ... ..	...	...	...	...	...	...
6. Gascoyne ... ..	...	...	...	...	...	...
7. Peak Hill ... ..	...	...	...	...	...	...
8. East Murchison	2	...	16	15	18	15
9. Murchison	3	2	13	20	16	22
10. Yalgoo ... ..	...	...	...	...	...	...
11. Mt. Margaret	2	...	59	16	61	16
12. North Coolgardie	1	...	3	5	4	5
13. N.E. Coolgardie ... ..	...	1	1	...	1	1
14. Broad Arrow ... ..	...	...	...	1	...	1
15. East Coolgardie	9	11	337	232	346	243
16. Coolgardie	1	...	2	...	3	...
17. Yilgarn	1	1	4	1	5	2
18. Dundas ... ..	...	...	...	1	...	1
19. Phillips River ... ..	...	...	...	1	...	1
MINING DISTRICTS—						
Northampton	1	...	8	...	9	...
Yandanooka ... ..	...	...	...	...	...	...
Greenbushes ... ..	...	1	...	...	...	1
Collie ... ..	...	1	94	52	94	53
Swan ... ..	...	1	1	...	1	1
Kendinup ... ..	...	...	...	...	...	...
Roelands ... ..	...	...	...	...	...	...
Total	21	18	538	344	559	362

From the above table it will be seen that the total number of fatal accidents for the year 1921 was three less than for 1920. The number injured shows a decrease of 194 compared with the preceding year. Details of these accidents will be found in the report of the State Mining Engineer, published as Division II. to this Report.

B.—According to Causes of Accidents.

	1920.		1921.		Comparison with 1920.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	1	10	...	7	— 1	— 3
2. Falls of Ground	7	54	7	30	...	— 24
3. In Shafts	5	20	7	13	+ 2	— 7
4. Miscellaneous—Underground	3	311	1	204	— 2	— 107
5. Surface	5	143	3	90	— 2	— 53
Total	21	538	18	344	— 3	— 194

Of the fatal accidents 15 occurred in gold mines, one in a coal mine, one in a tin mine, and one in a stone quarry. The death-rate per 1,000 men employed in gold mines was 2.57 as against 2.89 in 1920.

TABLE No. 27.

Deaths of Persons employed at Mines from Accidents during 1920 and 1921

	1920.						1921.					
	Number of Persons killed.			Death Rate per 1,000 men employed.			Number of Persons killed.			Death Rate per 1,000 men employed.		
	Above Ground.	Under Ground.	Total.	Above Ground.	Under Ground.	Total.	Above Ground.	Under Ground.	Total.	Above Ground.	Under Ground.	Total.
Coal Mines ... ..	...	...	...	...	...	...	...	1	1	...	1.49	1.15
Men employed	(218)	(612)	(830)	...	...	...	(198)	(672)	(870)	...	...	...
Gold Mines	12	8	20	3.60	2.13	2.82	1	14	15	.34	4.59	2.49
Men employed	(3,335)	(3,752)	(7,087)	...	...	...	(2,972)	(3,047)	(6,019)	...	...	...
Other Mines ... ..	...	1	1	...	4.44	1.73	1	1	1	8.26	...	5.13
Men employed	(354)	(225)	(579)	...	...	...	(121)	(74)	(195)	...	...	...
Total for all mines ...	12	9	21	3.07	1.96	2.47	2	15	17	.61	3.95	2.40
Total number of men employed	(3,907)	(4,589)	(8,496)	...	...	...	(3,291)	(3,793)	(7,084)	...	...	...

TABLE No. 28.

Deaths of Persons employed at Quarries from Accidents during 1920 and 1921.

Mining District.	Number of Persons employed.						Number of Persons killed.						Death Rate per 1,000 men employed.					
	Above Ground.		Under Ground.		Total.		Above Ground.		Under Ground.		Total.		Above Ground.		Under Ground.		Total.	
	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.	1920.	1921.
Swan	195	203	...	...	195	203	...	1	...	...	...	1	...	4.93	...	...	...	4.93
Roelands ... ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	195	203	...	...	195	203	...	1	...	...	...	1	...	4.93	...	...	...	4.93

TABLE No. 29.

Deaths from Accidents of Persons Employed in Gold Mines during 1921, and the Death Rate per 1,000 Men Employed and per 1,000 tons of Gold Ore raised during 1920 and 1921. (Number of men taken as in Table No. 23, not including Alluvial Gold Workers.)

Goldfield.	Number of Deaths.						Death Rate per 1,000 men employed.				Number of Deaths per 1,000 tons of Gold Ore raised.	
	1921.						1921.			1920.	1921.	1920.
	Above Ground.	Under Ground.	Total.	Above Ground.	Under Ground.	Total.	Above Ground.	Under Ground.	Total.	Total.		
1. Kimberley
2. West Kimberley
3. Pilbara
4. West Pilbara	142.86	...	14.286
5. Ashburton
6. Gascoyne
7. Peak Hill
8. East Murchison	5.48	...	.052
9. Yalgoo
10. Mt. Margaret	2.34	...	.009
11. North Coolgardie	3.53	...	.048
12. North-East Coolgardie	1	...	1	...	31.25	16.67	...	...	.198	...
13. East Coolgardie	1	10	11	.85	6.31	3.98	2.68	...	.017	.012
14. Broad Arrow
15. Coolgardie	2.16	...	.059
16. Murchison	2	2	...	6.08	3.37	5.60	...	.031	.040
17. Yilgarn	1	1	...	4.93	2.16	1.87	...	.030	.010
18. Dundas
19. Phillips River
Total	1	14	15	.36	4.59	2.57	2.89	...	.017	.016

The number of deaths per 1,000 men employed shows a slight decrease from 2.89 in 1920 to 2.57 in 1921, and that per 1,000 tons of gold ore raised shows a slight increase, being .017 as against .016 for the preceding year.

PART VI.—STATE AID TO MINING.

The number of Batteries existing at the end of the year was 29.

From inception to the end of 1921, gold and tin to the value of £5,496,360.57 have been recovered from the State plants. 1,318,282.44 tons of auriferous ore have been treated and have produced £4,508,401.05 by amalgamation; £661,512.04 by cyanidation; £224,674.12 worth by slimes treatment; £9,353.37 worth from residues, and 80,067.75 tons of tin ore produced tin to the value of £92,419.99, and, in addition, a sum of £572.32 has been recovered from residues.

During the year the gold ore treated was 34,761 tons for 24,035 ozs. bullion.

The working expenditure for all plants for the year totalled £44,324 1s. 3d. and the revenue £36,522 6s. 4d., which shows a loss of £7,801 14s. 11d. in the year's operations.

The capital expenditure since the inception of the scheme has been £394,071 8s. 1d.; £302,090 6s. 5d. from General Loan Fund, and £91,981 1s. 8d. from Consolidated Revenue.

The cost of administration for the year was £4,293 11s. 1d. as against £3,825 13s. 3d. for 1920.

The working expenditure from inception to the end of the year exceeds the revenue by £105,445 7s. 7d.

GEOLOGICAL SURVEY.

The work of the Geological Survey during the year 1921 has been more or less restricted owing to the changes which have taken place. Considerable public interest having been manifested in the search for petroleum; the energies of the relatively small staff available have been mainly directed towards meeting the demands for information. Chief interest has centred in the Kimberley Division and in the valley of the Fitzgerald River on the South Coast. Mr. Blatchford, Assistant Geologist, visited the Kimberley Division, where the presence of hydrocarbons had been found in a hot spring at Mt. Wynne, and in boring put down in carboniferous rocks in the Rough Ranges, in addition to a hard black asphaltum, akin to Gance Pitch, occurring in a weathered basalt on Texas Station in East Kimberley. The full reports of these occurrences will be found in the report of the Geological Survey hereunder. The tertiary rocks of the upper reaches of the Fitzgerald River have been pierced by bore holes, and the sanguine expectations of the prospectors doomed to disappointment, for no true asphaltum was disclosed. The auriferous deposits of Gibraltar were thoroughly examined, to-

gether with the asbestos deposits of the North-West, the manganese ore at Mt. Walton, on the Coolgardie Goldfield, and the Wilga coal deposits, in addition to the results of the deep boring on the Irwin River being fully investigated, full particulars in regard to which will be found in the report of the Government Geologist. In addition to the usual routine work of the laboratory staff, considerable additions were made to our knowledge of the minerals of the State, full particulars of which are to be found in the report of the Government Geologist which follows.

ASSISTANCE UNDER MINING DEVELOPMENT ACT, 1902.

The following statement shows the sums advanced during the year 1921 under the Mining Development Act:—

	£	s.	d.
Advanced in aid of mining work and equipment of mines with machinery	24,624	16	7
Subsidies paid on stone crushed for public	270	1	6
Boring	5,648	11	11
Providing means of transport and equipment to prospectors ..	7,398	15	6
	£37,942	5	6

In addition to the above, amounts totalling £6,917 1s. 9d. were expended from Mining Development Vote on various matters for the assistance of mining, such as water supply, subsidies to assist carting of ore long distances, and subsidies for development work done below 100 feet level in small mines, and rebates to prospectors working low grade mines. The subsidies paid on stone crushed for the public, amounting to £270 1s. 6d., are subsidies paid to owners of plants crushing for the public, the conditions being that they crush at fixed rates; in most cases a further requirement being imposed as to purchasing or treating tailings. The ore crushed at such plants during the year amounted to 3,122 tons. The receipts under the Mining Development Act, exclusive of interest payments, amount to £1,119 10s. 5d., and include—

	£	s.	d.
Refunds of advances	733	13	1
Sales of securities	325	7	3
Miscellaneous refunds	60	10	1
	£1,119	10	5

PART VII.—REMARKS ON THE GOLDFIELDS AND MINERAL DISTRICTS AND SUMMARIES OF THE WARDENS' AND OTHER OFFICERS' REPORTS.

ASHBURTON GOLDFIELD.

Twenty-two (22) fine ounces were reported from this field, where mining has been at a standstill for years. It was presumably got by alluvial workers.

BROAD ARROW GOLDFIELD.

The output of gold was 8,875 fine ounces, and in the preceding year 7,445 fine ounces; an increase of 1,430 fine ounces. Although a good many prospectors

were out, nothing of note was reported from this field.

COLLIE COAL FIELD.

The output of coal for the year was 463,817 tons, and for the preceding year 462,021 tons; an increase of 6,796 tons.

Five (5) collieries were producing, viz., the Proprietary, Co-operative, Cardiff, Westralian, and Premier.

Development on the field was fairly steady, and prospecting work revealed a further large area of coal-bearing land.

The outlook for the field is very good.

COOLGARDIE GOLDFIELD.

The output of gold was 9,548 fine ounces, and in the preceding year 5,986 fine ounces; an increase of 3,562 fine ounces.

In the Kunanalling district there was little change. A few prospectors were at work, and the Carbine mine continued to be a steady producer.

At Gibraltar there has been a revival, and the Lloyd George and Carlton mines are very promising.

The Department has assisted the former in connection with the erection of a treatment plant, and has also arranged for the installation of a water supply for the district.

At Widgiemooltha prospecting has been active, and developments are encouraging.

At St. Ives a State battery has been erected and commenced treatment. Some of the mines are most promising, and the next few months should serve to prove the permanency or otherwise of the district.

DUNDAS GOLDFIELD.

The output of gold for the year was 5,456 fine ounces, and in the preceding year 6,541 fine ounces; a decrease of 1,085 fine ounces.

The Mararoa, which was the principal mine for many years, closed down; otherwise there was little change, the number of prospectors being practically the same as in the previous year.

EAST COOLGARDIE GOLDFIELD.

The output of gold was 378,430 fine ounces, and in the preceding year 401,496 fine ounces; a decrease of 23,066 fine ounces. There was little change in any of the big mines, and no noteworthy developments.

A considerable amount of boring, with a view to proving an extension of the gold-bearing lodes of the Golden Mile, was undertaken at the South end. This work was subsidised by the Government, and is still in progress. At Hampton Plains and Mt. Monger development has proceeded steadily, and at each centre there are promising mines.

EAST MURCHISON GOLDFIELD.

The output of gold was 18,762 fine ounces, and in the preceding year 19,600 fine ounces; a decrease of 838 fine ounces. In the Lawlers district there was an improvement, and some of the old mines have been developing most encouragingly.

Outside of Lawlers itself there has been little activity, and no new finds reported. In the Wiluna district there was no improvement, and mining is very quiet, the expected capital for opening up some of the mines not having, so far, been forthcoming.

In the Black Range district there was no change. The Yuanmi G.M. Company's mine at Youanmi is still the chief producer.

GASCOYNE GOLDFIELD.

A production of seven fine ounces was reported from this field, presumably got by alluvial workers. The only mining tenements being worked were some mica claims.

GREENBUSHES MINERAL FIELD.

The output of black tin was 52.87 tons, valued at £5,778, and in the preceding year 190.09 tons, valued at £31,249; a decrease in tonnage of 137.22 tons, and in value of £25,471.

There was little mining activity, and owing to the low price ruling for tin the outlook is not too bright.

KIMBERLEY GOLDFIELD.

As hitherto, mining in this field has been confined to a few fossickers for alluvial gold. Forty-nine (49) ounces were reported.

MOUNT MARGARET GOLDFIELD.

The output of gold was 20,803 fine ounces, and in the preceding year 77,336 fine ounces; a decrease of 56,533 fine ounces. In addition, 6,116.66 tons of pyritic ore, valued at £7,871, were raised, and in the preceding year 6,019.98 tons, valued at £7,276; an increase in tonnage of 96.68 tons, and in value of £595.

In the Mt. Margaret district there was a considerable falling off, attributable to the closing down of the Lancefield mine, and mining generally was very quiet. In the Mt. Morgans district there was a satisfactory increase, the principal producers being the Westralia Mt. Morgans mine at Morgans, and the Bindah mine at Linden.

In the Mt. Malcolm district there was a heavy falling off accounted for by the cessation of operations at the Sons of Gwalia mine, owing to a disastrous fire which destroyed the greater part of the surface plant.

A good deal of prospecting was done in the district, but nothing of note discovered.

MURCHISON GOLDFIELD.

The output of gold was 41,257 fine ounces, and in the preceding year 46,604 fine ounces; a decrease of 5,347 fine ounces. In the Meekatharra district there was little change, the large mines being steady producers. In the Cue district there was a lessened production and nothing of note to report. The Light of Asia and Big Bell Mines were the principal producers. In the Day Dawn district there was little change. In the Mount Magnet district there was a falling off, but a good deal of prospecting was going on.

NORTHAMPTON AND YANDANOOKA MINERAL FIELDS.

No minerals were reported from Yandanooka.

In the Northampton field the output of lead ore was 10,330.43 tons, valued at £25,649, and in the preceding year 27,716.40 tons, valued at £172,483; a decrease in tonnage of 17,385.97 tons, and in value of £146,834.

Owing to the low price ruling for lead, mining was at a standstill for the greater part of the year. Towards its close an improvement resulted in some of the mines re-opening, and the outlook for the New Year is much brighter.

NORTH COOLGARDIE GOLDFIELD.

The output of gold was 10,640 fine ounces, and in the preceding year 12,024 fine ounces; a decrease of 1,384 fine ounces.

In the Menzies district there was a lessened output consequent on the principal producer, the Menzies Consolidated, at Yundaga, having temporarily closed down.

The other centres in this district remained very quiet.

In the Ularring district the Riverina South Mine was working and producing, and is expected to open up well. The Niagara and Yerrilla districts were exceedingly quiet.

NORTH-EAST COOLGARDIE GOLDFIELD.

The output of gold was 4,148 fine ounces, and in the preceding year 1,739 fine ounces; an increase of 2,409 fine ounces. Matters were very quiet in the field, nothing sensational having, so far, been revealed by the boring for deep alluvial mentioned in last year's report.

A few prospectors are still scattered throughout the field.

PEAK HILL GOLDFIELD.

The output of gold was 1,079 fine ounces, and in the preceding year 1,656 fine ounces; a decrease of 577 fine ounces. There was little change in this field, and nothing of note transpired.

No extensive work on the Manganese deposits at Horseshoe has been yet undertaken, the low price at present ruling for the ore being a retarding factor.

PHILLIPS RIVER GOLDFIELD.

The output of gold was 866 fine ounces, and in the preceding year 1,423 fine ounces; a decrease of 557 fine ounces.

The production of copper was 95.34 tons, valued at £1,207, and in the preceding year 217.27 tons, valued at £4,125; a decrease in tonnage of 121.93 tons, and in value of £2,918.

There was no improvement in this field, and until a good deal of capital is available for developing some of the large mines, no great change can be expected. The Government has been most liberal in helping many small owners to open up and prove their properties.

PILBARA GOLDFIELD.

The output of gold was 2,627 fine ounces, and in the preceding year 4,052 fine ounces; a decrease of 1,425 fine ounces.

Black Tin to the amount of 14.50 tons, valued at £1,460, was raised, and in the preceding year 41.50 tons, valued at £7,616; a decrease in tonnage of 27 tons, and in value of £6,156.

Also 235.35 tons of Asbestos, valued at £13,581, and in the preceding year 156.50 tons, valued at £7,286; an increase in tonnage of 78.85 tons, and in value of £6,295.

In gold mining the position was maintained, practically the same number of men being employed as in the previous year.

In Tin Mining, consequent on the low price ruling for the metal, there was a big falling off.

In Asbestos Mining there was considerable activity, and the outlook is good.

The general improvement commented on last year has been well maintained, despite adverse conditions.

WEST PILBARA GOLDFIELD.

The output of gold was 67 fine ounces, and the preceding year 134 fine ounces; a decrease of 67 fine ounces.

Copper ore amounting to 1,055 tons, valued at £18,955, was produced, and in the preceding year 1,700.50 tons, valued at £32,059; a decrease in tonnage of 645.50 tons, and in value of £13,104.

The principal producer was the Whim Well Copper Mine, but, owing to the big drop in copper, this mine practically ceased operations. Until a considerable improvement takes place in price, the outlook is not cheering.

WEST KIMBERLEY GOLDFIELD.

There is nothing to report from this field. No active development has yet been undertaken with regard to the iron leases at Yampi Sound.

Boring for oil will be undertaken by a strong company in the coming New Year.

YALGOO GOLDFIELD.

The output of gold was 3,579 fine ounces, and in the preceding year 2,965 fine ounces; an increase of 614 fine ounces. The bulk of the production came from Payne's Find, where prospecting has been active. At Gnow's Nest, about 22 miles S.E. of Yalgoo, a 10-head battery and treatment plant has been erected on a very promising looking mine, and crushing commenced towards the end of the year. At Field's Find some prospectors have a show, called Brown's Reward, which promises well. These developments have attracted quite a number of prospectors to the field, and the outlook is promising.

YILGARN GOLDFIELD.

The output of gold was 19,241 fine ounces, and in the preceding year 37,637 fine ounces; a decrease of 18,396 fine ounces.

There has been a considerable amount of prospecting throughout this field, but nothing sensational discovered.

At Westonia the position has not improved, and the outlook is not bright.

At Forrestania the principal difficulty is still the water supply, but the mine owners are struggling manfully.

In the other centres prospectors are actively engaged, and generally the outlook for the field is encouraging.

TABLE 30.

Value of Mining Machinery and Number of Stamps and other Mills erected on the 31st December, 1921, compared with the previous Year.

Goldfield.	District.	Value of Mining Machinery.		Batteries, Number of Stamps.		Mills.																				
		1920.	1921.	1920.	1921.	1920.							1921.													
						Prospecting.	Ball.	Griffin.	Huntington.	Puddlers.	Other Crushers.	Flint.	Grinding Pans.	Prospecting.	Ball.	Griffin.	Huntington.	Puddlers.	Other Crushers.	Flint.	Grinding Pans.					
1. Kimberley ...	...	£	£	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2. West Kimberley ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3. Pilbara ...	Marble Bar Nullagine	11,134	11,490	38	48	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4. West Pilbara ...		4,237	3,752	25	25
5. Ashburton ...	...	2,100	2,650	20	20	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6. Gascoyne ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7. Peak Hill ...	...	8,762	8,575	20	20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8. East Murchison ...	Lawlers ...	13,631	13,090	45	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Wiluna ...	36,830	24,989	80	65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Black Range	97,229	95,333	70	70	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9. Murchison ...	Cue ...	36,361	35,773	68	65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Meekatharra	76,730	67,000	97	77	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Day Dawn	6,200	5,200	50	50	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10. Yalgoo ...	Mt. Magnet	18,243	14,105	30	20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	...	27,393	32,732	48	58	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11. Mt. Margaret ...	Mt. Morgans	13,102	11,337	45	45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mt. Malcolm	234,704	234,121	127	75	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mt. Margaret	47,220	33,343	50	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12. North Coolgardie ...	Menzies	33,760	27,752	65	65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Ularring	27,953	26,856	20	20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Niagara	5,286	3,481	25	15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13. Broad Arrow ...	Yerilla	3,740	3,438	20	20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	...	64,260	64,126	45	45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14. North-East Coolgardie	Kanowna	9,048	9,135	55	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kurnalpi	250	180	5	5	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15. East Coolgardie ...	East Coolgardie	1,297,043	1,224,742	500	495	1	41	13	3	6	44	33	167	1	41	13	2	8	43	33	166	...	...	...	...
	Bulong	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16. Coolgardie ...	Coolgardie	13,796	24,922	63	78	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Kunanalling	7,300	7,650	30	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17. Yilgarn ...	...	102,056	101,515	180	155	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18. Dundas ...	...	31,317	29,537	55	17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19. Phillips River ...	...	10,850	10,250	45	45	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	State generally	30,000	30,000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total, Gold-extracting Machinery ...		2,270,544	2,157,074	1,921	1,748	4	52	13	7	10	65	42	317	3	52	13	9	11	62	42	309	...	...	...	...	...
Total, Machinery, other than Gold-extracting ...		363,654	357,308	...	...	...	...	...	5	...	26	4	3	...	...	...	2	...	27	4	3	...	...	...	...	...
TOTAL, MINING MACHINERY ...		2,634,198	2,514,382	1,921	1,748	4	52	13	12	10	91	46	320	3	52	13	11	11	89	46	312	...	...	...	...	...

PART VIII.—EXISTING LEGISLATION.

At the close of the year the Acts in force relative to Mining were:—

1. The "Mining Act, 1904."
2. "Mining Act Amendment Act, 1919."
3. "Mining Act Amendment Act, 1920."
4. "Mining Act Amendment Act, 1921."
5. "Sluicing and Dredging for Gold Act, 1899."
6. "Mines Regulation Act, 1906."
7. "Mines Regulation Act Amendment Act, 1915."
8. "Coal Mines Regulation Act, 1902."
9. "Coal Mines Regulation Act, 1915."
10. "Mining Development Act, 1902."
11. "Mines and Machinery Inspection Act, 1911."
12. "Gold Buyers' Act, 1921."

The following alterations, etc., regarding Regulations were gazetted:—

Under the "Mining Act, 1904":—

Additional Regulations 25a, 25b, 25c, 25d, 25e, 25f, 25g, 25h, 25i, 25j, 25k, 25l, 25m, 102a, 102b, 193a, 193b, 193c, and 193d.

Amendment to Regulations 1—25h, 80, 81, 82, 90, 137, 166, 189, 190, 191, and 192.

Under the "Coal Mines Regulation Act, 1902":—

Amendment of Regulation 9, Part I.

Amendment of Regulation 66, Part V.

Under the "Mines Regulation Act, 1902":—

Amendment of Regulation 15.

The "Mining Act Amendment Act, 1921," was passed during the year, and deals only with the question of tributing in mines. As considerable controversy had arisen regarding the existing Act a Royal Commission was appointed to investigate the whole position, and the recommendations of the Commission were embodied in the Act as passed.

PART IX.—INSPECTION OF MACHINERY.

The Chief Inspector of Machinery reports that the number of useful boilers at the end of the year totalled 2,892, as against 2,894 total for the preceding year, showing a decrease, after all adjustments, of two boilers.

Of the total 2,892 useful boilers, 1,366 were out of use at the end of the year; 1,433 thorough and 186 working inspections were made, and 1,454 certificates were issued.

Permanent condemnations totalled 22, and temporary condemnations 70. There were 4 conversions, and 14 boilers were exported.

The total number of machinery plants in use was 7,141, against 6,305 for previous year, showing an increase of 836.

Inspections made total 4,889, and 4,889 certificates were granted.

163 applications for engine-drivers' certificates were received and dealt with, and 118 certificates, all classes, were granted as follows:—

First Class Competency (including certificates issued under Regulation 27 and Section 63 of the Act)	1
Second Class Competency (including Certificates issued under Regulation 27 and Section 63 of the Act)	25
Third Class Competency (including Certificates issued under Regulation 27 and Section 63 of the Act)	54
Locomotive Competency	8
Traction Competency	12
Interim	6
Copies	12
Total ..	118

Total mileage travelled was 51,207 miles, of which 19,052 were by rail, 32,136 by road, and 19 by water.

PART X.—SCHOOL OF MINES.

During this, the eighteenth year of the School's existence, good progress was maintained.

The year commenced with a satisfactory enrolment, but primarily owing to the disturbed condition of the mining industry, the attendance in the third term showed a decrease when compared with the same period of the previous year. The proposed imposition of fees to students over 21 years of age may affect the attendance next year, but it is anticipated that few genuine students will be deterred. The installation of the Metallurgical Experimental Plant is now sufficiently advanced to allow a series of working tests to be commenced in 1922.

It is hoped that the experimental work will result in the elucidation of difficulties in ore treatment and prove of considerable educative value to the students. The system of free assays for prospectors was con-

tinued, and during the year a total of 550 assays and mineral determinations was made.

CONCLUSION.

In dealing with the operations of the various departments, I have only briefly commented on the principal items. Full and detailed information will be found in the reports of the various officers controlling, published as Divisions II. to VII. of this Report.

In conclusion, I desire to acknowledge the support received from all officers of the Department during the year.

M. J. CALANCHINI,

Under Secretary for Mines.

Department of Mines,
Perth, 31st March, 1922.

DIVISION II.

REPORT OF THE STATE MINING ENGINEER FOR THE YEAR 1921.

The Office of the State Mining Engineer,
Perth, 31st January, 1922.

The Under Secretary for Mines, Perth.

Sir,

I have to submit my Report for the year 1921, for the information of the Hon. the Minister for Mines.

INSPECTION OF MINES UNDER "THE MINES REGULATION ACT, 1906," AND "THE COAL MINES REGULATION ACT, 1902."

The only alteration in the personnel of the Inspectors of Mines was the retirement of Mr. S. Irwin of the Kalgoorlie District, it being considered by the Public Service Commissioner that the work could be carried on with one man less.

REPORTS OF INSPECTORS OF MINES.

The following reports from the various Inspectors of Mines give brief particulars of the development of the mines and the administration of the Act and Regulations in their districts.

REPORT OF MR. W. M. DEEBLE, INSPECTOR OF MINES, CUE.

I beg to submit herewith my annual report on the progress of mining in the Black Range, Peak Hill, and Murchison Goldfields.

During the year several new finds have been made, but in no case has any find developed into a mining proposition. We cannot overlook the fact that the future of mining in this State depends upon the finding of other mines to take the place of a large number now being worked, but which have a very limited future.

In the past prospectors mostly have been looking for gold in quartz and ironstone lodes, and other forms of lodes have been neglected. An Advisory Prospecting Board is now being formed in this district, and as this board will be chiefly composed of practical men it is to be hoped that some workable suggestions will be forthcoming to aid the Department assisting prospectors, and also in making advances towards the development of small shows. One great drawback to opening up and mining in the back country is that the further a man goes back the more he is penalised for being there. As pointed out in last year's report there is considerable mineral wealth in the Northern part of Peak Hill Goldfield in various commercial minerals, but until general costs are reduced these minerals will be of no value to the State. During the year a trial was again

given to copper shows North of Peak Hill, but the costs of materials and cartage were too high with present value of copper. On the copper mine a small benzine engine was used to pump the water, but as the cost of benzine was prohibitive at that place a home-made suction gas generator was installed and worked effectively with charcoal. If manufacturers were to make generators suitable to run small engines similar to the Morse type on charcoal, it would be of considerable value and assistance in opening up and developing small shows in far back places, and this is a direction in which mines in their initial stages could be assisted.

Peak Hill.—On the old Peak Hill mine a ten-head mill has been kept going fairly regularly during the latter part of the year on material from the old dump. A number of miners are also engaged working on leaders around the open cut, and the average grade is high.

Holden's Find.—The Waterloo G.M. at this place has employed an average of 12 men during the year, and 1,083 tons were treated for a yield of 544 ounces. During part of the year the mill was out of commission owing to the shaft having to be sunk another lift, which is now a total depth of 153 feet. The sinking of the shaft was retarded owing to an inflow of water, which amounted at one time to about 100,000 gallons daily. The manager now reports that the prospects for future work are bright.

Meekatharra.—The Ingliston Consols Extended G.M. has been employing an average of 96 men, and during the year treated 23,318 tons for bullion valued at £59,047. The bottom level is now 1,110 feet, and the values are reported to be good. An effort is being made to improve the treatment plant, and in addition to other plant two grinding pans and nine curvilinear tables are to be added. The Fenian G.M. employed an average of 114 men during the year, and during the same period 22,564 tons were treated for 12,901.76 fine ounces valued at £55,408 8s. 9d. The main shaft is now 1,196 feet deep, and the lowest level 1,150 feet.

Ingliston G.M.—The mill on this mine treated 543 tons for a return of 833.98 ounces fine over the plates. The rock in the mine is very hard, which makes progress slow.

Gwalia G.M. is the most Southern mine being worked on the line of lode. A parcel of 89½ tons treated returned 355 ounces fine.

Marmont G.M. treated 79.73 tons for 136.33 ounces of fine gold.

There are a number of smaller shows being worked in this district, and taken altogether there was an increase of 3,477 tons treated and an extra production of 1,798.34 ounces for the year 1921 over that of 1920.

Culculli.—At this place the leaders are small but rich, and the ground soft kaolin down as far as the deepest workings have gone. All the shows have been worked intermittently, and the following results were obtained. Culcilli, 35.25 tons, 74.95 ounces fine; Turn of Tide, 5.50 tons, 73.67 ounces fine; Wild Rabbit, 56.75 tons, 68.13 ounces fine; Tuckanarra, 23.50 tons, 52.23 ounces fine; P.A. 1393, 9 tons, 35.76 ounces fine; P.A. 1413, 9.50 tons, 27.73 ounces fine. Rich floaters have been found at various times off the lines worked, showing there must be other parallel lines not yet discovered.

Reedys.—The Emu G.M. is the only mine at this place being worked at present, and during the latter part of the year winding machinery was installed for the purpose of sinking the main shaft to try to get a sufficient water supply for milling purposes. The lode in the mine is large, and what has been treated up to date has been good grade milling ore. The last crushing of 140 tons returned 62.68 ounces fine. The cost of carting such ore to the State mill at Cue, a distance of over 30 miles, is prohibitive.

Tuckanarra.—There are a number of prospectors at this place, who obtained 191.70 ounces during the year.

Cue.—The chief mine at this centre is the Light of Asia, where an average of 45 men has been employed. During the year 6,098 tons were milled for bullion valued at £16,511 9s. 6d., and 6,210 tons sands cyanided for £4,420 14s. 2d. In the district generally 1.132 tons have been crushed from P.As. for 482 ounces. A rich patch was struck on the ground known at one time as the Caledonia, where it is said the largest nugget ever found around Cue was unearthed in the early days. Prospectors Messrs Carlsen and Patterson dollied 130.12 fine ounces, and a crushing of 57 tons treated at State mill returned 56 ounces. The reef, as far as worked by owners at 25 feet depth, will average about two feet in width, and the stone, judging by dish prospects, nearly an ounce per ton. This is certainly very promising for the amount of work done.

Cuddingwarra.—The Big Bell G.M. is the only one of note in this mining centre. The lode worked is very large and low grade, and during the latter part of the year a continuous decantation process, similar to the one on the Youanmi G.M., was installed in the hope that lower costs would be obtained and a larger tonnage treated; unfortunately, it did not realise expectations and has been dismantled.

Tuckabianna.—Very little is being done at this place at present. During the year, prospectors treated 87.5 tons from the district for a return of 121.29 fine ozs.

Mainland and Lake Austin.—An average of sixteen prospectors has been engaged at these places, but nothing found worth recording.

Moyagee.—The owners of the "Moyagee" G.M. crushed 556 tons for a return of 1,084.15 ozs. fine gold. The tonnage treated must, of necessity, be small when the ore has to be taken about twenty-five miles to the mill. This mine should pay well with a treatment plant on the ground.

Lennonville.—The old "Galtee Moore" lease has been worked as P.A. 868M, and 136.75 tons were treated for 149.53 ozs. The Empress G.M., which was worked by a Company, has been taken over by Grose Bros., the original owners, and they have started to unwater the mine again.

Mt. Magnet.—As has been the case for several years, mining in this District has been carried on by small parties and in some instances excellent returns have been obtained.

Sandstone.—Throughout the year only small parties of prospectors have been working in the district.

Youanmi.—The Youanmi G.M. employed an average of 110 men, and treated 18,242 tons for a return of £40,662 1s. 4d.

REPORT OF MR. H. P. ROCKETT, INSPECTOR OF MINES,
LEONORA.

Herewith I present to you my report on the Mt. Margaret, East Murchison, and North Coolgardie Goldfields for the year 1921.

As the result of high mining costs, there has been a general falling-off of mining production, especially gold, and there appears little prospect of any marked improvement in the current year, 1922, as it is unlikely that either of the main producers of other years, the Sons of Gwalia, or the Lancefield, will resume operations during 1922.

Laverton District.—At the end of 1920 the Lancefield mine closed down, and no mining has been done in it since. This meant a severe blow to the mining industry in the Mt. Margaret Goldfield, as 150 men suddenly became unemployed and the loss in gold yield for the year was probably in the neighbourhood of 23,000 ounces. A general clean up of the plant realised 2,775 ozs. From the Beria Main Reef only 32 ozs. were obtained from 202 tons by amalgamation. In the past it has always been found that less than one-third of the total gold in the ore from this mine can be recovered by amalgamation, and, though no figures are available, it is likely that the residue from the 202 tons contained 60 ozs. or more of gold. At the Cock of the North, J. Lyons broke 47 tons, which yielded 15 ounces.

From the Mary Mac's Lady Harriet lease 133 tons were broken, yielding 47 ounces. From the Triangle lease, formerly one of the Mary Mac leases, Messrs. Meugent and party raised 141 tons and obtained 43 ounces.

From Red Flag, W. Coleman sent in 40 tons, which yielded 63 ounces.

The Waubash, adjoining the Ida H., yielded 166 ounces, obtained from 163 tons; and from the Ida H. 157 ounces were obtained from 190 tons.

In the *Erlistoun district*, Mr. J. Dwyer completed the re-erection at Baneygo, of the Westralia Tasmania battery, and crushed for himself 284 tons, yielding 94 ounces from the Baneygo; and for Cox and Party, 41 tons, yielding 150 ounces from the Great Dolerite at Duketon Patch; and from Oxley and McCullum's Halmatite Mine, 11 tons yielded 81 ounces.

There was very little mining during the year in the *Burtville district*, the Nil Desperandum, formerly a fairly large producer, crushed only 44 tons, and this in conjunction with 460 tons of accumulated sand, yielded 277 ounces. Bond's Find, formerly the Yilgarn Consols, crushed 270 tons, from which 461 ounces were obtained.

The *Westralia Mt. Morgans* crushed 9,862 tons and obtained 3,259 ounces, and ceased operations about 16th December.

There was a revival of mining at *Murrin*, where the *Murrin Proprietary*, formerly *Hill's Proprietary*, crushed 1,250 tons and obtained 524 ounces. Unfortunately, this grade of ore has been found unpayable under present conditions.

At *Yundamindera*, Mr. J. Leitch removed the *Battlesville Battery* from its former site on the A.W.A., and re-erected it on the *Big Stone Lease* (formerly the *Golden Treasure*). Since then he has crushed 320 tons for himself from the *Big Stone*, obtaining 191 ounces; and for *Young Bros.* 76 tons worth 58 ounces, from the *Queen of the May*, and some smaller parcels, yielding together about 8 ounces.

In the *Linden district*, the *Bindah G.M.* is the principal producer, yielding 2,248 ounces on treatment of 7,380 tons of ore.

By last mail I received notification of the resumption of underground work on the *Torquay Mine*, formerly the *Devon G.M.* No underground work was done on the lease during 1921, but 68 ounces were obtained by treatment of 3,000 odd tons of accumulated sand and slime. It is expected that crushing will be resumed in a few weeks time. The cyanide plant has been put in order, and a *Wilfley table* and a 20ft. *Merton furnace*, capable of roasting 2,000 tons per month, have been erected.

The *Democrat*, formerly a good producer, has recently changed hands, and it is expected that during 1922 there will be a large increase in the output over the 37 tons containing 117 ounces produced during 1921. From the *Old Kelly*, 133 ounces were received from 84 tons, and from 74 tons raised at the great *Carbine* 33 ounces were obtained.

Nine other shows in this locality together yielded 140 ounces.

Yerilla District.—On the whole, mining was very quiet. At *Edjudina*, small quantities of stone were raised by Messrs. *Robertson*, of the *Senate*, and Messrs. *Brewer*, *Thomas* and others, but the total is said to have been the lowest yet recorded for that long line of lode.

From *Mt. Walbrook*, about 8 miles south of *Yarri*, about 100 tons were crushed, but the return was unsatisfactory.

Practically no mining was done at *Yerilla* or *Kookynie*.

Leonora District.—On the 19th January, a fire at the *Sons of Gwalia Mine* destroyed all the power plant and crushing machinery. Practically all the mine employees, some 400 in all, were thus suddenly thrown out of work.

With the double purpose of assisting married men with families, resident locally, who were out of employment as a direct result of fire, until they could be re-employed, and with a view to stimulating prospecting, the *Mines Department* assisted all applicants for sustenance, subject to the following conditions:—

1st. The applicant must have been actually in the mine employ at the time of the fire, and at the time of application out of work as a direct result of the fire. 2nd. That he must be a married man, whose family was ordinarily resident locally, or, if a single man, he must be the principal support of dependents resident locally. Under these conditions, about 50 men received sustenance, amounting to £3 per week each, until they were re-employed somewhere or to 4th June, when the sustenance ceased. Another con-

dition was that the applicant for sustenance must be able to show some mine workings in which he was engaged prospecting with some chance of success.

The *State Battery*, at *Leonora*, was put into first class order, and as a direct result of the sustenance scheme, eventually crushed 900 tons, yielding 146 ounces, in addition to ordinary crushings. From the point of view of mining development, the net result of the assistance scheme was disappointing, as no new mines or good prospects were opened.

The *Sons of Gwalia* crushed till 19th January, 1921, when the fire occurred, since when no ore has been broken in the mine. At the time of writing, there seems to be no indication of renewed activity underground, as no effort is being made to restore the crushing plant. The repaired fine-grinding plant was started in October, since when 33,000 tons of sand and slime from accumulated tailing, have been put through, yielding 2,890 ounces. There are no new features about the new plant. The old tailings are carried through by conveyor belts from the dump to a trommel, where they are mixed with solution, thence the pulp gravitates to a pump and is raised to a cone, the overflow goes direct to the cyanide vats, while the oversize goes to the tube mills and thence back to the cones where another classification is effected. From the overflow of the cones, the pulp goes through the cyanide vats and *Cassell's filters* in the ordinary way. The monthly output is about 12,500 tons.

Apart from the *Sons of Gwalia* mine, there has been a good deal more mining in *Leonora* district this year than for many years past.

The total tonnage put through the *State Battery* exceeded 1,350 tons, yielding 800 ounces, while the *Starlight Battery*, *Pig Well*, crushed 126 tons for about 53 ounces.

Some good parcels were put through, *B. Pozzi's* 56 tons for 97 ounces, and *Staunton's* 120 tons for 258 ounces, from the *Bannockburn*, being examples.

From *Cardinia Creek*, 29 ounces were dollied. Prospector *E. Cann* brought in six tons from *Dodger's Well*, from which he received 11½ ounces.

Very little mining is going on at *Darlôt*. All the old good producers, *Zangbar*, *Monte Cristo*, and *St. George* are now, for all practical purposes, idle. From a show on the *Lawlers Road*, four miles West of town, *Geo. Gilmore* obtained 87 ounces from 276 tons; and *R. Watson* took out 58 tons, yielding 14 ounces, from near the *Battery* site. About the middle of the year, there was some talk of a new find at the 40-mile peg, on the *Lawlers-Darlôt* road, 10 miles west of *Darlôt*. Five or six leases were pegged, but none have come up to expectations. *W. Corboy* has raised about six or eight tons of quartz, which, he says, carries over an ounce to the ton.

The *Victory Mine*, at *Mt. Clifford*, yielded 68 ounces obtained from 140 tons. In this locality, Messrs. *Craig* and *Legg* are still prospecting unsuccessfully.

At *Lawler's*, the *Daisy Queen Co.'s Queen Mine* crushed 1,150 tons for 547 ounces, or very approximately half an ounce per ton. A new 5-head stamp mill has been erected, and should be in working order at an early date; about 15 men are employed on the mine. The *Donegal G.M.* continued to work throughout the year; 324 tons returned 266 ounces, not including gold in residues, to the owners, Messrs. *Branson* and *Garrett*.

From the *Caroline* lease and from *P.A. 791*, Messrs. *Poole* and *Garrett* crushed 63 tons, yielding over 100 ounces.

At *Sir Samuel*, the *Bluey's Release* yielded 80 ounces from 150 tons of ore. Mr. *J. Currie* continues

to work his Yellow Aster Mine at *Kathleen Valley*, whence he obtained 197 ounces from 89 tons. During the coming year, Mr. Currie expects to commence treating his accumulated sands.

Mining at *Mount Keith* was nearly at a standstill, about 200 tons only being crushed for 130 ounces.

At *Cole's Find*, Messrs. McKenzie Bros. are at work on account of Mr. Geo. Dawson. Mr. Dawson hopes to make pay one of the lodes opened in the locality. At the Brilliant G.M., at the *Diorites*, Messrs. Pola and Mosman have broken over 200 tons of stone, but have not crushed yet.

Mr. Geo. Dawson is still working the *Violet* at *Wiluna*, but on a much reduced scale. He had only five men employed underground at the time of my last visit. At the *Happy Jack* some alterations to the shaft have been completed, and it is expected that the mine will become a constant producer and self-supporting at an early date. About 10 men are employed by the *Happy Jack*. On the *Moonlight*, Messrs. Aitken are employing three men. The *Justice*, *Callaghan's*, the *Essex*, *Bennet's*, and *Bourke's* are some of the small shows worked usually by a pair of mates. Individual returns from these small shows are not available.

REPORT OF MR. A. W. WINZAR, INSPECTOR OF MINES,
SOUTHERN CROSS.

I have the honour to submit my report for the year 1921, on the *Yilgarn*, *Phillip's River*, and *Yalgoo Goldfields*, the *Northampton* and *Greenbushes Mineral Fields*, and the *Swan Mining District*.

The first part of the year up to April 5th, I was relieving at *Southern Cross*, and then went on annual leave till May 12th, and put in the balance of the year in *Kalgoorlie*. As the Inspectors at *Kalgoorlie* will be reporting fully on that district, I will confine my report to the portion of the State comprised in the *Southern Cross Inspector's district*.

Care has been exercised to prevent and suppress any dust in dry places, the ventilation and safety of the mines have been well attended to, and all precautions taken to guard the health and comfort of those employed in the industry.

Yilgarn District.—Mining was rather brisker during the first few months of the year, but tailed off considerably towards the end. The *Bullfinch* closed down and was taken over by another firm, who did some development and opened up a fair amount of medium grade ore. The mine is closed down at present pending an improvement in cost of production. 9,465 tons were treated for 3,159 ozs., the total production from this mine to date is £680,000 from 514,165 tons.

At *Manxman* the *Radio* continues to produce high grade ore. 240 tons were treated for a return of 1,191 fine ozs. The quartz veins though not large are easily worked, and there appears to be enough to keep the mine working at the present rate for a considerable number of years.

At the new find made by Messrs. Withers and Slade towards the end of the year, about six miles N.E. of *Bullfinch*, some good prospects are being obtained. There appears to be more than one line of reef, and the indications point to the opening up of some nice little shows. The *Bullfinch* Company worked the original lease on option, doing some costeering and sinking. (Option since abandoned owing to the reef being too small for a company.) Several other leases

and prospecting areas are being worked by their owners, who are getting very encouraging results.

There are parties of prospectors operating north of *Southern Cross* to *Marda*, but so far nothing of importance has been reported.

In and around *Southern Cross* a fair amount of prospecting is being done with varying results. At *Fraser's Central* Messrs. Tasker and Faraday erected a *Huntingdon Mill* and put through several small parcels for the prospectors. A cyanide plant is to be erected which will enable the full value of the ore to be obtained. The winch and boiler are being got ready to make a start to unwater the mine to the bottom level.

The *Edna May Battler* treated a fair amount of ore from the *Trafalgar* property, but the grade proved too low to continue operations.

The *Golden Hope South* did a lot of development work on their holdings at *Marvel Loch*, and treated 541 tons for 168 ozs.

The *Bohemian* put through 295 tons for 356 ozs. The mine is looking rather well at present and should give a good return for the year 1922. There are several leases being worked around *Marvel Loch* which are payable propositions.

The *Butterfly* treated 4,420 tons for a return of 2,044 ozs. The bottom level is at 190 feet; values have not come up to expectation, and it is intended to further develop the mine.

The *Great Victoria* did little work during the year. Preparations are being made to get the mine in order, and a new leaching plant has been erected, the vats being constructed of cement; these are said to cost about the same as corrugated iron, and should be everlasting.

At the *Never Never* a few men are employed about the surface and open cutting.

At *Parker's Range* several leases are being worked. The *White Horseshoe* is looking well and some good stone is being obtained, 113 ozs. were returned from 112 tons.

At *Forrestonia* the *Great Southern* crushed 548 tons for 129.6 ozs., and the *Great Southern West* 96 tons for 10 ozs. The owners have had a hard struggle, and the future does not look bright. Trouble is experienced in obtaining an adequate supply of water to keep the mill going even part time; with sufficient water a fair amount of crushing material would be put through and the mine have a chance of doing better. The owners of the *Black Prince* have 130 tons at grass, estimated to be worth an oz. per ton.

At *Westonia* mining generally has slumped; the water difficulty being the cause.

The *Edna May Central* spent a lot of capital installing an electric pumping plant which proved ineffective, and the underground work had to be suspended pending arrangements either to instal a suitable plant or dispose of the property. Sands and slimes are being cyanided and a few parcels were milled for tributers.

Edna May Consolidated; a few parties of tributers worked on this mine taking out old blocks left by the company. The sands and slimes were sold and are being treated. The leases have been surrendered and partly taken up as *Machinery Areas*, etc. One party has taken up part as a *Prospecting Area* and is prospecting it.

The Edna May Deep Levels continued working throughout the year and treated 7,900 tons for 5,278 ozs. The stopes are being rapidly depleted, and the bottom level proved the granite to be intruding the ore body. There is a large dump of tailings to be treated, and a plant is being got ready for that purpose.

A few tributers worked about the Edna May Lease with little success. The plant has been disposed of, and most of it is off the lease.

Tributers on the Golden Points lease did a fair amount of work and crushed 125 tons for 148 ozs. The reef they were working out off and the mine has been abandoned.

Several parties have been working areas at the Sook and some good crushings were obtained. Intrusions of granite are very prevalent and interfere to such an extent that very little can be done with the reefs.

Yalgoo Goldfield.—This field has shown an improvement during the year, and appears likely to maintain it for some time.

At Payne's Find the usual number of men have been employed on the various holdings, the Lake View being the principal producer. The North shaft has been cleared out to 160 feet, and the porphyry bar which cut off the reef sunk through. A crosscut picked up the reef 22 feet west, and a drive proved a shoot 15 feet long worth 30 dwts. It is intended to fix up the shaft and do more work under the bar. A boiler and winch are on this shaft and some good stone will be got. The South shaft has been equipped with a six h.p. kerosene engine and winch, and the shaft was taken from 290 feet to 390 feet. The shoot is pitching into the adjoining lease. Somewhere about 1,000 tons were crushed from the property during the year, and an average of eight men was employed.

The Sweet William returned 16 dwts. per ton from 60 tons taken from about 90 feet. The mine is at present full of water. It is intended to take this out and again work the mine, which is 300 feet deep.

At the Orchid work was continued under the intrusion at 270 feet. A crushing returned 17 dwts. and work was discontinued here and confined to No. 2 shaft further N.W.; some good crushings were obtained, and a good shoot of stone shows in the bottom.

The Carnation was worked by tributers with fair success, and four parties are working in different portions of the lease.

The Marguerite is opening up well. Crushings were rather low during the year, but are improving.

Field's Find.—The Fields Extended has been acquired by Mr. Tobin, who is doing a little surface work.

Owen Hayes has the Field's Find Lease, and is sinking on stone of fair value. The prospects of this lease are decidedly encouraging.

Messrs. Hambleton and Carter found values about a big jasper formation about a quarter of a mile N.E. of the old battery; after working to 15 feet down they sold out to Mr. A. Brown, who is taking out a crushing which will be treated at the Warriedar State battery. The ore assays very high, and the prospects of the lease are good.

Prospecting is being done around Field's Find, and between there and Warriedar parcels are being obtained which will be put through the next run of the Warriedar battery.

At Warriedar a few parties are working and getting out parcels. The Highland Chief is being worked by Mr. Robinson, who reports encouraging prospects. At Rothsay work is being done on the Woodley's Reward, and a crushing broken out which is expected to give a good return; this will be treated at Warriedar.

At Gnow's Nest the mine has been taken over by a company, and a complete treatment plant erected consisting of 10 head of stamps, etc. The first clean up in December was very satisfactory. The mine is opening up well, and the main shaft is being sunk; some 40 men are employed, and the future of the mine looks bright. A fair amount of prospecting is being done in the vicinity, and it is possible other good mines will be opened up during 1922.

At Melville a party is arranging to work some of the shows around there, and put up a small battery.

At Yuin arrangements are in hand to start the Royal Standard mine, and production from this centre will take place in 1922.

The Yalgoo field embraces a large area with many belts of auriferous country, and is well worthy the attention of prospectors.

Northampton Mineral Field.—A fair amount of work is being carried out in lead mining.

The Narra Tarra at Prothero mined and milled 6,862 tons. The ore is crushed and concentrated on the lease, the products being shipped for smelting. The main shaft is down 550 feet, and the level driven 330 feet. The values disclosed are not as good as in the level above, and time is not far distant when the shaft will need sinking to open up another level. In the south end workings good copper ore exists, and this will no doubt be worked at some time or other. The surface is equipped with an effective concentrating plant, and very little of value is left in the residue.

The Wheal Ellen and Baddera were operated, the ore being treated at the Baddera plant. It is intended to shift the plant to the Wheal Ellen and confine operations to that mine. The plant is expected to be in full swing during 1922.

At Ajana the Surprise mine was temporarily closed, but the mine will be starting again. The plant is to be overhauled and the mine worked on a large scale. There are other mines in the district receiving attention.

I did not have an opportunity of visiting the tin mines at *Greenbushes* or the *Phillips River District*.

Fairly regular inspections of the various pits used to get materials for the brickworks and the *Stone Quarries* were carried out during the year. These were found to be kept in fair condition generally.

A large amount of time was taken up with inspections and reports in connection with loans and advances given to leaseholders under the Mining Development Act, and with loans to prospectors by the State Prospecting Board. This work also entails a lot of necessary travelling over different parts of the district.

REPORT OF MR. W. F. GREENARD, INSPECTOR OF MINES, KALGOORLIE.

I have the honour to submit my Annual Report, for the information of the Hon. the Minister for Mines, on the working and administration of the Mines Regulation Act and Amendments in the East Coolgardie, North-East Coolgardie, Coolgardie, North Coolgardie, Broad Arrow, and Dundas Goldfields.

A systematic routine inspection in the above Goldfields has been maintained throughout the year. The work has been carried on by two (2) Workmen's Inspectors, and four (4) District Inspectors, in which there has been a complete check of all details. Safety cages, hooks, and ropes have received special attention.

The storage of dynamite and detonators and conveyance into working places have been constantly under supervision.

Special attention has been given to change rooms on all the big mines. The area required for each mine has been provided, regular cleaning, together with sufficient washing basins and shower baths.

The filling of stopes has been carried out systematically, but a good deal of shrink stoping is still being done.

During the year, there have been several snaps of pillars, one snap was located in the Ivanhoe, and reported on. Others have occurred, and have not been located. These snaps are due to pressure, and it is apparent that the mines are much safer after the pillars have given way and the filling has taken the weight more uniformly.

Air receivers have been tested and examined in accordance with the requirements of Mines Regulation Act.

Dust underground has been continually under control, back holes and shrinkage stope shoots are troublesome, but the continual inspection and insistence of damping has a good effect, and reduced dust to a minimum.

All accidents have been carefully investigated and reported to Head Office.

Mr. Inspector Phoenix has continued to have charge of ventilation and has done good work. The control of air currents is systematically carried out in all mines.

Mining.—Very little mining development has been done during the year, and there has been a gradual decrease throughout the Goldfields in this district. The Great Boulder Proprietary, Ivanhoe Gold Corporation, and Golden Horseshoe Mine have continued to draw on their reserves.

The Great Boulder Perseverance is still being worked by tributers; many are making more than wages, and the mine continues to put out 14 to 15 thousand pounds' worth of gold monthly.

The South Kalgurli has developed some good ore in the lower levels.

The Kalgurli Mine has been taken over by the Oroya Links, and the plant re-arranged to treat tributers' ores.

The Lake View has continued to do some development at 2,300ft. level, and from recent developments the outlook is more promising. Hannans Star and Chaffers have been worked partially by tributers.

A good deal of prospecting has been done on the North End of Kalgoorlie. The Williamstown Mine is being worked by Sassella and party, and Mayman and party have equipped Mayman's Consols with a Huntingdon Mill and gas engine, and are now putting through a good tonnage of soft lode with payable results.

At Broad Arrow and Bardoc.—A good deal of systematic prospecting is being done, and several parties have found good patches.

At Ora Banda the Victorious and Gimlet South have been worked by tributers with payable results; the want of water has considerably handicapped this proposition. A good deal of prospecting has been

carried on in this district, and some excellent prospects located. Development work of a promising character is now in progress.

At Comet Vale the Sand Queen and Gladsome Mines are in process of being unwatered with the view of further development. This is a sound mining proposition.

At Yundaga the Menzies Consolidated Ltd., have commenced work and are now crushing; about 90 men are employed.

At Menzies, Mulline, Davyhurst, and Mulwarrie, there are a number of prospectors working.

At Kanowna several tributers are working the Red Hill with good results, and two or three other parties are getting gold in the old mines; a good deal of prospecting is being done in the district.

At Bulong a good number of prospectors are working. A very good find may be made at any time.

At Mount Monger mining development has been retarded through the shortage of water. A ten-head mill has been erected on the Proprietary Mine, which has done some crushing for the public from various leases, from which good returns were obtained. The water supply has been overcome by the Mines Department removing the pumping plant from Randalls, and there should now be ample for all battery requirements. The fresh water tank recently constructed is now full. Development work should now be pushed forward energetically.

At Coolgardie, Gibraltar, Kuanalling and Carbine, a good deal of prospecting has been done, and good payable gold has been obtained from several prospectors.

At Widgiemooltha prospecting has been energetically carried on, and several parties have found good gold.

At St. Ives the advent of the State Mill is permitting the testing of a long line of auriferous country. The results obtained from several claims are of a very promising character. St. Ives has a number of large lode formations, which require capital to allow them to be developed. They offer good chances to the investor. This locality promises to develop into a settled mining centre.

At Norseman the O.K. Mine is being worked by the Great Boulder Proprietary, Ltd., very good ore is being mined, and it is developing well. There are also a number of prospectors energetically testing many localities at Norseman.

Hampton Plains has settled down to mining development. The Celebration Mine has been equipped with a ten-head battery, and a large decantation cyanide plant. The underground development is of a much more re-assuring nature. The shoot of pay ore has been found extending into adjoining "Junction Mine"; the first cleanup will take place at the beginning of May.

The Mutooroo is equipped with winding plant, and good development has been carried on through the year. There is a considerable tonnage of low-grade ore in this mine.

Block 81 has been developed by the Hampton Plains Co., a good tonnage of pay ore has been opened to the 200ft. level.

The adjoining leases, the Jubilee Group, have quantities of low-grade ore which should pay to work.

The Golden Hope has been equipped with winding and pumping machinery. The development at the 100 ft. is good, and there are good grounds to think this mine will prove payable.

The White Hope is busy erecting a ten-head battery. With further development this mine may yet redeem itself. There is a considerable tonnage of pay ore to be treated.

On block 45 the Hampton Properties are developing a very promising mining claim. Development is being pushed on. The Company contemplates erecting winding, pumping, and crushing plant immediately.

Mining is suffering from the high costs prevailing for all mining requirements. It is evident that the auriferous areas are as rich as ever, and that a fall in prices would mean immediate and renewed activity in the whole of the localities mentioned in this report.

REPORT OF MR. E. J. GOURLEY, INSPECTOR
OF MINES, KALGOORLIE.

I have the honour to submit to you my Annual Report for 1921.

Kanowna.

Mining at this centre has been quiet, the only wages men employed being on the White Feather Main Reef, driving crosscuts, east and west, at the 400ft. level; and although veins of ore were passed through in both crosscuts values were too low to pay. This company have taken over the Ballarat and Sunbeam leases and plant owned by Mr. Willmott, and a 10-stamp mill is being removed from the Orion Mine, Niagara, to be erected on these leases.

Golden Valley.—A party of tributers worked this mine from the 200ft. and 300ft. levels, and obtained payable crushings monthly.

Red Hill.—This mine has also been worked by tributers, and a shoot of rich ore was discovered through a fault which cut off the values when being worked by the company. These tributers are still mining rich ore.

Alluvial.—Some work has been done to try and pick up the continuation of the deep leads, but owing to the small shaft and heavy ground and insufficient capital the work has been discontinued.

A number of men have been assisted through the Prospecting Board, and I have inspected the work done as frequently as possible; however, the results so far have proved of no value.

Gordons and Mulgarrie.

I have visited these places twice. On the Sirdar Mine four men were employed stoping and cross-cutting from the bottom of the open-cut at about 50 feet, and were obtaining some nice patches of ore from contact leaders out in both east and west walls. Three parties of assisted prospectors were also at work, one of which was on payable ore.

At the *Palm Gold Mine*, Mr. Barratt, who was assisted under the Mines Development Act to sink his shaft and erect a Huntington mill, obtained sufficient gold from quartz leaders in a formation to pay off his liabilities and make a decent profit for himself. Five men were employed on my last visit doing development work at the 100ft. level.

Broad Arrow.

There has been a number of assisted prospectors working in this district, some at Black Flag, and Dark Horse, but nothing of any importance was discovered. *Borland and Rudd*, also *Godfrey and Erickson* have had a successful year from their mines from 150 feet in depth through to the surface.

Ora Banda.

Owing to water difficulties the Victorious and Gimlet Mines, which were worked by tributers, have not been able to treat the ore continuously, and values were low for the last month of the year.

Lady Evelyn.—The owners of this mine, who were assisted under the Mines Development Act, struck a run of ore when driving north on the 400ft. level which has given good returns, and they are paying off their liabilities. They have not much backs left, but their ore and values appear strong underfoot.

Waverley.

Correll and party, owners of the Siberia Consols, have been breaking ore and crushing at their own mill from various places on this lease down to the 180ft. level, which has given them a fair profit.

At the *Hazel Mine* Mr. Archibald has unwatered the shaft, and the mine has been sampled, but up to date no business has been done. He, however, is hopeful of inducing a Melbourne company to take it over early this year.

At *Christmas Patch* small payable crushings have been mined from a flat formation under a laterite hill known as Paddy's Knob, and they are still on payable ore. About a mile north, Barker and party have opened up a quartz reef to a depth of 25 feet; it is about 12 inches wide, and crushed 18 dwts. from this place. Through the Mexico line of country to Siberia four parties of assisted prospectors have been at work, without success.

I have visited *Davyhurst*, *Mulwarrie*, and *Mulline*. Mining is very quiet, and the population has dwindled down to about 30 all told. Three assisted parties of prospectors have been out there but discovered nothing of value.

Carnage.

Two parties of prospectors have had three months' trial in this district with no success.

Carbine.

Messrs. Pimley, Crawford, and Son, crushing eight hours per day with a 10-stamp mill, have had a very successful year, the ore crushed being mined from between the 400ft. and 500ft. levels off an intermediate level. The lode varies in width from 4 to 20 feet, and is of low grade. However, during the year a winze sunk below the 500ft. level encountered very rich ore over a width of 3 feet 6 inches. A leader on the footwall, about 6 inches wide, carries the best values, and specimens wonderfully rich have been taken out. The values still continue.

Kintore.

Several parties of assisted prospectors have been at work in and around this district, chiefly at what is known as the 8 Mile and Dunns, also at Jourdie Hills. Patches yielding from a few pennyweights up to 30 ozs. (obtained by Perry and Martin) have been got, but no reef or lode of any consequence was opened up, the gold obtained coming from contact leaders. Mr. Doyle is cyaniding the old tailings from his battery on the Cement Leases.

Kunanalling.

The Turn of the Tide Mine has been worked continuously one shift of three men. The work being done is sinking on a short lens of ore, which can either be called a big shaft or an underhand stope.

The mine has given the owners a small profit over wages. They have stopped work at a depth of 380 feet, and were opening up a new lens of ore on the surface which prospects payably.

Pearce Bros. have had a good year on their indicator about half a mile east on the Star of Fremantle run of country. Several parties of assisted prospectors have tried the ground both north and south of this area, but with the exception of Nickel and Bray, who obtained a couple of rich small parcels and paid the amount advanced them, and a few ounces of dollied gold from the indicator at the head of what is known as "Dead Bird" Gully, the parties were not successful. At the Star of Fremantle Mr. Pearce put his cyanide plant in order and is treating his tailings, no work being done in the mine.

Bonnievale.

Rooke and party, assisted under the Mines Development Act to sink a winze and drive on the reef at 170 feet, did not cut payable ore, and the work has been stopped.

Coolgardie.

Mining is very dull at this place, although the State Battery has been kept going fairly well, Mr. Griffiths supplying the greatest quantity of ore from an open-cut on his lease. The ore body was to some extent covered with the residues from Tindals Mine, and, unfortunately, when open-cutting, the walls would not stand, and the western side collapsed, bringing the sand with it. It was not payable. This work has been stopped and attention given to other parts of the lease, but nothing of any consequence has been discovered.

Two parties are at work on Bayley's following leaders with varying results, and a number of other miners are at work in different places; but it is doubtful whether they are making wages. Wearmouth and party have had a fair year from their claim on the old Burbanks Main Lode lease. The reef is narrow and the ground hard.

Gibraltar.

Messrs. Clayton and Young, owners of the Carlton Mine, have been developing throughout the year by sinking a new shaft to 110 feet and driving and cross-cutting at that level. They have opened up a fine body of ore which, from the crushings taken out, averages about 15 dwts. They have now put their own 5-stamp mill in order, crushing parcels when they can get water, the supply from their shafts being limited.

The Lloyd George, which adjoins the Carlton on the north, has been taken over by a company. During the year no development work of any note has been done on the mine. A shaft has been sunk for water to a depth of 180 feet, but no water was struck. Overhead gear, with boiler and winch, a 5 Huntington mill with bins, boiler, pumps, winder, and overhead tramway has been erected, and the water supply from the scheme is well on the way, so that crushing will be started early this year. The prospects of this field are encouraging.

Widgiemooltha District.

At Logan, 10 miles north, Messrs. Finch and party discovered a lode formation, and disposed of some of their interest to a Kalgoorlie syndicate. They have crushed several parcels, which have yielded payable returns, from a depth of 50 feet. The forma-

tion, owing to the distance from a battery, is not payable. The quartz leaders only are picked out and sent to the mill.

The Host, Larkins, and Crown and Anchor leases have been tried by different companies, but their options have been abandoned. Hall and Bryant have been getting out regular crushings from their mine about three miles north-west of the town which have averaged about 4 ozs. The reef is narrow and the country rock hard.

Higginsville.

Messrs. Davey and Son have opened up a lode formation on the surface about half a mile south of Sons of Erin Battery. A drive has been put in north and south at 50 feet in payable ore for a length of 50 feet, and crosscuts off the north drive have exposed 24 feet of pay ore. Arrangements have been made with Messrs. Forward, Down, and Co. to put 5 head of stamps in order. On my last visit this was running. This new lode, on present appearance, looks as if it will open up a new mine.

Norseman.

I have inspected this district on three occasions. The mines, with the exception of the O.K. Mine, are being worked by parties of miners, some of which are being backed by the business people.

The *Mararoa Gold Mine* is held by four men, and they have taken out some payable parcels by sweeping down the footwalls of the old stopes, digging up the bottoms of levels, and a little stoping from pillars.

The Red, White, and Blue appears to be the best working miner show down there. It is a big soft lode formation, in which small quartz and ironstone leaders run in all directions. The owners are stoping and driving on this at a depth of 40 feet. It has only a slight dip to the north. They are keeping 5 head of stamps going at Rumble's mill, which is five miles away. The average yield is 15 dwts. per ton.

The *O.K. Mine* employs about 20 men, and they have sunk a new shaft to a depth of 308 feet. The reef, which runs east and west, has been cut at this depth, and levels driven on it for 500 feet at 200ft., and about 300 feet at 300ft. levels. The ground is hard, but values are good, and from 40 to 50 tons are being sent to the Great Boulder Mine, Kalgoorlie, weekly. Judging from the State Battery returns, the Hardy Norseman, Donaldson's, Peterson's, Viking, Viking South, and the Valkyrie are good working miners' claims, but on examination they do not appear to have much ore in sight.

At the Sun Mine, on the road to the Princess Royal, the owners are working on a quartz reef at a depth of 350 feet, which gives payable returns; the ore is, however, to some extent refractory.

Rawlings, Bullen, and Rumble have installed a new boiler at their salt works, and will be able to increase their output this year. The salt, which is extracted from the lake water by a coil of steam pipes in large vats, is of very good quality; but coarse, regular parcels are being sent away, and a fine grinder is to be put in.

Kalgoorlie.

I have made complete inspections of the following mines: Horseshoe (4), Ivanhoe (7), Great Boulder (8), Associated (6), Perseverance (8), South Kalgurli (6), Lake View and Star (6), Brown Hill (3), North Kalgurli (4), Oroya North Blocks (3), Asso-

ciated Northern (2), Chaffers (3), Dry Crushing Mills (6), with Workmen's Inspector Darcey. The shafts on the principal mines were examined, and repairs have been done where required.

The Lake View have completed the shaft sinking from 2,100ft. to 2,300ft., and the crosscut at this level should intersect the reef early this year.

On the Ivanhoe the 2,870ft. level has been driven a distance of 400 feet on payable ore, and the winzes put through from the levels above. A winze below the 2,870ft. level is down 40 feet in payable ore.

On the North Kalgurli Hoppner and party have opened up a shoot of ore for 130 feet in length over a width of 6 feet at the 100ft. level, near the Golden Gate bridge; value, 15 dwts. This is some considerable distance away from the old workings, and is entirely new. Kellock and party have opened up a new shoot of sulphide ore on the same lease, near the Hainault boundary; the ore averages 30 dwts., but so far the shoot is short.

The South Kalgurli have stripped and timbered Morty's shaft from the 1,000ft. to 1,100ft. level, and are preparing to open it. They have also opened out at 1,600ft. level for 350 feet in length on very good values. This is a continuation of the rich lode being worked on the 1,500ft. level, and it looks as if it will live to a greater depth.

Tributers on the Brown Hill, Associated Northern, Oroya Links, Associated Perseverance, and Lake View mines have in the majority had a good year; but they did not develop much ore ahead of them.

Re the water allowed to accumulate in the lower levels of some of the mines, the report on which I sent you early in the year, nothing has been done to remedy this except that the Oroya North Blocks are bailing daily from 1,100ft. and the Perseverance, at intervals of about three months, from about 2,050ft. level.

REPORT OF MR. W. PHOENIX, INSPECTOR OF MINES, KALGOORLIE.

I have the honour to submit my Annual Report for the year ending 31st December, 1921.

During the past year a great deal of detail work has been completed, and is in progress in various parts of these mines, with the object of further improving the underground conditions.

Owing to the great lateral pressure on the deeper portion of the unused parts of these mines, constant attention had to be given to the return airways, in

order to keep the sectional area as large as possible, which involves a great deal of labour.

Air connections by winzing, driving, and rising have been completed in many instances where development work is in progress, with satisfactory results.

It has also been found necessary, particularly where much firing is being done, to direct the air to parts where no men are employed, also to renew bratticing at regular intervals on the return side of the mines.

Mines in districts outside Kalgoorlie have been receiving attention from a ventilation point of view.

Prospectors in shallow workings have in many instances neglected to pay careful attention to ventilation.

I have done general inspection work in various parts of the district at intervals during the year. Progress reports have from time to time been forwarded.

Sanitation.—Very close attention has been given to this subject, and a better standard of cleanliness has been maintained.

Air receivers are carefully examined, also explosives, and the general use of them has been receiving attention.

The temperatures and hydrometrical state of these mines have been noted regularly and recorded in the Record Book, and all complaints attended to immediately.

REPORT OF MR. J. McVEE, INSPECTOR OF MINES, COLLIE.

I beg to submit my Annual Report on the Collie Coal Field during the year 1921.

Five collieries were producing coal during the year, viz., the Proprietary, Co-operative, Cardiff, Westralian, and Premier Collieries.

The total amount of coal produced during the year for sale was 468,816.65 tons, valued at £407,118.82 as against 458,699.48 tons, valued at £349,433.88 in 1920; the value per ton being 17s. 4.4d.

The Government Railways took 234,571.88 tons of large coal, 5,996.1 tons of nuts, and 1,279.66 tons of smalls, the Government tramways, bunkering and private trade taking the balance. The railway strike at the beginning of the year reduced the quantity, and during the year there was a shortening of hands at the collieries owing to slackness of trade, 192 men being put off, the average number of men employed during the year being 857, as against 849 during 1920.

Colliery.	Production in tons.	Production in tons.	Employees, 1920.		Employees, 1921.	
	1920.	1921.	Surface.	Under-ground.	Surface.	Under-ground.
Proprietary	134,512.15	133,571.46	29	167	32	167
Co-operative	92,003.00	91,491.99	63	154	55	132
Cardiff	101,505.00	109,210.51	42	127	39	145
Westralia	91,468.75	91,648.95	48	132	50	167
Premier	38,828.53	42,893.74	21	48	20	50
Scottish	380.00	...	9	9	...	...
	458,697.48	468,816.65	212	637	196	661

The increase in output being 10,118.17 tons, the output per person employed being 547.04 tons.

General Progress.—Development on the field has been fairly steady, the trade not warranting active development. Prospecting new areas has been carried out during the year, and a large area of coal bearing land has been proved by the Griffin Syndicate, full particulars of which I have forwarded to the Department.

Proprietary C.M.—The main dip heading still continues to open out well, and the mine generally is in good order and capable of a good output if necessary.

Co-operative C.M.—The main dip heading is standing on a down throw fault. Driving into this about 12ft. they struck the No. 1 or top seam about 7ft. thick, but as the strata give off a considerable quantity of water nothing has been done to open out this seam, the output being easily maintained from their present workings.

Cardiff C.M.—Development work is being carried on in the main dip, which has been standing for some years, and places capable of producing at least 300 tons daily have been opened out in this part of the mine.

• *Westralian G.M.*—The main dip has been driven beyond the fault and working places are now being opened out on both sides, the coal showing through the fault being of good quality, so that this practically makes a new mine of the Westralian.

Premier C.M.—Owing to heavy pumping of water, very little development work has been done, although the coal already proved should last some years at their present output.

Taking the whole of the mines, the conditions during the year have been fairly satisfactory, and the Coal Mines Regulation Act complied with as far as is practically reasonable.

MINING ACCIDENTS.

The following table shows the total number of fatal accidents recorded as having occurred on mines, whether to persons employed on the mines or not, for the last five years:—

	1917.	1918.	1919.	1920.	1921.
Total fatal accidents on mines reported	21	28	27	25	18
Less accidents to persons not engaged in mining, deaths in mines due to natural causes, and accidents to persons which were not due to their occupation as miners ... ..	...	3	1	4	1
Fatal accidents to men engaged in mining	21	25	26	21	17
Total men engaged in mining (average)	10,041	9,265	8,346	8,496	7,085
Accident death rate per 1,000 men engaged in mining ...	2.09	2.70	3.12	2.47	2.40
<hr/>					
Total fatal accidents on quarries reported ... ..	...	...	...	...	1
Total men engaged in quarrying	221	200	245	195	203
Accident death rate per 1,000 men engaged in quarrying ...	...	...	...	...	4.93

Tables 26, 27, 28, and 29, classify the mining accidents for the year 1921, the figures for the previous year being shown for comparison, and are forwarded herewith for inclusion in your Annual Report, together with diagram of the fatal accidents year by year, and their causes. (See Report of the Under Secretary for Mines.)

Table 26 classifies the accidents according to causes, from which it will be noted that during 1921 18 persons were killed, and 344 seriously injured, as compared with 21 killed and 538 seriously injured during the previous year. The diagram shows graphically the totals of fatal accidents year by year since 1891.

Table 27 shows the death rate per 1,000 persons employed on surface and underground in gold, coal, and other mines, the general average rate for 1921 being 2.40 as against 2.47 for 1920. The rates per 1,000 are based upon the figures in Table No. 21 (Annual Report, Under Secretary for Mines, 1921), which shows a grand total for 1921 of 7,084 men employed at mines above and underground, inclusive of alluvial workers.

Table 28 gives the average number of men employed above and underground at quarries, and the death rate per 1,000 persons employed therein. The total number of men employed during 1921 was 203, as against 195 for 1920; the death rate for 1921 being 4.93 as against nil for 1920.

Table 29 summarises all the fatal accidents for 1921 above and below ground in gold mines only, with rates per 1,000 men employed and per 1,000 tons of ore raised, similar figures for 1920 being given for comparison. The number of men on which these rates are based is taken from Table 23 (Annual Report, Under Secretary for Mines, 1921), and does not include alluvial workers.

The following table has been compiled of all fatal and serious accidents reported to this office which occurred during 1921. The accidents are classified according to the gold or mineral field in which they occurred, and also as to causes, the totals from each cause for 1920 being shown for comparison.

	Explosives.		Falls of Ground.		In Shafts.		Miscellaneous Underground.		Surface.		Machinery.		Total.	
	F.	S.	F.	S.	F.	S.	F.	S.	F.	S.	F.	S.	F.	S.
1. Coolgardie	2	3	5	6	10	1	151	...	61	1	3	11	232
2. Mt. Margaret	7	...	1	...	3	...	5	...	6	...	16
3. Murchison	2	1	...	1	...	11	...	1	...	...	2	20
4. E. Murchison	1	...	...	...	6	1*	7	...	1	1	15
5. Coolgardie
6. Yilgarn	1	1	...	...	...	...	...	...	...	1	1
7. N. Coolgardie	1	...	...	...	2	...	...	...	2	...	5
8. N.E. Coolgardie	1	1	...	...	...	...	...	...	...	...	...	1	...
9. Broad Arrow	1	...	...	...	...	...	...	...	...	...	...	...	...	1
10. Dundas	1	...	...	...	...	...	...	...	1
11. Pilbara
12. Peak Hill
13. Yalgoo
14. Phillips River	1	...	...	...	...	...	...	...	...	...	...	...	1
15. Collie	3	1	14	...	...	...	31	...	4	...	...	1	52
16. Greenbushes	1	...	...	...	1	...
17. Northampton
18. W. Pilbara
19. Swan	1	...	...	...	1	...
20. Ashburton
21. Roelands
22. Kendinup
Total for 1921	7	7	30	7	13	1	204	3	78	1	12	19	344
Total for 1920	1	10	7	54	5	20	6	311	3	131	3	12	25	538

* Not a true Mining Accident.

FATAL ACCIDENTS.

A short summary of particulars of each fatal accident occurring during the year is given hereunder:—

Explosives.

There were no fatal accidents due to use of explosives during 1921.

In Shafts.

A man met his death through falling down the shaft of the Edna May Deep Levels G.M., Yilgarn Goldfield. There was no witness to the accident, and no evidence to show how it occurred. The engine-driver received the signal to raise the skip from the No. 5 to the No. 4 level, and after waiting 8 or 10 seconds to give deceased time to enter the skip he raised it, but on arriving at the level the cage was seen to be empty, and the man's body was found at the bottom of the shaft. The Coroner's jury returned a verdict of accidental death, there being no evidence to show how the accident occurred. (1561/21.)

A deplorable accident occurred at the Golden Horseshoe G.M., East Coolgardie Goldfield, whereby six men lost their lives and one sustained serious injury. While the cage with the seven men in it was being hauled to the surface the main rod of the steam brake on the winding engine snapped where there was an invisible flaw in it from a bad weld, and the cage fell down the shaft on to the pen-house. At the Coroner's inquest the jury returned a verdict of accidental death, with no blame attachable to anyone, and added the following rider:—We are of the opinion that had it been possible to have had the steam applied immediately the brake rod broke and had the engine been more powerful the catastrophe would have been averted. Further, we consider that the margin of safety is insufficient to haul men from this depth, 2,600 feet, without the application of an extra brake on single winding engine. Very full inquiry was made into all the circumstances of this accident, and numerous tests by the Inspectors of Machinery, but the nature of the mishap was such that it could not be guarded against by any reasonable exercise of prudence and foresight. (2737/21.)

Falls of Ground.

A fatal accident occurred at the Fenian G.M., Murchison Goldfield. Deceased at the time of the fall was assisting to secure the ground by a pigstye. Every precaution appears to have been taken prior to the accident. The Coroner's jury returned a verdict of accidental death, with no blame attributable to anyone. (324/21.)

At the Light of Asia G.M., Murchison Goldfield, a man received fatal injuries through a piece of ground falling on him. Prior to the accident deceased had sounded the ground and considered it safe. On examination of the place afterwards, however, a greasy head was exposed running up into the lode at an angle of 50deg., which was doubtless responsible for the fall. The Coroner's jury brought in a verdict of accidental death with no blame attributable to anyone. (394/21.)

A fall of ground occurred at the Evelyn G.M., East Coolgardie Goldfield, killing a man who was working by himself, his mate having gone to Kalgoorlie; on examination of the scene of the accident it was found that the ground was decomposed porphyry, and the fall occurred through a fault 2ft. thick. The Coroner's jury found that deceased came to his death through a fall of earth. (642/21.)

A fatal accident to a man occurred at the Great Boulder Proprietary G.M., East Coolgardie Goldfield, a V-shaped piece of ground coming away whilst he was in the act of barring down after the stope had been fired. Deceased and his mate sounded the ground just previous to the accident, and it appeared safe. The Coroner's jury gave a verdict of accidental death. (891/21.)

Two men were engaged shooting down the roof in the main dip of the Westralian Colliery, Collie Coalfield, when a slab of stone fell and killed one of them. Every precaution appears to have been taken for safe mining. The Coroner's jury returned a verdict of accidental death, no blame being attributed to anyone. (1314/21.)

At the Oroya North Blocks G.M., East Coolgardie Goldfield, two tributers proceeded to sample a stope although they had been warned that the ground was bad. A heavy fall occurred, half burying one man and inflicting fatal injuries to which he succumbed three months later. The place where the fall occurred had been previously condemned by the Inspector of Mines and the management. The Coroner's jury brought in a verdict of accidental death. (2753/21.)

A man received fatal injuries while working in a stope at the Golden Horseshoe G.M., East Coolgardie Goldfield, to which he succumbed three weeks later. At the inquest it was stated that a stone weighing about 3 lbs. fell from the back and evidently struck deceased on the head, but although men were working with him none saw the stone fall or heard deceased call out. The stope had been examined and considered safe to work in. The Coroner's jury brought in a verdict of accidental death, but were of opinion that there was not sufficient evidence to show how the accident occurred. (209/22.)

Miscellaneous Underground.

At the Great Boulder Proprietary G.M., East Coolgardie Goldfield, a fatal accident occurred to a man who with his mate was engaged logging up a pass, and by some means unknown, probably a run of sand, one of the men fell into the pass and was buried under the sand, and on being extricated life was extinct. The Coroner's jury returned a verdict of accidental death, no blame being attributable to anyone. (1741/21.)

Surface (including Machinery).

At the Associated G.M., East Coolgardie Goldfield, while tightening up a nut on a leaky cap a man was fatally scalded through the cap suddenly blowing off and allowing the hot steam to escape. The accident was apparently due to an error of judgment on deceased's part in putting strong pressure on the cap when screwing it up while the boiler was under steam. He was skilled at the work, and well able to judge the risk. A verdict of death through accidental scalding was given by the Coroner's jury. (1922/21.)

While at work sluicing on the Lower Floyd's Gully Dredge on Extended Alluvial Claim 850, Greenbushes Mineral Field, a man was killed through a tree, which was being burnt down, falling on him. Just prior to the accident deceased and his mate examined the tree and decided there was no danger, and that the tree would not fall for several hours. The Coroner's jury returned a verdict of accidental death, no blame being attributable to anyone. (2266/21.)

A man at Boya Quarry, Swan Mining District, was in the act of attaching a horse to an empty wagon when the horse took fright and suddenly started for-

ward, the man being caught by the side chain and thrown under the wagon, sustaining fatal injuries. From the evidence adduced at the inquest the accident would appear to be due to deceased having hitched the horse to the wagon before instead of after putting the spreader in position. A verdict of accidental death was brought in by the Coroner's jury. (2361/21.)

Other Accidents.

In addition to the above the following accident was reported, but not classified as a mining accident.

A man, while under the influence of liquor, wandered on to the Youanmi G.M., got through the wire fence protecting an open cut, and fell into the open cut where his body was found some hours later. The Coroner's jury returned a verdict of death through falling into open cut, with no blame attachable to anyone. (1067/21.)

Serious Accidents.

Under Section 26 of the M.R. Act the term "serious" is applied to all accidents which cause injuries of such a nature as to incapacitate the sufferer from attending to his usual work for 14 days or more.

232 of the 344 accidents during 1921 were reported from the East Coolgardie Goldfield, but only 14 cases were breakages of larger bones, permanent injury to limbs, or injuries likely to have lasting disabling effects. The balance of injuries were of a less serious nature, such as bruises, cuts, broken and crushed fingers and toes, scalds, burns, poisoned cuts, shocks, smaller dislocations, sprains, wrenches, jars, etc., etc., but of a sufficiently serious nature to cause the injured person to be absent from his work for 14 days or more.

Explosions and Explosives.

Seven persons received serious injuries under the above classification. In two cases men were hurt by being struck by flying stones from explosions, and in two cases men were injured through detonators exploding while being handled. Two men received injuries through returning too soon to the place after firing, and one man's hand was poisoned while handling explosives.

Falls of Ground.

Under the above classification 30 accidents were reported during 1921. In two cases the injuries were sustained while men were engaged in the dangerous but necessary work of pulling down loose ground after firing. In the remaining 28 cases the injuries were due to ground falling on men, or their being struck by falling pieces of stone or coal in the workings of the mine.

In Shafts.

Thirteen serious accidents occurred in shafts during 1921. In one instance the injury was received while repairs to the knocker line were being effected; in another a man fell while leaving the cage; and a bolt coming out of a ladder caused a man standing on it to fall to the ground. While riding on the bridle of a skip a man was thrown into another compartment. One man received serious injury through a cage hanging up, and another through the rod breaking causing the cage to fall down a shaft. One man was struck by a guy rope, another by a descending bucket. The remaining five accidents caused injuries of a less

serious nature, such as jarred and jammed hands, poisoned cut, and bruises.

Miscellaneous Underground.

Two hundred and four accidents were classified as Miscellaneous Underground during 1921. In 42 cases the injuries were sustained while handling and loading trucks and skips, through fingers and bodies being jammed against chutes and other trucks, toes and feet run over, bodies struck by upsetting of trucks, men slipping and straining themselves while trucking, or lifting derailed trucks or material into trucks, and so on, the injuries being mostly wrenches, sprains, bruises, jars, fractures of fingers and toes and cuts. In 48 cases the injuries were due to falling and rolling loose rocks and stones, such as runs of ore and mullock, while shovelling, or stones running down rills and ore chutes; and 11 men received severe cuts and bruises while handling sharp stones. Eleven men were injured handling rock drills, coal cutting machines and parts of same, and one by the stage on which a machine was erected collapsing. Other falls in the workings from stages and ladders, in rills, passes, and so on, caused injury to 17 persons, and 17 were hurt by falling tools and pieces of machinery. Flying splinters of stone and steel were responsible for 20 men being injured, and 17 were hurt while handling timber. The remaining 20 cases were due to various accidental causes, jarring of hands and feet, blows from tools, strains, poisoned cuts, and so on.

Surface (Including Machinery).

While working on the surface 90 men received serious injury, three men were burnt in various ways, six sustained injuries from falls in the course of their work; four were hurt by trucks and skips, being jammed or struck by them, by them capsizing, or by men sustaining strains while working them. Flying splinters injured six men; falls of timber and pieces of machinery while being handled accounted for 31 cases of injury; 14 cases were caused by machinery in motion, three of these being caused by handling belts in motion; four men were hurt by being struck by stones or coal; five were struck by tools they were using falling or slipping, and one man was affected by the heat while working on tailings. Other causes of 16 accidents were strains and sprains from heavy weights falling on them, jarred and jammed hands, poisoned cuts, and so on.

WINDING MACHINERY ACCIDENTS.

(Without serious injury to persons.)

The following are brief particulars of winding machinery accidents occurring during 1921, without serious injury to persons:

The North skip at the main inclined shaft of the Sons of Gwalia mine left the rails at about the 23rd level and pulled out several shaft centre dividers including those below the No. 23 loading station. The cause of the derailment is unknown. (2532/21.)

A man was riding on the bridle of a skip when by some means the rope caught in the track and freeing itself suddenly threw the man into another compartment. The only damage was breakage of some of the shaft timbers and minor injuries to the man. (2532/21.)

PROSECUTIONS FOR BREACHES OF THE MINES REGULATION ACTS AND REGULATIONS.

The Coal Mines Regulation Act, 1902:—Proceedings were instituted against two men for neglecting to give warning that firing was in process thereby causing serious injury to a man. Both men were fined 10s. each with costs. (708/21.)

The Mines Regulation Act, 1906:—Nil.

EXEMPTIONS FROM SECTION 31, SUBSECTION 4 OF "THE MINES REGULATION ACT, 1906."

Twenty-three persons were granted exemption certificates, 13 being for mines in the East Coolgardie Goldfield; four in the Dundas Goldfield; one in the Coolgardie Goldfield; one in the North Coolgardie Goldfield; one in the Yalgoo Goldfield; one in the West Pilbara Goldfield; and two in the Yilgarn Goldfield.

Before issue of these permits the Inspectors of Mines satisfied themselves that the applicants were capable of taking charge of the machinery to which the permits applied, and that it was not reasonable in the circumstances of the case to insist on employment of a certificated driver.

SUNDAY LABOUR IN MINES.

Only two permits to work on Sundays were granted during the year, both being in the Collie Coalfield; one was for relaying a main haulage road, and the other for brushing gannon bord for extension on main road wheeling.

AMENDMENTS AND ADDITIONS DURING 1921 TO THE REGULATIONS UNDER "THE MINES REGULATION ACT, 1906," "THE MINES REGULATION AMENDMENT ACT, 1915," "THE COAL MINES REGULATION ACTS, 1902 & 1915," AND "THE MINING DEVELOPMENT ACT, 1902."

Mines Regulation Act, 1906:—Amendment of Clause 4 Division 2 of Regulation 15, increasing the rate of pay to Workmen's Inspectors of Mines from £5 to £6 15s. per week. (Gazetted 15/6/21.)

The Coal Mines Regulation Act, 1902:—Amendment of paragraph A., Regulation 9, Part 1 Accident Relief Fund by insertion, after the words "within 5 days," of the words "exclusive of Sundays." (Gazetted 5/1/21.)

Repeal of para. (1) Regulation 66 Part 5, and substitution of new para. (1) relating to persons

eligible to make surveys and plans of mines. (Gazetted 26/10/21.)

The Mining Development Act, 1902:—Extension of bonus for 12 months for production of graphite mined and prepared for market within the State. (Gazetted 9/10/21.)

SHIPMENT OF ORES TO ENGLAND.

The Metal Exchange granted permission to ship the following parcels of ore to England for various persons:—

One parcel of Manganese ore; six of Asbestos; and one of platinum ware.

One small parcel of copper ore was shipped to San Francisco for experimental purposes.

PHILLIPS RIVER SMELTING WORKS.

The tenth Campaign of the Smelting Furnace finished in December, 1920, and it was seen that with the increased costs of working and greatly decreased value of copper, it would not be possible to continue smelting except by greatly increasing the charges. As the costs of treatment were already so high, that no ore but that of the highest grade available on the field could be treated at a profit, and there was no prospect of securing adequate supplies of such ore to keep the furnace in operation in the present state of development and organisation of the mines, it became necessary to cease smelting operations, but receiving of ore for treatment and advances thereon in accordance with the Regulation of 1919 were continued, in order to enable ore-sellers to get some advances upon their ore.

In April, 1921, the manager and accountant were recalled to Perth in connection with the suit of McNeil and de Bernales v. the Crown, and after the hearing thereof in June, the accountant was taken on to general work in the Perth office. After advising the Department on the question of a central smelting works, the Surprise Mine, at Galena, and other matters, it became necessary to terminate the manager's services with the Department.

At the end of November, the lease of the Smelting Works and accessories was terminated, and the works returned to Mr. McNeil. The ore on hand was bagged and sent to Hopetoun for shipment when a favourable opportunity should arise.

It was arranged that ore should continue to be received at the Kundip Railway Station, and that advances thereon should continue to be given.

The following table summarises the operations of the Smelting Works during the seven years of the Government lease.

Campaign.	Period.	Ore Treated.	Metals Recovered.			Total Gross Value.
			Copper.	Gold.	Silver.	
		tons.	tons.	ozs.	ozs.	£ s. d.
I.	1914 to April, 1915 ...	7,950	641·559	4,891·900	5,290·471	78,734 3 4
II.	1915, Second Half ...	4,931	309·031	3,227·227	2,676·730	56,833 6 5
III.	1916, First Half ...	3,358	231·222	2,272·707	2,042·891	39,693 17 6
IV.	Second Half ...	3,421	244·424	3,104·108	2,501·085	42,020 9 10
V.	1917, First Half ...	3,469	242·744	2,232·155	2,447·097	38,216 2 5
VI.	Second Half ...	4,019	243·596	2,417·074	2,446·968	37,788 10 6
VII. & VIII.	1918, First Half ...	2,553	175·571	1,996·475	1,761·629	27,208 14 3
IX.	Second Half ...	2,901	161·815	2,156·081	1,845·675	28,208 19 4
X.	1919-1920 ...	2,174	96·914	2,701·116	1,763·338	21,428 16 10
		34,776	2,346·876	24,998·843	22,775·884	370,133 0 5

The ore accumulated after the close of the 10th Campaign to end of 1921, consisted of 494.2121 tons (net dry weight), containing 25.847 tons of copper and 657.766 ounces of gold (inclusive of 67½ tons of partially treated furnace material.)

The above-mentioned suit was determined in favour of the Petitioners, and at the end of the year an appeal was pending to the High Court of Australia.

At present, the best outlook for the treatment of the Phillips River district ores appears to be on the following general lines:—

- (1) Dry crushing of heavy sulphide ores unfit for concentration.
- (2) Wet crushing (with amalgamation in case of gold values) of ores suitable for concentration and concentration by gravity and flotation.
- (3) Roasting treatment of products of (1) and (2) to obtain material fit for wet methods of extraction of copper.
- (4) Treatment of roasted sulphides and oxidised ores by wet processes for extraction of copper and gold.
- (5) Shipment of cement copper to Smelters elsewhere for finishing treatment.
- (6) Melting and refining of recovered gold.

BORING FOR COAL.

Wilga.—Boring for coal was carried on at the new Wilga field, South of Collie, during 1921, with good results, which are fully set out in the report of Mr. R. C. Wilson, in the Annual Report of the Government Geologist.

Irwin River.—Boring for coal at the Irwin River was continued during the year, and the results are also recorded in the Annual Report of the Government Geologist.

BORING AT SOUTH END OF KALGOORLIE FIELD.

During the year under review, a large amount of boring has been done to look for continuation of the Boulder Belt series of lodes to the Southward. In August, 1920, the Hon. the Minister for Mines publicly stated his willingness to give £1 for £1 up to

£5,000 towards approved schemes of boring. The Golden Mile Ore Channel Extended Company, Limited, was formed to take advantage of this offer, and early in 1921 started boring on the "Mayland" lease, Gold Mining Lease No. 5128E. Three bores were put down during the year, and two of these were reported to have given cores carrying good values in gold, but on checking these reported results by the method of deflecting the bores and cutting a new core alongside the old one, they were not sustained. This is believed to be the first time the method of obtaining checks of cores by deflection has been used in Western Australia, and the Goldfields Diamond Drilling Company deserve much credit for the ingenuity and resource exhibited in carrying out the borings. The examination of the cores is fully reported by the Petrologist of the Geological Survey in the Annual Report of that Branch.

The boring operations of the Golden Mile Ore Channel Extended Company, Limited, have been continued in 1922, and will best be dealt with as a whole when completed.

Boring was also carried on further to the North during the year by Mr. A. H. Williams on the "Hesperus" and "Lady of the Lake" Leases. Four bores were put down, the cores from which are described in the Annual Report of the Geological Survey (Petrological Work), and the boring has been carried on into 1922, and will be best described more fully on completion.

ADVANCES ON ORES.

Besides the advances made on ores in the Phillips River District, as above recorded, the system was continued of making advances on ores suitable for shipment outside the State, to enable owners of mines to obtain the money necessary for continuation of their operations, which was unobtainable by them in the ordinary course of business, mainly owing to the great uncertainty as to what price would be realisable and how long it would be before returns could be obtained. Owing to the low price of base metals, however, very little was done in this way in comparison with former years, when base metal prices were higher.

The following table shows the minerals on which advances were made, the amounts advanced and results obtained.

ADVANCES ON ORES.

Statement of Transactions for Year 1921.

Miscellaneous Minerals.

Mineral.	File.	Tonnage.	Advanced Amount		Expenses in Shipping.		Balance of proceeds remitted to Owners.		Total Amount realised.		Remarks.				
			£	s. d.	£	s. d.	£	s. d.	£	s. d.					
Asbestos	3469/20	1.1174	...	...	10	7	3	223	5	3	233	12	6	Not final—one bag to be accounted for.
Do.	264/21	1.0071	...	...	3	17	3	238	1	11	241	19	2	
Do.	549/21	1.1	...	...	4	4	1	259	4	4	263	8	5	Part of shipment only, balance of proceeds not to hand.
Do.	477/21	.8508	50	0	0	2	10	3	Proceeds not to hand	...	...	...	...
Do.	491/21	1.1687	50	0	0	5	1	8	89	13	3	144	14		11
Do.	2557/21	1.9696	...	...	...	6	4	2	Proceeds not to hand	...	...	...	...
Copper Precipitates ...	417/21	6.6035	300	0	0	11	18	5	...	...	a146	17	4	
Copper Ore	111/21	300.00	2,050	0	0	Not yet shipped	...	...	...	...	...	...	...

a. Advance of £57 9s. 6d. per ton by Smelting Co.

LOANS AND SUBSIDIES UNDER "THE MINING DEVELOPMENT ACT, 1902," AND FROM THE MINING DEVELOPMENT VOTE.

The transactions under the above heading are shown in tabulated form in Appendix No. 4 hereunder.

The depressed condition of the mining industry has necessitated greatly increased assistance by the Government to mining and prospecting ventures of all sorts in the endeavour to re-establish greater productivity.

Field Work.

Owing to Mr. Blatchford, Assisant State Mining Engineer, being detached to the Geological Survey Branch for special work in the Kimberley Field, his services were available to this branch for only part of the year. In May his place was taken temporarily by Mr. R. C. Wilson of the Geological Survey.

Mr. Blatchford has submitted the following report:—

During January and February, 1921, I was on annual and accumulated leave.

Graphite Deposits.—Two inspections were made, one at a mine at Martagallup, 13 miles south of Cranbrook, and the other at Furniss' Graphite mine, 300 yards N.E. of the Frankland River and 1½ miles S. of Muir's Bridge. Reports are appended. (Appendix 1 and 2.)

Silk's Copper Show.—In accordance with your instructions, I made an inspection of the alleged new copper find near Dalgety Downs, north of the Gascoyne River. Unfortunately, as the appended report shows (Appendix 3), the discovery was of no importance.

Kimberley Oil Discovery.—I proceeded to the North-West to look into the reported discovery of oil in the Kimberley District, particularly Oakes' and Price's Finds. My report of this investigation is appended to the Government Geologist's Annual Report for 1921, as the matter came under his jurisdiction. As I am just leaving for Kimberley to make further investigation into these areas, a fuller and more comprehensive report will be supplied in the near future.

Bremer Bay Oil.—On my return from Kimberley my services were required to investigate an alleged discovery of oil at Bremer Bay to confirm or otherwise Mr. Wilson's report on this occurrence. (For details of the report see Geological Survey Annual Report for 1921.)

Water Question for Westonia.—The water question, which had an important bearing on the future of the Westonia Field, was gone into very thoroughly towards the end of the year. Unfortunately, the shutting down of the Edna May mine; the water difficulty in the Edna May Deeps; the fall of the gold premium; the increase in wages, and principally the failure of a pumping plant installed at the Central Mine, rendered the position hopeless. Although the development of the Central showed promise, and might have proved successful, difficulties arose through the inadequate and unsuitable

pumping plant which rendered the closing down of the mine inevitable. As the position now stands, the Deeps Mine is developing no ore reserves, and the future of the district will depend on the reduction of mining and working costs, etc., in the event of which the mine may be re-opened. The balance of the year was occupied with ordinary office routine work.

Mr. Wilson's report is as follows:—

From 13th May to the 20th October, 1921, I acted as Assistant State Mining Engineer, during which period Mr. T. Blatchford was engaged upon geological work in the Kimberley District.

My first duties were to carry out the general office work of the State Mining Engineer during the settling of the Law Court Suit on the Phillips River Smelter Case.

My next work was the preparation of a report on the Wilga Coal Field, which is published in the report of the Government Geologist for 1921.

Subsequently I investigated and reported upon a number of the more important applications for assistance under the Mining Development Act. These included an application from the Golden Hope Gold Mine at Hampton Plains for assistance to carry out a programme of development work. A similar application from the Mt. Zion G.M. at Magnet, one from Dr. Laver in connection with his Deep Lead at Kanowna, another from Dr. Laver for assistance to remove the battery at Gindalbie to Binti Binti, and one from the Central G.M. at Kalgoorlie for assistance to erect a treatment plant.

During the period under review I also visited the reported oil occurrence at the Fitzgerald River, near Bremer Bay, and found that the claim could not be substantiated. No oil or indications of the presence of such were found. (Full report appended to Annual Report of the Geological Survey 1921.)

Reid's manganese deposit near Mt. Walton was inspected. Some ore was found of good quality, but its extent and the tonnage available cannot be estimated until a good deal of opening up has been done. (For report see Annual Report for 1921 of the Geological Survey.)

In company with Inspector Deeble an inspection was made of the principal asbestos deposits of the Pilbara and West Pilbara Goldfields, including those at Lionel, Soanesville, Dead Bullock Well, Strelly River, Sherlock Station, Nungarrie Creek, and Roebourne. (For full report see Annual Report for 1921 of the Geological Survey.)

General administrative work of the Department during 1921 kept me almost entirely in the office in Perth, except for three visits to Kalgoorlie. Of late years it has become increasingly difficult to carry out any serious amount of field work personally.

I have, etc.,

A. MONTGOMERY,
State Mining Engineer.

APPENDIX No. 1.

Report on Graphite Deposit at Martagallup.

(By T. Blatchford, Assistant State Mining Engineer,
19th May, 1921.)

While on the way to visit the graphite deposits at Frankland River, I called in at Martagallup, 13 miles south of Cranbrook, and inspected another graphite deposit which was being worked by a party of three men, the leader being Mr. Parsons. The accompanying sketch shows the amount of work done. Graphite was first found in the locality in the surface ironstone, and shafts were sunk by the present party to try to locate the origin of what occurred on the surface. From shaft B drives were made in three directions on two veins cut at a depth of 20 feet. In the south-west drive the veins soon rose to above the level, and for the rest of the drive no graphite was found. A crosscut was then put out in the direction of shaft D, about half way down the drive. A graphite vein was met with in this drive, but this was dipping towards the central shaft. At the end of the drive a shaft had been sunk and connected, and was continued some 20 feet below the level of the drive without piercing any graphite-bearing rock. A drive was also put out north-west from the shaft on the two veins. For a little way the veins were horizontal, but soon began to rise and can be seen in the shaft at the end rapidly rising towards the surface.

In the north-east drive in the direction of A shaft the graphite vein, though more or less horizontal, is rising at the end of the level. A winze sunk 10ft. below the level at the end reveals no graphite. There is no graphite in shaft A. In a shaft nine chains west of the central shaft a very small seam of graphite occurs at the bottom of the shaft 25 feet, but is very insignificant.

Four samples were broken in the mine as follows:—

- No. 1.—From brow of south-west crosscut in shaft B, over 2ft. 6in.
- No. 2.—Top seam on brow of north-west crosscut, over 1ft. 6in.
- No. 3.—Bottom seam below sample (2), over 1ft. 6in.
- No. 4.—Seam in drive connecting to shaft D, over 1ft. 6in.

The results of these samples are to be found hereunder, and are not at all promising as the carbon contents are low, and without doubt this is caused by the presence of mica as in the Frankland deposit. The country rock is similar to that at Kendenup, and the discovery at Martagallup deserves notice in that it is more or less on the same line as the Munglimup, Kendenup, and Donnelly River deposits.

The two shafts A and D more or less condemn the proposition, for it is evident that the discovered veins are worthless, and in shaft D it has been proved that fresh veins do not occur 20 feet lower down. In any case the grade of the graphite is very low, and the prospectors would be well advised to prospect in other places rather than try and locate fresh veins in this locality.

APPENDIX No. 2.

Report on Furniss' Graphite Mine, Frankland River.

(By T. Blatchford, Assistant State Mining Engineer.
17th May, 1921.)

This mine is situated $1\frac{1}{2}$ miles south of Muir's Bridge and 300 yards north-east of the Frankland River. The main workings are one shaft 15ft. deep, from the bottom of which drives extend east and west 10ft. and 5ft. respectively. A few shallow costeens are the only other workings.

The country rock is a dense clay, probably a much weathered shale and very similar to the wall rock in the Kendenup deposits.

There are no outcrops on the lease, but massive granite hills lie at no great distance to the north.

Compared with Kendenup, the geological conditions show a strong similarity.

In the shaft and both crosscuts a narrow seam of graphite some 3in. to 6in. thick has been exposed on the hanging wall. The strike is east and west with a dip to the north of from 75deg. to 85deg. On the footwall a smaller and more imperfect vein occurs, but has only been exposed in the shaft.

Sample 8 was drawn from the main vein in the drives and sample 7 was picked from some of the vein which had been dumped on the surface. The graphite contents of the vein contain too much iron and mica to be of any commercial value, which, taken in conjunction with the size of the vein, makes the proposition worthless.

The picked sample 8 gives more favourable results, but against this is still the smallness of the vein.

In the other shallow workings there is no indication of any large deposit, but rather that the graphite occurs in narrow streaks.

Better results may certainly be found by crosscutting at a greater depth, but as there is every possibility of heavy water at no great depth owing to the proximity to the river, the deposit scarcely warrants further development. The results of the samples are as follows:—

No.	Car- bon.	Vola- tile.	Ash.	After grinding and concen- tration.			
				Con- cen- trates re- cover- ed.	Car- bon.	Vola- tile.	Ash.
1	9.52	9.42	81.05	%	75.36	5.32	19.32
2	7.84	11.86	80.30	2.8	67.22	6.80	25.98
3	7.62	11.47	80.91	3.6	57.76	6.94	35.30
4	13.08	8.80	78.12	3.1	70.46	5.94	23.60
*5	20.52	10.05	69.43	5.7	77.98	4.04	17.98
6	16.16	10.88	72.96	13.2	...	...	...
7	50.49	7.31	42.20	...	84.28	3.84	11.88
8	29.16	10.41	60.43	15.2	56.50	8.98	34.52

*Picked pieces.

Notes.—Sample No. 7 is moderately rich in graphite, yielding 15.2 per cent. of marketable flake by crushing through rolls and floating. A higher concentrate could be recovered from this ore by regrinding and refloating.

None of the other samples yielded a marketable product after regrinding and floating.

APPENDIX No. 3,

Report on New Copper Find near Dalgety Downs,
North of Gaseoyne River.

(By T. Blatchford, Assistant State Mining Engineer.
20th May, 1921.)

Locality.—The exact position of the leases is 3½ miles west 30deg. north of trig. station K. 25.

Geology.—The country rock in which the copper occurs belongs to the Gaseoyne series, and consists mainly of quartzites, schists, limestones, etc., through which numerous acid dykes have been subsequently ejected. These dykes in the vicinity of the leases are of no great size. They vary in composition from almost pure quartz to normal granite. In the more acid varieties tourmaline is very prevalent occurring both in massive bunches or well developed crystals. In isolated cases the combination forms a perfect graphic structure similar to the graphic granites of the eastern fields, the tourmaline taking the place of the felspar.

About one mile to the south of the leases is an extensive outcrop of hornblendic granite. This granite on the margin is distinctly porphyritic, the felspars occurring in a rounded form which gives the rock, particularly where weathered, a most pronounced mottled appearance.

Passing through the leases on a general strike of 125 degrees are two pronounced quartz outcrops which without doubt are very acid granite intrusions. Occasionally tourmaline is visible in the quartz, more particularly in the southern lease. Between these dykes a quartz mica schist occurs. From this schist specimens

have been taken and examined by the Petrologist. His opinion, though not positive in every instance, is in favour of most of the schists being derived from sediments rather than much sheared acid intrusives.

In two instances, however, felspar was present, and these samples he considers are crushed intrusives. All the samples contain a preponderance of quartz, and mica is invariably present in appreciable quantities. Scattered over the surface devil's dice are fairly plentiful. These were traced to the quartz schists derived from acid dykes, and the tourmaline quartz dykes. There is no doubt that they were shed from these rocks. The quartz schist lying between the two quartz outcrops is supposed to be a continuous lode. Copper stains may be seen occasionally, more particularly in two instances where traces can be seen over a width of from 30 to 33 feet. Specimens taken from where the copper was most pronounced showed the ore to be a very granular quartz rock, the copper occurring around and not in the quartz grains. With the exception that the outcrop had been broken in places with a pick, no work has been done on the lease, not even to the extent of a costean.

There is no ferruginous outcrop as one might reasonably expect if the lode was continuous, as the prospector Mr. Silk, assured me it was, neither is there any evidence of base metal of any kind in the quartz schist band (the lode) except the few copper stains referred to. The fact of the green carbonate copper stains being outside the quartz grains points to undoubted secondary deposition. The presence of the devil's dice, undoubtedly pseudomorphed by replacement after pyrites, proves the presence at one time of iron sulphides. Here we might reasonably look for traces of copper, ample, when subjected to weathering, to produce sufficient copper to account for the copper stains. In my opinion, such has been the case, and I consider the venture as more or less hopeless and lacking ordinary mining possibilities.

APPENDIX No. 4.

Summary of Expenditure from Mines Development Vote from 1st January to 31st December, 1921.

Advances in aid of Mining Work and Equipment—

	£	s.	d.
J. H. Green, Victory Gold Mine, Yilgarn ...	0	10	0
Hodges and Party, Erection of Plant, Forrestonia ...	999	2	10
Golden Lizard Syndicate, Edjudina ...	175	0	0
Purchase of Battlesville Mine, Yundamindera ...	364	3	9
Bryan and Party "Ardpatrick," Phillips River	377	8	8
Grant & Edwards, Flag Gold Mine, Phillips River ...	157	5	0
Edna May Battler Gold Mine, Westonia ...	169	14	0
Matthews & Mott, Roebourne Riverina South Gold Mining Co., Mulline ...	93	15	10
Falkiner & Lavery, Yilgarn	1,903	15	0
Crowe & Party, Kalgoorlie ...	91	2	9
Golden Mile Ore Channel Extended, Kalgoorlie ...	74	19	2
Munday, Livingstone & Austin, Kalgoorlie ...	1,628	10	0
Doyle & Archibald, Kalgoorlie ...	25	0	0
Haddon & Smith, Kalgoorlie	10	0	0
Griffin Syndicate, Collie ...	10	0	0
G. Bickerton, Phillips River	*333	0	7
E. A. Cox, Tributating on "Butcher Bird" G.M., Yilgarn ...	76	17	6
Mackay & Munro, Kalgoorlie ...	73	14	4
C. B. Rooke, Coolgardie ...	61	10	0
Ainsworth & Turnhill, Kalgoorlie ...	62	5	2
Holt & Rowe, Kalgoorlie ...	26	0	0
Sewell & Party, Yilgarn ...	50	0	0
Thomas and McDonald, Kalgoorlie ...	220	0	0
McLeod & Edwards, Kalgoorlie ...	35	0	0
G. H. Howlett, Donovan's Find ...	30	0	0
Mills & Barnes, Kanowna ...	433	0	0
McOmish, Walton & Lauritz ...	65	0	0
Murphy & Gray, Westonia	0	10	0
Green and Party ...	62	4	0
McGregor & Grylls, Yilgarn	109	0	0
F. Sonnenschien, Black Range ...	88	2	6
Mt. Magnet Prospecting Syndicate, Mt. Magnet ...	119	2	6
Wilson & Son, Broad Arrow	122	5	6
South Lancefield Gold Mining Co., Laverton ...	26	0	0
A. H. Williams, Boring, "Lady of the Lake," Kalgoorlie ...	52	0	0
Lalla Rookh G.M., Marble Bar ...	885	8	2
W. F. Black, Kalgoorlie ...	312	19	6
E. N. W. Bligh, ...	147	14	8
Dismantling and re-erecting Battlesville Battery, Yundamindera ...	24	6	7
D. Lewis, Bulla Bulling ...	358	7	7
Pascoe and Party, Coolgardie ...	18	18	0
Dunn & Parkinson, Phillips River ...	83	0	0
J. Mohr, Kalgoorlie ...	354	0	0
Bannister and Partners, St. Ives ...	143	5	7
A. Thorn, Widgiemooltha ...	52	0	0
F. B. Cumpston, Kalgoorlie	30	0	0
Lyons & Bacon, Mt. Malcolm ...	22	15	0
	29	5	0

Advances in aid of Mining Work and Equipment—contd.

	£	s.	d.	£	s.	d.
Pilgrim's Rest G.M., Ltd., West Pilbara ...	500	0	0			
Clifford & Richards, Southern Cross ...	25	18	6			
C. Hill, Kalgoorlie ...	102	15	0			
Manners and Party, Kanowna ...	73	5	0			
North, Hartley & Borwick, Holden's Find ...	168	15	0			
Grant, Mt. Iron G.M., Kundip ...	63	0	0			
Lloyd George G.M. Co., Coolgardie ...	1,750	0	0			
Faraday & Tasker, Southern Cross ...	2,879	16	4			
R. Curtis, Niagara ...	30	18	9			
Fingall Tributating Syndicate, Day Dawn ...	600	0	0			
Sheridan and Party, Kalgoorlie ...	27	2	6			
E. L. Maw, Marble Bar ...	12	18	0			
Sugrue and Party, Cue ...	150	0	0			
R. N. W. Bligh ...	35	5	5			
Snelgrove & Mendis, Widgiemooltha ...	49	12	0			
Meekatharra Prospecting Syndicate, Nannine ...	35	15	0			
Hobby & Party, Paynesville	117	11	10			
G. H. Howlett, Donovan's Find ...	78	0	9			
Thring & Green, Northampton ...	192	1	0			
G. Mayman, Kalgoorlie ...	638	0	0			
W. M. Hodges and Party, Forrestonia ...	280	0	0			
D. McLeod, Pilbarra ...	55	0	0			
W. J. Lynas, Marble Bar ...	100	0	0			
Allen & Beaton, Menzies ...	87	15	2			
Polson Bros., Parker's Range	15	0	0			
J. A. Deerness, Leonora ...	95	15	0			
Hobby and Party ...	20	18	6			
Purchase of Balkis Syndicate Battery ...	550	0	0			
				19,323	2	11
<i>Boring—</i>						
Boring for Coal, Irwin River	2,219	11	1			
Boring for Coal, Wilga ...	3,429	0	10			
				5,648	11	11
<i>Providing Transport and Equipment for Prospectors—</i>						
Prospecting, etc. ...				7,398	15	6
<i>Miscellaneous Expenditure—</i>						
Investigations, Mineral Industry ...	12	16	8			
Maintenance of Securities ...	45	6	3			
Pre-Investigations, Sampling Mines ...	773	2	5			
Subsidy towards marketing Cost of Asbestos ...	195	9	5			
Renovating State Battery, Darlot ...	271	5	4			
Renovating State Battery, Leonora ...	449	13	6			
Renovating State Battery, Siberia ...	324	4	0			
Investigating Collie Coal ...	16	5	9			
Subsidy to Amalgamated Collieries, Ltd., for Boring	135	17	5			
Subsidy to Benari Transport Boring Plant ...	9	15	7			
Subsidy to Railway Department, Special trains, Coolgardie to Widgiemooltha ...	859	7	3			
Sinking at Mt. McMahon ...	233	3	9			
Sinking Well No. 1, Mt. Gould	963	0	9			
Subsidy, Pola and Party, Billiants Diorite ...	130	0	0			

Klondyke Boulder	604	Warrawoona	1,000 0 0	999 10 7	...	163 5 6	886 5 1	34 5 4	150 12 7	986 17 8
Kirkland, A. G.	M.A. 12N	Nannine	500 0 0	500 0 0	...	336 9 11	163 10 1	20 17 4	12 12 5	176 2 6
Lady Evelyn	1289W	Ora Banda	300 0 0	216 14 2	...	151 12 9	65 1 5	20 17 7	3 3 6	89 4 11
Lake View Extended	4536E	Kalgoorlie	1,050 0 0	892 15 5	...	650 0 0	242 15 5	...	54 11 1	297 6 6
Lorna	4554	Coolgardie	100 0 0	36 10 2	62 5 2	4 0 0	94 15 4	2 17 6	3 0 5	87 15 9
Lady Carmen	4556	Coolgardie	500 0 0	...	83 0 0	...	83 0 0	...	2 5 9	85 5 8
Lady of the Lake	5083E	Kalgoorlie	1,100 0 0	...	885 8 2	...	885 8 2	1 7 6	16 14 4	902 2 6
Lewis, D.	...	Bulla Bulling	32 8 0	...	18 18 0	...	18 18 0	...	0 9 10	18 18 0
Lyons & Bacon	P.A. 1037C	Mt. Malcolm	33 10 0	...	29 5 0	...	29 5 0	...	34 14 4	29 14 10
Lloyd George G.M. Co., N.L.	4580, 4726, 4727	Coolgardie	1,750 0 0	...	1,750 0 0	600 0 0	1,750 0 0	...	600 0 0	1,784 14 4
Lupton, Chesson, & Mathers	...	Day Dawn	600 0 0	...	600 0 0	...	600 0 0	...	...	600 0 0
Mindelo	1518	Mindoolah	300 0 0	198 17 0	...	10 0 0	188 17 0	...	3 1 1	196 1 0
Mt. Rankin Gold Mines, N.L.	2416	Yilgarn	535 6 3	535 6 3	...	135 0 0	400 6 3	60 10 0	18 9 10	413 16 1
Mt. Rankin Gold Mines, N.L.	3135, 3136	Yilgarn	1,000 0 0	911 19 9	...	10 0 0	901 19 9	0 8 3	47 8 4	949 8 1
Mt. Iron	198	Kundip	200 0 0	125 0 0	63 0 0	...	188 0 0	...	17 0 11	205 0 11
Mciba	1053R	Yerilla	575 0 0	496 18 10	...	90 0 0	406 18 10	...	43 2 9	450 7 7
Mac's Lucky Ridge	2103T	Mt. Lucky	75 0 0	44 0 0	0 10 0	...	44 10 0	2 8 6	2 1 1	23 12 7
Main, A. M.	M.C. 11H	Carbarup	30 13 0	23 8 0	...	3 19 6	24 8 6	0 0 6	32 6 5	511 9 6
Mott & Matthews	P.A. 164	Roebourne	750 0 0	389 10 8	93 15 10	4 3 5	479 3 1	1 1 10	0 17 2	62 7 2
Mackay & Munro	P.A. 1507E	Kalgoorlie	75 0 0	...	61 10 0	...	61 10 0	...	0 4 5	25 4 5
Munday, Livingstone, & Austin	P.A. 1527E	Kalgoorlie	60 0 0	...	25 0 0	...	25 0 0	...	3 8 11	118 18 11
Mt. Magnet Prospecting Synd. & Dev.	1190M	Mt. Magnet	250 0 0	...	122 5 6	6 15 6	115 10 0	0 10 6	1 18 1	66 18 1
Mills & Barnes	P.A. 570X	Kanowna	65 0 0	...	65 0 0	...	65 0 0	...	2 1 5	64 5 5
Murphy & Gray	...	Westonia	90 0 0	...	62 4 0	...	62 4 0	...	2 12 5	145 18 0
Mohr, J.	P.A. 1522E	Kalgoorlie	150 0 0	...	143 5 7	...	143 5 7	...	1 10 5	74 15 5
Manners, W. G.	P.A. 572X	Kanowna	120 0 0	...	73 5 0	...	73 5 0	...	0 3 8	13 1 8
Maw, E. L.	P.A. 452	Marble Bar	100 0 0	...	12 18 0	...	12 18 0	...	0 6 7	36 1 7
Meekatharra Prospecting Co., N.L.	P.A. 1021N	Nannine	150 0 0	...	35 15 0	...	35 15 0	...	3 0 9	91 3 9
McGregor & Grylls	P.A. 1177	Yilgarn	100 0 0	...	88 2 6	...	88 2 6	...	0 6 9	30 6 9
McLeod & Edwards	P.A. 1535E	Kalgoorlie	30 0 0	...	30 0 0	...	30 0 0	...	...	550 0 0
Murrin Proprietary G.M. Co., N.L.	372F	Mt. Morgans	550 0 0	...	550 0 0	...	550 0 0	...	...	108 19 1
North Harbour View	M.L. 370	Phillips River	100 0 0	100 0 0	...	...	100 0 0	...	8 19 1	458 2 0
Norseman Prospecting Syndicate	1261	Norseman	515 3 8	415 3 8	...	...	415 3 8	6 10 3	1 7 8	104 2 8
North End	4632E	Kalgoorlie	150 0 0	...	102 15 0	...	102 15 0	...	2 15 9	171 10 9
Norma	1460N	Nannine	220 0 0	...	168 15 0	...	168 15 0	...	0 18 10	22 3 10
Oliver, Arthur	Temp. Res. 260H	Kendenup	50 0 0	21 5 0	...	...	50 0 0	...	...	85 0 6
Oates & Party	P.A. 1022Z	Menzies	90 0 0	...	90 0 0	4 19 6	85 0 6	...	24 18 2	100 18 2
Pearl	1095M	Mt. Magnet	76 0 0	76 0 0	...	...	76 0 0	...	24 15 0	558 9 1
Pyx	789B	Sandstone	600 0 0	571 4 8	...	37 10 7	533 14 1	12 14 5	15 14 4	514 12 6
Premier Coal Mining Co., N.L.	260/2, 363/6, 271	Collie	500 0 0	500 0 0	...	1 1 10	498 18 2	143 15 10	6 10 2	506 10 2
Pilgrims Rest G.M. Co., Ltd.	165, M.A. 14	West Pilbara	1,500 0 0	...	500 0 0	...	500 0 0	...	3 16 4	73 18 10
Quistini & Kinnane	P.A. 941W	Broad Arrow	75 0 0	70 2 6	...	...	70 2 6	...	24 13 5	373 10 10
Rupe & Young	M.A. 848	Nannine	848 17 5	848 17 5	...	500 0 0	348 17 5	...	8 1 1	123 17 7
Red Guard	M.L. 113E, 117E, 118E, M.A. 68E	Kalgoorlie	150 0 0	150 0 0	...	34 3 6	119 16 6	10 0 4	...	...
Rainbow G.M. Co., N.L.	5091	Coolgardie	230 0 0	182 10 0	...	1 8 4	181 1 8	6 3 7	16 0 4	197 2 0
Riverina South G.M. Co., N.L.	324U, etc.	Mulline	2,000 0 0	1,534 5 0	465 15 0	...	2,000 0 0	...	150 7 0	2,150 7 0
South Cornwall	567	Greenbushes	1,170 2 0	1,170 2 0	1,438 0 0	...	1,438 0 0	...	35 12 1	1,473 12 1
Stanley	1271X	Kanowna	150 0 0	112 0 0	...	26 0 0	1,144 2 0	...	...	1,144 2 0
Scots Greys	2801	Yilgarn	200 0 0	200 0 0	...	...	112 0 0	2 6 0	39 14 8	155 14 8
Smith, W. F. (Mt. Kooyoor)	G.M.L. 196	Phillips River	300 0 0	300 0 0	15 0 0	...	200 0 0	...	47 6 8	247 6 8
Surprise	M.L. 342	Ravensthorpe	600 0 0	327 4 1	...	...	200 0 0	...	37 6 6	237 6 6
Surprise	M.L. 150	Northampton	150 0 0	...	...	...	15 0 0	...	0 0 10	15 0 10
Sewell & Party (Tributers)	...	Westonia	260 0 0	...	109 0 0	11 9 0	300 0 0	...	15 19 1	315 19 1
Snelgrove & Mendis	P.A. 1880	Widgemooltha	100 0 0	...	220 0 0	...	315 15 1	1 5 1	28 5 0	344 0 1
Thomas & McDonald (Tributers)	...	Kalgoorlie	40 0 0	...	49 12 0	...	109 0 0	...	4 4 1	113 4 1
Thorn, A.	P.A. 1918	Widgemooltha	50 0 0	...	35 0 0	...	220 0 0	...	8 11 1	228 11 1
Thring & Green	M.L. 171	Northampton	200 0 0	...	30 0 0	...	49 12 0	...	0 10 4	50 2 4
Unexpected leases	5454Z, 5290Z	Mt. Ida	750 0 0	600 0 0	192 1 0	...	35 0 0	...	1 7 1	36 7 1
V's United	271F	Mt. Morgans	500 0 0	408 14 1	...	...	30 0 0	...	0 12 2	30 12 2
Victory	...	Marvel Loch	172 2 0	172 2 0	...	...	192 1 0	...	1 6 9	193 7 9
Victorian	5151	St. Ives	85 0 0	88 18 3	0 10 0	...	600 0 0	4 9 5	39 18 6	639 18 6
Western Graphite Co., Ltd.	M.L. 2PP	St. Ives	300 0 0	100 0 0	52 0 0	...	406 14 1	1 11 2	25 7 9	432 1 10
Wheat May	Loc. 6	Northampton	302 4 6	302 4 6	...	50 0 0	2 2 0	...	9 6 4	11 8 4
Williamson & Pender	...	Kanowna	180 0 0	180 0 0	...	...	87 18 3	6 13 5	2 15 5	90 13 8
Wilson & Son	P.A. 1103W	Broad Arrow	26 0 0	...	26 0 0	...	52 0 0	...	1 0 10	53 0 10
Totals	...	...	...	36,101 8 7	14,670 10 10	7,363 17 6	43,408 1 11	1,524 2 8	2,567 17 0	45,975 18 11

MINING DEVELOPMENT EXPENDITURE—Advances Outstanding 31st December, 1921—continued.

Name of Lease, Mine, or Borrower.	No. of Lease.	District.	Amount authorised.	Principal Moneys advanced		Principal Moneys		Interest		Total Principal and Interest outstanding at 31st December, 1921.
				Previously to 1921.	During 1921.	Repaid, including Sale of Securities, etc.	Balance outstanding.	Paid.	Outstanding.	
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
B.—ASSISTANCE IN ERECTING BATTERIES AND TREATMENT PLANTS TO BE USED FOR CRUSHING FOR THE PUBLIC.										
Battlesville	931R	Yundamindera ...	1,775 0 0	1,073 11 2	364 3 9	1,437 14 11	...	187 14 1	336 13 0	336 13 0
Big Stone	357F	Yundamindera ...	1,438 0 0	...	1,438 0 0	5 2 9	1,432 17 3	...	...	1,432 17 3
Butcher Bird	1933	Yilgarn	500 0 0	...	...	358 7 7	358 7 7	...	...	358 7 7
Chunderloo	1048N	Nannine	1,863 14 2	1,863 14 2	...	17 16 2	1,845 18 0	172 3 10	89 6 5	1,935 4 5
Donovan's Find	768	Yilgarn	2,032 12 8	1,730 10 2	...	558 4 2	1,172 6 0	...	218 16 2	1,391 2 2
Fraser's Central	3228	Yilgarn	1,000 10 0	1,000 10 0	...	190 16 11	809 13 1	463 12 11	20 8 2	830 1 3
Great Victoria	719, 944/5, 1229	Yilgarn	150 0 0	150 0 0	...	...	150 0 0	18 7 9	4 14 6	154 14 6
Great Southern	2909	Yilgarn	433 0 0	...	433 0 0	...	433 0 0	0 17 6	16 8 0	449 8 0
Hodder, E.	M.A. 64Y	Randalls	100 0 0	...	78 0 9	...	78 0 9	...	0 13 4	78 14 1
Kirton's South	M.L. 127	Northampton ...	3,000 0 0	...	2,971 16 4	...	2,971 16 4	...	49 7 1	3,021 3 5
Lalla Rookh	112, 786, T.A. 10	Marble Bar	2,000 0 0	1,643 3 0	...	1 7 9	1,641 15 3	771 10 8	41 7 7	1,683 2 10
Malcolm Prospecting Co.	1175C	Mt. Malcolm	3,881 12 7	2,882 9 9	999 2 10	...	3,881 12 7	...	321 4 11	4,202 17 6
McCahon & Party ... ..	...	Mt. Ida	253 3 2	253 3 2	...	148 13 0	104 10 2	6 8 4	35 11 3	140 1 5
Neta	1011R	Edjudina	2,050 0 0	2,028 12 9	...	98 2 4	1,980 10 5	537 3 10	146 3 0	2,076 13 5
Phoenix	622N	Quinns	200 0 0	200 0 0	...	...	200 0 0	15 8 5	14 19 9	214 19 9
Randwick	978C	Mt. Malcolm	500 0 0	500 0 0	312 19 6	...	500 0 0	8 14 1	46 16 8	546 16 8
Red, White, & Blue	641B	Curran's Find ...	3,000 0 0	2,581 3 7	...	...	2,894 3 1	173 18 4	165 7 5	3,059 10 6
Rocklee ... ..	...	Yaloginda	1,550 0 0	1,550 0 0	...	15 0 0	1,535 0 0	40 6 10	723 4 9	2,258 4 9
Ravensthorpe Battery Co. ... ..	...	Ravensthorpe	400 0 0	400 0 0	...	7 0 0	393 0 0	...	27 14 5	420 14 5
Southern Cross leases	1067Y, 1076Y	Bulong	200 0 0	200 0 0	...	17 11 7	182 8 5	44 19 2	21 19 3	204 7 8
Star of Fremantle	645S	Kunanalling	250 0 0	250 0 0	...	39 12 0	210 8 0	17 12 1	17 5 11	227 13 11
Spring Hill leases	724, 2633	Parker's Range ...	584 14 0	577 3 5	...	54 4 6	522 18 11	...	45 3 5	568 2 4
Triplicate	1914	Tuckabianna	2,676 9 0	2,676 9 0	...	224 12 2	2,451 16 10	856 18 10	121 10 1	2,573 6 11
Total ... ..	...	...	350 0 0	350 0 0	...	43 0 0	307 0 0	12 2 0	21 14 1	328 14 1
...	...	...	1,300 0 0	1,038 8 2	...	125 0 0	913 8 2	...	326 1 2	1,239 9 4
...	...	...	1,000 0 0	1,000 0 0	...	770 15 3	229 4 9	78 9 6	155 11 10	384 16 7
...	...	...	325 0 0	320 10 0	...	42 11 4	277 18 8	148 14 11	7 10 2	285 8 10
...	...	...	655 16 5	655 16 5	...	19 2 0	636 14 5	396 6 4	110 0 10	746 15 3
...	...	...	730 0 0	608 17 7	...	116 13 10	492 3 9	51 0 8	39 14 7	531 18 4
Total ... ..	...	...	...	25,534 2 4	6,955 10 9	3,933 0 8	28,556 12 5	4,002 10 1	3,125 7 9	31,682 0 2
C.—MISCELLANEOUS.										
Bligh, R. N. W. (Testing Dryblower) ... ..	...	...	75 0 0	...	59 12 0	...	59 12 0	...	1 7 0	60 19 0
D.—BORING.										
Mt. McMahon ... ..	...	...	...	474 7 8	...	...	474 7 8	...	...	474 7 8
Irwin River ... ..	...	...	...	1,587 2 4	2,219 11 1	...	3,806 13 5	...	...	3,806 13 5
Wilga ... ..	...	...	...	2,139 13 4	3,429 0 10	...	5,568 14 2	...	...	5,568 14 2
Totals ... ..	...	...	...	4,201 3 4	5,648 11 11	...	9,849 15 3	...	...	9,849 15 3
A.—PIONEER MINING AND PROSPECTING										
B.—ASSISTANCE ERECTING BATTERIES, ETC.										
C.—MISCELLANEOUS										
D.—BORING										
Totals ... ..	...	...	...	65,836 14 3	27,334 5 6	11,296 18 2	81,874 1 7	5,526 12 9	5,694 11 9	87,568 13 4

Annual Report of the Board of Examiners for Colliery Managers' and Under Managers' Certificates under "The Coal Mines Regulation Act, 1902."

The Under Secretary for Mines, Perth, W.A.

Office of the State Mining Engineer,
Mines Department, Perth.
26th April, 1922.

Sir,

We have the honour to submit, for the information of the Hon. the Minister for Mines, the Annual Report of the Board of Examiners for the year 1921.

Meetings were held on the 27th April and 26th October, 1921, at which all the Members of the Board were present.

The Board advertised its intention to hold examinations on the 6th, 7th, and 8th April, 1921, for First and Second Class Certificates of Competency under the Coal Mines Regulation Act, 1902, but as no applicants were forthcoming no examination was held.

An examination was held at Collie on the 5th and 6th October, 1921, for Second Class Certificates of Competency, Mr. McVee acting as supervisor and conducting the oral examination. Two applicants sat for the examination, and Mr. Thomas Oxley being successful in gaining a pass a Second Class Certificate of Competency was issued to him.

Reciprocity.—Further correspondence on this subject was received from the New South Wales Board of Examiners, the said board maintaining its refusal to recognise W.A. Certificates as of equivalent grade to New South Wales Certificates, stating that there was no evidence to show that Oral Examinations were held in connection with W.A. Examinations. In reply a letter was forwarded to the New South Wales Board by the Chairman, pointing out that the Coal Mines Regulation Act and Regulations requirement that an Oral Examination be held at the completion of the written examination for certificates of competency was strictly carried out.

We attach hereto copy of papers set for the October, 1921, Examination for Second Class Certificates of Competency.

We have the honor, etc.,

A. MONTGOMERY,
State Mining Engineer, Chairman.

A. GIBB-MAITLAND,
Government Geologist, Member.

JAS McVEE,
Inspector of Mines, Member.

F. A. LANE, Secretary.

THE COAL MINES REGULATION ACT, 1902.

Examination for Second Class Certificate of Competency as Under Manager or Overman.

SUBJECT: VENTILATION AND DANGEROUS GASES.

Wednesday, 5th October, 1921, 10 a.m. to 11.30 a.m.
Possible Marks.

- 50 1.—A volume of 10,000 cub. feet of air and CH_4 is at its most explosive point; how many cub. feet of gas does the mixture contain, and how much air will be required to be added to reduce the CH_4 to 2 per cent.?
- 50 2.—Apart altogether from the presence of inflammable gas state how a coal-dust explosion may be caused in a mine, and what should be done to prevent such an occurrence.
- 50 3.—Describe in detail how you would proceed to charge a shot hole and fire a shot in a mine in which firedamp is given off.
- 50 4.—Given two districts of workings in the same mine each supplied with just sufficient air to prevent the proportion of firedamp in its return airway from exceeding 2 per cent., if by means of a new drivage the return airway of one of the districts were greatly shortened what would happen in the other district if no precautions were previously taken to prevent it? What, if any, precautions would you take, and how would you ascertain whether they were sufficient or not?
- 50 5.—Indicate by means of the usual symbols how you would ventilate the workings on the accompanying plan.
- 50 6.—Describe the composition and properties of CH_4 , CO , CO_2 , and H_2S , and from what sources are they derived?

300

THE COAL MINES REGULATION ACT, 1902.

Examination for Second Class Certificate of Competency as Under Manager or Overman.

SUBJECT: MINING OF COAL.

Wednesday, 5th October, 1921, 11.30 a.m. to 1 p.m.
Possible Marks.

- 50 1.—There are twenty-five 8-yard bords in a district, seam 7ft. thick. How much coal can you get from this district by machines, and about how much explosive will be used?
- 50 2.—A slant has to be driven 200 yards diagonally across old 8-yard bords and 8-yard pillar workings; show by sketches how you would secure the slant in the bords, and how the pillar ends can be protected and strengthened.
- 50 3.—In driving places that are approaching old workings known to contain a body of water, what precautions must be observed? How would you carry out the work?
- 50 4.—As a responsible official you are visiting places whilst men are at work; to what points would you direct your attention? Assume your own conditions.
- 50 5.—To what principal points would you direct your attention in order to increase the output of coal per man from the working faces?

Possible
Marks.

- 50 6.—Describe the operation of working out a pillar 40 yards square in a 5ft. 6in. seam of coal where the roof is strong sandstone. Give position of props and other roof supports, and also describe how you would withdraw them.

300

THE COAL MINES REGULATION ACT, 1902.

Examination for Second Class Certificate of Competency as Under Manager or Overman.

SUBJECT: ARITHMETIC.

Wednesday, 5th October, 1921, 2 p.m. to 3 p.m.

Possible
Marks.

- 16 1.—If the output of a colliery be 2,400 tons a week and the cost for same period be—
- | | £ | s. | d. |
|-------------------------|-----|----|----|
| Miners | 579 | 18 | 6 |
| Other underground wages | 257 | 9 | 3 |
| Surface wages | 155 | 10 | 8 |
| Other charges | 362 | 1 | 7 |
- what is the total cost, and the total cost per ton?
- 17 2.—A pump delivers water into a pond with vertical sides 60ft. x 30ft. x 7½ft., and fills it in five and a quarter hours. What is the rate of delivery of the pump in gallons per minute, and in cubic feet per hour?
- 16 3.—In bord and pillar working the pillars are 6 yards wide and 18 yards long, cut thro's are 3 yards wide, bords 8 yards wide; what percentage of coal is left in the pillars?
- 16 4.—Two machine-meh cut 64 sq. yds. of coal in a 7ft. seam per shift, the rate being 4½d. per ton: how much do they earn? How much is paid for shooting and filling if the rate for this work is 2s. 3½d. per ton? (1 cub. ft. = 80lb.)
- 18 5.—A crosscut has been driven diagonally through a square pillar the area of which is 2,025 sq. yds.; what is the length of the crosscut? If the crosscut is 4 yards wide and 6ft. high, find the number of tons produced, S.G. being 1.28; also the amount earned by the miners, tonnage rate 3s. 1d., yardage 2s. 6d., and 1s. 6d. for slabs set 4ft. apart.
- 17 6.—What is the diameter of a rope 5½in. in circumference in one-sixteenth of an inch, and the area in square inches to three decimal places?

100

THE COAL MINES REGULATION ACT, 1902.

Examination for Second Class Certificate of Competency as Under Manager or Overman.

SUBJECT: ROADWAYS.

Wednesday, 5th October, 1921, 3 p.m. to 4 p.m.

Possible
Marks.

- 50 1.—What arrangements would you use at or near the top of inclines to guard against accidents caused through neglect to attach a rope to the skip?
- 50 2.—Show by sketches how you would timber roadways where the following conditions prevail:—
- (1) Lifting floor or pavement.
 - (2) Tender roof with strong sides.
 - (3) Heavy side pressure.
- 50 3.—At a tunnel entrance and for about 20 yards in the timbering is gradually lowering and will eventually interfere with the haulage. What should be done, and how would you do it?
- 50 4.—A special drive is started and it is required to be kept straight and at an even grade of 1 in 12. How would you carry out this work if it was left in your charge?
- 50 5.—In endless rope haulage, what are the various arrangements for keeping the rope tight?
- 50 6.—A self-acting incline rising 1 in 5 has four different levels from which coal has to be let down to the main level. Describe fully, with sketch, how you would do this.

300

THE COAL MINES REGULATION ACT, 1902.

Examination for Second Class Certificate of Competency as Under Manager or Overman.

SUBJECT: "The COAL MINES REGULATION ACT, 1902."

Wednesday, 5th October, 1921, 4 p.m. to 6 p.m.

Possible
Marks.

- 17 1.—Under what circumstances does it become necessary to withdraw workmen from a mine or any part thereof? If this has to be done, what further steps have to be taken?
- 17 2.—What are the various regulations as to shot firing and the treatment of explosives below ground?
- 16 3.—What are the distances between manholes which must not be exceeded, and what are the circumstances to which these distances apply?
- 16 4.—What does the Act require as to the division of the mine into parts?
- 16 5.—The Act says that every mine must have two shafts or outlets: to this there are certain exceptions. What are they?
- 18 6.—Write out a report from an examination under General Rule 4, Coal Mines Regulation Act and fill in the particulars of a typical report.

100

DIVISION III.

REPORT OF THE SUPERINTENDENT OF STATE BATTERIES.

Office of the Superintendent of State Batteries,
Mines Department,
Perth, 3rd May, 1922.

The Under Secretary for Mines.

Sir,—

For the information of the Hon. Minister for Mines, I herewith submit my report upon State Batteries operations for the year ended 31st December, 1921, being the twenty-fourth Annual Report.

MILLING.

Twenty-six State Batteries (175 stamps) were operated departmentally, and two batteries—Darlot (10-stamp), and Tuckanarra (10-stamp) were operated by lessees. Before the close of the year, the Mulline battery (10-stamp) was also leased.

Tonnage.—34,761 tons of ore were milled, the number of parcels handled having been 606, giving a mean weight per parcel of 57.36 tons. During 1920, there were 517 parcels crushed, aggregating 46,494 $\frac{1}{4}$ tons, or nearly 90 tons per parcel. The decline of 11,733 $\frac{3}{4}$ tons was serious, being one of two principal factors in sending up the cost of treatment. The increased number of parcels cleaned up also caused extra expense. The largest tonnages were crushed at Wiluna, 7,204 tons; Coolgardie, 6,804 $\frac{1}{4}$ tons; Cue, 3,275 $\frac{1}{2}$ tons; Payne's Find, 2,022 $\frac{1}{2}$ tons; and Black Range, 1,644 $\frac{1}{2}$ tons. The tonnage milled was only sufficient to keep batteries operative 17 per cent. of full time (Sundays excluded).

Stamp Duty.—The duty per stamp at 10-head batteries was 4.24 tons, and at 5-head batteries, 4.32 tons per 24 hours. The mean duty per stamp was 4.27 tons per 24 hours.

Amalgamation.—27,880 tons of ore were treated by the amalgamation process. 21,075 $\frac{1}{4}$ ozs. of bullion, estimated to contain 17,864 $\frac{1}{2}$ ozs. of fine gold, were recovered, equal to 75.8 per cent. of the gross value of the ore. The percentage recovery during 1920 was 74.6. The mean value of the ore was 71s. 10d. per ton compared with 65s. 6d. during 1920.

Charges.—Charges for milling were not increased, and have remained at pre-war rates. Rebates on 11,534 $\frac{1}{2}$ tons of low grade ore amounting to £1,595 6s. were allowed and paid from the Development of Mining Vote.

Expenditure.—£30,107 13s. 11d. was the gross expenditure, including £3,452 0s. 11d. for repairs and renewals, and £4,401 3s. 1d. for sundries. The cost per ton was 17s. 3.86d., an increase of 4s. 9.38d. per ton compared with the cost during 1920. (See General Remarks).

Revenue.—£15,746 14s. 8d. was the total milling revenue, equal to 9s. 0.72d. During 1920, revenue amounted to 8s. 8.26d. per ton. The loss on milling was £14,360 19s. 3d., compared with a loss of £8,954 6s. 2d. during 1920. (Schedules 1, 5, 8 and General Remarks.)

TAILING TREATMENT.

19,763 tons were treated at 11 plants. The mean value before treatment was 5.688 dwts. per ton, and the mean residue value was 1.267 dwts. per ton, the assay recovery being 77.72 per cent. The actual recovery was 80.6 per cent., which includes slag values. During 1920, the mean head value of 15,437 tons treated was 6.197 dwts. per ton, the mean residue value 1.347 dwts. per ton, and the recovery 78.15 per cent.

Expenditure.—The total cost of treatment was £9,952 6s. 11d., equal to 10s. 0.85d. per ton compared with 9s. 0.49d. per ton during 1920.

Revenue amounted to £17,629 6s. 11d., equal to 17s. 10.08d. per ton, and includes £7,000 on account of premiums since March, 1919. The profit was £7,677. (Schedules 3 and 9.)

SLIMES TREATMENT.

At Wiluna, 7,370 tons were treated by a vacuum filter process with a head value of 9.68 dwts. per ton, the residue value being 2.12 dwts. per ton, recovery 78.1 per cent.

Expenditure.—£4,042 9s. 11d., equal to 10s. 11.64d. per ton, compared with 9s. 11.28d. per ton during 1920.

Revenue.—£3,124 10s. 9d., equal to 8s. 5.73d. per ton, compared with 8s. 8.40d. during 1920. (Schedule 9, and General Remarks.)

TIN ORE TREATMENT.

During the year the market price of Tin was too low to permit claim holders to work their leases profitably, and, consequently, only 54 yards were treated in January, which was a carry-over from the treatment of the previous year. There are no indications at present that the plant at Greenbushes will become operative in the near future.

REPAIRS AND RENEWALS.

£4,499 18s. 11d. was spent on repairs and renewals to plants and includes a number of more or less small amounts spent at very old plants. Details of the total amount are—

	£	s.	d.
Milling	3,452	0	11
Tailing Treatment ..	746	18	1
Slime Treatment ..	300	19	11
	£4,499	18	11

TOTAL OPERATIONS.

61,976 tons were treated in all departments, compared with 74,302½ tons during 1920, the decrease being due to the decline in milling tonnage. The gross expenditure was £44,324 1s. 3d., equal to 14s. 3.64d. per ton. The gross revenue was £36,522 6s.

4d., or 11s. 9.43d. per ton. During 1920 the expenditure was 11s. 4.67d. per ton and the revenue 9s. 8.12d. per ton.

The gross loss on all operations was £7,801 14s. 11d., compared with £6,362 19s. 8d. during 1920.

Comparative Synopsis of Results at State Batteries for 12 Months ended 31st December, 1921 and 1920.

	1921.			1920.		
	Tonnage.	Expenditure.	Revenue.	Tonnage.	Expenditure.	Revenue.
		s. d.	s. d.		s. d.	s. d.
Milling	34,761	17-3·86	9-0·72	46,494½	12-6·48	8-8·26
Tailing Treatment	19,763	10-0·85	17-10·08	15,437	9-0·49	13-4·19
Slime Treatment	7,370	10-11·64	8-5·73	11,525	9-11·28	8-8·40
Tin Treatment	54	82-0·55	8-0·43	737	8-11·47	9-3·31
Ore Dressing ... ..	...	...	...	109½	20-10·63	14-9·43

Receipts and Expenditure, 1921.

	Tonnage.	Expenditure.	Revenue.	Profit.	Loss.
		£ s. d.	£ s. d.	£	£ s. d.
Milling	34,761	30,107 13 11	15,746 14 8	...	14,360 19 3
Tailing Treatment	19,763	9,952 6 11	17,629 6 11	7,677	...
Slime do.	7,370	4,042 9 11	3,124 10 9	...	917 19 2
Tin do.	54	221 10 6	21 14 0	...	199 16 6
	61,976	44,324 1 3	36,522 6 4	7,677	15,478 14 11
				Less Profit ...	7,677 0 0
					£7,801 14 11

PURCHASE OF TAILING.

16,756¼ tons of tailing were purchased for £24,711 2s. 2d. net to owners, compared with 22,436½ tons for £20,877 14s. during 1920.

unavoidable delays due to the railway strike, wet weather in May and cartage troubles, and difficulties in finding suitable water supply were experienced. The plant is a good one and the first 1,000 tons crushed have given most satisfactory results.

OUTPUT SINCE INCEPTION.

Tons of auriferous ore milled .. 1,318,282

Production	£
By Amalgamation	4,508,401
Sand Treatment	659,214
Slime Treatment	224,035
Residue Treatment	9,353
	<u>£5,401,003</u>

Tons of tin ore treated 80,068

Production	£
By Black Tin	92,420
Residue Treatment	572
	<u>£5,493,995</u>

NEW PLANT.

A five-stamp battery, having a suction gas power plant, and complete with all accessories, buildings, and water supply, was completed at St. Ives. Many

STAFF.

The Managerial Staff was decreased by one, Mr. E. D. Thorley having resigned to go into business elsewhere. At the present time, the retirement of two or three managers is being carried out to meet the decline in tonnage, and battery circuits are being re-arranged. Despite the decreased tonnage, the year has been strenuous and difficult for managers and head office staff, and I wish to congratulate and thank officers for their energetic and capable work.

GENERAL REMARKS.

The increased rates of wages for all employees, mentioned in last year's report, had two marked effects upon our operations during the year. They added 1s. 6d. per ton to the cost of treatment and were responsible for a decrease of not less than 10,000 tons of ore offered for treatment at plants on the Eastern Goldfields, which, in turn, seriously affected our costs. The cost per ton treated in all departments rose from 11s. 4.6d. in 1920 to 14s. 3.6d., an increase of 2s. 11d. per ton.

I have drawn attention in various minutes during the year to the rapid deterioration of plants when

idle. Galvanised iron vats and tanks, pipes and fittings, pumps, etc., suffer severely from oxidation despite cleaning and the use of protective paint, and belts perish when idle, in the heat of the Goldfields summers. It is an expensive matter to start plants after months of idleness, especially old plants, of which we have a number.

At several centres we have been compelled to close batteries on account of patronage almost ceasing. In such cases we have offered the plants to the public on lease at purely nominal rentals, but in only one or two instances have lessees been forthcoming.

The gold premium has declined to under 10s. per fine ounce, and, as the cost of mining is still very high, the outlook for tonnage at State Batteries in the immediate future is not bright.

The market price of base metals was weak and figures too low to permit holders of mineral leases to work them profitably. In consequence, the ore-dressing plants at Coolgardie and Greenbushes were idle.

Economy has been rigorously practised throughout the year, and we now have in hand a re-arrangement of managerial circuits which will reduce the staff still further. It will be necessary, in the interests of economy, to acquire a few motor cars for the transport of managers and employees from centre to centre.

Appended will be found the report of Mr. D. F. Browne, Inspector of State Batteries.

I have, etc.,

A. M. HOWE,
Superintendent of State Batteries.

Report by Mr. D. F. Browne, Inspector of State Batteries.

Herewith my report on the work of State Batteries for the year ended 31st December, 1921.

The decline in the total tonnage handled from 74,302½ tons in 1920 to 61,976 tons last year was more or less expected, but the serious decline in milling tonnage is disquietening.

The total receipts from all sources amounted to £36,522 6s. 4d., and expenditure aggregated £44,321 1s. 3d., leaving a loss of £7,801 14s. 11d. See Synopsis, etc.

MILLING.

Seventeen 5-stamp mills and nine 10-stamp mills were available for crushing auriferous ores for the whole year, whilst St. Ives started up in December. Of the mills above-mentioned, excluding St. Ives, nine 10-stamp mills ran 12,919 hours, and sixteen 5-stamp mills ran 18,670.25 hours inclusive of stoppages. 20-Mile Sandy was idle the whole time.

Out of a total of 54,775 stamp days available, our mills accounted for 9,277, equal to a run of 16.9 per cent. of full time.

Only four batteries crushed over 2,000 tons, namely, Wiluna (7,204.25), Coolgardie (6,804.25), Cue (3,275.5), and Payne's Find (2,022.5).

A profit of £39 16s. 3d. was made on Wiluna quartz and £78 9s. 1d. at Mulline, due in the case of the latter mill to a general clean up.

Expenditure.—The cost per ton was 17s. 3.86d., an increase of 4s. 9.38d. per ton on 1920 figures. The total expenditure amounted to £30,107 13s. 11d.

Revenue.—The revenue per ton was 9s. 0.72d. as against 8s. 8.26d. in 1920, an increase of 4.46d. per ton. The total revenue was £15,746 14s. 8d., showing a loss of £14,360 19s. 3d.

Cost per ton.—Wiluna quartz 8s. 1.70d., lode 8s. 4.08d., and Coolgardie 10s. 1.05d., show the best results for 10-stamp mills, and Cue 15s. 3.26d. and Ora Banda 16s. 3.00d. the lowest for 5-stamp mills.

Cost per hour.—Wiluna 15.03 and Leonora 21.18 shillings are the lowest for 10-heads, and Bamboo Creek 14.68, Mt. Ida 14.59, and Cue 15.74 shillings show the best results for 5-stamp mills.

Stamp Duty.—The nine 10-stamp mills averaged 4.24 tons per stamp per day, and the seventeen 5-stamp 4.32 tons—satisfactory figures especially as Wiluna figures are taken at 4.33 tons only. Coolgardie 5.61, Ora Banda 7.68, and Youanme 5.75 are the best results.

Fuel Consumption and Cost.—Owing to the small tonnages crushed at most batteries, the results as shown in the above schedule are not very conclusive in some cases.

Steam Plants.—Black Range, Coolgardie, and Leonora show good results as far as consumption and cost per B.H.P. These mills put through the largest tonnage in their class.

Charcoal producers.—Marble Bar shows .47lbs. per B.H.P. per hour, but the figure is too good to be true. Linden 0.85lbs., and Mt. Ida 0.98, Cue 1.05 are the best consumption figures, and Linden 0.46 pence,

Mt. Ida 0.36 and Cue 0.44 the best cost figures per B.H.P. hour.

Wood Plants.—Owing to the trouble of estimating the time the Wiluna mill is under full lode, the figures for fuel consumption are approximate. The consumption per B.H.P. shows at 1.77lbs. of wood per hour, and a cost of 0.19 pence. Bamboo Creek 3.32 lbs. and Mt. Keith 3.38lbs. show the next best consumption results.

LOW GRADE REBATES.

1921.	1920.
Tons—11,534.	20,338½.
Amount—£1,595 6s.	£2,391 13s.

The falling off was due to Griffiths not crushing so much ore at Coolgardie. The tonnage on which rebates were paid at Coolgardie fell from 13,398½ in 1920 to 5,704½ in 1921.

REPAIRS AND RENEWALS.

1921.	£	s.	d.	
Milling	..	3,452	0	11—1s. 11d. per ton.
Tailings	..	746	18	1—9.05d. per ton.
Slime	..	300	19	11—9.80d. per ton.

£4,499 18 11

1920.	£	s.	d.	
Milling	..	2,293	5	1—1s. 3.44d. per ton.
Tailings	..	408	2	4—6.34d. per ton.
Slimes	..	747	15	6—1s. 3.50d. per ton.

£4,149 2 11

TAILING.

Eleven tailing plants treated 19,763 tons, or 4,326 tons more than were handled in 1920, when 15,437 tons were cyanided. The increase was accounted for by the Coolgardie plant treating 5,052 tons more.

Cost per ton.—The average cost rose from 9s. 0.49d. to 10s. 0.85d., which is the highest on record, the two main causes of the increase being the cost of new vats at Coolgardie and the treatment of 3,348 tons of difficult tailings at Warriedar at a cost of 13s. 6.07d. per ton.

The best individual costs were Cue 7s. 10.00d. and Coolgardie 8s. 1.69d.

Revenue.—The revenue rose from 13s. 4.19d. in 1920 to 17s. 10.08d., due to the carry over of premiums, the total profit being £7,677.

Extraction.—Notwithstanding the low grade of the Coolgardie tailing, namely, 2.81dwts., the extraction has been well maintained. Head values dropped from 6.197dwts. to 5.688dwts., the actual extraction showing 80.60 per cent. See Schedule.

Wiluna.—The plant ran two shifts only on account of want of ore. The tonnage of slime handled dropped from 11,525 tons in 1920 to 7,370 tons in 1921. The costs rose from 9s. 11.28d. to 10s. 11.64d.,

and revenue declined from 8s. 8.40d. to 8s. 5.73d., the total loss amounting to £917 19s. 2d.

That the rise in cost was only 1s. per ton, considering the decreased tonnage, is due to careful

management, but the cost for the next year should be considerably reduced, if the plant maintains a run from now on of three shifts.

SCHEDULE. TAILING TREATMENT.

VALUES AND EXTRACTION—1921.

Battery	Tons.	Head Vague.	Contents.	Tail Value.	Con- tents.	Gold called for.	Gold Re- covered.	Sur- plus.	Short- age.	Extrac- tion
		dwts.	dwts.	dwts.	dwts.	£	£	£	£	%
Bamboo Creek ...	644	8.75	5,635	2.00	1,287	921	1,025	104	...	77.2
Black Range ...	470	11.44	5,378	1.47	694	1,003	992	...	11	87.09
Boogardie ...	725	5.56	4,032	1.20	871	672	811	139	...	78.30
Coolgardie* ...	6,659	2.81	18,852	0.69	4,599	3,016	3,259	243	...	75.43
Cue ...	3,330	5.22	17,387	1.12	3,730	2,901	2,955	44	...	77.9
Linden ...	760	6.30	4,789	1.41	1,072	789	763	...	16	...
Norseman ...	1,905	7.31	13,935	1.54	2,929	2,326	2,628	302	...	78.98
Ora Banda ...	240	2.75	661	.75	182	102	76	...	26	72.72
Payne's Find ...	1,140	3.03	3,458	.96	1,096	501	501	...	...	68.8
Warriedar ...	3,320	10.54	35,004	2.36	7,817	5,630	5,530	...	100	77.6
Youanme ...	240	5.89	1,410	1.12	360	223	218	...	5	74.46
	19,433	5.688	110,541	1.267	24,637	18,084	18,758	674	158	77.71
Wiluna ...	7,370	9.68	71,447	2.12	15,636	11,790	11,886	96	...	78.08

*Coolgardie figures are to clean up on December 19th.

COMPARATIVE FIGURES 1920 AND 1921—EXCLUDING WILUNA.

		1921.	1920.
Tons ...	...	19,433	15,292
Head Value (dwts.) ...	...	5,688	6,197
Tail Value (dwts.) ...	...	1,267	1,347
Theoretical Extraction (per cent.) ...	...	77.71	78.15
Actual Extraction (per cent.) ...	...	80.60	77.00

TIN TREATMENT.

The Greenbushes plant was closed down practically for the whole year, 54 tons being treated.

ERECTION.

The only mill erected was St. Ives, which commenced operations in December. Owing to a variety of causes, including railway strikes, wet weather, and cartage difficulties, the completion of this plant was considerably delayed.

STAFF.

During the year certain alterations to the staff were made, and the Murchison circuit was run with one less manager, though the services of Acting Manager Lees were availed of at Warriedar.

Manager Wann was transferred from Boogardie to Meekatharra and Peak Hill vice Manager Hepworth sent to Laverton, Leonora, and Mt. Keith circuit. Manager Moyes went to Norseman after Manager Hepworth relieved him.

Manager Wright was given Boogardie in addition to Sandstone and Youanme with head-quarters at the first mentioned place. Mr. D. Wilson, our Erection Officer, was left in charge of St. Ives battery when it commenced crushing in December.

GENERAL.

The small tonnage milled and the increased loss for the year are matters to be deplored, and there does not appear to be much hope of things mending to any appreciable extent this year.

The large increase in wages has been a big factor in our loss and it is questionable if we can expect any relief for some time, as at the time of writing, four months of the year have passed and the Arbitration Court has not commenced sitting yet.

Now that Manager Thorley's resignation is definite and two others pending, our Staff will be reduced to the lowest figure compatible with efficient treatment and the demands of the prospectors.

With only four Managers on the Murchison and six on the Eastern Fields and Wiluna, some difficulty will occur at times in starting up when 150 and 250 tons are available at 5-head and 10-head stamps respectively, but it is inevitable if expenditure is to be kept within bounds.

The policy of using Managers from one circuit to assist in other circuits where there is congestion, should assist materially, as it is impossible to group batteries effectively when the prospective tonnages cannot be determined, as at present.

Use of Motor Cars.—Managers who have wide circuits to control, suffer disabilities in travelling and in obtaining efficient hands, and when coach and rail fares and time for travelling is taken into consideration, the expense is heavy, especially as coach services out back are poor and only run weekly or fortnightly. Apart from these considerations in cases of break downs and accidents, considerable delay and expense occur in getting to centres where repairs can be executed and men attended to. I recommend, therefore, that at least two cars be purchased, one for use on the Murchison, and one on the Eastern Fields.

These cars would be available for my use and we could do away with at least two horses and sulkies for each car purchased, which would about cover the cost of upkeep.

Erection of new Plants.—For some years we have been erecting 5-head batteries only, and as the old plants have been closed down, the proportion of these mills has increased, and now that wages have soared to such an extent, the cost per ton has increased out of all proportion to the revenue received. A few years ago we could reasonably expect to offset the milling loss on a 5-head battery by the profit derived from tailings, but this is now impossible not only for the reason stated above, but also for the fact that tailings treatment costs have increased likewise.

It is advisable, therefore, that in future, when plants are to be erected, to consider the question of 10-head plants, so as to eliminate the proportion of wages charged per ton. I am of the opinion that, at the present price of timber and building materials,

with increased rail freights, it is not necessary to house our plants in new districts, with the exception of our power units. The saving of cost of buildings and erecting only single men's quarters and offices, as at Mt. Keith, would be sufficient to cover the cost of the extra 5-head.

Tailing Plants.—As mentioned, the cost of treatment has increased, and this is partly due to the cost of upkeep and renewal of vats and tanks.

Galvanised iron has been used for many years since the cost of erection is small compared with steel, but it is questionable if it is a good policy from our point of view, since we have to bear the cost of upkeep and renewals from revenue. Reinforced concrete tanks should be a suitable substitute and would probably cost about twice as much as galvanised iron and considerably less than steel.

D. F. BROWNE,
Inspector of State Batteries.

Schedule 1.

Return showing the number of tons crushed, gold yield, average per ton in shillings, and total value for year ending 31st December, 1921.

Battery.	Tons Crushed.	Gold Yield, Bullion.	Average per ton in shillings.	Total Value.
Bamboo Creek	652.5	1,337.80	147.61	4,816.08
Black Range	1,644.5	996.05	43.61	3,585.78
Boogardie	1,334.0	1,805.79	97.46	6,500.84
Coolgardie	6,804.25	2,299.91	24.32	8,279.67
Cue	3,275.5	2,900.12	63.74	10,440.43
Laverton	1,107.25	746.30	48.52	2,686.65
Leonora	1,373.25	942.86	49.16	3,388.29
Linden	378.5	496.30	94.40	1,786.63
Marble Bar	257.5	322.50	90.18	1,161.00
Meekeatharra	508.25	698.75	98.98	2,515.50
Mt. Egerton	311.0	67.00	15.51	241.20
Mt. Ida	793.0	379.70	34.46	1,366.92
Mt. Keith	186.5	133.20	51.42	479.52
Mt. Sir Samuel	164.5	106.05	46.40	381.73
Mulline	395.0	357.55	65.18	1,237.13
Niagara	435.5	337.82	55.84	1,216.15
Norseman	1,275.25	1,941.97	109.64	6,991.09
Ora Banda	1,348.5	663.97	35.44	2,390.29
Payne's Find	2,022.5	2,391.05	85.12	8,607.78
Peak Hill	838.0	578.65	49.72	2,033.14
Siberia	362.0	95.80	19.05	344.88
St. Ives	229.0	277.15	87.14	997.74
Warriedar	286.75	187.30	34.46	494.28
Wiluna	243.25	157.40	45.64	566.64
Yarri	935.75	785.40	60.43	2,827.44
Youanme	633.0	118.85	13.52	427.86
Wiluna Lode	27,805.0 6,956.0	21,075.24 No amalga- mation.	54.56	75,864.84

Tin Plants.

Plant.	Yards Treated.	Yield.
Greenbushes	54	Tons. 31

Schedule 2.

Return showing the number of tons crushed, gold yield, average per ton, and value since inception to 31st December, 1921.

Battery.	Tons Crushed.	Gold Yield.	Average per ton.	Value.
Bamboo Creek	9,543.25	16,260.46	1.703	58,537.66
Black Range	70,795.90	73,243.05	1.034	263,870.31
Boogardie	66,526.90	43,968.93	.661	159,682.33
Coolgardie	114,439.00	74,537.03	.652	268,566.96
Cue	7,987.50	10,675.45	1.336	38,431.61
Darlot	33,210.00	37,637.74	1.133	138,928.25
Laverton	17,321.00	17,827.21	1.030	65,349.63
Leonora	54,854.20	60,337.85	1.100	220,690.58
Linden	19,326.50	21,634.05	1.120	77,882.67
Marble Bar	10,733.75	13,575.55	1.259	48,871.93
Meekeatharra	74,970.75	89,996.94	1.200	326,668.37
Mt. Egerton	7,893.25	4,084.86	.517	13,972.32
Mt. Ida	42,065.40	54,008.76	1.284	197,733.71
Mt. Keith	9,669.00	8,555.85	.885	30,801.06
Mt. Sir Samuel	9,631.25	7,505.97	.775	27,021.48
Mulline	77,008.45	98,573.64	1.280	354,035.25
Niagara	64,608.00	57,643.81	.892	209,705.91
Norseman	61,470.95	67,971.11	1.106	247,878.46
Ora Banda	17,924.00	8,128.00	.454	29,260.76
Payne's Find	23,850.75	29,260.81	1.227	105,338.91
Peak Hill	19,946.30	20,875.67	1.047	76,323.65
Siberia	15,899.00	16,541.24	1.054	59,473.79
20-Mile Sandy	12,184.15	19,055.77	1.563	68,930.34
St. Ives	229.00	277.15	1.210	997.74
Tuckanarra	15,478.85	21,276.08	1.374	78,217.53
Warriedar	4,663.50	2,033.95	.436	7,322.22
Wiluna	55,831.50	30,288.99	.542	109,135.54
Yarri	47,006.25	31,238.91	.664	112,459.90
Youanme	28,034.50	94,479.23	.338	34,125.22
Batteries closed	259,629.34	270,313.31	1.041	931,998.47
Wiluna (Lode)	1,252,630.19 65,602.25	1,216,857.35 26,615.45	.971 .406	4,412,262.61 96,133.44
	1,318,232.44	1,243,472.80	.943	4,508,401.05

Tin Plants.

Plant.	Tons.	Yield. Black Tin.
Greenbushes	791.00	Tons. 3.566
Plants closed	79,276.75	969.276
	80,067.75	972.842

Milling.		ozs.		Tailing Treatment.		Tons.
Up to 1901 (3 years)	Tons.	68,791	75,553	1913	...	13,078
1902	39,517	57,255	1914	...	32,723	
1903	49,233	58,305	1915	...	31,887	
1904	71,616	78,309	1916	...	34,725	
1905	85,018	92,327	1917	...	24,890	
1906	95,831	94,187	1918	...	24,364	
1907	95,280	97,962	1919	...	15,764	
1908	95,624	89,875	1920	...	16,437	
1909	94,218	83,127	1921	...	19,763	
1910	89,278	80,074				
1911	59,373	56,265				
1912	56,636	53,868				
1913	60,573	52,515				
1914	56,570	45,641	Up to 1904	...	691	
1915	49,595	39,095	1905	...	7,028	
1916	47,330	31,734	1906	...	...
1917	42,947	38,015	1907	...	8,220	
1918	39,329	33,523	1908	...	5,818	
1919	40,291	27,027	1909	...	16,848	
1920	46,494	28,450	1910	...	28,519	
1921	34,761	24,035	1911	...	20,821	
			1912	...	8,085	
			1913	...	6,089	
			1914	...	6,246	
			1915	...	3,454	
			1916	...	15,636	
			1917	...	13,086	
			1918	...	11,892	
			1919	...	12,780	
			1920	...	11,525	
			1921	...	7,370	

Schedule 3.

Sand and Tailing Treatment, 1921.

Battery.	Tons.	Yield.	Value.
Bamboo Creek	644	Fine ozs. 240.40	£ 1,020.98
Black Range	470	233.66	992.36
Boogardie	725	181.17	769.48
Coolgardie	6,989	797.22	3,385.88
Cue	3,330	698.86	2,955.37
Linden	760	181.93	769.00
Niagara	...	1.08	3.19
Norseman	1,905	623.86	2,637.96
Ora Banda	240	17.87	75.92
Payne's Find	1,140	118.14	501.77
Warriedar	3,320	1,114.37	4,732.80
Youanme	240	51.85	218.12
	19,763	4,259.91	18,063.78

Slime Treatment.

Battery.	Tons.	Yield.	Value.
Wiluna	7,370	Fine ozs. 2,798.64	£ 11,886.04

Schedule 4.

Sand and Tailing Treatment since Inception to 31st December, 1921.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Bamboo Creek	7,378-00	2,649-39	11,266-56
Black Range	45,748-00	13,151-13	55,578-42
Boogardie	49,512-00	13,046-35	54,828-59
Burtville	16,788-75	5,404-13	22,793-76
Coolgardie	61,858-00	9,372-15	39,487-28
Laverton	14,996-00	2,566-98	10,708-48
Cue	4,470-00	1,068-68	4,526-04
Leonora	37,139-5	9,056-71	37,699-89
Linden	16,917-00	5,619-01	23,883-63
Meekatharra	49,700-00	9,855-41	41,245-78
Mulline	44,794-5	12,261-27	49,863-24
Mt. Keith	7,053-00	816-70	3,468-72
Mulwarrie	23,809-25	46,75-53	19,220-11
Mt. Sir Samuel	5,988-00	1,367-56	5,809-39
Niagara	43,764-0	6,697-42	27,868-93
Norseman	45,139-5	10,271-35	42,860-63
Ora Banda	8,372-00	1,734-05	7,366-65
Payne's Find	14,767-00	1,726-38	7,333-48
Quinn's	7,486-00	686-56	2,916-43
Sandy Creek	11,496-25	3,512-53	14,639-07
Siberia	5,550-0	1,201-56	5,105-20
Warriedar	3,320-00	1,114-37	4,732-80
Wiluna	17,852-00	7,930-79	33,590-87
Yarri	44,180-00	4,197-75	17,567-84
Youanme	11,905-00	3,121-43	13,255-87
Batteries closed	134,971-5	25,074-55	103,894-38
	734,955-25	158,239-74	661,512-04

Residue Treatment from Inception to 31st December, 1921.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Linden	670-00	95-14	349-34
Menzies	24,270-00	1,579-26	6,679-01
Mulwarrie	4,618-00	546-85	2,325-02
	29,558-00	2,221-25	9,353-37

Slime Treatment since Inception to 31st December, 1921.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Mulwarrie	4,733-5	751-79	3,194-22
Wiluna	75,829-00	23,108-00	119,369-23
Slime Plants closed	111,196-25	25,088-87	102,110-62
	191,758-75	53,948-66	224,674-12

Tin Residue Treatment from Inception to 31st December, 1921.

	Tons.
Greenbushes, Bunbury End ... ..	.315
Greenbushes, Salt Water Gully	1,444
	1,759

Schedule 5.

Return showing Number of Parcels treated and Tons crushed at State Batteries for Year 1921.

Number of Parcels crushed.	Battery.	Tons.	Yield by Amalgamation.		Gross Contents of Tailings of Fine Gold.	Total Contents of Ore. Fine Gold.	Average per ton. Fine Gold.		Gross Value of Ore per ton.
			Bullion.	Fine Gold.			dwt.	grs.	
11	Bamboo Creek	652½	1,337-80	1,33-99	160-41	1,294-40	39	17	8 8 3
34	Black Range	1,644½	996-05	844-31	631-83	1,476-14	17	23	3 16 3
50	Boogardie	1,334	1,805-80	1,530-69	408-74	1,939-43	29	2	6 3 6
104	Coolgardie	6,804½	2,299-92	1,949-54	641-87	2,591-41	7	15	1 12 5
71	Cue	3,275½	2,900-12	2,458-30	570-46	3,028-76	18	12	3 18 7
20	Laverton	1,107½	746-30	632-60	266-16	898-76	16	6	3 9 0
33	Leonora	1,378½	942-86	799-22	427-49	1,226-71	17	20	3 15 9
16	Linden	378½	496-30	420-69	140-11	560-80	29	14	6 5 8
6	Marble Bar	257½	322-50	273-37	91-38	364-75	28	13	6 1 3
8	Meekatharra	508½	698-75	592-30	218-58	810-88	32	1	6 16 1
1	Mt. Egerton	311	67-00	56-79	35-76	92-55	6	2	1 5 10
9	Mt. Ida	793	379-70	321-85	209-91	531-76	13	10	2 16 11
5	Mt. Keith	216½	133-20	112-90	25-08	137-98	12	18	2 14 2
3	Mt. Sir Samuel	164½	106-05	89-89	23-26	113-15	13	18	2 18 5
10	Mulline	395	357-55	303-08	66-91	369-99	18	17	3 19 7
16	Niagara	435½	337-82	286-35	98-07	384-42	17	15	3 15 0
41	Norseman	1,335½	1,941-97	1,646-12	534-31	2,180-43	32	15	6 18 8
26	Ora Banda	1,348½	663-97	562-82	134-05	696-87	10	8	2 3 11
37	Payne's Find	2,022½	2,391-05	2,026-79	191-51	2,218-30	21	22	4 13 2
21	Peak Mill	838	578-65	490-49	137-78	628-27	14	23	3 3 8
4	St. Ives	214	277-15	234-92	65-25	300-17	28	12	5 19 2
5	Siberia	362	95-80	81-20	26-09	107-29	5	22	1 5 2
6	Warriedar	286½	137-30	116-38	193-71	310-09	21	15	4 11 10
8	Wiluna	248½	157-40	133-42	70-17	203-59	16	9	3 9 8
25	Yarri	935½	785-40	665-75	225-94	891-69	19	2	4 1 0
1	Youanme	633	118-85	100-74	110-79	211-53	6	16	1 8 5
571		27,880	21,075-24	17,864-50	5,705-62	23,570-12	16	21	3 11 10
35	Wiluna Lode	6,956	No amal-	gamation	3,698-76	3,698-76	10	15	2 5 2
606		34,836							
	Add tonnage not completed, 31st December, 1921	15							
		34,851							
	Less tonnage not completed, 31st December, 1920	90							
		34,761							

Tin Ore Treatment.

	Yards of Tin Ore treated.	Yield, Black Tin.	Average per yard.
Greenbushes	54	tons. 31	lbs. 12-8

Schedule 6.

Expenditure from Consolidated Revenue Vote and Loan Expenditure Funds on Erection of State Batteries for Year ended 31st December, 1921, and Totals since Inception.

Battery.	From Revenue.	From Loan.	Total.
	£ s. d.	£ s. d.	£ s. d.
Erection of Leaching Plant, Warriedar	...	228 8 10	228 8 10
Erection of Leaching Plant, Cue	...	54 12 4	54 12 4
St Ives—Supply and Installation of 5-head Battery and Water Supply	...	8,568 5 4	8,568 5 4
Payne's Find—Reconstruction of Tailings Treatment	...	473 15 0	473 15 0
Mulline—Segregation of Machinery	...	94 5 4	94 5 4
Dismantling Quinn's Battery...	...	74 17 0	74 17 0
Tin Dressing Plant, Floyd's Gully	...	9,494 3 10	9,494 3 10
	...	0 3 0	0 3 0
Erection of State Batteries—Expenditure to 31st December, 1907	91,981 1 8	9,494 0 10	9,494 0 10
Loan Expenditure to 31st December, 1920	...	292,596 5 7	384,577 7 3
Totals ...	91,981 1 8	302,090 6 5	394,071 8 1

Schedule 7.

Direct Purchase of Tailing, 1921.

Battery.	Tons.	Amount.
		£ s. d.
Bamboo Creek	452.5	1,204 13 9
Black Range	948.75	1,976 6 4
Boogardie	882.75	1,345 16 9
Coolgardie	830.5	667 7 3
Cue	1,330.0	1,424 19 9
Laverton	402.75	415 16 8
Leonora	332.0	691 14 3
Linden	314.0	338 5 5
Meekatharra	391.5	733 6 8
Mt. Keith	...	8 14 1
Mt. Sir Samuel	56.25	25 9 3
Mulline	235.0	97 6 5
Mullwarrie	...	9 6 0
Mt. Egerton	...	11 3 1
Niagara	405.25	236 15 11
Norseman	1,012.25	1,532 16 11
Ora Banda	195.0	199 16 7
Payne's Find	516.0	75 0 3
Siberia	9.5	8 13 4
Warriedar	214.25	850 3 11
Wiluna	...	449 19 7
Wiluna (Lode)	7,265.5	11,976 8 1
Yarri	500.0	317 13 5
Youanme	506.5	118 8 6
Totals	16,756.25	24,711 2 2

Schedule 7a.

Return showing Tailing payable and unpayable and Gross Contents, 1921.

Battery.	Tailing payable.		Tailing Unpayable.		Totals.	
	Tons.	Gross Contents.	Tons.	Gross Contents.	Tons.	Gross Contents.
Bamboo Creek	493½	157 18 20	28½	2 9 12	522	160 8 8
Black Range	1,010½	611 15 8	163	20 1 7	1,173½	631 16 15
Boogardie	884	380 4 4	249½	28 10 15	1,133½	408 14 19
Coolgardie	735½	274 18 4	5,044½	366 19 12	5,779½	641 17 16
Cue	1,289	463 5 8	1,270½	107 3 19	2,559½	570 9 3
Laverton	695	234 3 21	222½	31 19 7	917½	266 3 4
Leonora	624½	355 17 21	526½	71 11 22	1,151½	427 9 19
Linden	298	137 14 20	17½	2 7 11	315½	140 2 7
Marble Bar	187½	88 14 11	17½	2 13 6	205	91 7 17
Meekatharra	406½	218 11 15	...	...	406½	218 11 15
Mt. Egerton	...	...	248½	35 15 4	248½	35 15 4
Mt. Ida	623	209 11 17	12	0 6 12	635	209 18 5
Mt. Keith	106½	16 11 21	77	8 9 21	183½	25 1 18
Mt. Sir Samuel	17½	5 18 2	122½	17 7 2	140	23 5 4
Mulline	235	65 13 14	10½	1 4 15	245½	66 18 5
Niagara	329½	94 6 4	37½	3 15 16	366½	98 1 20
Norseman	1,056½	526 17 3	68	7 9 2	1,124½	584 6 5
Ora Banda	229½	85 10 3	849½	48 10 20	1,079	134 0 23
Payne's Find	222½	41 13 3	1,067½	149 17 5	1,290	191 10 8
Peak Hill	337½	111 15 1	339½	26 0 15	676½	137 15 16
St. Ives	149½	62 7 18	27	2 17 6	176½	65 5 0
Siberia	9½	2 15 20	252	23 6 0	261½	26 1 20
Warriedar	214½	190 17 6	20½	2 17 2	235	193 14 8
Wiluna	208½	70 3 14	...	...	208½	70 3 14
Yarri	682	215 4 5	99½	10 14 18	781½	225 18 23
Youanme	506½	110 15 23	...	...	506½	110 15 23
Wiluna Lode	11,550½	4,733 5 22	10,772½	972 8 9	22,323½	5,705 14 7
	6,956	3,698 15 4	No amalgamation.		6,956	3,698 15 4
Totals	18,506½	8,432 1 2	10,772½	972 8 9	29,279½	9,404 9 11

Schedule 9.

Statement of Receipts and Expenditure for Year ending 31st December, 1921.

TAILING AND SLIME TREATMENT.

Plant.	Tonnage.	Management.	Wages.	Assays.	Stores.	Total Working Expenditure.	Cost per ton.	Repairs and Renewals.	Sundries.	Gross Expenditure.	Cost per ton.	Receipts.	Per ton.	Profit.	Loss.
		£ 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.	£ s. d.
Bamboo Creek ...	644	49 17 0	148 2 11	15 15 0	127 4 0	340 18 11	10 7-05	11 0-10	38 14 11	390 14 8	12 1-60	373 0 0	11 7-00	...	17 14 8
Black Range ...	470	45 0 0	85 6 3	21 6 5	95 1 4	246 14 0	10 6-00	130 6 5	45 11 2	422 11 7	17 11-78	439 6 0	18 8-32	16 14 5	...
Boogardie ...	725	64 0 0	111 4 1	15 17 1	110 5 2	301 6 4	8 3-74	11 2 10	48 12 7	361 1 9	9 11-53	622 14 11	17 2-13	261 13 2	...
Coolgardie ...	6,939	207 17 6	1,148 5 3	112 16 8	429 3 2	1,893 2 7	5 5-16	467 1 9	479 13 8	2,844 18 0	8 1-69	2,347 9 0	6 8-61	...	497 9 0
Cue ...	3,330	69 17 8	615 15 5	40 14 3	354 0 0	1,030 7 4	6 5-85	...	224 2 8	1,304 10 0	7 10-00	1,452 5 8	8 8-66	147 15 8	...
Laverton ...	...	...	...	0 14 6	...	0 14 6	...	...	...	0 14 6	...	...	...	...	0 14 6
Linden ...	760	89 0 0	133 7 1	17 9 0	114 8 4	354 4 5	9 3-86	3 17 3	63 12 7	421 14 3	11 1-15	491 5 10	12 11-13	69 11 7	...
Meekatharra ...	...	7 17 0	3 12 0	...	...	11 9 0	...	9 4 0	1 4 3	21 17 3	...	0 16 4	...	5 13 3	...
Mulline ...	...	...	...	...	...	...	...	...	4 5 4	4 5 4	...	168 10 0	...	164 4 8	...
Niagara ...	...	...	...	...	...	...	...	...	0 14 6	0 14 6	...	6 5 10	...	5 11 4	...
Norseman ...	1,905	135 5 2	236 2 11	64 11 6	236 0 1	771 19 8	8 1-24	24 1 2	186 10 5	982 11 3	10 3-76	1,631 3 11	17 1-48	648 12 8	...
Ora Banda ...	240	36 1 0	39 2 0	5 13 3	33 1 5	119 2 8	9 11-13	...	17 4 3	136 6 11	11 4-34	51 9 2	4 3-45	...	84 17 9
Payne's Find ...	1,140	99 5 9	151 18 3	45 14 3	191 7 5	488 5 8	8 6-79	29 12 4	108 1 8	625 19 8	10 11-78	428 16 3	7 6-26	...	197 3 5
20-Mile Sandy ...	...	...	...	...	...	...	...	...	...	...	...	34 11 0	...	34 11 0	...
Warriedar ...	3,320	261 10 4	723 7 11	80 15 1	926 12 7	1,997 5 11	12 0-38	41 13 4	221 19 9	2,260 19 0	13 7-44	2,375 1 3	14 3-67	114 2 3	...
Yarri ...	...	...	...	...	46 10 0	46 10 0	...	...	...	46 10 0	...	...	...	...	46 10 0
Youanm ...	240	8 0 0	44 2 3	16 4 1	21 14 0	90 0 4	7 6-02	18 18 2	17 19 9	126 18 3	10 6-91	191 4 1	15 11-20	64 5 10	...
Transferred from Revenue Suspense Account ...	...	...	...	...	...	...	...	...	...	...	...	7,000 0 0	...	7,000 0 0	...
Wiluna Slime ...	19,763	1,073 11 5	3,495 6 4	437 16 1	2,740 7 6	7,747 1 4	7 10-07	746 18 1	1,458 7 6	9,952 6 11	10 0-85	17,629 6 11	17 10-08	8,527 2 7	850 2 7
	7,370	251 19 5	1,251 14 2	357 12 0	1,203 19 0	3,070 4 7	8 3-93	300 19 11	671 5 5	4,042 9 11	10 11-64	3,124 10 9	8 5-73	...	917 19 2
	27,133	1,325 10 10	4,747 0 6	795 8 1	3,949 6 6	10,817 5 11	7 11-66	1,047 18 0	2,129 12 11	13,994 16 10	10 3-76	20,753 17 8	15 3-57	8,527 2 7	1,768 1 9

Schedule 10.

STATE BATTERIES.

Balance Sheet.

		£	s.	d.	£	s.	d.			£	s.	d.		
To Capital Expenditure:—								By Batteries, Tailing, and Slime Plants	394,071	8	1			
From General Loan								Less Depreciation	314,768	15	11			
Fund	302,090	6	5									79,302	12	2
From Consolidated								„ Stores				15,496	17	2
Revenue	91,981	1	8					„ Sundry Debtors				8,787	7	8
					394,071	8	1	„ Profit and Loss Account				704,165	19	6
To Treasury					120,541	5	3							
„ Interest and Sinking Fund					289,515	8	8							
„ Sundry Creditors					3,624	14	6							
					£807,752	16	6					£807,752	16	6

Profit and Loss Account.

		£	s.	d.			£	s.	d.	£	s.	d.
To Expenditure—					By Revenue	1,196,444	12	3				
Head Office and all Batteries	1,296,326	7	2		„ Loss on Working carried down	99,881	14	11				
To Loss on Working brought down	99,881	14	11						1,296,326	7	2	
„ Interest at 3½ per cent., and Sinking Fund at 1½ per cent. on Capital Expenditure	289,515	8	8									
„ Depreciation	314,768	15	11		By Gross Loss				£704,165	19	6	
	£704,165	19	6									

Schedule 11.

Working Profit and Loss Account for Year ended 31st December, 1921.

		£	s.	d.			£	s.	d.
To Working Expenditure—					By Revenue—				
„ Batteries and Tin Plants	30,329	4	5		„ Batteries and Tin Plants	15,768	8	8	
„ Tailing and Slime Plants	13,994	16	10		„ Tailing and Slime Treatment	20,753	17	8	
	£44,324	1	3		„ Loss on Year's Operations	7,801	14	11	
						£44,324	1	3	

Schedule 12.

State Battery Statistics from Inception to 31st December, 1921.

Year.	Milling.				Sand and Tailing Treatment.				Slime Treatment.				Tin Treatment.				Gross Loss. ‡
	Tons.	Expenditure per ton.	Revenue per ton.	Loss.	Tons.	Expenditure per ton.	Revenue per ton.	Profit.	Tons.	Expenditure per ton.	Revenue per ton.	Loss.	Tons.	Expenditure per ton.	Revenue per ton.	Loss.	
		s. d.	s. d.	£		s. d.	s. d.	£		s. d.	s. d.	£		s. d.	s. d.	£	£
1899 ...	18,806	...	...	2,827	...	...	...	...	...	...	...	...	...	...	...	...	2,827
1900 ...	22,675	22 10.1	17 4.5	7,611	...	...	...	...	...	...	...	...	...	...	...	...	7,611
1901 ...	26,775	18 0.0	16 6.0	1,983	9,534	16 9	...	1,337	...	...	...	...	...	...	...	...	646
1902 ...	39,516	14 8.6	14 8.2	169	9,721	22 3	...	724	...	...	...	...	1,170	12 2	...	286	†269
1903 ...	49,233	13 6.8	12 10.6	1,250	33,369	7 7	...	1,442	...	...	...	...	2,009	8 2	...	153	†2,539
1904 ...	71,616	14 4.4	12 6.5	6,423	43,251	7 10	...	1,448	...	...	...	...	2,337	8 2	...	165	5,141
1905 ...	85,018	12 4.0	12 2.5	957	54,420	7 3	9 8.5	6,689	7,028	12 1	...	410	3,697	5 8	5 0.3	324	†3,342
1906 ...	95,831	12 2.0	11 3.8	4,076	65,159	7 4	9 2.1	5,549	4,737	11 8	12 1.1	†2,254	11,428	4 2	4 3.3	†156	†2,880
1907 ...	95,280	12 6.0	11 4.8	8,724	64,514	6 8.7	9 2.8	6,474	8,220	8 7.6	13 5.5	†1,983	10,496	4 4.4	4 8.8	†191	1,688
1908 ...	95,628	12 1.9	9 3.6	13,669	62,272	6 4.7	8 11.0	8,017	5,818	12 0.9	11 8.0	120	5,573	4 5.2	3 6.3	254	7,278
1909 ...	94,218	11 1.7	9 6.6	7,568	61,032	6 5.8	8 9.7	7,096	16,848	10 0.7	9 6.7	423	5,043	4 8.2	3 7.5	267	1,965
1910 ...	89,278	11 3.3	9 6.6	7,709	43,391	6 2.9	8 6.1	4,903	28,600	8 9.1	9 11.5	†1,723	3,769	5 5.5	3 4.1	401	2,365
1911 ...	59,373	12 6.9	9 10.3	8,058	27,362	6 5.9	8 9.7	3,173	28,183	10 10.5	9 5.3	1,666	6,061	4 0.3	3 4.9	188	7,490
1912 ...	56,636	12 9.2	9 8.7	8,616	18,600	8 3.5	8 8.6	397	8,085	11 8.6	10 5.2	519	5,330	4 5.1	3 7.6	210	9,786
1913 ...	60,573	12 5.6	9 5.4	9,155	31,378*	7 5.0	9 5.2	3,160	6,089	12 4.1	9 6.1	862	8,032	5 5.1	4 1.7	513	7,711
1914 ...	56,570	12 6.8	9 2.9	9,413	38,942	6 6.5	8 2.2	3,202	6,246	10 10.2	9 0.0	578	3,340	7 10.6	4 6.6	557	7,418
1915 ...	49,595	11 10.7	9 2.6	6,642	31,887	6 9.3	8 0.6	2,041	3,454	12 6.2	9 10.1	462	1,767	8 1.2	3 11.7	364	5,415
1916 ...	47,304	12 6.7	9 1.9	8,018	35,665	7 1.7	8 7.3	2,510	15,536	8 8.2	8 7.3	56	943	11 11.6	4 0.3	374	5,982
1917 ...	42,947	12 1.5	9 0.0	6,714	24,674	8 3.3	8 10.3	727	15,408	9 8.5	8 3.1	1,104	1,118	11 2.9	3 8.2	422	7,554
1918 ...	39,330	13 2.9	8 11.4	8,442	24,364	8 3.7	9 5.7	1,420	11,892	9 4.8	7 9.0	982	5,985	4 10.2	3 0.2	558	8,650
1919 ...	40,290½	12 4.1	8 2.0	8,426	15,764	9 2.4	9 3.8	91	12,780	9 1.1	7 4.6	1,089	1,204	10 0.9	3 11.2	369	9,925
1920 ...	46,494½	12 6.4	7 11.5	8,954	15,437	9 0.4	13 4.1	3,325	11,525	9 11.2	8 8.4	713	737	8 11.2	9 3.3	†12	6,363
1921 ...	34,761	17 3.8	9 0 7	14,361	19,763	10 0.8	17 10.0	7,677	7,370	10 11.6	8 5.7	918	54	82 0.5	8 0.4	200	7,802

* Tailing Treatment commenced 1913.

† Profit.

‡ Details of Ore dressing and Residue Treatment not shown, but financial result included in the figure of this column.

DIVISION IV.

ANNUAL PROGRESS REPORT

OF THE

GEOLOGICAL SURVEY

FOR THE

YEAR 1921.

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Annual Progress Report of the Geological Survey for the Year 1921.

THE work of the Geological Survey during the year 1921 has been more or less restricted owing to the changes which have taken place in the personnel, and has resulted, *inter alia*, in the temporary abandonment of certain important and essential classes of field work, which have in the past been carried out as part of the regular work of the geological staff.

THE STAFF.

The work of the year has been carried out by 12 classified officers.

Mr. R. C. Wilson, formerly of the Mines Inspection Staff and latterly Mining Superintendent to the Hampton Plains Company, was appointed to the position of Field Geologist on the 1st of May; his services, however, were virtually lost to the Survey owing to his transference to the staff of the State Mining Engineer.

Mr. C. B. Kidson, draftsman, who joined the Geological Survey on the 23rd May, 1905, was retired in the month of September, 1921, under the Public Service Regulations. With the retirement of this officer the Survey was left without any draftsman, and had to fall back upon the staff of the Department of Mines to meet certain of its requirements—an arrangement which, owing to the scattered nature of the offices, leaves much to be desired.

FIELD WORK.

Little or no effective field work has been found possible during the year. The details regarding this are shown in the table attached, which indicates the distribution of the field work together with the names of the field officers engaged thereon.

Table showing the Distribution of Field Work for the Year 1921.

Goldfield or Land Division.	T. BLATCHFORD.		F. R. FELDTMANN.		R. C. WILSON.	
	No. of days in the field.	Percentage of working days.	No. of days in the field.	Percentage of working days.	No. of days in the field.	Percentage of working days.
Kimberley Division	116	31.78	...	...	Appointed 1st May, transferred to Mines Department 13th May.	
Coolgardie Goldfield ... ..	...	...	101	27.67		
Total	116	31.78	101	27.67	...	

As has been the case in the past few years administrative duties prevented me carrying out any systematic field work during the year 1921. On the 19th of September I accompanied Professor Sir Edgeworth David to the Irwin River Coalfield, and devoted a few days to investigations in that district.

T. Blatchford, Assistant Geologist.

This officer devoted the whole of the time between 29th May, 1921, and 22nd September, 1921, to inspection work in connection with certain reported oil occurrences in East and West Kimberley. In all he spent 116 days in the field.

F. R. Feldtmann, Field Geologist.

The first half of the year was spent by Mr. Feldtmann at headquarters in the preparation of reports and maps upon the field work of the previous year and other duties incidental thereto. The period intervening between the 21st of July and the 22nd December was devoted by Mr. Feldtmann to an examination and survey of the Gibraltar district, with the exception of a short interval at headquarters. In all this officer spent 101 days in the field, all being in the Coolgardie Goldfield.

R. C. Wilson, Field Geologist.

Mr. Wilson was appointed, on probation, from the 1st of May, but having been transferred to the Department of Mines on the 13th of that month was unable to carry out any field work required by the Geological Survey.

THE PROGRESS OF GEOLOGICAL SURVEY WORK SINCE 1896.

The close of the year 1921 marks the twenty-fifth anniversary of the establishment of the Geological Survey on modern lines. A complete account of the origin, history and work of the Geological Survey of Western Australia appeared in the Annual Report for the year 1910; the report set out fully the purpose for which the department existed, the circumstances which ultimately led to its establishment as a permanent part of the machinery of Government, and how its work was carried out, together with a brief *aperçu* of what it had been able to accomplish.

Since the publication of that report, eleven years ago, great advances have been made in our knowledge of the geology and the mineral resources of the State. The published results of the Survey's work are contained in twenty-five Annual Reports and eighty-

three Bulletins. The Bulletins deal with a great variety of subjects, *e.g.*, one is a Bibliography of the Geology of the State; five are devoted exclusively to the results of Palaeontological researches; one a General Index to all the official reports issued since 1870; four contain reports on Artesian Water resources; four on such general questions as The Mineral Wealth of the State, The Distribution of the Base Metals, Minerals of Economic Value, A Statistical Account of the Mineral Production of the State; one is devoted exclusively to tabulated lists of Analyses of Rocks, Natural Waters and Meteorites made in the Survey Laboratory since its inception in 1897; three refer solely to General Geology, whilst the remaining sixty-seven give more or less detailed accounts of the Geological Structure, Ore Occurrences, and future mining prospects of pretty well every field in Western Australia. The contents of all these publications are as far as possible restricted to actual facts, and to such inferences as follow directly from them.

ECONOMIC GEOLOGY AND ORE DEPOSITS.

The want of a general compendious account of the actual and potential mineral resources of the State having been felt for a number of years, there has been prepared a memoir—The Mining Handbook—which contains a *résumé* of all the scattered information relating to the structural, stratigraphical and economic geology. A very large, and the most extensive portion of the volume is devoted to a general statement of the facts relating to the areal distribution, mode of occurrence, geological relationships, and possible value of the known mineral deposits of the State, followed by a succinct account of typical occurrences of each in the different districts; thus constituting a statement of the present condition of knowledge relating to the Economic Geology of the State. The Memoir contains chapters on the following:—

- (a) A Summary of the Geology of Western Australia.
- (b) The Economic Geology and Mineral Resources of Western Australia.
- (c) The Physiography of Western Australia and its Relation to Prospecting and Mining.
- (d) Minerals of Economic Value and their Preparation for the Market.
- (e) Petrology and its Application in Economic Geology, together with an account of the chief Rock-making Minerals and Rocks.
- (f) Relation of the Law to Prospecting and Mining.
- (g) Assistance to Prospecting and Mining. (A: Free Determinations and Assays. B: Geological Reports arranged under—(1) Mining Centres, etc.; and (2) under the names of metals, minerals, etc. C: Geological Maps arranged under—(1) Mining Centres and Individual Localities; and (2) Goldfields, Mining Districts, etc. D: Assistance under the Mining Development Act. E: Assistance under the Industries Assistance Act. F: Advances on Ores, etc.).
- (h) Glossary of some common terms used in Mining, Field and Physiographical Geology.

The Memoir also includes:—1: A general Geological Map of the State. 2: A Map showing the Distribution of the Useful Minerals. 3: A Map indicating

the Areas covered by the Geological Maps issued since 1896.

The preparation of a general geological sketch map of the State has been the aim of the Department ever since the inauguration of the Survey, it being fully recognised that—

the highest function of a Geological Survey is to lay a basis for future scientific observations by accurately mapping the relation of the various formations met with in a given district.

The fact is, however, often overlooked that a correct knowledge of the general stratigraphical geology (using the term in its widest sense) of a country, such as reliable and detailed mapping alone can supply, is fundamental to any systematic development of its mineral wealth. An inventory of, and investigation into, the mineral and allied resources of a country is of necessity based upon a knowledge of its geological constitution and structure. The investigation of the geology of a mineral field or district, if it is to be of any real value and service, requires that the data shall have been obtained by actual survey. One of the concrete results of a quarter of a century's work is a geological sketch map of nearly the whole of the State, which is accurate as regards its main features and as regards the details in many parts of it; the map thus sums up graphically the work of the survey up to the date of publication, 1920.

In a report dealing with Geological Survey work, one of the most eminent and accomplished geologists of America stated—

A national Geological Survey is, of course, merely supported as a commercial investment A nation is, therefore, justified in asking, not how far questions of abstract speculation have been advanced, but as to what progress has been made in the preparation of the maps, for upon these so largely depends the economical working of mines, the development of mineral wealth of newly settled districts, the determination of the most profitable routes for roads and railways, and the establishment of the best water supply. It is generally recognised that the fundamental duty of a Survey is to survey, and that the progress in mapping is the best guide by which those responsible for the expenditure of the public funds can determine whether the nation is getting the best return for its money.

Two totally distinct classes of geological survey work necessary to meet public requirements have been carried out, as circumstances and opportunity offered, viz.—

- (a) Reconnaissance surveys and explorations, covering in a general way large tracts of country; and
- (b) Systematic detailed mapping and description of less extensive and individual mining areas.

Not the least important class of geological work in such a partially developed country as Western Australia is that of reconnaissance surveys, which, theoretically, should precede the occupation of the country for mining or other utilitarian purposes, and must for a good many years to come remain the only scientific and rational method of dealing with those very large areas of the State which lie beyond the boundaries of connected settlement.

Several such reconnaissances have already been made, viz., King Leopold Plateau (Kimberley Division) in 1901; the country between Wiluna, Hall's Creek, and Tanami in 1908-09; the outlying portions of the North Coolgardie and East Murchison Goldfields in 1911; parts of the North-West, Central, and Eastern Divisions, between longitudes 119deg. and

122deg. East and latitudes 22deg. to 28deg. South during the field seasons of the years 1912-13-14; and the country between Laverton and the South Australian Border (near South latitude 26deg.) in 1916.

The broad outlines of the areas occupied by the Pre-Cambrian Rocks, which constitute the matrices of the gold and other mineral deposits, having been defined as the first step, the second lay in the direction of the definition of the different gold-bearing belts, upon such a scale, generally four miles per inch, and in such detail as circumstances seemed to warrant, and the third the preparation of geological plans, sections, etc., of individual deposits within portions of these belts, where all the mineral deposits may possibly be genetically related and capable of throwing light upon one another.

This class of geological work supplies records of established facts in the disposition of the ore bodies and their productiveness under various conditions, thus affording data otherwise unobtainable, by which mining operations can be directed into the most useful channels. Few mines, as such, however, on any single field present data sufficient to enable an accurate mental picture of the real nature of an ore deposit to be obtained without careful and systematic investigation into the geological structure and stratigraphy of wide stretches of country being carried out in conjunction with the detailed examinations of the mines and mineral deposits occurring therein.

A typical instance of this class of detailed areal work, carried out to meet the special requirements of the mining community, is that on the Yilgarn Goldfield, the chief interest of which centres in the auriferous deposits, which form three well-defined belts, trending generally north-west. The gold-bearing belts have for convenience of description been designated—

(a) The Yilgarn Gold Belt: This, which has a length of over 100 miles, enters the goldfield on its southern boundary near Mount Ironcap, and passes through Mount Holland, Cheriton's, Parker's Range, Marvel Loch, Southern Cross, Corinthian, Bullfinch, Golden Valley, and terminates near Ennui.

(b) The Mount Jackson and Bungalbin Belt: This, which constitutes the most northerly of the gold-bearing areas, has a longitudinal extent of a little over thirty miles, with a general trend of north-west and south-east; and

(c) The Westonia Belt, which is a more or less isolated area lying about 35 miles to the west of the main or Yilgarn Belt. It includes Boodalin, and the length of the mineral-bearing zone, so far as is known, does not exceed twenty-five miles, whilst its width is about five miles.

These ore-bearing belts have been surveyed and the generalised results published on the scales of both 10 and 4 miles to the inch, of which there are seven continuous sheets (viz., Bulletin 49, Plate IX.; Bulletin 63, Plates II., III., IV.; and Bulletin 71, Plates VI., VII., and VIII.) which present in the most convenient form the salient geological features adjoining the ore bodies of the whole of the Yilgarn Goldfield. The Gold Belt is thus seen to be in reality a linear system of interrupted and overlapping veins arranged more or less *en echelon*.

Reference has merely been drawn to this particular piece of detailed geological work because it affords an illustration of a class of work the Department has been carrying out, the results of which, when properly presented and interpreted, with knowledge and

with judgment, should tend to prevent the useless expenditure of both time and money, and in this way assist in directing prospecting and mining operations into legitimate channels, and in the development of the natural resources as well as the advancement of geological science in general.

A commencement has already been made with a detailed survey designed to deal more or less exhaustively with the geology and ore deposits of Kalgoorlie. The work has been carried out with, *inter alia*, the object of affording a scientific basis for arriving at the behaviour and relationship of the ore deposits and their connection with the main rock masses of the field; this being the only reliable method by which geological efforts to assist mining enterprise along legitimate lines can be based. The results of this re-survey of Kalgoorlie and Boulder, so far as it has been carried out, are to be found in Bulletins 42, 51, and 69, to which atlases of geological maps have been added.

Separate descriptive reports on more or less isolated individual centres on the different goldfields have been issued at various times, and it is hoped to ultimately combine these in such a way as to make available complete surveys of each of the gold and mineral fields of the State on the lines of the work carried out at Yilgarn.

The energies of the staff have virtually been engaged in taking an inventory of the mineral and allied resources of the State, and it has amongst other things been directing its efforts towards the investigations of the raw materials capable of being used in the arts and industries. Surveys and other collateral chemical, petrological and palaeontological investigations have been made of the tin, copper, lead, iron, coal, molybdenum, graphite, gold, and other deposits, as well as the phosphatic and lime deposits in the interest of the agricultural industry, and of the artesian water areas as an aid to the pastoralist.

Copper ores are plentifully distributed throughout the length and breadth of the State, but up to the present time copper deposits have only been worked to any extent in a very few districts. The principal sources of copper are Northampton, West Pilbara, Mount Margaret, and Phillips River. These have all been geologically surveyed in more or less detail, and all show a similarity in their associations, mineralogical characters, and structural relations. There are in addition a number of more or less isolated copper deposits which have been examined.

Deposits of lead ore have a wide distribution in Western Australia: lead has been raised from the Narlarla Hills, in the Kimberley Division; Roebourne, Uaroo and Weston's, in the North-West Division; and Geraldine, Narra Tarra, Northampton, Oakagee and Mundijong in the South-West. All of the important known deposits have been examined and surveyed in such detail as was possible and circumstances warranted.

Tin deposits extend over a wide area of country, covering some hundreds of square miles, and have been actively exploited at several different mining centres. There are, however, only two districts in the State from which any considerable output of tin has been reported, viz., Greenbushes in the South-West and Pilbara in the North-West. Tin, however, is known to occur in widely separated localities in the Kimberley Division, the Thomas River in the Gascoyne Valley, and at Poona and Coodardie on the Murchison Goldfield. Full and complete surveys,

with explanatory reports, have been made of all the important-known occurrences.

Iron ores of all grades have a wide distribution in Western Australia, but with one or two exceptions the area in which the exploitation of such deposits has been actively proved is limited, such being confined to localities where ore used as a flux in copper and lead smelting can be readily obtained. Iron mining, however, has been carried out at Wilgie Mia by the aborigines ever since the human race made its appearance in the State. Their operations were carried out with the aid of fire-hardened and sharpened wooden tools, and the product has supplied the requirements of the natives all over the central portion of Australia and Southern Queensland. The large iron deposits of the State extend over an area from Kimberley to Cape Leeuwin: some of them are probably equal in size to any other known deposits in the world. The most noteworthy of the high-grade deposits are those of Yampi Sound, Kimberley Division, which contain somewhere about 97,300,000 tons of very rich ore; Wilgie Mia, in which the ore in sight above the level of the plains amounts to 27,000,000 tons; Gabanintha, 21 miles east of Nannine, containing about 1,300,000 tons above the general surface level; Mount Gibson, near the south-west corner of the Yalgoo Goldfield, in which there are not less than 10,000,000 tons of ore highly adapted for steel manufacture by the acid process; and at Koolyanobbing, 28 miles north-east of Southern Cross, where there is a very large exploitable deposit of very high grade micaceous haematite. Surveys have been made of several of the above deposits whilst examinations have been made of many amongst the extremely large number of much lower grade deposits, many of which could, under suitable conditions, be readily concentrated to iron ores of a high grade.

The deposits of that group of ores of industrial importance in steel manufacture, though out of all proportion to the small quantities consumed, when compared with those previously mentioned, have also been the subject of investigation, *e.g.*, manganese, tungsten, molybdenum and antimony.

Deposits of manganese ore have been found occurring in many widely separated localities in the State, and some of them are of high grade. The manganese deposits, when viewed in the light of their geological relationship and mode of occurrence, have been found to fall into two main classes, *viz.*, those formed more or less contemporaneously with the enclosing rocks, and those formed by a process of concentration at a later date. Ores of the first class have been met with on the Ashburton, Yalgoo, and Phillips River fields, and Balladonia, whilst an extensive deposit of the latter type occurs in the Horseshoe Range, about 16 miles north-west from Peak Hill. Many of the banded iron ores in the State pass gradually into manganiferous iron ores or ferruginous manganese ores of which the important deposit near Mounts Stuart and Minnie on the Ashburton River may be regarded as typical. The extensive and valuable deposit of the second class previously referred to occurs at Horseshoe on the Peak Hill Goldfield. Two distinct ore bodies, about 60 chains apart, have been met with, each forming a small plateau with a gentle slope to the westward. The northern ore body contains about 190,200 tons and the southern 1,282,000 tons of good manganese ore, lying within 100 feet of the surface, where it

can be expeditiously mined. There are, in addition, large quantities of ferruginous manganese ores of somewhat lower grade than the best occurring on the plateaux.

The ores of tungsten, Wolfram and Scheelite, have been recorded as occurring in several widely separated localities, though they have only been worked at a few places. Tungsten ores are commonly met with in the gold reefs, though as yet little or no attempt has been made to save them; they also occur in the associated alluvial deposits.

Deposits of molybdenum ore are widely distributed in Western Australia, though usually in small quantities, generally in close association with granitic rocks. There has not as yet been much commercial production of molybdenum ore, though some development work has been done on the deposits at Mulgine, near Warriedar on the Yalgoo Goldfield. From such surveys and investigations as have been made the deposits seem capable of producing a fair tonnage of ore containing about 1 per cent. of molybdenite.

Antimony ores were first discovered in Western Australia at Mallina, in the West Pilbara Goldfield; they are, however, known from other localities in the State. The production of antimony in Western Australia has not been very great.

Field and laboratory investigations of the raw materials required in the ceramic and glass-making industries have been undertaken.

Surveys and other collateral observations into such of the clays of those portions of the South-West and Central Divisions as were within reasonable reach of manufacturing centres have been made, and a large amount of valuable data regarding them obtained. The clays have been proved to have a wide geological distribution, ranging from the Pre-Cambrian rocks to the most recent residual and alluvial deposits. The State is abundantly supplied with every type of clay, and of other minerals, such as felspar, which form the basis of the most varied kinds of material used in the clay-making industries. The laboratory investigations resulted in much help being given to those engaged in the establishment of the roofing-tile industry, in improving the locally-made refractories and sanitary ware, and in laying the foundations of a local white-ware industry.

Sands suitable for the manufacture of glass for ordinary bottles and windows has been found by the officers of the Survey to be abundant in the Metropolitan district, whilst sand suitable for ordinary plate glass is not uncommon, and a fair quantity of sand suitable for making mirror plate and fine table glass has been located.

A good deal of work has been done in connection with the utilisation of local ochres and related pigments, both in the way of chemical and mechanical analyses, as well as in the field. The pure white kaolin required has been obtained from the washed kaolin in the Darling Range, the sedimentary clays from various localities in the South-West Division, and many of the fine-grained kaolinised rocks of the Eastern Goldfields. Red oxide of suitable quality, red ochre, yellow ochre, sienna, and umber have all been located in different and widely separated localities. A paint and distemper factory has now been established in Perth, and this, coupled with a demand for ochres by manufacturers in the Eastern States, have maintained the interest in the

search for suitable earths and soft rocks for the production of red and yellow pigments.

The lateritic deposits of the State, which result from the decomposition and consolidation of rocks *in situ*, consist largely of hydrated oxide of iron and alumina, producing on the one hand deposits of iron ore, and on the other, bauxite. In view of the fact that much of the clayey portion of the laterite is made up of bauxite (hydrate of alumina) considerable attention has been directed to the possibility of utilising some as an ore of aluminium. The most extensive aluminous deposit so far known is situated in close proximity to the railway lines connecting with the Metropolis. Detailed surveys have been made of the laterites extending from Bickley Brook to Mundaring, and a certain amount of sampling of the deposit has been carried out. So far as such investigations have at present gone, it appears that the laterites of the Darling Range in the vicinity of the Metropolis, situated on the highest ground, are richer in soluble alumina than those at the lower levels. The existence of considerable quantities of high-grade laterite within easy access of those railway lines which cross the Darling Range has been demonstrated.

There are several other deposits containing minerals of industrial value in addition to those previously mentioned which have been examined.

Salt is obtained from certain depressions in the calcareous sandstones of the coast which are filled to a shallow depth in winter with salt water. Lakes of this type dry up completely in summer leaving a layer of salt two or three inches thick, which is collected and afterwards refined by recrystallisation. The salt from this source is either consumed locally or is exported both as a fine and crude product. The four localities where salt collecting has been carried on are at Rottnest Island, off Fremantle; Middle Island, near Esperance; Yarra Yarra Lakes, near Three Springs; and Lynton, near Port Gregory. There is a very large number of salt and brine lakes in many districts of the State, which may ultimately be utilised as sources of salt.

Gypsum is widely distributed throughout the State in tertiary and late tertiary deposits associated chiefly with the salt lakes of the arid regions of the interior to the south of the tropics. Such of these deposits as have been examined occur as wind-blown dunes of powdery (flour) gypsum on the lee-side of salt pans and dry lakes, surface deposits of "seed gypsum" and beds of gypsum crystals in silts of old lacustrine deposits. Large tonnages of gypsum are obtainable from many of the lacustrine deposits.

The occurrence of phosphatic fertilisers has such an important bearing on the future of one of the State's prime industries, agriculture, that considerable attention has been given to investigations, both in the field and the laboratory, into the phosphate deposits. The known phosphate deposits of Western Australia are distributed principally in the islands along the coast, and in a portion of the Coastal Plain between Dongarra and Perth. Guano digging on the islands has been a large and profitable industry in the past, and there is no reason why it should not again revive; though in the past this phase of the mining industry has not been of much benefit to the State, as both the fertiliser itself and the money for which it was sold have for the most part gone abroad. In the Coastal Plain near Dandaragan, about 22 miles to the west of Moora, there occurs a series of low hills,

made up of (a) weathered rocks with 0.54 to 2.10 per cent. of phosphoric acid, (b) ferruginous sandstones, containing iron phosphates (dudrenite and vivianite) carrying from 7 to 15 parts per hundred of phosphoric acid, and (c) a "bone bed" containing fossil bones and coprolites with from 15 to 39 per cent. of phosphoric acid. The phosphate horizon, in the Cretaceous rocks, has been proved to extend over about 22 miles. In addition to these rock phosphates there are numerous cave deposits containing evacuations of wallabies, bats and birds, some of which have been proved to be of high grade. The comparatively recent coastal limestone country, which extends from Geraldton southward along the coast as far as Albany, contains numerous caves in which varying quantities of guano occur, and which yet remain to be worked.

Mica of commercial grade has been located in several localities in the State, but no mining of any consequence has been carried out, and up to the present not very much of the mineral has been raised. The exploitable grades occur in dykes and veins of pegmatitic granite, which are at times remarkable for the coarseness of their grain.

Corundum, the chief mineral in the natural abrasives, has been found as an original constituent of the acid igneous rocks on the Yalgoo Goldfield; in a pegmatite vein at Ubini, between Southern Cross and Coolgardie. The impure variety, emery, has been found at the Richenda River, Kimberley Division, as well as the neighbourhood of Roebourne in the North-West Division.

Graphite deposits of commercial grade have been discovered in the ancient metamorphic rocks over a wide extent of country, and a fair amount of mining carried out.

Magnesite deposits are known to occur in many parts of the State as veins in and associated with serpentine and allied basic rocks. The only deposit of magnesite which has been commercially worked is that near Bulong in the North-East Coolgardie Goldfield; the mineral is of a high degree of purity, and a considerable tonnage has been raised.

Chrysotile asbestos of high grade has a wide distribution in the State. Some very high grade material occurs at a number of localities in those serpentine rocks which lie between Nullagine and Roebourne, over a distance of 200 miles. Some of the asbestos veins are traceable for considerable distances and contain a high percentage of mineral.

Barytes occurs at many places in Western Australia as veins, sometimes of fair size; the chief locality for barytes is at Cranbrook in the South-West Division, where veins of deep-seated origin, made up of high grade ore, occur in the quartzites of the Stirling Range formation.

The rare minerals, monazite, gadolinite, euxenite, fergusonite, tantalite, pilbarite, etc., occur as accessory constituents in those pegmatite dykes which have a wide distribution in many parts of the granitic areas of the State. Over 80 tons of high grade tantalite have been raised from Wodgina. Uranium minerals have been met with in the Wodgina pegmatites in Pilbara.

Potash-bearing minerals have a wide distribution. The presence of glauconite, the hydrous silicate of iron and potash, has been proved in the mesozoic marine sediments in widely separated localities. A bed of glauconite sand, over 30 feet thick, occurs on the surface at Gingin, lying beneath a thin stratum

of chalk, and what is believed to be the same horizon was met with in a bore put down in the metropolitan area for artesian water, at a depth of 450 feet. The green sand proved to be 20 feet in thickness, and contained about 16 per cent. of glauconite. Alunite (sulphate of aluminium and potassium) and jarosite (sulphate of iron and potassium) have been found in widely separated localities in what appear to be sufficient quantities to warrant exploitation. Alunite occurs at Kanowna in veins traversing the older kaolinised sedimentary rocks, from which over 500 tons of the mineral have been raised. The Nullagine formation as developed in the Pilbara Goldfield has recently been found to contain both jarosite and alunite in considerable quantity. Considerable attention has also been paid to the possibility of the occurrence of potash deposits lying at a depth under the saline lakes of the Central Division.

Coals of different geological ages are known in the State, though the mineral has been mined to any extent, in rocks of permo-carboniferous age, in only one district, the Collie Coalfield, from which over 5,000,000 tons have been raised. Detailed surveys have been made of the field and a good deal of boring carried out, whilst an extension of the Collie field has been found at Wilga. Coal seams of a lower grade than those of Collie have been found in the Irwin River valley, which has been carefully surveyed and sampled, and the information so obtained has been supplemented by boring operations, resulting in the discovery of some fairly thick seams, of irregular habit. Search has also been made in the extensive areas of the North-West and Kimberley Divisions occupied by the carboniferous and permo-carboniferous formations, but they have unfortunately proved destitute of coal. The fact that a large proportion of the central parts of the State was high land and covered with an ice-sheet during this geological period furnishes an explanation as to why there are no coal deposits, for there was neither sufficient vegetable growth to produce it, nor were the geological conditions favourable for its accumulation and preservation.

Great interest has been taken in Western Australia in that world-wide search for petroleum, a mineral which has now become essential to industry, agriculture, commerce, and even the pleasures of life. Chief interest has centred in the Kimberley Division. At Mount Wynne, in West Kimberley, the gas which bubbles up freely in a hot spring has been found to contain hydrocarbons. Bores put down to a depth of 90 feet in certain rocks believed to be of carboniferous age on Price's Creek in the Rough Ranges about 100 miles south-east of Mount Wynne have yielded positive indications of free petroleum; from a second bore in the same ranges a sample of clay containing a small percentage of free oil was met with, whilst traces of mineral oil have been detected in a seepage. In East Kimberley a black bitumen, the residue left by evaporation and weathering of an asphaltic oil, has been found occurring in a weathered basalt at two localities five miles apart, thus indicating the former circulation of petroleum in the district.

The introduction of artesian wells into the more or less arid portions of the maritime districts of the State, which suffer from irregular and scanty rainfall, is perhaps one of the most noteworthy of the applications of the utilisation of that economic mineral, artesian water. This has played an important part, and is destined to play a still greater part, in the

development of the districts, which development finds its expression in an enhanced stock-carrying capacity, with a further reflection in the increased woolclip.

MINERALOGY AND PETROLOGY.

Great advances have been made in our knowledge of the minerals of Western Australia by Dr. E. S. Simpson, a good deal of which will be found embodied in the official reports on the deposits occurring in the gold and mineral fields. In addition a series of monographic accounts on what may be called regional mineralogy has been prepared by Dr. Simpson. This comprises—

Detailed Mineralogy of Kalgoorlie and Boulder, with special reference to the ore deposits. Bulletin 42.

The Minerals of the Meekatharra District. Bulletin 68.

The Minerals of Westonia. Bulletin 71.

Notes on the Minerals of Goongarrie and Comet Vale. Bulletin 79.

The Minerals of the Ashburton and Gascoyne Valleys. Bulletin 85 (not yet printed).

The Minerals of the Kimberley Division (not yet printed).

In addition to the above, several important contributions to the mineralogical side of geology have been made by Dr. Simpson in the series of Miscellaneous Reports, chiefly on applied geology:—

A Meteorite from the Nuleri District. Bulletin 26.

Radium-Uranium ores from Wodgina. Bulletin 48.

Monazite at Cooglegong and Moolyella. Bulletin 48.

Coals from the Collie Field. Bulletin 48.

Two New Meteorites from Western Australia. Bulletin 48.

A Peculiar Biotite (Anomite) from Ubini. Bulletin 48.

The Rare Metals and their distribution in Western Australia. Bulletin 59.

Some Western Australian Meteorites. Bulletin 59.

On Chloritoid and its Congeners, with special reference to the Chloritoid at Yampi Sound. Bulletin 62.

The Chemical and Physical properties of some of the Donnybrook Building Stones. Bulletin 74.

A further important contribution to geochemistry has been made by Dr. Simpson in Bulletin 67, which is exclusively devoted to a tabulation of the numerous analysis of rocks, meteorites, and natural waters made in the Geological Survey Laboratory since its inception in 1897; whilst an article on "The Progress of Mineralogical Research in Western Australia, 1897-1922" is in course of preparation by Dr. Simpson.

Considerable progress has been made in the domain of the petrological side of geology. One of the most noteworthy contributions to the petrography of the fundamental rocks of the Gascoyne and West Pilbara Goldfields was made by Mr. J. A. Thomson, B.A., M.Sc., F.G.S., in Bulletin 33.

Since the appointment of a petrologist to the staff in 1911 the knowledge gained of the petrology of the fundamental and other rocks of Western Australia has been materially increased, and much of which is

embodied in the bulletins descriptive of the goldfields and other districts. Amongst the more important contributions may be mentioned:—

Petrographical description of some rocks from the vicinity of Lake Giles. Bulletin 45.

Petrological notes on some specimens from Kanowna. Bulletin 47.

A special series of petrographical reports on the important goldfields has been prepared, *e.g.*—

Petrology of Southern Cross, Yilgarn Goldfield. Bulletin 49.

Petrology of Westonia. Bulletin 71.

Petrological Observations on the Rocks from Ora Banda, Broad Arrow Goldfield. Bulletin 54.

Petrography of the country between Kalgoorlie and Coolgardie. Bulletin 56.

Petrology of part of the northernmost portion of the Kalgoorlie Field. Bulletin 51.

Petrology of Meekatharra, Murchison Goldfield. Bulletin 68.

Petrological Notes on some Rocks from the Yerilla District, North Coolgardie Goldfield. Bulletin 73.

General Account of the Petrology of the Country between Laverton and the South Australian Border, and Correlation of the Rocks with those from other Localities in Central Australia and from the Western Australian Goldfields. Bulletin 75.

The Rocks of Comet Vale and Goongarrie, North Coolgardie Goldfield. Bulletin 79.

Petrology of the North-West, Central, and Eastern Divisions. Bulletin 83.

PALÆONTOLOGY.

Palæontological researches are of such importance in geological work in determining the relative age, succession, and correlation of strata that investigations into the fauna and flora of formations constitute an important factor in the early attempts in the development of the mineral and allied resources of regions in which the stratigraphy has been but imperfectly worked out. Despite the fact that there has been no palæontologist, as such, on the staff of the Survey, a good deal of valuable work has been accomplished for the Department by the late Mr. R. Etheridge, jun., Director of the Australian Museum; Mr. F. Chapman, of the National Museum, Melbourne; Mr. W. Howchin, of the University of Adelaide; Mr. E. A. Newell Arber, of the University of Cambridge; Dr. Geo. J. Hinde, F.R.S., Dr. Hy. Woodward, F.R.S., Mr. Rex W. Bretnall, of the Australian Museum; and Mr. L. Glauert, of the Western Australian Museum, formerly field geologist on the staff of the Geological Survey.

Cambrian.—Mr. Etheridge, jun., in Bulletin 72, gave some particulars regarding the obscure organism, *Girvanella*, which had been found in the Salterella Limestone of the Ord River in the Kimberley Division.

Devonian.—Definite proof of the occurrence of a Devonian fauna in the rocks of the Napier Range in the Kimberley Division is given by Dr. Hy. Woodward in Report 7, Bulletin 36.

Carboniferous.—Valuable additions to our knowledge of fossil types have been made by Mr. R. Etheridge as the result of a close study of the col-

lections from the Gascoyne River Valley made by Messrs. A. Gibb Maitland and H. W. B. Talbot. The results of these investigations, together with the illustrations by Messrs. F. R. Leggatt and E. R. Waite are set out *in extenso* in Bulletin 10. Further contributions to our knowledge of the fauna of the Carboniferous formation were made by Mr. Etheridge as the result of researches into the fossils collected by Mr. C. F. V. Jackson from the Irwin River Beds, which are fully set out in Bulletin 27. Important additions to our knowledge of the Carboniferous Polyzoa of the North-West and Kimberley Divisions have resulted from the work of Mr. Rex W. Bretnall, of the Australian Museum, which it is contemplated publishing in the next bulletin of the palæontological series.

Permo-Carboniferous.—Descriptions of a series of plant remains from the beds of the Collie Coalfield, together with that of an interesting series of foraminifera occurring in the sandstones interbedded with the Coal seams have been given by Mr. F. Chapman in Report II. of Bulletin 27.

Jurassic.—Valuable additions have been made to our knowledge of the Jurassic flora of Western Australia by Mr. Newell Arber, of the Palæobotanical Department of the University of Cambridge in Bulletin 36. Mr. R. Etheridge, jun., examined the collection of Oolitic fossils from the marine beds of the Greenough River district, and a considerable number of new species has been discovered, of which descriptions and drawings are given in Report III. in Bulletin 36.

Cretaceous.—A considerable amount of work has been done by Messrs. Etheridge, Howchin, and Chapman in connection with the organic remains of the rocks of the Cretaceous System, the fauna of which is very rich and contains much that is important and new. The results of the researches of these gentlemen are set out *in extenso* in Bulletins 27, 55, and 72, and have been summarised on pages 45 to 47 of the Summary of the Geology of Western Australia, which forms Chapter I. of the Mining Handbook.

Tertiary (and Post-Tertiary).—An important addition to our knowledge has been made by Dr. Geo. J. Hinde, F.R.S., on the marine sponge rock of Norseman on the Dundas Goldfield, which forms part of the Plantagenet Beds, outliers of which have been found on the shores of Lakes Cowan and Dundas.

Pleistocene and Recent.—An extinct genus of the Macropodidae (*Sthenurus occidentalis*) has been found in the Mammoth Cave in the Coastal Limestone Series of the Margaret River in the South-West Division, and has been described by Mr. L. Glauert in Bulletin 36.

General.—In addition to the previously mentioned palæontological investigations, there are still large collections of fossils which yet await examination and description by trained palæontologists. It is hoped to have this work, which promises to yield important results, carried out at an early date.

PHYSIOGRAPHY.

An outline of the Physiographical Geology of Western Australia, forming one of the series of Bulletins designed to include some of the more specialised sides of Western Australian geology, was prepared by Mr. J. T. Jutson, B.Sc., and forms Bulletin 61, which will for many years to come remain

a standard work on the subject. This officer also prepared a special chapter on the Physiography of Western Australia in its relation to Prospecting, Mining, and certain aspects of water supply, which forms Chapter III. of the Mining Handbook. A good deal of valuable physiographical work has been accomplished by Mr. H. W. B. Talbot in the topographical mapping which he has carried out concurrently with his geological surveys in the somewhat inaccessible and arid regions of the State, and which form the foundation upon which the work of future investigators must be based. Such topographical maps do a good deal to promote an exact knowledge of the country, and are in this way, apart from their many multifarious economic uses, capable of being made of considerable educational value.

GENERAL.

It being generally recognised that the acquisition of geological knowledge must in all cases precede the application of such knowledge, it follows that, in order to apply it, the facts must first be collected, and when collected they must be prepared for use. The real value attached to such knowledge depends very largely upon the ease with which it can be obtained when required. The results of such geological investigations as have been carried out since 1896 have been made available to the public in four distinct forms: Annual Reports, Bulletins, Memoirs and Maps. As the offices of the Geological Survey are naturally the centre for authentic reference to the applied side of geology, the need for a general index to the whole of the geological and cognate reports was felt, and in 1916 a General Consolidated Index of all the reports issued by the Government between the years 1870 and 1910 was prepared and published as Bulletin No. 60, as one of the literary contributions to the methods by which the exploitation of the mineral resources of the State could be legitimately fostered. This was supplemented in 1919 by the preparation and publication of "finding lists" to further facilitate reference, viz.—

- (a) Geological Reports arranged under Mining Centres and other localities, with the references to the publications in which they may be found.
- (b) Reports on Metals and Minerals arranged under localities, with the reference to the publications in which they may be found.
- (c) Geological Maps arranged under Mining Centre and individual locality, with the reference to the publication in which they may be found.
- (d) Geological Maps arranged under Goldfields, Mining Districts, etc., with the reference to the publications in which they may be found.

In addition to these the following Maps have been specially prepared:—

- (e) Map of Western Australia showing the chief localities at which Useful Minerals and Artesian Wells occur, together with the boundaries of the Goldfields and other Mining Districts.
- (f) Map of Western Australia showing the four miles per inch series of Geological Sketch Maps and other Geological Maps issued since 1896.

SOME PROBLEMS AWAITING SOLUTION.

It has been deemed advisable to briefly indicate some of the problems in connection with the geology of the State, which in the public interest call for solution.

Despite the fact that a good deal has already been accomplished, there is still much that requires elucidation in connection with the geology and mineral resources of the State, viz.—

Much mapping in those portions of the Pre-Cambrian Plateau, for the purpose of the production of geological maps of known mineral areas, the reconnaissance survey of lesser known geological areas, and investigation in more or less detail of the stratigraphy and structural geology of the associated bedded metamorphic rocks, with the view to the discovery of fresh mineral fields. The map of Western Australia showing the four miles to the inch series of Geological Sketch Maps and other maps issued since 1896 (published with the Annual Report for 1920) indicates in a graphic manner how much yet remains to be accomplished in this direction.

A much more thorough investigation into the stratigraphy of the large area of mesozoic and tertiary rocks which are so highly developed in the maritime districts of the State, and which are of considerable economic value.

A close and detailed survey of those areas in which the possible extension of the Collie and the Wilga Coalfields may be looked for.

Much more field work, supplemented by laboratory investigations in mineral technology, with the view to aiding in the development of the Salt, Gypsum, Limestone, Asbestos, Mica, Phosphates, and other materials utilised in the arts and industries, all of which have a wide distribution in the State.

A more thorough investigation than has yet been found possible into those multifarious petrological problems which have such an intimate bearing upon the genesis of the ore deposits of the State, and the conditions which govern their deposition and to a certain degree control the distribution, extent and value of the mineral deposits.

More palæontological researches into the fossiliferous areas of the State.

Researches into the topographical features of the State, inaugurated with the publication of the "Outlines of the Physiographical Geology of the State," which was published in Bulletin form during the year 1914, and the relationship between the major topographical features and the geological structure more closely established, as the results are capable of being turned to account in very many economic directions.

Detailed investigations into the structure, etc., of the artesian water areas of the State, if the maximum efficiency, combined with an intelligent and equitable policy of conservation is to be maintained.

**PRINCIPAL RESULTS OF THE YEAR'S
FIELD OPERATIONS.**

**1.—THE PROGRESS OF BORING FOR COAL
ON THE IRWIN RIVER AND SURROUND-
ING DISTRICT, AND ITS RESULTS.**

(A. Gibb Maitland.)

During the last quarter of a century a good deal of boring has been carried out in the district in which the Irwin River Coalfield is situated, with, *inter alia*, the object of defining the area covered by the Coal Measures, their probable extension beneath the Mesozoic and Newer Rocks, and testing the seams in the coal-bearing belt out-cropping in the north and south branches of the Irwin River.

The following table gives a list of the various bores and other cognate particulars:—

	Depth in feet.	Remarks.
Dongarra	2,111	Not bottomed
Yardarino	1,607	Not bottomed
Mingenew No. 2 ..	736	Not bottomed
Geraldton (Town) ..	420	Bottomed, Granite
Geraldton (Racecourse)	1,531	Not bottomed
Eradu (deep bore) ..	736	Not bottomed
Musk's	1,006	Not bottomed
Mullewa (47¼ M.) ..	1,418	Not bottomed
Kockatea (Tenindewa) Gully, 16 shallow bores Max.	300	Granite at 41-54ft. in two holes.
Irwin River No. 1 (P.W.D.)	674	6 thin coal seams met with
Irwin River No. 2 (P.W.D.)	723	7 coal seams met with.

Dongarra Bore.—The bore at Dongarra was put down with the dual object of testing the possible seaward continuation of the Irwin River measures and the likelihood of their containing coal seams, as well as to indicate whether any artesian water-bearing horizons were to be found in the strata. After having reached a depth of 2,111 feet below the surface, operations ceased owing to the capabilities of the drilling plant having been exhausted without the important objects of the bore having been attained and the base of the formation unequivocally reached. A thin coal seam, four inches in thickness, was met with at a depth of 265 feet in a bed of sandstone 45 feet thick. This coal, which proved to be of unworkable thickness, had the following composition:—

Moisture	13.13	per cent.
Volatile matter ..	29.47	"
Fixed carbon	49.40	"
Ash	8.00	"
	100.00	

Yardarino Bore.—The Dongarra Bore having failed to penetrate the Coal Measures and the main object of the boring operations being unaccomplished, it was originally recommended that a bore should be put down at Strawberry, near the junction of the Lockier and the Irwin Rivers, but it was ultimately decided to bore at Yardarino. Operations were commenced and boring continued to a depth of 1,607 feet, when the loss of the tools in the bore hole necessitated operations being stopped, without any coal seams being met with, or apparently the Coal Measures being encountered.

Mingenew Bore.—Some years later a bore was put down by the Government alongside the railway line at Mingenev, and carried down to a vertical depth of 736 feet. The bore hole passed through somewhat incoherent sandy strata, and ended in a grey clay shale, containing undeterminable plant remains without encountering any coal seams.

Geraldton Town Bore.—A bore was put down in the railway yard at Geraldton to a depth of 420 feet, after passing through alternations of sandstone. A seam of coal 10 inches thick was met with at a depth of 129 feet, in addition to other thin coal partings in the beds beneath. Operations were discontinued on encountering granite at 420 feet.

Geraldton Racecourse Bore.—Another bore hole was put down at the Geraldton Racecourse to a vertical depth of 1,531 feet, the bore passing through sandstones and shales with occasional limestones, but no coal seams were met with, and bed rock was not reached.

Eradu Bores.—Boring operations were next carried out on the Greenough River where it is crossed by the Geraldton-Meekatharra Railway. Four hand bores were put down to depths varying from 121 feet 6 inches to 191 feet, and some very inferior brown coal was met with. A calyx bore was put down to a depth of 297 feet, and at 118 feet from the surface a six-foot seam of somewhat weathered coal was encountered. The bottom two feet of this seam had the following composition:—

Moisture	9.59	per cent.
Volatile hydrocarbons	40.28	"
Fixed carbon	37.97	"
Ash (white)	12.16	"
	100.00	

and a calorific value of 9900 B.T.U. This coal is superior to that in the Irwin River and equal to that of the lower grades of Collie coal. Since the area of available Crown lands near these shallow bores was limited, it was ultimately decided to put down a deeper bore about a mile distant. This bore, known as Hindley's, was carried down to a depth of 736 feet, when operations were suspended, no coal seams having been met with, and bed rock not reached.

Musk's Bore.—Another bore known as Musk's was put down at a point about two miles lower down the Greenough River near Eradoo Pool. This bore hole reached a depth of 1,006 feet, and penetrated the coal measures to a depth of 675 feet, but no seams of coal were encountered. The bottom 330 feet were carried down through solid grey shale, which formed part of the non-coal-carrying lower carboniferous strata.

Mullewa (47¼-Mile) Bore.—A bore hole was put down at the 47¼ miles post on the Geraldton-Cue railway line. Operations were carried on to a depth of 1,418 feet, when, owing to difficulties connected with the boring, the hole was abandoned. In this bore hole no seams were encountered and bed rock was not unequivocally reached, though the shales in the deeper portion of the ground appeared to resemble lithologically the beds of the non-coal-bearing Lower Carboniferous formation.

Kockatea (Tenindewa) Gully Bores.—Sixteen shallow bores, the deepest being about 300 feet, were put down along the course of Kockatea (Tenindewa) Gully. These bores were so planned that the whole area would be thoroughly tested. In one of the bores

sunk at a point a little distance to the west of the junction of Kockatea Creek with the Greenough River, a bed of black carbonaceous shale, 10 feet in thickness, was encountered at a depth of 120 feet. The bore hole was carried down to a depth of 298 feet, but no other indications of coal seams were met with. The results obtained by this series of bores demonstrated the presence of the coal measures, though no coal seams were met with in any of them.

It will thus be seen that a good deal of boring has been carried out by the State, having for its object the delimitation of the area occupied by the Coal Measures beneath the cover of Jurassic and more Recent Strata. Difficulties connected with the boring plants precluded operations being completely carried out; hence one of the purposes for which the boring was designed remains unfulfilled, and the information sought for by these means has not been obtained.

Subsequent to these operations boring was undertaken at the expense of the Treasury in that portion of the upper reaches of the Irwin River valley occupied by the Coal Measures. The boring in this area was of necessity somewhat restricted owing to the fact that by far the larger portion of the possible coal-bearing lands in the district was held by the Midland Railway Company (under a title which reserved to that corporation all mines and minerals whatsoever, and the right to at all times prospect and mine for the same), thus necessitating very careful consideration being given to the general interests of the State rather than to those of a private corporation.

In the south branch of the Irwin River three shallow shafts were sunk by a private syndicate, and in one of the shafts a seam of coal was met with at a depth of 42 feet. An analysis of a sample of this gave the following result:—

Moisture	..	..	9.48	per cent.
Volatile Hydrocarbon	..	..	32.59	"
Fixed Carbon	..	..	49.17	"
Ash	..	..	8.76	"
			<u>100.00</u>	"

The Calorific value of this proved to be B.T.U. 10494, which was the highest recorded from the field, and attributable in part to the low percentage of ash and also to the thorough air drying to which the sample had been exposed prior to its being received at the Geological Survey laboratory for analysis. If any large area of coal of this grade and of workable thickness existed on the field, then the possibility of its exclusive use on the Murchison Railway system would become a matter of serious consideration by the Government, and would involve the construction of a branch line to either the Wongan Hills or the Geraldton-Cue railway systems.

Systematic boring operations were therefore undertaken in the south branch of the Irwin River at sites which had been fixed by a geologist in the field.

No. 1 P.W.D. Bore, South Branch, Irwin River.

No. 1 P.W.D. Bore was carried down to a depth of about 674 feet and proved the existence of six thin seams of coal at the following depths:—

Depth. from Surface.		Thickness.	
feet.		ft.	in.
342	.. ..	1	0
354	.. ..	1	0
357	.. ..	1	6
410	.. ..	1	0
457	.. ..	1	0
460	.. ..	1	0

None of the coal seams proved to be of a workable thickness, and therefore of no value whatever. The operations demonstrated the patchy nature of the seams and confirmed the results obtained by previous shallow boring and workings carried out both privately and departmentally.

No. 2 P.W.D. Bore, South Branch Irwin River.

No. 2 Bore was put down about a mile to the south of No. 1, close to the river, and continued to a depth of 723 feet. It proved the existence of coal seams at the following depths:—

Depth from Surface.		Thickness.	
ft.	in.	ft.	in.
451	6	..	.. 4 2
460	0	..	.. 1 6
525	0	..	.. 12 0
541	0	..	.. 2 0
557	0	..	.. 2 0
564	0	..	.. 1 0
591	0	..	.. 0 9

Careful analyses were made in the Geological Survey Laboratory of the more important of these seams. The 4ft. 2in. coal seam is a firm hydrous bituminous coal similar to the older Collie seams, but its high ash and moisture content makes it of little or no value for any industrial purpose. An analysis of it gave the following results:—

	Top.	Centre.	Bottom.
	Per cent.	Per cent.	Per cent.
Moisture	.. 22.71	23.16	24.86
Volatile hydrocarbons	.. 24.84	28.02	28.60
Fixed carbon	.. 27.96	29.85	26.06
Ash	.. 24.49	18.97	20.48
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>
Calorific Value B.T.U.	.. 6298	7312	6966

The 18in. seam at 460 feet is similar in its essential characteristics to the one previously mentioned. An analysis showed its composition to be:—

Moisture	..	..	26.52	per cent.
Volatile Hydrocarbons	..	..	26.40	"
Fixed Carbon	..	..	32.98	"
Ash	..	..	14.10	"
			<u>100.00</u>	"
Calorific Value B.T.U.	—7447.			

The thickness of the seam precludes the possibility of its being utilised for purposes for which it would be a possible fuel.

The 12ft. seam at 525 feet proved to be a non-caking hydrous bituminous coal with that characteristic woody appearance which is generally found associated with a high ash content. Analyses were made of the core, which, for this purpose, was divided into four equal sections of three feet each, and the following results obtained:—

	Top.	Upper Middle.	Lower Middle.	Bottom
	%	%	%	%
Moisture	.. 24.30	21.06	20.42	21.46
Volatile Hydrocarbons	.. 25.92	27.94	28.48	24.92
Fixed Carbon	.. 31.98	27.11	27.50	28.38
Ash	.. 17.80	23.89	23.60	25.24
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>
Calorific Value, B.T.U.	6886	5887	6121	5722
Do. after air drying for 5 days	.. 7778	6475	6678	6245
	%	%	%	%
Moisture	.. 14.49	13.16	13.18	14.28

The heating value of the coal as it would reach the consumer is represented by the figures given for the calorific value after air drying for several days.

The upper portion of the seam gave the highest calorific value, though it is about 20 per cent. below that of the average Collie coal. The high ash content is mainly responsible for the low calorific values. The ash appears to be evenly distributed through the coal, and on that account cannot be reduced by any process of washing. It might be possible to utilise the upper portion of the seam for household purposes and stationary boilers.

No analyses were made of any of the coal beneath the 12ft. seam.

While local variations in quality may be expected and are always to be found in coal seams, the geological features of the coal-bearing portion of the Irwin River Field give a fair index of the type of seams occurring, and there is no reason whatever to anticipate any great improvement in quality should the coals discovered in the boring operations be opened out and worked.

The geological structure of the field, being as it is so closely situated to the boundary (fault?) which marks the limits of the coal measures to the east, shows, as may be seen on the geological map (Plate I., Bulletin 38), that there is not any very large area of coal-bearing ground remaining in the hands of the Crown.

The coals of the Irwin River were deposited in shallow water under rapidly changing conditions, tending to result in the formation of very lenticular seams and beds of an erratic character. This feature may be observed in several places in the banks of the Irwin River and has been demonstrated by the boring which has been carried out.

The deep boring already completed on the eastern margin of the Irwin River coalfield has been sufficient to determine the question of the likelihood of the occurrence of coal seams of commercial quality in this portion of the district.

There is, however, a possibility that in the western portion of the area, somewhat remote from the margin of the basin in which the seams were deposited, any coal beds occurring would be freer from ash and of generally a somewhat higher quality. A bore hole put down to a sufficient depth somewhere in the vicinity of Urella Station (E. of N. 74) and Yara-gadee on the Irwin River on the western flank of the fold into which the Carboniferous and Permo-Carboniferous rocks have been thrown, should definitely settle the question for all time.

State boring with this purpose in view should *cæteris paribus*, bearing in mind the conditions, etc., regarding the tenure of the lands held by the Midland Railway, be carried out on any suitable areas not held by this corporation.

2.—NOTE ON THE PETROLEUM PROSPECTS ON THE FITZGERALD RIVER, SOUTH-WEST DIVISION.

(A. Gibb Maitland, with Appendices by R. C. Wilson, E. S. Simpson, R. A. Farquharson, and T. Blatchford.)

The desirability of ascertaining whether supplies of petroleum are to be found on the South Coast of Western Australia has resulted in attention being paid to the valley of the Fitzgerald River, where the existence of a coal seam and other sedimentary rocks was noted by Mr. J. S. Roe, the Surveyor-General in the year 1848.

A special and urgent visit was made by Mr. Field Geologist Wilson to the Fitzgerald River, and a few days devoted to a general examination of the more immediate vicinity of the site of the boring operations then being carried out by Messrs. Martin and Perkins, and in collecting samples for departmental investigation. The results of the analyses of the samples failed to disclose the presence of rock oil or any evidence of its existence in the locality.

A visit was paid to Bremer Bay by the Assistant Geologist, Mr. Blatchford, to investigate the claim put forward by Messrs. Martin and Perkins that free petroleum had been struck in a bore hole subsequent to the date of the field investigations by Mr. Wilson. The bore hole, which was 354 feet deep, has been carried down through weathered granite and allied rocks to a depth of 300 feet, and thence onward to 354 feet in granite or granitic gneiss. The observations made by Mr. Blatchford, which are detailed at length in his report on the cores from 120 to 354 feet, to which depth the bore had been carried since the visit of Mr. Wilson, show that there are no seepages of mineral oil in the bore hole in question, neither are there any signs of the occurrence of such seepages on the surface, nor on the water in the vicinity. Careful chemical analyses in the departmental laboratory showed no trace of rock oil nor any other known residuums in the samples collected by Mr. Blatchford between the depths of 120 feet and the bottom of the bore. The oil in the water coming from the bore hole proved to be the lubricant used in connection with the boring plant.

In order to correctly understand the structure and constitution of the Fitzgerald River valley, it has been deemed necessary to give a brief *aperçu* of its salient geological features, for the geologist has to deal primarily with the stratigraphical location of rock-oil.

The geology of the Fitzgerald River valley has been the subject of official reports since the year 1848. The first report was made by Mr. J. S. Roe, the Surveyor General, who described the occurrence of a coal seam, lying horizontally, and which had—

a very ligneous appearance, and, in some places, was in this respect not perfectly formed, the woody fibres being still hard and strong, encased in a crust of soft black coal. Bitumen was found in it from the size of a pea to that of a goose's egg.

In a paper communicated to the Geological Society of London in the year 1861, Mr. F. T. Gregory pointed out with reference to the occurrence of coal that—

On the Fitzgerald River a true seam has not yet been found; the known bed is horizontal, resting unconformably upon the edges of highly elevated carboniferous shales, and contains many distinct fragments of only semi-fossilised wood and pieces of infusible resin; it is in immediate contact with a band of greensand of several hundred feet in thickness, similar in appearance to the Upper Greensand in the Isle of Wight; but whether under or over lying I could not ascertain with certainty.*

In the year 1875 the Rev. Mr. Nicolay, who at that time acted as geological adviser to the Government, issued a report on the Geological Features of the country between Bremer Bay and the Fitzgerald River, South Coast, which was accompanied by a geological map. This gentleman had a shaft put down upon the coal seam described by Mr. J. S. Roe. The bed—

was found to be exactly five feet in thickness and of the same character throughout, but it neither presented the

*Journ. Geol. Soc., May 1861, p. 480.

thin laminae of coal nor the small masses of bitumen which Mr. Roe describes.

In the year 1890 Mr. H. P. Woodward visited the Fitzgerald River, and examined the old coal shafts and the material occurring in them. This officer reported that—

the coal when dry being found to consist of a brown peat-like substance full of quartz sand and fragments, which would not kindle alone, but when burnt in a fire gave a pungent bituminous smell.

The significant observation was made that—

further investigations proved that these shafts at a depth of about 10 feet encountered kaolinised slates, containing numerous quartz leaders, which formation was also exposed in the cliff-like banks of the river capped by sandstones containing casts of recent mollusca.

Mr. Woodward's report and maps showed that the valley of the Fitzgerald was carved out of ancient crystalline rocks, covered by a thin deposit of recent or tertiary rocks, forming flat-topped hills with steep cliff faces, in places about 100 to 155 feet in height. Further confirmation of and additions to, the geology of the ancient rocks of the Fitzgerald River was made by Mr. T. Blatchford in a report on the country between Hopetoun and the Fitzgerald River, published in the Annual Report of the Department of Mines in the year 1918, pages 72 and 73. The recent visit of Mr. Wilson added to the official information available, and though no systematic or detailed geological survey was made, his report appended, *inter alia*, points out the highly inclined nature and varying strike of the pre-tertiary rocks.

The geological observations to which brief reference has already been made have an important bearing upon the possibility of the occurrence of petroleum in the Fitzgerald River. Reference has been made in an earlier paragraph to the occurrence of what Mr. Roe originally described as bitumen occurring in the coal seam originally noticed by him. In 1884 Mr. Samuel Dixon submitted to the Royal Society of South Australia a paper entitled "Notes on the supposed Coalbeds of the Fitzgerald River." Mr. Dixon, who had specially visited the Fitzgerald River—

thought some connection might exist between the known occurrence of the bitumen and the reported beds of coal, but, unfortunately for the theory and myself too, the supposed coal was nothing but a few very thin beds of brown lignite, more or less mixed with quartz pebbles and with fragments of the gum of the grass tree, and portions of the seed vessels and leaves of eucalyptus. . .

Mr. Wilson devoted special attention to the occurrence of these so-called oil kernels occurring in the lignite of the Fitzgerald River, in view of the bearing which such might have on the possible occurrence of crude petroleum in the district. Those referred to in Mr. Wilson's report were found in all sizes up to that of about a hen's egg. With better opportunities than were available at the time Mr. Dixon's observations were made, Dr. Simpson and the officers working under his direction have, as may be seen by a reference to his report on the results of the investigations carried out on the samples collected by Mr. Wilson, shown conclusively that the kernels in question are fossil resin of vegetable origin, and as such are no indication whatever of the occurrence of mineral oil.

Prior to the present boring operations it is reported that two private bores had been put down in the locality; one is said to be 216 and the other 397 feet deep. These are stated to have passed through two seams of lignite 16 and 18 feet in thickness. The site, however, of only one of the bores in question has been located on a plan and there is neither record nor samples available of the rocks pierced.

The bore in progress at the time Mr. Wilson visited the Fitzgerald River is shown to be situated practically within the area occupied by the older beds of the Fitzgerald River valley, whilst the material penetrated consists of material such as would be derived from the granites and allied rocks which form the portion of the watershed above the junction of the Susetta with the Fitzgerald.

There is no actual indication of the occurrence of petroleum and its derivatives in any member of the geological series exposed in the Fitzgerald River and its tributaries, and there is nothing in the known geological constitution of the river valley in question to lend encouragement to the belief that indigenous crude petroleum exists.

APPENDIX A.

THE FITZGERALD RIVER OIL DISTRICT.

By R. C. Wilson, B.Sc., B.E.

As instructed, I left Perth for the Fitzgerald River on Thursday, 11th August, and arrived at the site of the bore on Saturday, the 13th inst. From Broomehill the journey was done by motor, the route being along the old Ravensthorpe road as far as the rabbit-proof fence, down the fence to the 241 mile post, and thence along a bush track to Perkins' camp alongside the river.

Three days were spent in an examination of this locality. Particular attention was given to all the supposed indications of oil pointed out to me by Mr. Perkins, the prospector, and a Mr. Martin, who I understand is an analytical chemist and a director of the South-Western Oil Company. These gentlemen were also present when I took my samples, and were, I think, perfectly satisfied that they were fairly representative.

The following is a list of the samples which I handed to Dr. Simpson for examination, and for determination of existence or otherwise of mineral oil contents:—

No. 1. A sample of the supposed seepage at Jonacoonack Rock.

No. 2. A sample taken by Mr. Martin of the Jonacoonack rock near the supposed seepage.

No. 3. Two samples of core from the bore at depths of 32ft. and 45ft.

No. 4. Two samples of core from the bore at depths of 67ft. and 77ft.

No. 5. Two samples of core from the bore at depths of 90ft. and 99ft.

No. 6. Two samples of core from the bore at depths of 105ft. and 112ft.

No. 7. A sample of lignite from the river bed containing nodules of resin.

No. 8. A sample of sandstone from fissure, at White Mound. (See litho.)

No. 9. Another sample of the same sandstone.

No. 10. Some scum taken from river water used for boring operations.

Note.—Eight samples were taken from the bore consisting of pieces of actual core. In order to lessen the work in the laboratory one sample was made of the first two pieces of core, another of the second two, and so on.

Location and General Description of Samples.

The Supposed Seepage.—Jonacoonack Rock, where the supposed seepage occurs, is situated on the south side of the Fitzgerald River, about 12 miles from the coast. This rock forms a cliff along the edge of the river basin for a length of about 200 yards. It is a hard indeterminate rock containing much secondary silica, but in spite of its hardness it is very cavernous, and there is ample evidence that the caves in this rock have been the home of marsupials for many years.

In the rock crevices and on ledges a black substance occurs which is sometimes semi-fluid and sometimes quite hard. It is not unlike bitumen in appearance, but, unlike the petroleum derivative, it is barely soluble in water, and has been determined by Dr. Simpson as a mixture of earthy matter with marsupial excreta and the well-known "dung bitumen" which is the dried-up rain-water extract of marsupial excreta.

The Bore.—Reference to the sketch plan accompanying this report will show that the bore is situated between Jonaconack Rock and the river. Mr. Perkins informed me that he had obtained oil in some of the sandstone forming the bank of the river, and that the present site for the bore had been selected because it was between the outcrop of the oil-bearing sandstone and the oil seepage at Jonaconack, and might therefore reasonably be expected to cut the oil-bearing strata. His log of this bore was as follows:—

0ft.—16ft.: ordinary top soil.
16ft.—20ft.: blue clay.
20ft.—28ft.: drift sands.
28ft.—129ft.: oil sands gradually improving with depth.

Samples No. 3 to 6 inclusive were all taken from the lower supposed oil-bearing portion of this bore. Dr. Simpson shows them all to consist of sandy clay containing no trace of mineral oil.

The supposed Oil Kernels.—Further up the Fitzgerald River, near its junction with the Susetta River, a quantity of brown coal or lignite is met with, which heavy floods have strewn along the river bed. More than ordinary importance has been attached to this particular coal seam on account of the dark brown to black nodules which occur in it. These are found in all sizes up to about that of a hen's egg and vary considerably in shape, but are always more or less rounded. Mr. Perkins and I spent some little time collecting a good sample (No. 7) for determination. Mr. Martin stated emphatically that this was not a coal at all but a rich oil-bearing shale containing kernels of bitumen derived from petroleum.

After a most thorough and exhaustive examination of this supposed oil shale and bitumen kernels Dr. Simpson's conclusions are as follows:—

- (1) The matrix is a lignite or brown coal of the following composition:—

	Per cent.
Moisture	7.86
Volatile	54.04
Fixed carbon ..	21.39
Ash	16.71
	100.00

At a low red-heat tar oils can be distilled in measurable quantities from this brown coal as from all other similar coals.

- (2) There is no doubt whatever that the dark nodules or kernels in this brown coal are a fossil resin of vegetable origin because of their mode of occurrence, their composition, their transparency (in fine powder under the microscope), and their reaction to the Liebermann-Storch test. They are no indication of the existence of mineral oil in the vicinity.

An old shaft which I was informed passes through the coal seam was pointed out to me, but as it was full of water nothing could be seen. This locality is well described, however, by the late Mr. H. P. Woodward in a report dated the 29th March, 1911. The following passage from this report is instructive, not only in respect to the local deposit of lignite but also in regard to the main geological features of this district:—

File 976/11, p. 11. "In the year 1890 I was despatched by the Government to report on the deposits, being accompanied by Sergeant Birch, who had constituted one of the guards who escorted Capt. Roe. I discovered the old coal shafts in the bed of the Fitzgerald River, and collected samples from there, the coal when dry being found to consist of a brown peat-like substance full of quartz sand and fragments which would not kindle alone but when burnt in a fire gave a pungent bituminous smell. Further investigations proved that these shafts at a depth of 10 feet encountered kaolinised slates containing numerous quartz leaders, which formation was also exposed in the cliff-like banks of the river capped by sandstones containing the casts of recent mollusca.

"A more extensive examination of the district, in conjunction with more recent work done by myself between the Pallinup River and Phillips River and also that in the Phillips River Goldfield, reveal the fact that a comparatively thin deposit of recent or tertiary beds overlies archæan as crystalline rocks, and that at the

mouths of the rivers, which are often sand-barred, 'inlets' exist in which the peaty beds are found, one of which series, drained or elevated, occurs in the Fitzgerald River."

Samples No. 8 and No. 9 were collected by Mr. Perkins and myself from a fissure in a sandstone which forms the cap of a hill known as White Mound. Mr. Perkins informed me that he had previously tested some of this sandstone and had extracted oil from it.

Dr. Simpson has determined each of these samples as a yellow spicular sandstone (spongolite) of Miocene age, in which no trace of petroleum or any of its residues could be detected.

General Remarks.—An extensive view of the surrounding country was obtained from the top of a hill marked Waijecoolallup on the lithographs. The bore site was seen to be situated near the eastern margin of an extensive flat more or less surrounded by flat-topped hills separated from one another by intervening rivers and valleys. These hills appear to rise to approximately the same level—about 200 feet above the flat. A plan of this district prepared by the late Mr. H. P. Woodward indicates that the hills are capped with the younger sandstones of miocene or tertiary age resting unconformably upon older rocks which are exposed at the river banks. My observations supported this view. The younger sandstone at the summit of White Mound is full of sponge spicules.

The older rocks consist for the most part of argillaceous and micaceous sandstones and shales. They contain numerous quartz veins and, as will be noticed by the plan attached, show quite considerable undulations: the bedding planes sometimes vary in inclination from zero up to 40° from the horizontal in as many yards.

By its position the bore might reasonably be expected to be in the older beds, as these are dipping towards the bore where they are outcropping at the river bank. The core in the bore indicates that at this point the bedding is nearly horizontal.

Petrological Examination.—A few of the typical rock outcrops were examined by R. A. Farquharson, M.A., M.Sc., F.G.S., and his determinations are here submitted:

Notes on some samples from Bremer Range Oil Operations. From E. C. Wilson.

No. 1.—Rock forming capping of White Mound.—Spicular earth or spongolite, composed chiefly of sub-angular grains of quartz and much less commonly of felspar (in part microcline) and numerous linear and cross sections of sponge spicules.

No. 2.—Rock forming bank of Fitzgerald River near bore.—A fine-textured pinkish, somewhat finely banded rock. Composed almost entirely of very small more or less subangular granules of quartz, a little kaolin and apparently some minute grains of untwinned felspar. The rock is a very friable and soft freestone or sandstone.

No. 3.—Rock immediately overlying No. 2.—An indistinctly banded very fine textured somewhat brittle white rock. In section it is very similar in structure to No. 2, but in addition to the quartz granules it contains numerous small micaceous scales and minute kaolinic patches derived from felspar, though no distinct felspar grains were seen in the section, probably owing to their being obscured by the alteration products. The rock is a sedimentary formed from the debris of an acid rock.

No. 4.—Jonaconack Rock.—The large brownish-yellow specimen with the bat manure seepage. In section this is a rock with no typical structure. It is composed of strings of quartz obviously secondary, large grains or patches of quartz in part at least secondary, and patches of brownish or yellowish-stained fine kaolinic and micaceous scales. The rock is not a type rock but appears to be a silicified decomposition product of a rock that was probably acid, i.e., it appears to be a silicified cap to some rock mass.

No. 5.—Core from Bore.—Sections were made of the white so-called "oil-bearing sands" from the bore. These all proved to consist of patches of granular quartz, partly broken down plates of quartz, and patches of kaolinic material. So far as can be judged from the very decomposed specimens, they are kaolinised and partly disintegrated granitic material, probably a granitic wash. In any case they are not sands or sandstones."

It will be noted that the core of the bore appears to be composed of a granitic wash and cannot properly be termed sands or sandstone.

The presence of the sponge spicules in the sample from White Mound is also interesting.

Conclusion.—The results of the analyses of my samples, which it must be remembered were those most likely to contain oil, lead me to the inevitable conclusion that no petroleum or any evidence of its existence has been found in this locality, and that the methods for detecting oil as carried out by Mr. Martin and Mr. Perkins have proved to be unreliable.

I realise that this report will be most disappointing to Mr. Perkins, who after prospecting for 18 years was fully convinced that he had at last found oil. His boring operations are being carried out on good lines, and his whole equipment is most creditable. During my visit he did everything that he could to assist me.

I understand that Mr. Martin will shortly be visiting Perth, and I think that an opportunity should certainly be afforded him to extract mineral oil from my samples.

If he succeeds he will have furnished us with some valuable information, and if he fails he may be shown how he has come to be misled.

ADDENDUM "A."

REPORT ON SAMPLES COLLECTED BY MR. R. C. WILSON.

(E. S. SIMPSON, D.Sc., B.E., F.C.S.)

The whole of Mr. Wilson's samples from the Fitzgerald River oil prospecting area have now been examined and the results obtained are:—

L. 7956E. Mark. "No 1, Seepage, Jonacoonaack."

This is a black bituminous looking material, sticky, slightly fluid in places, and mixed with lumps of siliceous rock. A proximate analysis showed the presence of—

Soluble in water—

Organic matter	.. ..	35.1 per cent.
Mineral matter	.. ..	8.5 "

Insoluble in water—

Organic matter	.. ..	39.9 per cent.
Mineral matter	.. ..	16.5 "

The "organic matter soluble in water" comprised the whole of the bright black material and possessed the strong pungent odour which characterised the original sample. The "insoluble organic matter" consisted of loose fur, marsupial excreta, a little vegetable matter, and numerous small dead beetles. The insoluble mineral matter consisted of sand and dust: the soluble of phosphates of lime and other salts.

Both the aqueous solution and the insoluble residue were tested for petroleum.

The aqueous solution yielded no trace of petroleum or of its usual residues, asphalt and ozokerite, both of which are completely insoluble in water.

The insoluble matter yielded no oil, but a solid extract amounting to 0.066 per cent., of which 0.042 per cent. was soluble in alcohol and therefore unrelated to petroleum. The remaining 0.024 per cent. was a light yellow wax too heavy and too infusible for ozokerite.

This sample No. 1 is therefore a mixture of earthy matter with marsupial excreta and the well-known "dung bitumen," which is the dried up rain water extract of marsupial excreta. It is found all over the drier parts of Australia, and is easily recognised by its odour and solubility in water. It contains no trace of petroleum or of its common residuums.

1. 7954E. Mark. "No. 2 Secondary quartz, etc., Perkins' sample."

A yellow quartz rock devoid of any outward indication of petroleum.

Tests proved the absence of any petroleum or petroleum residue.

L. 7950E. Mark. "No. 3, Perkins' Bore, Jonacoonaack, 32ft. and 45ft."

A yellowish white sandy clay with no outward indication of petroleum. No trace of petroleum or petroleum residues could be detected in it.

L. 7951E. Mark. "No. 4, Perkins' Bore, 67ft. and 77ft."

Similar to No. 3 and yielded similar negative results.

L. 7952E. Mark. "No. 5, Perkins' Bore, 90ft. and 99ft."

White sandy clay. No trace of petroleum or petroleum residues.

L. 7953E. Mark. "No. 6, Perkins' Bore, 105ft. and 112ft."

Grayish white sandy clay. No trace of petroleum or petroleum residues.

L. 7957E. Mark. "No. 7, Nodules or kernels in coal shale, Fitzgerald River."

The sample consisted of a light brown to dark brown lignite with numerous rounded nodules of a hard brownish black material, and a few much smaller bright red nodules.

The matrix is a lignite or brown coal of the following composition:—

Moisture	.. ..	7.86 per cent.
Volatile	.. ..	54.04 "
Fixed carbon	.. ..	21.39 "
Ash	.. ..	16.71 "
		100.00

At a low red heat tar oils can be distilled in considerable quantity from this brown coal as from all other similar coals.

The small red nodules are very transparent, have a density of 1.10, and respond readily to the Liebermann-Storch reaction for resins. It is undoubtedly a fossil resin of vegetable origin.

The large dark brown nodules are transparent under the microscope in fine powder, and have a density of 1.16 to 1.19. They respond to the Liebermann-Storch reaction for resins. An analysis shows their composition to be:—

	Including ash.	Excluding ash.
	Per cent.	Per cent.
Carbon	66.50	68.89
Hydrogen	7.84	8.12
Sulphur	5.13	5.31
Oxygen	17.06	17.68
Ash	3.47	..
	100.00	100.00

If these figures are compared with those of previously described ozokerites, asphalts and resins, the following facts are clear:—

(1) Ozokerites contain from 84 to 86 per cent. of carbon and never more than 2 per cent. of oxygen, usually only traces. The nodules are certainly not ozokerite.

(2) Asphalts usually contain over 80 per cent. of carbon, and never less than 77 per cent., whilst the oxygen content is never over 2.2 per cent., and is usually under one per cent. The nodules are undoubtedly not asphalt of any kind.

(3) Fossil resins are plentiful in brown coals all the world over. They are essentially "oxygenated hydrocarbons" (*vide* Dana), and analyses of them show from 69 to 85 per cent. of carbon; 5 to 12 per cent. hydrogen, and 4 to 20 per cent. oxygen. Usually the sulphur in them is low, but two from Austria contain 4 and 5 per cent. of sulphur.

There is no doubt whatever that the dark nodules or kernels in this brown coal are a fossil resin of vegetable origin because of their mode of occurrence, their composition, their transparency, and their reaction to the Liebermann-Storch test. There are no indication of the existence of mineral oil in the vicinity.

L. 7958E. Mark. "No. 8, Oil sandstone, White Mount."

A yellow spicular sandstone (spongolite) of Miocene age with dark brown films.

This gives no reaction for petroleum or any of its known residues.

L. 7959E. Mark. "No. 9, Oil sandstone, White Mount."

Yellow spicular sandstone (spongolite) of Miocene age.

No trace of petroleum or any of its residues could be detected in this.

L. 7955E. Mark. "No. 10, River water at Perkins' Bore."

A clear water with a fair amount of vegetable *débris* floating in it, including a little resin.

No trace of petroleum, ozokerite or asphalt could be detected in this.

Summary.—In all ten of Mr. Wilson's samples from the Fitzgerald River no trace of petroleum was detected, nor any trace of ozokerite or asphalt such as form surface indications of the existence of oil seepages.

APPENDIX B.

ON THE ALLEGED OCCURRENCE OF MINERAL OIL AT THE FITZGERALD RIVER, MORE PARTICULARLY BETWEEN THE 120 AND 354 FEET LEVELS IN A PROSPECTING BORE NEAR JONACONUP HILL.

(By T. Blatchford, B.A.)

In accordance with oral instructions I have visited the Fitzgerald River and inspected the locality and more particularly the bore cores between the 120 and 354 feet levels. As the cores from the surface to 120 feet had already been sampled by Mr. Wilson, Field Geologist, this section was not re-sampled.

Geology.—In dealing with the geology of the Fitzgerald River basin it is unnecessary at this juncture to go into the question in more detail than has a distinct bearing on the occurrence of mineral oil.

The Fitzgerald River basin is a sunken area the underlying rocks in which, though not definitely classified owing to the absence of fossil remains, are from their structure probably of considerable geological age. The rocks have a general east and west strike, with a prevailing southerly dip. Overlying these tilted beds are much more recent hardened fossiliferous strata, undoubtedly of Tertiary age. It is only when these upper beds have been cut away by the rivers draining the higher granite tableland to the north that the older underlying rocks are exposed. A good section of the lower beds is exposed in the Fitzgerald River a little to the north of the bore. Here these beds consist of fairly soft fine-grained sandstones ranging in colour from white to a deep purple.

An interesting feature in the beds in this section is a slight flexuring which has given scope for conjecture as to what the true dip is. If this flexuring is viewed as a slight side compression of the beds the variation of the dips can readily be produced and the cause of the anticlinal structure be easily accounted for without suggesting faulting, etc. Unfortunately the folds run parallel and not at right angles to the dip, so that even if oil were present the folds would not form reservoirs, as might be the case if running parallel to the strike.

The only other surface rock in the vicinity of the bore worthy of notice is one forming the bluff known as Jonaconup. This bluff, which is cavernous, is a silicified rock containing secondary quartz in irregular masses and so closely resembles the siliceous laterites of the goldfields that there is little doubt its origin is the same, namely, the silicified surface debris of a granitic rock. There is no evidence in favour of the bluff itself being an intrusive rock.

From the bore all the recoverable cores had been carefully boxed by the foreman and the depths tabulated. Unfortunately the rocks pierced were so friable that over certain sections only scattered pieces of core were recoverable.

There is a considerable degree of uniformity in most of the core, and it must be considered as granitic debris, possibly partly sorted; but in the lower portions the gneissic structure is so apparent that there is little doubt that the bore is in true gneissic granite. As Mr. Farquharson has dealt at some length with this subject his full report has been attached.

Sampling.—Samples were taken of the bore core in sections from the 120ft. to 338ft. levels.

At Mr. Perkins' request a sample was taken of the sludge in the settling tank and the scum on a water-hole in the Fitzgerald adjacent to the bore.

A sample was also taken of the oil used on the boring plant and rods.

The results of the tests for oil in these samples are appended.

Oil Occurrences.—In dealing with the alleged oil occurrences at the Fitzgerald River it may be as well to

mention and discuss the points particularly stressed by Mr. Perkins. These were:—

1. That the oil floating on the settling tank for the water coming from the bore was an indication of underground mineral oil seepage.
2. That the black material found in Jonaconup Bluff was bitumen.
3. That the scum on the water-holes in the Fitzgerald contained mineral oil.
4. That the chemical methods for testing samples used by the department were at fault, and that by his method oil could be extracted where the recognised methods failed.

1. The oil floating on the settling tank.—When the plant was working there was no doubt that mineral oil could be seen floating on the tank and that at intervals fresh quantities of oil made their appearance. On inquiry as to what class of oil was being used for lubricating the boring rods and ball race immediately above the bore hole, Mr. Perkins first told me it was castor-oil they were using, then admitted that it was not true castor-oil but a substitute, and finally that it was a mineral oil which did not contain benzine. The point raised was that the natural oil they were searching for and had allegedly found being essentially benzine, it was of no consequence using a non-benzine-bearing oil of any kind for lubrication. The lubricating oil used is 62 per cent. mineral oil. After the rods had been drawn, the joints wiped, and boring restarted, oil was almost totally absent from the surface of the water in the settling tank. Any evidence that there might have been to prove the occurrence of seepage of mineral oil from oil sands cut in the bore was obviously nullified by the use of the mineral oil used in lubrication.

2. The alleged bitumen in Jonaconup Bluff is in my opinion the result of animal excreta. Similar deposits are common and are to be seen in granite break-away caves on the goldfields. There is no doubt in my own mind that the cause of it appearing in the small caves of Jonaconup is that a large deposit of excreta has been formed in a cave at the top of the bluff, now fallen in, and what is now causing the discussion comes from the water-soluble portions oozing through the cracks of the rock.

3. With regard to the scum on the water holes in the Fitzgerald River.—Mr. Perkins skimmed off a tinfal from the surface of a pool he himself chose. The report from the analyst states that this sample contains no trace of mineral oil.

4. Chemical method for testing samples for mineral oil.—Mr. Perkins pressed the point that the Department did not use the benzol sulphuric method for extracting mineral oil from samples submitted. Why the well-known methods by petroleum spirit, chloroform, etc., should be put on one side for benzol was not clear, except that the statement was made that benzol was less expensive. Incidentally the London quotes for rectified benzol are slightly higher than for other petroleum spirit or chloroform, and one of the large Perth firms could not quote me benzol at all. So far as Mr. Perkins is concerned I must say that the results obtained by him with the benzol method were most remarkable provided that the resultant oily aromatic liquid obtained was mineral oil, which I am not prepared for one moment to admit. In fact, so remarkable were they that it seems more probable that the quantities of supposed mineral oil obtained depend more on the quantity and quality of the chemicals used and the methods adopted than on the samples submitted for test.

Conclusions.—My conclusions are as follow:—

1. That there is no reliable evidence to show that mineral oil seepages occur in the bore.
2. That there is no evidence to show the occurrence of mineral oil seepage either at the surface or on the water in the vicinity.
3. That the oil pointed out to me as coming from the bore comes from the lubricating oil used on the boring rods and ball race of the boring machine.
4. That the so-called bitumen is animal excreta.
5. That the bore has been in either weathered granite or unclassified granitic material from the surface to 300 feet, and from 300 feet to 354 feet has undoubtedly passed through granitic rock *in situ*.

6. That the chemical method adopted by Mr. Perkins for testing samples for mineral oil, though probably effective in the hands of a first-class chemist, is risky in the hands of a novice, and that the results said to be obtained on the mine by this method have been erroneous, and therefore misleading.

ADDENDUM "A."

EXAMINATION OF THE BORE CORE FROM FITZGERALD RIVER.

(From Mr. T. Blatchford.)

(By R. A. Farquharson, M.A., M.Sc., F.G.S.)

For a previous report by Mr. Wilson, I examined some specimens of rock obtained by him from the vicinity of the bore, and also some material forming the bore core to a depth of 129 feet. The rock comprised:

Spicular earth.

A fine-textured somewhat banded pinkish sandstone.

A fine-textured indistinctly banded rather brittle white micaceous and kaolinic sediment, rather similar to the pinkish sandstone.

A brown highly silicified cherty rock, probably the result of the silicification of the decomposed surface of an underlying acid igneous rock.

The rock from the bore core consisted of loose, more or less incoherent whitish material composed of patches of granular quartz, partly broken-down, more or less angular plates of quartz, patches of kaolinic material, strings of micaceous scales, many more or less angular grains of quartz, some surrounded by kaolin, and in some sections minute grains and rods of tourmaline. In places large plates of quartz were in process of being broken down to a fine-textured mass of quartz plates that resembles the indistinctly banded white sediment mentioned above.

Down to 129 feet in the bore the material is fairly uniform in composition and structure. It apparently contains no chlorite and no carbonate. The constituents are granitic, but the structure is that of a detrital sediment, *i.e.*, a rock which has been derived from the debris of a granite or gneiss and which may be called a kaolinic and micaceous grit or granitic wash.

After Mr. Wilson's visit, the bore was continued to a depth of about 350 feet, and Mr. Blatchford was able to obtain samples of the material between 226 and 309 feet, and between 309 and 338 feet. The samples included:

(a) Material somewhat similar to that obtained down to 129 feet, but with a few noteworthy differences;

(b) A soft dark-green fissile slaty rock.

(a.) The former consists in part of a mass of granular quartz and kaolinic material as at 105 feet, but with a few green chloritic strings, and a considerable number of aggregates of a carbonate that, on being tested, proves to be siderite; in part, of much coarser material composed of large kaolinic aggregates and larger more or less completely broken-down plates of quartz, with an appreciable amount of granular siderite and large and small strings and patches of green chlorite. The material becomes coarser and more chloritic with increase in the depth of the bore. At first sight, the coarseness of the grain of the rock, the composition and the irregular platy form of the constituents suggest that the rock from 300 feet onwards is a decomposed somewhat sheared granite or gneiss. The presence in it, however, of a fair amount of siderite is hard to account for on any other view than that the rock is still detrital. Nevertheless, the presence of thick strings and patches of green chlorite in the granitic material tends strongly to show that the rock from 300 feet onwards is not a normal sediment, but that either it is formed by the debris of a decomposed and disintegrated sheared or gneissic type or that it is very near the bed-rocks, which, to judge from what is known about the rocks in the neighbourhood of Bremer Bay and elsewhere in the country, are probably themselves gneissic.

(b.) The soft dark-green fissile rock has some of the external characters of a shale, but microscopic examination proves beyond doubt that the rock is not a shale at all, but an extremely sheared chloritic schist, *i.e.*, a member of the metamorphic series. This rock is either

a fragment of the country rock in the detrital granitic material or it is part of the country or bed-rock.

The Rocks in Relation to the Occurrence of Oil.—So far as is known, the rocks having any relation to the alleged occurrence of oil are:—

(a) A series of fine-banded sandstones (the pink and the white rocks) capped with the spicular earth, the former inclined at a low angle, the latter practically horizontal.

(b) The somewhat incoherent kaolinic and in places micaceous grit or wash.

(c) The rocks on which lie this grit and the sandstones.

From the dip of the sandstones where observed nearest the bore, it is permissible to conclude that they would be carried under the kaolinic grit, either under the whole thickness of the deposit at some point, or so that they would appear in the grit at some depth below the surface. As a matter of fact, calculations based on the dip observed by Mr. Wilson nearest the bore, namely, 20 degrees, on the depth of the bore, and on its position as outlined in Mr. Wilson's plan and section, show that the sandstones would be met with at a depth somewhere about 250 feet from the surface. So far as the samples afford information, these rocks have not been met with in the bore. Therefore, either their horizontal extension is not sufficient to enable them to be picked up in the bore, or, owing to an alteration in the dip, they pass underneath the grit and have not yet been reached.

The character of the rocks at the bottom of the bore strongly suggests that the bed-rock is not far away, so that the chance of picking up the sandstones by continuing the bore is meagre in the extreme.

The presence of the metamorphic chlorite schist is important, for, whether it is only a fragment or not, it indicates the proximity of the bed-rock, and the character of the rocks below the detrital or sedimentary material. It is generally recognised that metamorphic rocks are most unfavourable for the occurrence of oil, for, even if before the metamorphism they did contain it, the action of stresses would completely dissipate or destroy it, and if, as is most probable, the stresses occurred before the sedimentaries were formed, either the oil indications would still be in the latter, or, as the sandstones, etc, are so porous and comparatively incoherent, the oil would have disappeared through these rocks unless sealed in by structural or other phenomena. No such structural or other phenomena have been found in connection with the rocks in the bore. Moreover, no sample from the bore or from the sandstones has shown incontestably any trace whatever of the natural occurrence of mineral oil, and not one indubitable surface indication, solid or liquid, has been found in the vicinity.

Conclusions.

1. While the character of the sandstones and of the kaolinic grit is favourable for carrying oil on account of their loose texture and consequent porosity, it is also equally favourable for its dissipation, and as far as the structural conditions near the bore are known from Mr. Blatchford's observations, there are no phenomena which could have sealed up the oil in these rocks and prevented its dissipation.

2. The chances of the existence of oil-bearing sandstones under the material exposed in the bore are meagre. If present, they would in all probability be the soft sandstones, and as these outcrop and are so far as known not sealed up, chemically or structurally, any oil they once carried would now have disappeared.

3. The basal rocks belong apparently to the igneous and metamorphic series, which are held to be most unfavourable for oil.

ADDENDUM "B."

REPORT ON SAMPLES FROM FITZGERALD RIVER COLLECTED BY THE ASSISTANT GEOLOGIST.

(E. S. Simpson, D.Sc., B.E., F.C.S.)

I have examined the eight samples collected by Mr. Blatchford during his recent visit to the site of the oil boring operations at the Fitzgerald River, and am

unable to find in them any trace of petroleum or any of its known residuums. The detailed results are—

8221E	No. 1.	Mineral Oil, <i>nil.</i>
	Seam in Fitzgerald R., near Bore.	
8222	No. 2.	Mineral Oil, <i>nil.</i> Petroleum spirit extracted from this sample a small amount of thick yellow fluid, the greater part of which was saponifiable and the re- mainder soluble in recti- fied spirits. It was not, therefore, in any way re- lated to mineral oil, but apparently a vegetable product.
	Fine sediment in return water tank at Bore.	
8223	No. 3.	Mineral Oil, <i>nil.</i>
	Bore 120ft.—140ft.	
8224	No. 4.	Mineral Oil, <i>nil.</i>
	Bore 140ft.—225ft.	
8225	No. 5.	Mineral Oil, <i>nil.</i> Petroleum spirit extracted a trace of material identical with that in No. 2.
	Bore 225ft.—246ft.	
8226	No. 6.	Mineral Oil, <i>nil.</i>
	Bore 309ft.	
8227	No. 7.	Mineral Oil, <i>nil.</i>
	Bore 309ft.—312ft.	
8228	No. 8.	Mineral Oil, <i>nil.</i>
	Bore 314ft.—338ft.	

I have examined the sample of oil (G.S.L. 8220E) called "castor oil substitute" which was used on the boring plant at Fitzgerald River with the following results:—

Density	.. ..	0.930 per cent.
Unsaponifiable hy- drocarbons	.. ..	62.16 "

This is a mixture of approximately two parts of a heavy fraction from petroleum with one part of a vegetable oil.

3.—PETROLEUM INDICATIONS IN THE KIMBERLEY DIVISION.

(T. BLATCHFORD, B.A.)

(With Appendices by E. S. SIMPSON and
R. A. FARQUHARSON.)

INTERIM REPORT OF THE OCCURRENCES OF MINERAL OIL IN A BORE AT PRICE'S CREEK IN THE ROUGH RANGE IN THE WEST KIMBERLEY DIVISION.

Location.—Price's Creek drains the south-western portion of the Rough Range, which is a continuation of the Napier, Oscar, and Geikie Ranges. The bore is situated on the western slope of a spur of the main range, and lies at a distance of some 20 miles north-east of Mount Synnot.

History.—Indications of mineral oil were first noticed by Mr. Harry Price, who was in charge of a boring party searching for water for the Gogo cattle station. While sinking the bore, Price noticed a peculiar odour rising from the bore-hole, and also a black scum floating on the water which was pumped from the bore. Samples were taken, and an analysis proved the presence of traces of mineral oil. This led to further investigations by Mr. M. Freney, and eventually to a departmental inspection and re-sampling, the results of which are the purport of this report. I have named the creek on which the bore is situated, after the prospector, as it is the first instance in which traces of mineral oil have been departmentally recorded in the State.

Field Work.—In addition to taking samples of the bore and supposed oil seepages, a limited amount of mapping was done of the country in the immediate vicinity. As there were no official results of the sampling available at the time, the work was limited to an amount sufficient only to ascertain the general geological structure, and before any boring is undertaken, I would strongly recommend a considerable amount more work in this direction. Both the spur and main ranges are extremely rough though almost devoid of heavy vegetation. Three sections were made across the spur range, which shows a minor anticline, the crest of which strikes north-north-west and south-south-east, and is therefore more or less parallel with the range itself.

Geology.—The Rough Range, in which the bore is situated, is the southern extension of the Napier, Oscar, and Geikie Ranges. According to Hardman, who has examined the system from North to South, the prevailing rock is limestone, often of the magnesian variety, weathered very rough on the surface, and abounding in places with Carboniferous fossils. The general strike of the beds is parallel to that of the range, which has a prevailing strike of north-west and south-east. In describing the Geikie Range, which lies at no great distance north of the Rough Range, he states "the strike is generally north-west and south-east, and the beds have a rolling dip north-east and south-west, often at angles of 20deg. to 35deg., forming anticlinals and synclinals. He also draws attention to the fact that in places where the basal beds are exposed, shales are found to be more prevalent than limestones. This is also noticeable at Mount Pierre, which lies about eight miles to the north of Rough Range, and probably accounts for the course of the Margaret River, the shales being more readily worn down than the harder limestones. Unfortunately the lower beds of the formation are not visible in the vicinity of the bore at Price's Creek. There we find a main range with a more or less parallel spur, the intervening country and western flank being covered over with talus from the main range. The prevailing strike of the beds is parallel to the range, *i.e.*, approximately north-west and south-east, with a dip in places to the north-east, in places south-west in the spur. As far as could be ascertained at the time, the dip in the main range is north-east. Owing to the western flank being more or less masked with detritus, it is not quite evident how the dip of the beds behaves on the western side, and in this respect there are certain important points to consider. On descending the western slope of the spur range to near the base, the dip to the north-east gradually becomes less and less, until the lower beds are almost horizontal. Where the bore has been sunk, which is nearly 40 chains from the last outcrop, there is no doubt that limestone beds were pierced. Some two miles due west of the bore a flat-topped sandstone hill occurs. This hill, like the hills still further to the west—Mounts Synnot, Hutton, etc.—belongs to the Upper Carboniferous sandstone series, which at one time covered the lower Carboniferous limestone beds, and which in other parts of the Kimberleys has been proved to be conformable to it. The bedding planes in these sandstone beds dip to the south-west. The base of the closest hill is at least 100 feet below the limestone beds where last seen. Further to the north it has been proved by a deep bore that the lime-

stone of the main range dips for many miles beneath the overlying sandstones and more recent deposits, which form extensive plains. From the above evidence it would appear highly probable that the limestone of Rough Range in the vicinity of the bore behaves in a like manner, and that the dip of the limestone beds has slowly changed underneath the sediments to the west from north-easterly to south-westerly. If this is the case, the bore is situated on the long western flank of a broad asymmetrical anticline.

The Bore and Supposed Seepages.—As previously stated, indications of oil were found in the first place when boring for water. A second bore was put down by Mr. Freney, who took a second series of samples. On my arrival, preparations had been made to make a third bore, the site chosen being between the first two sites. Until the bore was cased to a depth of about 20 feet, I did not leave the spot, either night or day, when any of the party were present, but after the top length of casing had been inserted, the bore was sealed each night, and the seal personally examined and broken each morning before boring was resumed. No oil was used on any of the boring rods, the only lubricant allowed being animal fat, and that in very small quantities. When the rods were drawn, all the "pumpings" were run into vessels and personally sampled, the samples being immediately placed in stoppered bottles and sealed. The sealed bottles were then placed in boxes, which were also sealed. I have no suspicion whatever of any attempt to tamper with the bore or samples, and any request I made to Mr. Freney or the foreman was immediately granted. The results of the samples taken may be found in the appended list. On the banks of Price's Creek, in the vicinity of the bore, and also in the south gorge in the spur range, more or less dry patches occur which are devoid of vegetation. In these patches a brown coating was sometimes noticed, and as there was a possibility of these containing oil in the form of a seepage, several samples were taken; but the analysis confirmed the presence of mineral oil in one instance only. The results of the borings are definite, and in every case mineral oil was found to be present, the samples from the bottom of the hole (90ft. from the surface) containing, with the exception of the shale from the 50-60ft. section, the highest oil contents. As an indication of the presence of mineral oil, the samples from the bore must be regarded as satisfactory. With regard to the nature of the rocks encountered in the bore, after passing through about 16 feet of alluvium, bands of limestone and possibly thin layers of shale, were pierced. It was not possible to correlate the various layers owing to the falling of pieces of rock from the sides of the bore, the casing not reaching a lower level than about 20 feet.

Conclusions and Recommendations.—After duly considering the data collected during my inspection of the country in the vicinity of Price's Bore in Rough Range, together with the result of the analysis of samples taken personally, I have come to the following conclusions:—(1) that the rock formation of Rough Range is limestone, probably overlying beds of shale, etc., and is of carboniferous geological age; (2) that due to earth movements, the limestone has been flexured in the spur range, forming a distinct anticline, which has been traced along

the crest of the range. I am of the opinion that this minor anticline is probably the crest of a much more extensive broad asymmetrical fold; (3) that the geological conditions are favourable for the storage of mineral oil; (4) that mineral oil has been found in the bore, and in one instance in surface seepage; (5) I would therefore strongly recommend that boring be undertaken, probably on one of the gorges in the spur range to the west of the minor anticline, but would preferably recommend that before choosing a definite site a more detailed survey be made of the spur range, and also of the main range, particularly east from the bore.

APPENDIX "A."

SAMPLES FROM PRICE'S BORE, ROUGH RANGE.

(By EDWARD S. SIMPSON, D.Sc., B.E., F.C.S.)

I beg to submit the following report upon the samples collected by Mr. Blatchford at Price's Bore in the Rough Ranges, Kimberley. These samples were sealed with Mr. Blatchford's official seal, and the seals were intact when the samples were delivered to me by Mr. Freney. In all, ten samples of material from this bore were treated for petroleum, with the results given below:—

G.S.L., 7877E (Mark No. 5).—Skimmings from pumpings, Price's Bore, 45-90ft.; water: (about 1 litre), with small amount of mud; odour: indefinite, unpleasant; mineral oil: found in water; traces: in dried, solid matter, 0.025 per cent. of a yellowish-brown, fairly mobile, unsaponifiable oil with a paraffinic odour, and apparently of mineral origin.

G.S.L., 7878E (Mark No. 6).—Clay from borings, Price's Bore, 50-60ft.: dark grey clay with lumps of shale and limestone; odour: almost imperceptible; mineral oil: 0.007 per cent.

G.S.L., 7879E (Mark No. 7).—Shale rubble from borings, Price's Bore, 50-60ft.: gritty, clay and water; odour: faint of decaying vegetation; mineral oil: 0.044 per cent. on dry sample.

G.S.L., 7880E (Mark No. 8).—Clay from borings, Price's Bore, 60-70ft.; gritty clay with many limestone and shale pebbles; odour: distinctly petroliferous; mineral oil: 0.016 per cent.

G.S.L., 7881E (Mark No. 9).—Shale rubble from borings, Price's Bore, 60-88ft.: dark grey clay and fine grit; odour: slight, petroliferous; mineral oil: 0.012 per cent.

G.S.L., 7882E (Mark No. 10).—Clay from borings, Price's Bore, 70-85ft.: dark grey clay with lumps of shale and limestone; odour: distinctly smoky and kerosene-like; mineral oil: 0.010 per cent.

G.S.L., 7883E (Mark No. 12).—Clay from borings, Price's Bore, 88-90ft.: dark grey clay, with fragments of shale; odour: distinctly petroliferous; mineral oil: 0.026 per cent.

G.S.L., 8015E (Mark No. 11A).—Seepage, Price's Creek: black loam; earthy odour; mineral oil: nil.

G.S.L., 8016E (Mark No. 11B).—Seepage, Price's Creek: brown loam; earthy odour; mineral oil: 0.001 per cent.

G.S.L., 8017E (Mark No. 11C).—Seepage, Price's Creek: brown loam; earthy odour; mineral oil: nil.

The oil found in all these samples was of precisely similar nature to that described in the case of Sample No. 5; no asphalt or ozokerite was observed in any of the samples.

INTERIM REPORT ON THE OCCURRENCE OF GLANCE PITCH NEAR THE JUNCTION OF THE NEGRI AND ORD RIVERS, KNOWN AS "OAKES' FIND."

(T. BLATCHFORD, B.A.)

In accordance with verbal instructions I have inspected the spot from which Mr. Oakes first obtained samples of glance pitch in Kimberley. I regret to state that owing to the extremely rough

condition of the roads, considerable difficulties were encountered in reaching the locality by car, which, coupled with the fact that my chauffeur was laid up on six separate occasions with the prevalent fever (*malaria*), rendered it impossible for me to do the amount of field work the discovery undoubtedly warranted. In addition neither Mr. Oakes nor Mr. Durack was able to be present to point out what they particularly wanted me to see. The spot where the pitch occurred and from which evidently the samples submitted previously had been taken was, however, found. The following is a short description of the locality and surrounding country, partly based on the previous reports of Mr. Hardman and Dr. Jack, and partly the results of my own personal observations.

Locality.—Oakes' Find is situated about half-a-mile up the Negri River from the junction of the Negri with the Ord River. From the place at which the Ord River Station-Wyndham Road crosses the Negri, it is about $1\frac{1}{2}$ miles down stream on the north bank of the Negri.

Geology.—The general geology of the Oakes' Find locality and surrounding district has been mapped and described in detail by both Mr. Hardman and Dr. Jack who, though differing in minor details, are in accord as to relative ages and descriptions. Briefly, the geology of the district is as follows:—

Following down the westward side of the Ord River, and extending eastward on the south side of the Negri River are two belts of rock consisting chiefly of sandstones and grits. These form the higher ground, and may be seen as flat-topped tablelands. The geological age of this formation has been placed as upper carboniferous. Immediately underlying these sandstones and grits are fairly thick limestone beds which extend beyond the flanks of the first series, particularly to the east and south. These limestones are lower carboniferous, and resemble very closely the limestones of the Rough Range-Geikie-Napier series. As a matter of fact, there is every reason to believe they are part of the same beds. In his description of these beds, Hardman states: "Over a great part of the country the limestones outcrop in bare masses cut through by numerous gullies and watercourses, along which the rock often forms high cliffs and scours, showing the stratifications (which dip at a very low angle in various directions) very distinctly." This alteration in dip referred to corresponds to the same structural features of the limestones in the Rough Ranges, referred to in my report on that locality. Under the limestones is a very extensive basalt sheet which extends for miles to the north, south, and east. There is no evidence of contact metamorphism in the limestone, a fact which, taken in conjunction with the vesicular nature of the basalt, points to the improbability of the latter rock being intrusive. As the pitch occurs in the basalt, further reference to this rock will be made later in the present report. Underlying the basalt are older sandstones, grits, shales, conglomerates, etc., probably of Devonian age, which rest unconformably on still older slates, schists, and gneisses, possibly Lower Silurian or Upper Cambrian in age. The section by Hardman, at a point some 50 miles south of Oakes' Find, shows the general relation of the various beds to each other. From

the above it is apparent that the rock system at Oakes' Find is, with the exception of the basalt sheet, a repetition of that found in the Fitzroy Basin. It seems highly probable, therefore, that the rocks in the vicinity of Rough Range form the south-western flank, and those near Oakes' Find the eastern flank of an extensive anticline of which the granites north of the Leopold Ranges are the core. If such is the case, the rocks in the vicinity of Oakes' Find will probably have undergone the same strains and stresses, and developed similar structural features, though, owing to the overlying upper carboniferous beds and denuding agencies of the Ord and Negri Rivers, they are not apparent in the vicinity of Oakes' Find as they are in the more open country found in the Rough Range district.

Oakes' Find.—In the early part of the present year, samples of glance pitch were sent to the Geological Survey Department from Kimberley, by a Mr. Oakes. The discovery is certainly the most definite surface indication of mineral oil residue which has been found in the State, and certainly one of the most important indications yet recorded. Although the pitch was first reported by Mr. Oakes as coming from where the Negri junctions with the Ord, it was handled unknowingly by man years previously in a well near Texas homestead, on the bank of the Ord, some five miles up the river from the junction, but was unfortunately passed over and its importance not noticed. Pitch is also found in the basalt on the banks of the Ord between this well and the Ord-Nagri junction. In every instance which came before my notice, the pitch was in the basalt or the limestone immediately above. It had not impregnated the limestone to any appreciable extent. In hand specimens the basalt is seen to be extremely vesicular, the vesicles being sometimes empty, sometimes completely filled with pitch, lime, or rarely silica, and very often partially filled with lime and pitch. It is further noticeable that thin veins of pitch sometimes impregnate the lime, and at times the reverse. Not uncommonly the lime forms a coating to the vesicle, the central portion being pitch. The pitch also fills the cracks in the rock, and in this form occurs in quite considerable quantities. Where the basalt rock has been blasted out by mining operations to a depth of from four to five feet, the same conditions prevail, and the numerous fissures in the rock in particular are heavily charged with pitch. The same features are noticeable in the well at Texas Station. About two miles south of Texas Station brine springs are depositing salt in considerable quantities, amounting to from 20 to 40 tons per annum, on a smooth rock floor in the valley of the Ord River. This deposition of salt only occurs during the summer months, the springs being flooded during, and immediately after, the wet season. Whether these springs reach below the basalt is not certain. Further down the Ord, and in the Negri, near the junction, the water is distinctly salt, pointing to the likelihood of springs coming up through the basalt rock into the overlying otherwise fresh, water. I have been assured that in dry seasons the springs can be distinctly seen. Unfortunately the structure of the country where the pitch occurs is much obscured both by denudation and the overlying sandstones and grits, and the structure of the rocks has been hidden. The general evi-

dence, however, points in favour of rock folding, for at no great distance such has been observed.

In dealing with the origin of the pitch, there is strong evidence in favour of the following:—(1) That it occurs chiefly in the basalt where that rock has been fractured; (2) that it has not penetrated into the overlying limestone, at least, to any appreciable extent; (3) that, where observed in the basalt, is along an apparent line of weakness, and not promiscuously through the basalt sheet; (4) that there is no evidence to show that it has come from the overlying limestone beds; (5) that there is every reason to believe it has come in the form of mineral oil from unexposed underlying beds which, by a process of inspissation, has left the pitch residual behind, filling the cavities in the rock through which it has migrated.

With regard to the possibility of the existence of a payable oil basin in the underlying beds, it would be mere conjecture to offer an opinion. It is certain, however, that mineral oil did once exist in the locality, and the certainty as to whether it still exists can only be proved by systematic survey work and boring.

CONCLUSIONS AND RECOMMENDATIONS.

(1) I am thoroughly convinced by my investigations that undoubted evidence of the occurrence of mineral oil at some past time exists at Oakes' Find, and the country for five miles to the south in the course of the Ord River; (2) that the rock complex in the vicinity of Oakes' Find is a repetition, with minor variations, of that found on the western side, and extending from the Napier-Oscar-Geikie-Rough Ranges to Derby; (3) that though the structure of the encasing rocks in the immediate vicinity of Oakes' Find has been obscured to a great extent, taken as a whole there is sufficient evidence to reasonably assume a similar structure to that existing in rocks on the western flank.

I strongly recommend that: (1) A detailed geological survey be made of the locality; (2) that on the completion of this survey, boring sites be chosen at the most suitable points, and the ground be systematically tested for oil.

APPENDIX A.

REPORT UPON THE OCCURRENCE OF GLANCE PITCH AT OAKES' FIND.

(By R. A. Farquharson, M.A., M.Sc., F.G.S.)

The material first sent to Perth from near the junction of the Negri and the Ord Rivers, in North-Eastern Kimberley, by Mr Oakes, and later on brought in by Mr. Blatchford, who collected his own samples, is a solid bituminous hydrocarbon with a high fusion point that can be included under the term "glance pitch," used as a group name, and which is very closely allied physically and chemically to "manjak." In Emmons' classification it is a solid asphaltite. The importance of the asphaltites and very closely related substances lies in the fact that they are generally regarded as favourable indications of the presence of petroleum. They are considered to be produced by the drying or inspissation of petroleum, *i.e.*, as the residual products of natural distillation, in which the more volatile fluids have been scattered, and between oil and asphalt there are all stages ranging from the liquid to the solid state. The differences

between the members are largely due to differences in composition of the original oil, and to differences in the degree of drying. "Manjak," in the words of Cunningham Craig, is inspissated oil in veins which occur where a thick series of strata partly, or wholly, of impervious material overlies a source of asphaltic oil, and where, due to earth movement or to the softness of the overlying rock, planes of weakness have been developed, enabling intrusion of petroleum from below to take place.

As any indication of oil is to be interpreted in connection with its geological position, the character of the rocks, the structure of the district, and the degree of metamorphism shown in associated beds, the circumstances of occurrence of this "glance pitch" are of considerable significance. The rock in which it occurs is a very fine grained dull greenish, somewhat weathered, vesicular doleritic basalt, composed of a very fine plexus of felspar rods, in a greenish mass of chlorite scales. It is in part massive, in part more or less sheared. The massive variety shows a fairly clean cut junction with the sheared variety, and along the surfaces of separation are fairly well marked slickensides. Moreover, this variety shows a few very thin cracks extending for some distance through the rock, and the important feature of some of these cracks is that they are partly filled with the glance pitch. Microscopic examination of the junction between the two varieties shows the presence of a sheared zone filled with fragments of the basalt surrounded by granular quartz (the remains of a vesicle), granular felspar, and granular calcite, with black strings of glance pitch intimately associated with the calcite. Further, some of the basaltic fragments are almost black, and appear as though they had been partly impregnated with the pitch.

The vesicular nature of the rock is very marked. The vesicles range in size from a pin-head to a walnut. Some are spherical, others elliptical, and others again, almost disc shaped. They consist (a) of calcite (the largest), (b) of greenish chlorite, (c) of quartz, (d) of glance pitch, and (e) of calcite and glance pitch, the latter appearing to float in the calcite. A few of the vesicles are only partly filled.

The sheared variety is much more heavily impregnated by the glance pitch than the massive, for, whereas in the massive the glance pitch occurs only in a few vesicles, and in very thin cracks, in the sheared the mineral occurs in strings and irregular patches of noticeable size.

Owing to the fineness of texture of the rock, the amount of pore space in it, exclusive of the vesicles, is small. Moreover, though the number of vesicles is considerable they are not connected, and quite a number of them are filled by calcite or by chlorite and, consequently, the permeability of the rock and its capacity for storage cannot have been large, at any rate until earth movements had caused cracks and planes of shearing in the rock.

Age of the Rock and its Geological position.

The rock enclosing the glance pitch occurs in the bed of the river, and no detailed geological survey of its geological setting has, up to the present, been made, but according to Hardman's map and sections, the basalt lies as a sheet between the Devonian sandstones—grits, shales, etc.—and the Lower Carboniferous limestone. It was, therefore, formed at the close of the Devonian, or at the beginning of the Lower Carboniferous epoch.

Mode of Occurrence of the Glance Pitch.

The mineral occurs:—(a) In vesicles, filling the whole of the cavity, and with a border of chloritic material between it and the basalt; (b) in vesicles with calcite, the pitch in some cases appearing to float in the calcite and show cracks filled in by calcite, in others occurring as a partial border to a calcite amygdaloid; (c) in very thin strings along cracks in the massive rock; (d) in strings and patches in the apparently sheared portions of the rock.

Significance of the mode of occurrence of the mineral:—(1) As the glance pitch is a vesicular filling, it must have permeated the rock after the formation of the vesicles, or gas pores; (2) as the glance pitch occurs as a border to the calcite that fills some of the vesicles,

it would appear to have penetrated the rock after the formation of the calcite in the holes. On the other hand, the occurrence of the pitch as though floating in calcite, and with cracks filled with calcite, tends to show that the calcite was in part later than the pitch. As the Lower Carboniferous limestone occurs immediately above the basalt, some of the calcite fillings may easily be due to carbonate solutions from the limestone which have detached the pitch from the walls of the holes, and on re-crystallising have surrounded the pitch. Similarly, the vesicles showing a border of the pitch round calcite may be due to a partial filling of the hole by the pitch or the shrinkage of the latter, and subsequent filling up of the remaining space by the carbonate solutions; (3) the occurrence of the glance pitch as thin cracks in the massive rock shows that the mineral must have been introduced after the cracks were developed, and the occurrence of a heavier impregnation in the apparently sheared portion of the rock indicates the same thing.

Conclusion.—After consideration of the facts set out, the following conclusions appear permissible:—(a) The glance pitch was introduced into the basalt after the rock had solidified, after it had been subjected to earth movements, which produced in it cracks and some degree of shearing, and probably after the rock had become somewhat weathered; (b) the basalt, therefore, is not the original reservoir of the oil, the latter having been intruded, or squeezed, into the openings in the rock from some reservoir hydrostatically, and probably stratigraphically below the basalt sheet. The Devonian rocks under the basalt consist, according to Hardman, of sandstones, grits, shales, etc.—rocks which are regarded as not unfavourable for the occurrence of oil.

As there is so little detailed information about the find, it is essential that a careful geological survey be made of the district in which it exists, in order that the character of the rocks, the structure, the succession, in short, the geological setting of the district, and of the find, which are so important in regard to the occurrence of oil, may be satisfactorily unravelled.

APPENDIX B.

REPORT ON THE ASPHALTUM OCCURRING ON TEXAS STATION, EAST KIMBERLEY.

(Edward S. Simpson, D.Sc., B.E., F.C.S.)

During the past twelve months several samples of asphaltum have been examined in the Geological Survey laboratory which were said to have been found on Texas Station in the East Kimberley district. The complete list of samples is:—

- No. L6103E—Junction Ord and Negri Rivers (Oakes' Find), submitted by W. Oakes.
- No. 6104—Junction Ord and Negri Rivers (Oakes' Find), submitted by Engineer of Commonwealth Railways.
- No. 6507—Junction Ord and Negri Rivers (Oakes' Find), submitted by M. P. Durack.
- No. 8229—Junction Ord and Negri Rivers (Oakes' Find), submitted by T. Blatchford.
- No. 8230—Well near Texas homestead, T. Blatchford.

Oakes' Find.

All four samples from this find, including that collected on the spot by the Assistant Geologist (Mr. Blatchford) are identical in nature. They consist of a brilliant black combustible mineral, partly in angular fragments, quite free from visible rock or earth, partly adherent to and enclosing large calcite crystals, partly adherent to a grey or brownish calcareous rock into which it penetrates along cracks and cavities.

Detailed examination proves the black mineral to belong to the group of hard asphaltum, sometimes called glance pitches. It is very brittle, and not sticky. It ignites and burns freely, and does not melt on heating even above 300deg. C., decomposition taking place without any signs of softening. Specially selected clean fragments had a density of 1.154, but many fragments had densities rising from this figure to 1.20, the higher

figures being due to contamination with small quantities of calcite and rock. The calorific value of the purest material was 16,573 B.T.U. (9,207 K.C.U.).

Analyses were made of three specimens:

Source.	No. 6507.		No. 8229.		No. 6104.	
	M. P. Durack.		T. Blatchford.		Engr. Com- with Rlys.	
<i>Ultimate Analysis.</i>						
C.	89.40	89.30	—	—	—	—
H.	7.26	6.95	—	—	—	—
S. .. ..	.68	.57	—	—	—	—
N. .. ..	.41	.36	—	—	—	—
O.	2.25	2.82	—	—	—	—
	100.00	100.00				
Ash .. ..	.43	.49			19.96	
<i>Proximate Analysis.</i>						
Moisture ..	0.37	—			0.84	
Volatile ..	41.54	—			38.20	
Fixed Carbon	56.27	—			41.00	
Ash	1.82*	—			19.96	
	100.00	—			100.00	

(*The proximate analysis was made on a separate lot of fragments to those used for the ultimate analysis. Hence the slight difference in the ash content.)

Volatile Matter (by moderately low temperature distillation).

Water	1.74	—	1.90
Oil	19.89	—	16.00
Gas	19.91	—	20.30
	41.54%		38.20%

The gas burnt freely with a slightly luminous flame. The oil had a density of 0.758 at 25deg. C. It was dark brown in colour, translucent, fluorescent, and of low viscosity. The water which distilled over was distinctly acid in reaction.

Digestion of the asphaltum with carbon bisulphide in the cold, extracted a bright black bitumen, amounting to 15.38 per cent. of the whole in the case of sample 6507, and 10.30 per cent. in the case of 6104.

As the result of these tests, there is no doubt whatever that the material collected on the spot by Mr. Blatchford is identical with that originally submitted by Mr. Durack and the Commonwealth Engineer. It is a true asphaltum, the residue left from an asphaltic petroleum by natural evaporation of the more volatile oils, with consequent concentration of the heavier oils and sulphur compounds, accompanied by a small absorption of atmospheric oxygen, and by the chemical change known as polymerisation.

A long series of residues of this nature are known, varying from the tar-like fluid maltha, from which evaporation has only just begun, through soft and hard asphaltums to graphitoid, a mineral resembling graphite, and representing the last stages of chemical change in an original asphaltic oil.

The Texas Station mineral is a hard asphalt of the kind known as Impsonite, the type of which was found some years ago in the Impson Valley in Indian territory, U.S.A. Impsonite is characterised by its hardness and brittleness, infusibility, low solubility in carbon bisulphide, and high percentage of fixed carbon.

Texas Homestead.

The sample collected by Mr. Blatchford from a well near Texas homestead is a much weathered vesicular basalt with a bright black asphaltum filling (in association with calcite) most of the vesicles as well as some small fractures in the rock. This mineral was proved by its physical properties and its behaviour on heating to be identical with that from Oakes' Find.

The discovery of this asphaltum at two localities, five miles apart, is of great importance, since, as already explained, the mineral is beyond doubt the residue left

by evaporation and weathering of an asphaltic oil. From the manner in which the material has filled narrow cracks and isolated vesicles in a somewhat denser rock, it is evident that the original oil was a thin oil with a large proportion of light hydrocarbons. There has undoubtedly, therefore, been at some time a leakage of oil to the surface at these points, but that it has not been in recent years is proved by the hardness and advanced chemical alteration of the asphaltum.

4.—THE AURIFEROUS DEPOSITS OF THE GIBRALTAR DISTRICT, COOLGARDIE GOLDFIELD.

(F. R. Feldtmann.)

INTRODUCTION.

The present examination of the Gibraltar district arose from a report by Inspector Phoenix, in which he stated that the ore bodies of the Carlton and Lloyd George mines were different from anything he had yet seen, and suggested a geological examination. Instructions were accordingly given to examine the ore bodies of this centre. As this belt had been only briefly examined hitherto, it was deemed advisable to extend the examination to include a large portion of the belt, near the centre of which the above-mentioned mines are situated, more particularly as there has been some revival of mining in this district.

GEOGRAPHY.

The Gibraltar gold-mining centre, a little to the north of the middle of which are the Carlton and Lloyd George leases, is situated, as the crow flies, about 13 miles westsouthwest of Coolgardie and six miles eastsoutheast of Bullabulling Station, on the Eastern Goldfields Railway.

In the immediate neighbourhood of Gibraltar, the country is fairly strongly undulating, but the hills and ridges are, with a few exceptions—usually capped by laterite—low and separated by fairly wide valleys. Between the Gibraltar area and the Gnarlbine group of leases the country is flat and covered by soil. About 1½ miles northwest of the Lloyd George lease, and a short distance east of the Ubini road, is a fair laterite breakaway with several large caves.

The Gibraltar area is drained by numerous watercourses. The main drainage channel starts near the south corner of G.M.L. 4952 and runs southwest, passing close to the western boundaries of the Limerick, Lloyd George, and Carlton leases; thence it runs south to a point about 15 chains east of the Reform lease (which includes part of the old De Beers lease), where it is joined by a watercourse which runs east through that lease. Thence the flow is in a general southsoutheasterly direction, the channel passing to the east of the Gnarlbine group. There is a very considerable width of alluvial ground, as much as a quarter of a mile in places, along this channel and the soil and wash are, in places west of the Lloyd George and Carlton, at least 9 feet deep. A systematic search across this alluvial channel might reveal an alluvial lead, as it receives the drainage from most of the auriferous area.

Another well-defined creek starts a little north of G.M.L. 4419, west of the Reform, being separated from the Reform watercourse by a low divide. It

runs in a general southerly direction, probably to lose itself in the sand plain west of the schist belt.

GEOLOGY.

The Lloyd George-Carlton group of leases lies near the middle of a belt of highly schistose rocks which runs northnorthwest from a point about three-quarters of a mile northnortheast of Gnarlbine Rock, includes the Gibraltar groups of leases, and extends past Bullabulling—lying to the east of Bullabulling townsite and including the Bullabulling group of leases—and joins the Dunnsville-Jaurdie Hills greenstone belt north of the Eastern Goldfields Railway.

The Gibraltar belt was briefly examined and mapped by Mr. Blatchford during his survey of the Burbanks-Londonderry area, but he stated in his report* that in consequence of the small amount of development work and the fact that the whole of the area was more or less covered with surface detritus, the boundaries of the schist area could only be mapped in a very unsatisfactory manner, and that further developments would probably considerably alter the boundary lines shown on the map.†

The schist belt is bounded on the south, west, and east by granite, but, as stated by Mr. Blatchford, the boundaries are almost entirely obscured, and only in three places within the area examined was I able to determine them with any certainty. Two of these points were on the northeastern boundary, one in the vicinity of the Ubini Road, where the granite approaches to within three-quarters of a mile of the Lloyd George lease, the second rather more than three-quarters of a mile eastsoutheast of the first, between G.M.Ls. 4893 and 4952, and near the north branch of the road to Coolgardie. Along the south branch of the Coolgardie road (Walsh's track), the schists apparently extend to, and possibly beyond, the junction with the northern track. The third was at the southern end of the belt, northnortheast of Gnarlbine Rock, where there is a marked change of soil and vegetation.

The southwestern boundary of the schists is, so far as could be determined, entirely obscured, but a few outcrops and mining done since Mr. Blatchford's examination, show it to extend somewhat farther west of Gibraltar than is shown on his map.

The rocks composing this belt may be divided into three types: (a) a dark greyish-green medium to coarse-grained highly basic rock, probably a hornblende, and comparatively slightly sheared; (b) a dark-greenish usually fine-grained, granulitic foliated amphibolite or hornblende schist; and (c) a fine-grained paler, grey granulitic gneissic rock composed largely of felspar with a fair amount of biotite, probably derived from hornblende. A flaggy structure is common in this rock, which is described by the Petrologist as a granulitic biotite-chlorite-hornblende gneiss.

The rocks of the first two types appear to be closely related, though it is possible that a few outcrops of the first type may be later dykes intrusive into the hornblende schists. The relationship of the gneissic rocks to those of the other types is not yet clear. They may be an altered less basic facies of

*Blatchford, Torrington, The Burbanks and Londonderry Mining Centres: W.A. Geol. Survey Bull. 53, p. 23, 1913.

†*Op. cit.*, Plate I.

the amphibolitic rocks or may have been derived from a granodiorite of different age. They occupy a much smaller area than the other types, occurring chiefly in the Reform lease and, to a lesser extent, in the Lloyd George group. In each case they appear to be closely associated with the hornblendic rocks.

Outside of the Lloyd George-Carlton group, the strike of the schists, so far examined, is slightly south of east. The dip is to the south, but is very variable, particularly in the neighbourhood of the larger pegmatite dykes, mentioned later. The dips observed range from 22deg. to 72deg., the mean of those taken being 42deg.

In the Lloyd George-Carlton group, which lies to the east of a large granitic boss, described later, the schists are greatly contorted and the strike and dip may be in any direction; the dip is usually fairly flat, whatever the direction, but in places the schists forming the Lloyd George lode are vertical.

The schistose and gneissic rocks are cut by numerous pegmatite dykes differing widely in size and ranging in composition from rocks little different from normal granite, but usually somewhat gneissic in structure, through typical pegmatites to "buck" quartz reefs. Many of the "buck" reefs occur in the larger pegmatites and, in places, appear to pass indefinitely into coarse pegmatite veins. They evidently represent one of the final phases of the granitic intrusion.

In the neighbourhood of the Reform group the pegmatites usually strike a few degrees south of east, but they are very irregular in shape; those in and near the Lloyd George group strike either approximately northeast or northwest. Some of the larger pegmatites cut across the planes of schistosity of the older rocks, which are usually somewhat contorted near the junction, but the smaller dykes, including off-shoots from the larger, usually run along the planes of schistosity.

The largest dyke in the Gibraltar area is one, previously mentioned, immediately west of G.M.Ls. 5125, Gibraltar, and 4871. It strikes approximately north-northeast and has a maximum width of about 18 chains, but its boundaries are very irregular and the southeastern boundary is largely obscured. The dyke consists for the most part of fine-grained somewhat gneissic granite, but coarser pegmatitic facies, with large feldspars, occur. From the northern end of this dyke a long tongue runs in a north-northeast-erly direction.

The pegmatites are usually worth examination, as rare minerals have been found in them in the Ubini and Londonderry areas. So far as reported, the only one found in the Gibraltar area is manganocolumbite, a specimen of which was picked up by my assistant, Mr. R. le Mesurier, near a large buck reef on G.M.L. 5036. A search in the vicinity revealed several fragments of the mineral, including one of 3lbs. weight.

THE ORE BODIES.

Examination of the ore bodies was, owing to the inaccessibility of the deeper workings on the Reform lease, confined to the oxidised zone. The descriptions given, therefore, apply only to that zone, which, in the immediate neighbourhood of the ore bodies, extends to a considerable depth.

The ore bodies of the Reform, Carlton, and Lloyd George leases differ from those of most other centres in their shallow dip, great width, and indefiniteness. They consist of wide bands of impregnated schist; their boundaries are indefinite and their extent can only be determined by assaying. The gold content is erratic, but as a whole the ore bodies are of comparatively low grade, though rich shoots, usually short, occur. The gold is, as a rule, coarse, and is said to be exceptionally pure. In places, small pegmatite dykes form the hanging-walls of the shoots.

The ore bodies differ in strike. The main lode in the Reform lease strikes nearly east, the Carlton, Lloyd George-Limerick line has a general north-northeast-erly strike, but the schists forming the ore body are greatly contorted and, in places, the shoots, particularly in the Carlton lease, strike nearly east. The dip of the ore bodies in general follows that of the schists, and is therefore usually very flat, but, in places, especially where in contact with one of the larger steeply dipping pegmatites, the shoots may be nearly vertical for a short distance; for example, a shoot between Fitzgerald's shaft and the Prospecting shaft on the Carlton lease, and one west of the whip shaft on the Lloyd George lease. In the west crosscut from the north shaft on the Carlton lease, the schists forming the ore shoot are contorted into more or less dome-shape.

Quartz stringers, usually of no great length, are characteristic of the richer ore, and occasional short thick lenses of quartz also occur. The quartz stringers, in places, are said to be poorer than the enclosing schists; in such cases, however, it is probable that much of the gold originally occurred in the quartz from which it has since been leached. The impregnated schists appeared, so far as could be judged from the oxidised rock, to be largely, though not wholly, of the gneissic type.

The great width of the ore bodies in the oxidised zone is probably largely due to secondary impregnation. It may be expected, therefore, that below that zone the lodes will be better defined and the ore bodies narrower.

The unoxidised ore contains a little pyrites, but as a whole the ore bodies appear to be fairly free from refractory minerals. The oxidised ore appears to be suited to treatment in Huntingdon mills, of which the Lloyd George Syndicate has installed one. The ore from the Carlton lease is crushed at a five-head battery on the Reform lease, both leases being held by Messrs. Clayton and Young.

Owing to the indefiniteness of the ore bodies in the oxidised zone, the estimation of the quantity and value of the ore in a mine would be extremely difficult without very detailed and careful sampling, but, from the information supplied, there should be a very considerable tonnage of payable ore in the Lloyd George and Carlton mines.

It is necessary for prospectors used to working vertical or steeply-dipping lodes and reefs to realise that the horizontal extent of these shallow-dipping formations exposed in a crosscut is not their true width, which is at right angles to the dip and strike.

One of the main hindrances to the development of this district has been lack of water, the quantity obtained from the deeper shafts, such as those on the Reform lease, being negligible, and the only source of supply at Gibraltar itself being such shafts and costeans as hold water after rain. Arrangements

have now been made to supply the Lloyd George mine with water from the Goldfields Water Supply main pipe by a small pipe from Ubini.

5.—THE BADDERA LEAD MINE, NORTH-AMPTON, SOUTH-WEST DIVISION.

(F. R. FELDTMANN.)

INTRODUCTION.

The Baddera is one of the oldest lead mines in the Northampton District, being discovered in 1873. It was worked on a small scale for about 10 years after its discovery, but subsequently lay idle until a few years ago, when it was reopened by its present owners, the Fremantle Trading Co., Ltd. In July, 1920, the General Manager of the Company stated that the ore reserves were nearly exhausted, but that there was a chance that the ore body had only been faulted, and suggested that a geologist should visit the mine to investigate this point. Commenting upon this, the State Mining Engineer remarked that "in the event of it" (the mine) "having to close down it would be very valuable for future reference to have a report upon its position by a Government official on record as it stood at the time of closing."

Examination of the mine had to be deferred owing to a strike of employees and to departmental exigencies, but—together with a brief examination of other mines in the district—was carried out during October and November, 1920.

I wish to record my indebtedness to Mr. Sharp, Superintendent of the Baddera, and to Mr. Weir, Underground Manager, for much valuable information and for the assistance afforded in the examination of the underground workings.

GENERAL REMARKS.

Location.—The Baddera Mine is situated 5½ miles north of Northampton township and about half a mile northnorthwest of Baddera Siding on the Geraldton-Ajana Railway. It comprises Freehold Block 1472 and Mineral leases 121, 11^{PP}, and 15^{PP}.

Topography.—The country in the vicinity of the mine is undulating. About three-quarters of a mile west of the main shaft a low bare granite hill forms a conspicuous feature, and about half a mile south of the mine and immediately south of the road to the siding is another fairly prominent hill, the backbone of which is formed by a large "buck" quartz reef. Near the main workings in Block 1472, the drainage runs northeast from a small divide, on which the southwest corner is situated, to a tributary of Udandarra Creek, the tributary running southeastward through the northeast portion of the block. Owing to the quantity of water drained from the mine this northeast portion is now practically a marsh.

Geology.—The country rock of the Baddera, in common with that of the rest of the Northampton metalliferous area, is garnet gneiss, intersected by a number of pegmatite dykes, which in the neighbourhood of this mine appear to consist mainly of ultra-acid aplitic varieties. The ore bodies of the district are closely associated with the pegmatites and were probably derived from the same magma under lower

temperature conditions. Pegmatite veins have been cut in several places by the mine workings. As a rule it was impossible to determine the size or strike of these veins, but the lodes probably largely follow the junctions of the pegmatites with the gneiss. Fragments of pegmatite are common in the lode breccia in places, particularly in the branch lode.

The bare hill west of the mine I was unable to examine closely, but it appears from the road to be composed of different rock to the gneiss composing most of the hills of the district, and probably consists of younger granite genetically related to the pegmatites.

The buck reef forming the backbone of the hill south of the mine is probably an ultra-acid pegmatite. It has a northerly strike and runs towards the Baddera lode. The garnetiferous quartz rock cut in the east crosscut off the branch drive at the 341 feet level may be the northern extension of this or a similar parallel dyke.

No dolerite or epidiorite dykes were seen in the immediate vicinity of the mine, but one is shown on Mr. Maitland's map* about a quarter of a mile west of the main shaft.

THE LODES.

General description.—In the following description of the lodes it is necessary to distinguish between—(a) the *shear zones*, or bands of rock along which the shearing stresses found relief by the formation of sheer planes and by brecciation, and the limits of which mark the limits of the possible occurrence of ore veins; (b) the *lodes*, or zones of most intense shearing and brecciation which later formed the main channels for the ore-bearing solutions, and in which all the ore bodies, with the exception of occasional narrow veins, occur; and (c) the *ore shoots* themselves. The lodes are not necessarily confined to the middle or to any particular side of a shear zone, but may follow a tortuous course within it. The ore bodies may occur in the middle or along either wall of a lode channel and may in places occupy the full width of the channel.

The main lode, to which work on this mine has been almost entirely confined, outcropped close to the south boundary of Block 1472, a little more than 100 feet from the southwest corner; thence the outcrop extended in a northeasterly direction for about 460 feet. A good deal of work was done from the surface between these two points apparently on two parallel ore bodies on the hanging-wall and footwall sides of the shear zone. Farther northeast the cap of the lode is obscured by superficial deposits, but the lode has been followed underground to a point about 820 feet, in a direct line, northeast of the south boundary of the block. At a point about 700 feet northeast of where it crosses the south boundary the lode branches, the branch lode running slightly east of south from the junction; this branch has been followed for about 280 feet from the junction at the 341 feet level, but has not been worked above the 150 feet level. The rock in the angle between the main and branch lodes—particularly the eastern portion—is much shattered, and faulted in places. In the crosscut connecting the two lodes at the 442 feet level, the rock for about 30

*Maitland, A. G., The Geological Features and Mineral Resources of Northampton: W.A. Geol. Survey Bull. 9, Map, 1903.

feet west of the branch lode is completely shattered and more or less decomposed, and is difficult to determine in the hand specimen; on the east side of this lode, however, the rock appeared to be a somewhat shattered and highly acid pegmatite. Between 30 and 50 feet west of the lode are several faults, mostly striking about N. 20° W. and dipping about 60° W. Between the westernmost fault and the main lode the rock is gneiss—jointed but otherwise compact.

The general strike of the main shear zone is about N. 52° E., and the average dip about 73° NW. The average dip of the branch lode is about 65° W.

The main shear zone ranges from about 5 to fully 33 feet in width, probably averaging about 16 feet; the lode channel ranges from 1 to 33 feet, averaging, probably, 4 or 5 feet; the ore shoots (including veins) ranged from a thread to about 33 feet—at the junction with the branch lode above the 234 foot level, where the ore shoot apparently occupied the full width of the shear zone—but only in a few places attained a width of more than 4 feet. Owing to lack of data it is impossible to estimate the width of the branch shear zone, which appears to be less defined than the main shear zone; the lode channel ranges from a thread—near the junction at the 150 feet level—to about 24 feet—at a point about 28 feet below the branch drive at the 341 feet level, where the ore shoot apparently occupied the full width of the channel; the average width of the ore shoot in the branch lode was probably between 2 and 3 feet.

At the southernmost shaft—in M.L. 121, close to the south boundary of Block 1472 and 97 feet from the southwest corner of that block—the main lode meets a narrow shear zone with a strongly marked hanging-wall plane, possibly marking a fault line, and apparently turns and runs along it. The shear zone is approximately parallel to the branch lode and has an average dip of about 67° between the surface and the 341 feet level, and of about 77° between the 341 feet and the 442 feet levels. This shear zone or fault is discussed in the final chapter.

According to Mr. Sharp, another lode was cut in Block 1472 near the bottom of a shaft about 60 feet in depth and 570 feet north of the northeast corner of M.L. 121. This lode is possibly a continuation of the branch lode north of the junction with the main lode.

In the northeast portion of Block 1472 some work has been done on two parallel lodes, about 60 feet apart. The general strike of these lodes, so far as followed, is about N. 43° E., and the dip is northwest. They cut the north boundary of the block about 200 feet and 275 feet, respectively, west of the northeast corner. Going south they bend slightly, striking more southerly. They appear to be on the same line as the main shear zone of which they are probably a continuation—the more easterly lode corresponding to the main lode, the more westerly possibly to that cut in the shaft 570 feet north of the northeast corner of M.L. 121.

Structure and composition.—The shear zones in which the lodes and ore shoots occur are the results of earth movements which sheared and brecciated the gneiss and dyke rocks along comparatively narrow channels, the rock along the line of most intense shearing, usually near the middle of the shear zone, being crushed into angular fragments of varying size. Shear planes, generally parallel to the

brecciated zone but in places running into it at an acute angle, were formed on both sides of that zone. In places the rock for a few inches on the footwall side of the shear planes was crushed to a fine powder. Joints approximately at right angles or at acute angles to the main zone of shearing were formed in the rock for a few feet outside that zone. The brecciated zone and the shear planes subsequently formed paths for the ore-bearing solutions which deposited quartz, galena, blende, pyrite, and chalcopyrite in the open spaces, the resulting ore bodies consisting, in the body of the lode, of irregular masses, small lenses, and veinlets of galena, with a little pyrite in places, in a gangue composed of fragments of gneiss or pegmatite cemented by quartz. Where there were open spaces, the quartz is white or milky, and coarsely granular; where the spaces between the rock fragments were filled with powdered rock, the quartz is dense and fine grained, and usually of a greyish colour. Where the solutions carried insufficient material to fill the open spaces completely, the galena and quartz found room to form crystals. Along the shear planes, galena and quartz were deposited, in places, to form veins of varying size. Blende, which is present only in small quantities in this mine, occurs as a rule along shear planes or joints near the limits of the shear zone or in those portions of the lode in which galena is practically absent. Pyrite occurs in disseminated grains in the quartz matrix of the lode breccia, particularly round the rock fragments; occasionally as small lenses of finely granular material in the galena veins, usually in the centre; and rarely as narrow veins of more coarsely crystalline material, in places containing a little galena, in the poorer portions of the lode. In the larger veins, galena usually occurs as irregular interlocking groups of coarse imperfect cubic crystals, but where vugs occur, forms octahedral and cubo-octahedral crystals, which, however, are seldom perfect. Two particularly fine specimens consisting of octahedral and cubo-octahedral crystals of galena, up to 1½ inches in length, scattered in an irregular platy network of sugary crystalline quartz, were obtained from the junction of the main and branch lodes near the 341 feet level. The veinlets in the body of the lode are usually composed of more finely crystalline material. A very fine grained massive variety occurs in a few places as seams along narrow zones of intense shearing, *e.g.*, in the stope below the drive on the branch lode at the 341 feet level.

According to the early descriptions of the mine, a fair amount of lead carbonate, resulting from the oxidation of galena, was obtained from the surface workings, but no particulars are available as to the depth to which it extended.

Movement subsequent to ore deposition.—Certain features in the lode suggest that movement has taken place subsequently to ore deposition. What now appear as the main shear planes are marked in many places by a few inches of flucan, or crush clay, and by bands of crushed rock and clayey material which carry no ore even where the lode in their immediate vicinity is rich; joints carrying no metalliferous material also occur in the richer portions of the lode. Moreover, the fine-grained galena in the body of the branch lode has in places a schistose structure, and the planes of schistosity are marked by striæ.

As the ore deposits are of great geological age, the occurrence of earth movements subsequent to their formation is highly probable, and the shear zones once formed would always be lines of weakness most likely to be affected by later shearing.

It is possible that some of the shear planes, now barren, contained in places galena which has since been removed by surface waters, but even so it is probable that shearing subsequent to their formation rendered them more accessible to those waters.

The ore shoots.—(a) The main lode: The ore shoot in the main lode apparently consisted rather of a number of more or less discontinuous lenses of varying length than of one continuous lens. It is difficult to form a definite conclusion as to the direction of pitch—or greatest length—of the ore shoot as a whole. From the work done so far it appears to be almost horizontal, but as a considerable portion of the original lode above the present surface has probably been worn away, the pitch may have been southwest at a steep angle. The greatest horizontal, or “stope” length—including the intervening poor or barren portions of the lode—is at the 234 foot level, where the total length is about 900 feet; included in this, however, are several breaks, including one of about 120 feet in the northeast drive. The longest continuous body of ore at this level occupied the northeastern half of the northeast drive for a length of nearly 300 feet, including the ore northeast of the junction with the branch lode; the greater part of this ore body was of fair grade. Beyond the junction with the branch lode at this level the ore body was 24 feet wide for a length of nearly 50 feet.

At the 341 foot level, the ore shoot was less broken, and more regular in width and grade of ore, but the total horizontal length was less, being about 680 feet, including a few short breaks. The greatest continuous length, including low-grade ore, was about 550 feet, mostly in the northeast drive.

At the 442 foot level, the lenses of ore were short and were practically confined to one about 80 feet long, including low-grade ore, in the south-west drive and one of the same length in the northeast drive; they were comparatively narrow, averaging about 15 inches and 18 inches respectively. From its relative length at the different levels the shoot appears to be shortening rapidly and it is probable that it does not extend for any great distance below the 442 foot level.

The junction of the main and branch lodes has not yet been cut at the 442 foot level, but judging by the general trend of the ore shoot, the prospects of obtaining a rich patch at this point are slight. The junction at this level should be between 100 and 115 feet north of the present face of the north branch drive—or from 165 to 180 feet north of the crosscut connecting the main and branch drives—and from 135 to 150 feet from the face of the northeast drive on the main lode.

Few data are available as to the extent and value of the ore bodies between the surface and the 234 foot level. According to Woodward*, the lode was

extraordinarily rich at the bottom of the old workings, but the depth of these is not stated; according to Provis† the old level was said to be at a depth of 25 feet and the old shaft down to 90 feet.

(b) The branch lode: The shoot worked in this lode has, judging by that portion exposed in the workings, a southerly pitch of about 52°. Judging from the stope section, it started at a point about 45 feet above the 234 foot level and, on its present course, should end at a point about 60 feet below the 442 foot level and a little south of a point below winze 270 feet south, from the 341 foot level. This would give it a pitch length of about 360 feet. The average breadth (at right angles to the pitch and to the width) is about 150 feet, the maximum being about 190 feet.

The lode was cut in a short crosscut at the 150 foot level, close to the junction with the main lode, but was said to be a mere thread at this point. No work was done on it at this level, but it was followed to where exposed in the crosscut by a rise from the 234 foot level. The lode has been worked for some distance at and from the 234 foot level. At this level the stope length was a little more than 100 feet. No particulars were available as to the value or width of the ore at this level.

At the 241 foot level, the shoot was about 250 feet long. The average width was about 2 feet, the maximum being 4 feet. The ore was mostly of good grade. The shoot ends at this level at winze 270 feet south.

The best patch so far worked in this lode is that about 28 feet below the 341 foot level and halfway between winzes 200 feet south and 270 feet south, the shoot here attaining a width of about 24 feet. At a depth of about 30 feet below the level and about 12 feet north of winze 270 feet south, the lode is about 9 feet wide; the shoot ends at the south side of the winze.

At the 442 foot level the branch shoot was between 150 and 160 feet long. The ore was of fair grade, on the average, but somewhat patchy. The average width of the shoot was about 3 feet, the maximum width being 6 feet.

The Workings.—Information as to the work done when the property was held by Messrs. Crowther and Mitchell is scanty and indefinite. Apparently a shaft was put down on the main lode, in the southwest portion of Block 1472, to a depth of about 90 feet. According to Provis,* the main level was said to be at a depth of 25 feet and the lode was stoped to the surface from this level. The dressed ore was said to average 82 per cent. lead. The two parallel lodes in the northeast portion of the block were also worked, to a depth of 72 feet.

Since the property was acquired by the Fremantle Trading Company, the lode has been worked from a main vertical shaft 450 feet deep, situated 274 feet northeast of the southwest corner of Block 1472. From this shaft levels have been driven at depths of 150, 234, 341, and 442 feet. The amount of driving done is approximately:—612 feet northeast and 407 feet southwest, including 176 feet south along the supposed fault near the southwest corner of Block 1472, at the 150 foot level; 558 feet northeast, with an addi-

*WOODWARD, H. P., *Mining Handbook to the Colony of Western Australia*, p. 122, 1895.

†PROVIS, JOHN, *The Northampton Mining District*: W.A. Geol. Survey Bull. 9, App. C., p. 25, 1903.

tional 175 feet (about) south on the branch lode, and 393 feet southwest, including 100 feet on the fault, at the 234 feet level; 560 feet northeast with 280 feet south on the branch lode and 35 feet on a seam west of the main lode, and 351 feet southwest, including 27 feet on the fault, at the 341 feet level; and 244 feet northeast on the main lode, 67 feet north and 120 feet south on the branch lode, and 315 feet southwest on the main lode, including between 15 and 20 feet on the fault, at the 442 feet level—at which level a crosscut 135 feet in length connects the main and branch lodes.

In addition to the main shaft there are, or were, eight shafts on the main lode, mostly connecting with the stopes above the 150 feet level; a ninth shaft, apparently on a branch or parallel lode, 570 feet north of the northeast corner of M.L. 121, has already been mentioned. A number of winzes connect the various levels, at intervals ranging from about 60 to 100 feet. The payable ore between the levels is now practically stoped out.

In the northeast corner of the block shafts were sunk in the early days of the mine on each of two lodes, and a level was driven for about 60 feet southwest and 80 feet northeast, at a depth of 70 feet, from the shaft on the northwest lode. The ore shoots have been stoped to the surface. More recently a vertical shaft was sunk about 290 feet southwest of the old shaft on the northwest lode, and 175 feet south of the north boundary of the block.

The ground between these workings and those on the main lode—a distance along the line of lode of nearly 18 chains—does not appear to have been tested.

CONCLUSIONS.

Regarding the strongly-defined southward-striking shear plane in the southwest corner of Block 1472, the question has arisen whether this shear plane marks a fault line, and if so, whether the lode has been faulted by it. There appear to be three alternatives, namely:—either it is (a) a fault or shear zone formed prior to ore deposition and of the same age as, or even older than main shear zone, by which it is joined; (b) as (a) but has been affected by earth stresses, with consequent faulting, subsequent to ore deposition; or (c) it is of later origin than the ore bodies and has faulted them.

The only workings along the shear plane that I was able to examine were the drive at the 341 feet level, and a portion of the drive at the 442 feet level in the immediate vicinity of the junction of the lode and the shear plane. According to Mr. Sharpe, the lode at these levels turned and ran along the shear plane, but the galena was cut off at the junction. As regards the first portion of this statement, the rock on the footwall side of the plane, in the face of the drive at the 341 feet level, consists of somewhat shattered aplite or aplitic pegmatite very similar to that found in places in the barren parts of the lode, but as the shearing or shattering might easily be due to movement subsequent to ore deposition, this evidence is inconclusive.

The apparent cutting off of the galena certainly suggests faulting, but according to the stope sections

and to statistics supplied by Mr. Sharpe, the ore shoot at the 150 feet level and more particularly at the 234 feet level extended for a considerable distance along the footwall side of the shear plane. As the formation of this ore by secondary deposition is exceedingly improbable, this is strong evidence that shearing took place along this line prior to ore deposition. On the other hand, as so far as I know no galena actually occurred on the shear plane itself or in the thin band of crush clay beneath it, it is probable that there has been further movement along the plane subsequent to ore deposition. This subsequent shearing, however, would not affect the ore body if that were wholly on the footwall side of the plane. With the exception of a few feet at the 341 feet level, driving along the plane has, according to the mine officials, been confined to the footwall side. It would, I think, have been advisable to test the rock on the hanging-wall side, at intervals, to see whether there has been any deposition of galena on this side also.

Prospecting on this property, probably owing to lack of funds, has apparently not been kept sufficiently far ahead of mill requirements. The rock on both sides of the lode has been but little tested by crosscutting. The large area of apparently untested ground between the main workings and those in the northeast corner of the block has already been mentioned; at the present time, the testing of the lode between these points is hindered by the ground being practically a swamp, owing to the great quantity of water drawn from the mine—the natural drainage being in this direction. A line that might be further tested is that of the branch lode south of the present workings; if this lode extends south it should cut the north boundary of Reserve 12022 about 50 feet east of the northeast corner of M.L. 121.

Regarding the possibilities of the mine at depth—although the Baddera is the deepest mine in the district, its depth is not great compared with those of many lead mines in other parts of the world, where rich ore has been found at much greater depths than that hitherto found in the Northampton district, even taking into consideration the possibility that the rocks forming the present surface in this district were at considerable depths below those at the surface during the period of ore deposition and that large portions of the lodes have been worn away. There is so far but little evidence as to the occurrence or non-occurrence of payable shoots below those mined. In 1902 and 1903 two bores were put down, one on the Wheal Margaret Mine, and one near Old Cow Rock at Narra Tarra. The vertical depths reached were 558 feet and 424 feet respectively—what were probably the downward extensions of the lodes being cut at considerably less depths. Both bores were unsuccessful.

Reviewing the evidence of these bores—the Wheal Margaret is a copper lode, and rich shoots of copper ore are essentially of secondary origin, consisting either of concentrated oxidised ore, or of secondary sulphides. Primary copper ores, which usually consist of grains of chalcopyrite disseminated through the lode, are seldom payable. Rich shoots of galena, on the other hand, appear to be almost wholly of primary origin, the depths to which they extend depending very largely on conditions of temperature and pressure at the time of their deposition.

**Op. cit.*, p. 25.

Although the Narra Tarra bore was stated to be on a long line of lode which carried good shoots of galena at and near the surface in places, the outcrops in the vicinity of the bore were apparently poor, and the chances of cutting a payable shoot at this point were not great. One bore, if unsuccessful, does not prove the non-existence of ore shoots at or below the depth at which the lode is cut, nor, if successful, their extent. The evidence of these bores cannot, therefore, be regarded as conclusive as regards the occurrence of payable lead ore below the depths yet reached.

Should the company decide to test the Baddera lode at greater depths, perhaps the best method would be to put down a series of bores, arranged in fan shape if the boring were done from one spot, to cut the lode at different points at a depth of, say,

150 feet below the 442ft. level. As stated, a single bore would not give sufficient information as to the richness of the lode nor the extent of the payable ore, if any.

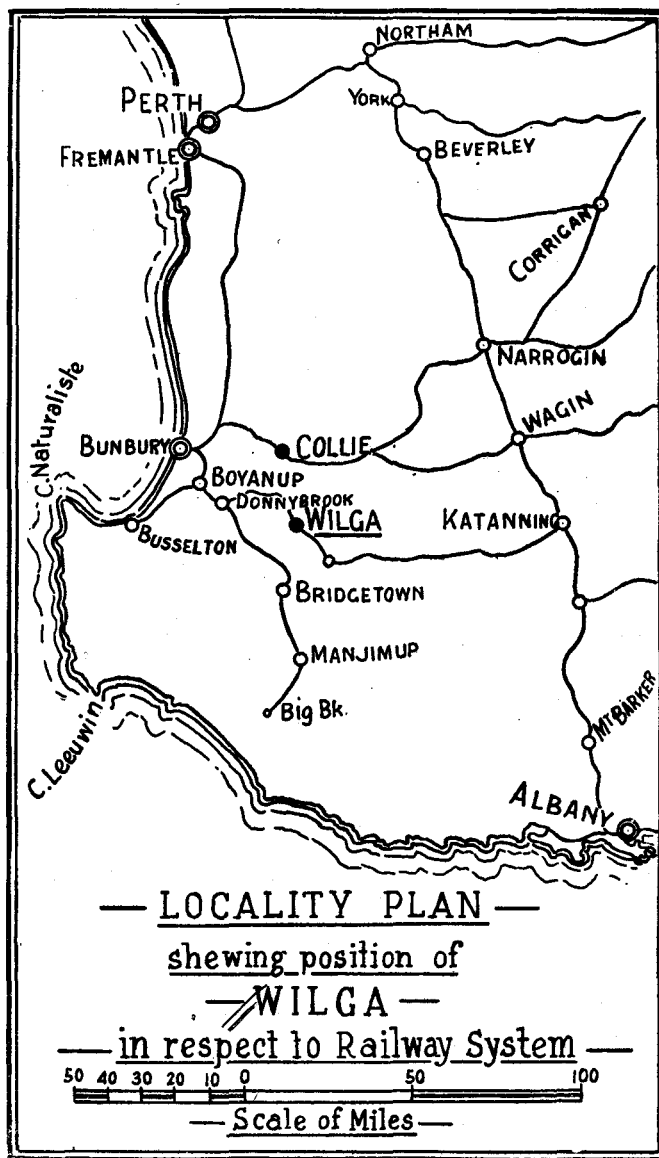
6.—THE WILGA COALFIELD.

(R. C. WILSON, B.Sc., B.E.)

INTRODUCTION.

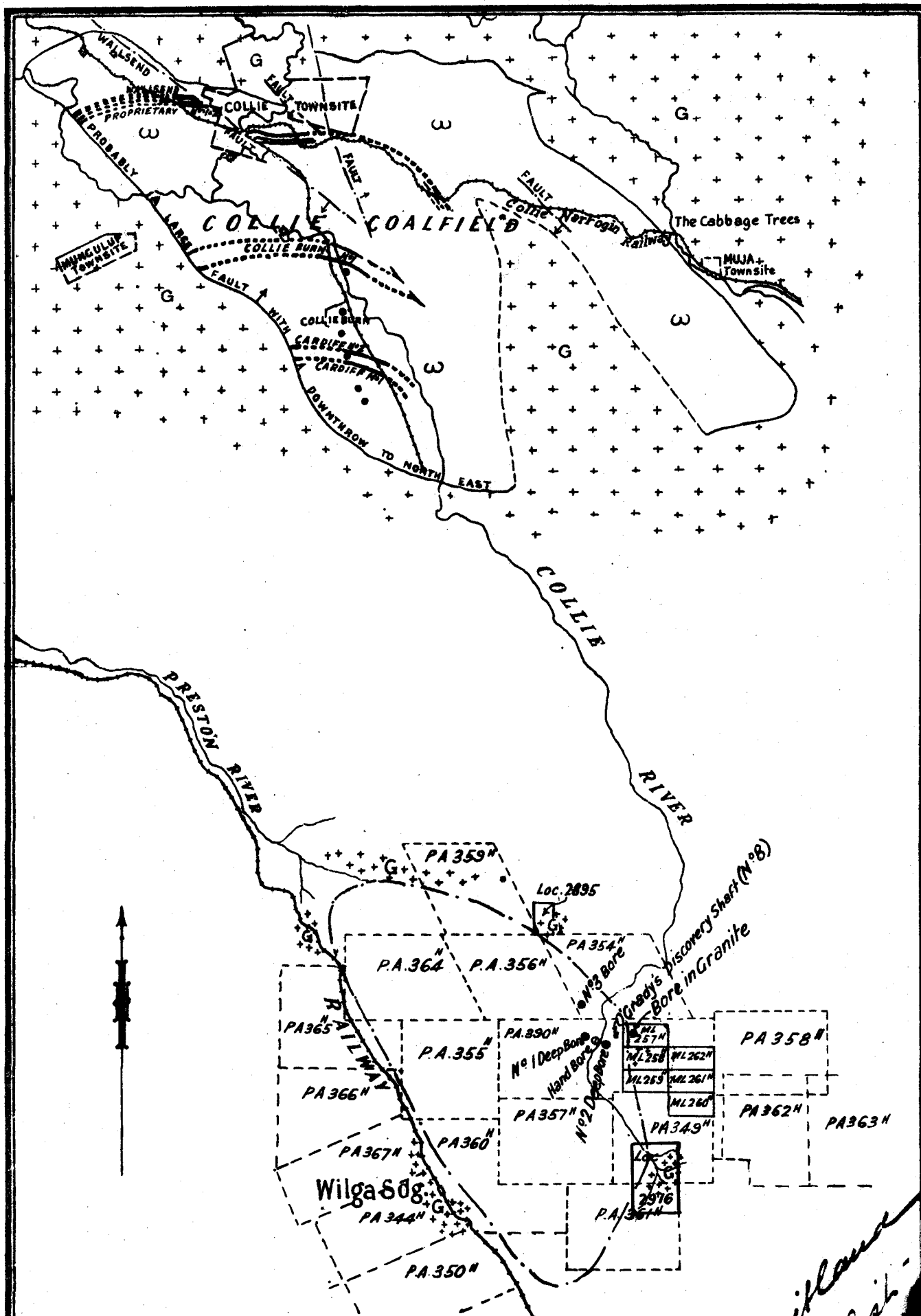
Coal was first found in this coal field by Michael O'Grady, who on the 8th September, 1918, reported having passed through a coal seam 6ft. 6in. thick in his Discovery shaft at a depth of 55 feet.

Fig. 1.

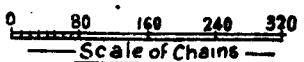


Assistance was granted Mr. O'Grady under the Mining Development Act to carry on further development work, and the results were so encouraging that the Hon. the Minister for Mines

decided, on the recommendation of the State Mining Engineer, to carry out deep boring operations to prove the field.



PLAN OF
WILGA COALFIELD
 shewing relation to Collie Coalfield



Collie River Beds — [W] Granite — [G+]
 Coal Seams — [---] Bores — [•] Diamond Drill — [•] Calyx core

Possible extent of Coal bearing area — [---] at Wilga

*A Giff Maitland
 Geol. Dept. 10/11/19*

This boring has now been completed. Three bores have been put down at sites selected by the State Mining Engineer right through the coal measures to bed rock. A number of coal seams were intersected, the depths and thicknesses of which have been carefully recorded, and an analysis made of the coal.

These results have been communicated to the Press from time to time, but as the information has been somewhat disconnected it seemed advisable to bring it together in a convenient form, and it is with this object that this report has been compiled from official records.

The plans and sections which accompany this report have not previously been published. These will admit if its being more easily understood and will also serve to indicate the significance of the recorded information.

A plan of the Wilga and Collie Districts (Plate I.) shows the close relationship between these two Coal Fields.

The similarity of the coal and of the geological conditions make it very evident that Wilga represents an extension of the Collie Field. There is reason to think that both these areas were part of a much more extensive coal field, and were preserved owing to downward faulting. Outside of these areas the coal and all the strata associated with the coal have been removed by denudation, leaving the

underlying granite now exposed at the surface. These areas now appear as islands on the Geological Plan (Plate I.), and it should always be borne in mind that other similar coal-bearing areas may exist which have not yet been located.

A plan and section (Fig. 3) on a larger scale shows the relative positions of the bores and of the coal seams met with, and is meant to indicate the general geological conditions prevailing.

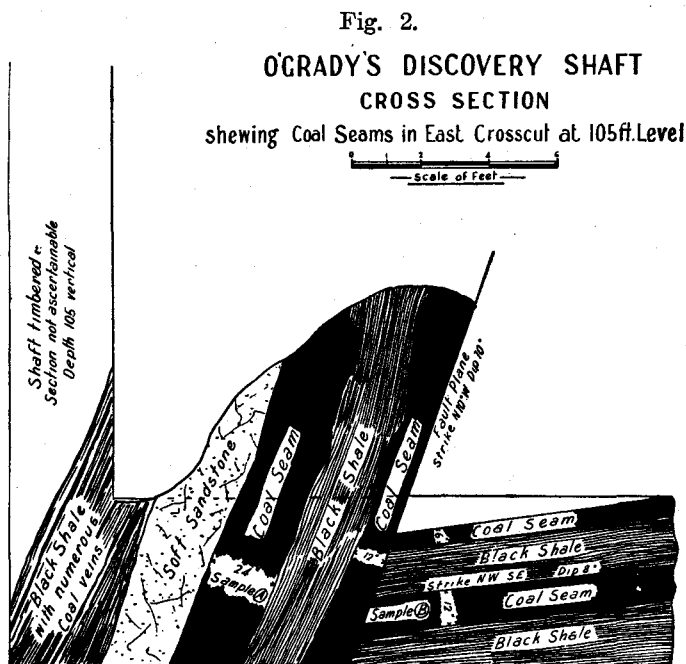
A locality plan (Fig. 1) gives the position of Wilga in respect to our railway system, and shows the transport facilities at present available.

Mr. T. Blatchford's report on O'Grady's Discovery shaft will now be given, followed by the results obtained in the three deep bores, and in a hand bore in the bed of the river.

O'GRADY'S DISCOVERY SHAFT.

In December, 1918, a preliminary investigation was made by Mr. Blatchford, Assistant Geologist, who on his return furnished the following report:—

“In accordance with verbal instructions of the Government Geologist to investigate the late discovery of coal in the vicinity of Wilga, and more particularly to locate the prospector's workings and if possible draw samples from any coal seams, I beg to report as follows:—



Locality of Workings and General Description.

The workings with one exception are situated on the north-west corner of Location 2009, lying at a direct distance of 5½ miles north-east of Wilga Siding.

They consist of eight shafts in all, seven of which have fallen in almost to the surface and are now unsafe and inaccessible. To what depths these shafts were sunk I was unable to ascertain. The last shaft sunk, No. 8, on the accompanying plan, Plate I., has reached a vertical depth of approximately 100 feet. It is close timbered almost to the bottom, which made it impossible to examine the

strata pierced. From hearsay evidence, it appears that two coal seams have been cut in this shaft, one five feet thick at 55 feet, and one four feet thick at 85 feet.

On account of the timber the top seam was not visible. Fortunately, some of the timber opposite the bottom seam was open and part of a section of the lower seam was visible, though the strike, dip, and the exact thickness were not procurable.

The coal seam here is, however, more than three feet thick and a sample was drawn over that dimension, the result of which is appended with Dr. Simpson's remarks.

Taking these results and the general appearance of the coal for a guide, there is every reason to believe that the lower seam is of the same age and quality as several of the Collie River seams; but it is not equal to the higher grade Collie coal. It is certainly not a coking coal.

Extent.—The probable extent of the new coal area cannot be even roughly determined without a more thorough and lengthy examination, for the country in the vicinity is mostly void of outcrops, and for the most part covered with ironstone, gravels, etc.

The presence of a belt of granite striking approximately east and west a short distance north of the workings indicates that, though it is probably a geological replica of the Collie Area, it is not directly connected with that field.

However, there is a certain amount of importance in the discovery, inasmuch as it has increased the probable area in which coal of the Collie River type is likely to be discovered and therefore in that direction increases the State coal reserves."

In August, 1919, Mr. Blatchford again inspected the locality and reported as follows:—

Further Observations on the Wilga Field.

"Since my visit in December, 1918, very little useful work has been done to prospect probable coal bearing area. A certain amount of shallow boring has certainly tested the upper strata, but it is obvious that what is wanted is a deep bore or two to test the ground to depths which the average prospector cannot reach either by sinking or hand boring. Mr. O'Grady has sunk his shaft down to slightly over 100 feet, and opened out a very interesting section. It is clearly seen at the bottom of his shaft and east crosscut that he has sunk close to a very pronounced fault, also that the steep dip of the coal seams cut in the shaft is due to a drag of the ends of the seams on this fault. In the east crosscut he has opened out two seams of coal six and twelve inches thick east of the fault, which strike approximately N.W. and S.E., and dip to the S.W. at an angle of eight degrees. This strike and dip would probably be more likely to be the true strike and dip of the strata of the field than any other, and should be a valuable guide to set out bores or shafts for future prospecting. A section of the shaft and crosscut is as follows:—

From shaft going east to end of crosscut.	
Bottom of shaft in black shale with numerous coal seams, thickness not known but at least	4 feet
Soft sandstone	2 "
Coal seam (Sample A—Result of analysis attached)	2 "
Black shale	2 "
Coal seam	1 foot

The strata up to this point dip to the west at an angle of 70 degrees. Fault plane strike N. 10 degrees W. dip west 70 degrees. From the fault plane on the strike of the strata is N.W.-S.E., with a dip to the S.W. of eight degrees. They consist of black shale with two seams of coal, the top one six inches thick, the bottom one 12 inches. From the latter a sample (B) was taken and analysed. The calorific value of this sample was much lower than the seam (A), which gave a higher calorific value than usual, particularly

when the high moisture is taken into consideration. The results of the analyses are appended. The only other prospecting of any importance is a bore on Block 257H, 280 yards east of O'Grady's which reached a depth of 125 feet in clays and sandstones. On Block 298H (S.E. corner) a shaft 50ft. deep and two bores 75 feet and 110 feet have been sunk. In the shaft after the first few feet of surface detritus is passed a dark shale is pierced, which gradually becomes almost black. These strata have a slight dip to the south of west and, therefore, roughly correspond to the eastern section in O'Grady's shaft. No coal seams were found in these workings.

Another party is sinking a shaft in weathered granite, about ¼ mile east of Wilga siding. The water shaft at the Wilga timber mill is sunk in a weathered dolerite, probably a dyke.

An examination of the surface of the field was made and an attempt to fix, roughly, the boundaries of the likely coal bearing area.

Granite outcrops were found at Wilga Siding and a few miles further north, on the railway line. Also on the north side of the Preston River, and on Block 2895 there is also an unmistakable granite outcrop. Granite is also said to outcrop two miles east of O'Grady's shaft, but I did not see this occurrence or one which I have every reason to believe exists on Block 2916 further south. The area of the field may, therefore, reasonably be allowed to be at least more than 24 square miles, and probably much greater, quite large enough to prove a valuable coal field.

With reference to the Government Geologist's suggestions that a detailed geological survey be made, I feel sure that the accompanying map is what is deemed necessary, and will be sufficient for the present especially as further detail for a survey will depend entirely on that supplied by the bores.

Boring.—If the suggested deep boring be undertaken, it is apparent that one of the first sites to choose is one, say, 800 to 1,000 yards east of trench mark C. 54. Any other sites should be chosen when the results of the first bore are known. To bore east of O'Grady's is to test the unproved strata, whereas it would be far more beneficial to test the known coal-bearing strata on the west first, particularly as one of the lower seams west of the fault has given the highest calorific value."

The Assay Certificate from the Laboratory of the Geological Survey gives the following results:—

Sample A—	
Bottom seam, O'Grady's	Moisture 17.06 %
Coal mine W. of fault	Calorific value, 10458 B.T.U.
Sample B—	
Seam in E. crosscut, O'Grady's	Moisture 17.04 %
Coal mine	Calorific value, 8322 B.T.U.

With regard to the quality of the coal in the shaft Dr. Simpson states:—

"This is a thin bedded coal of the hydrous bituminous class, similar in all respect to that found in the lower parts of the Collie basin. It loses moisture rapidly on exposure to the air, increasing thereby in calorific value, but losing cohesion to large extent. It does not cake when retorted."

No. 1 DEEP BORE

In view of the encouraging results met with in O'Grady's shaft, the Government decided to undertake sufficient deep boring to test the field at sites to be selected by the State Mining Engineer. The site selected for the first deep bore was 1,100 yards south of west from O'Grady's Discovery shaft.

The work was carried out by the Department of Public Works Water Supply. The foreman in charge of the boring operations supplied the Mines Department with the following log:—

Depth.		Thickness.	Description of Strata.
ft. in.	ft. in.	ft. in.	
0	0 to 7	7	0 Ironstone gravel.
7	0 ,, 20	13	0 Ironstone conglomerate.
20	0 ,, 27	7	0 Grey clay.
27	0 ,, 29	2	0 Ironstone conglomerate.
29	0 ,, 34	5	0 Grey clay.
34	0 ,, 39	5	0 Coarse sand.
39	0 ,, 42	3	0 Shale.
42	0 ,, 47	5	0 Sandy shale.
47	0 ,, 48	1	6 Coal.
48	6 ,, 60	11	6 Sandy shale with quartz boulders.
60	0 ,, 66	6	0 Greasy shale.
66	0 ,, 69	3	0 Coal with carbonaceous shale bands.
69	0 ,, 73	4	0 Hard sandy shale.
73	0 ,, 79	6	0 Coarse sandstone.
79	0 ,, 87	8	0 Sandstone.
87	0 ,, 92	5	0 Coal.
92	0 ,, 93	1	0 Carbonaceous shale.
93	0 ,, 99	6	0 Sandy shale.
99	0 ,, 109	10	0 Sandstone.
109	0 ,, 110	1	0 Carbonaceous shale.
110	0 ,, 112	2	0 Puggy shale.
112	0 ,, 119	7	6 Sandstone.
119	6 ,, 127	7	6 Carbonaceous shale with coal bands.
127	0 ,, 130	3	0 Sandy shale.
130	0 ,, 133	3	6 Sandstone.
133	6 ,, 136	2	6 Coal with band of stone in middle.
136	0 ,, 138	2	0 Sandy shale.
138	0 ,, 149	11	0 Sandstone.
149	0 ,, 150	1	0 Coal.
150	0 ,, 152	2	0 Sandy shale.
152	0 ,, 181	29	0 Sandstone.
181	0 ,, 185	4	0 Carbonaceous shale with coal seam.
185	0 ,, 186	1	0 Sandy shale.
186	0 ,, 187	1	0 Coal.
187	0 ,, 191	4	0 Black shale.
191	0 ,, 276	85	0 Sandstone.
276	0 ,, 279	3	0 Sandy shale.
279	0 ,, 318	39	6 Sandstone.
318	6 ,, 320	1	6 Carbonaceous shale.
320	0 ,, 323	3	0 Shale.
323	0 ,, 362	39	6 Sandstone.
362	6 ,, 379	16	9 Greasy shale.
379	3 ,, 380	0	9 Hard band.
380	0 ,, 381	1	6 Hard dark sandstone.
381	6 ,, 382	0	6 Granite boulder.
382	0 ,, 390	8	0 Hard dark sandstone.
390	0 ,, 405	15	0 Hard grey shale with fine sandstone seams.
405	0 ,, 406	1	0 Grey shale.
406	0 ,, 406	0	6 Hard mudstone band.
406	6 ,, 408	2	0 Dark shale.
408	6 ,, 409	0	6 Hard mudstone band.
409	0 ,, 413	4	0 Dark shale.
413	0 ,, 467	54	0 Brown shale with hard seams.
467	0 ,, 469	2	8 Brown shale.
469	8 ,, 470	0	7 Lime and mudstone band.
470	3 ,, 479	9	3 Brown shale.
479	6 ,, 480	0	6 Lime and mudstone band.
480	0 ,, 484	4	8 Brown shale.
484	8 ,, 485	0	7 Lime and mudstone band.
485	3 ,, 498	13	6 Brown shale.
498	9 ,, 499	0	9 Lime and mudstone band.
499	6 ,, 504	5	0 Hard grey shale.

No. 1 DEEP BORE—continued.

Depth.		Thickness	Description of Strata.
ft. in.	ft. in.	ft. in.	
504	6 to 515	10	6 Hard grey shale.
515	0 ,, 516	1	0 Lime and mudstone band.
516	0 ,, 519	3	9 Hard grey shale.
519	9 ,, 520	1	0 Lime and mudstone band.
520	9 ,, 529	8	6 Hard grey shale.
529	3 ,, 530	0	9 Lime and mudstone band.
530	0 ,, 540	10	0 Hard grey shale.
540	0 ,, 540	0	6 Granite boulder.
540	6 ,, 545	4	6 Hard grey shale.
545	0 ,, 548	3	6 Hard grey shale with granite boulders.
548	6 ,, 555	7	0 Sandstone conglomerate and granite boulders.
555	6 ,, 561	6	0 Fine sandstone.
561	6 ,, 598	37	0 Hard sandstone conglomerate with granite and quartz boulders.

The analyses of the coal seams met with are as follows:—

Coal Seam at depth 87-92 feet—

Thickness	.. .. .	5ft. 0in.
Proximate Analysis—		
Moisture	.. .. .	13.12
Volatile hydro carbon	.. .. .	36.71
Fixed carbon	.. .. .	43.76
Ash	.. .. .	6.41
100.00		

Calorific value	.. .. .	B.T.U. 9502
Calorific value, moisture free	.. .. .	B.T.U. 10937
Calorific value, ash and moisture free	.. .. .	B.T.U. 11808

Coal Seam at depth 187 feet—

Thickness	.. .. .	1ft. 0in.
Analysis—		
Per cent.		
Moisture	.. .. .	10.65
Volatile hydro carbons	.. .. .	35.64
Fixed carbon	.. .. .	45.24
Ash	.. .. .	8.47
Colour of ash	.. .. .	Light red brown
Calorific value	.. .. .	9463

A complete analysis of a sample of shale from a depth of 469 feet was made by Dr. Simpson, giving the following result:—

	per cent.
SiO ₂	63.61
Al ₂ O ₃	15.45
Fe ₂ O ₃	2.90
FeO	3.10
MnO	.14
MgO	2.66
CaO	Nil
Na ₂ O	.43
K ₂ O	4.87
H ₂ O—	1.77
H ₂ O +	4.20
TiO ₂	.76
CO ₂	.04
P ₂ O ₅	.22
FeS ₂	Trace
Cl	Trace
Organic	.28
100.43	

A cone prepared from this shale reached the stage of advanced vitrification at 1,050 degrees centigrade, and following temperature at 1,200 degrees C., at which temperature most micaceous clays melt.

The shale would be classified for technical purposes as a "terra cotta" clay, and would be used in the manufacture of roofing tiles and other terra cotta ware, and vitrified pipes.

The following are determinations of the strata met with in boring, examined by the Petrologist, Mr. R. A. Farquharson:—

ft. in.	
469	0—Brown shale with conchoidal fracture and velvety feel.
530	0—Fine-grained impure (shaly) limestone band.
535	0—Finely banded grey shale.
540	6—Microcline granite boulder.
545	0—Fine-grained shale with decomposed granitic boulders.
547	0—Grey shale and shaly grit intermixed.
548	0—Loose conglomerate wash with fragments of granite, ironstone, quartz, etc.
569	0—A much decomposed amphibolised and chloritised fine-grained quartz-dia-base or quartz-dolerite.
580	0 (approximately)—A very coarse epidotised, zoisitised and chloritised epidiorite of dioritic structure.

The Basal Limestone Band—

This is a fine-textured granular limestone containing fragments of quartz, of felspar and of quartzite with a few scales of green chlorite. Despite a careful search of several sections, no trace of organic remains, whether of calcareous algae, glauconite, foraminifera, or shells, could be found.

No. 2 DEEP BORE.

This bore was also put down on the west side of O'Grady's Discovery shaft, but nearer to the shaft, and a little further south. Its exact position is given as 473 yards in a direction of S. 58 degrees W. from O'Grady's shaft. Considerably more coal was met with in this bore than in the No. 1 deep bore and at a noticeably greater depth. The first coal met with was at 148ft. 6in., and the last at 476 feet. It is not at all easy to say which seams in this bore correspond with those met with in No. 1 bore or in O'Grady's Discovery shaft, and it seems probable that a fault occurs between No. 1 and No. 2 deep bores, causing the coal to be found at the greater depth in the No. 2.

The log of the bore is given by the foreman in charge of the boring as follows:—

Depth.		Thickness.	Description of Strata.
ft. in.	ft. in.	ft. in.	
Surface to	4 0	4 0	Sand.
4 0 "	6 0	2 0	Ironstone gravel.
6 0 "	62 6	56 6	White sandy clay.
62 6 "	63 0	0 6	Limestone conglomerate.
63 0 "	102 0	39 0	Yellow clay.
102 0 "	129 0	27 0	Soft sandstone.
129 0 "	138 0	9 0	Dark sandy shale.
138 0 "	143 0	5 0	Compressed sand.

No. 2 DEEP BORE—continued.

Depth.		Thickness.	Description of Strata.	
ft. in.	ft. in.	ft. in.		
143	0 to 148	6	Soft grey sandstone.	
148	6 "	149	0	6 Coal, No. 1 seam.
149	0 "	150	0	1 Dark shale.
150	0 "	160	6	10 Soft grey sandstone.
160	6 "	163	6	3 Coal, No. 2 seam.
163	6 "	165	0	1 Dark sandy shale.
165	0 "	166	0	1 Sandstone.
166	0 "	167	0	1 Dark sandy shale.
167	0 "	170	6	3 Hard coarse sandstone.
170	6 "	173	6	3 Carbonaceous shale with coal bands.
173	6 "	179	0	5 Fine sandstone.
179	0 "	191	0	12 Coarse sandstone.
191	0 "	191	6	0 Carbonaceous shale.
191	6 "	196	0	4 Sandstone.
196	0 "	197	6	1 Black shale.
197	6 "	219	0	21 Hard sandstone.
219	0 "	220	6	1 Sandy shale.
220	6 "	222	0	1 Coal, No. 3 seam.
222	0 "	234	6	12 Sandstone.
234	6 "	236	0	1 Shale.
236	0 "	259	0	23 Soft sandstone.
259	0 "	268	6	9 Sandstone.
268	6 "	277	6	9 Coal, No. 4 seam.
277	6 "	279	6	2 Black shale.
279	6 "	283	6	4 Sandy shale.
283	6 "	287	0	3 Black shale.
287	0 "	293	0	6 Sandstone.
293	0 "	295	0	2 Sandy shale.
295	0 "	300	0	5 Sandstone.
300	0 "	303	0	3 Coal, No. 5 seam.
303	0 "	304	0	1 Grey shale.
304	0 "	304	6	0 Coal, No. 6 seam.
304	6 "	308	0	3 Shale.
308	0 "	311	3	3 Conglomerates, quartz pebbles and sandstone.
311	3 "	316	0	4 Black shale.
316	0 "	328	0	12 Hard sandstone.
328	0 "	338	4	10 Hard sandstone.
338	4 "	343	6	5 Coal, No. 7 seam.
343	6 "	345	0	1 Carbonaceous shale.
345	0 "	345	8	0 Coal, No. 8 seam.
345	8 "	346	8	1 Hard band.
346	8 "	348	0	1 Sandy shale.
348	0 "	359	0	11 Sandstone.
359	0 "	365	6	6 Coal, No. 9 seam.
365	6 "	368	0	2 Black shale.
368	0 "	376	9	8 Sandstone.
376	9 "	382	9	6 Coal, No. 10 seam.
382	9 "	388	0	5 Sandy shale.
388	0 "	392	0	4 Fine sandstone.
392	0 "	394	6	2 Coal, No. 11 seam.
394	6 "	395	3	0 Black shale.
395	3 "	397	0	1 Fine sandstone.
397	0 "	401	0	4 Shale.
401	0 "	406	0	5 Soft sandstone.
406	0 "	411	0	5 Coarse sandstone.
411	0 "	414	8	3 Coal, No. 12 seam.
414	8 "	416	0	1 Shale.
416	0 "	420	0	4 Fine sandstone.
420	0 "	426	0	6 Sandstone (soft).
426	0 "	426	6	0 Coal, No. 13 seam.
426	6 "	428	0	1 Shale.
428	0 "	447	8	19 Soft sandstone.
447	8 "	450	0	2 Fine sandstone.
450	0 "	451	0	1 Sandy shale.
451	0 "	458	6	7 Soft sandstone.
458	6 "	459	3	0 Shale.
459	3 "	461	9	2 Carbonaceous shale.
461	9 "	462	9	1 Sandstone.
462	9 "	468	0	5 Sandy shale.
468	0 "	491	9	23 Soft sandstone with pyrites.
491	9 "	493	0	1 Sandy shale.
493	0 "	498	0	5 Sandstone.
498	0 "	498	6	0 Shale.
498	6 "	516	0	17 Hard sandstone.
516	0 "	534	0	18 Grey pugy shale.
534	0 "	543	0	9 Grey shale.
543	0 "	550	6	7 Blue clay and decomposed granite.

The analyses of the principal coal seams met with are as follows:—

COAL SEAMS IN No. 2 BORE.

Seam No.	Depth.		Thick-ness.	Moist-ure.	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	Calorific Value.			Remarks.
								As received B.T.U.	Moisture free calculation B.T.U.	Moisture and ash free calculation B.T.U.	
	ft. in.	ft. in.	ft. in.	%	%	%	%	%	%	%	
2	160 6 to	163 6	3 0	12.27	33.63	33.38	20.72	8553	8748	12764	Whole seam.
3	220 6 „	222 0	1 6	16.07	28.39	41.66	13.88	8689	10353	12404	do.
4	268 6 „	270 6	2 0	19.29	30.24	40.29	10.18	8509	10542	12064	Upper section.
	270 6 „	273 0	2 6	19.74	31.23	43.02	6.01	9224	11492	12422	2nd section.
4	273 0 „	275 6	2 6	19.33	32.47	39.47	8.73	8802	10911	12235	3rd section.
	275 6 „	277 6	2 0	19.57	30.06	44.26	6.12	8944	11120	12036	Lower section.
4	268 6 „	277 6	9 0	19.32	32.40	41.01	7.27	8852	10972	12058	Average of whole seam.
5	300 0 „	303 0	3 0	18.50	25.73	37.86	17.91	7068	8675	10957	Whole seam.
7	338 4 „	343 6	5 2	20.61	25.56	37.90	15.93	7583	9551	11948	do.
8	345 0 „	345 8	0 8	21.63	20.65	36.26	21.46	6905.	8810	12133	do.
9	359 0 „	362 0	3 0	27.37	26.76	34.60	11.27	7590	10450	12369	Upper section.
	362 0 „	365 6	3 6	27.90	24.66	40.51	6.93	8012	11112	12294	Lower section.
9	359 0 „	365 6	6 6	27.24	27.76	36.12	8.88	7838	10772	12269	Average of whole seam.
10	376 9 „	379 9	3 0	28.91	29.86	34.24	6.99	8104	11399	12642	Upper half.
10	379 9 „	382 9	3 0	27.56	33.23	30.26	8.95	8194	11311	12905	Lower half.
	376 9 „	382 9	6 0	27.65	29.45	35.06	7.84	8199	11332	12709	Average of whole seam.
11	392 0 „	394 6	2 6	23.88	30.60	37.07	8.45	8707	11438	12866	(Unreliable sample; portion of core lost).
12	411 0 „	414 8	3 8	28.60	32.70	33.52	5.18	8608	12056	12999	do. do.

Samples from the bottom of this bore were examined by Mr. R. A. Farquharson, Petrologist, who reported as follows:—

"I have examined these specimens and find that they consist of a very coarse conglomerate or 'wash' composed of large and small pebbles of decomposed greenstone (quartz epidiorite of quartzdiorite) in a

matrix of detritus from a greenstone probably of the same character as the pebbles. It will be noted that on 13th December, 1920, I determined similar rocks from depths 569ft. and 590ft. in No. 1 Bore, *i.e.*, chloritised epidiorite and amphibolised quartz diabase or quartz epidiorite."

No. 3 DEEP BORE.

It was first intended to put down this bore at a point about half a mile east of No. 2 bore, but as it was found that granite would be met with at a shallow depth another site was selected, and the bore was started at a point one mile northwest of O'Grady's shaft.

The log forwarded by the foreman in charge of the boring operations was as follows:—

Depth.		Thickness.	Description.
ft. in.	ft. in.	ft. in.	
12 0 to	19 0	7 0	Yellow clay.
19 0 „	34 0	15 0	Grey clay and ironstone boulders.
34 0 „	38 0	4 0	Ironstone.
38 0 „	48 0	10 0	Black sandy shale.
48 0 „	51 0	3 0	Grey pug with quartz boulders.
51 0 „	68 0	17 0	Soft sandstone.
68 0 „	80 0	12 0	Shale.
80 0 „	81 6	1 6	Coal, No. 1 seam.
81 6 „	86 9	5 3	Soft sandy shale.
86 9 „	87 6	0 9	Hard band ironstone.
87 6 „	110 6	23 0	Soft reddish sandstone.
110 6 „	113 0	2 6	Coal, No. 2 seam.
113 0 „	141 0	28 0	Fine soft sandstone.
141 0 „	150 0	9 0	Soft yellow sandstone.
150 0 „	169 0	19 0	Fine soft sandstone.
169 0 „	174 0	5 0	Coal, No. 3 seam.
174 0 „	179 0	5 0	Black shale.
179 0 „	183 0	4 0	Sandy shale.
183 0 „	184 0	1 0	Carbonaceous shale.
184 0 „	189 6	5 6	Hard sandstone.
189 6 „	196 4	6 10	Coal, No. 4 seam.
196 4 „	199 0	2 8	Sandy shale.
199 0 „	216 0	17 0	Soft sandstone.
216 0 „	219 0	3 0	Coal, No. 5 seam.
219 0 „	222 3	4 3	Sandy shale.

RECORD OF BORING—continued.

Depth.		Thickness.	Description.
ft. in.	ft. in.	ft. in.	
222 3 to	228 0	5 9	Coal, No. 6 seam.
228 0 „	230 6	1 6	Sandy shale.
230 6 „	235 6	5 0	Hard sandstone.
235 6 „	238 0	2 6	Coal, No. 7 seam.
238 0 „	241 6	3 6	Sandy shale.
241 6 „	249 8	8 2	Hard sandstone.
249 8 „	253 3	3 7	Coal, No. 8 seam.
253 3 „	255 3	2 0	Shale.
255 3 „	281 0	25 9	Sandstone.
281 0 „	286 5	5 5	Carbonaceous shale with coal seams.
286 5 „	287 6	1 1	Shale.
287 6 „	293 10	6 4	Coal, No. 9 seam.
293 10 „	295 0	1 2	Shale.
295 0 „	301 10	6 10	Hard sandstone.
301 10 „	304 11	3 1	Coal, No. 10 seam.
304 11 „	333 0	28 1	Hard sandstone.
333 0 „	341 6	8 6	Shale.
341 6 „	347 8	6 2	Hard sandstone.
347 8 „	349 0	1 4	Coal, No. 11 seam.
349 0 „	351 0	2 0	Sandy shale.
351 0 „	355 4	4 4	Sandstone.
355 4 „	358 0	2 8	Shale.
358 0 „	370 0	12 0	Hard sandstone.
370 0 „	470 6	100 6	Sandstone.
470 6 „	471 0	0 6	Carbonaceous shale.
471 0 „	535 4	64 4	Fine sandstone.
535 4 „	565 6	30 2	Brown shale.
565 6 „	566 0	0 6	Mudstone band.
566 0 „	570 0	4 0	Brown shale.
570 0 „	570 6	0 6	Mudstone band.
570 6 „	590 0	19 6	Brown shale.
590 0 „	596 0	6 0	Brown and grey shale.
596 0 „	607 0	11 0	Conglomerate with granite boulders.
607 0 „	608 0	1 0	Granite.

The analyses of the coal seams met with in the bore are given in the following table:—

ANALYSES OF COAL SEAMS MET WITH IN NO. 3 DEEP BORE.

Coal Seam No.	Depth.		Thick-ness.	Distance between seams.	Analysis.				Calorific Value.			After drying for five days.		Remarks.
					Moist-ure.	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	As re-ceived. B.T.U.	Moist-ure free (calcu-lated) B.T.U.	Moist-ure and ash free (calcu-lated) B.T.U.	Moist-ure.	Cal. Val. B.T.U.	
1	ft. in.	ft. in.	ft. in.	ft. in.	%	%	%	%	%	%	%	%	%	
	80 0 to	81 6	1 6	...	12.58	30.76	27.87	28.79	6959	7960	11870	9.29	7221	
2	110 6 "	113 0	2 6	29 0	7.50	27.59	46.21	8.70	8918	10810	12084	12.80	9427	
	169 0 "	174 0	5 0	56 0	17.14	29.22	47.63	6.01	9205	11109	11978	12.47	9725	
3	189 6 "	196 4	6 10	15 6	14.83	28.74	40.17	16.26	8307	9753	12055	10.86	8693	Top half.
4				19 8	16.48	32.83	44.76	5.93	9913	11869	12776	13.38	10399	Bottom half.
5	216 0 "	219 0	3 0	3 3	17.15	31.62	37.60	13.63	8531	10297	12324	12.50	9010	
6	222 3 "	223 0	5 9	7 6	18.82	29.87	44.34	6.97	9073	11177	12226	13.65	9650	Top half.
				11 8	18.90	30.92	42.11	8.07	8642	10656	11833	13.44	9224	Bottom half.
7	235 6 "	233 0	2 6	3 3	19.09	33.22	39.15	8.54	9072	11212	12535	13.66	9681	
8	249 8 "	253 3	3 7	34 3	19.61	31.10	40.61	8.68	8537	10619	11905	13.20	9218	
9	287 6 "	293 10	...	8 0	20.38	31.59	36.94	11.09	8532	10716	12450	12.12	9418	Top Section.*
				42 9	20.31	34.41	37.19	8.09	8888	11153	12413	13.39	9660	Middle Section.*
				...	19.43	35.87	35.50	9.20	9077	11266	12718	13.41	9755	Bottom Section.*
10	301 10 "	304 11	3 1	...	18.63	32.58	44.07	4.77	8960	11011	11697	13.68	9505	
11	347 8 "	349 0	1 4	...	18.18	30.12	46.81	4.89	9462	11564	12300	13.47	10006	

NOTE.—The samples from coal seams No. 1 to No. 4 had been stored in the core boxes for several months before analysis, and consequently contained several per cent. less moisture than they had when fresh out of the ground. * Three equal portions.

HAND BORE IN RIVER BED.

A 5ft. seam of coal was met with at a depth of 36 feet in a hand bore put down in the bed of the river 11 chains east of No. 1 bore. The results of analysis were as follows:—

Moisture	.. .. .	per cent.	19.07
Volatile hydro-carbons	.. .. .	.. .. .	33.83
Fixed carbon	.. .. .	.. .. .	39.73
Ash	.. .. .	.. .. .	7.37

100.00

Calorific value B.T.U. (as received)	.. .. .	9266
Calorific value—Moisture free	.. .. .
B.T.U.	.. .. .	11449
Moisture and ash free B.T.U.	.. .. .	12596

Colour light red brown with white particles. In a footnote accompanying his assay certificate Dr. Simpson states:—"This coal is of the Collie type and lost an appreciable amount of weight in a short time on exposure to air. It would, therefore, be drier and have a higher calorific value by the time it was actually used as a fuel."

COMPARISON OF THE WILGA COALS WITH THOSE OF COLLIE.

For comparative purposes the following figures are instructive. They give the average results of analyses of the coals of the Collie Coal Field made by Mr. J. H. Boas, of the Technical School, on behalf of the Royal Commission on the Collie Industry of 1914.

Table of average results of the analyses of the coals of the Collie Coal Field:—

Colleries.	Co-oper-ative.	West-ralian.	Propri-etary.	Scottish.	Cardiff.
Ash	7.69	8.12	6.40	3.95	4.50
Moisture	19.26	19.30	24.70	24.70	25.10
Sulphur	0.42	0.50	0.40	0.04	0.78
Nitrogen	1.12	1.13	1.15	1.04	0.92
Volatile hydrocarbons	26.40	26.90	26.20	38.30	32.10
Calorific value B.T.U. (as received)	9803	9779	9112	9354	8988
Calorific value B.T.U. moisture free	12141	12117	12100	12422	12000
Calorific value B.T.U. ash and moisture free	13374	13486	13231	13079	12874

The Collie coals all belong to one general class, but Dr. Simpson has divided them into two types which he designates as the Proprietary and the Collie Burn.

The following table gives the mean composition of these two types of Collie coal:—

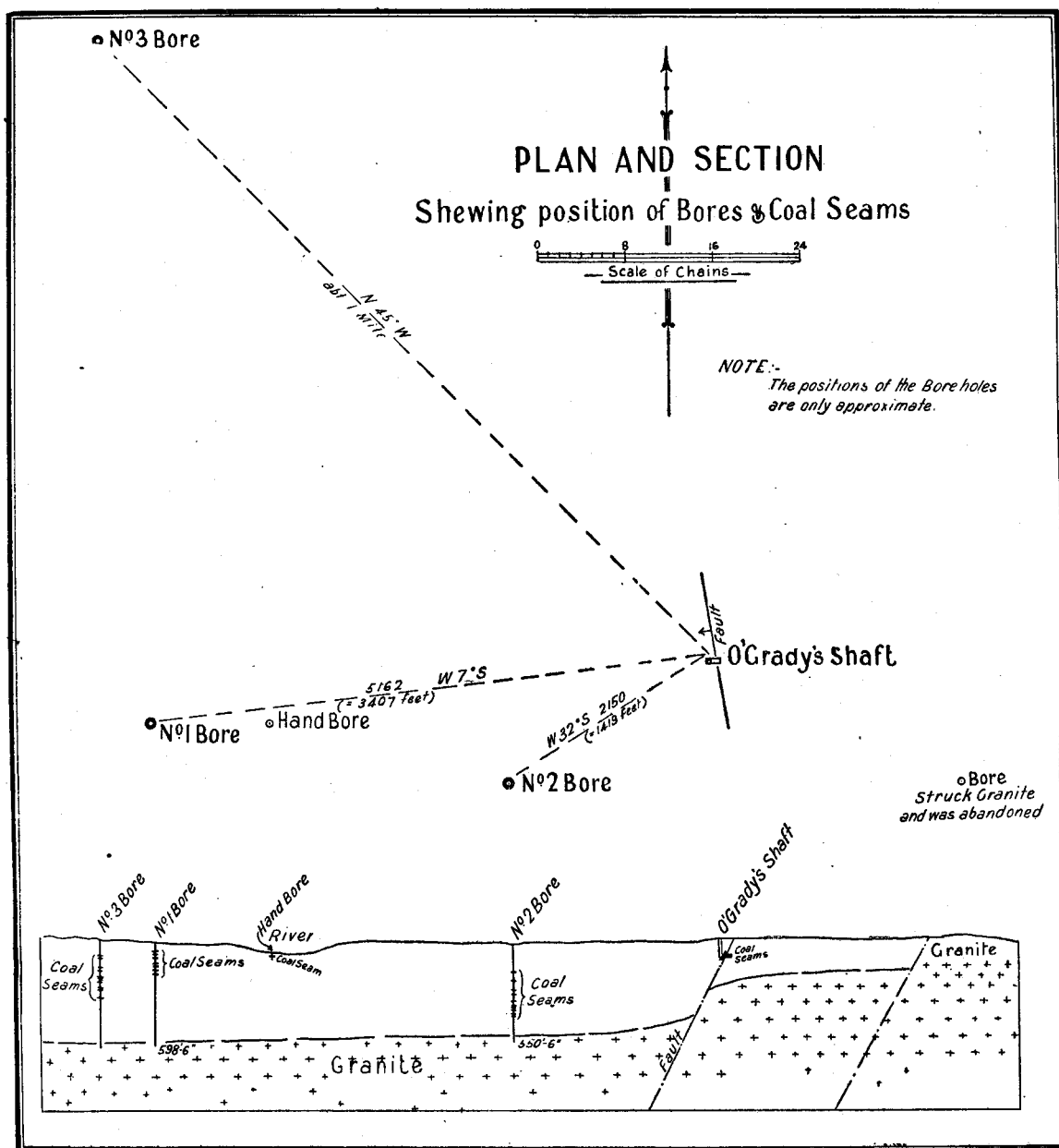
Proximate Analysis.	Proprietary Type.	Collie Burn Type.
Moisture	18.62	23.32
Volatile hydro-carbons	24.79	32.17
Fixed carbons	48.48	40.20
Ash	8.11	4.31
Totals	100.00	100.00
Calorific Value—		
1. As received	9695	9516
2. Excluding moisture	11911	12409
3. Excluding ash and moisture	13232	13149

The analyses indicate the similarity of the Wilga and the Collie coals. As far as quality is concerned it will be noted that the coal obtained from the bottom half of No. 4 Seam in No. 3 Deep Bore and from one of the seams in O'Grady's shaft (Sample A) had a higher calorific value than the general average of the Collie coals, but that most of the coal seams met with have proved to be just a little lower than the best at Collie.

POSSIBLE AREA OF THE FIELD.

Mr. Blatchford has shown, roughly, the limits of the field by mapping the outcrops of granite which surround it. He came to the conclusion that the area might be at least 24 square miles. Further information is, however, required before anything very definite can be said in this regard. In the meantime quite a large tonnage of coal would seem to be assured, and all new work will, if carefully plotted, assist us in arriving at the true extent and value of this new coal field.

Fig. 3.



7.—MANGANESE ORE AT MOUNT WALTON, COOLGARDIE GOLDFIELD.

(R. C. Wilson, B.Sc., B.E.)

In accordance with instructions a visit was paid to Mr. Reid's manganese deposit, near Wallangie, on the Coolgardie Goldfield, in company with Mr. R. Slee, of the Broken Hill Proprietary, and Inspector Gourley. The find is situated near the end of the Kurrawang woodland, on the main range of hills about six miles north by east of Wallangie Rock. The Wallangie greenstone belt extends from Mount Walton in a northnorthwesterly direction for about 62 miles. For about 40 miles it is five miles wide, and tapers at each end. The surface of the greenstone area traversed to reach the deposit consists of a rich reddish brown clay soil, covered with an extensive gum forest, and no sign of outcrop was seen. Mr. Talbot, in the Annual Progress Report of the Geological Survey for the year 1919, reports that here and there there are unweathered outcrops which show that the rocks are similar to those usually found

in the greenstone belts of the eastern goldfield, and that they consist of epidiorites, hornblendites and jasper. A strong jasper bar forms a conspicuous ridge, running for some miles along the greenstone belt. The top of the hill is 300 feet above the surrounding flat country, and consists of banded jasper with occasional patches of specular iron. The first outcrop of manganese ore seen by us occurs on the western slope of this jasper bar. A few shots have been fired here, exposing it for a width of 16 feet 6 inches. This manganese ore consists of psilomelane, with small seams of ironstone. The samples taken across this deposit in sections gave an average value of 27.8 per cent. metallic manganese. An attempt has been made to separate the ore into two grades, firsts and seconds, by hand-picking. This resulted in a much improved product. A sample of the dump, Sample No. 4, assayed 48.27 per cent. manganese.

Details of the sampling were:—No. 1, west section, 42in. wide, 22.07 per cent. manganese; No. 2, middle section, 78in. wide, 27.75 per cent. manganese; No. 3, east section, 78in. wide, 31.14 per cent. manganese;

or an average value over the full width of 198 in. of 27.8 per cent. manganese. No. 4 sample of dump, 48.27 per cent. manganese.

About 100 yards north of east from this outcrop, and higher up the hill, there is another deposit which can be seen outcropping for a length of 42 feet and a breadth of 20 feet. Curiously enough, this manganese ore consisted for the most part of polianite. Two samples (No. 5 and No. 6) were taken from this outcrop, one of which was exceptionally rich. The assay results were: No. 5, 20 ft. width, 57.39 per cent. manganese, taken at 100 yards from the first outcrop; No. 6, 20 ft. width, 37.15 per cent. manganese, taken at 114 yards from the first outcrop. From the above it will be noted that with a little picking a good grade manganese ore can be obtained.

No very great quantity of ore can be assumed until the deposit has been further opened up. Deposits of this nature are frequently lateritic in character, *i.e.*, forming a capping only of limited thickness. It might be mentioned that ores containing from 40 to 45 per cent. of the metal are saleable, but that a minimum of 45 per cent. ore should be aimed at, and every 1 per cent. above this minimum greatly improves the value of the ores. Lime is not objected to in an ore, and is sometimes paid for. Silica is penalised when it exceeds 8 or 9 per cent. Phosphorus should not exceed 0.20 per cent. The English price of manganese ore is now about 1s. 4d. per unit, equal to £3 6s. 8d. per ton of 50 per cent. ore.

The Broken Hill Proprietary, it is understood, will require about 5,000 tons of ore per week for steel manufacture, consequently the value of the manganese ore may be governed to some extent by the price that this company can obtain it from other sources.

8.—THE LIONEL ASBESTOS FIELD, PILBARA GOLDFIELD.

(E. S. SIMPSON, D.Sc., B.E., F.C.S.)

When recently accompanying Prof. Sir Edgeworth David on a flying trip to the Pilbara Goldfield, I was able to spend a few hours on the new asbestos field between Nullagine and Marble Bar. This locality has been named "Lionel" by the people chiefly interested in it.

Lionel lies $1\frac{1}{2}$ miles east of the main Nullagine-Marble Bar road, being 18 miles from Nullagine and about 55 from Marble Bar. A good road runs all the way from both towns to the small settlement on M.L. 18, and from this a fair road has been made to M.L. 22, about one mile farther to the north-east.

The asbestos leases lie in rough mountainous country forming an outlying mass surrounded by undulating country. The latter is composed partly of rocks of the Mosquito Creek series and partly of overlying lavas near the base of the Nullagine Series. The asbestos area is composed of a mass of serpentine said to be about three miles square, against which jasper conglomerate of the Mosquito Creek Series is seen to abut on the road to Hale's Well a little south of Lionel. The following is a technical description by the Petrologist of the serpentine rock:—

1/3282: A. Serpentine from surface M.L. 18, Lionel.

A granular rather pistachio-green rock composed of numerous yellowish-green grains and a few more or less columnar black forms. If the rock is split in one direction there is a sheen on some of the faces of the minerals. In section the rock is almost wholly composed of crystals

of two forms: (a) large platy or columnar, with or without indistinct parallel cleavage traces marked by rows of small black dots of iron ore, or with the interior covered by a fine black dust; (b) smaller rounded and elliptical or ovoid, some covered with a fine black dust. All the forms are completely serpentinised, but the larger in all probability represent former plates of enstatite and the smaller represent former olivine grains. In places wrapping round both forms are shapeless plates of a chlorite referred to pennine. A few grains of a black ore occur, of which some appear to be brownish by transmitted light, and are therefore referable to chromite.

The rock in my opinion was originally an enstatite-peridotite, which by failure of the enstatite would pass into a dunite.

1/3281: B. Serpentine from freshwater well, Lionel.

This is a nearly black granular serpentine seamed with numerous thin asbestos veinlets approximately parallel to one another.

In section the rock consists, as in A, of large platy and rectangular and smaller more or less rounded forms completely serpentinised, the former with parallel rows of black iron ore or an aggregate of fine black dust, the latter with and without fine black dust. A few large plates of a carbonate (magnesian) occur in places in the section and a few larger grains of black ore, slightly brownish by transmitted light. The structure and composition of the rock is very similar to that in A (except for the presence of carbonate), and there is little doubt that B has also been derived from an enstatite-peridotite.

Both rocks, therefore, are similar in origin, but B probably contained more rhombic pyroxene and less olivine than A.

The serpentine mass is traversed by silicified bands which stand out plainly like narrow dykes, and also by shear zones which are inconspicuous at the surface. In these latter chrysotile asbestos of the highest commercial quality is developed. These asbestos lodes where seen were found to be from 2 feet to 6 feet wide and to consist of innumerable parallel or anastomosing veins divided by narrow lenticular masses of the massive serpentine rock. The appearance of a typical lode is shown in a photograph which was taken at the face of a costean on M.L. 22. The lodes strike approximately north-west, and usually curve somewhat in horizontal section. The dip varies from 90° to 35°. The lode seen on M.L. 18 was about 100 feet long and had been followed down on the underlie for 100 feet. That on M.L. 22 has been traced along the outcrop for about 500 feet, but the deepest workings on it are nowhere deeper than 15 feet. There are no data, therefore, on which to base any estimate as to the depth to which the lodes will reach or to which they will maintain a workable width and richness.

Within the lodes the chrysotile veins vary from one-eighth of an inch up to four inches in width, on rare occasions being still wider. Owing to the rapid variations in the width of the veins it is impossible to give an average length of fibre, but only a small proportion appears to be under half an inch in length. The proportion of marketable fibre in the lodes seen varies from 20 per cent. to 50 per cent. of the whole mass. At one point in the underlie shaft on M.L. 18 the lode was found to be 3 feet wide, with innumerable parallel veins of chrysotile averaging one inch in length but varying from one-eighth to three inches, the proportion of fibre in the lode being estimated at 50 per cent. At a somewhat greater depth there was 2 feet of poor ore (20 per cent.) on the footwall, then 2 feet of very good ore (50 per cent.), 2 feet of barren rock (a horse), and finally 2 feet of fair grade ore (30 per cent.) on the hanging wall. A large

proportion of the lode on this lease should yield 30 per cent. of commercial fibre. The lode strikes N. 20° W. to N. 30° W. and changes in dip from 70° to 35°.

On M.L. 22, about one mile distant by road but much less in a straight line, an S-shaped lode 500 feet long has an average width of 2 feet 6 inches. At the surface it is vertical in dip with a strike varying from N. 50° W. to N. 90° W. The fibre varies in length from one-eighth to one and a half inches, with occasional longer masses, and the grade in several shallow workings averaged about 20 to 25 per cent. Near the surface on this lease the fibre is slightly hard, but it should soften at a shallow depth.

I was informed that several other veins have been opened up in other portions of the serpentine area, and I myself saw outcrop specimens of chrysotile in two places which had not been opened up. It seems probable, therefore, that within the serpentine area there are quite a number of small lenticular lodes which are workable.

All the asbestos seen at Lionel was true chrysotile, the variety which brings the highest price and commands the readiest sale in the world's markets. An analysis of a typical specimen gave the following results:—

<i>Chrysotile, Lionel.</i>			
SiO ₂	..	..	39.54
Al ₂ O ₃	..	..	nil
Fe ₂ O ₃	..	..	1.35
FeO	..	..	.16
MnO	..	..	.17
MgO	..	..	39.89
CaO	..	..	1.38
K ₂ O	..	..	.12
Na ₂ O	..	..	.54
H ₂ O —	..	..	1.80
H ₂ O +	..	..	15.58
TiO ₂	..	..	nil
Cl	..	..	trace
			100.53

(Analyst, H. Bowley.)

Except for a slight hardening in some places near the surface, the fibre is very soft, fine, flexible and tough, being eminently suited for use in all cases where a very high quality asbestos is required. In colour it varies from a yellowish green to an olive green.

A small and primitive dressing plant has been erected on M.L. 18. I was informed that this had proved to be a failure, as much fibre being lost as was saved. It is evident that none of the lodes disclosed so far is sufficiently large to keep a dressing plant going. The field can only be exploited by means of a central plant treating at reasonable cost lodestuff from all the lodes in the locality, each lode being preferably worked by small parties of tributers or independent miners, and the ore being brought to the plant by aerial or ground tramways or otherwise. In such rough country the cost of road making and cartage by round-about routes will always be high. Before a site for a plant is selected it is essential that a survey of the field should be made, showing not only lease boundaries and lode outcrops, but also a rough impression of the surface contours.

There is no surface water in the locality except in small quantities and for a short time after heavy storms, but fresh water in sufficient amount for dom-

estic and mining purposes can be obtained at a moderate depth in wells sunk in the bottoms of the numerous gullies. The water level in the well from which present supplies are drawn is at 60 feet, and the supply is slightly magnesian.

Platinum and osmiridium, valued respectively at £16 and £23 per ounce, are only found in areas of serpentine rock. They are easily recognised by their great weight, metallic appearance, and pale grey colour. A careful search should be made for these metals in this and other serpentine areas in the North-West.

9.—THE ASBESTOS DEPOSITS OF THE PILBARA AND WEST PILBARA GOLD-FIELDS, NORTH-WEST DIVISION.

(R. C. Wilson, B.Sc., B.E.)

INTRODUCTION.

Acting upon official instructions a tour of inspection through the Pilbara and West Pilbara Gold-fields was made in company with Inspector Deeble for the purpose of reporting upon the proposal to erect a State-owned Asbestos Treatment Plant at Lionel (near Nullagine), and to look into the possibilities of the commercial exploitation of the asbestos deposits at Soanesville, Dead Bullock Well, Strelly Creek, Sherlock Station, Nungeri River, and Roebourne, as well as to inspect some mines which were receiving assistance under the Mines Development Act.

The time occupied on this work was from 25th October, when we left Meekatharra by motor car, to 15th November, when we caught the "Gorgon" at Port Sampson, the port of Roebourne.

It was thought advisable to bring together into one report all the official information relating to the asbestos deposits in this portion of the State.

A general account of the different varieties of asbestos and of their properties and commercial application, as well as some information regarding the latest methods of treating the crude ore has been included in the report. For this purpose acknowledgment is made of having utilised to the fullest extent the following publications:—

"Asbestos, its Occurrence, Exploitation and Uses," by Fritz Cirkel, M.E.

"Asbestos in the Union of South Africa," by A. L. Hall, B.A., F.G.S.

"Asbestos Deposits at Soanesville," W.A. Geological Survey Bulletin 52, by T. Blatchford, B.A.

Cirkel's extensive memoir gives a very complete description of the Canadian fields and treatment plants, and Hall deals in a similar comprehensive manner with the South African occurrences; both may be regarded as standard works.

Varieties of Asbestos.

The name "asbestos," which is derived from the Greek and signifies unquenchable, unextinguishable, inconsumable, is a general term given to a number of minerals of variable chemical composition, but having similar physical properties, viz., non-inflammability, resistance to acids, and fibrous nature. Good asbestos can be divided into the finest silky threads, which are elastic and flexible and have a considerable tensile strength. If it is to be used for weaving pur-

poses length of fibre is also important. Asbestos is of poor quality if it can be divided into coarse brittle fibres only, which are easily broken.

A. H. Hall, in his memoir, gives the following list of asbestiform minerals:—

I. Serpentine group: Hydrated magnesium silicate with the composition $2H_2O, 3MgO, 2SiO_2$, and characterised by high percentage of magnesia and water:—

Chrysotile.

Picrolite.

II. Rhombic Amphiboles: Silicate of magnesia and iron with the composition $(MgFe)O, SiO_2$:—

Anthophyllite.

III. Monoclinic Amphiboles:

Tremolite: Silicate of calcium and magnesium of the composition $CaO, 3MgO, 4SiO_2$.

Actinolite: Silicate of calcium, magnesium and iron with the composition $CaO, 3(MgFe)O, 4SiO_2$.

Crocidolite: Silicate of iron and sodium; its composition is given by Dana as $NaFe, (SiO_2)_3, FeSiO_3$. Soda is an invariable constituent of this amphibole.

Amosite: Chemically characterised by high percentage of iron with variable amounts of aluminium, magnesium and calcium. Soda may or may not be present.

Single crystals of serpentine with the polyhedral habit, so as to show crystal faces, are not known, and while some amphiboles show this habit to a marked degree, crocidolite has never yet been met with otherwise than in a finely divided condition. In the case of amosite, the fibrous growth is very common, but in the Lydenburg

District certain phases of the same country rock develop stellate groups of an amphibole, showing in their section the characteristic lozenge-shaped prismatic outlines of hornblende, intimately associated with slender needles and fibres of amosite.

Chrysotile is the most important variety of asbestos from a commercial standpoint, followed by Crocidolite and Amosite. The remaining varieties are of little commercial value, and their application very limited.

Chrysotile.—This variety of asbestos is delicately fibrous, the fibres being usually flexible and separating easily. Its lustre is silky or silky metallic, and its colour greenish white, green, olive green, yellow or brownish. Under the microscope the fibres appear like polished metallic rods. The absence of any jagged edges, which cause cotton and other fibres to cling together in spinning is one of the commercial difficulties. The smallest obtainable fibre according to Professor H. T. Barnes has a diameter of 0.001 millimetres, which is equivalent to 250,000 fibres per linear inch.

With regard to the heat-resisting properties, temperatures of 2,000 deg. and 3,000deg. F. are easily withstood. For acid resisting, however, it is slightly inferior to the hornblende variety, in which the percentage of silica is much higher in proportion of the base. The following are some typical analyses of chrysotile asbestos:—

	SiO ₂ .	MgO.	FeO. Fe ₂ O ₃ .	Al ₂ O ₃ .	H ₂ O.	CaO.	N ₂ O. K ₂ O.
<i>Canadian</i> —							
Quarries	39.05	40.07	2.41	3.67	14.48	...	(1)
Black Lake Amalg. Asb. Co. ...	40.42	41.85	2.60	0.82	14.37	...	(2)
Standard Quarries ... ..	...	...	...	...	...	...	...
Black Lake South Wark Mine ...	39.22	40.27	2.26	3.64	14.37	...	(3)
<i>Italian</i>	40.30	43.37	0.87	2.27	13.72	...	(4)
<i>Carolina, U.S.A.</i>	41.90	36.30	<i>Nil</i>	<i>Nil</i>	18.00	0.51	2.71 (5)
<i>West Australian</i> —							
Soanesville	42.98	39.92	1.92	0.44	...	...	(6)
Lionel	39.54	39.89	1.51	<i>Nil</i>	17.38	1.38	0.66 (7)

Authorities:—(1) Dr. J. T. Donald, Montreal.
(2) Dr. Milton Hersey, Montreal.
(3) Dr. J. T. Donald, Montreal.
(4) Dr. Milton Hersey, Montreal.
(5) Gardthausen.
(6) Dr. E. S. Simpson, W.A.
(7) Dr. E. S. Simpson, W.A.

There would seem to be a relationship between the quality of the asbestos and its chemical analysis. Professor Donald points out that harsh fibre contains less water in the combined form than soft silky fibre. It is noticeable that chrysotile fibre is liable to "perish" and become brittle at the surface. This is no doubt due to partial dehydration.

Picrolite is a fibrous variety of serpentine and occurs in fibrous aggregations. It is found in the Canadian chrysotile asbestos mines and is known by the miners as "Bastard Asbestos." The fibres are sometimes long but are usually harsh and brittle and lack tensile strength. It is not used in commerce.

Anthophyllite.—This is a fibrous form of amphibole which is usually too deficient in tensile strength to be of commercial value. A sample of anthophyllite from the Moora district, however, was examined by Dr. Simpson, who found it to consist of soft flexible fibres easily separated from one another from

$\frac{1}{4}$ inch to 2 inches in length, and possessed of high tensile strength. Such a material should find a ready market, and would be particularly useful for making fibro-cement, wall sheets, etc. A chemical analysis gave the following result:—

Silica	57.8
Magnesia	30.9
Iron oxide	8.2
Water	3.1
	—
	100.0

Tremolite.—This asbestos is a calcium magnesium amphibolite, often light coloured to pure white, though sometimes found in dark grey long bladed crystals. The soft silky fibre possesses inferior flexibility and tensile strength, but is capable of withstanding high temperatures. It is used where these qualities are not important, *e.g.*, for boiler and steam pipe cover-

ing, as a medium for filtering acids and corrosive liquids, etc. It has been worked commercially in Natal.

Actinolite.—This asbestos is a fibrous form of hornblende which occurs extensively in this State, but it is usually deficient in flexibility and tensile strength. It has been worked on a limited scale in Canada, but does not command a high price. It is sometimes known as mountain leather or mountain cork.

Crocidolite.—This variety can be readily distinguished from all other forms of asbestos by its characteristic lavender blue colour. It possesses a highly pronounced fibrous structure and the fibre has a tensile strength greater than chrysotile. In length it varies from a fraction of an inch up to 3 inches. As regards heat-resisting capacity, Hall points out that there is a marked difference between fibrous serpentine and crocidolite. Both forms of asbestos readily lose their flexibility even at moderate heat and become brittle, but chrysotile retains its quality of resisting high temperatures, whereas crocidolite easily fuses before the blow-pipe and turns into a magnetic glass with yellow flame colouration. Crocidolite is superior in resistance to acids, chemical solutions, and sea water. Both as regards heat and electrical insulating qualities special advantages are claimed for crocidolite. The elasticity of its fibres is also greater than that of chrysotile. This asbestos is now being worked on a fairly large scale in South Africa. During the three years ending 1917 the crocidolite output from the Cape Asbestos Company's mines was 4,020 tons. Specimens of crocidolite, said to have come from the Hamersley Ranges, have been exhibited in Perth, but no deposit has yet been officially examined.

Amosite.—According to Hall, this amphibole asbestos is apparently a new variety characteristic of a definite horizon in the North-Eastern Transvaal. On the whole it is related fairly closely to the crocidolite variety. A strongly marked fibrous structure is again well developed. As regards length of fibre, amosite is unique and easily surpasses chrysotile and crocidolite. Fibre 11 inches in length is the largest yet found. Lengths of 4 to 7 inches are common and are used for spinning. Held in a flame strands of amosite lose their flexibility and become brittle. They can be fused in the blow-pipe, but not so readily as crocidolite. Acids have little effect on amosite.

All the asbestos deposits at present being worked in these districts lie between the Fortescue and the de Grey Rivers. That at Lionel is the most easterly and is about 200 miles south of east from Roebourne. The remaining deposits lie between these centres.

It is noticeable that a line drawn through Lionel, Soanesville, Sherlock Station and Roebourne is practically parallel to the Fortescue and de Grey Rivers, and suggests a line of weakness.

The following is a brief description of each of the deposits visited:—

LIONEL.

Barnett Bros. Leases.—Barnett Bros. are the chief operators at Lionel. They have erected a treatment plant on Mineral Lease No. 18L consisting of a rock-breaker, a set of rolls, and revolving tromels. This machinery is driven by a 30-horse power producer gas engine.

The plant, which was idle at the time of my visit, does not seem to have proved entirely satisfactory. Too high a percentage of asbestos is left in the tailings. I was given to understand that additions and improvements to the plant were to be effected shortly.

In the meantime the manager was getting out some long-fibred asbestos from lease 18 by hand-picking. On this lease, a strong lode, varying from 3 to 6 feet in width, has been driven on, at the 50 feet level, for a distance of about 60 feet. It would yield 30 per cent. of fibre or thereabouts. This is the best known shoot of ore in Lionel.

On a lease some distance north of M.L. No. 18L a little work has been done on two lodes about 2½ chains apart, which run approximately north and south. A shaft has been sunk on the western lode 40 feet in depth, and has exposed nice fibre over a width of 30 inches. The ore might contain 25 per cent. of asbestos.

On lease No. 22 a lode can be traced from one end of the lease to the other, which has been opened up by a series of shallow shafts, the deepest being 30 feet in depth (*see sketch*). There was a little fibre showing along the whole line. In places the fibre is short and the percentage would be low, but in the best places the fibre is up to 2 inches in length and might average 25 per cent. fibre over a width of 3 feet. As is common in gold-mines, shoots of good ore occur at intervals along the main line of lode.

On lease 19L, about 500 yards southeast of lease 22, a shaft has been sunk by Barnett Bros. to a depth of 25 feet. This appears to be on the same line of lode which traverses Lease 22, but the quality of the asbestos is not so good here. A small dump might average 10 per cent. of fibre.

Thompson and Layner.—This party were taking out some good asbestos from their P.A. 84L, south and east of M.L. 19L. There were 29 bags each weighing 114 lbs. The lode, which is opened up for a length of 15 feet and a depth of 9 feet, averages about 30 inches in width and contains a number of small seams (½in.), and a little long fibre (1½in.). There were 10 tons of ore at grass averaging about 20 per cent. fibre.

Malone and Gunnalles have a prospecting area No. 85L between M.L. 33L and Geddes and Urquhart's lease No. 32L, and have opened up an east and west lode for 12 feet in length and 10 feet in depth. The seams of asbestos are mostly half an inch in width; about half a ton has been bagged ready for transport.

Edwards and Cooke's P.A. No. 82.—This P.A. is about 12 chains northeast of M.L. 32. The lode exposed at the surface runs northeast and southwest, and dips to the southwest at a flat angle. This party has sold 2 tons 17 cwt. of hand picked ore, and has 100 tons of 20 per cent. ore at grass ready for treatment.

Geddes and Urquhart's M.L. No. 32L.—This mineral lease adjoins Malone and Gunnalle's on the south side. One shaft has been sunk 30 feet, and has yielded 2 tons of asbestos, containing about 60 per cent. of fibre. It is intended to sink to 40 feet and cross-cut at this depth. From another shaft 90 yards further north, 6 tons of asbestos ore has been obtained, averaging 25 to 30 per cent. of fibre.

Wood's Mineral Lease 31L.—On this lease a shaft has been sunk 20 feet deep on good milling ore, 36 inches in width and averaging about 20 per cent. of fibre.

Reidy's Show.—This show is situated about a mile north of the treatment plant, on the eastern side of a gully. Very little work has been done, but asbestos could be seen out-cropping at intervals for quite a considerable distance. Some distance up the gully a small cut has been put into the side of the hill, and has exposed some flat seams of asbestos fibre up to one inch in width. The average fibre contents of the face might be 20 per cent. More work is necessary to ascertain the width and nature of this deposit.

Leases Nos. 21 and 28.—A line of lode runs through these leases, having a general strike of 170 degrees. On lease No. 28 a shaft has been sunk below water level (about 50 feet), and a cross-cut at this depth exposed 36 inches of good asbestos ore, which would average about 35 per cent. fibre. On Lease No. 21 a shaft has been sunk 40 feet and some ore taken out by open cutting.

Southern Leases.—There is a small group of leases about 1½ miles or 2 miles southeast of Barnett's Treatment Plant. High hills separate them from the northern group of leases, and the distance by road might be 3 miles from the plant.

Cotton's M.L. 29I., "Toledo."—This lease takes in the original workings, which were inspected and reported on by myself on 18th September, 1918. Two lodes, an east and a west, come together going north, and form a large body about 10 feet wide on the side of a hill. Mr. Cotton has driven on the west lode for a distance of 60 feet into the hill, and has begun to winze and rise at this point. The lode here is 42 inches in width, and contains about 30 per cent. fibre. The prospects of this lease appear to me to be quite encouraging. I understand that Mr. Cotton has sent away some 12 or 14 tons of asbestos. A portion of this amount has been obtained by hand picking, but most of it by beating the ore, which, fortunately, is rather soft, with a heavy stick and then hand sieving it. He has about 200 tons of asbestos ore at grass, which may average 20 per cent. fibre.

Zanetti's Lease No. 77L.—Zanetti has a lease north of Cotton's. A well defined line of lode runs right through it, which is 5 or 6 feet wide in places, but it appeared to be mostly low grade. The rock is also much harder than Cotton's. He was following the best asbestos veins and obtaining a small parcel by hand picking.

General Remarks.

The asbestos lodes would seem to represent shear zones, and are often traceable for quite considerable distances. Although there appear to be comparative few places where the lodes can be mined on anything like a large scale, I think that with crushing facilities and with asbestos at its present high price, a good deal of mining in a small way would be done.

In view of the fact that the asbestos industry may become one of value to the State, it is recommended that some assistance be given at this stage, and it would appear that crushing facilities would be more likely to be beneficial than any other form of assistance.

It is to be regretted that the prospectors have not been able to arrange to have their ore treated at Barnett Bros.' treatment plant, but, apparently, its capacity has been sufficient only for their own requirements. The company, it is understood, are about to increase the capacity of its plant, and might be prepared to crush for the public as cheaply as the State could do if a small subsidy were granted.

Failing this, it is recommended that a small plant be erected consisting of a Producer Gas engine driving a rock-breaker, 2 sets of rolls, a fiberiser, and the necessary screens. The fibre being sucked off the screens by a fan and deposited in a collector.

The product obtained would probably not be very clean, but would be marketable, and further cleaning and refining could be carried out under more favourable conditions than exist at Lionel.

It would, therefore, seem to be a matter of departmental policy whether the State Battery system be extended or not.

A dressing plant would hardly be kept going continuously, but on the other hand there might be a reasonable tonnage to crush at intervals, as is the case with most of the State Batteries.

SOANESVILLE.

Locality.—Soanesville is situated some 11 miles in a westerly direction from Cooglegong, and 13 miles in an easterly direction from Woodstock, while it is, roughly, 8 miles north of Dead Bullock Well. The distances by road are considerably greater than this, as Soanesville is on the northern side of a high range of hills, and is not at all easily accessible. An old road, which was made by Mr. Soanes, has been abandoned by the present lease owners, and a new road made through a deep gorge, which leads to the asbestos deposits.

Geology.—The geology of this district and a description of the deposits is given in some detail in Geological Survey Bulletin No. 52, by Mr. T. Blatchford, in which will be found the following passage:—

Briefly, the geological features are a mass of highly basic rock, probably an altered peridotite, now a serpentine which has since been intruded by several dolerite dykes. Bounding the serpentine rock on all sides and covering up the edges are the Nullagine Series of rocks.

It will be noted that here, as in other parts of the State, the asbestos deposits occur in the serpentine rock, and are intimately associated with the intruding dolerite dykes.

The two principal lodes, known as "A" lode and "B" lode, occur alongside a persistent dolerite dyke, the former on the north and the latter on the south side of it.

"A" Lode.—The workings on the "A" lode were for the most part inaccessible, and no fresh work has been done here. The last available information is that supplied by Mr. Blatchford as follows:—

The workings on "A" lode consist of two shafts sunk to a vertical depth of 54 and 97 feet level with a drive 163 feet in length. These workings were inaccessible at the date of my visit. On the surface the occurrence of the asbestos veins was apparent. Here the dolerite dyke forms the hanging wall to the asbestos veins, and I believe the same obtains at the bottom of the shafts and the drive. The dyke underlies to the east at an angle of about 70 degrees and, I think, approximately north-east to south-west.

The veins of asbestos are lying close up to the dolerite dyke and run parallel to the same, forming a kind of

banded formation about two feet in thickness. The fibre of the asbestos is short and fit only for mill treatment, as there is scarcely any long enough to warrant cobbing for crude. The fibre near the surface is much decomposed, judging from the material on the dumps, but improves in quality as greater depths are reached. Farther to the north and close to the dyke "A" the lode has been traced for a considerable distance, but does not apparently improve in size or quality. A tunnel has also been driven westward for a distance of 54 feet into the serpentine to try and locate fresh seams. In this tunnel there is no evidence of asbestos veins, in fact the reverse, for the serpentine rock throughout is very much altered and full of joints, probably due to contact metamorphism caused by the dolerite dyke.

"B" Lode.—The lode has been opened up by shafts and pot holes for a length of 1,000 feet. It has a general strike of N. 60 deg. E. and dips southeast at a steep inclination. Most of the recent work has been done at the eastern end of the lode. At the time of my visit a party of tributers were stoping out some very good fibre from a stope above the 60 feet level. The shoot of rich ore appeared to be about 20 feet long. The width was from 20 to 36 inches, and it contained approximately 40 per cent. of fibre, varying from 1 inch to 2½ inches in length. The nature of the lode here may be seen from the following section across the lode in stope above 60 feet level:—

H. W. Country.
2½in. asbestos seam.
lin. country.
1½in. asbestos seam.
3½in. country.
2in. asbestos seam.
3in. country.
1½in. asbestos.
3in. country.
lin. asbestos.
F. W. country.

The deeper workings were under water at the time of my visit, but have been inspected and described by Mr. Blatchford as follows:—

The two deepest shafts, viz., the "Whip Shaft" and the "No. 1 West," are connected by a drive at the 140 feet level. This drive is in all about 300 feet long and exposes the asbestos veins for the whole of that distance. The average width of the veins here is slightly greater than that in the "A" lode, and is about 2 feet 6 inches to 3 feet, taken for the whole length of the drive, with fibre showing in both faces. In the northern end of the drive some fine fibre was showing, and I was informed that this was the bottom of a shoot some 30 feet in length, and from which most of the cobbled ore had been won. Some of the fibre in this part of the lode had a length of several inches, and was of exceptional quality. The fibre in the other portion of the drive was only fit for mill treatment.

The percentage of fibre in "B" lode is difficult to estimate, even roughly, for at times it is very low and the fibre very small, while, on the other hand, in places the fibre is first class and abundant.

Plant.—Mr. Linas, who is the only lease owner at present carrying on operations, has a small treatment plant of the same type as Barnett Bros. at Lionel. The ore is crushed in a small cracker. It is then taken by a bucket elevator to a bin, from which it is fed into a single set of rolls. From here it is again elevated and passed through a revolving trommel. The cracker is driven by one small oil engine, and the balance of the plant by another.

The efficiency of the plant would probably be greatly increased by the addition of a second set of rolls.

Two tons of asbestos was obtained in three weeks by running one shift only, and that the ore on the

dump gives about one bag of asbestos of 120 lbs. per ton of material treated.

Transport.—The cost of transporting the asbestos from Soanesville to Fremantle is, as nearly as I could ascertain, as follows:—

	Per ton.		
	£	s.	d.
Cartage Soanesville to Cooglegong ..	4	0	0
Cartage Cooglegong to Marble Bar ..	4	0	0
Agency Marble Bar	0	7	0
Railage Marble Bar to Port Hedland	1	12	6
Agency Port Hedland	0	7	0
Wharfage	0	9	0
Freight Port Hedland to Fremantle	0	17	6
	<hr/>		
	£11	13	0

General Remarks.—The fact that the asbestos occurs on a main line of lode alongside a persistent dolerite dyke suggests permanency, and I see no reason why it should not continue downwards to quite considerable depths.

Another encouraging feature is the fact referred to by Mr. Blatchford that the "B" lode is looking better in the bottom than in the upper levels, and there is no doubt that the fibre obtainable is of good quality.

Owing to the comparative narrowness of the lode, however, cheap mining can hardly be looked for, and the handling of the product under present conditions is a serious item, as asbestos worth £32 per ton at Fremantle will have a value of about £20 10s, only at Soanesville, which, it is understood, is the price that a local firm is prepared to pay for short fibre. In the case of the best quality asbestos with fibre over 1½ inches, of which there is a small proportion of the total, the transport is not so serious, for as high a figure as £250 per ton has been obtained for it in London.

The Clan Macleod Reward Lease.

This lease is situated on the western side of the Strelly River, about two miles up the river from Strelly Pool. This pool is 29 miles from Carlindi as the crow flies, and about 37 by the present roads. The asbestos is of the chrysotile variety and occurs on the slope of the hill alongside the river in a serpentine rock.

Two shafts, 130 feet apart, have been sunk in the main line of lode. One of these is 30 feet in depth and the other 20 feet. About 36 inches of lode is exposed in these shafts which might average 30 per cent. of fairly good fibre up to ¾in. in length.

About 30 yards further south a costean about 30 feet in length shows asbestos over the full width in irregular shaped cracks. The same thing occurs again in another costean 10 feet in length and 30 feet further south.

There is another parallel make of asbestos which is worth opening up nearer the river bed. Practically no work has been done on it up to the present.

About six miles further up the river, or eight miles from Strelly Pool, a big hill forming a razor back was followed for half a mile. It contains ribbon asbestos of small widths from tiny threads up to, say, half an inch, running along it. In isolated places some long slip-fibre occurs. One shaft has been sunk 40 feet on a shear plane containing 1½in. of long-fibred asbestos running with the plane of shearing.

The Clan Macleod appears to be an encouraging little property which may develop into something larger, though the erection of a plant is not recommended at present. The best plan would be to spend the money advanced as a loan in further opening up the property, when the advisability of erecting a plant would be again considered.

The proximity of this property to the railway line gives it an advantage over the Soanesville and Lionel deposits in the transport of fibre to Fremantle.

DEAD BULLOCK WELL.

Locality.—As indicated on the Locality Plan attached, Dead Bullock Well is situated about 15 miles west by south of Cooglegong, and 12 miles east of Woodstock Hotel, in the Pilbara Goldfield. The road from Cooglegong does not seem to have been used much lately and is very rough.

Nature of Occurrence.—The asbestos is of the chrysotile variety and, as usual, is found in veins in serpentines. A small excavation in the side of a hill at "A" has exposed one seam of asbestos $1\frac{1}{2}$ in. in width and two or three seams $\frac{1}{2}$ in. in width. The fibre is strong and of good quality. Before being teased out it has a golden tint in place of the more common greenish colouration. No other work has been done, but a number of small seams to $\frac{1}{4}$ in. fibre can be seen along the top of the hill. About 100 yards south of "A" another outcrop "B," occurs alongside a coarsely crystalline pegmatite dyke. The lode here is about 12 in. in width, and it contains one seam of $1\frac{1}{2}$ in. fibre, and a few seams of shorter fibre. The asbestos here is also of good quality, but is rather dirty owing to surface contamination.

SHERLOCK.

Locality.—Sherlock Station is situated about 14 miles west by south of Whim Well, and 35 miles east by south of Roebourne. Good roads connect it with each of these centres.

Nature of Occurrence and General Description.—The country around the homestead consists of an extensive, well-grassed granite flat. Two more or less isolated hills of serpentine, having the general appearance of dykes, rise up conspicuously above the surrounding flat granite country. They are a little over a mile and-half apart, and the ridges of these hills are practically in line. Both are traversed in different directions by numerous veins of asbestos of the chrysotile variety. They are also intruded by a number of pegmatite dykes of rather fine texture, and by an occasional basic dyke (dolerite?).

The opinion was formed after a consideration of the evidence, that in this and in other areas asbestos occurrences are genetically connected with intruding dykes.

A Reward Lease has been applied for which takes in the whole, or nearly the whole, of the southern hill, locally called Green Hill, while the leases known as Sherlock No. 1, Sherlock No. 2, and Sherlock No. 3 have been pegged out along the northern hill. Brief details are as follows:—

Green Hill Reward Lease.—This is a 48-acre lease situated about $1\frac{1}{2}$ miles S. 30 deg. W. from the homestead. Reference to the plan attached will show that this lease includes quite a large number of asbestos veins, most of which range from 12 to 30 inches in width.

Although the deepest hole is only 7ft., asbestos of very good quality has been obtained. A large proportion of the fibre would be between $\frac{1}{2}$ in. and $1\frac{1}{2}$ in. in length, and in a few places, at least, long fibre ($1\frac{1}{2}$ to 4 inches) has been obtained.

The best asbestos outcrop occurs at the north end of the serpentine hill. Here a seam of practically pure asbestos 24 in. in width has been exposed for a length of 50 ft., and looks best in the bottom of the shaft, which is 7ft. deep. Some picked fibre from here was 4 in. in length, and of excellent quality, being white and silky in appearance, and suitable for weaving purposes. Most of it is shorter, but is of consistently good quality. It is desirable that a shaft should be sunk on this lode and a parcel of asbestos forwarded from here to London, where the best price may be expected. Development work should also be carried out at a number of other points where the surface prospects are good, notably at the points B, C, D, E, F, and G.

As it appears that this lease can be profitably worked, and the other necessary conditions having been fulfilled, the granting of the Reward Lease is recommended.

Leases north of Homestead.—As in the case of the Reward Lease, asbestos is found in small seams striking at varying angles over the whole length of the serpentine hill, which, in this case, is about one mile in length.

The seams usually contain a high percentage of asbestos over a narrow width. The fibre at present exposed is in all lengths up to about 2 inches. The quality is not equal to that in the Reward Lease, and, owing to surface weathering, is more brittle and does not tease into the same silky fibre. An improvement may be expected, however, at, say, 30 or 40 feet below the surface. Shafts should be sunk on the lode on the most promising makes of asbestos.

Plant.—Caution should at the present state be exercised in the matter of the erection of a plant. A small plant would seem to be justified, and would permit of an immediate return from ore won; at the same time the property will be further opened up, and it will then be seen if a larger plant is advisable.

NUNGARRIE RIVER.

Locality and General Description.—This asbestos deposit is situated about 35 miles south of Sherlock Station at the head of the Nungarrie River. The asbestos is of the chrysotile type, and, as usual, occurs in a serpentine rock in hilly country. Two shafts have been sunk on what may or may not be the same lode, 150 yards apart. In the east shaft, 15ft. deep, alongside the road, about 15 in. of lode is showing, most of which is asbestos. The fibre would be up to 2 in. in length, but slightly perished. The western shaft, 21ft. deep, was inaccessible, but judging by the comparatively small heap of asbestos obtained (3 to 4 cwt.), the lode is probably small. There would be considerable transport difficulties in connection with the asbestos from here. The roads are not good, and the nearest port, Roebourne, is 80 miles away.

DEPOSIT NEAR ROEBOURNE.

Locality and General Description.—Mr. Porter took me to see an asbestos occurrence situated about six miles in a southeasterly direction from Roebourne in rough hilly serpentine country. Two lodes, one at

least of which is of quite considerable width, can be seen outcropping one on each side of a strong pegmatite dyke. Their strike is northeast and southwest.

These lodes are right alongside the dyke and are evidently intimately associated with it. The eastern lode shows asbestos of short fibre ($\frac{1}{4}$ in.) in ribbon form, over a width of 25ft. Asbestos could be seen on the western side of the dyke similar to that on the eastern, but no work of any kind had been done, and no width could be ascertained.

General Remarks.—This deposit is interesting because it is one of the few in this State which indicate a possibility of being worked on a large scale. It is also conveniently placed for transport purposes. Its chief drawback would be that the fibre is apparently all very short.

The lodes have been exposed by costeans across them at intervals. No opinion as to the prospects of the property can be expressed.

Further prospecting is desirable in this locality as the asbestos is of the valuable chrysotile variety, for evidences of its occurrence were noticed in more than one place between Porter's deposit and the 5-Mile well, which is about $1\frac{1}{2}$ miles north.

Viking and Cornelius Leases.

These leases are situated about eight miles north by east from Pulleurah Hill and about six miles west of Soanesville. It was my intention to visit them the same day as we visited Dead Bullock Well, but owing to car troubles our visit to these leases had to be abandoned. Mr. Gallop, of Cooglegong, gave me a sample of fibre from the Cornelius lease. This was 2in. in length and, although slightly stained, was of good quality for surface fibre. He also showed me a report by Mr. Alfred Brown from which the following excerpt has been taken:—

The Viking Lease.—Small veins of asbestos extend along the outcrop for 50 feet. There are a few surface holes, the deepest being five feet. This shaft disclosed some nice veins of fibre of fair strength and quality, which should command a fair price. Further development is recommended.

The Cornelius Lease.—This lease is situated about one mile north of the Viking. The largest fibre is two inches. There is about 3 cwt. of fibre at grass. This property compares favourably with any other surface show in the district.

ORIGIN OF CHRYSOTILE ASBESTOS.

The origin of chrysotile is of some importance outside of its scientific interest, inasmuch as the manner in which it has been formed has a bearing on its continuity with depth.

Hyde Pratt,* of the United States Geological Survey, expresses the following opinion:—

The original rock in cooling would solidify first along its contact with the rocks through which it had penetrated, and where it was in contact with any included masses of country rock that had been broken off during the intrusion of the molten magma. The outer portions of the molten rock would thus cool much more rapidly than the interior portions, and there would be a tendency for them to develop cracks and parting planes. In the alteration of these primary rocks to serpentine through the agency of aqueous solutions, vapours, etc., there would be to some extent at least a widening of these cracks, but in the end they would be filled with serpentine deposited from aqueous solutions from their walls and the resulting fibrous structure of the serpentine filling the seams represents the nearest approach to a true crystallisation that the mineral serpentine assumes except when it is found as pseudomorph after another mineral.

*United States Geological Survey, 1904, Bulletin on Asbestos.

George Merrill† holds that crevices in serpentine are due to shrinkage such as are incidental to a change of a highly hydrated colloidal substance into a less hydrated and more solid form, and perhaps also to a loss of silica, as suggested by Prof. Kemp. He compares them with the shrinkage cracks which appear in clay on drying, or those which result from the shrinkage of a gelatinous mass of iron carbonate, as in the so-called septarian nodules of clay ironstone. As to the filling, Merrill refers to the fibrous structure formed under similar conditions in gypsum, and more rarely in calcite. In the first-named the crystallisation apparently takes place by a process of growth from one of the walls.

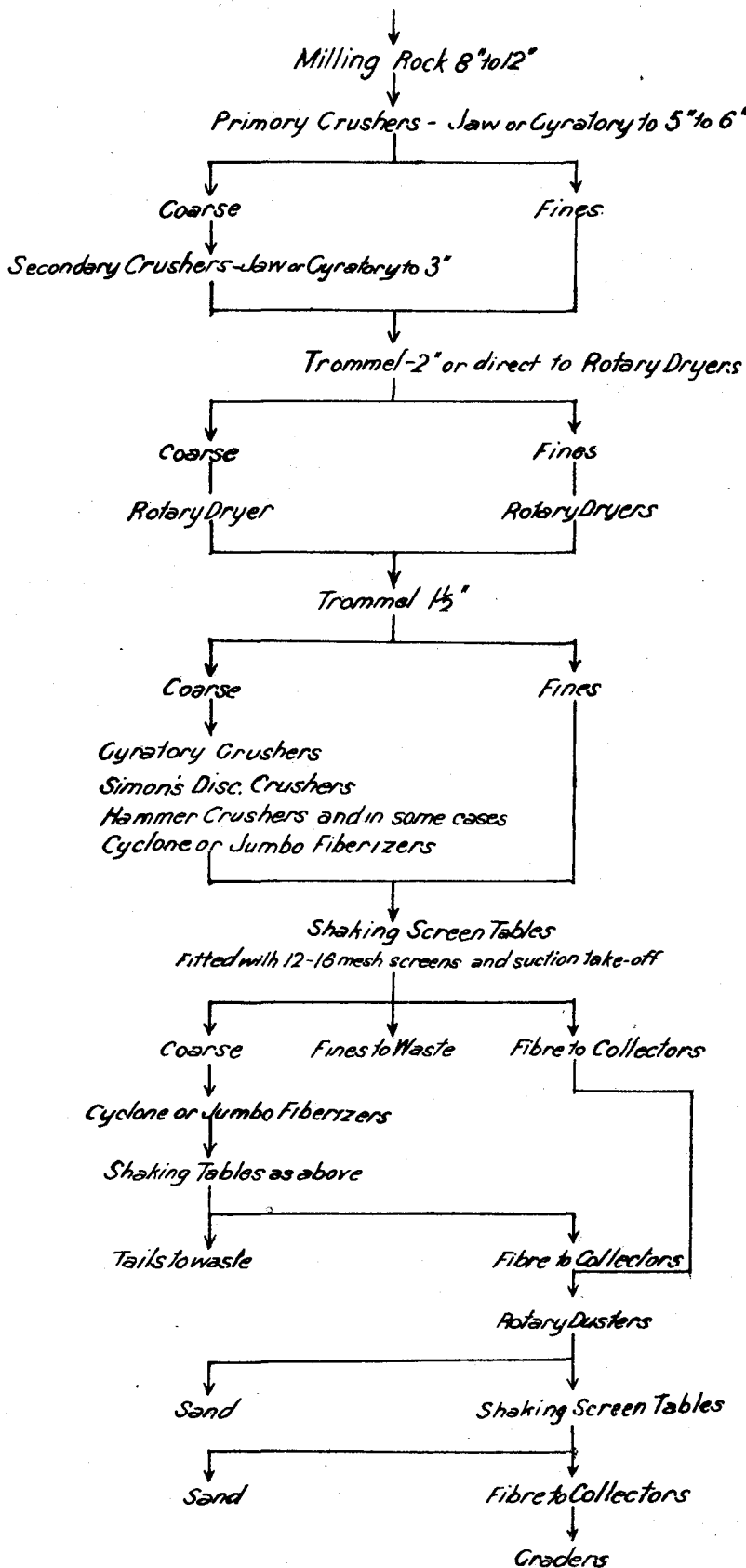
Cirkel is of opinion that while the dehydration which forms cracks in clay ironstone may have gone on in serpentine masses on a large scale, and the process may have been facilitated by loss of silica during serpentinisation, as suggested by Prof. Kemp, it is also very probable that the intrusion of those granite dykes so frequently met with in the serpentine masses has caused or facilitated to a great extent the formation of numerous fissures in the immediate proximity of these intrusions by rapid dehydration through the agency of heat. He points out that very frequently an accumulation of asbestos veins can be noticed approaching these intrusive dykes, a fact which seems to substantiate this theory. As to the vein filling, he believes that the asbestos has been formed through segregation of serpentinous matter from the sides of the fissure. In support of this theory he mentions that a number of veins, especially those of larger size, have in the middle between the two walls a parting of serpentinous matter and chromic iron ore; that the arrangement of the fibre is at right angles to the sides of the fissure, excepting, of course, those veins which have been disturbed, and that further—and this he regards as the most important proof—some of the veins in which the process of formation of the asbestos has not been completed exhibit an arrangement of alternate layers of mineral matter from the sides of the walls similar to metalliferous veins which frequently contain alternate layers of ore on either side of a central comb of mineral.

My own observations on the asbestos deposits under review were that the veins sometimes appear to be quite disconnected and to traverse the serpentine in all directions. The theory of dehydration, assisted by the intrusion of dykes, would seem to give a feasible explanation of the origin of such veins. But in the various descriptions and theories of asbestos formation in Canada, and in other parts of the world, little or no mention is made of the fact, which is quite striking in this State, that the asbestos quite commonly occurs along distinct lines of lode, traceable for quite considerable distances. This fact can hardly be explained by the theory that the cracks have been formed by a process of dehydration. There does not appear any reason to assume that the fracturing and fissuring had not been caused by larger earth movements, as is known to be the case in the formation of other mineral lodes.

Dynamic forces, in addition to those set up by dehydration, may, it is suggested, have caused fracturing along the lines of least resistance. This would commonly be alongside an intrusive dyke. A release of pressure such as might be caused by a contraction of the whole mass due to dehydration would tend to open any fissures formed and allow crystallisation to take place without restriction, in

†*Mining World*, April, 1905, p. 398.

GENERAL FLOW SHEET of the DRESSING of ASBESTOS ROCK



After Commercial Grades are recovered, Excess fines, from Graders are ground to powder making an Asbestic material weighing 25-30 lbs to Cub.ft, for Which product there is a limited market.

much the same way that quartz crystallises out from the sides of vughs.

DRESSING OF ASBESTOS FOR THE MARKET.

Hand Dressing.—Hand dressing is carried out on the best grade of fibre only. A rough separation of the ore from the country rock is first made in the mine. This is followed by a more complete separation in the cobbing sheds. The asbestos-bearing rock is broken up with hammers and sieved. No. 1 fibre is cleaned by a sieve with 9/16in. holes and No. 2 fibre by a sieve with 3/8in. holes. All refuse and screening go to the mill for mechanical treatment.

Treatment Plants.—The principle underlying the mechanical treatment of asbestos ore is that when thoroughly dried asbestos-bearing rock has been reduced to a fine state, and the asbestos separated into finely divided fibre of feather-like appearance and weight, the latter will remain on a shaking screen and can be sucked off by a fan, while the crushed rock passes through. All fibreised asbestos is taken up from the screens by suction fans and is blown into collectors or settling chambers. Fibreisers may be regarded as special machines used in the mechanical dressing of asbestos ores. The chief parts which enter into the construction of a cylindrical fibreiser or beater are a shaft on which are fastened the beaters and a shell made of strong boiler plate. The arms, when revolving at 500 to 700 revolutions per minute, crush the lumps and fibreise the asbestos.

The Cyclone machine, which is another form of fibreiser, consists of two beaters of the screw propeller type driven at a speed of 2,000 to 3,000 revolutions per minute in opposite directions in an iron chamber. A Cyclone will treat from 25 to 50 tons in a ten-hour shift according to the hardness of the rock. As a rule, the size of the rock charged is not larger than a walnut, while the bulk of the discharge is about pea-nut size.

A good description of Canadian practice in 1910 is given by Cirkel in his treatise on asbestos, a portion of which has been reproduced by Mr. T. Blatchford in Geological Survey Bulletin No. 52, but, as far as I am aware, very little has since been published. Recently the Under Secretary for Mines wrote to the Canadian Department of Mines asking for a description of the latest Canadian practice. His

letter was referred to Mr. W. B. Timm, Chief of the Division of Ore Dressing and Metallurgy at Ottawa, who kindly supplied the following information:—

In connection with the letter of enquiry from the Under Secretary for Mines, Government of Western Australia, I submit herewith a general flow sheet of the dressing of Asbestos rock in Canada. Each mill will have some variations from this, to suit their own particular problem, but on the whole it gives a fair idea of the practice followed in the asbestos districts of this country.

The reduction of the rock as it is mined to about three-inch size is done in the standard jaw or gyratory crushers. Some of the operators reduce even finer in the standard machines, but the final reduction and fibreising is accomplished by machines built in the asbestos districts, and specially constructed and adapted for the separation of asbestos fibre from the rock. These machines, known as hammer crushers, cyclone, and jumbo fibreisers, are built for the operating companies by two foundries in the district, namely, the Thetford Foundry Company and the Asbestos Foundry Company, both located at Thetford Mines, Quebec.

The Standard Testing machine is also built by these foundries, and it is on this machine that all grades are tested for marketing purposes.

The shaking screen tables are built at the mills, and consist of tables 12 to 16 feet long by 4 feet wide, sloping forward, and supported by hardwood strips which yield to the forward and backward vibration given to the table by an eccentric. As the ground rock moves down the table to the discharge end it separates in the following manner: the small particles of rock next the bottom of the table, on top of this the coarser material, and on top of all the liberated fibre. The fines pass through a 12 or 16m. mesh screen as waste. The fibre is sucked off into collectors, and the coarse material passes over the end of the table for further reduction.

The collectors are the ordinary dust collectors, situated between the tables and an exhauster.

The dusters are only a fine trommel for removing the sand and grit from the fibre.

The graders are simply a three-screen trommel, generally of 2, 4, and 10 mesh screens, depending on the grades desired. These trommels are built as one trommel with three sections, or as three one inside the other.

There is generally an excess of short fibre, which has no market value. In some cases this is ground in a Hardinge pebble mill, or some other fine grinding mill, making a product averaging 25 to 30 pounds to the cubic foot, for which there is a limited market.

MARKET FOR ASBESTOS.

The amount of Asbestos consumed in recent years is indicated by the following statistics taken from the report on the Mineral Resources of the United States in 1919:—

Year.	Production in U.S.		Imports (unmanufactured). ^a		Exports (unmanufactured).		Apparent Consumption. ^b	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.	\$	Short tons.	\$	Short tons.	\$	Short tons.	\$
1913 ...	1,100	11,000	97,145	1,928,705	c	c	c	c
1914 ...	1,247	18,965	71,866	1,407,758	c	c	c	c
1915 ...	1,731	76,952	93,566	1,981,483	c	c	c	c
1916 ...	1,479	448,214	116,162	3,303,470	d 312	d 6,313	c	c
1917 ...	1,683	506,056	134,108	4,521,172	708	116,580	135,083	4,910,648
1918 ...	1,002	124,687	137,700	6,337,608	697	51,053	138,005	6,411,219
1919 ...	1,412	325,530	135,270	7,369,685	1,119	157,416	135,563	7,537,799

^a. Mainly from Canada. recorded prior to July, 1916.

^b. Production plus imports minus exports. ^c. Exports not separately recorded. ^d. Figures commence period July to December, 1916

WORLD'S PRODUCTION OF ASBESTOS 1913-1918 IN METRIC TONS.*

Country.	1913.	1914.	1915.	1916.	1917.	1918.
Canada (a)	124,239	87,580	100,826	121,053	122,925	128,334
South Africa Rhodesia (b)	263	442	1,823	5,586	8,675	7,778
Union (c)	873	1,080	1,940	4,224	5,642	3,333
Russia (d)	17,494	15,691	9,779	8,192	...	6,000
United States (e)	998	1,131	1,570	1,342	1,527	909
Italy (f)	175	171	162	82	85	(e) 80
Totals	144,042	106,095	116,110	140,479	138,854	146,434

(a.) Reports of Mineral Production of Canada, Canadian Department of Mines. (b.) Report Secretary for Mines, Southern Rhodesia, for Years 1913-1918. (c.) Union of South Africa Annual Reports, Secretary of Mines and Industries and Mining Engineers, 1918, p. 28. (d.) Mineral Industry, 1918. (e.) Estimated; statistics not available. (f.) Revista del Servizio Minerario, 1917, p. 63.

* Taken from "Asbestos" (Secretarial Journal, Philadelphia, U.S.A.), Vol. 2, No. 7, p. 46.
NOTE.—Australian Production is not included.

With regard to the production of asbestos in Australia, the following paragraph is taken from the Official Year Book, 1920, page 480:—

Asbestos.—This substance has been found in various parts of Australia, but up to the present has not been produced in any considerable quantity. In New South Wales 180 tons of ore were raised by a company from deposits in the Barraba division. In Queensland seams of asbestos have been found over a belt of country extending from Cawarral to Canoona. Samples of the fibre proved suitable for the manufacture of fibro-cement, sheeting, and tiles, but so far a payable deposit has not been located. In Western Australia a deposit of the fibrous chrysotile variety was located at Soanesville, on the Pilbara goldfield, and in 1909 £154 worth of this material was raised. The discovery of a deposit of com-

mercial quality was reported from the Nullagine district in 1917. In 1899 Tasmania raised 200 tons, valued at £363, but there was no further production until 1916, when a small quantity was raised at Anderson's Creek, near Beaconsfield. In 1917, 271 tons, valued at £271, and in 1918, 2,854 tons, valued at £5,008, were produced. Deposits of asbestos of the mountain leather and mountain cork varieties have been discovered at Odlawirra, while deposits of a good blue variety have been discovered near Hawker and about 23 miles from Eudunda, in South Australia.

The Customs tariff on asbestos goods and the imports of such goods into Australia during the financial year 1919-20 are shown below:—

	British Preferential Tariff.	Intermediate Tariff.	General Tariff.	Imports.
Item 240:— Mosaic Flooring Tiles of all kinds and materials. Sheets and roofing slates composed of cement and asbestos or similar materials; articles, <i>n.e.i.</i> , composed wholly or in chief value of cement or of cement and asbestos, including articles of reinforced cement, <i>ad val.</i>	%	%	%	£
Item 369:— Articles not included under any other heading in the Tariff of Celluloid, Xylonite, Bone, Ivory, Pulp, Papiermache, Indurated Fibre or Asbestos, <i>ad val.</i>	25	30	35	7,334
Item 374:— (A.) Asbestos Millboards, Asbestos Yarn, Asbestos Cloth (with or without wire) unproofed, <i>ad val.</i>	Free	5	15	4,094
(B.) Asbestos cotton and other packings, including Asbestos Cloth (with or without wire) proofed with rubber asbestos cord, <i>ad val.</i>	20	25	30	...
(C.) Asbestos pipe and boiler covering; Asbestos mattresses for boilers, <i>ad val.</i>	20	25	30	64,330
(D.) Silicate of cotton, Slag wool, Mineral wool and matter made thereof; Felts, Fabrics, and compositions for covering pipes and boilers, <i>ad val.</i>	20	25	35	...

There is no import duty on crude asbestos. (NOTE.—Taken from File 2287/21.)

The Asbestos Slate and Sheet Manufacturing Co., Ltd., claim to be the largest users of crude asbestos in Australasia. For the 12 months ending 31st March, 1921, their consumption was 1,515 tons, of which 1,149 tons was imported.

The Secretary of the Wunderlich Ltd. has expressed the opinion that not 25 per cent. of the requirements of asbestos fibre can be produced locally at a cost suitable for their manufacturing purposes.

There would seem to be a steady local demand for short-fibre asbestos at £30 per ton, and it is understood that the Asbestos Slate and Sheet Manufacturing Co. are prepared to purchase 60 tons per month for their factory at Burswood. The last sale of long-fibre asbestos, over 1½in., of good quality, was that of John A. Cotten, of Lionel, which, sold in London, brought £225 per short ton. The fol-

lowing is a copy of his account sales:—

13 bags—weight	cwt.	qr.	lbs.	
	12	2	19	
• less	0	1	12	
	12	1	7	at £225 ...
				£ s. d.
				155 5 0
Charges—				£ s. d.
Interest on undermentioned freight	0	0	7	
Freight	6	2	9	
Fire Insurance	0	3	10	
Port Charges	1	0	10	
Brokerage	3	2	1	
				10 10 1
				£144 14 11

Note.—The amount sold represents a little more than one-half of the parcel shipped and suggests that the market for high-grade long-fibre is somewhat limited.

SUMMARY AND CONCLUSIONS.

Chrysotile asbestos of good quality is found in the serpentine rocks which outcrop at a number of localities between Lionel and Roebourne, a distance of 200 miles. It is just possible that these serpentine outcrops occur along a line of weakness striking north of west and south of east.

Numerous small asbestos veins traverse the serpentine in all directions and may owe their origin to cracks formed during a process of dehydration of the serpentine. Commonly, however, the asbestos veins occur along distinct lines of lode which at Lionel and Soanesville at least are traceable for quite considerable distances. Such deposits probably owe their existence to the filling with asbestos of fissures formed by the fracturing of the serpentine along a line of weakness when subjected to a dynamic stress.

The biggest drawback, from a commercial standpoint, in the exploitation of the asbestos is the comparative narrowness of most of the seams. In consequence mining operations must necessarily be on a small scale. As an off-set, however, the veins commonly contain quite a high percentage of asbestos. In other words, they are mostly small high grade rather than big low grade propositions.

The fibre is superior in quality to any other found in Australia and compares quite favourably with that in any other part of the world, with the possible exception of the best Canadian.

Asbestos mining must be regarded as being quite in the initial stages, and the prospects of establishing the industry in this State are very encouraging.

A number of the deposits have quite recently been prospected and further search will almost certainly disclose other occurrences.

CHEMICAL AND MINERALOGICAL WORK.

(E. S. Simpson, D.Sc., B.E., F.C.S.)

This is the 25th Annual Report of the Geological Survey Laboratory which was inaugurated in April, 1897. It is also the eve of its disappearance as a separate entity, the Government having decided to amalgamate it with the Laboratory of the Government Analyst. The time is therefore opportune for the presentation of a review of the work done in it since 1897 and this is being done in a document entitled "The Progress of Mineralogical Research in Western Australia, 1897-1922."

STAFF.

The staff has been the same as in the previous year, viz., six professional officers, one clerk, and one general assistant. Three of the professional officers are still on the temporary list, and their continuation has to receive Executive Council approval every six months, though they have been employed in their present positions for periods of two and a-half and three and a-half years, and their services could not now be dispensed with, unless a radical change were made in the policy of the Government with regard to State aid to mining.

Owing to ill-health I, myself, was absent from the Department for ten weeks during the autumn.

ROUTINE WORK.

A tabulated statement of the routine work of the Laboratory, which is hereunder, shows that the volume of the work remains at about the same figure as

in previous years. A noticeable feature has been the number of tests made for petroleum and for natural petroleum residuums: this matter is dealt with more fully below. The fact that this Laboratory affords a means whereby prospectors and travellers through the country can obtain, at no cost to themselves, rapid and, above all, accurate tests of mineral substances which they collect, is a valuable concession which has proved of the greatest assistance in opening up new sources of mineral wealth. There is also a continual demand on the staff for technical and scientific advice and experiment to assist the establishment of new branches of industry.

Table showing the routine work carried out by the Geological Survey Laboratory during 1921.

	Public Pay.	Public Free.	Geo-logical Survey.	Other Depart-ments.	Total.
Samples	27	414	367	925	1,733
Analysis—Complete ... ..	...	4	27	8	39
Gas ... ..	...	...	2	...	2
Partial	1	18	8	5	32
Proximate	1	4	20	37	62
Qualitative ... ..	...	...	1	2	3
Assays for—Barium ... ..	...	1	...	...	1
Chromium	1	2	...	...	3
Copper	1	52	...	5	58
Gold	9	114	88	791	1,002
Iron ... ..	...	16	3	8	27
Lead ... ..	...	19	...	17	36
Lime	4	...	...	...	4
Manganese ... ..	...	10	...	16	26
Lithia ... ..	...	1	...	...	1
Mercury ... ..	...	1	...	...	1
Nitrogen ... ..	...	3	...	...	3
Petroleum	6	23	61	14	104
Phosphorus ... ..	...	7	1	4	12
Platinum ... ..	...	1	...	...	1
Potash ... ..	...	4	4	6	14
Silver ... ..	...	53	...	20	73
Silica	1	10	...	6	17
Soda ... ..	...	3	4	4	11
Sodium Chloride ... ..	...	...	104	...	104
Sulphur ... ..	...	2	3	1	6
Tantalum ... ..	...	1	...	...	1
Tellurium ... ..	...	...	6	...	6
Tin ... ..	...	19	...	1	20
Tungsten ... ..	...	2	...	3	5
Zinc ... ..	...	...	...	12	12
Mineral Determinations	4	216	53	46	319
Tests for—Burning ... ..	...	9	...	...	9
Calorific value ... ..	...	...	20	28	48
Distillation ... ..	...	...	...	1	1
Absorption ... ..	...	1	...	...	1
Clay ... ..	...	20	1	4	25
Grading ... ..	...	2	...	...	2
Graphite ... ..	...	3	1	8	12
Metallurgical ... ..	...	...	...	1	1
Pigment ... ..	...	16	...	1	17
Plaster ... ..	...	4	1	...	5
Plasticity ... ..	...	2	...	...	2
Sizing ... ..	...	1	...	...	1
Miscellaneous ... ..	...	4	2	4	10
	28	648	410	1,053	2,139

MINERALOGY OF THE NORTH-WEST DIVISION.

During the Spring Professor Sir Edgeworth David spent several weeks in the State gathering material for his work on the geology of Australia. I was privileged to accompany this eminent authority on his flying trip to the North-West and was able, even in the very short time available, to add considerably to our knowledge of the mineral resources of that region. An important discovery, made then and

since amplified, was that alunite (sulphate of aluminium and potassium), and jarosite (sulphate of iron and potassium) are widespread in the Nullagine formation, and may possibly occur in quantities of economic importance. The details of their occurrence are being incorporated in a paper entitled "Secondary sulphates in the Nullagine Series."

A visit was made to the new asbestos find at Lionel, from which a few tons of chrysotile of the highest quality have been shipped. This place is 18 miles north of Nullagine. On returning to headquarters a short report on the occurrence of this asbestos was submitted to the Government Geologist.

The structural geology of the North-West Division has been fully elucidated by the work of the Government Geologist and Messrs. H. P. Woodward and H. W. B. Talbot, but of the mineralogy or the area only so much is known as to prove beyond doubt that the Pilbara region is one of the most remarkable mineral regions in the world. A detailed mineralogical survey of it is urgently needed and should amply repay the cost.

OIL PROSPECTING.

During the past 12 months there has been great interest taken in the search for petroleum in Australia. The fever has spread to our own State where surface prospecting and shallow boring have been carried out at many widely separated places. Chief interest has centred in the Kimberley Division and in the Fitzgerald River valley on the south coast. At Mt. Wynne, in West Kimberley, the gas which bubbles up freely in a hot spring has been found to contain hydrocarbons, an analysis showing—

Natural Gas, Mt. Wynne.

	%
Methane (with a little Ethane) ..	36.3
Unsaturated hydrocarbons .. ..	.8
Carbon dioxide .. ..	.9
Carbon monoxide	Nil
Oxygen	4.3
Nitrogen (including Argon and Helium)	57.7
	<hr/>
	100.0

Bores put down to a depth of 90 feet in Carboniferous rocks on Price's Creek in the Rough Ranges, about 100 miles southeast of Mt. Wynne, have yielded positive indications of free petroleum, the cores below 40 feet containing from 0.007 to 0.044 per cent. of a yellowish brown, fairly mobile, unsaponifiable oil with a paraffinic odour. A second bore in the same ranges yielded a sample of clay containing 0.076 per cent. of free oil, whilst traces of oil have been detected in a seepage.

On Texas Station in East Kimberley a black asphaltum has been found filling vesicles and cracks in a weathered basalt at two places five miles apart. After chemical and physical investigations had been made of the properties of this asphaltum the following report was written:—

Report on the Asphaltum occurring on Texas Station, East Kimberley.

During the past 12 months several samples of asphaltum have been examined in the Geological Survey Laboratory which were said to have been found

on Texas Station in the East Kimberley District.

The complete list of samples is—

No.	Locality.	Submitted by.
L6103E	Junction Ord and Negri Rivers (Oakes Find)	W. Oakes.
6104	do.	Engineer Commonwealth Railways.
6507	do.	M. P. Durack.
8229	do.	T. Blatchford.
8230	Well near Texas Homestead	T. Blatchford.

Oake's Find.—All four samples from this find, including that collected on the spot by the Assistant Geologist, Mr. Blatchford, are identical in nature. They consist of a brilliant black combustible mineral, partly in angular fragments quite free from visible rock or earth, partly adherent to and enclosing large calcite crystals, partly adherent to a grey or brownish calcareous rock* into which it penetrates along cracks and cavities.

Detailed examination proves the black mineral to belong to the group of hard asphaltums, sometimes called glance pitches. It is very brittle and not sticky. It ignites and burns freely, and does not melt on heating even above 300 deg. C., decomposition taking place without any signs of softening. Specially selected clean fragments had a density of 1.154, but many fragments had densities rising from this figure to 1.20, the higher figures being due to contamination with small quantities of calcite and rock. The calorific value of the purest material was 16,573 B.T.U. (9,207 K.C.U.).

Analyses were made of three specimens:—

No. Source.	6507 M. P. Durack.	8229 T. Blatchford.	6104 Engineer, Comwith. Railways.
<i>Ultimate Analysis:</i>			
	%	%	%
Carbon ...	89.40	89.30	...
Hydrogen ...	7.26	6.95	...
Sulphur ...	.68	.57	...
Nitrogen ...	.41	.36	...
Oxygen ...	2.25	2.82	...
	<hr/>	<hr/>	
	100.00	100.00	
Ash ...	.43	.49	19.96
<i>Proximate Analysis:</i>			
Moisture ...	0.37	...	0.84
Volatile ...	41.54	...	38.20
Fixed carbon ...	56.27	...	41.00
Ash ...	1.82*	...	19.96
	<hr/>	<hr/>	<hr/>
	100.00		100.00

*The proximate analysis was made on a separate lot of fragments to those used for the ultimate analysis. Hence the slight difference in the ash content.

Volatile Matter (by moderately low temperature distillation).

	6507.	8229.	6104.
Water	1.74	..	1.90
Oil	19.89	..	16.00
Gas	19.91	..	20.30
	<hr/>	<hr/>	<hr/>
	41.54% ..		38.20%

The gas burnt freely with a slightly luminous flame.

The oil had a density of 0.758 at 25deg. C. It was dark brown in colour, translucent, fluorescent and of low viscosity.

The water which distilled over was distinctly acid in reaction.

Digestion of the asphaltum with carbon bisulphide in the cold extracted a bright black bitumen, amounting to 15.38 per cent. of the whole in the case of sample 6507, and 10.30 per cent. in the case of 6104.

As the result of these tests there is no doubt whatever that the material collected on the spot by Mr. Blatchford is identical with that originally submitted by Mr. Durack and the Commonwealth Engineer. It is a true asphaltum, the residue left from an asphaltic petroleum by natural evaporation of the more volatile oils, with consequent concentration of the heavier oils and sulphur compounds, accompanied by a small absorption of atmospheric oxygen, and by the chemical change known as polymerisation.

A long series of residues of this nature are known varying from the tar-like fluid maltha, from which evaporation has only just begun, through soft and hard asphaltums to graphitoid, a mineral resembling graphite and representing the last stages of chemical change in an original asphaltic oil.

The Texas Station mineral is a hard asphalt of the kind known as Impsonite, the type of which was found some years ago in the Impson Valley in Indian Territory, U.S.A. Impsonite is characterised by its hardness and brittleness, infusibility, low solubility in carbon bisulphide, and high percentage of fixed carbon.

Texas Homestead.—The sample collected by Mr. Blatchford from a well near Texas Homestead is a much weathered vesicular basalt with a bright black asphaltum, filling (in association with calcite) most of the vesicles as well as some small fractures in the rock. This mineral was proved by its physical properties and its behaviour on heating to be identical with that from Oake's Find.

The discovery of this asphaltum at two localities five miles apart is of great importance, since, as already explained, the mineral is beyond doubt the residue left by evaporation and weathering of an asphaltic oil. From the manner in which the material has filled narrow cracks and isolated vesicles in a somewhat dense rock it is evident that the original oil was a thin oil with a large proportion of light hydrocarbons. There has undoubtedly therefore been at some time a leakage of oil to the surface at these points, but that it has not been in recent years is proved by the hardness and advanced chemical alteration of the asphaltum.

In the Tertiary beds of the upper Fitzgerald River on the south coast, prospecting for oil has been carried on by means of drills which have penetrated to a depth of over 300 feet. No true petroleum has been disclosed, though the prospectors have been spurred on by what appeared to them to be indications of its presence. Investigations made on the spot by Messrs. Blatchford and Wilson, and in the laboratory by myself, have proved the supposed indications to be misleading. Briefly, they were of three kinds:—

(1) Oil films containing hydrocarbons which were observed on the surface of water issuing from the bore hole. These were proved to be a contamination with lubricating oil from the machinery, the oil used being a "castor oil substitute" containing 62 per cent. of mineral hydrocarbons.

(2) Black asphalt-like substance found coating and impregnating a Miocene spicular sandstone. This contained no trace of free oil, asphaltum or ozokerite.

It was the well known "dung-bitumen" found throughout the drier parts of Australia, and consisting of the inspissated rain-water extract of beds of marsupial (in this case, opossum) guano. An analysis showed—

Insoluble in water	{	Organic matter ..	35.1%
		Mineral matter ..	8.5%
Soluble in water	{	Organic matter ..	39.9%
		Mineral matter ..	16.5%

The "organic matter soluble in water" comprised the whole of the bright black constituent and possessed the pungent odour which characterised the original sample. The "insoluble organic matter" consisted of loose fur, marsupial excreta, a little vegetable matter, and numerous small dead beetles. The insoluble mineral matter consisted of sand and dust: the soluble of acid phosphate of lime and other salts.

The source of this material was traced by Mr. Blatchford to caves frequented by opossums situated a little above the seepage.

(3) Black nodules of supposed asphalt occurring in a bed of brown coal. Samples submitted consisted of a brown lignite with numerous nodules of a hard brownish black substance, and a few much smaller, bright red, nodules.

The coal contained—

Moisture	7.86	per cent.
Volatile	54.04	"
Fixed Carbon	21.39	"
Ash	16.71	"
	<hr/>	
	100.00	

At a low red heat tar oils could be distilled from this coal as from all other similar coals.

The small red nodules were transparent, had a density of 1.10, and responded readily to the Liebermann-Storch reaction for resins. It was undoubtedly a fossil resin of vegetable origin.

The larger dark brown nodules (the supposed asphalt) were transparent in fine powder under the microscope, had a density of 1.16 to 1.19, and responded to the Liebermann-Storch reaction for resins. Their composition was—

Fossil Resin, Fitzgerald River.

Carbon	68.89	per cent.
Hydrogen	8.12	"
Sulphur	5.31	"
Oxygen	17.68	"
	<hr/>	
	100.00	

Ash 3.47 per cent.

If these figures are compared with those of previously described ozokerites, asphaltums and fossil resins, the following facts are clear—

(1) Ozokerites and asphaltums contain over 80 per cent. carbon, with usually less than 1 per cent. oxygen, and never more than 2.5 per cent. oxygen. Furthermore, asphaltums are opaque in even the finest powder. The nodules are certainly neither ozokerite nor asphalt.

(2) Fossil resins are plentiful in brown coals all the world over. They are essentially highly oxidised compounds, and analyses of them show from 69 to 85 per cent. carbon, 5 to 12 per cent. hydrogen, and 4 to 20 per cent. oxygen. The sulphur content is often low, but there are records of two Austrian resins containing 4 and 5 per cent. sulphur.

There can be no doubt that these nodules were fossil resin, and therefore no indication of petroleum.

CLAYS.

The exhaustive information regarding our clays made available by the researches carried on in this laboratory during the past five years has done much to establish the fine pottery industry in the State. During the past year, for the first time, domestic ware of several types, made in two Perth factories out of local raw materials, has been placed on the market and has found a ready sale.

WILGA COAL.

A number of samples of coal from Wilga have been analysed. These were taken from bores put down to test the quality and extent of the seams struck some time ago in a shaft put down by the prospector who discovered this extension of the Collie Field. The coal is all of the sub-bituminous class, characterised by the presence of a large proportion of ab-

sorbed water and by an inability to form a coherent coke. The water causes a difficulty in regard to a definite statement regarding the calorific value, since much of it is very loosely held, and in consequence the total water, and with it the calorific value, varies from hour to hour for some days after the coal is brought to the surface. The samples are hermetically sealed immediately they are received at the laboratory, but already they may have been exposed to the air for anything from a few hours to a few months. The figures for the calorific value given in column 10 in the accompanying table are those from the coal as received at the laboratory, and owing to the previous uncertain and varying exposure of the coals, are not strictly comparable. I have therefore added for comparative purposes in column 11 the calorific value on a uniform basis of 12 per cent. moisture, which, according to experiment, should represent approximately the amount present in the coal as it reaches the consumer.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Bore No.	Seam No.	Thick-ness.	Depth to Top.	Mois-ture.	Vola-tile.	Fixed Carbon.	Ash.	Specific Gravity.	Calorific Value Moisture as in col. 5.	Calorific Value basis 12% Moisture.	Remarks.
		feet.	feet.	%	%	%	%		B.T.U.	B.T.U.	
Hand	...	5	36	19.07	33.83	39.73	7.37	...	9266	10076	
I	...	5	87	13.12	36.71	43.76	6.41	...	9502	9624	
		1	187	10.65	35.64	45.24	8.47	...	9463	9320	
II.	...	3	160½	12.27	33.63	33.38	20.72	...	8553	8579	
		1½	220½	16.07	28.39	41.66	13.88	...	8689	9110	
		3	300	18.50	25.73	37.86	17.91	...	7068	7632	
		9	268½	19.29	30.24	40.29	10.18	...	8509	9277	Top 2ft.
				19.74	31.23	43.02	6.01	...	9224	10113	Next 2½ft.
				19.33	32.47	39.47	8.73	...	8802	9602	Next 2½ft.
				19.57	30.06	44.25	6.12	...	8944	9786	Bot. 2ft.
		5	338½	20.61	25.56	37.90	15.93	...	7583	8405	
		0ft. 8in.	345	21.63	20.65	36.26	21.46	...	6905	7753	
		6½	359	27.37	26.76	34.60	11.27	...	7590	9196	Top 3ft.
		6	377	27.90	24.66	40.51	6.93	...	8012	9779	Bot. 3½ft.
				28.91	29.86	34.24	6.99	...	8104	10032	Top 3ft.
				27.56	33.23	30.26	8.95	...	8194	9954	Bot. 3ft.
		2½	392	23.88	30.60	37.07	8.45	...	8707	10066	
		3½	411	28.60	32.70	33.52	5.18	...	8608	10610	
III.	1	1½	80	12.58	30.76	27.87	28.79	1.34	6959	7005	
	2	2½	110½	17.50	27.59	46.21	8.70	1.30	8918	9512	
	3	5	169	17.14	29.22	47.63	6.01	1.34	9205	9776	
	4	7	189½	14.83	28.74	40.17	16.26	1.52	8307	8583	Top 3½ft.
				16.48	32.83	44.76	5.93	1.35	9913	10445	Bot. 3½ft.
	5	3	216	17.15	31.62	37.60	13.63	...	8531	9061	
	6	6	222	18.82	29.87	44.34	6.97	...	9073	9835	Top 3ft.
				18.90	30.92	42.11	8.07	...	8642	9377	Bot. 3ft.
	7	2½	235½	19.09	33.22	39.15	8.54	...	9072	9867	
	8	3	250	19.61	31.10	40.61	8.68	...	8537	9345	
	9	6½	287½	20.38	31.59	36.94	11.09	...	8532	9430	Top 2ft.
				20.31	34.41	37.19	8.09	...	8888	9815	Mid. 2½ft.
				19.43	35.87	35.50	9.20	...	9077	9914	Bot. 2ft.
	10	3	302	18.63	32.53	44.07	4.77	...	8960	9690	
	11	1½	347½	18.18	30.12	46.81	4.89	...	9462	10177	

IRWIN RIVER COAL.

Analyses have been made of three seams of coal passed through in a bore on the Upper Irwin River. This coal is a sub-bituminous one of the same type

as that found at Collie and Wilga. The three seams proved to be of poor quality, mainly owing to their high ash content.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Bore No.	Seam No.	Thick-ness.	Depth to Top.	Mois-ture.	Vola-tile.	Fixed Carbon.	Ash.	Specific Gravity.	Calorific Value Moisture as in col. 5.	Calorific Value basis 12% Moisture.	Remarks.
		feet.	feet.	%	%	%	%		B.T.U.	B.T.U.	
II.	1	5	452	22.71	24.84	27.96	24.49	...	6298	7171	Top.
				23.16	28.02	29.85	18.97	...	7312	8374	Middle.
				24.86	28.60	26.06	20.48	...	6966	8158	Bottom.
	2	1½	460	26.52	26.40	32.98	14.10	...	7447	8918	
	3	12	525	24.30	25.92	31.98	17.80	1.408	6886	8005	Top 3ft.
				21.06	27.94	27.11	23.89	1.529	5887	6562	Next 3ft.
				20.42	28.48	27.50	23.60	1.498	6121	6769	Next 3ft.
				21.46	24.92	28.38	25.24	1.448	5722	6411	Bot. 3ft.

MINERAL NOTES.

The following notes have been made on various specimens of interest which have been submitted to the laboratory during the year.

Auriferous copper ore, Nullagine District.—Samples of carbonate copper ore from a spot about 30 miles northeast of Nullagine were found to contain from 3 to 44 per cent. of copper, with 2 to 12 ounces of gold per ton, and 1 to 2 ounces of silver. The mean of four samples was:—

Copper	.. ..	27.7 per cent.
Gold	.. ..	8 ozs. 9 dwts per ton.
Silver	.. ..	1 oz. 18 dwts. per ton.

Argentiferous copper ore, Wodgina.—A sample of ore from Wodgina assayed:—

Copper	.. ..	49.7 per cent.
Gold	.. ..	Trace.
Silver	.. ..	59 ozs. 17 dwts. per ton.

This ore consisted chiefly of chalcocite (copper sulphide) and quartz, the silver being present as sulphide (argentite).

Meteorites.—A preliminary examination has been made of three meteorites not previously described. These are:

(1) Lake Brown. A pale grey aerolite with but little metallic nickel iron. Total weight, 2½ lbs. Found in 1919 by Mr. Stuckey.

(2) Naretha. A dark grey aerolite with much nickel-iron. Total weight, 6 lbs. Found in 1915 by Mr. Darbyshire.

(3) Milly Milly. An octahedral siderite. Total weight, 58 lbs. Reported in 1921 by an aboriginal native to the manager of Milly Milly station.

Magnetite, Soanesville.—Mr. R. C. Wilson has collected some quite unique specimens of magnetite at the inner end of the gorge leading from Cooglegong to Soanesville. The specimens show veins about one inch wide completely filled with a bright black fibrous mineral, the walls being composed of weathered serpentine. The black mineral is highly magnetic and polar and has a density of 5.16. It dissolves readily in warm strong hydrochloric acid, leaving only a trace of siliceous residue, and contains 71.3 per cent. of iron. As magnetite has a density of 5.17 and contains 72.4 per cent. of iron, it is evident that the mineral is practically pure magnetite. The fibres are readily separated and are extremely fine. They are about 1.5 inches in length, crossing the veins diagonally. Except in colour, the vein has all the appearance of a typical vein of chrysotile or crocidolite, including the wrinkling of the fibres, and there is no doubt that the magnetite is a pseudomorph after chrysotile or crocidolite, the former of which occurs plentifully in the neighbourhood.

Manganocolumbite, Gibraltar.—Angular pebbles of this mineral have been picked up on the surface near a pegmatitic quartz outcrop by Mr. F. R. Feldtmann. An analysis gave the following figures:—

	per cent.
Ta ₂ O ₅	27.28
Nb ₂ O ₅	51.17
TiO ₂	1.75
SnO	.12
Fe ₂ O ₃	1.70
FeO	7.87
MnO	10.16
CaO	nil
MgO	nil
H O -	nil
H O +	.14
SiO ₂	.39
	100.58
Sp. Gr.	5.81

Analyst—H. Bowley.

Minerals of the columbite group have previously been found in the Londonderry district about eight miles to the southeast, and in the Ubini district six miles to the north.

Manganese ore, Eyre Range.—The existence of manganese ores in several parts of the Eyre Range has been known for many years, but samples collected in the past have usually proved to be too highly ferruginous to be worth working. Samples of superior quality in this respect have been obtained this year, assays showing:—

	6971	7817	7818	7819	9761
	%	%	%	%	%
Manganese dioxide, MnO ₂	69.93	62.01	64.47	86.67	57.58
Manganese mon-oxide, MnO	2.72	4.15	2.49	nil	5.57
Total metallic manganese	46.30	42.39	42.67	54.77	40.69
Ferric oxide, Fe ₂ O ₃	10.02	7.94	9.07	1.49	5.19
Silica, SiO ₂ ...	6.55	9.36	1.72	4.13	15.57

No. 7819 (pyrolusite) is of excellent quality for the production of chlorine for use in gold refining, etc. The other samples are composed of psilomelane, and should be well fitted for the production of ferromanganese.

Sulphur, Cliff Head.—Sands containing finely granular native sulphur were collected by W. D. Campbell at Leander Point near Dongara in 1909, a typical specimen containing 14.24 per cent. of free sulphur. Recently a similar sand cemented with free sulphur into a soft sandstone has been obtained near Cliff Head south of Dongara. This contained 12 per cent. of free sulphur with about 40 per cent. of gypsum sand and about 45 per cent. of calcite (foraminifera, etc.). The origin of this sulphur is obscure.

PUBLICATIONS.

Late in the year Bulletin 79 was published officially. This contained, as Part III., a short account of the minerals of the Comet Vale-Goongarrie district, written in the early part of 1918.

In the Journal of the Royal Society of Western Australia for the year 1920-21 are the following:—

Presidential Address: "Science and the Mineral Industry," by E. S. Simpson.

"Notes on Staurolite from the Mogumber District," by E. S. Simpson.

"A Contribution to the Chemistry of Alunite," by H. Bowley.

The last named is a valuable addition to the literature of a commercial mineral, and one which cannot fail to be of great use to those who employ alunite as a source of alum or other potassium or aluminium salts.

PETROLOGICAL WORK.

(R. A. Farquharson, M.A., M.Sc., F.G.S.)

The work for the past year is conveniently summarised under the following heads:—

I. Determinations and Reports for the Geological Survey Staff.

II. Determinations and Reports for other Departments, for Mine Managers, for Prospectors, and for the general public.

III. Miscellaneous.

1. *Determinations and Reports for the Geological Survey Staff.*—As usual, a considerable part of the work for the year has been the determination, description, and correlation of rocks collected by officers in the field, discussions with the officers concerned of the geological problems of their respective districts or areas, careful consideration of the field occurrence

of the rocks in the light of the ascertained microscopic characters, and the interpretation of the general results. The results of this work—which cannot be emphasised too much—are that the mapping, which should be and is of the utmost importance to prospectors and, in live mining fields, to mine managers and mine surveyors, is as accurate as circumstances will allow.

The suites of rocks examined and reported on include those from:—

1. *Northampton*.—These rocks were collected by Mr. Feldtmann while he was engaged on making a somewhat detailed survey of the lead mines, in order that as much light as possible might be thrown on the inter-relationships of the rocks and the nature and origin of the lead lodes.

The rocks comprise:—

- (a) garnetiferous acid gneiss.
- (b) garnetiferous aplites.
- (c) pegmatites, some with tourmaline.
- (d) lode-breccia, a mass composed in part of galena, sphalerite and secondary quartz, in part of small fragments of decomposed epidiorite, of fragments of gneiss and of pegmatite, of galena, secondary quartz, etc.
- (e) dolerite dykes, some small, others of considerable width, all intrusive into the gneiss.

The full account of these appears in the Report on the Mines and Mining Geology, now nearing completion.

2. *Kanowna Deep Lead*.—The rock from Dr. Laver's Lease was so decomposed as to be little more than a yellowish ochreous clay. From an examination, however, of specially treated sections of the rock, the writer is of opinion that it was a decomposed igneous rock, and, as relics of small and large columnar feldspar crystals could be made out, that it was formerly most probably a greenstone. The rock itself could not be described as a "lode," and whatever gold values it showed could be ascribed to the percolation of descending solutions.

3. *Gibraltar*.—These rocks were collected by Mr. Feldtmann during the course of his geological survey of the area. They comprise:—

- (a) foliated amphibolites.
- (b) sheared actinolitic hornblendites.
- (c) finely foliated very slaty gray granulitic biotite-hornblende gneiss. In many respects, this gneiss is very similar to the Edna May gray biotite gneiss.
- (d) pegmatites and aplites.
- (e) several varieties of quartz.
- (f) biotite granite.

The report on these rocks has not yet been published, but will be incorporated in the Bulletin now nearing completion.

4. *Lionel, 17 miles north of Nullagine*.—These specimens were examined for Dr. Simpson's report on Asbestos, to determine the origin of the mineral. They all proved to be serpentines derived from a type containing much pyroxene and a little olivine.

5. *Bremer Bay*.—Two sets of samples were examined from this locality, one collected by Mr. Wilson in connection with his investigations of the alleged occurrence of oil, and the other collected by Mr. Blatchford in his examination of the same alleged occurrence. As the results of the examination of Mr. Wilson's samples are included in the report on those

of Mr. Blatchford, only the latter report need be given here.

EXAMINATION OF THE BORE CORE FROM FITZGERALD RIVER FROM THE BREMER BAY OIL AREA.

From a previous report by Mr. Wilson, I examined some specimens of rock obtained by him from the vicinity of the bore, and also some material forming the bore core to a depth of 129 feet. The rock comprised:

Spicular earth.

A fine-textured somewhat banded pinkish sandstone.

A fine-textured indistinctly banded rather brittle white micaceous and kaolinic sediment, rather similar to the pinkish sandstone.

A brown highly silicified cherty rock, probably the result of the silicification of the decomposed surface of an underlying acid igneous rock.

The rock from the Bore Core consisted of a loose, more or less incoherent whitish material composed of patches of granular quartz, partly broken-down, more or less angular plates of quartz, patches of kaolinic material, strings of micaceous scales, many more or less angular grains of quartz, some surrounded by kaolin, and in some sections minute grains and rods of tourmaline. In places large plates of quartz were in process of being broken down to a fine-textured mass of quartz plates that resemble the indistinctly banded white sediment mentioned above.

Down to 129 feet in the bore the material is fairly uniform in composition and structure. It apparently contains no chlorite and no carbonate. The constituents are granitic, but the structure is that of a detrital sediment, *i.e.*, a rock which has been derived from the *debris* of a granite or gneiss and which may be called a kaolinic and micaceous grit or granitic wash.

After Mr. Wilson's visit the bore was continued to a depth of about 350 feet, and Mr. Blatchford was able to obtain samples of the material between 226 and 309 feet and between 309 and 338 feet. The samples included:

(a) Material somewhat similar to that obtained down to 129 feet, but with a few noteworthy differences.

(b) A soft dark-green fissile slaty rock.

(a) The former consists in part of a mass of granular quartz and kaolinic material as at 105 feet, but with a few green chloritic strings, and a considerable number of aggregates of a carbonate that, on being tested, proves to be siderite; in part, of much coarser material composed of kaolinic aggregates and larger more or less completely broken down plates of quartz, with an appreciable amount of granular siderite and large and small strings and patches of green chlorite. The material becomes coarser and more chloritic with increase in depth of the bore. At first sight, the coarseness of the grain of the rock, the composition and the irregular platy form of the constituents suggest that the rock from 300 feet onwards is a decomposed somewhat sheared granite or gneiss. The presence in it, however, of a fair amount of siderite is hard to account for on any other view than that the rock is still detrital. Nevertheless, the presence of thick strings and patches of green chlorite in the granitic material tends strongly to show that the rock from 300 feet onwards is not a normal sediment, but that either it is formed by the *debris* of a decomposed and disintegrated sheared or gneissic type or that it is very near the bed-rocks, which, to judge from what is known about the rocks in the neighbourhood of Bremer Bay and elsewhere in the country, are probably themselves gneissic.

(b) The soft dark green fissile rock has some of the external characters of a shale, but microscopic examination proves beyond doubt that the rock is not a shale at all, but an extremely sheared chloritic schist, *i.e.*, a member of the metamorphic series. This rock is either a fragment of the country rock in the detrital granitic material or it is part of the country or bed-rock.

The Rocks in Relation to the Occurrence of Oil.

So far as is known, the rocks having any relation to the alleged occurrence of oil are:—

- (a) A series of fine banded sandstones (the pink and the white rocks) capped with a spicular earth, the former inclined at a low angle, the latter practically horizontal.

- (b) The somewhat incoherent kaolinic and in places micaceous grit or wash.
 (c) The rocks on which lie this grit and the sandstones.

From the dip of the sandstones where observed nearest the bore, it is permissible to conclude that they would be carried under the kaolinic grit, either under the whole thickness of the deposit at some point, or so that they would appear in the grit at some depth below the surface. As a matter of fact, calculations based on the dip observed by Mr. Wilson nearest the bore, namely, 20 degrees, on the depth of the bore, and on its position as outlined in Mr. Wilson's plan and section, show that the sandstones would be met with at a depth somewhere about 250 feet from the surface. So far as the samples afford information, these rocks have not been met with in the bore. Therefore, either their horizontal extension is not sufficient to enable them to be picked up in the bore, or, owing to an alteration in the dip, they pass under neath the grit and have not yet been reached.

The character of the rocks at the bottom of the bore strongly suggests that the bed-rock is not far away, so that the chance of picking up the sandstones by continuing the bore is meagre in the extreme.

The presence of the metamorphic chlorite schist is important, for, whether it is only a fragment or not, it indicates the proximity of the bed-rock, and the character of the rocks below the detrital or sedimentary material. It is generally recognised that metamorphic rocks are most unfavourable for the occurrence of oil, for, even if before the metamorphism they did contain it, the action of stresses would completely dissipate or destroy it, and if, as is most probable, the stresses occurred before the sedimentaries were formed, either the oil indications would still be in the latter, or, as the sandstones, etc., are so porous and comparatively incoherent, the oil would have disappeared through these rocks unless sealed in by structural or other phenomena. No such structural or other phenomena have been found in connection with the rocks in the bore. Moreover, no sample from the bore or from the sandstones has shown incontestably any trace whatever of the natural occurrence of mineral oil, and not one indubitable surface indication, solid or liquid, has been found in the vicinity.

Conclusions.

1. While the character of the sandstones and of the kaolinic grit is favourable for carrying oil on account of their loose texture and consequent porosity, it is also equally favourable for its dissipation, and as far as the structural conditions near the bore are known from Mr. Blatchford's observations, there are no phenomena which could have sealed up the oil in these rocks and prevented its dissipation.

2. The chances of the existence of oil-bearing sandstones under the material exposed in the bore are meagre. If present, they would in all probability be the soft sandstones, and as these outcrop and are so far as known not sealed up, chemically or structurally, any oil they once carried would now have disappeared.

3. The basal rocks belong apparently to the igneous and metamorphic series, which are most unfavourable for oil.

In addition to these reports on specimens from Bremer Bay, an investigation was made by the writer of the nature and origin of the so-called bituminous nodules in the shales at the Fitzgerald River. These bodies proved to be quite distinct microscopically from bitumen and to be in all probability fossil resin derived from some plant indigenous to the area.

6. *Mount Monger and St. Ives, Goddard, Paris Mine, etc.*—As stated in the Annual Report for 1920, these rocks were collected by Mr. Clarke and by Mr. Blatchford, by the former during the course of his detailed examination of the whole of the Mount Monger and St. Ives Field and by the latter during the course of his examination of the mines at Mount Monger and the workings at St. Ives. Though much of the examination of the rocks was done towards the end of 1920, it was not completed until the beginning of 1921. The results, owing to the need for

severe economy in printing, will not be published as a separate chapter in Mr. Clarke's Bulletin, but will be incorporated in his text. The chief rocks recognised are as follows:—

1. Serpentine and talc-chlorite-carbonate rocks. These form a very important part of the Mount Monger field and are to a great extent the country rock of the Mount Monger Mines. They have been derived from pyroxenites and peridotites. They include the well-known "chlorite rock" of Mount Monger, and the talcose green rock which shows a gradual passage from the "chlorite rock" to a talc rock.

2. Epidiorites, some fine grained fibrous with platy or confused structure, some fibrous and zoisitic, and a few sheared, granulated and coarse-grained.

3. Actinolite-chlorite hornblendites.

4. Dolerites, some fresh ophitic without quartz, others ophitic with quartz, others that are chloritised and carbonated quartz-dolerites or epidiorites.

5. Medium-grained gabbro with pink diallage.

6. Some doubtfully albitised quartz-dolerite greenstones.

7. Quartz porphyries, some felsitic, others coarse and fine, micacised and sheared.

8. Rhyolitic quartz porphyries with rudimentary intergrowths and with a brecciated structure causing them to resemble some flow breccias.

9. Porphyrites:

(a) sheared chloritic porphyrite.

(b) hornblende porphyrite with and without quartz and resembling a rock at Bulong.

(c) sheared chloritic quartz porphyrite, in places with xenolithic fragments.

(d) black augite porphyrite, similar to the rock at Bulong.

Some of the sheared chloritic porphyrites possess characters suggestive of a volcanic origin, and resemble the porphyrite breccias at Bulong.

10. Jasper bars and laminated slates more or less associated with them.

11. A porphyritic olivine pierite which very closely resembles a basaltic olivine dolerite. This is a rare rock, which occurs as a dyke.

II. *For other Departments, for Mine Managers and for Prospectors and the General Public.*—In no year since the appointment of a Petrologist to the staff of the Mines Department has there been so much work to be done under this head as in 1921. What with the search for and examination of indications of oil-bearing strata and investigation of the petrological features of the alleged occurrences of oil, what with the just interest developed in the occurrence and exploitation of asbestos, the decided increase in the number of requests for petrological assistance in prospecting and mining, and, above all, the serious attempts made by means of bores to pick up the southerly continuation of the lodes of the Golden Mile at Boulder and on the fringe of Hannan's Lake, I have found it extremely difficult at times to keep pace with the work, and on more than one occasion investigations for members of the staff have had to be held over until the completion of important and urgent public work.

This state of affairs is of course very gratifying, for it shows that the value of petrological work in all forms of mining is now genuinely recognised not only by the department but by the mining and pros-

pecting public themselves. The range of the work carried out will be realised by consideration of the following synopsis.

A. For other Departments:

1. Examination of the strata from Hector Street and King Edward Street Water Bores. A full account of the strata met with in these bores and the depths at which they were encountered has been attached to the Metropolitan and Suburban Water Supply File. The Hector Street bore at Osborne Park was put down to a depth of 762 feet, and the chief kinds of material met with in the bore are: White and brown sands, fine black carbonaceous shales, impure sandy and clayey limestone with shell fragments, earthy grits, very coarse quartz sand. The bore ended in very dark gray carbonaceous gritty shale with large quartz grains.

The King Edward bore was put down to a depth of 566 feet, and the main types of strata encountered proved to be: Fine brownish sand, ochreous yellow and white sand, coarse sand with fragments of calcareous sandstone, coarse white calcareous sandstone, green muddy glauconitic sandstone, fine carbonaceous mudstone in places sandy or gritty, soft gritty silt, coarse gritty mudstone, gray sand both coarse and fine. The bore ended in soft black carbonaceous mudstone.

2. Determination of Bore Cores from the Wilga Coal Field. These cores were examined to ascertain the nature of the strata passed through, the depth at which the coal measures disappeared and rocks indicating the proximity of bed-rock came in, and consequently at what depth boring should cease. The results from the cores were:—

No. 1 Bore.—

- 469ft.: brown shale with conchoidal fracture and velvety feel.
- 530ft.: fine-grained impure (shaly) limestone band.
- 535ft.: finely banded gray shale.
- 540ft. 6in.: microcline granite boulder.
- 545ft.: fine-grained shale with decomposed granitic boulders.
- 547ft.: gray shale and shaly grit intermixed.
- 548ft.: loose conglomerate wash with fragments of granite, ironstone, quartz, etc.
- 569ft.: much decomposed amphibolised and chloritised fine-grained quartz diabase or quartz-dolerite.
- 590ft.: very coarse epidotised and chloritised epidiorite with dioritic structure.

The basal limestone band: this is a fine-textured granular limestone containing fragments of quartz, of felspar and of quartzite with a few scales of chlorite. Despite a careful search of several sections, no trace of organic remains, whether of calcareous algæ, glauconite, foraminifera, or shell could be found.

No. 2 Bore.—Specimens from the bottom of this bore consisted of a very coarse conglomerate or "wash" composed of large and small pebbles of decomposed greenstone (quartz epidiorite) in a matrix of detritus from a greenstone probably of the same character as the pebbles. It should be noted that similar rocks were determined from 569ft. and 590ft. in the No. 1 Bore.

No. 3 Bore.—Determinations of the character of the rock at the bottom of the bore were given orally.

3. Notes on Rocks from the Lockyer Range Copper Find. These were prepared from specimens brought down by Mr. Blatchford and for the purpose of indicating the relation between the character

of the rocks and the origin of the copper. The results of the examination were incorporated in Mr. Blatchford's report.

4. Report on specimens from Carter and Hambleton's P.A., Field's Find, with comparison between the specimens and those from the Ninghan Conglomerate. This report was prepared at the request of the Minister for Mines, and the conclusions set out in it are as follows:—

1. The specimens, though somewhat different in appearance, are essentially similar, the differences being due to colour, the size of the constituents, and the relative proportion of the quartz fragments and the matrix.

2. The gold is in part in the yellowish ferruginous material on the margin of some of the specimens, but chiefly in the matrix of the breccia. In the coarse breccia the gold is solely in the matrix, particularly in the dark grayish dusty aggregates. No grains of it have been found in the quartz fragments. The character of the gold is fine granular with very rough outline.

3. The rocks have not the structure of a typical sediment. The very angular nature of the fragments, the character of the cementing material, and the presence of growth lines in this cement, very strongly suggest that the rocks have been formed by the cementing of quartz fragments by secondary quartz, the latter enclosing in places yellowish-brown ferruginous and grayish dust which, together with grains of gold that were in part at least associated with the dust, were taken up by the siliceous solutions. Some of the rocks, in fact, are very similar both in hand specimen and in section to varieties of siliceous laterite, and others to the secondary flinty quartz found in the oxidised zones of a few of the mines.

4. Owing, apparently, to certain broad similarities between the rocks and the Ninghan conglomerate (*e.g.* in both cases, quartz pieces in a quartzose matrix which is auriferous) a genetic relationship has been suggested for the two rocks.

The conglomerate is composed of large angular and subangular pieces of opaque whitish quartz in a fine-textured purplish-red matrix. The latter in section is composed chiefly of round, subangular and ragged grains of quartz united by a red or red-brown ferruginous cement. The cementing material is very sparse and secondary quartz as a binder was not observed, though a little may be present. The grains of quartz are of fairly uniform size, though a few larger than the others occur. There is no doubt whatever that the matrix is a true ferruginous compact sandstone of sedimentary origin, so that the conglomerate is a true conglomerate with a matrix uncommonly large in amount.

Comparison of the rocks from Carter and Hambleton's P.A. with the specimens of Ninghan conglomerate in the office of the Geological Survey shows that in structure the two rocks have little in common. The conglomerate is a true sedimentary rock with a sandstone matrix, and while the ferruginous sandstone acts as the binding material of the pebbles, it has a ferruginous cement of binding material of its own. The matrix carries gold, but some of the enclosed quartz pebbles also carry it. The quartz breccia of Field's Find can scarcely be regarded as a normal sedimentary rock; the quartz fragments do not carry gold, and it would even appear that in part the gold of the matrix is really gold contained in decomposed clayey material and incorporated in the matrix. Further, the quartz cement is not a sandstone, and there is not to be found any cementing or binding material between the individual quartz grains of the cement. The rock is a breccia and not a conglomerate, and even the quartz of the fragments is different in the two cases, being nearly water-clear in the breccia and opaque white or whitish in the conglomerate.

I am of opinion, therefore, that there is no genetic connection between the two sets of rocks.

5. Determination of rocks from Freney's Oil Find, Lower Liveringa, Noonkambah, etc. Chief among these rocks are: a peculiar mica-leucitite lava, leucitite agglomerates and tuffs, fine green tuff, quartzite, ferruginous sandstone. The leucite rocks have never before been found in the State and appear to be the counterparts of those found in Borneo, Java, the Celebes, etc.

6. Report on Rocks from Mount Magnet for the State Mining Engineer. These were alleged to con-

tain wolfram, but were found on examination to be varieties of amphibolised epidiorite. The metallic mineral present was ilmenite.

7. Examination of Bore Cores from the "Maylands" lease, Boulder, for the Golden Ore Channel, Ltd. The work in connection with this lease extended from 8th March to the end of the year. On that date I left for Boulder with instructions to fix the site of the bores and to examine the cores from No. 1 Bore, and the circumstances surrounding the finding of 6 feet of altered quartz dolerite giving assay results up to 48 ozs. per ton at a depth of 875ft. 6in. in the bore. The work at Boulder and at the lease occupied me for two weeks and, on my return to Perth, a careful petrological examination was made of the samples brought down. No fewer than 120 sections were cut from the core and a report of 38 paragraphs was forwarded to the Minister for Mines. The condition the core was in at my visit, the nature of the rock forming the core, the character and value of the six feet of lode and its petrological relations to the rock above and below it in the bore, a discussion on the alleged presence of tellurium in the lode, the circumstances surrounding the making of the respective sets of assays, the conditions under which the boring was carried out and those under which it should be carried out, the conditions under which the examination of all further cores should be made and the manner in which all further assays should be carried out; in short, every phase of core examination, sampling, etc., was thoroughly gone into by me. The whole tenor of the Report was, as set out by the State Mining Engineer to the Minister, that, on petrological grounds, there was the strongest reason for believing that the six feet of altered quartz dolerite had not genuinely come from the rock at 875ft. 6in., but had been interpolated in the core. Owing to the fact, however, that the No. 1 Bore had been put down without strict Government supervision, it was considered advisable by the Government that another bore should be put down to prove the No. 1. In the second bore, despite supervision, another lode represented by 6 feet of core was found at a depth of 688 feet in the core boxes when they were opened in the Geological Survey Office, and it was claimed by the company that this occurrence proved the genuineness of the lode in the No. 1 Bore. The petrological relations of the lode, however, in the No. 2 Bore were identical with those of the lode in the No. 1 Bore, and at a conference with the Minister for Mines, it was stated by me that it would be little short of a miracle for the lodes in No. 2 and No. 1 to be genuine in spite of the fact that the core from the No. 2 was supervised from the time it came out of the ground until it arrived in Perth. The identity of the circumstances of occurrence of the No. 2 lode with that of the No. 1 lode, so far from proving the No. 1 lode genuine, convinced me that both had been interpolated. A third bore, nevertheless, was put down to pick up the No. 1 and the No. 2 lodes, but it did not encounter any lode at all. Finally, a deflection bore was put down in the No. 2 hole to test the nature of the rock at the depth of 688 feet, at which the lode in the No. 2 Bore was alleged to occur. The deflected core consisted wholly of porphyrite. There was no trace of altered quartz-dolerite and there were no values in the material. As any doubts about the validity of the deflection method of testing any particular depth were soon set at rest, there was no escape from the conclusion that the lode in the No. 2 Bore did not occur genuinely or naturally in the rock, and that therefore it had been inter-

polated. The conclusion arrived at by the Petrologist after examining the No. 1 and No. 2 Bores was therefore completely vindicated.

The depth attained in the No. 1 Bore was 1,075 feet, that in the No. 2 Bore was 1,316 feet, that in the No. 3 Bore was 761 feet. The whole of the core of each bore was examined two inches at a time and all rock changes and varieties were carefully noted; all portions of the cores showing even slight mineralisation were assayed, and progress reports on each instalment of the core were forwarded to the Minister and to the Company. Further, the six feet of core alleged to have come from the No. 2 Bore was carefully sliced longitudinally, and one half has been kept in the office for registration and record purposes. A section drawn to scale, showing the inclination of the bores, their depths and the results of assays of the core made by the Company's assayer, by the School of Mines, Kalgoorlie, and by the Geological Survey was also prepared by me and a copy of it given to the Company, and every possible assistance and advice has been at all times tendered to the Secretary and Manager of the Company.

8. Examination of Bore Cores from the Lady of the Lake Lease for Mr. A. H. Williams. During the first half of 1921, Mr. A. H. Williams began boring near the Hesperus Leases with the object of picking up a continuation of the lodes of the Great Boulder, Ivanhoe, etc. His No. 1 Bore encountered alluvial and graphitic schist and was discontinued after a depth of about 100 feet had been reached.

Another bore was put down some distance away from the No. 1 and core from 406 feet to 590 feet was examined by me. From 406 feet to 478 feet, the rock at first proved to be a pale greenish gray facies, then at 435 feet a heavily graphitised slate which, at 467 feet, passed into a black graphitic breccia. From 469 feet to 478 feet the rock was again a graphitic slate. At 478 feet a grayish-white highly sheared porphyry came in and persisted to 590 feet, at which depth the bore was discontinued.

Later, Mr. Williams again began boring on a new lease about half a mile south of the Horseshoe Mine, the Lady of the Lake Lease 5083E. The core from the No. 3 Bore proved to be amphibolised quartz dolerite or epidiorite of the Warden's House type, but as boring progressed several different facies of the type were met with. Some of these, carbonated, bleached and pyritic, resembled in external appearance the true Boulder Lode material, but not only was the pyrites present in cubes of considerable size, but there was a marked absence in the pyritic material of the shearing characteristic of the Boulder lodes. Assays made of the bleached rock failed to give more than five grains or so of gold per ton. As was pointed out by me to Mr. Williams, such bleaching of the rock was to be attributed to one of two causes:

- (a) mineralisation similar to that of the Boulder lodes.
- (b) contact alteration of the epidiorite by the intrusion either of quartz veinlets or of a dyke not actually met with.

Reasons were given him for my assertion that what looked like lodes were in reality the result of (b.)

Bleached facies were met with in the No. 3 Bore at:

- 218 feet—219 feet 6 inches.
- 458 feet—475 feet.
- 549 feet—553 feet 6 inches.
- 668 feet—689 feet 6 inches.

No assays between these limits gave a result higher than 5 grains of gold per ton.

On the completion of No. 3 Bore, Mr. Williams put down No. 4 Bore some 200 feet to the north-east of the No. 3, and to a depth of 447 feet the rock met with was as in No. 3, the amphibolised quartz dolerite or epidiorite, in places chloritised, in places bleached and pyritic. Bleached facies were found at depths:—
209 feet 6 inches—222 feet.

370 feet 7 inches—375 feet 6 inches.

The maximum value of the assays between these limits was 3 grains of gold per ton.

The whole of Mr. Williams' Cores, aggregating 1896 feet, have been carefully examined, 2 inches at a time, and by means of rock sections; progress reports on each instalment have been given him; assays have been made of material which appeared to afford the slightest chance of obtaining values; and all information and advice in regard to his rock, the Boulder lodes, the principles of boring, etc., etc., have been offered him.

B. For Mine Managers, Prospectors and the General Public.

1. Investigation of the occurrence of "kerosene shale" at Cheyne Beach and of the relation between this shale and the Joddja Shale in New South Wales. Microscopically, the loose blocks found on this beach by Mr. Le Mesurier and others are essentially identical with the Joddja Shale (Torbanite.)

2. Report on Rocks from a Water Well at Pingelly and their relation to the occurrence of oil.

3. Report on a suite of rocks from the Hampton Celebration Mine for the Manager. The mining geology of the mine has been largely elucidated by the reports on suites of specimens obtained from it by the Manager, the surveyor and the writer. Most of the rocks were very much decomposed and examination of them was attended with much difficulty. The rocks comprised:—

Doubtful decomposed greenstones.

Sheared porphyry.

Jasperoid.

Sheared decomposed epidiorite. Several specimens were probably different facies of this rock produced by different kinds of alteration.

Chlorite-carbonate schist.

Chlorite-carbonate-felspar rock, a facies of the epidiorite.

Fine-grained gabbro. This rock outcrops some distance from the Hampton Celebration Lease.

Sheared micacised quartz porphyry.

Chlorite schist.

Fuchsitz-quartz-carbonate rock.

Pale reddish-gray felsitic porphyry.

4. Investigation of the composition of some commercial polishing powders.

5. Report on a building stone from Benjabbering. This stone, a fine-grained granite, was wanted for the use of settlers if it could be recommended for local use. It was reported that, provided all weathered portions were discarded, the rock should prove of good value for local use.

6. Report on Asbestos from (a) Garden Gully, (b) Kumarina District, (c) Goomalling.

7. Report on the nature and origin of the graphitic slate encountered in "Mayland's" No. 2 bore in regard to the possibility of its being an alteration product of the Golden Mile lode material. In this report it was pointed out that the graphitic slate is most probably of sedimentary origin, bears no resemblance whatever to an altered quartz dolerite, and carries no gold.

8. Reply to questions propounded by the Directors of the Golden Ore Channel Ltd. in regard to the official report on No. 1 and No. 2 Bore cores, and entitled "Comments on Government Reports."

9. Report on Gypsum from Esperance and Narryer Station.

III. Miscellaneous.

Included under this head are:—

1. Determination of 265 minerals and rocks for prospectors and the public generally.

2. Cutting 560 rock sections, of which 360 have been registered.

3. Revising and editing Bulletins 78 and 79.

4. Preparation of Progress Reports on each instalment of core from all the bores put down by Mr. A. H. Williams and by the Golden Ore Channel Ltd.

5. Preparation of Collections of:—

(a) Ores, earthy ores and some minerals of no commercial importance but resembling ores, for the Warden at Meekatharra.

(b) Gold ores for the Minister for Mines.

(c) Rocks and minerals for Capt. Cosby.

(d) Oxidised lead and copper ore for prospectors.

6. Numerous discussions in regard to the principles of boring.

7. Registration of rock sections and bringing the register up to date.

8. Preparation of Annual Report for 1920.

GEOLOGICAL MUSEUM AND COLLECTIONS.

The collection of minerals, rocks and fossils belonging to the Department remains precisely in the same unsatisfactory condition as heretofore, for the reasons which have been set out at length in the annual reports for several years past.

The accessions to the Geological Survey Collection during the year 1921 amounted to 309, bringing the total number registered up to 17,319. The number of micro-sections cut and registered amounted to 360, in addition to 200 as yet unnumbered: the total number of sections in the Survey Collection now amounts to 4,318.

Suites of bore cores have been received and registered as set out in the following list:—

Reg. No.	Locality and Particulars.
1/3187	Metropolitan Area, Osborne Park, Hector Street Bore. Public Works Department.
1/3194	Murchison Goldfield, Cue, Light of Asia Gold Mine.
1/3204	East Coolgardie Goldfield, Boulder. Lady of the Lake Lease. Williams Bore.
1/3213	Metropolitan Area, Osborne Park, King Edward Street Bore. Public Works Department.
1/3180	South-West Division, Wellington District, Wilga. No. 1 Coal Bore, 598 feet.
1/3215	South-West Division, Victoria District. Irwin River No. 3 Government Bore. Coal 18in. thick, 460 feet.
1/3216	South-West Division, Victoria District. Irwin River No. 3 Government Bore. Coal 6 feet thick, 451 feet 6 inches.
1/3217	South-West Division, Wellington District. Wilga No. 2 Bore. No. 5 Seam. Coal 3 feet thick, 216 to 219 feet.
1/3223	South-West Division, Wellington District. Wilga No. 3 Bore, No. 10 Seam. Coal 3 feet 1 inch thick.
1/3224	South-West Division, Victoria District. Upper Irwin River. No. 2 Government Bore. Coal Seam 12 feet thick.
1/3257	South-West Division, Wellington District. Wilga No. 3 Bore. Shale 560 to 600 feet.
1/3261	South-West Division, Wellington District. Wilga No. 3 Bore. Bottom.
1/3296	South-West Division, Wellington District. Wilga No. 3 Bore. Coal. No. 3 Seam. 5 feet.
1/3297	South-West Division, Wellington District. Wilga No. 3 Bore. Coal. No. 4 Seam, 6 feet 10 inches.

Special acknowledgment is made of the additions to the Collections of the following:—

Reg. No.	Donor.	Mineral.	Locality.
1/3065	O' Bourke	Gypsum Crystals	South-West Division. Lake Grace.
1/3067-8	H. B. Curlewis	Fossil Shells	Trans. Railway. 460 miles from Kalgoorlie.
1/3069	A. Main	Fossil Shells	South-West Division. Carbarup.
1/3070	A. Bunbury	Fossil	South-West Division. Three miles West of Busselton.
1/3072	P. McGovern	Cyanite with white mica	North-West Division. 200 miles East of Derby.
1/3185	T. Breen	Ironstone Concretion	Peak Hill Goldfield. Horseshoe.
1/3188	... ..	Graphitic Granite	Coolgardie Goldfield. Bulla Bulling.
1/3189	W. Hudson	Arsenical Pyrites	Coolgardie Goldfield. Paris G.M.
1/3190	J. Purser	Staurolite-chlorite-biotite rock	South-West Division. Mogumber.
1/3191	A. D. Jones	Bismutite	North-West Division. Gascoyne. Arthur River.
1/3193	R. T. Slee	Manganese Ore	South Australia, Wocalla. Australian Manganese Mine.
1/3195	Bewick, Moreing & Co.	Salt with acicular gypsum coating	Yilgarn Goldfield. Salt Lake, near Southern Cross.
1/3197	W. B. Gordon	Fossil Wood	South-West Division. Gingin.
1/3198	G. S. Lab	Crude Mineral Oil	S. Sumatra.
1/3200	E. S. Simpson	Fluorite from barite vein	South-West Division. Cardup. Location 24.
1/3201	R. A. Farquharson	Rutile needles in quartz	East Coolgardie Goldfield. Kalgoorlie.
1/3202	S. Gillies	Alunite	South-West Division. Northampton.
1/3203	S. Gillies	Jarosite	South-West Division. Northampton.
1/3210	M. P. Durack, M.L.C.	Waterstones	East Kimberley. Argyle Station.
1/3211	H. P. Durack, M.L.C.	Quartz crystals	Kimberley. 160 miles South of Wyndham.
1/3219	R. T. Slee	Molybdenite	New South Wales. Bathurst District. Tetholme.
1/3220	R. T. Slee	Graphitic Sandstone	New South Wales. Broken Hill, Block 11, 300ft. level.
1/3221	R. T. Slee	Native Silver	New South Wales, Broken Hill Proprietary Mine. Below 500ft. level.
1/3222	F. C. S. Cook	Rutile needles in quartz	East Coolgardie Goldfield, Hampton Plains. Block 50. Lease 17.
1/3226	H. B. Curlewis	Fossil Sponge	East Kimberley. Argyle Downs Station Boundary Survey Camp.
1/3227	H. B. Curlewis	Quartz Geode	East Kimberley. Argyle Downs Station Boundary Survey Camp. Basalt country.

LIBRARY.

The Geological Survey library was added to during 1921 by direct contribution from cognate institutions throughout the world of 1,093 publications, in addition to which 166 volumes were added by purchase and 11 volumes have been bound. The full titles of the accessions are recorded in the official catalogue. The number of publications received has shown an increase in the number of Geological Surveys throughout the world, and as a consequence the world-wide dissemination of knowledge relating to their geological structure and mineral resources. The distribution of the official publications of the Geological Survey during 1921 amounted to 7,841.

PUBLICATIONS.

The publications issued during the year 1921 have been as follow:—

Annual Progress Report for the year 1920.

Bulletin 78. Mining Geology of Kookynie, Niagara and Tampa. By J. T. Jutson, Field Geologist.

Bulletin 79. Mining Geology of Comet Vale and Goongarrie, North Coolgardie Goldfield. By J. T. Jutson, Field Geologist.

Bulletin 80. The Mining Centres of Quinn's and Jasper Hill, Murchison Goldfield. By F. R. Feldtmann, Field Geologist.

Bulletin 81. The Geology and Mineral Resources of the Yalgoo Goldfield, Part I. The Warriedar Gold-mining Centre. By F. R. Feldtmann, Field Geologist.

Bulletin 83. The Geology and Mineral Resources of the North-West, Central and Eastern Divisions. By H. W. B. Talbot, Field Geologist.

There are still certain sections of Memoir No. 1—The Mining Handbook—in hand.

The following publications have been completed and await authority for printing:—

Bulletin 84. The Field Geology and Broader Mining Features of the Leonora-Duketon District, including parts of the North Coolgardie, Mount Margaret and East Murchison Goldfields; and a Report on the Anaconda Copper Mine and neighbourhood, Mount Margaret Goldfield. By E. de C. Clarke, Field Geologist.

Bulletin 85. A Geological Reconnaissance of Part of the Ashburton Drainage Basin, with notes on the country southwards to Meekatharra. By H. W. B. Talbot, Field Geologist.

Bulletin 86. The Geology and Mineral Resources of the Yalgoo Goldfield, Part II. The Geology of Goodingnow (Payne's Find), Rothesay and Noongal (Melville). By E. de C. Clarke, Field Geologist.

Bulletin 87. A Geological Reconnaissance in the Country between Longitude 122° 30' and 123° 30' East and between Latitude 25° 30' and 28° 30' in the Central and Eastern Divisions. By H. W. B. Talbot, Field Geologist.

Bulletin 88. Palaeontological Contributions to the Geology of Western Australia. Series VII., Nos. 13 and 14. By Rex W. Bretnall, The Australian Museum, and L. Glauert, The West Australian Museum.

Bulletin 89. The Auriferous Lodes of the Gibraltar District, Coolgardie Goldfield. By F. R. Feldtmann, Field Geologist.

Bulletin 90. General Geology and Mineral Resources of the Monger-St. Ives District, Coolgardie and East Coolgardie Goldfields. E. de C. Clarke.

There are in active preparation or contemplation:—

The Present Condition of our Knowledge of the Geology and Mineral Resources of the Kimberley Division: A. Gibb Maitland.

The Artesian Water Resources of Western Australia. A. Gibb Maitland.

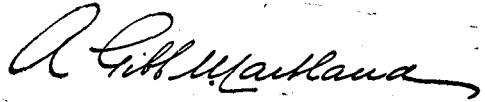
The Clay Deposits of Western Australia. E. S. Simpson and others.

Geological Sketch Map of Western Australia, Four Sheets, Scale 25 miles per inch, Natural Scale 1 : 1,584,000.

As pointed out in the last Annual Report, it is very much to be regretted that in the public interest arrangements cannot be made to have the whole of the outstanding bulletins of the Geological Survey printed immediately, thus insuring more prompt publication, so that all the present arrears may be wiped out.

A very large part of the usefulness of the Geological Survey depends almost entirely upon the promptitude with which the final results of its work

are made available to the public. Whilst this is the case, it ought not to be forgotten that reports which are expected to have scientific and official accuracy take time to prepare—which only those who are called upon to do it adequately realise—and that for those who have to accept the responsibility in connection therewith it is, *inter alia*, essential that the necessary facts should be definitely ascertained, and their accuracy assured, rather than that the demands for hastily written and badly digested reports, not based on accurate survey, which tend to defeat their own ends, should be acceded to.



Government Geologist.

Geological Survey Office,
Perth.

1st May, 1922.

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DIVISION V.

SCHOOL OF MINES OF W.A.

School of Mines,
Kalgoorlie, 10th February, 1922.

The Under Secretary for Mines.

I beg to forward, for the information of the Hon. the Minister, my report for the year 1921.

The year commenced with a satisfactory enrolment, but owing to the disturbed condition of the mining industry, the prevailing uncertainty as to future developments, and the lack of suitable employment, the students in attendance during the third term showed a decrease as compared with 1920. For several years past the school accommodation has been severely taxed to adequately provide for the increased number of students desiring instruction. No additional classrooms were provided during 1921, but a continuance of the existing adverse conditions in mining, combined with the re-introduction of class fees, may so affect the attendance that the necessity for extra accommodation may not be as severely felt during 1922 as formerly. The scale of fees proposed for next year is similar to that in force up to the end of 1912. It is to be expected that the re-imposition of class fees will decrease the attendance to some extent, but as it may be anticipated that few genuine students will be deterred from attendance, and as students under 21 years of age are to be admitted free, the adverse effect may not be great. The payment of fees acts as a direct incentive to students to attend regularly so as to secure, as far as possible, the full benefit of the classwork.

At the beginning of 1921, Mr. A. S. Winter, who has had considerable practical experience in works as well as in teaching, was appointed Assistant Lecturer in Chemistry, and has devoted himself energetically to the work of the school. His appointment enabled students to obtain a larger amount of practice in Chemistry and Assaying, and led to increased efficiency in each of these classes.

The students worked steadily throughout the year, and at the annual examinations secured fair average results. The preparatory classes in Mathematics, Physics, Chemistry, Drawing, and Geology, which constitute an excellent introduction into the more advanced classwork of the Associateship Courses, proved, as usual, very popular. The large enrolment in Mathematics necessitated the appointment of a part-time instructor to assist the Lecturer. In Preparatory and first year Mathematics, the number of passes secured was disappointing. Students generally experience considerable difficulty in mastering the intricacies of Mathematics, which is an essential part of all the courses, but unfortunately the time that can be devoted to classwork is very limited. Although trial has been made with specially selected

weekly exercises to supplement the instruction given during class hours, the results secured at the annual examinations were not sufficiently encouraging to warrant the extra labour involved in their continuance, and an endeavour will be made in 1922 to secure better results in Mathematics by utilising the services of the Assistant in Physics. As a smaller attendance is expected in 1922, it is thought that by a re-organisation of the classes in Mathematics, Physics, and Electrical Engineering, the part-time instructor in Mathematics and one of the cadets in Physics may be dispensed with, and part of the time of the Assistant in Physics made available for Mathematics. In this way it is hoped to secure increased efficiency and a reduction in expenditure.

The attendance at Mining and Surveying was small. Several of those who joined the classes discontinued because of pressure of work in other directions or because they were leaving the district. There have been inquiries for higher grade instruction in these subjects, but although honours work would be beneficial in several ways, not only to the students themselves but also to the staff and the school, only a limited number of students would take advantage of any higher classes that might be established.

The Engineering classes were well attended. Students worked industriously throughout the year, the attendances were good, and the results satisfactory. The practical classes conducted in connection with the Steam Engine, the Gas Engine, and in Fitting and Turning, were well patronised, and were of great value in supplementing the theoretical portions of the classwork. The Engine Driving classes also accomplished good work. There is, however, a need for increased equipment in all sections of the engineering classes, as well as in the other departments of the school. The Staff feel the want of up-to-date apparatus for demonstration purposes. Of recent years, even when the money was available, it has been particularly difficult to secure suitable equipment, and on several occasions the orders for material have been cancelled by the Staff because of the excessive cost. The school work will continue to be severely handicapped as long as there is a dearth of up-to-date scientific apparatus for the proper demonstration of the lectures, and it is hoped that there will soon be a marked improvement in the quantity and quality of the equipment procurable.

Two associates of the School of Mines who were given the opportunity of employment at the Midland Junction workshops in order that they might gain

practical experience in workshop practice have been steadily at work during the past twelve months, and have acquitted themselves creditably.

Following upon the thorough technical training at the School of Mines, the practical experience in the workshops, affording an insight into details of construction methods of organisation and economic conditions, should fit these students to occupy responsible positions in the future. It is gratifying to know that such a valuable avenue of advancement is open to School of Mines associates.

During the August vacation a party of 12 students and two instructors journeyed to Perth with the object of visiting electrical and mechanical engineering workshops, including the Midland Junction Workshops, the Perth Power Station, the State Implement Works, and the Fremantle Sub-station. Visits were also paid to the "Zealandia," the Claremont Asylum, and the Observatory. By the courtesy of the officers in charge the members of the party were afforded every facility for observing machines and equipment under working conditions, and, as the result of their week's visit, they obtained a very large amount of useful information. The students evinced very keen interest in everything brought under their notice. The tour, which is the second one made by School of Mines students, had a high educative value, and the opinion was freely expressed that at least one such excursion should be arranged annually.

Although considerable delay has occurred in the delivery of the equipment required for the completion of the Metallurgical Experimental Plant, the installation is sufficiently advanced to allow a series of working tests to be commenced in 1922, and steps are being

taken to secure supplies of suitable material for treatment. It is hoped that the experimental work will be the means of elucidating difficulties in ore treatment and will prove of considerable educative value to the students. Students in the metallurgical and mining classes will be required to carry out experimental work in the plant as part of their regular course.

The volume of public assay work was well up to the average. By furnishing reports as to assay values, and by indicating the means of utilising and disposing of base metal ores, every effort was made to give prospectors information likely to be of assistance to them.

During 1921, 550 free assays and mineral determinations were made for prospectors of material from Crown lands not held under lease for mining purposes, as follows:—

Assays for gold and silver ..	435
Assays for copper	3
Analyses	37
Determinations of rocks, minerals etc.	75
	550

The statistics dealing with the enrolment of students, examination results, etc., are forwarded herewith.

I have the honour to be,

Sir,

Your obedient servant,

F. B. ALLEN,
Director, School of Mines.

The following is a list of some of the positions held by former students:—

Butement, J. C.—1920-21, Construction Engineer with Burma Corporation, Burmah; 1921 (later), Works Manager, Viking Tenax, Ltd., London.

Gabel, J.—1920-21, Assistant Surveyor and Sampler, Block Ten Mine, Misima, New Guinea; 1921 (later), returned there as Surveyor.

Lang, J. H.—1920, Engineer, Edna May Deepes Mine; 1921, Engineer, Edna May Central Mine.

Midgley, F. M.—Lately with Municipal Light Station, Kalgoorlie; now in a similar position with Bunbury Municipality.

Nairn, T. W.—In the early part of year was in the Assay Office, Great Boulder Mine; later left to take up position as Assayer, Block Ten Mine, Misima.

Waite, T. A.—Early in year was in charge of ore-dressing plant, Island of Billiton, East Indies; later was Assistant Metallurgist, Block Ten Mine, Misima.

Others such as the following, who have been mentioned from time to time, still hold their old positions with credit to themselves and to the School:—

Banks, R.; Burrows, M.; Cain, J. H.; Griffiths, D. D.; Godden, F. W. R.; Head, D.; Kurth, E. E.; Leever, J. C.; Mundle, E. B.; Noall, J. C.; Nowland, L.; Peart, T.; Shaw, C. C.; Terrell, J. H.; Hilton, L.; Edmundson, F. C.; Galt, W.; Davies, W.

SCHOOL OF MINES OF WESTERN AUSTRALIA.

EXAMINERS.

The following Examiners conducted the Examinations in November, 1921:—

Subject.	Examiners.
Preparatory Mechanics	F. B. Allen, M.A., B.Sc.
Preparatory Chemistry	A. S. Winter
Preparatory Physics and Electricity	C. Cecil.
Preparatory Geology	C. O. G. Lacombe, B.Sc., F.S.T.C., F.G.S.
Preparatory Mechanical Drawing	C. Cecil.
Mathematics I.	E. H. Illidge, B.Sc., and W. E. Thomas, B.A.
Mechanics—Theoretical	R. Davis, B.Sc., and F. H. Illidge, B.Sc.
Physics I.	R. Davis, B.Sc.
Chemistry I.	D. McDougall, A.I.E.E.
Engineering Chemistry I.	B. H. Moore, B.E., F.S.A.S.M., and R. R. Baxter, B.Sc.
Assaying I. and II.	L. W. Phillips, B.Sc., and B. H. Moore, B.E., F.S.A.S.M.
Metallurgy I. and II.	B. H. Moore, B.F., F.S.A.S.M.
Petrology	G. S. Compton, A.W.A.S.M.
Mineralogy	C. O. G. Lacombe, B.Sc., F.S.T.C., F.G.S., and G. S. Compton, A.W.A.S.M.
Geology	C. O. G. Lacombe, B.Sc., F.S.T.C., F.G.S.
Mining Geology	E. H. Illidge, B.Sc.
Practical Mathematics	J. H. Tate.
Mechanical Drawing I. and II. ...	B. H. Moore, B.E., F.S.A.S.M.
Applied Mechanics	J. H. Tate.
Mechanical Engineering I. and II. ...	J. H. Tate, and T. Butement, A.O.U.S.M.
Surveying I. and II.	T. Butement, A.O.U.S.M.
Mining I. and II.	D. McDougall, A.I.E.E.
Electrical Engineering I. and II. ...	W. J. Troup.
Fitting and Turning I. and II. ...	C. C. Meredyth.
Engine Driving I. and II.	A. R. E. Bosustow.
Gas Engine	
Indicator	

JUNIOR SCHOLARSHIP.

Subject.	Examiners.
English	B. H. Moore, B.E., F.S.A.S.M.
Physical Geography	C. O. G. Lacombe, B.Sc., F.S.T.C., F.G.S.
Mathematics	F. B. Allen, M.A., B.Sc.

SCHOOL OF MINES OF WESTERN AUSTRALIA. KALGOORLIE.

ATTENDANCES.

Subjects.	Effective Enrolment.		
	1st Term.	2nd Term.	3rd Term.
Elementary Mathematics (Thursday) ...	19	14	11
” ” (Friday) ...	9	8	5
Preparatory Mathematics (Monday) ...	47	42	36
” ” (Tuesday) ...	11	10	10
” Drawing (Thursday) ...	18	12	8
” Physics ” (Friday) ...	42	35	27
” Chemistry	37	31	23
” Geology	73	59	49
Mathematics—First Course	17	15	11
Theoretical Mechanics	27	24	23
Physics—First Course	7	6	6
Chemistry—First Course	24	21	21
Engineering Chemistry I.	18	18	17
” ” II.	6	4	4
Chemistry II. (old course)	2	2	1
Assaying—First Course	1	1	...
” Second Course	2	2	1
Metallurgy—First Course	3	3	3
” Second Course	4	4	4
Geology	1	1	1
Mineralogy	7	6	6
Petrology	1	2	1
Mining Geology	2	2	1
Mining I.	2	4	4
” II. (Mine Sampling)	1	...	...
” (Ore Dressing)	2	...	...
” (Mine Accounts)	3	...	2
” (Mine Administration) ... ..	...	1	...
Surveying I.	1	1	...
” II.	5	4	3
Mechanical Drawing I.	4	5	4
” II.	16	15	14
Applied Mechanics	7	7	7
Mechanical Engineering I.	6	5	5
” II.	8	8	8
Engine Driving I.	6	6	6
” II.	4	5	5
Electrical Engineering I.	7	8	9
” II.	3	3	3
Fitting and Turning I.	2	2	2
” II.	20	20	18
Gas Engine	5	5	4
Practical Mathematics	24	20	20
	3	3	2
	507	445	385

	1920.			1921.		
	1st Term.	2nd Term.	3rd Term.	1st Term.	2nd Term.	3rd Term.
Total Enrolment	597	552	461	607	445	385
Individual Students	254	239	197	205	181	163

EXAMINATION RESULTS, 1921.

The following table shows the passes obtained by students of the Western Australian School of Mines, Kalgoorlie, at the Annual Examinations held in November, 1921, including the Supplementary Examinations held in February, 1921:—

Subject.	Class of Pass.		
	Credit.	Pass.	Total.
Elementary Mathematics ... ..	...	4	4
Preparatory Mathematics ... ..	...	3	3
Preparatory Mathematics, Arithmetic	1	7	8
Preparatory Mathematics, Algebra ... ..	...	5	5
Preparatory Mathematics, Geometry ... ..	...	3	3
Preparatory Mechanical Drawing	6	14	20
Preparatory Chemistry	5	28	33
Preparatory Physics	5	13	18
Preparatory Geology	2	7	9
Mathematics I. ... ..	...	3	3
Mathematics I., Algebra ... ..	...	1	1
Mathematics I., Trigonometry ... ..	...	1	1
Mathematics I., Geometry ... ..	...	2	2
Theoretical Mechanics ... ..	...	3	3
Physics ... ..	...	8	8
Chemistry I. ... ..	...	10	10
Engineering Chemistry I.	1	3	4
Engineering Chemistry II. ... ..	...	1	1
Assaying I.	1	1	2
Assaying II. ... ..	...	1	1
Metallurgy I. ... ..	...	2	2
Geology	2	3	5
Mineralogy ... ..	...	1	1
Petrology ... ..	...	1	1
Mining Geology (Surveyor's Course) ... ..	...	2	2
Mining and Economic Geology ... ..	...	2	2
Mine Sampling (Mining II.) ... ..	...	1	2
Surveying I.	2	...	2
Surveying II.	1	4	5
Mechanical Drawing I.	7	7	14
Mechanical Drawing II.	5	2	7
Applied Mechanics	3	2	5
Mechanical Engineering I.	4	4	8
Mechanical Engineering (Gas Engine)	4	7	11
Mechanical Engineering (Indicator)	3	6	9
Building Construction	1	2	3
Engine Driving I.	3	1	4
Engine Driving II.	2	5	7
Electrical Engineering I. ... ..	...	2	2
Electrical Engineering II.	2	2	4
Fitting and Turning I.	2	13	15
Fitting and Turning II. ... ..	...	4	4
Machine Design	2	2	4
Mechanical Engineering II.	2	4	6
Practical Mathematics	1	...	1
	68	197	265

ASSAYERS' CERTIFICATES.

The following have gained Certificates:—

Adams, H.	P.T.S.	...	March, 1904.
Adams, P.	P.T.S.	...	February, 1905.
Beech, S. J.	K.S.M.	...	November, 1906.
Brown, T.	P.T.S.	...	November, 1906.
Brooking, J.	P.T.S.	...	November, 1906.
Hutchinson, D. M.	K.S.M.	...	November, 1906.
Banks, R.	K.S.M.	...	November, 1908.
Gabel, J.	K.S.M.	...	November, 1908.
Pike, R. W.	P.T.S.	...	November, 1908.
Baxter, R. R.	P.T.S.	...	November, 1909.
Bradley, W. S.	K.S.M.	...	November, 1909.
Burrows, M. F.	P.T.S.	...	November, 1909.
Compton, G. S.	P.T.S.	...	November, 1909.
Cook, H. J.	P.T.S.	...	November, 1909.
Klem, L. G.	P.T.S.	...	November, 1909.
Fraser, W.	K.S.M.	...	November, 1910.
Rowledge, H. P.	P.T.S.	...	November, 1910.
Benjamin, L. R.	P.T.S.	...	November, 1911.
Jackson, L. T. C.	P.T.S.	...	November, 1911.
Leevers, J. C.	K.S.M.	...	November, 1911.
Lapsley, R. G.	P.T.S.	...	November, 1912.
Kurth, E. E.	K.S.M.	...	November, 1913.
Grace, J. N. A.	P.T.S.	...	November, 1916.
Noall, J. C.	K.S.M.	...	November, 1917.
Cecil, Clyde	K.S.M.	...	November, 1918.
Terrell, J. H.	K.S.M.	...	November, 1918.
Nairn, T. W.	K.S.M.	...	November, 1918.
Roberts, T. J.	K.S.M.	...	November, 1919.
Chapman, F. E.	P.T.S.	...	November, 1920.
Lethlean, H. V.	K.S.M.	...	November, 1921.

MINE SURVEYORS' CERTIFICATES.

The following have gained Certificates:—

Peat, J.	K.S.M.	...	November, 1909.
Adams, H.	K.S.M.	...	November, 1910.
Banks, R.	K.S.M.	...	November, 1911.
Gabel, J.	K.S.M.	...	November, 1911.
Pike, R. W.	K.S.M.	...	November, 1912.
Godden, F. W. R.	K.S.M.	...	November, 1915.
Mundle, E. B.	K.S.M.	...	November, 1915.
Leevers, J. C.	K.S.M.	...	November, 1916.
Crutchett, I. A.	K.S.M.	...	November, 1920.
Powell, T.	K.S.M.	...	November, 1921.

DIPLOMAS.

The following Students have gained Diplomas:—

Beech, S. J. (K.S.M.), Diploma in Metallurgy, November, 1906.
Adams, P. (P. and K.), Diploma in Metallurgy, November, 1907.
Adams, H. (P. and K.), Diploma in Metallurgy, November, 1908.
Banks, R. (C. and K.), Diploma in Metallurgy, November, 1910.
Burrows, M. F. (P. and K.), Diploma in Metallurgy, November, 1910.
Compton, G. S. (P.T.S.), Diploma in Metallurgy, November, 1910.
Cook, H. J. (P.T.S.), Diploma in Metallurgy, November, 1910.
Gabel, J. (K.S.M.), Diploma in Metallurgy, November, 1910.
Gabel, J. (K.S.M.), Diploma in Mining, November, 1911.
Pike, R. W. (P. and K.), Diploma in Metallurgy, November, 1911.
Galt, W. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1915.
Butement, J. C. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1915.
Edmondson, F. C. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1915.
Lang, J. H. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1915.
Grace, J. N. A. (P.T.S.), Diploma in Metallurgy, November, 1915.
Bradley, W. S. (K.S.M.), Diploma in Metallurgy, November, 1915.
Kurth, E. E. (K.S.M.), Diploma in Metallurgy, November, 1916.
LeMesurier, C. B. (K.S.M.), Diploma in Metallurgy, November, 1919.
Leevers, J. C. (K.S.M.), Diploma in Mining, November, 1916.
Davies, Watcyn (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1917.
Weselman, Carl (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1917.
Nairn, T. W. (K.S.M.), Diploma in Metallurgy, November, 1919.
Mundle, E. B. (K.S.M.), Diploma in Mining, November, 1920.
Thompson, E. P. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1920.
Gill, L. J. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1921.
McBeth, R. A. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1921.
Rosenberg, J. M. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1921.

ENGINE-DRIVERS' CERTIFICATES.

The following Students of the School of Mines passed Examinations held by the Chief Inspector of Machinery during 1921, for various Engine-drivers' Certificates:—

Marshman, H. F.
Mason, G. E.
Smith, J. E.
Thrupp, T. W.
Turner, B. L.
Willmott, E.
Woodward, J.

SCHOLARSHIP EXAMINATIONS, 1921.

JUNIOR SCHOLARSHIP.

Candidate.	District.
Manners, G.	Kalgoorlie.
Illg, B.	Boulder.
Alexander, J.	Boulder.
McNicol, M.	Boulder.
Lowry, L.	Boulder.
Fyfe, G.	Boulder.
Oldfield, T.	Kalgoorlie.
Morris, B.	Kalgoorlie.
Denman, B.	Kalgoorlie.
Bailey, V.	Kalgoorlie.
Golding, H.	Kalgoorlie.
Thompson, A.	Kalgoorlie.

G. Manners gains the Junior Scholarship.

ENTRANCE SCHOLARSHIP.

Candidate.	District.
Doyle, J. F.	Trafalgar.
Hopkins, A.	Boulder.
Lloyd, A. C.	Kalgoorlie.
Hicks, L.	Kalgoorlie.
Cleghorn, J.	South Kalgoorlie.

J. F. Doyle gains the Entrance Scholarship.

SENIOR SCHOLARSHIP.

Candidate.	District.
Moody, C. O. V.	Fimiston.
Downie, J. H.	Kalgoorlie.
Fulcher, J. H. E.	Gomalling.
Hopgood, L. J.	Boulder.

Scholarship not awarded.

CHAMBER OF MINES SCHOLARSHIP OF £20 IN METALLURGY.

Candidate.	District.
Paterson, A. V.	Kalgoorlie.

A. V. Paterson recommended for the Scholarship.

THE CRITCHLEY PARKER PRIZE.

The following has been recommended for the prize offered by Critchley Parker, Esq., Melbourne.

T. W. Thrupp—The Industrial Australian and Mining Standard, 1922.

ANNUAL EXAMINATIONS, 1921.

T. denotes terminal pass only.

PREPARATORY CHEMISTRY.

- Credit—
Cullen, George C.
Vincent, Jack
Doyle, John F.
Williams, Victor L.
Weidner, Eileen J.
- Pass—
Weidner, Phyllis M.
Leslie, Bernard H. P.
Morrow, Arthur E.
Hopkins, Arthur J.
Newman, Henry B.
Raven, Stanley C.
White, Herbert V.
Underwood, Stanley L.
Macpherson, M. D. C.
Carter, Arnold J.
Lynch, Thomas
Hicks, Leslie J.
Serjeant, Miss Nina B.
Boulter, Thomas
Rowe, John S.
Lloyd, Arthur C.
Cribb, Arthur H.
Griffiths, John T.
Duke, Ronald A.
Goodacre, Robert C.
Taylor, Francis A. L.
Sansum, Harold A.
Enderby, George W.
Leggett, Stanley W.
Fitzgerald, Sydney L.
Smith, Roland T.
Edmonds, Arthur H.

PREPARATORY MECHANICAL DRAWING.

- Credit—
Hicks, Leslie J.
Doyle, John F.
Hopkins, Arthur J.
Thompson, Robert M.
Vincent, Jack
Cullen, George C.
- Pass—
Lynch, Thomas
Rowe, John S.
Lloyd, Arthur C.
Cleghorn, John M.
Hilditch, Athel S.
Underwood, Stanley L.
Wishart, Gordon D.
Leslie, Bernard H. P.
Macpherson, M. D. C.
Enderby, George W.
Mitchell, Frank
Williams, Victor L.
Glendinning, Angus R.
McLean, Charles E.

PREPARATORY PHYSICS.

- Credit—
Doyle, John F.
Glendinning, Angus R.
Cullen, George C.
Morrow, Arthur E.
Thompson, Robert M.
- Pass—
Lloyd, Arthur C.
Head, Bert.
Rowe, John S.
Baker, Stanley
Hopkins, Arthur J.
Williams, Victor L.
Macpherson, M. D. C.
Taylor, Francis A. L.
Hilditch, Athel S.
Hicks, Leslie J.
Cleghorn, John M.
Murray, Francis J.
Johnson, Harold E.

PREPARATORY GEOLOGY.

- Credit—
Doyle, John F.
Esdalle, Alex. N.
- Pass—
Hopkins, Arthur J.
McDermott, James J.
Lloyd, Arthur C.
Williams, Victor L.
Cleghorn, John M.
Hicks, Leslie J.

PREPARATORY MATHEMATICS.

- Pass—
Hopkins, Arthur J.
Doyle, John F.
Raven, Stanley C.

PREPARATORY MATHEMATICS.

ARITHMETIC SECTION.

- Credit—
Glendinning, Angus R.

- Pass—
Rowe, John S.
White, Herbert V.
McInerney, Brian
Sansum, William A.
Murray, Francis J.
Edmonds, Arthur H.
Hicks, Leslie J.

ALGEBRA SECTION.

- Pass—
Lloyd, Arthur C.
Murray, Francis J.
Raven, Stanley C.
Lloyd, Robert F.
Cleghorn, John M.

GEOMETRY SECTION.

- Pass—
Thompson, Robert M.
Lloyd, Arthur C.
Noble, William J.

ELEMENTARY MATHEMATICS.

- Pass—
Morrow, Arthur E.
Macpherson, M. D. C.
Enderby, George W.
Hilditch, Athel S.

MATHEMATICS.

- Pass—
FIRST COURSE.
Blurton, Norman C.

MATHEMATICS.

- Pass—
FIRST COURSE.
ALGEBRA SECTION.
Esdalle, Alex. N.

MATHEMATICS.

- Pass—
FIRST COURSE.
TRIGONOMETRY SECTION.
Esdalle, Alex. N.

MATHEMATICS.

- Pass—
FIRST COURSE.
GEOMETRY SECTION.
Martin, Henry R.

THEORETICAL MECHANICS.

- Pass—
Blurton, Norman C.
Carrigg, Clifford G.
Sinclair, Robert J.

PHYSICS.

- Pass—
FIRST COURSE.
Esdalle, Alex. N.
Midgley, Frank M.
Parker, Stanley C.
Moody, Charles O. V.
Blackmore, Frederick J.
Brown, Charles W.
Downie, James H.

CHEMISTRY.

- Pass—
FIRST COURSE.
Powell, Thomas
Brown, Charles W.
Rudwick, Frederick J.
Scott, Thomas C. (Junior)
O'Keefe, Bernard J.
Moody, Charles O. V.
McDermott, James J.
Taylor, Harry
Downie, James H.
Davies, Idris

ENGINEERING CHEMISTRY.

FIRST COURSE.

- Credit—
Paterson, Arthur V.
- Pass—
Greer, Jack H.
Carrigg, Clifford G.
Lethlean, Hedley V.

ENGINEERING CHEMISTRY.

SECOND COURSE.

- Pass—
Cecil, Clyde
- ASSAYING.
- Credit—
FIRST COURSE.
Paterson, Arthur V.

ASSAYING.

- Pass—
SECOND COURSE.
Lethlean, Hedley V.

METALLURGY.

- Pass—
FIRST COURSE.
Greer, Jack H.
Carrigg, Clifford G.

- Credit—
GEOLOGY.
Agnew, Rudolph J.
Paterson, Arthur V.

- Pass—
Greer, Jack H.
Milesen, Albert
Carrigg, Clifford G.

- Pass—
MINERALOGY.
Carrigg, Clifford G.

- Pass—
PETROLOGY.
Gibbons, Leo. P. J.

MINING AND ECONOMIC GEOLOGY.

- Pass—
Powell, Thomas
Gibbons, Leo. P. J.

MINING GEOLOGY.

- Pass—
SURVEYOR'S COURSE.
Agnew, Rudolph, J.
Davies, Idris

MINE SAMPLING.

- Credit—
Milesen, Albert
- Pass—
Eddy, John T.

SURVEYING.

- Credit—
FIRST COURSE.
Rosenberg, Julius M.
Milesen, Albert

SURVEYING.

- Pass—
SECOND COURSE.
Provisional Pass pending Plan.

- Agnew, Rudolph J.
Gibbons, Leo. P. J.
- COMPLETE PASS.

- Crutchett, I. A.
(Written examination 1920—
Plan now accepted.)
Crutchett, E. G.
(Written examination 1919—
Plan now accepted.)

- COMPLETE PASS WITH CREDIT.
Powell, Thomas
(Written examination 1919—
Plan now accepted.)

MECHANICAL DRAWING I.

- Credit—
Duke, Ronald A.
Leggett, Stanley W.
Yews, Douglas C.
Sinclair, Robert J.
White, Herbert V.
Willcocks, William F.
Baker, Stanley

- Pass—
Hanks, Alfred H. E.
Martin, Henry H.
Sansum, William A.
Hopgood, Lionel J.
Downie, James H.
Moody, Charles O. V.
Fulcher, James H. E.

MECHANICAL DRAWING II.

- Credit—
Johns, Edward N.
Carrigg, Clifford G.
Blurton, Norman C.
Dingle, Mervyn M.
Brown, Alexander O.

- Pass—
Armstrong, Daniel T.
Thrupp, Thomas W.

APPLIED MECHANICS.

- Credit—
Cecil, Clyde
Thrupp, Thomas W.
Ehlers, Charles R.

- Pass—
Dingle, Mervyn M.
Rosenbrock, Ernest L.

MECHANICAL ENGINEERING.

FIRST COURSE.

- Credit—
Blurton, Norman C.
Carrigg, Clifford G.
Johns, Edward N.
Sinclair, Robert J.

- Pass—
Lloyd, Robert F.
Baistow, Leslie J.
McLean, Charles E.
McCahon, John H.

GAS ENGINE.

- Credit—
Dowrick, Albert R.
Irons, William
Dingle, Mervyn M.
Cleghorn, John

- Pass—
Kellow, Stephen M.
Gibbons, Leo P. J.
Whitney, Thomas
Lapham, Edgar M.
Richards, Gilbert
Rosekelly, William G. (T.)
Young, Ronald C. (T.)

INDICATOR.

- Credit—
Dingle, Mervyn M.
Dowrick, Albert R.
Irons, William

- Pass—
Gibbons, Leo. P. J.
Kellow, Stephen M.
Whitney, Thomas
Lapham, Edgar M.
Richards, Gilbert
Rosekelly, William G.

BUILDING CONSTRUCTION.

- Credit—
Gill, Leslie J.
(Written Examination, 1920,
Thesis now accepted.)

- Pass—
Spalding, John
(Written Examination, 1920,
Thesis now accepted.)

ANNUAL EXAMINATIONS—*continued.*

T. denotes terminal pass only.

ENGINE DRIVING.
FIRST COURSE.
Credit—
Woodward, James
Warnes, Frank
Rasmussen, Lauritz P. (T.)

Pass—
Hopkins, Thomas H.

ENGINE DRIVING.
SECOND COURSE.
Credit—
Turner, Benjamin L.
Head, Bert

Pass—
Willmott, Edward
Smith, James E.
Mason, George R.
Cairns, Matthew R.
Bayley, D. H. E. P.

ELECTRICAL ENGINEERING.
FIRST COURSE.
Pass—
Blurton, Norman C.
Sinclair, Robert J.

ELECTRICAL ENGINEERING.
SECOND COURSE.
Provisional Pass pending Thesis.
Ehlers, Charles R.

Credit—
Spalding, John
(Written Examination, 1920,
Thesis now accepted.)
Macbeth, Robert A.
(Written Examination, 1920,
Thesis now accepted.)

Pass—
Gill, Leslie J.
(Written Examination, 1919,
Thesis now accepted.)

FITTING AND TURNING.
FIRST COURSE.
Credit—
Leslie, Bernard H. P.
McLean, Charles E.

Pass—
Sinclair, Robert J.
Duke, Ronald A.
Downie, James H.
Underwood, Stanley L. (T.)
Leggett, Stanley W.
Wishart, Gordon D.
Thrupp, Thomas W.
Moody, Charles O. V.
Macgregor, Kenneth R.
Hopgood, Lionel J.
Fulcher, James H. E.
Hahn, Victor J.
Mason, George R.

FITTING AND TURNING.
SECOND COURSE.
Pass—
Rosenbrock, Ernest L.
Mason, George R.
Goodacre, Robert C.
Loxton, Bruce (T.)

MACHINE DESIGN.
Credit—
Macbeth, Robert A.
(Written Examination, 1920,
Thesis now accepted.)
Gill, Leslie J.
(Written Examination, 1920,
Thesis now accepted.)

Pass—
Spalding, John
(Written Examination, 1920,
Thesis now accepted.)
Rosenberg, Julius M.
(Written Examination, 1920,
Thesis now accepted.)

MECHANICAL ENGINEERING.
SECOND COURSE.
Credit—
Meredyth, Cyril C.
Thrupp, Thomas W.

Pass—
Ehlers, Charles R.
Dingle, Mervyn M.
Rosenbrock, Ernest L.
Stanton Harry D.

PRACTICAL MATHEMATICS.
Credit—
Sinclair, Robert J.

SUPPLEMENTARY EXAMINATIONS.
HELD IN FEBRUARY, 1921.

PREPARATORY CHEMISTRY.
O'Keefe, Bernard J.

PREPARATORY GEOLOGY.
Manners, Joseph E.

MATHEMATICS.
FIRST COURSE.

Carrigg, Clifford C.
Ehlers, Charles R.

MATHEMATICS.
FIRST COURSE.

Geometry Section.

Manners, Joseph E.
PHYSICS.

FIRST COURSE.

Agnew, Rudolph J.
ASSAYING.

FIRST COURSE.

Manners, Joseph E.

BUILDING CONSTRUCTION.

Provisional Pass pending Thesis.

Dunstan, Gordon T.

OPERATIONS UNDER "THE INSPECTION OF MACHINERY ACT, 1904."

**Annual Report of the Chief Inspector of Machinery and Chairman of
the Board of Examiners for Engine-drivers, for the Year
ending 31st December, 1921, with Statistics.**

The Under Secretary for Mines.

Office of the Chief Inspector of Machinery,
"The Barracks," St. George's Terrace,
G.P.O., Box 158,
Perth, 6th March, 1922.

Sir,

I have the honour to submit, for the information of the Hon. the Minister for Mines, the following report on the operations of "The Inspection of Machinery Act, 1904," in the Districts proclaimed thereunder, together with statistical tables, for the year ending 31st December, 1921.

The report is divided as follows:—

- (1) Inspection of Boilers.
- (2) Explosions and interesting defects.
- (3) Inspection of Machinery.
- (4) Prosecutions under the Act.
- (5) Accidents to persons caused by machinery.
- (6) Engine-drivers' examinations and kindred matters.
- (7) General.

DIVISION I.

Inspection of Boilers.

The number of boilers useful as steam generators on the register at the end of the year was 2,892, as against 2,894 at the end of 1920, showing a decrease of two boilers. There were 33 new boilers registered during the year; five permanently condemned boilers were thoroughly repaired and reinstated. As against this there were 22 permanently condemned, and 18 transferred beyond the jurisdiction of the Act; 14 of these latter were exported to the Eastern States. The reinstated boilers had been condemned some years ago, when it was an easy matter to replace a boiler by a new one; and owners preferred to do this rather than face expensive repair bills. Latterly, when new boilers were not to be had, a certain number of such condemned boilers have been thoroughly repaired, and reinstated, generally at reduced pressures.

Operations in the various Districts.

The following return shows the operations in the various proclaimed districts in connection with boilers, as compared with 1920:—

Return showing Operations in the Proclaimed Districts (Boilers only) during the year ended 31st December, 1921.

	Totals.	
	1921.	1920.
Total number of boilers registered and capable of being used as steam generators	2,892	2,894
New boilers registered during the year	33	27
Boilers reinstated	5	7
Inspections for year—		
Thorough	1,433	1,397
Working	186	123
Boilers condemned during year—		
Temporarily	70	50
Permanently	22	33
Boilers converted into tanks, air receivers, etc., during year	4	5
Boilers transferred beyond the jurisdiction of this Act	14	32
Number of notices issued for repairs during the year	465	351
Number of certificates issued (including those issued under Section 30) during the year	1,454	1,435
Number of useful boilers out of use at end of the year	1,366	1,411
	£ s. d.	£ s. d.
Total amount of fees for 1921 ...	3,063 5 6	...
Total amount of fees for 1920 ...	...	2,975 2 0
Total number of Inspectors ...	8	*8

* Seven only up to December.

The number of thorough and working inspections was 1,433 and 186 respectively, making a total of 1,619, showing an increase of 36 thorough inspections and 63 working inspections.

In the South-Western district 1,166 inspections were made, or 72 per cent. of the total number made in all districts. The inspections made in this district show an increase of 86 as against 1,920.

In the Kalgoorlie group 318 inspections were made, being 19.6 per cent. of the total inspections. The inspections in this district showed a decrease of 16.

In the North Coolgardie and Mount Margaret districts 58 inspections were made, or 3.6 per cent. of the total number. The inspections showed a decrease of 25.

In the East Murchison and Murchison and Yalgoo districts 77 inspections were made, or 4.75 per cent. of the total number, and the inspections showed an increase of 54.

Several inspections due at the end of 1920 in this district were not made until January, 1921, which accounts for the increase. The inspections in this district are now up to date.

The following table shows the number of boilers temporarily or permanently condemned, as a percentage of inspections made, since the inception of the Act controlling boilers:—

Number of Temporarily and Permanently Condemned Boilers, per 100 Inspections made, since 1899.

Year.	Temporarily		Permanently.	
	Per cent.		Per cent.	
1899	2.64		1.42	
1900	2.21		.498	
1901	4.34		.511	
1902	5.00		.958	
1903	2.43		.697	
1904	3.08		.389	
1905	2.84		.388	
1906	3.98		.960	
1907	4.36		.802	
1908	3.18		.599	
1909	2.89		.797	
1910	4.49		1.382	
1911	3.54		8.070	
1912	3.93		2.471	
1913	2.64		2.431	
1914	2.97		2.178	
1915	4.72		1.538	
1916	3.97		1.456	
1917	3.19		1.301	
1918	3.25		1.563	
1919	3.14		3.547	
1920	3.28		2.171	
1921	4.33		1.358	

In connection with the above table I wish to point out that owing to abnormal conditions due to the War making it nearly impossible to procure new boilers, or material with which to make or repair them, considerable leniency has, for the last few years, been shown in the matter of renewals and repairs.

Many boilers have had to be very extensively repaired with material which has often been procured by cutting up old boilers, and has consequently little or no history as far as tensile strength, etc., goes.

The above policy had, of necessity, to be adopted in order to prevent certain industries from being closed down and so throwing men out of work.

The difficulties referred to are now passing, and it will not in future be possible to continue to sanction repairs of the class mentioned. It is probable that there will shortly be an upward trend in the number of boilers permanently condemned. Many locomotives and other boilers are rapidly reaching an old-age limit. A large number of these old boilers have been very extensively repaired, and the time is rapidly drawing near when they will either have to be discarded or subjected to such a reduction in pressure as will greatly limit their utility.

Owners possessing such old boilers should be prepared for the possibility of renewals, or considerable reduction in pressures.

DIVISION II.

Explosions and Interesting Defects.

Another year has passed without having to record the explosion of a boiler under the jurisdiction of the Act.

A fatal accident occurred in connection with a Paxman water tube boiler at the Boulder (see "Accidents to Persons"), but it was not in any sense a boiler explosion. The accident occurred through the deceased, who was in charge of the boiler work, making the joint of one of the header caps with two thin copper rings instead of one thick one. The joint leaked, and he attempted to screw it up under a pressure of 140 lbs. per sq. inch. The header cap blew out, and the man was severely scalded that he succumbed to his injuries.

A steam jacketed pan at a jam factory burst under somewhat peculiar circumstances. These vessels are not under the jurisdiction of the Act as "boilers," inasmuch as they are not steam generators. It has, nevertheless, always been the custom to cursorily inspect them, once a year, particularly in regard to the safety fittings (without granting any certificates). The pan in question was one of several, all of which have inlet and outlet cocks; and on the particular pan which burst there was a "safety valve." The practice is to open the steam inlet valve slightly, and leave the outlet valve *always open*. In this case the outlet valve was found tightly closed by some person unknown, and the "safety valve," which had been supplied and fitted by a local firm of engineers, had been so tampered with as to be quite useless for its purpose. The pan, which is of copper, tore away at the top edge and doubled back against opposite side, projecting a mass of scalding jam all round for several yards. Six persons were scalded, fortunately none of them severely. The occurrence points to the necessity of closer supervision; and power for this is provided by the Inspection of Machinery Act of 1921, which is not yet proclaimed. The explosion of the vessel was due to over-pressure through the outlet cock being closed, and safety valve being tampered with.

During the year some rather serious defects were discovered in locomotive boilers. In two of these, working at 160 lbs. per sq. inch, the plates at the longitudinal seams along the sides of firebox casing were found cracked badly between the rivet holes. It was the *inner* plates which fractured, so that the defects were quite invisible from outside, and, owing to construction, it was not possible to get at them from the inside. In one of these cases there had been repeated leakage from the seam which no amount of caulking would stop. The inspector, becoming suspicious, rightly stopped the boiler, and ordered some rivets to be cut out. He then found evidence of a crack in the inside plate. The plate was removed and was found cracked through, from rivet hole to rivet hole, for over five feet in length. A serious explosion was probably only narrowly averted. Subsequently, and as a consequence of above discovery, similar (though not so serious) defects were found in other boilers of same make and class. The possibility of the existence of such de-

fects is the strongest possible argument in favour of expert and systematic inspection.

A good example of the pernicious effects of oil in boilers occurred in a multitubular boiler. The boiler was underfired, and got its feed water from the hot well of a condenser.

In October, 1920, the circumferential seam over fire started to leak freely, causing stoppage of the boiler. The seam was badly sprung, and had to be re-riveted for three or four feet. To do this all the tubes had to be drawn, and when the inspector arrived, although very suspicious of oil being the cause, he was unable to find any trace of it in the boiler. The repairs were completed, and the boiler started. Within a few days the plate overheated again, this time so seriously as to necessitate a patch 5 feet by 4 feet being fitted. On this occasion there was definite evidence of the presence of oil, and it was traced to a faulty type of lubricator on the cylinder of an air compressor. It cannot be too generally known that the presence of even a very small quantity of oil in boilers is always a source of danger; and wherever there is a chance of its occurrence, means should at once be taken to prevent its admission to the boiler. Owing to a little carelessness in the matter of a defective lubricator the owners of the above boiler were put to the expense of drawing all the tubes twice within a few months, re-riveting a seam on the first occasion, and fitting a large patch on the second.

A serious explosion of a Tangyes Colonial-type boiler occurred in Victoria towards the end of the year. The owner, a farmer, was preparing to cut chaff when the explosion occurred. He was blown some 30 yards from the boiler and fearfully injured, death being instantaneous.

This boiler, having been situated in a "Shire," did not come within the scope of the existing Act in Victoria beyond the fact that *explosions* of boilers so situated must be reported and investigated. The investigations showed that the plates were as thin as paper over a large area; compulsory inspection would undoubtedly have detected the corrosion in the earlier stages, and proper repairs would have been executed, or the boiler would have been condemned and prevented from working.

The only reason for referring to this occurrence is to, once more, call attention to the absolute necessity for uniformity throughout the Commonwealth in the matter of dealing with the safety of boilers and machinery. It has been proved again and again that *all* steam boilers should be compulsorily inspected; and in the case of States having no authority to do this very necessary work, legislation should be introduced giving the necessary powers as soon as possible.

DIVISION III.

Inspection of Machinery.

The following return shows a classification of the power-driven machinery in the proclaimed districts. The number of groups driven by oil engines (including kerosene, petrol, and benzine engines) again keeps the highest place. There are now 3,183 registered groups of such engines, as against 2,618 last year, showing an increase of 565.

Electrically-driven groups again take second place with 2,406, showing an increase of 297 during the year. Steam-driven groups take third place with

1,266, as against 1,287 last year, showing a decrease of 21. Suction gas groups, now numbering 222, have decreased by two; ordinary town gas groups have decreased by from 20 to 16; hydraulic groups have increased by one, and compressed air groups remain as they were, viz., 38.

Return showing Classification of various sources of Power-driven Machinery in use or likely to be used again in Proclaimed Districts during the year ended 31st December, 1921.

Classification.	Totals.	
	1921.	1920.
No. of groups driven by—		
Steam engines	1,266	1,287
Oil engines... ..	3,183	2,618
Ordinary gas engines	16	20
Suction gas engines	222	224
Compressed air engines	38	38
Electric motors	2,406	2,109
Hydraulic pressure	10	9
Totals	7,141	6,305

The following table shows the number and description of all the lifts in this State:—

Passenger lifts:—	
Electrically driven	66
Hydraulically driven	—
Goods lifts:—	
Electrically driven	99
Hydraulically driven	9
Belt driven	11
Total	185

There has been an increase of seven new lifts, which were registered during the year.

The following return shows the work done in connection with machinery inspections:—

Return showing Operations in the Proclaimed Districts (Machinery only) during the year ended 31st December, 1921.

	Totals.	
	1921.	1920.
Total registrations of useful machinery	7,141	6,305
Total inspections made	4,889	3,247
Certificates bearing fees	4,259	2,685
Certificates (steam) without fees	630	562
Notices issued "Machinery dangerous"	522	305
Total amount of fees for 1921	£ 1,523 9 0	£
Total amount of fees for 1920 ...	...	1,065 4 5
Number of Inspectors	8	*8

* Seven only up to December.

There has been a considerable increase—viz., 836—in the total number of machinery registrations. In the South-Western district the increase was 893, or from 4,752 to 5,645.

In the Kalgoorlie groups the registrations decreased by 11, or from 829 to 818. In the remaining districts there was a decrease of 40. The total number of inspections made shows an increase of 1,642.

The provisions of the Act have been satisfactorily carried out as regards providing necessary safeguards against accidents, but in a few cases the guards provided have been discarded by the men using the machines, and more than one accident during the year occurred through this practice. Provision has been made in the new Inspection of Machinery Act of 1921 for a penalty for such actions.

As long as machinery exists there will be accidents, but if men using machinery would only faithfully co-operate with inspectors and owners, and not take stupidly unnecessary risks, accidents would be considerably reduced.

The following is an instance of the utterly unnecessary risks men will take:—

A relieving gas engine-driver was assisting the engineer on a mine to alter the position of the driving ropes on the pulleys *while the engine was running*. He fell through the handrailing on the ropes on the driving side close to the engine, but fortunately rolled off the ropes before he was caught between them and the grooves in the pulley.

During the year four accidents to suction gas engines of large horse-power occurred. Two of these appear to have been due to failure of the bolts in crank pin brasses. I have frequently called attention to the necessity of changing and annealing "big end" bolts. The engines in both these cases were badly wrecked, but no injury to person occurred. The third accident was the fracture of a crank shaft. Fortunately this was noticed at once, the belt was shifted to the loose pulley, and no further damage was done. The fourth accident was also a fractured crank shaft, the break occurring under the bevel wheel actuating the valve gear. Portions of this wheel were flung in all directions, but fortunately no one was hurt, and the engine was not vitally damaged.

An air compressor at a stone quarry was badly damaged. The front and back covers of the air cylinder were broken, the piston head ring grooves were broken away at front end, the piston rod was badly bent at the centre, and the cylinder liner burst into several pieces. The cause of the accident is somewhat obscure, but the bursting of the liner appears to have been the primary result. The metal in the liner appeared to be good, and had a high factor of safety. The actual cause of the liner bursting must remain a conjecture, but I think it more than probable that the lubricating oil used at the time of the accident must have been of too low a flash point.

Too much stress cannot be laid on the necessity for using high flash point oil in such cylinders. If low flash point oil be used, it vaporizes, and forms an explosive mixture with the compressed air, often accompanied by very serious consequences. No one was injured in the present case, but this result might easily have been very different.

Dangerous Machinery.

Five hundred and twenty-two notices were issued ordering various guards and fences to be erected; the number of notices issued being 16.78 per cent. of the number of inspections made.

DIVISION IV.

Prosecutions under the Act.

No prosecution in regard to boilers or machinery was instituted during the year.

DIVISION V.

Accidents to Persons caused by Machinery.

During the year accidents to 71 persons were reported, including 10 which ended fatally. This shows an increase of 27 in the total number, and an increase of six fatal, as compared with 1920. There has been an increase of 10 in the number of accidents in the goldfields districts, and an increase of 17 in the South-Western district, as against the year 1920.

Three machinery accidents accounted for 16 accidents to persons, viz.: a winding engine accident, seven; a passenger lift accident, three; and a steam-jacketed pan, six. It will be seen that, counting these as three accidents instead of 16, accidents were caused by 58 machines, instead of, as would appear, by 71.

The following table shows the number of accidents and the percentage of these, based on the total number recorded, caused by the various kinds of machinery mentioned:—

No. of accidents.	Class of Machinery.	Percentage of total accidents:
13	Circular saws	18.31 per cent.
5	Buzzers	7.04 "
1	Ore treating machinery ...	1.40 "
6 (1)	Flywheels, pulleys, and shafting	9.86 "
6	Belting	8.45 "
3	Passenger lift	4.23 "
2 (6)	Winding engines	11.37 "
1 (2)	Geared wheels	4.23 "
6 (1)	Scalds	9.86 "
18	Other causes	25.35 per cent. or 1.42 per cent. each.
61 (10)	Total 71.	

The accidents from circular saws, as usual, head the list, and account for 18.3 per cent. of the whole number. I am again of the opinion that many of these accidents were caused by carelessness on the part of the injured men, and not on account of defective machinery.

The 10 fatal accidents above referred to are as follows:—

1. Early in the year the W.A. Portland Cement Works at Burswood started operations, and during a trial run, before the machinery was registered, an employee met his death by falling on a large horizontal geared wheel. He was caught between this wheel and the bevel pinion driving it. He was badly mangled, and died soon after the accident. There was a stout guard rail in front of the wheel in question, and had the unfortunate man remained on the proper side of this guard, as he had been definitely instructed to do, the accident could not have happened. The management appeared to have taken every care to school all their employees as to danger points, and though the plant was still in a more or less unfinished condition, as is inevitable while a big new plant is in the experimental stage, it was well guarded at all really dangerous points.

2. This accident occurred at a small electrically driven bark-crushing plant in Fremantle. The plant was not registered, the owner being under the impression that electrically driven machinery was not under the provisions of the Act.

It is most regrettable, and almost incredible, that such an impression should exist, after the Act has been in operation for 17 years. Prosecution would, of course, have resulted if the owner had not been so obviously ignorant of the provisions of the Act.

Deceased was feeding bark into a crusher, dropped the knife with which he was cutting the bands on bark bundles, and in stooping to recover it got caught just above the hip, on his left side, by a pair of exposed geared wheels. He was drawn in, and death was instantaneous. Had this machinery been registered, the wheels in question would have been ordered to be guarded, and no accident of this kind would have happened.

3. This accident was due to the deceased endeavouring to tighten up a cap on the front header of one of the Paxman boilers, at the Associated G.M., Boulder, while at work at 140 lbs. pressure. The joint had been improperly made by deceased with two copper rings instead of one, and he obviously put too great a strain on the bolt, and drew cap right through the rings. He was severely scalded, and succumbed nine hours after the accident. (This accident is referred to earlier in this report under "Explosions and Interesting Defects.")

4. This accident occurred at the Eureka Flour Mill, Cottesloe, where a man lost his life through utilising a countershaft driving other machinery as a hoisting winch. Three or four turns of rope were thrown round the shaft. Deceased was trying to get another turn round it when the fingers of his left hand were caught in the rope and he was thrown from the ladder on which he was standing. The three fingers were torn off, and his arm was broken. He died from injuries received about a week later. The use of the shafting for the purpose of hoisting was entirely improper, and the practice has been stopped.

5 to 10. In December a very serious winding engine accident occurred at the auxiliary shaft or 3rd compartment of the Golden Horseshoe G.M., Boulder, which resulted in the death of six persons, and severe injury to a seventh.

The engine was about to raise men from the 2,600ft. level to surface. Six men was the full load. There were, however, seven in the cage. The engine had difficulty in starting, and in order to get the cranks into a good position the cage was lowered about five feet on brake. At this juncture the main brake rod broke, rendering the brake useless. The cage travelled down to the pent house at the 3,000ft. level, and this stopped its further progress. The driver applied full steam against the engine almost immediately the brake rod broke, but this, though greatly retarding the cage, failed to hold it.

A coronial inquiry was held, and all the circumstances were fully investigated. The verdict of the jury was: "The men were accidentally killed as the result of breaking of the main rod on the winding engine brake, and that no blame was attachable to

anyone." A rider was added that "it was unsafe to haul from a depth of 2,600 feet with a single winding engine unless it was fitted with an extra brake."

The winding engine is a first motion one with single drum; the diameter of the cylinders is 16 inches and the stroke is 36 inches. As originally supplied it was fitted with a single foot brake. As the depth increased an inspector of this department interviewed the management and pointed out the necessity for additional brake power, and in 1917 the engine was fitted with the Whitmore patent gravity plus steam brakes. The brake is applied by a deadweight and released by steam. There is also an auxiliary cylinder which provides for further and more powerful brake application by steam.

The engine and brakes are strongly built, and have worked satisfactorily for several years. After the accident officers of this department made a thorough investigation into the whole matter. Tests were conducted, indicator diagrams were taken, and all necessary computations made. The brake rod which failed, due to a defective weld, which it was impossible to detect, was the sole cause of the accident. This rod had worked since 1917, when it was supplied with the new Whitmore brake, the makers of which hold a world-wide reputation for this class of work.

The operation of lowering the cage on brake had been performed hundreds of times in perfect safety. The brake fulfilled all the conditions of the departmental test, which is a severe one; and no one contemplated the possibility of the rod breaking as it did.

The weld, however, was so defective that it is extraordinary it stood for so long. The weld was sound all round the outside, but the greater part of the internal section was defective. The broken rod has been replaced by a new and very strong one without welds, and the cut off of the engine slightly altered. The latter alteration has greatly increased the retarding power of the engine when using steam against the piston as a brake, with the result that the engine is now fully capable of holding the maximum load at the greatest depth even if brake were to fail. The engine has been very thoroughly tested since the alterations were made. The accident is, of course, most regrettable, but there has never been any doubt about the holding power of the brakes, and the fact of such a serious defect in a vital part was not possible to detect, and was never suspected by anyone. The accident was therefore in no way due to failure to provide sufficient brake power, but simply the direct result of a piece of bad workmanship which, owing to its nature, no one could have detected.

DIVISION VI.

Engine-drivers' Examinations and kindred matters.

During the year four examinations were held in Perth, two in Kalgoorlie, two in Bunbury. Examinations were advertised to be held at Southern Cross, Leonora, Mt. Magnet, Geraldton, and Albany, but fell through owing to the necessary number of candidates not being forthcoming.

The following table shows the certificates granted, and their classification:—

Return showing Total Number of Engine-drivers' Certificates (all classes) granted in 1921, and compared with 1920.

Class of Certificate.	Number granted.	
	1921.	1920.
First Class Competency (including certificates issued under Regulation 27 and Section 63 of the Act)	1	2
Second Class Competency (including certificates issued under Regulation 27 and Section 63 of the Act)	25	29
Third Class Competency (including certificates issued under Regulation 27 and Section 63 of the Act)	54	52
Locomotive Competency	8	7
Traction Competency	12	6
Interim	6	10
Copies	12	9
Totals	118	115

There is a slight increase in the number of certificates granted, the number being three more than last year.

In my last annual report I remarked upon the paucity of applicants for first class certificates, there being only two during the year 1920. The official representatives of the Federated Engine-drivers and Firemen's Association interviewed me at Kalgoorlie, on the 19th April last, with regard to my comments, and were quite in agreement with me as to the difficulty of getting first class drivers for outlying mines. They informed me that they would take such steps as were necessary in order to induce the younger members who had already obtained second class certificates to qualify for first class certificates. I have every reason to believe that they did their best in the matter, but, nevertheless, during the last year only one application for a first class certificate was received, and this was merely for the removal of a restriction on an existing first class certificate. However, as no complaints as to the difficulty of procuring first class men have come under my notice during the year under review, I can only conclude that, for the present, the supply meets the demand.

Inquiries, Prosecutions, etc.

No proceedings were undertaken against any engine-driver during the year.

Two cases of "overwinding" were inquired into by the Board. In each case the damage done was not great, and the Board took no action beyond recording the facts on their respective files, and cautioning the drivers.

A complaint was lodged against a driver for having started a winding engine before properly draining the cylinders, with the result that the piston was broken and the mine was stopped for three days. With a view to inquiring into this matter the Board tried to find the man in question. He has, however, disappeared, probably out of the State, and so no action could be taken.

DIVISION VII.

General.

With the return to more normal conditions the demand from the Eastern States for second-hand boilers is diminishing.

In 1920, 30 boilers were transferred East; last year there were only 14. Thirty-three new boilers were registered during the year, being an increase of six as against 1920; and the new boilers outnumber those sold out of the State by 19.

Ten boilers which were out of use—some more or less useful, and some which had been condemned—were cut up for plates.

Where such plates were used for boiler repairs the greatest care has been exercised to see that they were fit for this purpose. It often happens that in Cornish and Lancashire boilers many of the upper plates are in perfect condition long after those in the lower parts and flue tubes are far worn. Where plates for repair work are chosen with discretion, no great harm can ensue. At the same time it should be understood that, wherever possible, nothing but new material should be used for boiler repair work, and as new plates rolled by recognised makers are now becoming fairly plentiful, there should no longer be any excuse for using old ones.

During the year there has been an unusually large amount of repair work carried out. One inspector points out that for the whole year there have never been less than 12 men, and occasionally up to 19, employed entirely on boiler repairs in the South-Western district, south of Armadale. The men engaged on this work are, I am pleased to note, skilled tradesmen, and the "boiler jobber" has become merely a reminiscence of the past.

There is, of course, a limit to the extent of repairs that can justifiably be carried out, and there is now a large number of boilers in the State upwards of 20 years old, many of which are rapidly reaching this limit. I have referred to this aspect in the latter part of Division I. of this report, and pointed out that owners of such boilers should be prepared for renewals, or reductions in pressures.

Some very good repair work has been done by the "Oxy weld" process. It is, however, a method of repair requiring considerable skill, and is only applicable under certain conditions. No work of this kind should be permitted in connection with boilers without the direct order or sanction of an officer of this department, and all such work should be submitted to careful inspection and hydraulic test before the boiler resumes work.

In Division III. will be found statistics relative to machinery. It will be seen that though there has been a decrease in the number of registrations in all the goldfields, due largely to increasingly difficult mining conditions, this decrease is handsomely balanced by an increase of 893 new registrations in the South-Western district. At one time mining was our one important industry. Now that it has temporarily declined, and only temporarily I trust, many other industries are springing up, and the State is producing within its own borders many commodities previously imported.

The W.A. Portland Cement Co. started operations at Burswood early in the year, and is now in full swing. The fact that they are already duplicating some of the large units of their plant appears to speak well for their product.

A large factory for manufacturing porcelain and pottery of all kinds has been erected at Subiaco, and is doing good work.

In the same district a plant has been erected for treating asbestos.

Many other small industries have been started, including a fruit de-hydration plant. This latter industry should have a considerable future before it, and in all probability will lead to kindred work, such as fruit canning and preserving, which in their turn will lead to further fruit growing.

The timber industry has been responsible for several new plants during the year. A large new mill is nearing completion in the place of the one burnt down at Mornington in December, 1920; and the industry appears to be prospering, though suffering from disabilities which no doubt will right themselves in time.

Coal mining is also in a prosperous condition, and the machinery used shows a steady improvement. Tin mining is depressed owing to the post-war slump in the price of tin ore; but several of the power plants which would otherwise have been idle have been utilised temporarily in the timber industry.

The gold-mining industry is still suffering from the high cost of production, and low-grade mines, when they continue to work at all, are doing so under great difficulties. Early in the year the surface plant at the Sons of Gwalia G.M. was considerably damaged by fire. The entire electrical equipment was almost totally destroyed. The main winding engines and boilers, however, were undamaged.

In my report for the year 1914 I mentioned that the Kalgoorlie Electric Power Co., who, in common with most other users of steam power, had difficulty with regard to the upkeep of their boiler feed pipes, had installed new steel pipes lined with a coating of lead. These pipes, after eight years' wear (feed pipes frequently require renewing after six to twelve months' use), are now being replaced by copper pipes, which should give still better results. The lead-lined piping became defective through the coating of lead becoming worn off at connections, bends, etc., and thus allowed the water to work down between the metals. Considering the large sums that must be expended annually on feed pipes, it is remarkable that copper piping is not more used.

The temporary shutting down of several mines is affecting revenue, and is rendering the matter of making satisfactory arrangements for boiler inspections very difficult. No mine can afford to stop all its boilers at one time. Where there were several mines working in a given district, an inspector, by careful planning, could get through all of the boilers by taking one or two at each mine in turn and going back to the one first visited and completing the remaining inspections. Now it often means separate visits and, of course, increased travelling for less revenue.

There are also instances where there are small isolated plants situated at considerable distances off the main tracks, e.g. Mt. Ida, where 150 miles has to be travelled for a revenue return of £2 15s.; Baneygo, where 120 miles is travelled for a return of £3; and Linden, 120 miles for about £5. Such inspec-

tions, owing to their isolation, greatly increase the mileage per inspection, and consequently the expenses.

A complaint was lodged, under Section 68 of the Act, relative to the impossibility of the engine-drivers of the compressor at the Lake View and Star G.M. attending to the engines and assisting with firing the boilers. It was contended that boilers and engines were too far apart to admit of the drivers exercising effective supervision over the engines. The case was fully investigated by the District Inspector, and I subsequently personally visited the mine, and was satisfied that the complaint was a just one. A letter was written to the management requesting that "on and after 1st May the engine-driver in charge of engines on each shift in the compressor room should have continual supervision of such engines, and should be relieved of all fireman's duties whilst existing stoke-hole remains in its present position." This request was at once complied with.

During the last session of Parliament a new Inspection of Machinery Bill was introduced by the Hon. the Minister for Mines; and it finally became law at the end of the session. The Act will not, however, be proclaimed until the 1st of July this year, as decided by Parliament.

The new Act, whilst amending certain anomalies and making clear some phrases which were vague and open to more than one interpretation, provides for the inclusion of all steam-jacketed pans, and all air receivers above a certain capacity; and the necessary fittings for such vessels are defined.

Boilers working under 10 lbs. pressure will no longer be exempt (as they are under the 1904 Act), as it was found by experience that many of these were a source of public danger.

No special new provisions with regard to machinery have been introduced, with the exception that it is provided that all lifts shall be inspected twice a year instead of once as at present, and that certain conditions must be complied with before erecting any new lift. Safety appliances in connection with lifts and winding engines are also defined.

The Act also provides that certain simple plants in outlying districts, having been once inspected, may, at the discretion of the inspector, and under certain conditions, have their certificates extended. It is hoped that this provision will result in considerable economy.

The new Act also provides that when coronial inquiries are ordered inspectors of machinery shall be notified and have certain privileges in the matter of calling and examining witnesses. This is a much-needed provision.

Additional sections have been inserted providing penalties in case of tampering with guards, governors, or other safety appliances, or concealing defects.

In addition to the above, certain sections have been included in order to facilitate economical administration. These chiefly refer to new registrations of boilers and machinery.

I am confident that the Inspection of Machinery Act of 1921 is an up-to-date measure, and that its clear provisions will give general satisfaction to both manufacturers, employers, and employees.

The exemptions provided for under the 1904 Act have been considerably extended, chiefly in the interests of agriculturists. The most extensive alterations and additions occur in the sections dealing with engine-drivers' certificates. For many years past the necessity for some uniform scheme of certificates, which should have the same value in each State of

the Commonwealth, has been recognised; and at a conference held in Sydney, to which I referred in my reports for 1919 and 1920, such a uniform scheme was agreed upon. The grading of certificates decided upon include those for drivers of internal combustion engines above a certain size, and for boiler attendants. Provision is made for preserving the rights of holders of engine-drivers' certificates issued under previous Acts; and, in addition, power is provided to grant "transfer" certificates, which means that holders of any old certificates granted in this State can exchange such certificate for a new one of equivalent value under the 1921 Act if he so desires.

The new Act is the first to embody the results of the decisions arrived at during the conference with a few slight modifications decided upon by Parliament. This is a step in the right direction, but there is a good deal yet to be accomplished. A uniform syllabus for the different grades of certificates and uniform methods of examination will have to be decided on, and then regulations will have to be agreed to. This is a matter which must be left to a future conference, but in the meantime regulations will be prepared for carrying out the intentions of this Act.

Whilst dealing with the matter of uniformity, there is much to be desired in the direction of uniform regulations relative to the qualifications of inspectors, boiler construction, computations, and the methods dealing with winding engine and lift tests, etc. This is as much in the interests of manufacturers and of owners as of the various departments which have to adjudicate upon and control the issue of certificates in the various States.

This is a matter which, in my opinion, should be taken up by the various States and referred to a competent committee or tribunal to deal with. As long as so many different methods, regulations, etc., exist there must and will be differences of opinion and discrepancies in regard to boilers transferred from State to State.

In the July, 1921, issue of the "Indian and Eastern Engineer" there was an interesting article showing that in India they have been labouring under the same disabilities as in the Commonwealth, through a diversity of the laws controlling the management, construction, and inspection of steam boilers. The Government of India, in November, 1920, appointed a committee to consider to what extent the existing differences could be assimilated by unification of the laws and regulations in force. The committee submitted their report in March, 1921. The main proposals of the committee are contained in a draft All-India Act, on the basis of which legislation may be undertaken. A draft set of regulations for the material design, construction, registration, and inspection of boilers to be framed by the Government of India, and a model set of administrative rules for the guidance of local governments.

The committee lay stress on the fact that uniformity of standard, and accordingly of maximum permissible pressure, cannot be obtained and maintained unless the inspection of boilers in all provinces is subject to the same Act and the same technical regulations. They accordingly propose that the Government of India alone should have power to finance and amend the Act and regulations; and they point out that in these circumstances manufacturers will be benefited by having a single standard on the basis of construction, while the importer and owner will know that any boiler constructed up to the standard can be used

at the same maximum working pressure in any part of India.

WORK DONE FOR OTHER DEPARTMENTS.

Several inspections, valuations, and investigations were conducted for other departments during the year over and above those provided for by the Act. In the majority of cases no charge could be made, and the expenses were debited to this department.

Inspectorial Staff.

There were no changes in the staff during the year under review, and I am pleased to be able to report that at the end of the year the work was well up to date, in spite of a very large increase in the number of registrations. This result was made possible by the appointment of an additional inspector at end of 1920.

The Senior District Inspector at Kalgoorlie resumed work on 1st April after seven months' furlough.

The staff has worked well throughout the year, and has kept up its record for careful and efficient work.

Clerical Staff.

This remains the same, with the exception of slight changes in the junior clerks.

The staff has had a busy year, and has responded well.

Revenue.

The total revenue from all sources during the year was £4,981 0s. 3d., made up as follows:—

	£	s.	d.
Fees for boilers	3,063	5	6
Fees for machinery	1,523	9	0
Fees, Engine-drivers' Certificates	164	0	0
Incidentals (being fees for special inspections, special expenses, etc.)	230	5	9
	£4,981	0	3

This shows an increase of £707 4s. 5d., which is very satisfactory, and appears to be a sign that the State is returning to more normal conditions. This increase is made up as follows:—

	Increase.			Decrease.		
	£	s.	d.	£	s.	d.
Boiler Fees	88	3	6	...	...	...
Machinery Fees	458	4	7	...	...	...
Engine-drivers' Fees	4	15	0	...	...	...
Incidentals	156	1	4	...	...	...
Total Increase ...	£707	4	5	...	...	...

On analysing the increases from the district point of view:—

	Increase.			Decrease.		
	£	s.	d.	£	s.	d.
S.W. Group	671	2	1	...	...	...
Kalgoorlie ... ..	...	...	...	39	5	8
North Coolgardie and Mt. Margaret	...	...	...	48	15	11
East Murchison and Murchison and Yalgoo	119	8	11	...	...	...
Engine-drivers' Fees	4	15	0	...	...	...
	795	6	0	88	1	7
	88	1	7			
Total Increase ...	£707	4	5	...	...	...

The loss in revenue to this department for past year, owing to fees not charged to Government non-trading concerns in accordance with Treasury instructions, was £41 5s., and the expenses connected with these inspections, exclusive of salary, amounted to £12 4s. 8d. Had the above sum been charged as heretofore, our revenue would have been over £5,022.

During the year it has been necessary to write off as bad debts 13 items, totalling £6 17s. 5d. The amount represents only .138 per cent. of the total revenue.

MILEAGE.

The total distance travelled by inspectors during the year was 51,297 miles, of which 19,052 were by

rail, 32,136 by road, and 19 by water. The distance travelled shows an increase of 9,314 miles as against 1920, with an increase of 1,741 in the number of inspections made. The average miles travelled per inspection was 7.86, showing a decrease of .92 miles per inspection as against last year.

CONCLUSION.

In conclusion, my thanks are due for kindly assistance rendered by the officers attached to the Crown Law, Police, and Postal Departments in various districts in matters connected with the administration of the Act.

My staff have continued to carry out their duties efficiently, and to them, also, my thanks are due.

I have the honour to be,
Your obedient servant,

C. J. MATHEWS,
M. Inst. C.E.,

Chief Inspector of Machinery and
Chairman of the Board of Examiners.

Report of the Chief Inspector of Explosives and Government Analyst for the Year 1921.

The Under Secretary for Mines.

I have the honour to submit, for the information of the Hon. Minister for Mines, my twenty-sixth Annual Report dealing with the work of this Department during the year 1921. As usual I will group my remarks under the headings of the three main divisions of my work.

As is usually the case, some fluctuation has been apparent in the volume of work carried out under the different headings; some have shown a falling-off but others a considerable increase. The increase has been principally manifested in connection with my work as Agricultural Chemist, for, in addition to an increase in the total number of analyses carried out, quite a notable growth was seen in the closer co-operation with the Agricultural Department into which this laboratory has been brought during the last three or four years, and this has been manifested in directions which are not actually shown in the analytical returns.

GOVERNMENT ANALYST.

While there have been no special investigations of an outstanding character during the year the general routine work has kept fairly well up to standard, the only new feature introduced being a few samples of supposed oil-bearing material submitted for test in connection with the recent outburst of interest in the question of oil deposits. Only a few of these have been done as this work did not strictly belong to the scope of this Department, and samples have only been tested here when the applicants have stated that, owing to pressure of work, they were unable to get tests made at the Geological Survey.

Staff.—Early in the year Mr. M. McVeigh was appointed as Milling Assistant. Mr. McVeigh, who is a returned soldier and before going on active service had had some experience in connection with commercial milling, has taken up this work most successfully, and his interest and enthusiasm have resulted in very good work being done during the year.

The only other change in the staff has been caused by the withdrawal from this Department of the section dealing with Economic Botany and Plant Pathology. Mr. D. A. Herbert, M.Sc., who has been Economic Botanist for about three and a-half years, having received an appointment in connection with the University of the Phillipines at Manilla, resigned towards the end of the year, and Miss Prowse, his assistant, has been re-transferred to the Agricultural Department with this section of the work.

When, in 1917, the Government requested me to take over the control of this branch there was considerable need for re-organisation and systematisa-

tion of work. The abilities displayed by Mr. Herbert from his appointment in 1918, however, soon helped me to put this work on a thoroughly good basis, and when handed back to the Agricultural Department last year the herbarium had been entirely re-classified and re-arranged. Valuable bulletins dealing with the practical side of botanical work in relation to agriculture had been issued, or revised, especially those relating to the poison plants of Western Australia; and the valuable assistance which could be rendered in connection with plant pathology to all branches of the Agricultural Department has been clearly manifested, so that this section had become one of the most valuable practical branches of the Department.

General Analytical Work.—The tests made from time to time in connection with the investigations of the representatives of Messrs. Brunner, Mond & Co. in relation to alkali manufacture in this State have been continued throughout the year, and it is understood that these investigations are now approaching their close.

In connection with the Pure Foods work of the Health Department the preliminary steps which have been taken in the various States towards a suggested interstate conference on the question of pure foods standards have called for considerable attention. No such conference has been held since 1913, when important work was done in Melbourne. In order to prepare for such a conference it has been necessary to carefully study and revise many of the suggested standards for foods, and generally prepare data to enable delegates from this State (if the conference is held) to effectively represent the point of view of Western Australia.

The toxicological work and other investigations connected with criminal chemistry have been particularly heavy during the year, the poisoning cases alone having averaged over one a week. In most cases some satisfactory solution of the matter has been arrived at, but in a few cases in connection with the alleged poisoning of stock in the country districts negative results were obtained. These negative results are always unsatisfactory, but such cases are naturally often very obscure, and apparently unexplained death of stock is naturally somewhat readily attributed to deliberate poisoning. It must be remembered, however, that the possibility of poison plants, either unknown or hitherto unsuspected, must be taken into account as well as the possibility of infectious bacterial diseases, some of which are not as yet understood, an example of which may be quoted in the destructive so-called Beverley sheep disease.

In the case of native poison plants of which the poisonous principles are unknown it is impossible to determine the cause of death from the contents of an animal's stomach unless recognisable portions of the plant can be detected in the ingested material.

The following table gives a summary of the chemical analyses performed during the year:—

TABLE No. 1.
General Analytical Work.

Spirits	131
Powellising	291
Hydrometers	18
Foodstuffs	67
Waters	224
Milks and Creams	25
Sewage	374
Criminal	54
Medicinal Compounds	9
Inks	23
Oils	25
Disinfectants	4
Rocks	8
Miscellaneous	39
Total	1,292

CHIEF INSPECTOR OF EXPLOSIVES.

This section of the work shows the greatest variation of any for the last twelve months. The importation of explosives has been exceptionally light. This has been due to two causes—(1) the very

heavy stocking which had taken place in the previous year so that at the beginning of 1921 we had practically twelve months' supplies in the magazines of the State; (2) a decline in mining owing to the various economic and other conditions existing in this State as in other parts of the world. A revival is, however, anticipated in the mining industry during the next twelve months which will probably soon restore the explosives trade to its former activity.

The falling-off in importations, while reducing the amount of testing incidental to new shipments, requires greater care and attention to be devoted to the inspection of stocks in magazines throughout the State. Stocks which have been stored for over twelve months, especially in hot portions of the country, are naturally somewhat prone to exhibit signs of deterioration, and this has necessitated a careful inspection of all explosives stored in remote centres. On this account the Assistant Inspector (Mr. Kirton) again made a tour during the year of the North-Western coast, which has not been visited by an inspector since 1911. The long distances to be travelled render such excursions as this impracticable except at long intervals, but it nearly always happens that when such an inspection is made small stocks of seriously deteriorated explosives are discovered and have to be destroyed, which if left undetected might be a serious source of danger leading to the destruction of much larger stocks of good explosives which may be stored with them. For this reason I intend that more frequent visits to this part of the State shall be made in the future, especially as greater transport facilities than in the past now exist.

TABLE No. 2.
Importation of Explosives.

	1920		1921.	
	Quantity.	Value.	Quantity.	Value.
	lbs.	£	lbs.	£
Gelignite	2,035,300	111,192	375,325	20,904
Gel. Dynamite	149,050	9,130	75,000	4,978
B. Gelatine	67,950	5,425	25,100	1,976
Dynamite . . . . .	...	...	...	...
Permitted Explosives . . . . .	...	...	...	...
Detonators . . . . .	...	10,309	...	2,107
Fuse (coils)	121,003	4,776	4,500	195
Powder, Blasting	172,500	9,507	25,000	1,237
Powder, Sporting	10,675	1,627	...	...
Explosives, N.E.I. . . . .	...	4,449	...	3,900
Fireworks . . . . .	...	1,144	...	1,185
Totals	2,556,478	157,559	504,925	36,482

Comparisons of Importations for last five years.

	1917.	1918.	1919.	1920.	1921.
	£	£	£	£	£
Nitro Compounds	93,377	77,166	55,935	125,747	27,858
Blasting Powder	13,339	4,030	1,453	9,507	1,237
Sporting Powder...	36	189	...	1,627	...
Fuse	5,005	4,779	1,593	4,776	195
Fireworks	1	240	349	1,144	1,185
Detonators	7,619	3,500	248	10,309	2,107
N.E.I.	4,784	193	543	4,449	3,900
Totals	124,161	90,097	60,121	157,559	36,482

Sodium and Potassium Gelignite.—With reference to the question of the substitution of sodium nitrate for potassium nitrate in gelignite, which has been a great subject of discussion for some years past, and has frequently formed the subject of comment in my annual and other reports, it is interesting to note the following extract from the 54th Annual Report of the Dominion Laboratory in New Zealand, which in an appendix contains the report on the administration of the Explosives and Dangerous Goods Act, 1908, for the financial year ended 30th June, 1921:—

Amendment No. 6—Definition of "Gelignite."

—During the war it was impossible for the explosives manufacturers to obtain potassium salts, and the definition of "gelignite" was amended by the British Home Office to permit the replacement of potassium nitrate by the corresponding sodium salt. The latter is highly hygroscopic, and the explosive in which it was used gave much less satisfactory results in New Zealand than the potassium-nitrate gelignite. There are two factors contributing to this result. The climate of the country is on the whole decidedly moist—particularly in the mining districts—and owing both to the distance of New Zealand from the manufacturing countries and also the peculiar difficulties of internal transport it is necessary to hold large stocks of explosives in the country, and for considerable periods. Now that supplies of potassium nitrate are again obtainable it is considered that the two kinds of gelignite should be distinguished from one another, and the amending regulation provides that the name "gelignite" shall be used only in respect of an explosive containing potassium nitrate.

It is evident from this that in New Zealand exactly the same position has arisen as arose in Western Australia, and that as in our regulations it has been found necessary to call for distinctive markings of the two classes of explosives. In New Zealand, however, they have gone further than we have in restricting the name "gelignite" to the potassium nitrate explosive only. Up to the present there is no indication of any intention on the part of manufacturers to return to the use of potassium nitrate as in pre-war days, and in accordance with the views I have previously expressed I think that this fact is to be regretted.

Ships' Magazines.—In September the s.s. "Essex" arrived in the port of Fremantle with a consignment of explosives which were in bad condition. This was due to three causes—

- (1) The explosive had been stored in refrigerating chambers between decks and the sweating in these chambers had caused damage by moisture to gunpowder included in the cargo.
- (2) Three cases of nitroglycerine explosive were placed in the same magazine as the detonators.
- (3) Owing partly to weak packages containing the gunpowder and perhaps partly to rough handling, a number of cases had become so damaged that loose gunpowder had obtruded from the packages and become scattered about in a dangerous manner.

This is the most serious and dangerous condition in which any cargo has arrived in this State, and had any movement of the cargo taken place with loose gunpowder scattered about amongst the packages a very serious disaster indeed might have been caused. This is not the first time that I have drawn attention to the undesirability of explosives being stored in refrigerating chambers. In May, 1920, a similar method of storage was followed in the s.s. "Durham," and attention was then drawn to the matter and representations made to the Agent General, but I have, up to the present, received no reply to that communication. The damage to the cases in the "Essex" may have been caused during transshipment in South Africa, but the boxes themselves were apparently weak, and complaints on this score have also previously been made. The matter was immediately taken up and communications sent both to the Agent General and to the South African Government, but at the time of writing no reply has been received from either of these two sources.

Magazine Reserves.—During the year it was decided to remove the caretaker from the Magazine Reserve at Kalgoorlie. Owing to the shrinkage in trade it was not considered that the heavy expenditure involved was justified. Those holding magazines on the reserve have been given keys to the enclosure so that they can gain access to their buildings, and the police and forest ranger have been asked to patrol the neighbourhood so as to take all precautions possible. The magazine keeper was transferred to the magazine staff at Fremantle where a vacancy had occurred through the retirement of watchman Cornell, and on account of his experience and standing has been made the senior watchman at the main depot at Woodman's Point. Considerable economy was thus effected, and although some protests in the earlier stages were naturally made from the Kalgoorlie district, I think the change has been justified.

As foreshadowed in last year's annual report, the method of leasing sites for private magazines has been entirely altered, only annual tenure now being given instead of extended leases. This arrangement is of mutual benefit, for, being more elastic, it enables merchants to accommodate their arrangements to fluctuating conditions in different circumstances, and at the same time it removes from the Government any extended obligation which, in some cases, as at Fremantle, might involve the Government in very heavy expenditure.

No new reserves have been declared during the year. There are 64 privately-owned magazines situated on explosives reserves throughout the State, and two Government buildings with a total licensed capacity of 919 tons. There are also 47 magazines erected on private property, with a licensed capacity of 33 tons. The above figures are exclusive of buildings licensed for storage of detonators only.

There were 100 store licenses for the sale of explosives issued during the year; also 263 licenses for the sale of fireworks only.

Inspections.—During the year 110 inspections of magazines and licensed premises were made, and the following places were visited:—Woodman's Point Explosives Reserve, Perth, Fremantle, Northam,

York, Quairading, Toodyay, Westonia, Southern Cross, Bullfinch, Coolgardie, Norseman, Kalgoorlie, Broad Arrow, Menzies, Kookynie, Malcolm, Morgans, Laverton, Leonora, Cue, Day Dawn, Nannine, Meekatharra, Peak Hill, Nullagine, Marble Bar,

Port Hedland, Roebourne, Bunbury, Busselton, Jarrahdale, and Collie.

As a result of these inspections proceedings were only found necessary in one case, but the following explosives were destroyed from time to time:—

Prosecutions.

Date.	Defendant.	Offence.	Penalty.
14-10-21	Quairading Farmers Co-operative Co.	Storing explosives on unlicensed premises	Fined £2 (costs, 9s.). Case heard by R.M.

TABLE No. 3.

Date.	Place.	Kind and Quantity.	Remarks.
21-1-21	Perth	5 lbs. Viking Powder	Chemical deterioration..
11-5-21	Kalgoorlie	700 lbs. Gelnite	Exudation.
		100 lbs. B. Gelatine	Chemical deterioration.
		100 lbs. Gelnite	do.
		5 lbs. Gelnite	do.
24-5-21	Laverton	350 lbs. Gelnite	Exudation.
		100 lbs. Gel. Dynamite	do.
10-5-21	Coolgardie	5 lbs. Gelnite	Chemical deterioration.
15-6-21	Fremantle	200 lbs. Viking Powder	Owing to having absorbed moisture.
25-8-21	Byfield	1 lb. Gelnite	Chemical deterioration.
		40 lbs. Powder	Absorbed moisture.
27-8-21	Fremantle	10 detonators	Owing to having been damaged by moisture.
17-10-21	Fremantle	10 lbs. Gelnite	Owing to exudation.
		75 lbs. B. Powder	Owing to having absorbed moisture.
		83 lbs. Pellet Powder	do. do.
1-11-21	Marble Bar	100 lbs. Gelnite	Exudation.
8-11-21	Port Hedland	1,000 E. detonators	Old Stock.
18-11-21	Roebourne	5 lbs. Gelnite	Exudation.
6-12-21	Fremantle	1,250 lbs. Viking Powder	Chemical deterioration.
		160 lbs. Gelnite	Exudation.
		900 lbs. Gelnite	do.
		8,050 E. detonators	At request of owners.

Exudation.—Special trouble was met with during the year during a trip of inspection through the Eastern Goldfields. Early in the year free exudation was discovered in a consignment of explosives manufactured in February and March of 1920. On making a thorough investigation it was found that the consignment was distributed throughout the goldfields centres as well as a large quantity stored at the Woodman's Point Explosives Reserve. Representations were made to the agents, with the result that the entire stocks were collected at Fremantle and Kalgoorlie and arrangements made to treat it with keiselguhr and rewrap it.

The number of cases affected was found to be no less than 1,976. Of these 917 were treated at Kalgoorlie and 1,059 at Fremantle. The treatment consisted of unwrapping the cartridges and removing all the excess nitro-glycerine by means of keiselguhr. This treatment was found efficient with the explosive manufactured in February which was put into consumption, and up to the present no complaints have been received by the Department as to its efficiency. But with the explosive manufactured in March it was found about a month after treatment that it was again exuding freely and complaints began to come in to the effect that it would not explode. On a close examination it was found that the inertness was due to the absorption of moisture which appeared to be replacing the nitro-glycerine. This was again brought

under the notice of the agents, who made arrangements for its consignment to Melbourne for remanufacture. This arrangement was approved, as it was considered to be quite safe for transport, but I was not prepared to allow it to go into consumption. The remaining stock of March manufacture, which consisted of 480 cases, was consigned to Melbourne by the s.s. "Ashbridge" on 26th September, 1921.

About thirty cases of this consignment were found after the bulk had been shipped, and this was destroyed as being unfit for consumption.

Authorised Explosives.—No new explosives have been added to the authorised list, but application has been made for the inclusion of four new explosives which are now being subjected to analysis and physical tests prior to placing them permanently on the authorised list.

The tests carried out in connection with the inspection of explosives were as follows:—

TABLE No. 4.

Heat Tests	188
Fuse	62
Velocity of Detonation and other special tests	93
Total	343

AGRICULTURAL CHEMIST.

The chemical work carried out under this heading comprises the following tests:—

TABLE No. 5.

Soils	87
Fertilisers	145
Wheats and Flours	73
Waters	90
Beets	25
Limes	28
Salts	6
Miscellaneous	24
	478

Statistical figures in this case convey only a meagre idea of the full extent of agricultural work accomplished, and some of these matters call for special attention.

Experiments at Harvey.—The experiments carried out in 1918-19 at Harvey on the effect of lime on the orchard soils of that district were duly referred to in previous reports, but three years having elapsed since the lime dressing was applied it became desirable to ascertain, as far as possible, by chemical examination, whether and to what extent the effect of the three-ton dressing then given still persisted in the soil. A further series of samples was therefore taken towards the end of the year and were subjected to careful examination, the results of which led to the following conclusions:—

1. That there was still considerable residual effect from the lime added towards the end of 1918.
2. That nevertheless the soils showed a tendency towards retrogression to their original condition. They still, however, compared favourably with soil which had not been treated with lime at all.
3. The results of the earlier tests indicated that had four tons of lime been added instead of three, a proportionately greater benefit would have been derived, and this conclusion is borne out by the tests of 1921.

The general result obtained from all these tests, therefore, is the suggestion that in soils of this class it is probable that a dressing of four tons of lime to the acre would have an extremely beneficial effect, and that such dressing would probably need to be repeated about every four years.

This is the first series of tests on any extensive scale made in this State on this particular point, and it is interesting to find that the experiments confirmed the opinions which have been given from this Department from time to time based upon experiments in other parts of the world.

Sugar Beet.—A particularly interesting series of tests was made in connection with experiments carried out by a special officer of the Agricultural Department on sugar beet culture. A number of plots were planted by different growers under the terms of a competition inaugurated by a private firm, and under the supervision of the department. The beets grown in various parts of the State were all subjected to analysis and the results have already been published, so that it is not necessary to repeat them here. Some of the results, however, were very high and

were extremely gratifying as indicating the possibility of growing beet rich in sugar in various parts of the State. This favourable result is probably due not only to the free and open character of the soils, but also to the magnificent sunny climate of Western Australia, which seems to be favourable to sugar secretion in the plant.

Potato Soils.—In various parts of the coastal districts, notably near Bunbury and at Young's Siding near Albany, considerable difficulty has been experienced by potato growers owing to the diminution of yields in some of the swampy peat soils which are looked upon with such favour for growing potato crops. Some of these soils had been found to require much heavier dressings of potato manure than had been required in years past and yet failed to give a corresponding yield. I paid several visits to these districts and enquired into the difficulty both personally and also by analyses of samples submitted, and came to the conclusion that the difficulty experienced was due to the growing acidity in these soils, due partly to the acid nature of the fertiliser employed over long periods of years augmented by the natural tendency in some of these swamps to the formation of acid conditions indicated by the presence of sulphate of iron in the ground waters. These cases appear to me to be a clear indication of the need of heavy lime dressings on these soils, by which it is believed not only a reduction in fertiliser cost would be obtained but also improved yields would result.

These investigations were carried out in conjunction with two other officers of the Department of Agriculture, who united in a recommendation for a definite scheme of experimentation along the lines recommended, in which the department should co-operate with the growers by bearing a certain proportion of the expense. The results of these experiments will be awaited with great interest both from the practical and theoretical point of view.

Agricultural Chemistry in Rural Schools.—Certain schools under the Education Department in the country districts which make a speciality of endeavouring to train children to acquire an intelligent interest in agricultural matters have found the necessity for some more systematic method of teaching elementary agricultural chemistry, and in consequence of this I have received from the Education Department a request to draw up a simple curriculum to meet the requirements of different classes of schools controlled by the department. This is a most important piece of work which I will willingly undertake, but it is feared that it will not be possible to get the matter in order before the new school year begins. An endeavour will be made, however, to bring this about at the earliest opportunity.

Soil Survey.—I have for many years past at intervals urged upon the Government the desirability of initiating, even on a small scale, a soil survey of Western Australia, in order to meet many of the requirements of settlers. Such a scheme would be of special value connected with the forward immigration policy now being inaugurated for this State. The most notable example of soil survey at present known is that which is conducted in the United States of America, and which is controlled by the Chemical Branch of the Department of Agriculture. There is up to the present no systematic soil survey in any of the States of Australia, although a certain amount of preliminary work to that end has been carried out in

some of the Eastern States, and the Australian National Research Council (an organisation of scientific authorities of the Commonwealth in order to promote national research), recognising the desirability of work in this direction, last year appointed a special committee to enquire into the question of soil survey in Australia. I have received from the Committee of the Research Council a request to act as a member of this committee, and I have consented to do so, but the time which has elapsed since the appointment of the committee has not been sufficient to permit of any extensive work being done.

Avon River Investigations.—The investigations into the salinity of the winter flow in the Avon River, as measured at the Northam weir, which was carried on throughout the wet season of 1920, were repeated during 1921. The object of these investigations, as previously pointed out, is to try and accumulate definite data of a systematic kind which may in the future prove useful in connection with any scheme which may be taken up with a view to rendering available the large flow of water in this stream for irrigation purposes.

The results of the tests for 1921 are shown in an appendix (No. 1) in a diagrammatic way, as was done in the previous year, and it is very remarkable to note the extraordinary difference in this diagram and that for the previous twelve months. Although the aggregate rainfall was as great in the one year as in the other the "run-off" shows a remarkable difference, showing the importance of studying not only the total rainfall but the intensity of precipitation in connection with the "run-off" of these inland streams. The results of the tests for the last year go to confirm the opinion, which I have before expressed, that investigations for at least five consecutive years are necessary before it is desirable to draw any conclusion from the data collected. I therefore include the figures in my report without comment for the time being, hoping however that continued observations from year to year will eventually prove of valuable assistance in solving what may be a very important problem.

Dieback in Fruit Trees.—Investigations and observations, extending over the last three years, into the causes of that trouble which is generally known amongst orchardists as "Dieback" had caused certain tentative conclusions to be arrived at which I thought it desirable to lay before the fruitgrowers of this State. They were, therefore, embodied in a draft of a bulletin which indicated the connection between soil and climatic conditions and the physiological processes of growth in the trees, with practical suggestions as to how the governing factors might be controlled or modified. Unfortunately it was found that the bulletin could not be issued as an official bulletin from the Department of Agriculture because of the expense involved, and it was, therefore, submitted to the editor of the "Primary Producer," who kindly undertook to publish it in his weekly journal. In this way it has been possible to lay the results of my investigations before those concerned in the practical problem of fruitgrowing throughout the State.

Superphosphate and Guano.—Those who have carefully studied the soil conditions in Western Australia can hardly fail to have come to the conclusion that in certain districts particular classes of soil may in time fail to respond to the best advantage to dressings of superphosphate, which is the com-

monest form of manuring practised in connection with our wheat growing. On theoretical grounds there seems to be good reason to believe that neutral phosphates, such as those which are procurable in the natural guano deposits occurring along our coast-line, might give equally favourable results, especially in those soils which are naturally deficient in lime. A few, but interesting, pot experiments were, therefore, carried out during the year in which wheat was grown in pots containing Western Australian guano and compared with similar tests made with an equal weight of superphosphate. The results were so interesting as showing an equality in the yields given by guano that they were exhibited at the Royal Society's annual Show, and attracted considerable attention. I have since been very pleased to ascertain that the same conclusion had been arrived at by quite a number of farmers, and that in certain districts a considerable amount of wheat is being grown with guano, some farmers considering it superior to superphosphate.

It must be here most clearly emphasised that this conclusion is not to be taken as a general one in all wheat districts, or in all classes of soils. The greatest care should be exercised by farmers to avoid unnecessary risk by using guano on soils which are obviously unsuitable, but personal experimentation upon the point is urged upon growers, and this Department would be very willing to assist at any time in answering inquiries on the subject, and in giving advice with regard to particular localities. If only a small plot of an experimental nature is put in by farmers who are interested, most valuable data will be collected in various districts.

If guano can be substituted for superphosphate it must be a great advantage to this State because in the first place, weight for weight, the guano is at least not more expensive than super, and, being richer in phosphates, the phosphoric acid content is proportionately cheaper if it will produce the yield. In the second place, it is obviously a desirable thing if the rich natural deposits of guano can be turned to profitable account in stimulating our production of soil wealth.

Stock Waters.—A large number of stock waters has been examined during the year, as the provision of water for stock in the dry districts of the State is a continual problem to settlers. The standard usually adopted in this laboratory in determining the suitability of water for stock is as follows:—

Good stock water containing up to 300 grains of salt per gallon.

Fair stock water containing from 300-600 grains of salt per gallon.

Bad stock water containing over 600 grains of salt per gallon.

This is in accordance with the standard usually adopted in some of the other States of the Commonwealth. Some criticism has been levelled during the year at the accuracy of this standard, and I therefore feel that it is a matter which calls for somewhat lengthy notice.

A standard of this kind cannot of course be rigidly applied and is only taken as a rough guide in interpreting the results of chemical analyses. In order to explain this fully and to enable settlers to exercise a more intelligent interest in the matter a special leaflet was prepared and is issued to all

enquirers on this subject. Owing to the great importance of this to the stock-raising industry of the State I think it is advisable that this leaflet should be reproduced, and is printed in an appendix (No. 2) to this report.

Two or three years ago special steps were taken to check the accuracy of the standard adopted. Samples were carefully obtained from authentic sources and accompanied by the opinions of experienced stock owners as to the suitability of the waters based on their practical experience. These were subjected to careful analysis and judgment passed upon the samples according to the scale already referred to. These results have never before been published and I think it is, therefore, advisable to include them in this report (appendix No. 3).

It will be seen that there is a remarkable agreement between the classification of the water based on chemical analysis and that derived from practical experience of stock owners. In only one case is there a material difference, and it will be seen that in this instance the water classified as bad was drawn from a well on a stock route which was situated midway between two wells yielding excellent supplies. Under such circumstances any ill effect upon travelling stock might be entirely nullified by the good quality of the neighbouring wells. The result of these tests goes to confirm, therefore, the accuracy of the standard adopted and upon which all advice issued to settlers is primarily based.

Lectures.—I have delivered quite a considerable number of lectures, particularly on Agricultural Chemistry, during the year, and have repeatedly found settlers upon the land not only in great need of instruction upon the fundamental scientific facts bearing upon their work, but also eagerly desirous of acquiring information in this direction. Agriculture is too competitive a calling to permit of the continuance of mere rule of thumb methods, and an appreciation of the bearing of simple scientific theories upon their work cannot fail both to improve the productiveness of their land but to increase the interest and broaden the outlook of those who are so energetically developing our natural estate. I consider this is the branch of the agricultural chemist's work which can be made most immediately helpful to the settlers, and it is certainly that in which I feel the deepest personal interest.

BOTANICAL AND PATHOLOGICAL.

As already mentioned, this work was towards the end of the year removed from my control, but the following is a statistical statement of the work performed during the year. This shows a considerable increase on the previous year's figures, which showed a total of 651 as compared with 1,489 for this year.

TABLE No. 6.

Botanical identifications	1,327
Pathological diagnoses	110
Quarantine samples	39
Germination tests	13
Total	1,489

In addition to the laboratory work the re-classification of the State Herbarium was completed and the specimens re-arranged. By this means a large number of spare specimens were found to be available for exchange or sale, and a suggestion was made to the Government that these might, by being advertised in various parts of the world, be sought after by collectors, and by their sale might produce quite a useful source of revenue. The suggestion was approved and instructions were issued for a catalogue of these specimens to be printed for distribution in various parts of the world, but the work was transferred from my care before this project could be completed. It was estimated that some hundreds of pounds worth of specimens were available for this purpose.

A fairly extensive collection of plants made by Professor Wilson of the Harvard University was classified by the Economic Botanist, and quite a considerable number of new botanical species were found and named. By carrying out this identification work for Professor Wilson the herbarium benefited also by obtaining a duplicate set of the specimens, which were of considerable interest.

In conjunction with Mr. Despeissis, the Agricultural Department's bulletin on Foot Rot (*Armillaria*) was revised; also the bulletin on Noxious Weeds of Western Australia was revised by Mr. Herbert, and as a companion publication to the latter a new and complete bulletin on the Poison Plants of Western Australia was compiled. This was in manuscript when the work was transferred to the Agricultural Department and was handed over to that Department for publication. A revised leaflet for the information of settlers on the Poison Plants of Western Australia was also drawn up and issued.

The following table shows a complete summary of all the scientific work performed in this laboratory under the departments for which it was carried out:—

TABLE No. 7.

Health Department	148
State Hotels	124
Water Supply Department	459
Public Works Department	357
Explosives Department	343
Agricultural Department	1,967
Police Department	54
Railway Department	23
Government Stores	23
Government Tender Board	17
Private analyses	70
Miscellaneous	17
Total	3,602

I beg to acknowledge the valuable assistance rendered during the year by the Commissioner of Police and his officers, and also by the State Mining Engineer and by the Inspectors of Mines.

E. A. MANN,

Government Analyst, Agricultural Chemist,
and Chief Inspector of Explosives.

Appendix No. 1.

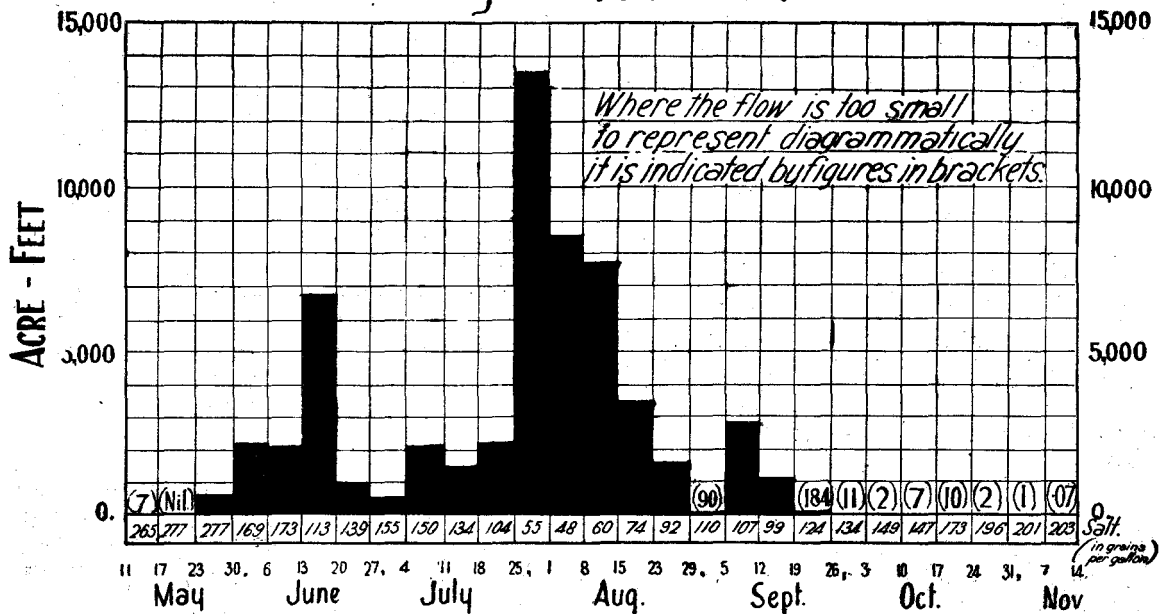
WATER FROM NORTHAM WEIR, 1921.

(Figures represent grains per gallon.)

Date.	Overflow.	Gallons.	Chlorine.	Equiv. to Sodium Chloride.	Total, Magnesium Oxide	Total Solids.	Reduced Level.
17-5-21	From 9 p.m. on 11th to date	2,000,000	160.44	264.73	29.89	341.60	480.09
23-5-21	...	...	168.00	277.20	31.15	339.50	480.09
30-5-21	From 23rd to 30th	173,000,000	168.00	277.20	26.86	341.60	480.46
6-6-21	From 30th to 6th	601,000,000	102.20	168.63	17.22	201.60	480.67
13-6-21	From 6th to 13th	594,000,000	105.00	173.25	18.90	229.60	480.51
20-6-21	From 13th to 20th	1,850,000,000	68.60	113.19	10.77	132.30	480.46
27-6-21	From 20th to 27th	266,000,000	84.00	138.60	13.30	170.10	480.26
4-7-21	From 27th to 4th	139,000,000	93.80	154.77	15.96	193.90	480.34
11-7-21	From 4th to 11th	585,000,000	91.00	150.15	16.10	191.80	480.38
18-7-21	From 11th to 18th	404,000,000	81.20	133.98	14.70	163.10	480.38
25-7-21	From 18th to 25th	606,000,000	63.00	103.95	10.36	123.20	480.76
1-8-21	From 25th to 1st	3,673,000,000	33.60	55.44	3.29	67.90	480.67
8-8-21	From 1st to 8th	2,351,000,000	29.40	48.51	4.56	60.20	481.09
15-8-21	From 8th to 15th	2,108,000,000	36.40	60.06	5.60	72.80	480.59
23-8-21	From 15th to 23rd	926,000,000	44.80	73.92	7.63	91.00	480.59
29-8-21	From 23rd to 29th	443,000,000	56.00	92.40	9.87	119.00	480.26
5-9-21	From 29th to 5th	24,600,000	66.50	109.72	10.50	137.20	480.21
12-9-21	From 5th to 12th	783,000,000	65.10	107.41	9.80	135.10	480.46
19-9-21	From 12th to 19th	308,000,000	60.20	99.33	9.38	123.90	480.34
26-9-21	From 19th to 26th	5,000,000	74.90	123.58	11.41	148.40	480.17
3-10-21	From 26th to 3rd	3,000,000	81.20	133.98	13.30	167.30	480.13
10-10-21	From 3rd to 10th	700,000	90.30	149.00	14.70	189.70	480.13
17-10-21	From 10th to 17th	2,100,000	88.90	146.68	14.00	179.90	480.17
24-10-21	From 17th to 24th	2,700,000	105.00	173.25	15.19	217.70	480.13
31-10-21	From 24th to 31st	700,000	119.00	196.35	16.45	238.00	480.13
7-11-21	From 1st to 7th	400,000	121.80	200.97	16.94	249.90	480.11
14-11-21	From 7th to 14th	20,000	123.20	203.28	22.05	239.00	480.09

Overflow stopped on 10th November, 1921.

OVERFLOW OF AVON RIVER AT NORTHAM WEIR May to Nov. 1921.



Appendix No. 2.

STOCK WATERS : STANDARDS FOR
COMPOSITION OF.

[Leaflet No. 90.]

For the Information of Settlers.

Samples of water are frequently submitted from different parts of the State to know whether they are suitable or otherwise for stock. This is not a question which can always be answered readily.

The nature of water which stock will drink varies greatly with circumstances and conditions. In this country the variation between the summer and winter compositions of the same water supply are very great, and if stock have been accustomed to watering from one source the gradual increase of salinity which occurs with growing summer concentration probably passes unnoticed by the animals, who become accustomed to it and suffer little ill effects. If, however, stock which have been accustomed to drinking fresh water are suddenly put on to a very salt supply, it may be quite distasteful to them, and they may either refuse to drink it or suffer ill effects from its use.

Again, a flock of sheep travelling on a stock route may be able to drink from a well which is exceedingly saline and suffer no ill effects if it occurs at a point intermediate between two wells of good quality. Stock if thirsty through travelling, or extreme conditions, may take and thrive on a very saline water for a short period from which they would suffer if used extensively. The effect of different constituents in the water probably varies under different conditions, and when the proportions between them are different—for instance, a case is known in which a large proportion of magnesia in the water was particularly deleterious to a large number of ewes during the lambing period.

All the above factors make the question more complicated than at first appears, and although certain standards of composition are recorded and have been published in reports by the Department of Agriculture in New South Wales and Queensland, it is not certain whether these standards are universally applicable, and especially under our local conditions.

The standard usually adopted in this State has been as follows:—

Good stock water containing up to 300 grains of salt per gallon.

Fair stock water containing from 300-600 grains of salt per gallon.

Bad stock water containing over 600 grains of salt per gallon.

This standard has been modified if large amounts of magnesia were found to be present, as this has been looked upon as specially deleterious.

In applying this standard when reporting upon samples of water submitted by settlers in the dry areas, the Department has sometimes been encountered with considerable criticism because the settlers state that where a water has been judged as unfit for stock it has sometimes supported stock satisfactorily. Further inquiry has shown that these statements may be only partially correct, and there is a tendency on the part of settlers to apply the standards set down too rigidly. It is considered advisable to amplify with a few comments the scale of quality above set forth.

It is not possible always to lay down hard and fast rules; for instance, when a water has been declared as unfit for stock by the Department it has in some instances been shown that though cattle and horses would not drink the water sheep have thrived upon it, or apparently done so. It is also probable that working animals, such as team horses, would have greater difficulty in thriving upon a salt water than cattle which are living a quiet and sedentary life. There seems to be also some evidence for believing that animals can stand salt water better on very dry food, but this is not proven.

It seems desirable, therefore, to point out to settlers that in judging a given water supply consideration should be given to the kind of stock which it is desired to water (whether horses, horned cattle, or sheep), and the conditions of life under which the animals live (whether strenuously worked or otherwise).

Again, it is well to point out that it is not wise to conclude too hastily that because sheep will readily drink very salt water that it does them no harm. While it is not easy to arrive at a definite decision on this point, it would be well for every settler to make careful observations as to whether his animals are suffering indirectly by the use of saline drinking water; for instance, a settler should ask himself whether his stock are suffering either in the number or health of their progeny, or in the strength and quality of their wool.

These are questions which require long and careful observation, because these waters cannot be considered as directly poisonous, but only as affecting gradual and not readily observed physiological degeneration. When, therefore, a water is recorded as unfit for stock, the recipient of such a report should read it as indicating merely that it is desirable to exhaust every possible means of obtaining a better supply, and that it is at least desirable not to use such a water if it can be avoided. Careful attention also requires to be paid to the time of year at which a sample is taken—one examined at the close of the summer season may appear quite unfit for stock which earlier in the year would be quite harmless.

The great difficulties experienced by many settlers during recent periods in obtaining suitable stock waters lead the Department to issue this circular, so that while assisting settlers in every possible way by chemical analyses the reports based thereon may not be misinterpreted, or misunderstood.

Appendix No. 3.

ANALYSES OF STOCK WATERS.

Sample No.	District.	Station.	Owner.	Date.	Analyses.			Quality according to Local Opinion.	Quality according to Chemical Standard.
					Salt.*	Magnesia.	Total Solids.		
1	Roebourne Well	...	...	1917	18.94	4.2	56.42	Good stock water	Excellent.
2	No. 2 Well	...	...	1917	24.95	2.63	36.00	do.	do.
3	No. 3 Well	...	...	1917	36.5	6.39	78.96	do.	do.
4	No. 3a Well	...	...	1917	120.6	15.14	154.00	do.	do.
5	No. 4 Well	...	...	1917	186.2	17.38	236.30	do.	Good.
6	No. 5 Well	...	...	1917	276.0	19.92	351.0	do.	do.
7	No. 6 Well, Pine Grove	...	...	1917	84.6	6.59	111.2	(Not stated)	Excellent.
8	No. 9 Well	...	...	1917	627.0	42.0	681.0	Good	Bad.
9	No. 10 Well	...	...	1917	89.2	9.89	141.8	do.	Excellent.
10	No. 18 Well	...	...	1917	89.8	6.95	145.6	do.	do.
11	No. 19 Well	...	...	1917	59.1	4.81	107.1	do.	do.
12	No. 47 Well	...	...	1917	32.3	6.15	62.6	do.	do.
13	Millstream Pool	...	...	1917	134.0	8.73	219.2	do.	Good.
14	Gurunginah Well...	5 miles from Moola Moola Station	...	1917	13.9	2.28	56.0	do.	Excellent.
15	Eastern Harding Well	...	...	1917	82.7	2.28	124.0	do.	do.
16	Eramurra Well	...	...	1917	231.0	11.73	320.9	Fair to indifferent	Good.
17	Eramurra Pool	...	...	1917	266.0	28.52	344.1	do.	do.
18	Nine Mile Well, on Road Hall's Creek to Moola Bulla	...	...	1917	2.31	3.04	14.0	First class water	Excellent.
19	Well on Wogoola Sheep Run	7 miles West of Station	...	1917	56.4	9.05	103.0	Good	do.
20	Warrandul Well	...	...	1917	115.5	7.74	159.6	do.	do.
21	Pardoo Well Windmill, near Charlymia	...	...	1917	137.4	7.80	199.1	Fair	Good.
22	Minda Werrie Werrie Well, Mulga Downs	...	...	1917	10.2	43.0	108.2	Good	Excellent.
23	Post Office, Onslow	...	...	1917	450.0	6.89	637.6	Bad	Fair.
24	1.—Gingin Brook Water	...	J. E. Wedge, Gingin	1918	76.0	9.66	114.1	Good	Excellent.
25	2.—Hillside Water	...	do.	1918	156.0	13.60	235.2	do.	Good.
26	3.—Hillside Stream	...	do.	1918	196.0	16.9	275.8	do.	Good.
27	Mt. Taylor, Moorarie	...	W. Kerr, Minginew	1918	12.7	1.2	18.1	do.	Excellent.
28	Horse Paddock, Moorarie	...	do.	1918	178.0	8.27	197.2	Fair	Good.
29	Buthingah, Moorarie	...	do.	1918	26.6	2.31	34.2	Good	Excellent.
30	No. 1, Gullewa	Cattle Station	C. Mitchell, Gullewa	1918	299.0	26.2	388.0	do.	Good.
31	No. 2, Gullewa	Pillia Pillia	do.	1918	596.0	35.2	713.0	Good for sheep not horses	Dubious.
32	No. 3, Gullewa	Widgullea Creek	do.	1918	415.0	29.8	515.0	do. do.	Fair.
33	No. 4, Gullewa	Woodite	do.	1918	272.0	18.0	332.0	do.	Good.
34	No. 5, Gullewa	Coodardoo	do.	1918	818.0	28.0	922.0	Not good	Bad.
35	No. 6, Gullewa	Widgullea (2)	do.	1918	234.0	14.5	293.0	Good	Good.
36	No. 1, Beringarra	...	N.Z. and Aust. Land Co., Beringarra, via Yaalgo	1918	37.42	5.54	75.25	First Class	Excellent.
37	No. 2, Beringarra	...	do.	1918	293.2	22.47	427.77	Good	Good.
38	No. 3, Beringarra	...	do.	1918	344.19	27.65	534.8	Indifferent	Fair.
39	No. 4, Beringarra	...	do.	1918	653.73	50.26	1,006.7	Bad	Bad.
40	No. 1, Moora	Soak, Granite country	F. Hamilton, Moora	1918	13.86	1.33	24.81	Excellent	Excellent.
41	No. 2, Moora	18ft. Well	do.	1918	49.90	1.46	74.20	Good (summer only)	Excellent.
42	No. 3, Moora	60ft. Well	do.	1918	17.56	0.7	23.27	Good	do.
43	No. 4, Moora	Bonham's Tank	do.	1918	190.57	12.31	236.60	Fit if kept on it	Good.
44	No. 5, Moora	Craig's Well, 70ft.	do.	1918	175.56	21.23	220.60	Good	do.
45	No. 1, Carnarvon	Hills Spring Station	Hearman & Loeffler	1918	441.2	24.33	760.90	Good for sheep and camels; not horses and stock	Fair to dubious.
46	No. 2, Carnarvon	do.	do.	1918	749.6	22.31	1,026.20	do.	Bad.
47	Lake Austin, Mt. Magnet	Wandarric Station	Pastoralists' Association	1918	645.64	24.33	760.20	...	do.
48	No. 1, Mt. Magnet	Wydgee Station, 14ft. Well	A. Thorn	1918	211.36	14.9	278.64	Fair	Good.
49	No. 2, Mt. Magnet	Wydgee Station, 75ft. Well	do.	1918	69.30	6.49	108.15	Good	Excellent.
50	No. 3, Mt. Magnet	Wydgee Station, 53ft. Well	do.	1918	165.16	15.46	236.25	do.	Good.
51	No. 4, Mt. Magnet	Wydgee Station, 83ft. Well	do.	1918	279.51	20.28	369.25	Unsuitable	do.
52	No. 5, Mt. Magnet	Wydgee Station, 85ft. Well	do.	1918	165.16	10.9	226.1	Good	do.
53	No. 6, Mt. Magnet	Wydgee Station, 40ft. Well	do.	1918	35.80	6.84	70.70	do.	Excellent.

* Total chlorine calculated as common salt.

WESTERN



AUSTRALIA.

DEPARTMENT OF MINES.

MINING STATISTICS,
1921.

MINING STATISTICS TO 31st DECEMBER, 1921.

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EXPLANATIONS OF SIGNS AND ABBREVIATIONS.

Gf. Goldfield.
Mf. Mineral field.
D. District.
G.M.L. Gold Mining Lease.
M.L. Mineral Lease.
Loc. Location.
L.C. Lode Claim.
Q.C. Quartz Claim.
R.C. Reward Claim.

M.C. Mineral Claim.
M.R.C. Mineral Reward Claim.
M.A. Machinery Area.
Mach. L. Machinery Lease.
P.A. Prospecting Area.
T.A. Tailings Area.
T.L. Tailings Lease.
W.R. Water Right.
S.L. Special License.
N.E.I. Not elsewhere included.

WESTERN AUSTRALIA.

SUMMARY OF MINERAL PRODUCTION.

GOLD AND OTHER MINERALS PRODUCED DURING 1921, AND THE ESTIMATED VALUE THEREOF, TOGETHER WITH A COMPARISON FOR PREVIOUS YEARS, AND THE TOTAL PRODUCTION TO DATE.

DESCRIPTION OF MINERAL.	1921.		1920.		1919.		1918.		Previously to 1918.		Total to date.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1. Antimony (Exported) statute tons	...	£	2½	£	...	£	...	£	86	£	89	£
2. Arsenical Ore (Exported) do.	7	16	1,765	4,260	...	...	679	2,564	68	726	2,519	7,566
3. Asbestos (Reported) do.	235	13,581	157	7,286	53	1,443	...	...	43	1,754	488	24,064
4. Bismuth (Exported) do.	...	...	...	...	1 cwt.	15	...	...	10½	829	11	844
5. Coal (Reported) do.	468,817	407,117	462,021	350,346	401,713	270,355	337,039	204,319	3,870,907	1,849,237	5,540,497	3,081,374
6. Copper { Ore (Exported) do.	1,040	16,153	1,511	22,467	455	9,740	1,643	24,877	67,733	800,480	72,382	873,717
{ Ingot and Matte (Exported) do.	206	8,448	137	2,698	4	365	478	41,269	10,872	734,146	11,697	786,926
7. Gadolinite (Reported) do.	...	...	...	...	...	...	...	...	1	112	1	112
8. Gold (Exported and Minted) fine ounces	553,731	2,352,098	617,842	2,624,427	734,066	3,118,113	876,511	3,723,183	31,519,972	133,888,331	34,302,122	145,706,152
9. Graphite (Exported) statute tons	...	...	13	130	...	...	5	75	47	488	65	693
10. Gypsum (Reported) do.	665	622	...	...	...	...	...	...	...	...	665	622
11. Ironstone (Reported) do.	...	...	...	...	...	...	...	...	57,830	36,695	57,830	36,695
12. Lead (Ore and Concentrates) (Exported) do.	...	...	...	...	...	...	...	...	44,032	508,748	44,032	508,748
13. Lead and Silver Lead (Ore and Concentrates) (Exported) do.	...	...	3,427	84,743	248	3,704	282	3,045	4,273	59,729	8,230	151,221
14. Lead (Pig) (Exported) do.	2,156	48,863	1,930	69,136	1,780	48,462	5,489	163,880	8,881	228,478	20,236	558,819
15. Limestone (Reported) do.	...	...	...	...	...	...	...	...	93,706	18,290	93,706	18,290
16. Magnesite (Exported) do.	...	...	...	...	...	...	62	225	742	1,293	804	1,518
17. Manganese (Exported) do.	16	145	...	...	...	...	...	...	2	7	18	152
18. Mica (Exported) do.	...	...	*	120	1	514	...	...	*	663	...	1,297
19. Molybdenite (Exported) do.	...	...	½	5	7	100	5	97	14	158	27	360
20. Pyritic Ore (Reported) do.	6,116	7,871	6,020	7,276	4,136	4,919	2,252	1,629	52,082	19,598	70,606	41,293
21. Silver (Exported) fine ounces	116,151	18,658	130,692	36,605	223,332	55,342	109,830	22,711	3,425,542	418,759	4,005,547	552,075
22. Tantalite (Exported) statute tons	...	...	...	...	...	...	...	...	82	18,017	82	18,092
23. Tin Ore (Exported) do.	67	6,485	243	49,449	318	47,269	415	76,952	14,281	1,303,886	15,324	1,484,041
24. Tungsten Ore { Scheelite (Exported) do.	...	...	2½	395	6	772	5	720	7½	620	21	2,507
{ Wolfram (Exported) do.	...	...	...	...	½	15	...	31	14½	1,395	15	1,441
25. Zinc (Exported) do.	...	...	...	...	...	...	...	...	184	5,437	184	5,437
Unenumerated (Exported) ... ..	...	112	...	23	1	1	...	...	...	6,278	...	6,414
TOTAL VALUES ... ..	...	2,880,169	...	3,259,411	...	3,561,204	...	4,265,577	...	139,905,852	...	153,872,213

* Weight not stated.

The value of gold is calculated at the fixed price of £4.24773 per fine oz. Sales of gold by the Gold Producers' Association averaged £5.£25 per fine oz. for the year 1920, and £5.314 for the year 1921. The amounts of £974,504 and £590,428 should, therefore, be added to the years 1920 and 1921 respectively, to make up the actual value of such gold.

AUSTRALASIAN MINERAL PRODUCTION.

COMPARATIVE TABLE SHOWING THE OUTPUT OF ALL MINERAL PRODUCTS FROM THE SEVERAL STATES OF AUSTRALIA AND THE DOMINION OF NEW ZEALAND DURING 1921.

DESCRIPTION OF MINERAL.	Western Australia.		NEW SOUTH WALES.		QUEENSLAND.		VICTORIA.		TASMANIA.		SOUTH AUSTRALIA.		NEW ZEALAND.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		£		£		£		£		£		£		£
Alunite Statute tons	...	...	520	2,080	...	...	...	...	...	...	15	60	...	...
Antimony (Metal and Ore) do.	...	...	125	900	...	...	347	5,890	...	...	...	...	...	...
Arsenical Ore ... do.	7	16	397	17,865	220	12,325	...	...	...	...	...	...	...	...
Asbestos do.	235	13,581	945	23,736	...	...	...	...	...	2	71	...	50	
Bismuth (Metal and Ore) do.	...	...	8	912	...	21	...	...	21	...	...	...	...
Coal do.	468,817	407,117	10,793,387	9,078,388	954,763	831,483	583,883	634,397	66,476	63,446	...	...	1,809,095	1,809,095
Copper (Ingot and Matte) do.	206	8,448	499	41,267	2,428	168,556	...	...	6,181	463,163	1,532	106,370	...	...
Copper Ore do.	1,040	16,153	...	...	...	...	...	...	...	...	...	...	...	...
Gold Fine ounces	553,731	2,352,098	51,173	217,370	40,376	171,504	104,512	443,938	5,340	22,683	2,628	11,163	111,627	474,160
Gypsum Statute tons	665	622	...	...	...	...	11,139	6,914	...	...	34,383	29,427	...	...
Iron do.	...	...	90,053	639,376	...	...	...	...	...	...	...	...	...	...
Iron Oxide do.	...	...	3,109	2,917	...	...	...	...	...	...	...	...	...	...
Ironstone do.	...	...	7,473	9,132	4,061	5,976	...	...	...	...	506,993	628,770	...	...
Lead and Silver Lead do.	2,156	48,863	73,860	1,002,201	1,057	24,077	...	...	1,435	32,241	...	...	...	...
Limestone do.	...	...	111,558	41,834	63,275	31,518	...	...	...	...	44,277	15,546	...	...
Magnesite do.	...	...	12,268	14,407	...	...	128	384	...	...	172	373	...	...
Manganese Ore ... do.	16	145	3,515	10,545	833	4,710	10	100	...	...	1,596	9,774	...	...
Molybdenite do.	...	...	...	...	9	2,187	5	70	...	...	...	...	...	...
Osmiridium Ounces	...	...	...	...	...	...	...	...	1,751	42,935	...	...	...	...
Phosphate Rock ... Statute tons	...	...	...	...	369	1,570	1,541	1,541	...	...	5,079	6,203	...	...
Platinum Fine ounces	...	...	249	3,441	...	...	...	...	...	...	...	...	...	...
Precious Stones do.	...	...	...	14,935	...	47,024	...	...	...	...	...	...	...	...
Pyritic Ore Statute tons	6,116	7,871	...	...	...	...	...	...	...	...	...	...	...	...
Tungsten } Scheelite do.	...	...	...	...	...	...	...	...	...	...	...	...	...	...
} Wolfram do.	...	...	...	...	5	280	...	...	10	676	...	...	38	1,785
Shale (Oil) do.	...	...	32,489	77,380	...	...	...	...	868	1,506	...	...	...	...
Silver Fine ounces	116,151	18,658	1,963,379	325,163	195,328	30,111	5,204	862	348,658	57,576	1,449	240	440,248	72,945
Tin (Ore and Ingot) ... Statute tons	67	6,485	1,595	163,451	1,050	98,471	80	11,961	790	130,257	...	...	...	...
Zinc (Spelter and Conc.) do.	...	...	79,694	283,455	...	...	...	...	...	...	...	...	...	...
Other do.	...	112	...	2,047,893	...	26,623	...	2,577	...	2,635	...	136,055	...	369,170
Total Value ...	...	2,880,169	...	14,018,648	...	1,456,436	...	1,108,634	...	817,139	...	944,052	...	2,727,205

PART I.—GOLD.

TABLE I.

MONTHLY PRODUCTION OF GOLD, IN FINE OUNCES, SHOWING THE QUANTITY REPORTED TO THE MINES DEPARTMENT DURING 1921.

GOLDFIELD.	DISTRICT.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.	
		District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.
Kimberley	34.86
Pilbara ...	Marble Bar ...	97.64	97.64	193.10	204.40	10.36	20.72	...	10.29
Do.	Nullagine		11.30			10.36	
West Pilbara	6.27	...	3.18	28.42	...	2.54
Ashburton
Gascoyne
Peak Hill	335.63	...	10.90	179.72	...	117.37
East Murchison ...	Lawlers ...	258.83	1,406.46	6.80	1,256.12	151.93	1,326.50	195.93	1,529.40	128.32	1,596.80	80.78	1,266.52	77.12	1,425.36
Do.	Wiluna ...	330.26		367.95		355.23		285.79		279.15		170.36		411.23	
Do.	Black Range ...	817.37	881.37	819.34	1,047.68	1,189.33	1,015.38	937.01							
Murchison ...	Cue ...	475.73	609.43	375.03	835.44	883.33	324.29	428.98							
Do.	Meekatharra ...	2,444.39	2,016.97	1,796.46	2,156.81	2,188.68	2,467.71	3,748.16							
Do.	Day Dawn ...	7.65	18.31	84.80	91.47	17.22	216.78	49.80							
Do.	Mt. Magnet ...	46.65	57.23	75.74	789.17	...	55.73	73.89							
Yalgoo ...	...	...	...	...	329.23	652.43	...	...					
Mt. Margaret ...	Mt. Morgans ...	55.74	1,041.00	...	704.63	857.42	364.47	753.14							
Do.	Mt. Malcolm ...	3,112.67	...	228.85	1,351.59	1,343.69	256.53	688.84							
Do.	Mt. Margaret ...	1,970.95	48.61	418.11	290.48	67.84	729.69	57.46							
North Coolgardie ...	Menzies ...	675.31	699.11	782.61	911.33	989.10	1,113.80	1,482.72							
Do.	Ularring ...	101.30	...	24.66	...	8.21	...	...					
Do.	Niagara ...	17.36	25.80	4.49	815.76	911.33	8.45	1,367.83							
Do.	Yerilla ...	...	...	4.00	...	...	117.02	254.03			
Broad Arrow ...	...	...	14.70	827.67	177.12	146.15	...	88.95					
N.E. Coolgardie ...	Kanowna ...	665.45	224.21	136.86	271.15	270.37	270.37	152.03							
Do.	Kurnalpi ...	268.88	162.09	...	...	...	...	...		
East Coolgardie ...	East Coolgardie ...	9,674.21	37,415.02	35,771.74	33,371.77	19,949.59	37,223.13	35,379.64							
Do.	Bulong ...	3.58	...	...	6.52	4.47	23.40	6.11					
Coolgardie ...	Coolgardie ...	259.62	196.73	472.63	457.98	251.65	451.56	317.31							
Do.	Kunanalling ...	...	106.71	1,838.55	176.43	54.86	160.12	46.25						
Yilgarn ...	...	2,478.17	1,866.18	...	1,929.76	2,036.55	...	1,885.23						
Dundas ...	...	503.51	161.49	...	502.12	659.52	...	108.95						
Phillips River ...	...	...	...	...	126.03	...	...	263.23	
State generally ...	...	...	...	...	...	...	...	...
TOTAL	Fine Ounces ...	24,311.93	46,937.08	47,436.68	45,449.89	28,758.71	48,858.24	48,379.39							
	Sterling Value	£103,270	£199,376	£201,711	£193,059	£122,159	£207,537	£205,502							

TABLE I.—Monthly Production of Gold in Fine Ounces—continued.

GOLDFIELD.	DISTRICT.	AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.		Total for 1921.	
		District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.
Kimberley	...	...	...	...	14.49	...	...	...	...	...	...	...	49.35
Pilbara	Marble Bar	180.04	...	105.31	...	145.20	...	493.45	...	1,331.85	...	2,556.95	...
Do.	Nullagine	...	180.04	19.17	...	...	145.20	15.00	...	3.50	1,335.35	69.62	2,626.57
West Pilbara	...	...	...	...	1.60	...	1.71	...	16.32	...	7.06	...	67.10
Ashburton	...	...	...	...	12.89	...	...	...	9.42	...	...	...	22.31
Gascoyne	...	...	...	...	7.46	...	...	...	...	...	...	...	7.46
Peak Hill	...	...	3.15	...	66.40	...	136.11	...	226.99	...	2.26	...	1,078.53
East Murchison	Lawlers	487.37	...	648.07	...	417.95	...	109.36	...	446.35	...	3,008.81	...
Do.	Wiluna	422.85	1,784.68	607.43	2,220.96	390.19	1,674.01	202.13	1,607.91	269.73	1,667.54	4,092.30	18,762.26
Do.	Black Range	874.46	...	965.46	...	865.87	...	1,296.42	...	951.46	...	11,661.15	...
Murchison	Cue	367.32	...	501.98	...	737.79	...	950.40	...	697.11	...	7,186.83	...
Do.	Meekatharra	2,707.42	4,298.59	2,884.33	3,789.78	2,372.23	3,440.44	2,677.74	3,720.05	2,585.87	3,671.77	30,046.77	41,256.53
Do.	Day Dawn	12.32	...	59.07	...	40.72	...	54.83	...	73.83	...	726.80	...
Do.	Mt. Magnet	1,211.53	...	344.40	...	289.70	...	37.08	...	314.96	...	3,296.13	...
Yalgoo	...	...	110.97	...	55.28	...	685.63	...	466.69	...	512.70	...	3,579.20
Mt. Margaret	Mt. Morgans	551.84	...	1,050.93	...	733.02	...	710.14	...	293.48	...	7,612.89	...
Do.	Mt. Malcolm	140.15	746.72	219.27	1,378.23	983.87	2,089.66	1,312.52	2,354.12	1,096.17	1,765.65	8,364.49	20,803.51
Do.	Mt. Margaret	54.73	...	108.03	...	372.77	...	331.46	...	376.00	...	4,826.13	...
North Coolgardie	Menzies	444.46	...	354.91	...	94.83	...	269.06	...	217.01	...	8,034.25	...
Do.	Ularring	...	615.18	158.51	530.73	165.89	260.72	679.99	1,068.45	466.50	875.83	1,605.06	10,640.08
Do.	Niagara	170.72	...	10.10	...	...	...	...	...	38.38	...	345.17	...
Do.	Yerilla	...	...	7.21	...	...	...	119.40	...	153.94	...	655.60	...
Broad Arrow	...	...	893.80	...	939.93	...	977.36	...	60.98	...	2,419.07	...	8,875.01
N.E. Coolgardie	Kanowna	532.74	...	60.71	...	650.05	...	...	...	116.51	...	3,378.29	...
Do.	Kurnalpi	144.61	677.35	184.09	244.80	...	650.05	...	...	...	116.51	769.69	4,147.98
East Coolgardie	East Coolgardie	39,173.41	39,173.41	35,894.88	35,894.88	35,383.74	35,386.64	35,915.34	35,915.34	23,192.15	23,230.47	378,344.62	378,429.92
Do.	Bulong	...	...	...	...	2.90	...	...	...	38.32	...	85.30	...
Coolgardie	Coolgardie	591.55	1,762.09	97.30	201.34	469.44	507.23	517.07	1,587.50	546.70	699.18	4,629.54	9,547.74
Do.	Kunanalling	1,170.54	...	104.04	...	37.79	...	1,070.43	...	152.48	...	4,918.20	...
Yilgarn	...	...	1,457.69	...	1,183.77	...	1,409.67	...	1,240.70	...	907.67	...	19,241.50
Dundas	...	...	638.32	...	1,237.37	...	161.13	...	207.26	...	953.81	...	5,455.77
Phillips River	...	...	45.69	...	127.11	...	4.56	...	159.59	...	19.71	...	865.75
State generally	...	...	...	...	...	...	...	...	...	...	99.85	...	99.85
TOTAL	Fine ounces	...	52,387.68	...	48,031.50	...	47,536.12	...	49,140.77	...	38,284.43	...	525,556.42
	Sterling value	£222,529		£204,025		£201,895		£208,737		£162,622		£2,232,422	

The total gold yield of the State is as shown at page 5, being the amount of gold exported and also that lodged at the Royal Mint, which total includes alluvial and other gold not reported to the Department.

TABLE II.

TOTAL YEARLY PRODUCTION OF GOLD, IN FINE OUNCES, AS REPORTED TO THE MINES DEPARTMENT, TO 31ST DECEMBER, 1921.

GOLDFIELD.	DISTRICT.	1921.		1920.		1919.		1918.		1917.		1916.	
		District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.
		ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.
Kimberley	49·35	150·73	...	15·08	...	82·25	...	161·91
Pilbara ...	Marble Bar ...	2,556·95	2,626·57	3,164·15	4,052·49	2,960·51	3,421·39	2,991·73	3,748·40	2,463·66	5,406·75	3,515·58	5,881·60
Do. ...	Nullagine ...	69·62		888·34		460,88		756·67		2,943·09		2,366·02	
West Pilbara	67·10	...	133·91	...	95·26	...	120·37	...	304·77	608·84	
Ashburton	22·31	6·50	...	
Gascoyne	7·46	14·48	
Peak Hill	1,078·53	...	1,655·71	...	2,255·38	...	1,089·31	...	1,743·72	2,389·29	
East Murchison ...	Lawlers ...	3,008·81	18,762·26	2,693·15	19,600·25	4,951·82	27,413·89	4,115·55	29,210·72	4,784·50	32,856·56	6,579·41	46,811·44
Do. ...	Wiluna ...	4,092·30		5,478·99		7,035·72		7,909·60		9,523·65		14,472·13	
Do. ...	Black Range ...	11,661·15	11,428·11	15,426·35	17,185·57	18,548·41	25,759·90						
Murchison ...	Cue ...	7,186·87	9,642·63	9,020·49	10,183·75	9,689·81	6,011·29						
Do. ...	Meekatharra ...	30,046·77	28,163·45	35,436·80	44,119·86	44,269·00	51,322·56						
Do. ...	Day Dawn ...	726·80	4,671·54	2,383·58	4,176·83	23,746·93	18,134·71						
Do. ...	Mt. Magnet ...	3,296·13	4,126·45	3,728·98	4,804·99	4,600·09	8,954·33						
Yalgoo	3,579·20	...	2,965·43	...	4,788·38	...	4,397·89	...	5,812·74	8,194·69	
Mt. Margaret ...	Mt. Morgans ...	7,612·89	5,560·87	5,302·34	5,294·03	6,314·21	8,439·99						
Do. ...	Mt. Malcolm ...	8,364·49	42,800·83	49,506·74	46,368·64	59,488·04	57,541·13						
Do. ...	Mt. Margaret ...	4,826·13	28,974·14	33,342·85	33,684·30	36,072·29	34,631·22						
North Coolgardie ...	Menzies ...	8,034·25	11,468·50	20,859·22	30,345·06	30,725·13	36,756·35						
Do. ...	Ularring ...	1,605·06	57·53	931·66	4,791·82	1,090·35	2,989·66						
Do. ...	Niagara ...	345·17	223·26	746·51	1,203·81	1,185·17	1,790·01						
Do. ...	Yerilla ...	655·60	274·89	482·02	489·22	1,794·90	3,610·55						
Broad Arrow	8,875·01	...	7,445·23	...	11,728·57	...	4,125·88	...	16,518·64	22,215·92	
N.E. Coolgardie ...	Kanowna ...	3,378·29	1,248·14	5,250·96	3,439·60	5,912·39	6,392·00						
Do. ...	Kurnalpi ...	769·69	490·66	221·12	260·65	20·78	286·02						
East Coolgardie ...	East Coolgardie...	378,344·62	401,417·01	396,995·28	524,729·46	557,874·83	578,183·41						
Do. ...	Bulong ...	85·30	78·90	59·61	93·90	108·54	1,160·93						
Coolgardie ...	Coolgardie ...	4,629·54	3,482·79	4,222·21	5,334·36	6,980·68	8,768·13						
Do. ...	Kunanalling ...	4,918·20	2,503·64	1,592·09	2,628·39	3,305·00	4,850·19						
Yilgarn	19,241·50	...	37,636·51	...	54,002·74	...	70,765·88	...	78,244·77	87,993·68	
Dundas	5,455·77	...	6,541·18	...	12,529·61	...	15,949·44	...	18,419·01	21,594·78	
Phillips River	865·75	...	1,422·76	...	1,700·12	...	4,478·49	...	4,734·52	5,418·97	
*Donnybrook	
State generally	99·85	...	20·67	...	46·41	...	195·43	...	111·41	...	618·78
TOTAL	Fine Ounces	525,556·42	...	626,659·37	...	688,214·94	...	856,045·56	...	957,419·78	...	1,031,726·86
	Sterling Value	£2,232,422	£2,661,880	£2,923,351	£3,636,250	£4,066,861	£4,382,497						

* Abolished 4th March, 1908.

TABLE II.—Total Yearly Production of Gold, in Fine Ounces, etc.—continued.

GOLDFIELD.	DISTRICT.	1915.		1914.		1913.		1912.		Previous to 1912.		Total to December 31st, 1921.	
		District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.	District.	Goldfield.
Kimberley	144·34	...	453·29	271·63	...	16,741·12	...	18,069·70
Pilbara ...	Marble Bar ...	6,462·36	8,541·97	3,304·94	5,177·46	3,845·81	5,598·21	3,441·44	5,999·11	96,742·07	160,915·10	131,449·20	211,369·05
Do. ...	Nullagine ...	2,079·61		1,872·52		1,752·40		2,557·67		64,173·03		79,919·85	
West Pilbara	1,507·02	...	1,022·70	...	1,421·15	...	1,118·20	...	21,483·78	...	27,833·10
Ashburton	11·70	...	38·73	...	8,826·31	...	8,905·55
Gascoyne	80·85	...	3·76	...	31·45	...	6·55	...	539·45	...	684·00
Peak Hill	2,813·13	...	2,602·62	...	2,765·59	...	1,861·64	...	236,451·90	...	256,716·82
East Murchison ...	Lawlers ...	6,055·13	58,082·36	4,324·57	70,008·46	4,843·05	87,977·47	7,307·72	99,130·78	864,413·73	1,298,161·61	913,077·44	1,788,815·80
Do. ...	Wiluna ...	6,746·78		6,936·34		7,501·11		7,728·33		22,088·00		99,512·95	
Do. ...	Black Range ...	45,280·45	59,547·55	75,633·31	84,094·73	411,659·88	776,225·41						
Murchison ...	Cue ...	6,185·89	4,491·02	6,525·65	8,993·26	305,739·57	383,670·19						
Do. ...	Meekatharra ...	73,834·57	80,400·07	115,722·42	72,701·81	122,027·56	50,558·20	105,372·78	435,292·66	2,225,081·54	946,145·75	3,044,698·68	
Do. ...	Day Dawn ...	19,168·14	18,926·64	27,126·72	28,283·42	1,162,575·89	28,283·42	1,162,575·89	1,162,575·89	1,309,921·20	1,309,921·20	3,044,698·68	
Do. ...	Mt. Magnet ...	8,861·18	11,904·69	15,673·38	17,537·90	321,473·42	17,537·90	321,473·42	321,473·42	404,961·54	404,961·54	1,788,815·80	
Yalgoo	8,841·88	...	6,025·92	...	8,163·47	...	6,165·92	...	69,184·59	...	128,120·11
Mt. Margaret ...	Mt. Morgans ...	7,463·52	4,880·95	1,255·47	3,438·55	466,884·09	3,438·55	466,884·09	466,884·09	522,446·91	522,446·91	1,788,815·80	
Do. ...	Mt. Malcolm ...	63,995·64	66,071·07	72,738·73	34,288·81	1,654,352·92	34,288·81	1,654,352·92	1,654,352·92	1,654,352·92	1,654,352·92	3,006,933·58	
Do. ...	Mt. Margaret ...	35,103·85	25,840·49	17,278·50	25,242·24	830,133·75	25,242·24	830,133·75	830,133·75	830,133·75	830,133·75	3,006,933·58	
North Coolgardie ...	Menzies ...	49,096·24	53,789·52	44,227·89	36,126·25	996,843·70	36,126·25	996,843·70	36,126·25	675,415·29	996,843·70	1,988,314·63	
Do. ...	Ularring ...	2,474·10	5,026·09	7,710·48	9,526·65	289,617·04	9,526·65	289,617·04	9,526·65	253,413·64	289,617·04	1,988,314·63	
Do. ...	Niagara ...	3,155·13	6,724·42	6,941·08	6,342·67	502,237·97	6,342·67	502,237·97	6,342·67	473,580·74	502,237·97	1,988,314·63	
Do. ...	Yerilla ...	4,787·75	6,648·02	9,647·15	6,274·90	199,615·92	6,274·90	199,615·92	6,274·90	164,950·92	199,615·92	1,988,314·63	
Broad Arrow	22,290·03	...	9,285·98	...	34,739·33	...	13,375·43	...	345,303·76	...	495,903·78
N.E. Coolgardie ...	Kanowna ...	10,077·23	9,560·02	11,133·30	11,364·53	694,634·42	11,364·53	694,634·42	11,364·53	626,877·96	694,634·42	725,126·65	
Do. ...	Kurnalpi ...	783·75	574·08	1,259·58	2,491·18	30,492·23	2,491·18	30,492·23	2,491·18	23,334·72	30,492·23	725,126·65	
East Coolgardie ...	East Coolgardie ...	668,913·16	680,494·61	719,323·42	755,368·56	18,115,758·80	755,368·56	18,115,758·80	755,368·56	12,454,114·44	18,115,758·80	18,277,129·11	
Do. ...	Bulong ...	1,875·08	2,400·80	605·30	1,426·58	161,370·31	1,426·58	161,370·31	1,426·58	153,475·37	161,370·31	18,277,129·11	
Coolgardie ...	Coolgardie ...	11,990·23	17,009·37	28,407·27	37,246·77	980,366·46	37,246·77	980,366·46	37,246·77	852,295·11	980,366·46	1,197,308·06	
Do. ...	Kunanalling ...	6,324·54	3,972·08	3,484·22	4,934·82	216,941·60	4,934·82	216,941·60	4,934·82	178,428·43	216,941·60	1,197,308·06	
Yilgarn	91,123·57	...	88,744·72	...	82,333·96	...	30,675·40	...	377,095·09	...	1,017,857·82
Dundas	23,884·18	...	26,590·76	...	27,039·47	...	25,314·35	...	436,031·11	...	619,349·66
Phillips River	3,816·76	...	4,665·42	...	2,788·47	...	4,201·36	...	53,837·88	...	87,930·50
*Donnybrook	841·76	...	841·76
State generally	272·59	...	144·16	...	178·60	...	240·40	...	5,899·33	...	7,827·68
TOTAL	Fine Ounces	1,195,498·68	...	1,214,239·19	...	1,299,088·82	...	1,267,844·79	...	23,247,491·58	...	32,909,785·99
	Sterling Value ...	£5,078,156		£5,157,760		£5,518,179		£5,385,462		£98,749,067		£139,791,885	

* Abolished 4th March, 1908.

TABLE III.

GENERAL RETURN.

RETURN SHOWING, FOR THE RESPECTIVE GOLDFIELDS AND DISTRICTS, THE AREA IN SQUARE MILES, LEASES IN FORCE, PARTICULARS OF PLANT, MEN EMPLOYED AND DIGGERS, ALLUVIAL, DOLLIED, AND SPECIMEN GOLD AND ORE TREATED, WITH GOLD AND SILVER YIELD, IN FINE OUNCES, AS REPORTED TO THE MINES DEPARTMENT FOR THE YEAR 1921.

Goldfield.	District.	Date of Proclamation of Goldfield.				Area in Square Miles.		Leases in force. 31-12-1921		Particulars of Plant.					Average Number of Men engaged in Gold Mining		
		Proclamation gazetted.	To take effect from.	Latest Amendment of Boundaries gazetted.	To take effect from.	Goldfield.	District.	No.	Area in Acres.	Milling.		Cyaniding.			Men employed.		Diggers.
										Stamps.	Other Mills.	Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	Above Ground.	Under Ground.	
Kimberley		20-5-86	20-5-86	31-10-02	1-11-02	33,833	...	...	...	...	...	...	...	...	...	...	6
West Kimberley		19-3-20	1-3-20	...	...	98,600	...	...	...	...	...	...	...	...	...	...	...
Pilbara	Marble Bar	1-10-88	1-10-88	1-3-07	1-3-07	32,696	25,809	14	126	48	1	9	...	...	19	30	21
	Nullagine	...	...	...	...	...	6,887	3	24	25	2	16	...	...	14	5	26
West Pilbara		20-9-95	1-11-95	1-3-07	1-3-07	10,843	...	1	6	20	1	...	...	...	4	5	10
Ashburton		11-12-90	11-12-90	18-10-01	14-10-01	14,230	...	...	...	...	...	...	...	...	...	...	1
Gascoyne		25-6-97	15-4-97	...	...	5,313	...	...	...	...	...	...	...	...	...	...	1
Peak Hill		19-3-97	1-4-97	13-11-14	1-12-14	23,650	...	14	116	20	3	5	...	...	25	11	3
East Murchison	Lawlers	...	...	...	...	...	6,691	14	213	40	1	25	...	...	49	24	1
	Wiluna	28-6-95	28-6-95	2-2-20	2-2-20	26,058	10,496	16	292	65	7	8	3	3	49	29	...
	Black Range	...	...	...	...	...	8,871	22	408	70	7	21	3	2	100	77	...
	Cue	...	...	...	...	...	8,593	22	248	65	6	35	...	...	81	44	7
Murchison	Meekatharra	24-9-91	24-9-91	28-11-13	1-1-14	25,474	12,250	40	581	77	16	23	3	3	118	232	10
	Day Dawn	...	...	...	...	...	896	8	82	50	9	14	8	...	26	15	3
	Mt. Magnet	...	...	...	...	...	3,735	14	138	20	3	19	...	2	40	38	1
Yalgoo		8-2-95	23-1-95	30-7-15	9-8-15	23,230	...	15	259	58	9	21	5	...	45	39	...
	Mt. Morgans	...	...	...	...	...	14,007	16	259	45	6	16	4	1	72	70	5
Mt. Margaret	Mt. Malcolm	12-3-97	1-4-97	2-2-20	2-2-20	59,918	6,018	32	668	75	17	1	...	1	143	67	...
	Mt. Margaret	...	...	...	...	...	39,893	20	348	40	21	18	7	3	42	33	5
	Menzies	...	...	...	...	...	6,805	16	293	65	13	44	4	2	75	62	...
	Ularring	...	...	...	...	...	3,093	13	161	20	6	5	4	...	33	25	...
North Coolgardie	Niagara	28-6-95	28-6-95	7-9-17	17-9-17	13,746	688	2	36	15	7	9	...	12	13	10	...
	Yerilla	...	...	...	...	...	3,160	9	138	20	2	6	...	...	18	18	...
Broad Arrow		17-11-96	20-11-96	8-6-06	1-7-06	1,038	...	21	314	45	20	20	...	2	58	63	3
North-East Coolgardie	Kanowna	20-3-96	15-4-96	27-3-08	1-4-08	20,604	1,094	19	315	40	3	...	...	...	24	28	2
	Kurnalpi	...	...	...	...	...	19,510	6	40	5	1	...	...	...	4	4	2
	East Coolgardie	...	...	...	...	...	810	233	4,112	495	307	165	170	92	1,159	1,576	10
East Coolgardie	Bulong	21-9-94	1-10-94	27-3-08	1-4-08	1,800	990	...	...	...	...	...	...	...	18	9	4
	Coolgardie	...	...	...	...	...	9,384	57	1,029	78	9	23	8	...	213	224	44
	Kunanalling	6-4-94	6-4-94	1-3-07	1-3-07	11,702	2,318	12	143	30	2	11	...	...	32	37	10
Yilgarn		1-10-88	1-10-88	28-1-16	1-2-16	17,700	...	65	1,080	155	19	55	4	3	260	203	...
Dundas		31-8-93	31-8-93	1-3-07	1-3-07	11,430	...	23	284	17	1	10	...	...	46	53	...
Phillips River		21-9-00	14-9-00	28-1-16	1-2-16	5,078	...	8	118	45	...	...	...	...	13	16	1
State generally		...	...	...	...	...	...	...	...	...	2	...	...	...	3	...	...
Total		...	...	...	...	436,943	...	735	11,831	1,748	501	579	223	126	2,786	3,047	176

TABLE III.—Return showing for the respective Goldfields and Districts, etc.—continued.

Goldfield.	District.	1921 GOLD AND SILVER YIELD—DISTRICTS.						1921 GOLD AND SILVER YIELD—GOLDFIELDS.					
		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	...	...	...	...	...	...	...	49.35	...	...	...	49.35	...
Pilbara	Marble Bar	123.27	58.83	1,782.00	2,374.85	2,556.95	...	192.89	58.83	1,782.00	2,374.85	2,626.57	...
Do.	Nullagine	69.62	...	...	...	69.62	...	...	...	...	...	...	...
West Pilbara	...	...	...	...	...	...	...	29.65	...	57.00	37.45	67.10	...
Ashburton	...	...	...	...	...	...	...	22.31	...	...	...	22.31	...
Gascoyne	...	...	...	...	...	...	...	7.46	...	...	...	7.46	...
Peak Hill	...	...	...	...	...	...	...	4.48	15.31	3,905.00	1,058.74	1,078.53	...
East Murchison	Lawlers	...	...	2,925.50	3,008.81	3,008.81	108.63	...	...	...	...	...	...
Do.	Wiluna	4.98	...	7,747.75	4,087.32	4,092.30	...	19.10	169.64	29,254.90	18,573.52	18,762.26	259.16
Do.	Black Range	14.12	169.64	18,581.65	11,477.39	11,661.15	150.53	...	...	...	...	...	...
Murchison	Cue	21.48	213.72	8,487.50	6,951.63	7,186.83	...	...	...	...	...	...	...
Do.	Meekatharra	25.75	185.29	52,664.32	29,835.73	30,046.77	...	54.88	643.91	64,406.32	40,557.74	41,256.53	...
Do.	Day Dawn	7.65	126.38	1,032.00	592.77	726.80	...	...	...	...	...	...	...
Do.	Mt. Magnet	...	118.52	2,222.50	3,177.61	3,296.13	...	...	...	...	...	...	...
Yalgoo	...	...	...	...	...	...	...	...	9.35	2,353.00	3,569.85	3,579.20	...
Mt. Margaret	Mt. Morgans	7.53	...	19,591.14	7,605.36	7,612.89	...	...	...	...	...	...	...
Do.	Mt. Malcolm	37.78	77.17	9,265.61	8,249.54	8,364.49	688.14	45.31	285.11	32,329.14	20,473.09	20,803.51	1,654.19
Do.	Mt. Margaret	...	207.94	3,472.39	4,618.19	4,826.13	966.05	...	...	...	...	...	...
North Coolgardie	Menzies	13.17	9.38	12,822.39	8,011.70	8,034.25	...	...	...	...	...	...	...
Do.	Ularring	...	...	2,971.33	1,604.35	1,605.06	204.51	22.82	24.20	17,081.80	10,593.06	10,640.08	204.51
Do.	Niagara	8.94	14.82	327.00	321.41	345.17	...	...	...	...	...	...	...
Do.	Yerilla	...	...	961.08	655.60	655.60	...	...	...	...	...	...	...
Broad Arrow	...	...	...	...	...	...	...	32.46	652.33	16,489.32	8,190.22	8,875.01	...
N.E. Coolgardie	Kanowna	39.32	66.86	4,654.45	3,272.11	3,378.29	...	47.08	518.79	5,052.35	3,582.11	4,147.98	...
Do.	Kurnalpi	7.76	451.93	397.90	310.00	769.69	...	...	...	...	...	...	...
East Coolgardie	East Coolgardie	134.33	1,323.25	635,721.69	376,887.04	378,344.62	85,961.73	148.36	1,326.83	635,815.76	376,954.73	378,429.92	85,961.73
Do.	Bulong	14.03	3.58	94.07	67.69	85.30	...	...	...	...	...	...	...
Coolgardie	Coolgardie	62.78	256.08	7,938.34	4,310.68	4,629.54	...	62.78	333.41	11,234.02	9,151.55	9,547.74	...
Do.	Kunanalling	...	77.33	3,295.68	4,840.87	4,918.20	...	...	...	...	...	...	...
Yilgarn	...	...	...	...	...	...	...	...	67.59	33,342.80	19,173.91	19,241.50	972.20
Dundas	...	...	...	...	...	...	...	...	311.32	3,334.00	5,144.45	5,455.77	...
Phillips River	...	...	...	...	...	...	...	...	...	1,072.22	865.75	865.75	...
State generally	...	...	...	...	...	...	...	...	...	...	99.85	99.85	87.77
Total for 1921	...	...	...	...	...	...	...	738.93	4,416.62	857,509.63	520,400.87	525,556.42	89,139.56

TABLE III.—Return showing for the respective Goldfields and Districts, etc.—continued.

Goldfield.	District.	TOTAL GOLD AND SILVER YIELD—DISTRICTS.						TOTAL GOLD AND SILVER YIELD—GOLDFIELDS.					
		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 ...	...	...	...	...	...	...	...	3,942·45	...	17,597·50	14,127·25	18,069·70	...
Pilbara ...	Marble Bar ...	12,026·36	3,375·46	76,649·93	116,047·38	131,449·20	574·01	} 18,585·81	} 3,781·70	} 117,227·17	} 189,001·54	} 211,369·05	} 574·01
Do. ...	Nullagine ...	6,559·45	406·24	40,577·24	72,954·16	79,919·85	...						
West Pilbara ...	...	...	...	...	...	...	...	5,650·16	275·00	19,219·71	21,957·94	27,883·10	1,331·07
Ashburton ...	...	...	...	...	...	...	...	8,589·91	315·64	...	...	8,905·55	7,787·69
Gascoyne ...	...	...	...	...	...	...	...	327·66	18·51	356·70	337·83	684·00	...
Peak Hill ...	...	...	...	...	...	...	...	1,971·31	4,063·46	504,260·76	250,682·05	256,716·82	2,287·63
East Murchison ...	Lawlers ...	5,614·49	7,234·60	2,024,676·36	900,228·35	913,077·44	25,954·74	} 7,187·84	} 22,907·95	} 3,406,458·72	} 1,758,720·01	} 1,788,815·80	} 42,681·92
Do. ...	Wiluna ...	95·77	197·27	197,227·75	99,219·91	99,512·95	232·00						
Do. ...	Black Range ...	1,477·58	15,476·08	1,184,554·61	759,271·75	776,225·41	16,495·18	} 15,515·82	} 40,361·83	} 4,317,599·94	} 2,988,821·03	} 3,044,698·68	} 175,919·32
Murchison ...	Cue ...	1,116·38	5,458·74	449,311·05	377,095·07	383,670·19	505·80						
Do. ...	Meekatharra ...	10,346·88	11,817·55	1,358,811·99	923,981·32	946,145·75	5,028·90	} 169,210·44	} 40,361·83	} 4,317,599·94	} 2,988,821·03	} 3,044,698·68	} 175,919·32
Do. ...	Day Dawn ...	2,292·97	8,994·90	1,967,355·65	1,298,633·33	1,309,921·20	169,210·44						
Do. ...	Mt. Magnet ...	1,759·59	14,090·64	542,121·25	389,111·31	404,961·54	1,174·18	} 1,451·29	} 1,825·88	} 182,414·39	} 124,842·94	} 128,120·11	} 167·40
Yalgoo ...	...	...	...	...	...	...	...
Mt. Margaret ...	Mt. Morgans ...	1,745·47	3,761·47	951,333·33	516,939·97	522,446·91	5,775·05	} 7,822·58	} 18,995·22	} 5,820,825·41	} 2,980,115·78	} 3,006,933·58	} 139,786·07
Do. ...	Mt. Malcolm ...	2,653·13	7,401·48	3,243,252·49	1,644,298·31	1,654,352·92	77,247·49						
Do. ...	Mt. Margaret...	3,423·98	7,832·27	1,626,239·59	818,877·50	830,133·75	56,763·53	} 3,839·28	} 13,820·93	} 2,592,437·31	} 1,970,654·42	} 1,988,314·63	} 30,182·23
North Coolgardie ...	Menzies ...	1,086·64	3,678·15	1,180,501·24	992,078·91	996,843·70	18,639·21						
Do. ...	Ularring ...	22·17	1,144·32	296,374·51	288,450·55	289,617·04	5,876·56	} 19,277·98	} 13,833·89	} 848,617·91	} 462,791·91	} 495,903·78	} 2,181·96
Do. ...	Niagara ...	1,484·13	1,426·09	898,680·27	499,327·75	502,237·97	5,603·42						
Do. ...	Yerilla ...	1,246·34	7,572·37	216,881·29	190,797·21	199,615·92	63·04	} 116,440·67	} 16,596·11	} 941,488·60	} 592,089·87	} 725,126·65	} 2,533·34
Broad Arrow ...	...	...	...	...	...	...	...
N.E. Coolgardie ...	Kanowna ...	104,441·92	10,853·00	935,961·69	579,339·50	694,634·42	2,522·12	} 54,201·53	} 47,700·44	} 28,669,707·23	} 18,175,227·14	} 18,277,129·11	} 1,807,054·77
Do. ...	Kurnalpi ...	11,998·75	5,743·11	5,526·91	12,750·37	30,492·23	11·22						
East Coolgardie ...	East Coolgardie ...	27,601·61	32,709·43	28,515,573·39	18,055,447·76	18,115,758·80	1,807,041·85	} 9,680·51	} 16,152·23	} 1,801,231·54	} 1,171,475·32	} 1,197,308·06	} 930·46
Do. ...	Bulong ...	26,599·92	14,991·01	154,133·84	119,779·38	161,370·31	12·92						
Coolgardie ...	Coolgardie ...	8,948·72	11,038·40	1,526,178·13	960,379·34	980,366·46	881·79	} 91·65	} 1,469·21	} 2,236,432·34	} 1,016,296·96	} 1,017,857·82	} 32,280·54
Do. ...	Kunanalling ...	731·79	5,113·83	275,053·41	211,095·98	216,941·60	48·67						
Yilgarn ...	...	...	...	...	...	...	...	2,027·12	13,593·25	896,322·95	603,729·29	619,349·66	36,392·90
Dundas ...	...	...	...	...	...	...	...	472·20	781·93	90,869·29	86,676·37	87,930·50	15,688·17
Phillips River ...	...	...	...	...	...	...	...	23·24	...	1,653·30	818·52	841·76	...
Donnybrook †	...	...	...	...	...	...	...	124·89	209·56	27·00	7,493·18	7,827·63	9,916·99
State generally	...	...	...	...	...	...	...	277,223·90	216,702·74	52,464,747·77	32,415,859·35	32,909,785·99	2,307,696·47
Total to 31st December, 1921	...	...	...	...	...	...	...	277,223·90	216,702·74	52,464,747·77	32,415,859·35	32,909,785·99	2,307,696·47

* By-product in the treatment of auriferous ore except Ashburton and State generally. † Abolished 4th March, 1908.

TABLE IV.

PRODUCTION OF GOLD AND SILVER FROM ALL SOURCES, SHOWING IN FINE OUNCES THE OUTPUT AS REPORTED TO THE MINES DEPARTMENT DURING 1921, AND THE TOTAL PRODUCTION TO DATE.

Kimberley Goldfield.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Hall's Creek	Voided leases ...	...	...	...	...	...	...	...	423·00	477·76	...
Do.	Sundry claims ...	...	...	...	...	...	...	...	94·55	62·68	...
Mt. Dockrell...	...	Voided leases ...	...	...	...	...	...	...	...	44·00	435·93	...
Ruby Creek	Voided leases ...	...	...	...	...	...	...	...	12,633·50	9,435·13	...
Do.	Sundry claims ...	...	...	...	...	...	...	...	151·00	127·28	...
The Brockman	Voided leases ...	...	...	...	...	...	...	...	1,352·75	1,404·40	...
Do.	Sundry claims ...	...	...	...	...	...	...	...	2,462·00	1,820·33	...
The Mary	Voided leases ...	...	...	...	...	...	...	...	399·00	210·03	...
The Panton	Voided leases ...	...	...	...	...	...	...	...	34·70	138·70	...
Do.	Sundry claims ...	...	...	...	...	...	...	...	3·00	15·01	...
<i>From Goldfield generally:—</i>												
Reported by Banks and Gold Dealers ...			49·35	3,942·45
Total ...			49·35	3,942·45	...	17,597·50	14,127·25	...

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Pilbara Goldfield.

MARBLE BAR DISTRICT.

Bamboo Creek	(807)	...	Bonney Doon	190·00	80·21	...
Do.	795	...	Bulletin	...	...	7·50	19·30	...	...	65·25	154·52	...
Do.	816	...	Friendly Stranger	...	54·05	...	...	...	54·05	...	...	...
Do.	707	...	Kitchener	...	...	308·25	572·45	...	...	2,790·75	6,033·77	...
Do.	806	...	Lloyd George	...	...	...	...	...	...	22·00	8·98	...
Do.	740	...	(Mount Prophecy)	...	...	...	...	...	1·11	1,040·50	1,898·07	...
Do.	740, 794	...	Mount Prophecy leases	...	...	255·75	358·64	...	...	1,094·00	1,813·81	...
Do.	794	...	(Perseverance)	...	...	...	...	...	...	290·50	584·21	...
Do.	(789)	...	Princess May and Charlie	...	...	...	...	...	...	131·75	317·55	...
Do.	...	...	Voided leases	...	...	...	...	...	454·61	14,824·50	22,818·89	...
Do.	...	...	Sundry claims	...	...	81·00	185·28	...	307·83	976·35	1,318·52	...

Boodalyerrie	...	Voided leases ...	...	...	...	...	...	292·07	120·25	587·86	...
Do.	...	Sundry claims	...	...	...	...	...	7·16	...	...	...
Breen's Find	...	Voided leases	...	...	...	...	...	...	14·00	66·82	...
Elsie ...	...	Voided leases ...	...	...	...	...	...	...	178·00	352·06	...
Do.	...	Sundry claims	...	...	...	38·20	...	...	10·25	58·01	...
Lalla Rookh...	786, R.C. 112 ...	Haig ...	...	4·78	670·00	440·97	...	4·78	1,819·00	1,323·06	...
Do.	...	Voided leases ...	...	...	...	...	...	...	224·50	2,186·65	574·01
Do.	...	Sundry claims	...	...	23·00	10·68	...	...	6,992·00	6,881·04	...
Marble Bar ...	(803) ...	Australian Heroes	...	...	...	...	...	...	102·00	100·10	...
Do.	805 ...	Homeward Bound East	...	...	67·50	93·92	...	...	200·00	228·21	...
Do.	815 ...	Ironclad ...	...	...	60·00	46·58	...	...	60·00	46·58	...
Do.	694 ...	Jo Jo ...	...	...	59·00	97·17	...	33·97	2,368·00	2,550·96	...
Do.	790 ...	Rufus Henry ...	...	...	68·00	54·21	...	...	625·75	1,015·70	...
Do.	(804) ...	Verdun ...	...	...	32·50	43·43	...	...	75·50	102·55	...
Do.	811 ...	Victory ...	...	...	60·00	48·10	...	...	60·00	48·10	...
Do.	722 ...	Viking ...	...	...	51·00	68·69	...	...	1,488·25	1,606·50	...
Do.	...	Voided leases ...	...	...	...	...	...	147·90	15,932·45	21,078·48	...
Do.	...	Sundry claims	...	...	38·50	30·49	...	38·68	149·23	4,689·89	5,148·80
North Pole ...	...	Voided leases ...	...	...	...	...	...	...	474·00	340·75	...
Do.	...	Sundry claims	...	...	...	...	...	...	50·50	69·56	...
North Shaw	...	Voided leases ...	...	...	...	...	7·53	...	351·45	674·72	...
Do.	...	Sundry claims	...	...	...	...	...	567·06	...	...	...
Sharks	...	Sundry claims	...	...	...	...	145·08	19·37	24·50	93·14	...
Shaw River	...	Voided leases ...	...	...	...	...	...	...	101·00	49·63	...
Talga Talga ...	...	Voided leases ...	...	...	...	...	...	83·83	574·50	975·98	...
Do.	...	Sundry claims	...	...	...	...	50·26	68·99	204·65	520·25	...
Tambourah ...	...	Voided leases ...	...	...	...	...	...	...	1,438·50	1,739·44	...
Do.	...	Sundry claims	...	...	...	...	...	79·29	639·25	797·44	...
Warrawoona	...	Voided leases ...	...	...	...	...	...	16·99	10,072·80	18,136·84	...
Do.	...	Sundry claims	...	...	...	...	44·30	362·50	1,127·04	2,163·74	...
Western Shaw	...	Voided leases ...	...	...	...	...	...	...	1,222·50	957·80	...
Do.	...	Sundry claims	...	...	...	...	12·52	67·47	...	...	...
Wyman's Well	744 ...	Euro ...	...	...	...	...	...	...	438·00	443·68	...
Do.	...	Voided leases ...	...	...	...	...	...	33·55	115·04	493·98	...
Do.	...	Sundry claims	...	...	...	...	·93	18·09	355·86	592·18	...
Yandicoogina	...	Voided leases ...	...	...	...	...	...	140·76	2,733·20	5,824·23	...
Do.	...	Sundry claims	...	...	...	...	...	238·35	103·75	120·34	...
<i>From District generally :-</i>												
Sundry Parcels treated at :												
State Battery, Bamboo Creek ...												
State Battery, Marble Bar ...												
Various Works ...												
Reported by Banks and Gold Dealers ...												
Total ...			123·27	58·83	1,782·00	2,374·85	...	12,026·36	3,375·46	76,649·98	116,047·38	574·01

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

PILBARA GOLDFIELD—continued.

NULLAGINE DISTRICT.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Eastern Creek	(180L)	Crescent ... ..	...	...	...	...	...	...	1,067·75	2,117·52	...
Do.	176L	(Doherty Reward) ... ..	...	...	...	...	...	...	142·25	171·43	...
Do.	176L	Doherty Reward ... ..	...	...	...	...	...	...	1,450·00	2,755·53	...
Do.	176L (177L)	(Doherty Reward leases) ... ..	...	...	...	...	...	...	219·00	1,007·68	...
Do.	...	Voided leases ... ..	...	...	...	...	...	8·19	1,458·00	2,558·11	...
Do.	...	Sundry claims ... ..	...	...	...	...	...	3·77	301·50	523·27	...
Elsie ...	...	Voided leases ... ..	...	...	...	...	...	...	408·25	1,323·85	...
Do.	...	Sundry claims ... ..	...	...	...	...	...	...	24·00	27·48	...
McPhee's Creek	...	Voided leases ... ..	...	...	...	...	...	...	113·00	137·92	...
Middle Creek	...	Voided leases ... ..	...	...	...	...	...	...	6,211·90	8,433·68	...
Do.	...	Sundry claims ... ..	...	...	...	...	...	...	286·00	408·82	...
Mosquito Creek	...	Voided leases ... ..	...	...	...	...	1·07	21·42	7,259·80	12,464·00	...
Do.	...	Sundry claims ... ..	...	...	...	...	...	166·47	2,188·94	3,116·77	...
Nullagine ...	...	Voided leases ... ..	...	...	...	...	...	13·96	7,453·25	11,335·12	...
Do.	...	Sundry claims ... ..	...	...	...	...	104·70	133·14	3,984·75	9,336·03	...
Twenty - mile Sandy	...	Voided leases ... ..	...	...	...	...	...	3·20	5,093·70	7,786·99	...
Do.	...	Sundry claims ... ..	...	...	...	...	33·10	20·55	2,802·65	3,855·08	...
<i>From District generally:—</i>												
Sundry Parcels treated at:												
Doherty's Works ... ..			...	...	...	...	...	...	...	1,177·32	...
Fremantle Trading Co.'s Works ... ..			...	...	...	...	...	...	...	8·29	...
State Battery, Twenty-mile Sandy ... ..			...	...	...	...	...	...	62·00	1,767·60	...
Various Works ... ..			...	...	...	...	...	...	50·50	2,641·67	...
Reported by Banks and Gold Dealers			69·62	...	...	...	...	6,420·58	35·54	...	...
Total			69·62	...	...	...	...	6,559·45	406·24	40,577·24	72,954·16

West Pilbara Goldfield.

Croydon ...	...	Voided leases ... ..	...	...	...	...	...	...	8·00	5·44	...
Hong Kong ...	...	Voided leases ... ..	...	...	...	...	...	...	331·00	442·45	...
Do. ...	...	Sundry claims ... ..	...	...	...	...	...	21·40	·02	9·00	3·15

Lower Nicol ...	...	Voided leases ...	...	...	...	...	...	...	1·10	653·20	402·22	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	10·44	2·71	10·00	11·51	...
Mallina ...	...	Voided leases ...	...	...	...	...	...	...	...	141·60	128·44	...
Nicol ...	...	Voided leases ...	...	...	...	...	...	...	...	30·00	11·47	...
Pilbara ... (168)	...	Black Prince ...	...	...	45·00	24·59	...	...	...	115·00	114·43	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	48·12	152·00	299·16	...
Do. ...	...	Sundry claims ...	...	...	12·00	12·86	...	1·11	86·24	80·00	113·92	...
Roebourne ...	M.L. 174	Good Fortune ...	...	...	...	...	...	...	...	...	3·96	112·83
Do. ...	M.L. 183	Carlow Castle : Roebourne Copper Mines, Ltd.	...	...	...	...	...	...	...	...	6·12	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	113·36	573·91	237·91
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	108·60	93·85	96·53
Station Peak ...	165	Belladonna ...	...	...	...	...	...	...	17·93	943·00	262·93	...
Do. ...	...	Voided leases ...	...	...	...	...	...	177·74	23·44	9,993·00	11,084·49	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	37·50	48·19	...
Towranna ...	...	Voided leases ...	...	...	...	...	...	...	2·62	3,965·80	5,187·51	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	22·00	12·35	...
Upper Nicol ...	...	Sundry claims ...	...	...	...	...	...	...	...	6·50	2·57	...
Weerianna ...	...	Voided leases ...	...	...	...	...	...	...	...	2,436·15	3,079·81	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	64·00	62·90	...
Whim Creek ...	...	Voided leases ...	...	...	...	...	...	...	...	...	...	883·80
<i>From Goldfield generally:—</i>			...	...	...	...	...	...	...	...	...	...
Reported by Banks and Gold Dealers			...	29·65	...	...	...	5,439·47	92·82	...	7·16	...
Total			...	29·65	...	57·00	37·45	...	5,650·16	275·00	19,219·71	21,957·94	1,331·07

Ashburton Goldfield.

Mt. Mortimer ...	...	Sundry claims ...	...	...	...	...	...	354·37	315·64	...	...	74·47
Uaroo ...	M.L. 43, M.L. (49)	Uaroo Silver-Lead Mines, Ltd.	...	...	...	...	...	...	...	...	...	7,551·20
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	...	...	162·02
<i>From Goldfield generally:—</i>			...	...	...	...	...	...	...	...	...	...
Reported by Banks and Gold Dealers			...	22·31	...	...	...	8,235·54	...	...	...	...
Total			...	22·31	...	...	...	8,589·91	315·64	...	...	7,787·69

Gascoyne Goldfield.

Bangemall ...	...	Voided leases ...	...	...	...	...	...	...	6·22	350·70	313·82	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	12·29	6·00	24·01	...
<i>From Goldfield generally:—</i>			...	...	...	...	...	...	...	...	...	...
Reported by Banks and Gold Dealers			...	7·46	...	...	...	327·66	...	...	...	...
Total			...	7·46	...	...	...	327·66	18·51	356·70	337·83	...

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

Peak Hill Goldfield.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	
Egerton ...	352P ...	Hibernian ...	...	...	311.00	63.75	...	...	...	4,410.00	1,659.78	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	.91	315.25	360.00	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	23.51	1,093.75	506.79	...
Horseshoe ...	...	Voided leases ...	...	...	...	...	...	...	1,962.66	728.38	1,973.46	2.00
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	639.53	16.05	45.14	...
Mt. Fraser ...	...	Voided leases ...	...	...	...	...	...	...	...	389.50	320.96	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	80.00	55.41	...
Peak Hill ...	459P ...	Atlantic ...	...	...	59.50	35.78	...	...	...	184.50	525.61	...
Do. ...	474P ...	Atlantic North ...	...	...	11.00	8.39	...	...	...	11.00	8.39	...
Do. ...	462P ...	Enterprise ...	...	...	48.00	45.01	...	...	...	160.00	433.49	...
Do. ...	448P ...	Evening Star ...	...	...	220.00	118.54	...	...	...	1,203.00	2,719.41	...
Do. ...	472P ...	Independent ...	...	...	18.50	34.98	...	...	...	18.50	34.98	...
Do. ...	5P, 306P ...	No. 1 North leases ...	...	...	209.00	161.61	...	...	...	61.10	2,589.50	2,194.73
Do. ...	(1P), (2P), (4P), 5P, (6P), (8P), (9P), (13P), (15P), (16P), (26P), (27P), (28P), (29P), (35P), (36P), (43P), (53P), (54P), (63P), (146P), (152P), (190P), (213P), (222P), (239P), (248P), (252P), (262P), (274P), 306P, (313P)	(Peak Hill Goldfields, Ltd.)	191.46	462,057.01	223,273.59	2,285.59
Do. ...	468P ...	Simpson ...	...	...	2,756.00	267.40	...	...	...	2,946.00	286.68	...
Do. ...	398P ...	Temperance ...	...	...	...	...	...	...	6.65	797.00	509.20	...
Do. ...	465P ...	Wowser ...	...	...	...	...	...	...	...	37.50	97.54	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	521.54	5,459.62	4,843.91
Do. ...	...	Sundry claims ...	...	15.31	272.00	117.62	...	23.54	182.70	16,770.25	4,606.68	...
Ravelstone ...	...	Voided leases ...	...	...	...	...	...	...	101.64	4,219.85	3,117.68	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	553.60	283.17	...
Wilgeena ...	...	Voided leases ...	...	...	...	...	...	...	23.54	128.50	146.79	...
Wilthorpe ...	...	Voided leases ...	...	...	...	...	...	...	...	47.00	20.93	...

From Goldfield generally:—

Sundry parcels treated at—

Purcell's Works
 State Battery—Egerton
 State Battery—Ravelstone
 Various Works
 Reported by Banks and Gold Dealers

Total

...	...	...	3.15	...	...	...	...	524.56	...
...	...	...	...	...	...	...	...	294.87	...
...	...	...	202.51	...	...	3.05	15.00	1,518.33	...
...	...	...	...	...	...	...	30.00	319.97	...
4.48	...	...	...	...	1,947.77	345.17	...	...	...
4.48	15.31	3,905.00	1,058.74	...	1,971.31	4,063.46	504,260.76	250,682.05	2,287.63

East Murchison Goldfield.

LAWLERS DISTRICT.

NOTE.—On the 1st March, 1910, the Lawlers District was subdivided into Wiluna and Lawlers. The gold produced after that date by the mines at Wiluna will be found in the Wiluna District, and the lease numbers of both districts are shown in each case.

Bronzewing ...	...	Voided leases ...	...	...	...	...	...	468.00	318.03	1.94
Cork Tree ...	...	Voided leases ...	...	...	...	...	29.90	3,767.00	3,292.87	...
Do. ...	...	Sundry claims ...	...	...	...	...	25.50	13.00	9.32	...
Kathleen Valley ...	382	(Yellow Aster) ...	...	...	...	...	...	37,605.00	27,051.42	...
Do. ...	382	(Yellow Aster) ...	...	...	...	...	...	1,714.00	949.04	...
Do. ...	382, 1197	Yellow Aster leases ...	...	390.00	197.39	...	...	2,596.00	1,450.86	...
Do. ...	382	(Yellow Aster: Yellow Aster G.M. Co., N.L.)	...	...	...	...	...	10,395.75	5,425.26	...
Do. ...	...	Voided leases ...	...	...	...	...	141.57	23,291.50	11,350.24	...
Do. ...	...	Sundry claims ...	...	60.00	19.49	...	478.40	1,489.75	875.31	...
Lake Darlot ...	1207, [1515c]	New Discovery ...	...	...	...	...	...	220.00	84.11	...
Do. ...	273, [1514c]	St. George ...	...	...	...	...	3,251.30	899.00	7,974.00	...
Do. ...	...	Voided leases ...	...	...	...	...	1,197.12	64,266.30	40,682.33	...
Do. ...	...	Sundry claims ...	...	...	...	1.16	474.45	3,972.64	3,387.61	2.60
Lawlers ...	1211	Donegal ...	...	324.00	316.55	...	...	795.00	467.58	...
Do. ...	(22), (37), 58, 62, (70), (155), (156), (157), (158), (376), (377), (381), (385), (399), (426), (427), (459), (474), (500), (508), (509), (510), (511), (512), (552), (562), (563), (573), (811), (840)	(East Murchison United, Ltd.)	...	...	...	...	...	291,797.00	155,594.26	900.48
Do. ...	1171	(Great Eastern) ...	...	...	...	...	...	927.00	337.72	...
Do. ...	1171	Great Eastern ...	...	40.00	7.30	...	...	40.00	7.30	...
Do. ...	1171, (1186)	(Great Eastern leases) ...	...	...	...	...	...	1,601.74	1,352.43	...
Do. ...	1220	Lawlers View ...	...	130.00	28.03	...	...	130.00	28.03	...
Do. ...	(37), 58, 62, (70), (155), (156), (157), (158), (376), (377), (381), (385), (399), (426), (427), (459), (474), (500), (508), (509), (510), (511), (512), (552), (562), (563), (573), (811), (840)	London and Western Australian Exploration Co., Ltd.	...	...	...	...	...	179,563.00	40,438.14	2,560.31

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

EAST MURCHISON GOLDFIELD—continued.

LAWLERS DISTRICT—continued.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Lawlers	(1163)	(May Bee)	...	...	...	...	...	...	4,157·00	1,270·06	...
Do.	(1163)	May Bee	...	...	...	...	...	...	1,014·00	238·21	...
Do.	(1163), (1189)	(May Bee leases)	...	...	...	...	...	...	935·00	303·93	...
Do.	(22), (37), 58, 62, (70), (155), (156), (157), (158), (376), (377), (385), (459), (508), (509), (562), (563), (811), (840), 918, (1053), (1106), (1109), (1110), (1123), (1160)	(Northern Mines, Ltd.)	...	...	...	...	...	...	398,856·50	102,005·52	8,356·89
Do.	1212	(Queen)	...	...	76·00	46·61	...	...	168·00	124·30	...
Do.	1212	Queen: Daisy Queen G.M. Co., N.L.	...	...	1,076·00	500·87	...	...	1,076·00	500·87	...
Do.	910, (923)	Sunrise leases	...	...	...	...	...	...	8,644·00	4,076·63	...
Do.	(1188)	Try It	...	...	120·00	35·14	...	...	1,376·00	363·23	...
Do.	58, 62, 918	Waroonga G.M. Co., Ltd.	...	...	435·00	859·72	...	...	46,884·00	9,797·08	...
Do.	62, (562), (563)	(Waroonga South Leases)	...	...	...	...	...	...	42,150·00	14,329·48	...
Do.	58	(Waroonga: London and Western Australian Exploration Co., Ltd.)	...	...	...	...	...	...	2,438·50	2,755·45	...
Do.	...	Voided leases	...	...	...	...	...	687·39	287,557·48	150,712·03	2,533·25
Do.	...	Sundry claims	...	...	110·00	120·94	...	14·81	247·83	10,952·48	6,699·40
New England	...	Voided leases	...	...	...	...	...	57·54	899·00	720·25	...
Do.	...	Sundry claims	...	...	...	...	...	4·32	554·50	465·23	...
Sir Samuel	1190	Bellevue South	...	...	...	...	...	...	254·00	139·13	...
Do.	1214	Bluey's Release	...	...	154·00	81·68	...	...	352·50	192·06	...
Do.	...	Voided leases	...	...	...	...	...	13·49	265,433·00	138,468·17	10,225·58
Do.	...	Sundry claims	...	...	10·50	4·57	...	21·37	3,820·00	2,778·92	...
Wiluna	(140), ([2j]), 162, [4j], (163), ([5j])	(Golden Age Consolidated, Ltd.)	...	...	...	...	...	...	42,521·00	19,750·45	...
Do.	542, [6j], 548, [7j], 550, [8j], (906), ([11j]), (930), ([13j]), (931), ([14j]), (932), ([15j]), (937), ([17j]), (938), ([18j]), (943), ([21j]), (944), ([22j]), (952), ([26j])	(Gwalia Consolidated, Ltd.)	...	...	...	...	...	...	210,230·32	74,536·14	69·03

Do.	...	162, [4j], (163), (5j)	(Lake Way leases)	...	...	...	...	...	...	630.00	369.60	...
Do.	...	162, [4j]	(Lake Way: Western Australian Goldfields, Ltd.)	...	...	...	...	...	...	2,786.00	1,238.44	...
Do.	...	870, [10j]	(Moonlight)	...	...	...	...	...	...	1,856.00	787.66	...
Do.	...	917, [12j]	(Squib)	...	...	...	...	...	...	276.50	67.00	...
Do.	...	...	Voided leases	...	...	...	...	...	537.27	58,149.75	41,452.53	124.00
Do.	...	...	Sundry claims	...	...	...	...	5.30	...	2,841.15	1,516.76	...
<i>From District generally —</i>													
Sundry Parcels treated at:—													
			Great Eastern Battery	...	...	...	414.02	108.63	...	...	2,882.09	108.63
			Lawlers Public Battery (Retreatment Works)	...	...	...	319.53	...	...	...	319.53	...
			Queen Works	...	...	...	56.97	...	...	...	1,275.11	39.36
			State Battery—Lake Darlot	...	...	...	...	...	...	315.00	1,097.09	...
			State Battery—Sir Samuel	...	...	...	...	...	...	23.50	1,290.13	...
			State Battery—Wiluna	...	...	...	...	...	...	390.00	2,047.17	20.00
			Western Machinery Co., Ltd.	...	...	...	...	...	...	...	13.84	...
			Various Works	...	...	...	...	...	...	1,619.50	14,563.26	744.33
			Reported by Banks and Gold Dealers	...	...	...	...	5,593.22	67.15	...	5.74	...
			Total	2,925.50	3,008.81	108.63	5,614.49	7,234.60	2,024,676.36	900,228.35	25,954.74

WILUNA DISTRICT.

Note.—Previous to the 1st March, 1910, Wiluna formed part of the Lawlers District. The gold produced by mines at Wiluna previous to that date will be found in the Lawlers District, and the lease numbers of both districts are shown in each case.

Collavilla	...	...	Voided leases	...	...	...	...	...	...	1,518.00	496.28	...
Do.	...	...	Sundry claims	...	...	...	...	...	...	30.00	21.47	...
Gum Creek	...	(226j) ([1386N])	Alma May	...	...	300.00	94.01	...	...	1,314.00	543.73	...
Do.	...	261j	Little Sweetheart	...	...	17.00	31.52	...	...	17.00	31.52	...
Mt. Keith	...	(207j)	Miss Deal	...	...	141.00	62.42	...	...	2,162.00	1,839.38	...
Do.	...	...	Voided leases	...	...	...	...	...	8.29	6,117.50	5,042.67	...
Do.	...	...	Sundry claims	...	...	75.50	49.84	...	78.26	1,482.25	933.04	...
New England	...	...	Voided leases	...	...	...	...	...	...	952.00	309.11	...
Do.	...	...	Sundry claims	...	...	...	...	...	...	115.00	100.62	...
Wiluna	...	91j [940]	(Adelaide)	...	...	...	...	...	...	401.00	33.29	...
Do.	...	(242j)	Cromarty East	...	...	...	...	...	...	43.25	68.81	...
Do.	...	259j	Cromarty Hope	...	...	28.00	44.66	...	...	28.00	44.66	...
Do.	...	233j	Double Gee Reward	...	...	...	...	...	...	28.50	48.91	...
Do.	...	218j	Great Zig Zag	...	...	88.25	33.29	...	...	773.50	423.37	...
Do.	...	6j, [542], 7j, [548], 8j, [550], (11j), (13j), (14j), (15j), (17j), (18j), (21j), (22j), (24j), (25j), (26j), (39j), (161j), (163j)	(Gwalia Consolidated, Ltd.)	...	...	...	...	...	...	29,774.50	10,780.42	20.29
Do.	...	119j	(Happy Jack)	...	...	...	...	...	...	743.00	236.41	...
Do.	...	202j	Happy Jack South: Wiluna G.Ms., Ltd.	...	...	...	...	...	...	1,464.75	803.75	...
Do.	...	230j	Just in Time	...	...	249.75	116.06	...	...	367.75	180.46	...
Do.	...	4j, [162], (5j), (163j)	Lake Way leases: Wiluna G.Ms., Ltd.	...	...	...	...	...	...	2,044.00	975.78	...

TABLE IV.—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 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.		
Wiluna	10j, [870]	(Moonlight)	...	...	...	...	...	...	...	...	...	...	...	...
Do.	10j, [870], 137j, 91j, 109j, (123j)	Moonlight Leases	...	...	998·25	572·37	...	...	...	5,181·00	1,078·40	...	...	...
Do.	6j, [542], 7j, [548], 8j, [550], (11j), (13j), (14j), (15j), (17j), (21j), (161j), (163j), 193j, (194j), (256j), (257j)	Western Machinery Co., Ltd.	...	...	5,369·50	2,763·92	...	...	...	65,565·00	30,345·32	...	...	...
Do.	12j, [917], (23j), (946), (28j), (954), (30j), (959), (33j), (967), (36j), (975), (43j), (1018), (76j), (1090), (113j), 119j, (124j), (137j), (1002j)	Wiluna Gold Mines, Ltd.	...	...	77·25	47·76	...	...	...	24,372·75	10,751·78	...	...	...
Do.	...	Voided leases	...	...	...	...	...	...	27·92	18,254·75	7,779·03	...	...	...
Do.	...	Sundry claims	...	...	403·25	271·47	...	87·59	79·88	7,134·50	3,310·30	...	...	33
<i>From District generally:—</i>			...	...	...	...	...	...	...	...	...	...	...	...
Sundry Parcels treated at:			...	...	...	...	...	...	...	...	...	...	...	...
State Battery, Mt. Keith			...	...	...	...	...	...	...	...	556·95	12·68	...	...
State Battery, Wiluna			...	...	...	...	...	...	...	202·00	11,482·98	198·70	...	...
Reported by Banks and Gold Dealers			...	4·98	...	...	...	8·18	2·92	...	...	...	...	...
Total			...	4·98	7,747·75	4,087·32	...	95·77	197·27	197,227·75	99,219·91	232·00	...	...

BLACK RANGE DISTRICT.

Barrambie	...	Voided leases	...	...	...	...	...	...	...	455·50	1,862·24	...	...	...
Do.	...	Sundry claims	...	3·37	...	...	...	...	19·38	127·00	127·18	...	...	...
Bellchambers	...	Sundry claims	...	...	...	...	...	...	...	45·00	36·12	...	...	...
Birrigrin	...	Voided leases	...	...	...	...	...	...	820·68	12,018·16	15,040·45	...	...	...
Do.	...	Sundry claims	...	...	...	...	...	...	34·52	744·50	678·89	...	...	...

Curran's Find	641B	...	Red, White, and Blue	...	...	...	...	...	24.58	6,874.00	2,929.20	...
Do.	878B	...	Despised	...	14.12	68.36	...	...	68.36	...	...	...
Do.	...	...	Voided leases	...	...	...	...	...	107.70	164.50	71.82	...
Do.	...	...	Sundry claims	...	...	...	...	...	27.20	540.50	228.39	...
Errolls	...	...	Voided leases	...	...	...	...	14.17	132.04	72.00	426.68	...
Do.	...	...	Sundry claims	...	...	63.95	...	6.53	399.11	228.00	327.90	...
Hancocks	881B	...	Bounty	...	...	59.00	31.60	...	...	59.00	31.60	...
Do.	875B	...	Comedy King	...	...	69.00	216.44	...	...	111.00	305.02	...
Do.	...	...	Voided leases	...	...	...	...	...	6,489.84	26,691.25	27,343.04	52.08
Do.	...	...	Sundry claims	...	...	175.00	57.24	4.21	119.02	2,081.00	1,160.99	...
Maninga Marley	203B	...	(Havilah)	...	...	...	...	...	...	1,507.50	2,315.74	...
Do.	203B	...	(Havilah)	...	...	...	...	...	...	638.00	716.05	...
Do.	203B, (243B), (249B), (254B), (287B), (288B), (289B), (305B), (350B), (504B)	...	(Havilah G.M. Co., N.L.)	...	...	...	...	...	...	36,508.00	20,052.80	22.55
Do.	203B, (243B), (287B), (289B), (350B)	...	(Havilah G.M. Co., N.L.)	...	...	...	...	...	...	6,026.00	5,029.69	...
Do.	203B, (243B), (249B), (254B), (287B), (288B), (289B), (305B)	...	(Havilah leases)	...	...	...	...	...	...	2,240.00	2,432.48	...
Do.	203B, 345B	...	Havilah leases	...	...	...	...	...	...	...	127.54	...
Do.	203B, (243B), (289B)	...	(Havilah leases: Tailings Treatment, Ltd.)	...	...	...	...	...	...	371.00	2,086.50	...
Do.	...	...	Voided leases	...	...	...	...	...	195.20	11,977.23	14,442.35	...
Do.	...	...	Sundry claims	...	...	...	...	...	158.16	853.50	669.68	...
Montagu	...	...	Voided leases	...	...	...	...	...	94.39	9,133.40	7,223.46	...
Do.	...	...	Sundry claims	...	...	...	...	...	45.67	794.50	471.76	...
Nungarra	...	...	Voided leases	...	...	...	...	25.94	986.09	12,171.25	8,808.41	3.64
Do.	...	...	Sundry claims	...	...	...	...	46.67	1,455.98	3,601.90	2,212.33	...
Sandstone	(4B)	...	(Adelaide)	...	...	...	...	...	7.21	7,443.00	12,675.94	...
Do.	(4B), (5B), (11B), (17B), (26B), (70B), (140B), (150B)	...	(Adelaide leases)	...	...	...	...	...	...	21,010.00	30,255.28	...
Do.	(5B)	...	(Black Range)	...	...	...	...	...	152.68	637.00	1,477.66	5.60
Do.	(4B), (5B), (255B), (332B), (562B), (850B)	...	Black Range Consolidated Mines, N.L.	...	...	299.00	65.88	...	...	688.00	324.78	...
Do.	(4B), (5B), (9B), (11B), (17B), (26B), (70B), (140B), (150B), (256B), (494B), (509B), (620B), (627B)	...	(Black Range Mining Co., N.L.)	...	...	...	...	4.75	199.90	227,485.00	159,278.43	1,315.00
Do.	(4B), (5B), (11B), (70B), (140B)	...	(Black Range Pinnacles Co., N.L.)	...	...	...	...	...	...	1,228.50	1,684.82	...
Do.	(255B)	...	(Black Range West G.M. Co., N.L.)	...	...	...	...	...	...	1,077.65	1,035.43	...
Do.	(255B), (332B), (562B), (601B)	...	(Black Range West G.M. Co., N.L.)	...	...	...	...	...	51.62	613.00	377.95	...
Do.	(4B), (5B), (255B), (332B), (562B), (601B), (850B)	...	(Black Range West G.M. Co., N.L.)	...	...	...	...	...	...	87.50	100.67	...

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

EAST MURCHISON GOLDFIELD—continued.

BLACK RANGE DISTRICT—continued.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	
Sandstone ...	(854B) ...	Entente ...	...	...	79.50	24.72	...	...	10.83	1,399.50	999.62	...
Do. ...	(856B) ...	Nancy's Reward ...	...	33.96	...	...	...	77.96	647.00	657.46	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	2,865.27	424,960.12	232,227.36	10,433.62	...
Do. ...	...	Sundry claims ...	...	...	963.15	416.82	...	24.01	972.03	4,147.15	2,410.02	...
Youanmi ...	514B ...	United ...	...	...	1,990.00	1,207.51	...	...	11.86	17,902.00	5,559.66	...
Do. ...	863B, 864B, 865B, 866B	Yuanmi G.Ms., Ltd. ...	...	...	14,947.00	9,222.88	150.53	...	...	53,673.00	36,959.54	1,653.44
Do. ...	...	Voided leases ...	...	...	...	...	...	36	115.06	283,509.75	132,261.45	2,949.72
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	2.31	1,773.75	456.26	...
<i>From District generally:—</i>													
Sundry parcels treated at:													
State Battery: Black Range ...			...	...	...	234.30	...	...	...	202.00	14,805.02	59.53
State Battery: Youanmi ...			...	...	...	...	...	...	...	...	2,900.81	...
Various Works ...			...	...	...	...	...	...	...	37.00	5,664.78	...
Reported by Banks and Gold Dealers ...			...	...	...	...	...	1,336.82	11.43	...	...	...
Total ...			14.12	169.64	18,581.65	11,477.39	150.53	1,477.58	15,476.08	1,184,554.61	759,271.75	16,495.18	

Murchison Goldfield.

CUE DISTRICT.

Barrambie ...	...	Voided leases ...	...	...	...	...	...	...	22.49	16,903.92	14,338.52	125.60
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	70.50	35.81	...
Cuddingwarra ...	1860 ...	Big Bell ...	...	...	440.00	193.51	...	...	...	41,004.36	7,498.47	85.29
Do. ...	...	Voided leases ...	...	...	...	...	...	10.59	124.53	35,855.75	43,796.59	15.42
Do. ...	...	Sundry claims ...	...	40.30	...	...	...	...	82.10	498.54	1,064.83	...
Cue ...	2012 ...	Amythas ...	...	...	164.50	158.70	...	...	...	164.50	158.70	...
Do. ...	203, 1148 ...	(Cue Consolidated G.M.s, Ltd.) ...	...	...	...	...	...	...	...	23,427.50	18,382.10	...
Do. ...	203 ...	Cue No. 1 ...	...	...	...	3.87	...	...	...	7,753.75	12,959.73	20.40
Do. ...	2013 ...	Frances Amelia ...	...	...	70.00	17.02	...	...	...	70.00	17.02	...
Do. ...	1148 ...	(Light of Asia) ...	...	...	...	...	...	...	...	10,175.00	7,302.20	...

Do.	1148, (1299), (1300), (1666), (1634), (1667)	(Light of Asia leases)	...	...	...	...	...	...	...	14,024-00	9,078-43	...
Do.	1148, 1151, 1252, (1300), 1362, 1498, (1634), (1667), 1884, 1892, 1904, 1906	(Light of Asia and Queen of the May leases)	...	...	...	...	...	...	...	23,043-00	18,341-27	...
Do.	1148, 1151, 1252, 1362, 1498, 1884, 1892, 1904, 1906	Mararoa G.M. Co., N.L.	...	...	6,098-00	4,927-84	...	...	...	11,360-00	9,751-04	...
Do.	1151, 1252, 1362, (139P), 1498, (1689), (1978)	(Queen of the May leases)	...	...	...	...	...	...	...	6,926-00	6,974-06	...
Do.	...	Vera	...	...	...	...	...	...	5-89	172-00	76-12	...
Do.	...	Voided leases	...	...	...	...	...	34-72	529-45	182,380-62	129,219-46	43-35
Do.	...	Sundry claims	...	1-11	137-29	1,191-50	370-53	22-06	530-57	16,924-34	10,254-73	...
Eelya	...	Voided leases	...	...	...	...	...	...	8-78	971-00	1,778-94	...
Do.	...	Sundry claims	...	...	...	...	...	...	101-86	569-65	602-43	...
Errolls	...	Voided leases	...	...	...	...	...	...	20-25	14,098-50	8,902-24	...
Do.	...	Sundry claims	...	...	...	...	...	...	...	227-00	92-86	...
Mindoolah	...	Voided leases	...	...	...	...	...	3-07	...	7,935-50	4,773-33	42-97
Do.	...	Sundry claims	...	...	...	...	...	...	9-81	1,004-00	1,123-77	...
Reedy's Find	1932	Culculli	...	...	35-25	74-95	...	...	...	220-00	1,318-78	...
Do.	1977	Emu	...	...	140-00	62-68	...	...	...	299-50	164-03	...
Do.	1981	Emu North	...	...	...	...	...	...	...	104-00	43-45	...
Do.	(1991)	Rand Extended	...	...	...	...	...	...	...	11-00	4-52	...
Do.	1934	Tuckanarra	...	...	23-50	58-23	...	...	...	69-50	231-25	...
Do.	(1923)	Turn of the Tide	...	...	5-50	73-67	...	...	4-00	307-00	3,196-97	...
Do.	2014	Wild Rabbit	...	...	46-00	45-31	...	...	...	46-00	45-31	...
Do.	...	Voided leases	...	...	...	...	...	...	210-65	622-00	801-07	...
Do.	...	Sundry claims	...	11-72	21-25	89-84	...	164-88	87-00	375-05	315-96	...
Tuckabianna	(2016)	Nigel	...	...	20-50	40-49	...	...	...	20-50	40-49	...
Do.	(1914)	Triplicate	...	...	...	...	...	...	...	631-00	243-00	...
Do.	1924	Triplicate North	...	...	30-00	41-33	...	...	...	221-00	270-49	...
Do.	...	Voided leases	...	...	...	...	...	...	162-70	2,147-50	3,748-53	...
Do.	...	Sundry claims	...	10-10	37-00	66-37	...	23-44	102-14	289-25	187-29	...
Tuckanarra	1337	Nemesis	...	...	127-00	98-97	...	...	742-25	2,371-00	6,220-01	...
Do.	...	Voided leases	...	...	...	...	...	14-65	2,095-42	15,584-10	14,405-28	172-77
Do.	...	Sundry claims	...	18-72	14-31	37-50	65-81	85-89	611-31	2,989-20	6,637-13	...
<i>From District generally:—</i>												
Sundry parcels treated at:												
Cue No. 1 Works												
State Battery—Cue												
State Battery—Tuckanarra												
Triplicate Works												
Various Works												
Reported by Banks and Gold Dealers												
Total			21-48	213-72	8,487-50	6,951-63	...	1,116-38	5,458-74	449,311-05	377,095-07	505-80

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

MURCHISON GOLDFIELD—continued.

MEEKATHARRA DISTRICT.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Abbotts ...	...	Voided leases ...	...	...	...	...	...	...	26·45	35,210·60	37,124·40	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	55·60	90·87	...
Burnakura ...	...	Voided leases ...	...	...	...	...	...	3,239·43	38,480·95	30,579·03	26·90	...
Do. ...	...	Sundry claims ...	...	...	7·50	7·11	...	12·51	81·11	144·50	118·98	...
Chesterfield ...	...	Voided leases ...	...	...	...	...	...	29·02	409·15	6,756·26	7,445·01	80
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	38·83	428·60	472·64	...
Gabanintha ...	...	Voided leases ...	...	...	...	...	...	...	16·93	21,918·00	13,447·58	815·57
Do. ...	...	Sundry claims ...	...	...	...	...	...	13·05	74·38	1,063·50	715·19	...
Garden Gully ...	...	Voided leases ...	...	...	...	...	...	26·36	74·91	29,854·06	21,435·37	1,102·59
Do. ...	...	Sundry claims ...	...	2·06	11·00	31·22	...	...	5·38	249·10	351·23	...
Gum Creek ...	(1386N), ((226J)	Alma May ...	...	...	...	...	...	...	...	1,082·00	248·83	...
Do. ...	...	Voided leases ...	...	...	...	...	...	25·27	88·12	2,557·08	3,110·73	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	338·00	278·36	...
Holden's Find ...	1460N ...	Norma ...	...	...	51·75	50·14	...	...	...	51·75	50·14	...
Do. ...	1291N ...	Waterloo ...	...	...	1,134·00	594·16	...	...	...	12,341·00	4,126·83	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	18·00	1,273·25	987·62	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	44·63	196·00	161·73	...
Jillawarra ...	...	Voided leases ...	...	...	...	...	...	...	1,134·68	1,499·55	2,801·53	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	169·02	142·95	23·50	53·81	...
Meeka Pools ...	...	Voided leases ...	...	...	...	...	...	...	...	111·58	82·27	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	2·84	211·72	184·83	...
Meekatharra ...	597N ...	(Commodore) ...	...	...	...	...	...	...	...	498·00	1,268·71	...
Do. ...	597N, (915N), (1041N), (1365N)	(Commodore G.M. Co., N.L.)	...	...	...	...	...	...	...	40,527·00	16,121·38	3·32
Do. ...	477N ...	(Fenian) ...	...	...	...	...	...	...	...	8,831·75	18,289·22	...
Do. ...	477N, 814N ...	Fenian leases ...	...	...	21,946·17	13,026·23	...	...	...	299,645·94	244,984·53	...
Do. ...	1331N ...	Gwalia ...	...	...	89·50	355·41	...	...	115·72	2,820·50	8,912·28	...
Do. ...	1457N ...	Halcyon Extended ...	...	...	...	...	...	...	...	43·55	67·20	...
Do. ...	1466N ...	Haveluck ...	...	...	39·00	30·19	...	...	...	69·00	47·61	...
Do. ...	555N ...	(Ingliston) ...	...	...	...	...	...	...	...	1,202·49	2,332·27	...
Do. ...	475N ...	(Ingliston Consols Extended) ...	...	...	...	...	...	...	...	1,536·25	4,248·25	30
Do. ...	475N, 515N, 729N, 822N	Ingliston Consols Extended leases	...	...	28,318·00	13,968·71	...	...	...	276,206·22	152,527·25	...
Do. ...	1461N ...	Ingliston Extended ...	...	...	...	...	...	...	...	9·00	25·41	...

Do.	555N, 1239N	Ingliston leases		548-00	833-98				16,942-85	15,928-53	
Do.	1453N	Ingliston United	13-46					76-84	15-00	57-72	
Do.	533N	Marmont		79-75	529-25				54,544-35	38,881-57	
Do.	580N	(Marmont Extended)							43-00	38-03	
Do.	580N, 888N	Marmont Extended leases							152-00	129-61	
Do.	597N, (915N), (1041N), (1365N)	New Commodore G.M. Co., N.L.							127-10	76-78	
Do.		Voided leases					3-88	388-60	283,801-40	141,862-34	2,451-42
Do.		Sundry claims		413-15	240-70		181-83	183-34	5,231-70	2,643-52	
Munara Gully		Voided leases							13,167-75	6,489-65	
Do.		Sundry claims						11-62	80-00	47-38	
Nannine	166N	Nannine		15-00	59-87			218-15	214-00	214-61	
Do.	(16N), (25N), 166N	(Nannine leases)						8-71	23,649-60	24,385-66	127-60
Do.		Voided leases					34-02	372-54	68,097-02	43,048-73	39-85
Do.		Sundry claims	157-95				14-93	401-68	2,327-20	1,803-14	
Quinns		Voided leases					7-30	1,186-50	18,931-16	8,886-79	90-70
Do.		Sundry claims	7-27				2-25	1,103-07	1,671-50	1,281-62	
Ruby Well		Voided leases							7,443-00	3,988-36	
Do.		Sundry claims	4-55					13-03	261-00	341-66	
Stake Well		Voided leases						200-12	21,362-00	9,566-18	
Do.		Sundry claims		11-50	22-69			31-79	233-50	257-20	
Star of the East		Voided leases							27,244-00	20,305-40	
Do.		Sundry claims							127-62	94-97	
Yaloginda	(1434N)	Rocklee South Extended						611-71		126-88	
Do.		Voided leases						951-84	25,744-02	13,122-85	8-68
Do.		Sundry claims			86-07		10-89	530-71	1,978-17	1,674-87	
<i>From District generally:—</i>											
Sundry Parcels treated at:											
		Ruby Well Battery								699-32	
		State Battery, Meekatharra							14-00	10,242-65	19-00
		State Battery, Quinns								618-79	
		Various Works							172-75	4,475-42	342-17
		Reported by Banks and Gold Dealers	25-75				9,816-55	13-79			
Total			25-75	185-29	52,664-32	29,835-73	10,346-88	11,817-55	1,358,811-99	923,981-32	5,028-90

DAY DAWN DISTRICT.

Day Dawn	552D	Croesus			208-00	54-83			208-00	54-83	
Do.	1D, 2D, (86D), (87D), (99D), (119D), (129D), (158D), (159D), (170D), (185D), (191D), (209D), (210D), (211D), (212D), (213D), (224D), (225D), (249D), (424D), (453D), (455D), (467D)	Great Fingall Consolidated, Ltd.			273-00	264-78			1,865,025-85	1,184,913-69	169,210-20

TABLE IV.—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 1921.					TOTAL PRODUCTION.				
			Alluvial.	Dolled and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dolled and Specimens.	Ore treated.	Gold therefrom.	Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Kirkalucka ...	...	Sundry claims ...	...	...	...	...	...	...	...	8.80	4.01	...
Messenger's Patch	880	Gnow's Nest ...	...	...	...	...	...	...	...	57.00	60.86	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	315.99	587.20	305.89	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	463.12	315.11	438.55	280.85	...
Mt. Farmer ...	...	Voided leases ...	...	...	...	...	...	...	...	64.00	40.19	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	5.00	6.22	...
Mt. Gibson ...	722, 723	Golden Harp leases ...	...	...	...	...	...	...	6.44	187.50	706.10	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	147.00	70.99	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	76.00	40.84	...
Ninghan ...	...	Voided leases ...	...	...	...	...	...	...	...	10.00	1.41	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	5.00	17.89	...
Noongal ...	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...
Do. ...	...	Sundry claims ...	...	...	7.25	7.86	...	11.55	15.86	3,086.95	1,847.66	...
Nyounda ...	...	Voided leases ...	...	...	...	...	...	...	...	293.75	206.50	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	217.63	416.00	183.91	...
Pinyalling ...	...	Voided leases ...	...	...	...	...	...	...	4.28	18.00	21.67	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	1.36	2,281.60	902.03	...
Rothsay ...	...	Voided leases ...	...	...	...	...	...	...	2.59	160.50	132.57	...
Wadgingarra ...	...	Voided leases ...	...	...	...	...	...	...	...	8,971.00	3,331.15	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	541.61	600.91	...
Warriedar ...	(841)	Highland Chief ...	...	...	50.00	29.88	...	...	...	71.50	38.21	...
Do. ...	890	Iron Clads ...	...	...	170.00	55.28	...	...	...	722.25	449.03	...
Do. ...	(708)	Mug's Luck ...	...	...	63.75	16.24	...	...	...	755.50	219.06	...
Do. ...	(731)	Poreupine ...	...	...	...	...	...	...	...	6,886.75	2,109.82	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	231.00	43.51	...
Do. ...	...	Sundry claims ...	...	...	17.50	5.34	...	...	1.80	3,206.25	1,362.35	7.30
Yalgoo ...	...	Voided leases ...	...	...	...	...	...	...	...	574.25	273.90	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	3.23	6,314.50	9,965.18	...
Yuin ...	712 (735)	Bullrush Gold Estates, N.L.	...	...	...	...	...	...	17.77	850.50	513.97	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	23,690.00	7,302.83	130.13
Do. ...	...	Sundry claims ...	...	...	3.00	1.32	...	...	127.12	31,381.50	14,957.04	...
			...	...			...	...	4.70	279.50	59.20	...

From Goldfield generally:

Sundry Parcels treated at:

Field's Find Extended Treatment Works	...	...	...	...	...	...	...	...	152.40	...
State Battery, Goodingnow (Payne's Find)	...	...	...	119.81	...	...	...	38.50	1,675.25	...
State Battery, Warriendar	...	...	...	1,140.49	...	...	...	...	1,140.49	...
Youanmi G.Ms., Ltd. Works (Warriendar Options)	...	...	...	...	...	...	...	...	310.93	26.67
Various Works	...	...	...	...	...	9.42	...	664.00	1,332.45	...
Reported by Banks and Gold Dealers	...	...	...	...	...	666.73	...	...	...	...
Total	9.35	2,353.00	3,569.85	...	1,451.29	1,825.88	182,414.39	124,842.94	167.40

Mount Margaret Goldfield.

MOUNT MORGANS DISTRICT.

NOTE.—Prior to 31st August, 1917, the mining centres of Eucalyptus, Linden, Mt. Celia, Mt. Howe, and Yundamindera were included in Yerilla District, and the output is recorded in that district. From 1st September, 1917, the output from these centres is shown in Mt. Morgans District, to which they were transferred.

Australia	...	Voided leases	...	...	...	...	...	1,911.63	15,913.69	23,305.76	1.76
United	...	Sundry claims	...	...	...	...	...	580.98	799.25	2,072.62	...
Do.	...	Sundry claims	...	...	...	...	...	...	11.00	5.40	...
Eucalyptus	...	Voided leases	...	...	...	...	...	...	1,248.50	1,782.71	...
Well	...	Sundry claims	...	...	...	...	...	...	108.07	64.68	...
Do.	...	Voided leases	...	...	...	...	17.95	72.23	2,722.00	3,473.45	...
Korong	...	Sundry claims	...	...	...	...	...	34.97	279.28	232.89	...
Do.	...	Bindah	...	7,580.00	2,237.91	...	...	...	14,542.00	4,339.41	...
Linden	344F, [998R]	Danube	...	...	...	...	...	...	78.25	81.99	...
Do.	348F, [1035R]	Democrat	...	37.00	117.65	...	...	...	635.50	940.08	...
Do.	340F, [871R]	Great Carbine	...	74.00	33.49	...	...	...	74.00	33.49	...
Do.	346F, [1024R]	Great Junction	...	...	...	...	...	...	693.50	474.24	...
Do.	(342F), ([942R])	Old Kelly	...	84.00	133.22	...	...	...	84.00	133.22	...
Do.	379F	Olympic	...	...	...	...	...	...	10.00	3.05	...
Do.	(375F)	Torquay leases	...	...	681.90	...	...	...	3,940.77	2,332.96	68
Do.	341F, (903R), 343F, [985R]	Voided leases	...	...	...	...	...	...	183.50	196.69	...
Do.	...	Sundry claims	...	183.00	140.78	...	...	...	859.75	529.00	...
Mt. Margaret	(376F)	Mt. Margaret Reward	...	6.89	6.57	...	...	...	6.89	6.57	...
Do.	...	Voided leases	...	...	...	...	...	...	6,406.00	4,283.96	12.55
Do.	...	Sundry claims	...	...	...	...	37	16.61	365.50	281.86	...
Mt. Morgans...	6F	(Lily of the Valley South: Westralia Mt. Morgans G.M. Co., Ltd.)	...	...	...	...	...	...	1,587.50	808.18	...
Do.	6F	(Lily of the Valley South: Westralia Mt. Morgans Syndicate, Ltd.)	...	...	...	...	...	...	3,002.00	1,022.90	...
Do.	(325F)	Millionaire	...	...	...	...	...	...	206.50	728.27	...
Do.	5F, (10F), (19F), (22F), (32F), (73F)	(Westralia Mt. Morgans G.M. Co., Ltd.)	...	...	...	...	...	...	575,148.00	294,758.28	5,552.63
Do.	7F, (20F), (21F)	(Westralia Mt. Morgans G.M. Co., Ltd.)	...	...	...	...	...	...	18,261.00	8,127.69	...
Do.	5F, 6F, 7F, (10F), (19F), (20F), (22F), (32F), 301F	Westralia Mt. Morgans Mines, N.L.	...	9,862.00	3,259.02	...	...	...	133,624.00	34,134.29	...

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

MT. MARGARET GOLDFIELD—continued.

MT. MORGANS DISTRICT—continued.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					TOTAL PRODUCTION.						
			Alluvial.	Dolled and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial.	Dolled and Specimens.	Ore treated.	Gold therefrom.	Silver.		
			Fine ozs.	Fine ozs.	Tons(2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons(2,240lbs.)	Fine ozs.	Fine ozs.		
Mt. Morgans...	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	6.61	76.56	34,127.75	20,210.28	77.86	...	...
Murrin Murrin	(374F) ...	Bound to Win ...	...	...	18.00	8.40	...	...	...	18.00	8.40	...	...	...
Do. ...	372F ...	Murrin Queen G.M. ...	...	...	1,254.50	523.10	...	...	...	1,323.50	543.30	...	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	10.43	222.93	127,364.72	100,606.89	29.60	...	...
Do. ...	...	Sundry claims ...	...	...	44.00	14.20	...	...	222.89	1,167.55	1,190.81	...	...	...
Redcastle ...	...	Voided leases ...	...	...	...	...	...	4.49	436.54	2,509.95	2,169.63	...	...	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	103.58	139.00	163.01	...	...	...
Yundamindera	357F ...	Big Stone ...	...	...	321.25	191.64	...	...	...	617.50	418.46	...	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	230.00	337.18	...	...	...
Do. ...	...	Sundry claims ...	...	...	126.50	69.48	...	...	...	631.10	405.24	...	...	...
<i>From District generally:</i>														
Sundry Parcels treated at:														
Battles Ville Battery ...			...	...	...	...	...	...	...	126.00	370.00	15.94	...	...
Hainault Sulphide Plant, Kalgoorlie ...			...	...	...	...	...	...	...	127.21	83.91	...	...	...
Mt. Morven Cyanide Works ...			...	...	...	...	...	...	...	...	129.48	...	...	...
State Battery, Linden ...			...	...	...	188.00	...	...	...	10.00	1,367.08	...	...	...
Westralia Mt. Morgans Works ...			...	...	...	...	...	...	...	...	153.10	...	...	...
Various Works ...			...	...	...	...	...	...	...	788.50	3,010.07	84.03	...	...
Reported by Banks and Gold Dealers ...			7.53	...	...	...	...	1,689.01	32.47	...	...	...	...	...
Total ...			7.53	...	19,591.14	7,605.36	...	1,745.47	3,761.47	951,333.33	516,939.97	5,775.05	...	...

MOUNT MALCOLM DISTRICT.

Cardinia ...	1532c ...	Contact ...	9.80	5.10	...	...	...	9.80	5.10	...	...	...	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	1,568.29	1,628.24	3,550.42	...	...	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	22.37	8.00	24.24	...	...	...
Diorite King	...	Voided leases ...	...	...	...	...	...	...	819.15	34,470.53	31,460.33	24.05	...	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	1.40	131.02	2,537.80	3,025.03	...	...	...
Dodger's Well	...	Voided leases ...	...	...	...	...	...	...	57.90	1,299.30	1,927.94	...	...	...
Do. ...	...	Sundry claims ...	...	...	6.00	11.62	...	...	3.37	792.25	656.57	...	...	...
Lake Darlot...	1515c [1207]	New Discovery leases ...	...	...	276.11	106.89	...	...	...	276.11	106.89	...	...	...
Do. ...	1516c [1210]	Sundry claims ...	...	...	66.00	18.29	...	...	...	66.00	18.29	...	...	...

Leonora	...	(1473c)	...	(Auckland)	...	...	...	...	...	...	...	226.50	82.22	...
Do.	...	(1473c)	...	Auckland: Chaffers G.M. Co. (1916), Ltd.	...	...	...	...	...	...	...	300.00	56.92	...
Do.	...	1504c	...	Dawn of Hope	...	...	43.00	14.37	...	...	...	162.50	296.47	...
Do.	...	198c	...	(Eastern)	...	...	...	...	...	...	...	302.00	321.72	...
Do.	...	1530c	...	Leonora Gold Blocks	...	5.15	185.50	151.50	...	...	5.15	240.00	227.84	...
Do.	...	1533c	...	Leura	...	...	10.00	8.25	...	...	...	10.00	8.25	...
Do.	...	(1485c)	...	Ping Pong	...	...	...	...	...	...	79.35	499.50	531.91	...
Do.	...	190c, 198c, 207c, 352c, 353c, 380c, 446c, 447c, (450c), (476c), 489c, 490c, 504c, (523c), 741c, 742c, 807c, 809c, 811c, 812c, (813c), (814c), 980c, (981c), 1082c, (1225c), (1226c), (1227c), (1228c), (1229c), (1230c), (1231c), (1232c), 1259c, (1291c), (1292c), 1341c, 1342c, (1343c), (1344c), (1345c), (1346c), (1347c)	...	Sons of Gwalia Ltd.	6,910.00	7,078.05	688.14	2,682,668.50	1,252,172.86	75,523.50
Do.	...	198c, 1082c	...	(Sons of Gwalia South G.M. Co., N.L.)	...	...	...	...	...	...	...	631.00	903.61	...
Do.	...	198c, 1082c, (1257c), (1258c), 1259c, (1284c), (1285c), (1300)c, (1301c)	...	(Sons of Gwalia South G.M.s., Ltd.)	...	...	...	...	...	...	...	98,239.00	51,593.99	8.66
Do.	...	198c, 1082c, 1259c	...	Sons of Gwalia South G.M.s, Ltd.)	...	...	...	...	...	...	...	9,909.00	3,169.89	...
Do.	...	263c	...	(Trump)	...	...	...	...	...	...	...	562.50	2,393.40	...
Do.	...	263c	...	Trump: Gwalia Central G.M.s., Ltd.	...	...	...	77.06	...	...	...	1,541.00	3,060.75	...
Do.	...	263c, (744c), (793c)	...	(Trump leases)	...	...	...	...	...	...	...	21,794.45	16,002.07	...
Do.	...	...	...	Voided leases	...	...	...	...	...	...	1,768.07	137,093.25	64,781.08	10.71
Do.	...	...	...	Sundry claims	...	37.42	1,015.00	366.84	...	6.59	253.02	9,527.55	8,376.44	...
Mt. Malcolm	...	...	...	Voided leases	...	...	...	...	...	...	47.07	62,301.78	47,425.54	...
Do.	...	...	...	Sundry claims	...	15.36	62.00	15.83	...	5.75	24.24	3,043.90	2,101.68	...
Mertondale	...	...	...	Voided leases	...	...	...	...	...	...	...	88,663.00	60,840.00	1,497.58
Do.	...	...	...	Sundry claims	...	...	...	...	...	...	61.55	1,092.46	1,538.97	...
Mt. Clifford	...	1329c	...	Victory No. 1	...	...	410.00	65.84	...	...	249.29	1,280.46	7,202.28	...
Do.	...	...	...	Voided leases	...	...	...	...	...	...	1,364.45	3,274.00	7,060.57	...
Do.	...	...	...	Sundry claims	...	32	164.00	285.54	...	13.21	256.77	1,000.50	1,595.92	...
Pig Well	...	...	...	Voided leases	...	...	...	...	...	...	...	13,575.32	14,673.13	63.68
Do.	...	...	...	Sundry claims	...	...	118.00	49.46	...	...	34.61	2,716.40	1,152.24	...
Randwick	...	...	...	Voided leases	...	...	...	...	...	...	239.49	8,065.15	8,671.57	...
Do.	...	...	...	Sundry claims	...	14.14	...	...	...	66.57	159.37	1,282.14	944.20	...
Webster's Find	...	...	...	Voided leases	...	...	...	...	...	30.30	...	21,760.00	13,970.17	...
Do.	...	...	...	Sundry claims	...	...	...	...	...	36.37	15.73	1,397.80	939.58	...

TABLE IV.—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 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Wilson's Creek	...	Voided leases	333·50	168·27	...	
Do.	...	Sundry claims	...	...	...	...	4·24	5·00	19·04	...
Wilson's Patch	(1496c)	Great Western	...	...	...	...	...	1,047·00	162·61	...
Do.	...	Voided leases	...	...	...	...	99·38	26,348·10	12,475·57	1·05
Do.	...	Sundry claims	...	...	...	...	1·50	814·00	1,086·36	...
<i>From District generally:—</i>												
Sundry parcels treated at:												
		Fremantle Trading Coys' Works	...	...	...	...	...	...	1·42	...
		State Battery—Leonora	...	...	...	...	...	95·50	10,370·34	98·14
		Various Works	...	...	...	...	...	371·50	7,149·72	20·12
		Reported by Banks and Gold Dealers	27·66	...	...	...	2,483·14	131·00	...	...
		Total	37·78	77·17	9,265·61	8,249·54	688·14	2,653·13	7,401·48	3,243,252·49	1,644,298·31	77,247·49

MOUNT MARGARET DISTRICT.

Burtville	2095T	Bell	...	...	...	...	...	...	12·00	12·15	...
Do.	2123T	Bond	...	...	270·00	461·46	...	...	270·00	461·46	...
Do.	(2103T)	Mac's Lucky Ridge	...	2·34	...	...	...	2·34	97·50	17·68	...
Do.	(1044T)	Nil Desperandum	...	...	30·00	190·97	...	...	8,426·00	13,640·24	...
Do.	2138T	Nil Desperandum	...	...	14·00	86·52	...	...	14·00	86·52	...
Do.	...	Voided leases	...	...	...	...	2·29	411·46	57,758·18	89,132·21	275·27
Do.	...	Sundry claims	...	...	28·50	38·06	...	122·10	3,199·90	2,900·37	...
Duketon	2102T	Dolorite	...	32·87	20·50	76·20	...	200·04	20·50	76·20	...
Do.	2114T	Hematite	...	27·99	5·00	40·20	...	280·73	5·00	40·20	...
Do.	(2029T)	Limonite	...	...	...	...	...	294·51	42	26·44	...
Do.	...	Voided leases	...	...	...	...	3·54	2,431·75	31,442·50	22,096·60	...
Do.	...	Sundry claims	...	...	...	...	...	65·43	238·50	366·37	...
Eagle's Nest	...	Voided leases	...	...	...	...	...	145·34	331·00	1,215·78	...
Do.	...	Sundry claims	...	116·83	40·50	63·77	...	4·00	310·58	109·42	...
Erlistoun	2113T	Baneygo North	...	...	278·00	94·50	...	...	278·00	94·50	...
Do.	...	Voided leases	...	...	...	...	...	11·66	27,012·07	18,461·35	...
Do.	...	Sundry claims	...	...	...	...	1,179·43	116·81	2,120·98	1,837·10	...
Euro	(1984T)	(Lone Star)	...	...	...	...	...	...	2,840·00	714·96	...
Do.	(1984T), (1991T), (2009T), (2014T)	Lone Star leases	...	...	...	...	...	...	4,752·00	910·81	...
Do.	...	Voided leases	...	...	...	...	...	65·14	83,964·25	35,957·12	...
Do.	...	Sundry claims	...	...	...	...	...	46·52	259·50	116·69	...

Laverton	2058r	...	Augusta	...	...	...	...	...	3.95	248.51	167.20	...
Do.	2083r	...	Beria Main Reef	...	...	202.50	36.45	...	...	829.50	127.25	...
Do.	838r	...	(General Wabash)	...	...	...	...	...	...	100.00	288.72	...
Do.	838r	...	General Wabash	...	...	163.00	166.27	...	...	163.00	166.27	...
Do.	(829r)	...	(Ida H)	...	...	...	...	...	...	111.00	285.13	...
Do.	(829r), 838r, (846r), (1219r), (1310r), (1671r), (1894r)	...	(Ida H G.M. Co., Ltd.)	...	...	...	...	...	...	229,995.96	170,654.90	4,674.69
Do.	(829r), (846r)	...	Ida H leases	...	...	190.50	157.57	...	...	190.50	157.57	...
Do.	715r, 806r, 1206r, (1207r), (1483r), 1523r, 1524r, 1525r, 1542r, (1544r), (1548r)	...	(Kalgoorlie and Boulder Firewood Co., Ltd.)	...	...	...	...	...	...	71,802.00	25,003.11	3,364.01
Do.	(1897r)	...	(Lady Harriet)	...	...	...	...	...	...	991.00	98.94	...
Do.	715r, 806r, 1206r, (1207r), (1483r), 1523r, 1524r, 1525r, 1542r, (1544r), (1548r)	...	(Lancefield G.M. Co., Ltd.)	...	...	...	...	...	...	102,179.78	39,402.81	...
Do.	715r, 806r, 1206r, (1207r), (1483r), 1523r, 1524r, 1525r, 1542r, (1544r), (1548r)	...	(Lancefield G.M. Co., Ltd.)	...	...	...	...	...	...	153,829.00	58,842.47	5,824.39
Do.	715r, 806r, 1206r, (1207r), (1483r), 1523r, 1524r, 1525r, 1542r, (1544r), (1548r)	...	(Lancefield G.M. Co., Ltd.)	...	...	...	...	...	...	260,749.00	103,535.54	21,612.29
Do.	715r, 806r, 1206r, 1523r, 1524r, 1525r, 1542r, (1544r), (1548r)	...	Lancefield Gold Mines, Ltd.	...	...	1,679.57	2,981.77	966.05	...	352,654.57	127,152.62	21,012.88
Do.	2050r, 2051r	...	Mary Mac G.M. Co., N.L.	...	...	133.00	47.71	...	...	42,240.00	8,603.12	...
Do.	(1897r), (1900r), (1948r), (1949r), (1950r), (1962r), (1974r), (1996r), (1997r), (2106r)	...		...	...	...	...	...	...	...	...	...
Do.	(1949r)	...	(Pinnacles)	...	...	...	...	...	...	96.00	36.51	...
Do.	(2134r)	...	Rosetta	...	...	39.32	10.75	...	...	39.32	10.75	...
Do.	2112r	...	South Lancefield	...	...	59.00	20.31	...	...	81.00	26.24	...
Do.	...	...	Voided leases	...	...	...	...	...	17.66	2,020.16	181,451.70	79,941.78
Do.	...	...	Sundry claims	...	27.91	319.00	145.68	...	195.37	1,303.75	4,388.45	3,857.43
Mt. Barnicoat	...	...	Voided leases	...	...	...	...	...	...	652.00	359.12	...
Do.	...	...	Sundry claims	...	...	...	...	...	...	23.00	23.37	...
Quartz Hill	...	...	Voided leases	...	...	...	...	...	...	10.00	3.86	...
Red Hill	...	...	Sundry claims	...	...	...	...	...	...	27.00	13.76	...
<i>From District generally:—</i>												
Sundry Parcels treated at:												
Brown Hill Consols Works, Kalgoorlie												
Mulga Queen Works												
State Battery—Laverton												
Various Works												
Reported by Banks and Gold Dealers												
Total												
				207.94	3,472.39	4,618.19	966.05	3,423.98	7,832.27	1,626,239.59	818,877.50	56,763.53

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

North Coolgardie Goldfield.

MENZIES DISTRICT.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	
Comet Vale ...	5217z ...	(Gladsome) ...	...	...	...	...	...	...	...	...	10,879·50	8,678·16	95·29
Do. ...	5217z, 5333z, (5380z)	Gladsome leases ...	...	...	...	453·80	...	...	...	...	64,870·00	48,193·42	1,410·36
Do. ...	(5300z) ...	Happy Jack: Forwood, Down and Coy., Ltd.	...	...	...	...	...	...	...	...	136·00	53·00	...
Do. ...	(5300z) ...	(Happy Jack) ...	...	...	...	...	...	...	...	...	1,363·50	776·10	...
Do. ...	(5300z), (5325z) ...	(Happy Jack leases) ...	...	...	...	...	...	...	...	...	7,691·50	3,922·48	...
Do. ...	5410z ...	Lake View ...	...	...	303·79	99·97	...	...	6·66	...	629·75	208·60	...
Do. ...	(5300z), (5325z) ...	(Princess Royal G.M. Co., N.L.) ...	...	...	...	...	...	...	...	...	1,110·00	427·34	...
Do. ...	(5451z) ...	Voided leases ...	...	...	...	...	...	...	409·70	...	136,810·07	113,843·41	3,839·28
Do. ...	...	Sundry claims ...	...	...	...	89·65	97·63	...	31·91	...	722·40	533·35	...
Goongarrie ...	...	Voided leases ...	...	...	...	...	...	...	·94	1,027·51	27,198·29	17,428·84	...
Do. ...	...	Sundry claims ...	...	7·73	20·95	44·83	...	33·72	509·88	...	1,127·10	1,271·41	...
Menzies ...	(5440z) ...	Crusoe North ...	...	...	...	...	...	...	...	...	1,356·00	1,228·27	...
Do. ...	5423z ...	Lady Shenton ...	...	...	...	85·00	195·41	...	...	...	4,892·25	3,851·72	...
Do. ...	4931z, 4934z, 4935z, 4936z, 5074z, 5075z, 5260z, 5261z, 5315z	Menzies Consolidated G.Ms., Ltd. ...	...	...	10,856·00	5,993·80	...	...	...	...	464,577·00	245,771·66	78·67
Do. ...	(2823z) ...	Robinson Crusoe ...	...	...	12·00	7·42	...	...	13·24	...	5,085·75	2,788·46	...
Do. ...	(2823z) ...	(Robinson Crusoe: Crusoe Gold Claims, Ltd.)	...	...	...	...	...	...	...	...	33,135·00	32,978·74	1,038·47
Do. ...	(5479z) ...	Watson's Find ...	...	...	15·00	10·38	...	...	...	...	15·00	10·38	...
Do. ...	...	Voided leases ...	...	...	...	...	...	45·42	1,035·80	...	333,714·21	386,930·67	10,224·59
Do. ...	...	Sundry claims ...	...	1·65	728·50	310·31	...	6·69	361·33	...	18,444·50	13,249·74	776·49
Mt. Ida ...	5467z ...	Forest Belle ...	...	...	187·00	247·28	...	...	...	...	671·00	513·45	...
Do. ...	(5471z) ...	Lucknow ...	...	...	...	...	...	...	...	...	138·00	170·95	...
Do. ...	5473z ...	Mt. Ida Consolidated ...	...	...	443·00	112·09	...	...	...	...	443·00	112·09	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	77·07	...	55,949·37	66,945·85	106·63
Do. ...	...	Sundry claims ...	...	...	75·00	35·80	...	31·22	9·57	...	4,917·00	2,806·88	...

<i>From District generally:—</i>											
Sundry parcels treated at:											
Balkis Battery	...	...	...	...	...	...	...	65-75	4,648-28	...
Crusoe Wedderburn Cyanide Works	...	...	...	...	...	...	...	...	1,497-89	...
Fremantle Trading Coy., Ltd., Works	...	...	...	...	...	...	...	...	212-98	...
Gidney's Cyanide Works	...	...	...	...	...	136-35	...	...	799-93	...
Lady Harriet Battery	...	...	6-50	...	266-63	...	...	270-50	3,366-61	30-00
Menzies Mining and Exploration Corporation, Ltd., Works	...	...	...	...	...	...	...	639-50	732-04	...
State Battery—Mt. Ida	...	...	...	...	...	...	...	1,842-25	4,484-34	...
Various Works	...	...	...	...	...	...	...	1,807-05	23,641-87	1,039-43
Reported by Banks and Gold Dealers	...	13-17	...	...	...	...	968-65	195-48	...	...
Total	...	13-17	9-38	12,822-39	8,011-70	...	1,086-64	3,678-15	1,180,501-24	992,078-91	18,639-22

ULARRING DISTRICT.

Davyhurst	...	Voided leases	...	...	...	2-93	138-99	155,644-73	123,063-43	5,403-14
Do.	...	Sundry claims	...	53-50	29-10	...	30-12	5,945-35	3,125-78	...	
Diemel's Find	...	Sundry claims	...	...	...	...	7-37	102-50	119-13	...
Mulline	(139v), (235v), (555v), (670v), (671v), (679v), (732v), (862v)	(Lady Gladys G.M. Co., N.L.)	...	...	...	...	...	16,871-50	17,777-42	...
Do.	(139v), (235v), (555v), (670v)	(Lady Gladys G.M. Co., N.L.)	...	...	...	...	...	1,220-50	512-52	...
Do.	(139v), (235v), (555v)	(Lady Gladys leases)	...	...	...	...	170-89	7,741-00	15,025-05	...
Do.	(139v), (555v)	Lady Gladys leases	...	...	...	...	...	997-50	482-14	...
Do.	324v, 600v, 730v, 969v, 970v, 974v, 975v, 982v, 983v	Riverina South G.M. Co., N.L.	...	2,544-00	1,353-20	204-51	...	7,561-25	6,408-22	431-55	
Do.	324v, 600v, 730v	(Riverina South leases)	...	...	...	...	43-87	18,480-50	13,442-65	...
Do.	736v	Young Australian	...	50-00	8-21	...	...	581-25	731-93	...
Do.	763v	(Young Australian)	...	...	...	...	...	1,295-00	3,609-26	...
Do.	763v, (938v), (939v)	(Young Australian leases)	...	...	...	...	...	2,672-25	5,763-88	...
Do.	...	Voided leases	...	...	...	...	59-33	39,761-72	33,971-35	2-71
Do.	...	Sundry claims	...	253-50	121-52	...	35-53	6,048-26	4,710-15	69	
Mulwarrie	(992v)	Ullaring Westralia	...	34-93	53-88	...	...	43-04	97-95	12-10
Do.	...	Voided leases	...	...	...	...	56-84	18,397-64	25,527-59	26-37
Do.	...	Sundry claims	...	10-40	19-48	...	21-45	2,099-07	1,888-49	...	
Ularring	...	Voided leases	...	...	...	...	563-34	9,429-60	13,647-97	...
Do.	...	Sundry claims	...	...	...	...	...	143-00	113-15	...
<i>From District generally:—</i>											
Sundry parcels treated at:											
Hannan's Central Battery—Kalgoorlie	...	...	...	...	...	...	...	...	18-40	4-66
State Battery—Mulline	...	...	...	25-00	18-96	...	...	538-50	13,011-15	...
State Battery—Mulwarrie	...	...	...	...	...	...	...	595-20	4,762-31	...
Various Works	...	...	...	...	...	...	15-82	186-75	654-37	...
Reported by Banks and Gold Dealers	...	...	71	...	...	...	19-24	77	...	...
Total	...	71	...	2,971-33	1,604-35	204-51	22-17	1,144-32	296,374-51	288,450-55	5,876-56

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

NORTH COOLGARDIE GOLDFIELD—continued.

NIAGARA DISTRICT.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.		
Desdemona ...	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Kookynie ...	757G ...	(Cosmopolitan No. 2: Cosmopolitan Proprietary, Ltd.)	...	...	...	...	...	...	...	...	...	...	...	...
Do. ...	757G ...	Cosmopolitan No. 2: Western Machinery Co., Ltd.	...	...	149·00	155·44	...	...	...	3,380·00	3,913·10	...	...	...
Do. ...	769G ...	(Two Ds) ...	...	...	...	...	...	...	...	100·00	14·01	...	...	...
Do. ...	769G, (770G), (771G)	Two Ds leases ...	...	...	...	79·66	...	...	...	810·00	574·03	...	...	...
Do. ...	...	Sundry claims ...	...	1·88	160·50	70·70	...	30·59	93·85	4,887·35	4,411·94	...	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	257·33	729,921·81	383,551·35	5,375·97	...	...
Niagara ...	...	Voided leases ...	...	...	...	...	...	...	104·54	84,472·50	51,887·97	...	...	...
Do. ...	...	Sundry claims ...	...	...	17·50	15·61	...	13·27	70·23	9,836·29	6,055·27	...	...	...
Tampa ...	(777G)	Grafter ...	...	12·94	...	...	...	...	12·94	...	...	...	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	15·66	49,271·87	22,173·80	174·24	...	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	5·07	69·44	3,202·00	1,888·09	...	...	...
<i>From District generally:—</i>			...	...	...	...	...	...	...	...	...	...	...	...
Sundry parcels treated at:			...	...	...	...	...	...	...	98·00	448·91	...	...	...
Grafter Battery ...			...	...	...	...	...	...	...	...	9·03	...	...	...
Hainault Sulphide Plant—Kalgoorlie ...			...	...	...	...	...	...	...	...	153·47	...	...	...
Lubra Queen G.M. Co., N.L. Works ...			...	...	...	...	...	...	...	622·50	8,875·11	...	...	...
State Battery—Niagara ...			...	...	...	...	...	...	...	451·00	6,356·43	41·17	...	...
Various Works ...			...	...	...	...	...	...	...	...	...	...	...	...
Reported by Banks and Gold Dealers ...			8·94	1,435·20	787·38
Total ...			8·94	14·82	327·00	321·41	...	1,484·13	1,426·09	898,680·27	499,327·75	5,603·42

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YERILLA DISTRICT.

NOTE.—Prior to 31st August, 1917, the mining centres of Eucalyptus, Linden, Mt. Celia, Mt. Howe, and Yundamindera were included in Yerilla District, and the output is recorded in that District. From 1st September, 1917, the output from these centres is shown in Mt. Morgans District, to which they were transferred.

Edjudina ...	1060R ...	Big Ben ...	...	58·00	30·40	...	...	...	58·00	30·40	...
Do. ...	1057R ...	Fingall ...	...	27·00	15·38	...	...	...	27·00	15·38	...
Do. ...	1059R ...	Martin ...	...	21·00	30·98	...	...	...	21·00	30·98	...
Do. ...	1011R ...	Neta ...	...	...	...	...	...	...	145·75	96·82	...

Do.	(1010R),	1011R	(Neta leases)	...	...	...	...	...	...	...	407.00	340.01	...
Do.	1015R	...	Senate	...	...	...	193.00	153.27	...	4.38	1,614.50	1,787.21	...
Do.	...	...	Voided leases	...	...	...	...	...	...	14.06	30,367.70	39,778.46	37.79
Do.	...	...	Sundry claims	...	...	...	245.58	198.78	...	21.26	3,353.08	2,797.88	...
Eucalyptus	...	...	Voided leases	...	...	...	...	...	...	2,864.77	1,351.35	3,020.68	...
Do.	...	...	Sundry claims	...	...	...	...	...	...	367.50	362.50	381.82	...
Linden	998R	[344F]	Bindah	...	...	...	...	...	...	...	1,462.50	531.95	...
Do.	871R	[340F]	Democrat	...	...	...	...	...	...	9.01	2,245.25	5,026.30	...
Do.	1024R	[346F]	Great Carbine	...	...	...	...	...	...	...	67.75	20.30	...
Do.	(942R)	[(342F)]	Great Junction	...	...	...	...	...	...	6.11	1,086.75	1,030.90	...
Do.	903R	[341F],	Torquay leases	...	...	...	...	...	...	...	325.68	107.45	...
Do.	985R	[343F],	(Westralia United Goldfields, Ltd.)	...	...	...	...	...	...	...	1,995.00	1,452.42	...
Do.	903R,	[341F],		...	...	...	...	...	...	...	...	...	...
Do.	(904R),	985R,		...	...	...	...	...	...	...	...	...	...
Do.	[343F],	(992R)		...	...	...	...	...	...	...	...	...	...
Do.	...	...	Voided leases	...	...	...	...	...	7.53	538.04	12,385.10	15,509.59	...
Do.	...	...	Sundry claims	...	...	...	...	...	77.81	35.11	6,493.25	4,798.42	...
Mt. Celia	...	...	Voided leases	...	...	...	...	...	...	...	14.00	5.39	...
Mt. Howe	...	...	Sundry claims	...	...	...	...	...	...	...	5.00	11.13	...
Mt. Remarkable	...	...	Voided leases	...	...	...	...	...	...	17.74	528.72	415.09	...
Do.	...	...	Sundry claims	...	...	...	...	...	...	...	4.00	1.32	...
Pingin	...	...	Voided leases	...	...	...	...	...	...	46.99	14,637.80	10,306.68	...
Do.	...	...	Sundry claims	...	...	...	...	...	...	99.36	3,422.35	2,297.51	...
Yarri	1058R	...	Mt. Wallbrook Main Lode	...	...	...	62.00	40.92	...	...	62.00	40.92	...
Do.	1055R	...	Redbrook G.M.	...	...	...	223.00	137.92	...	...	223.00	137.92	...
Do.	...	...	Voided leases	...	...	...	...	...	6.30	87.08	36,822.75	19,124.10	2.00
Do.	...	...	Sundry claims	...	...	...	131.50	47.95	...	...	5,747.10	3,031.16	...
Yerilla	...	...	Voided leases	...	...	...	...	...	...	3,089.51	15,619.21	12,313.06	13.93
Do.	...	...	Sundry claims	...	...	...	...	...	19.30	15.88	2,401.00	1,338.07	...
Yilgangie	...	...	Voided leases	...	...	...	...	...	...	...	218.75	295.45	...
Do.	...	...	Sundry claims	...	...	...	...	...	121.67	29.83	25.50	46.17	...
Yundamindera	Voided leases	80.47	69,067.85	46,004.87	5.82
Do.	Sundry claims	85.22	3,151.25	2,740.75	...
<i>From District generally:—</i>														
Sundry parcels treated at:														
												621.83	...	
												4.92	...	
												325.69	...	
												72.00	4,030.90	...
												125.50	1,278.16	...
												231.50	4,412.89	3.50
												72.00	1,257.22	...
												660.85	3,999.04	...
Reported by Banks and Gold Dealers												1,011.56	154.74	...
Total							961.08	655.60	...	1,246.34	7,572.37	216,881.29	190,797.21	63.04

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

NORTH-EAST COOLGARDIE GOLDFIELD—continued.

KANOWNA DISTRICT—continued.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Kanowna ...	(14x), 15x, 18x, (19x), (974x), (1035x), (1103x), (1263x), (1276x), (1278x)	(North White Feather G.Ms., Ltd.) ...	...	...	...	...	...	...	37,768·50	10,594·79	...
Do. ...	12x, 13x, (14x), 15x, 18x, (19x), (72x), (855x), (974x), (1035x), (1103x), (1263x), (1278x)	North White Feather G.Ms., Ltd. ...	...	...	18·00	11·65	...	...	54,334·27	24,361·28	...
Do. ...	(1411x) ...	Red Hill North ...	4·88	4·28	...	...	...	4·88	4·28	...	...
Do. ...	12x, 13x, (14x), 15x, (855x), (1001x), (1012x), (1103x), (1107x), (1108x), (1109x)	(White Feather Main Reefs, Ltd.) ...	...	...	...	...	...	...	123,327·56	82,334·52	1,675·68
Do. ...	(9x), (10x), 12x, 13x, (72x), (83x), (201x), (855x), (1001x), (1012x), (1108x), (1249x)	(White Feather Main Reefs (1906), Ltd.)	...	...	...	...	...	20·45	24,393·00	9,138·31	...
Do. ...	...	Voided leases ...	...	...	...	...	...	3·59	3,674·54	246,178·46	137,452·71
Do. ...	...	Sundry claims ...	...	39·58	26·38	242·14	...	88·95	1,404·33	13,942·84	7,243·46
Mulgarrie ...	1426x ...	Palm ...	...	...	755·00	383·84	...	...	...	755·00	383·84
Do. ...	...	Voided leases ...	...	...	...	...	...	...	1,216·63	5,843·26	3,567·48
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	13·29	1,184·00	596·64
Six Mile ...	...	Voided leases ...	...	...	...	...	...	...	1,595·63	559·00	767·72
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	31·44	141·50	103·37
<i>From District generally:—</i>												
<i>Sundry Parcels treated at:—</i>												
		Kalgoorlie Foundry, Ltd., Works	...	...	...	...	...	...	...	...	553·56
		Lady Pratt Works	...	...	...	...	...	...	...	...	16·00
		Old Cement Works—Martin's	...	...	...	...	...	...	...	...	102·78
		Reidel and Norton's Works	...	...	...	...	...	...	...	...	642·00
		Various Works	...	...	...	...	...	...	...	...	2,306·21
		Cement from Alluvial Claims:										
		Reported by Owners	...	...	...	...	...	...	25·01	...	903·10
			...	...	...	...	...	...	305·41	867·52	26,376·40
			...	...	...	...	...	...	...	...	12,715·90

Treated locally (not reported by Owners):												
		Kalgoorlie Foundry, Ltd., Works	...	...	...	...	...	...	...	50-00	12-75	...
		Lady Pratt Works	...	...	...	...	...	...	...	15-00	3-18	...
		Old Cement Works—Martin's	...	...	...	...	...	...	...	10,791-00	3,527-94	...
		Reidel and Norton's Works	...	...	...	...	...	...	...	14,717-00	2,190-47	...
		Various Works	...	...	...	...	...	...	...	77,350-21	54,918-51	...
Treated outside District (not reported by Owners)												
		Reported by Banks and Gold Dealers	...	...	...	...	...	...	...	27,804-55	36,711-17	...
			34-44	...	...	...	...	103,983-54	86	...	84-69	...
		Total	39-32	66-86	4,654-45	3,272-11	...	104,441-92	10,853-00	935,961-69	579,339-50	2,522-12

KURNALPI DISTRICT.

Jubilee	...	Voided leases	...	...	...	...	...	...	145-13	1,821-25	1,408-51	...
Do.	...	Sundry claims	...	...	...	...	...	18-87	...	46-00	28-91	...
Kurnalpi	427K	Agoriad Aur	...	11-24	...	...	...	...	129-35	14-00	48-70	...
Do.	(429K)	Kurnalpi Gem	...	...	...	...	...	...	50-02	...	...	...
Do.	(432K)	Kurnalpi Gem South	...	104-60	...	...	...	...	283-41	...	...	...
Do.	423K	Kurnalpi Pride	...	62-37	21-90	136-40	...	...	640-82	33-70	368-13	...
Do.	...	Voided leases	...	...	...	...	...	371-18	1,785-95	2,805-31	2,245-39	6-27
Do.	...	Sundry claims	...	108-42	374-00	71-24	...	226-49	185-60	526-00	242-92	...
Mulgabbie	428K	Try Again	...	165-30	...	92-34	...	...	463-73	...	92-34	...
Do.	...	Voided leases	...	...	...	...	...	...	606-79	84-65	7,290-69	4-95
Do.	...	Sundry claims	...	...	2-00	10-02	...	6-50	1,432-79	139-50	831-63	...
<i>From District generally:—</i>												
Sundry Parcels treated at:												
Various Works												
Reported by Banks and Gold Dealers												
			7-76	...	...	...	...	11,375-71	19-62	56-50	193-15	...
		Total	7-76	451-93	397-90	310-00	...	11,998-75	5,743-11	5,526-91	12,750-37	11-22

East Coolgardie Goldfield.

EAST COOLGARDIE DISTRICT.

Binduli	(5091E)	Belle of Kalgoorlie	...	...	...	...	...	...	...	12-30	8-96	...
Do.	(5144E)	Blue Belle	...	...	...	...	...	...	...	61-00	10-00	...
Do.	...	Voided leases	...	...	...	...	...	...	...	175-80	97-60	...
Do.	...	Sundry claims	...	...	79-60	35-50	...	...	...	218-07	109-84	...
Boorara	4635E	Florence May	...	...	...	...	...	...	...	26-00	41-58	...
Do.	3908E, 3910E, (3912E), (4033E), (4045E), (4327E),	(Golden Ridge G.M. Co., Ltd.)	...	...	...	...	...	...	...	239,600-10	132,893-92	408-36
Do.	4629E	Jewel	...	...	...	...	...	...	...	139-50	232-45	...
Do.	3908E, (3910E), (4625E)	Waterfall G.M. leases: Forwood, Down, and Co., Ltd.	...	...	5-40	55-98	...	...	...	5-40	55-98	...
Do.	3908E, (3910E), (4625E)	(Waterfall G.M. leases)	...	...	...	...	...	...	...	6,671-50	4,097-17	...
Do.	3908E, (3910E), (3912E), (4033E)	(Waterfall leases)	...	...	...	...	...	...	...	2,849-00	2,389-48	...
Do.	(4634E)	Waterfall South	...	...	29-00	8-12	...	...	...	110-20	57-27	...
Do.	...	Voided leases	...	...	...	...	...	...	381-56	57,072-15	31,673-52	...
Do.	...	Sundry claims	...	...	126-30	82-46	...	49	53-46	523-90	501-55	...

TABLE IV.—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 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.		
Boulder	(33E), 35E, (975E)	(North Boulder G.Ms., Ltd.)	...	...	...	...	...	...	...	...	...	...	...	...
Do.	281E, 287E, 444E	(North Kalgurli Co., Ltd.)	...	...	...	...	...	...	...	...	...	...	...	...
Do.	281E, 287E, 444E	North Kalgurli (1912), Ltd.	...	...	...	...	...	...	...	...	...	...	...	...
Do.	5232E	Old Bank of England	...	...	...	...	...	...	...	...	...	...	...	...
Do.	73E, 410E, 443E, 532E, 578E, 698E, 944E, 1395E, (3031E), (4180E),	(Oroya Brownhill Co., Ltd.)	...	...	...	...	...	...	...	...	...	...	...	...
Do.	6E, 73E, 131E, 245E, 269E, (301E), 410E, 448E, 532E, 578E, 698E, 739E, 743E, 750E, (794E), 944E, 969E, 1004E, 1395E, 1621E, (3031E), (4180E)	Oroya Links, Ltd.	...	...	10,813·26	9,620·38	14·52	...	...	871,435·82	346,515·22	28,476·57	...	...
Do.	392E	(Paringa Mines (1909), Ltd.)	...	...	...	...	...	...	...	26,890·74	12,599·54	...	...	...
Do.	1208E, 3612E, 3643E	South Kalgurli Consolidated, Ltd.	...	...	70,172·00	31,863·49	...	...	...	743,275·00	258,599·77	15,071·52	...	...
Do.	1208E, 3612E	(South Kalgurli G.Ms., Ltd.)	...	...	...	...	...	...	...	826,909·00	347,222·75	17,609·67	...	...
Do.	4537E	Union Jack	...	...	3,851·00	1,645·80	...	...	...	4,537·00	1,980·96	...	...	...
Do.	...	Voided leases	...	...	...	...	...	...	109·90	5,780·86	207,032·57	133,377·59	...	...
Do.	...	Sundry claims	...	...	132·70	69·76	...	...	24·58	...	1,755·07	1,220·70	...	...
Feysville	4949E, 5152E	Britannia G.Ms., N.L.	...	59·29	140·00	129·59	...	...	87·88	171·00	201·20	...	...	...
Do.	Block 41	Hampton Gold Mining Areas, Ltd. — PPL 275, Long Looked For	...	...	5·20	6·61	...	...	...	5·20	6·61	...	...	...
Do.	Block 48	Hampton Gold Mining Areas, Ltd. — PPL 63, 84, Golden Hope G.Ms., N.L.	...	...	202·60	156·14	...	...	...	202·60	156·14	...	...	...
		PPL 1, Hopeful	...	...	753·36	571·32	...	...	...	753·36	571·32	...	...	...
		PPL 175, Jubilee Central	...	...	29·00	7·70	...	...	...	29·00	7·70	...	...	...
		PPL 207, Lancashire Lass	...	...	18·30	29·17	...	...	...	18·30	29·17	...	...	...
		PPL 264, Marion	...	...	16·29	25·52	...	...	...	16·29	25·52	...	...	...
		PPL 98, Red Indian	...	...	...	...	...	...	...	8·50	11·20	...	...	...
		PPL 37, Ring Neck	...	...	...	...	...	...	15·36	4·40	58·25	...	...	...
		PPL (78), Triangle	...	...	...	...	...	...	...	17·10	66·95	...	...	...
Do.	Block 48	(Hampton Plains Estate, Ltd.)	...	...	...	...	...	...	4,565·62	21·59	20,615·28	2,502·56	...	...
Do.	Block 50	(Hampton Plains Estate (1906), Ltd.)	...	...	...	...	...	...	...	...	85·00	108·82	...	...
Do.	Block 41	(Hampton Properties, Ltd.)	...	...	...	...	...	...	...	...	41·00	22·66	...	...

Do.	...	Block 45	...	Hampton Properties, Ltd.	...	...	...	...	...	52·75	51·75	76·63	...
Do.	...	Block 50	...	(Hampton Properties, Ltd.)	...	...	...	...	...	7·26	6,348·00	3,956·22	...
Do.	...	Block 50	...	Hampton Properties, Ltd. :-	...	...	...	...	...	106·23	671·73	579·99	...
				PPL 138, Edna May Hampton	...	8·00	3·00	...	...	...	22·00	9·70	...
				PPL 222, Hampton Jubilee	...	118·88	103·11	...	...	...	111·88	103·11	...
				PPL 165, Hampton Pride	...	7·23	5·74	...	...	...	7·23	5·74	...
				PPL 183, 184, Melvina leases...	...	...	...	...	...	...	170·00	44·00	...
				PPL 23, Mutooroo Copper Corporation, N.L.	...	738·85	1,361·80	...	...	...	1,048·91	1,992·66	...
				PPL 10, Pernatty Central Mining Co., N.L.	...	100·00	30·38	...	...	...	125·11	42·56	...
				PPL 25, Pioneer	...	...	...	...	...	...	10·40	5·41	...
				PPL 293, Union Jack	...	25·73	4·38	...	...	...	25·73	4·38	...
Do.	...	(5081E)	...	Mineral King	...	...	...	...	...	...	4·75	2·40	...
Do.	...		...	Voided leases	...	...	...	...	...	22·86	305·70	111·90	...
Do.	...		...	Sundry claims	...	5·76	8·40	14·96	...	10·62	230·95	146·21	...
Kalgoorlie	...	(5168E)	...	Albert	...	...	...	...	...	...	16·00	1·90	...
Do.	...	5166E	...	Black Princess	...	86·96	23·35	...	...	...	86·96	23·35	...
Do.	...	796E, (1228E)	...	(Bonnie Lass leases)	...	...	...	...	...	160·69	6,011·00	5,945·22	...
Do.	...	796E, (1228E), (3771E)	...	Bonnie Lass leases	...	...	...	...	...	...	16,329·65	8,403·33	...
Do.	...	5279E	...	Cassidy's Hill	...	52·00	38·38	...	...	...	52·00	38·38	...
Do.	...	4557E	...	Corn Cob	...	...	...	...	...	...	87·65	41·58	...
Do.	...	(5101E)	...	Corn Cob North	...	...	...	...	...	...	41·00	7·20	...
Do.	...	(4585E)	...	(Creswick)	...	...	...	...	...	...	88·00	78·65	...
Do.	...	(4585E), (4597E), (4598E)	...	Creswick leases	...	864·00	523·55	...	...	...	4,784·00	3,072·21	...
Do.	...	(4509E)	...	(Enterprise)	...	...	...	...	...	...	219·00	76·49	...
Do.	...	(4609E)	...	Fair Play	...	11·70	22·58	...	...	...	99·91	219·47	...
Do.	...	4546E, 4547E, 4548E	...	Hannans Reward, Ltd.	...	1,356·00	453·34	...	...	5·72	30,647·00	8,300·53	...
Do.	...	796E, (1228E)	...	(Hannans Reward North G.M. Co., N.L.)	...	...	...	...	...	16·87	334·00	247·34	...
Do.	...	4001E, (4035E), 4036E	...	Hidden Secret leases	...	87·50	52·59	...	...	105·65	10,849·25	15,356·42	43,383·29
Do.	...	4586E	...	Hidden Secret West	...	...	...	...	...	...	18·00	2·90	...
Do.	...	4477E	...	Lord Nelson	...	72·00	42·35	...	...	123·27	3,004·54	1,520·85	...
Do.	...	(4587E)	...	Mayman's Consols	...	90·68	57·60	...	...	...	231·43	116·86	...
Do.	...	(5112E)	...	Mite	...	272·00	300·65	...	...	...	360·00	383·34	...
Do.	...	(5160E)	...	North Collier	...	...	...	...	...	...	6·00	4·10	...
Do.	...	4632E	...	North End	...	...	...	...	...	...	24·00	3·30	...
Do.	...	(5099E)	...	Princess Royal South	...	168·41	85·31	...	...	...	168·41	85·31	...
Do.	...	(1228E)	...	(Red, White, and Blue)	...	...	...	...	...	...	130·00	25·56	...
Do.	...	5147E	...	Reservoir	...	63·00	62·50	...	...	...	101·79	79·84	...
Do.	...	(4542E)	...	Successful	...	...	...	...	...	...	20·00	10·12	...
Do.	...	5193E	...	Surprise North	...	89·56	19·49	...	...	...	89·56	19·49	...
Do.	...	4499E	...	Williamstown	...	721·13	484·49	...	...	...	4,116·62	2,058·20	...
Do.	...		...	Voided leases	...	...	...	...	242·48	9,072·33	868,132·15	329,466·47	633·83
Do.	...		...	Sundry claims	...	4,164·44	1,959·66	...	207·69	332·26	29,816·61	8,967·24	...
Wombola	...	4574E	...	Creedon's Welcome	...	38·90	163·39	...	...	...	396·41	1,807·73	...
Do.	...	4600E	...	Daisy	...	9·80	29·60	...	...	...	299·05	1,640·79	...
Do.	...	4555E	...	Dinnie	...	25·30	51·43	...	...	...	370·70	1,234·90	...
Do.	...	4766E	...	Great Hope	...	359·00	3,063·47	...	...	...	359·00	3,063·47	...
Do.	...	4770E	...	Great Hope North	...	595·00	628·31	...	...	...	720·24	1,465·40	...
Do.	...	(4824E)	...	Lass O'Gowrie East Gold Mining Co., N.L.	...	...	...	...	...	...	17·30	8·99	...

TABLE IV.—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 1921.					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(2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons(2,240lbs.)	Fine ozs.	Fine ozs.
Wombola ...	(4607E) ...	Little Jean ...	...	...	...	...	...	...	53·00	280·06	...	
Do. ...	4774E ...	Mount View: McCahon's Treasure G.M. Co., N.L.	...	...	...	...	...	...	7·80	9·07	...	
Do. ...	5263E ...	Scotch Star ...	...	1,254·05	...	...	...	1,254·05	...	...	...
Do. ...	...	Voided leases ...	...	...	...	...	...	613·86	4,935·13	3,501·03	...	
Do. ...	...	Sundry claims ...	...	4·15	80·25	160·81	...	4·15	742·91	791·71	...	
<i>From District generally:—</i>												
		Sundry claims ...	...	...	...	...	...	10,907·93	431·95	5,208·00	1,560·12	...
		Sundry parcels treated at:										
		Adeline Works ...	...	...	...	...	...	42·64	35·12	127·90	20,900·12	...
		Associated Northern Works ...	...	...	...	...	...	...	...	...	287·41	...
		Bonnie Lass leases ...	...	...	...	...	...	...	...	55·00	1,297·73	...
		Brownhill Consols Works ...	...	...	27·12	13·06	...	...	...	780·38	45,161·54	...
		Dunstan and Cumming's Works ...	...	...	...	286·20	450·00	...	...	...	9,244·56	1,644·00
		Fremantle Trading Co., Ltd., Works ...	...	...	...	907·83	328·55	...	...	...	10,742·36	7,925·45
		Hainault Sulphide Plant ...	...	...	...	255·54	...	...	...	...	2,055·14	711·79
		Hannans Central Lakeside Works (A.W.A. Slimes Plant)	...	...	...	...	...	...	...	58·06	4,788·43	...
		Hannans Central Works ...	...	...	...	1,663·87	...	...	...	142·80	63,508·97	67·17
		Kalgurli G.Ms., Ltd. ...	...	...	...	261·40	...	...	...	7·44	658·04	...
		Lone Hand Works ...	...	...	...	74·17	...	...	14·43	200·00	1,511·47	...
		North Kalgurli Battery ...	...	...	...	...	...	...	...	...	810·22	...
		Various Works ...	...	...	...	...	...	341·72	15·15	38,756·72	75,908·77	1,968·67
		Reported by Banks and Gold Dealers ...	134·33	...	...	...	...	11,114·57	9,013·32	...	4·57	...
		Total ...	134·33	1,323·25	635,721·69	376,887·04	85,961·73	27,601·61	32,709·43	28,515,573·39	18,055,447·76	1,807,041·85

BULONG DISTRICT.

Balagundi ...	...	Voided leases ...	...	...	...	...	...	2,408·98	1,110·68	1,473·73	12·92
Do. ...	...	Sundry claims ...	...	...	53·00	23·40	...	120·34	268·40	221·31	...
Bulong ...	...	Voided leases ...	...	...	...	...	...	107·54	8,433·70	99,606·01	82,419·97
Do. ...	...	Sundry claims ...	...	3·58	7·27	6·69	...	1,648·60	991·51	6,847·03	14,550·04
Hogan's Find	...	Voided leases ...	...	...	...	...	...	908·82	309·50	276·51	...
Majestic ...	(1172y) ...	Godkin Gold Mine ...	...	...	3·30	2·90	...	...	...	3·30	2·90
Do. ...	...	Voided leases ...	...	...	...	...	...	...	1,001·25	318·78	...
Do. ...	...	Sundry claims ...	...	...	26·00	3·07	...	43·20	77·90	30·04	...

Mt. Monger ...	(1124y) ...	Golden Shovel East ...	...	...	...	...	...	...	...	...	7-00	9-90	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	1,862-57	1,121-35	969-69	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	215-60	...	369-80	302-47	...
Randalls ...	...	Voided leases ...	...	...	...	...	...	...	...	60-04	31,820-04	10,645-98	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	20-45	...	1,893-55	486-04	...
Sudden Jerk...	...	Voided leases ...	...	...	...	...	...	...	...	63-91	14-25	53-67	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	...	15	10-23	...
Taurus ...	...	Voided leases ...	...	...	...	...	...	...	...	2-06	3-70	1,678-15	760-83
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	112-69	...	276-00	411-01	...
Trans Find ...	1174y ...	Triangle ...	...	...	4-50	31-63	...	...	...	...	4-50	31-63	...
Woodline ...	...	Voided leases ...	...	...	...	...	...	...	...	...	792-75	610-57	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	...	39-33	61-57	...
<i>From District generally:—</i>			...	...	...	...	...	...	...	...	...	...	...
Sundry claims ...			...	...	...	...	...	...	5-64	41-85	790-75	284-26	...
Sundry Parcels treated at:			...	...	...	...	...	...	...	...	6,102-15	5,848-25	...
Various Works ...			...	...	...	...	...	...	...	...	...	...	...
Reported by Banks and Gold Dealers			...	14-03	...	...	...	...	24,487-34	52-39	...	...	...
Total ...			...	14-03	3-58	94-07	67-69	...	26,599-92	14,991-01	154,133-84	119,779-38	12-92

Coolgardie Goldfield.

COOLGARDIE DISTRICT.

Bonnievale ...	4554 ...	Lorna ...	...	...	8-00	3-08	...	...	...	8-36	343-75	333-45	...
Do. ...	4600 ...	Melva Maie ...	...	...	21-00	128-39	...	...	...	...	71-00	288-66	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	16-64	350,509-09	187,753-75	...
Do. ...	...	Sundry claims ...	...	...	29-50	222-41	...	...	...	23-54	1,975-18	1,387-97	...
Bulla Bulling	...	Voided leases ...	...	...	...	...	...	...	...	...	612-38	346-15	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	12-82	314-60	182-17	...
Burbanks ...	(134), (135), (136), (1527), (1705), (2761), (3571), (3661), (3806), (3996), (4025), (4032)	(Burbanks Birthday Gift G.M., Ltd.)	...	...	...	...	...	...	...	...	132,706-00	126,351-59	...
Do. ...	(134), (135), (136), (1527), (1705), (2761), (3571), (3661), (3806), (3996), (4025), (4032)	(Burbanks Birthday G.Ms., Ltd.)	...	...	...	...	...	...	...	...	36,677-20	25,186-99	334-85
Do. ...	(134), (135), (136), (1527), (2761), (3571), (3661)	Burbanks Birthday G.Ms., Ltd.	...	...	...	...	...	...	...	...	34,992-18	22,337-68	89-38
Do. ...	(2160) ...	Lady Robinson ...	...	...	...	...	...	...	...	...	5,733-00	2,233-49	...
Do. ...	(2160) ...	(Lady Robinson)	...	...	...	...	...	...	...	...	5,315-40	3,327-12	...

TABLE IV.—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 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Burbanks ...	(2160), (3950), (4125)	(Lady Robinson G.M. Co., N.L.) ...	...	...	...	...	...	...	...	16,823·50	7,797·88	...
Do. ...	4623 ...	National ...	...	...	128·00	220·09	...	...	...	376·00	487·14	...
Do. ...	4601 ...	Victor ...	...	11·35	37·00	30·29	...	...	11·35	55·50	61·10	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	13·36	331·61	174,831·33	113,206·94
Do. ...	...	Sundry claims ...	...	...	319·00	259·58	...	...	43·37	141·95	4,388·50	3,521·38
Cave Rocks ...	...	Voided leases ...	...	...	...	...	...	...	...	132·00	28·04	...
Coolgardie ...	5127 ...	Bayley's Reward ...	...	...	57·50	44·74	...	...	...	57·50	44·74	...
Do. ...	4559 ...	Cockshot ...	...	56·03	18·00	3·25	...	...	182·77	283·43	696·92	...
Do. ...	4555 ...	(Dreadnought) ...	...	...	...	...	...	...	...	867·85	870·10	...
Do. ...	4555, 4561, (4563), 5065	Dreadnought leases ...	...	...	267·55	466·43	...	...	...	725·47	840·26	...
Do. ...	4567 ...	Griffith's Gold Mine ...	...	...	2,994·00	299·06	...	...	1·70	17,782·00	2,042·20	...
Do. ...	Block 59 ...	Hampton Gold Mining Areas, Ltd. P.P.L. 119—Golden Eagle ...	...	...	9·00	1·57	...	...	...	9·00	1·57	...
Do. ...	Block 35 ...	Hampton Plains Estate, Ltd. ...	...	...	56·34	62·19	...	...	...	56·34	62·19	...
Do. ...	Block 49 ...	Hampton Plains Estate, Ltd. ...	...	...	...	...	...	...	10·94	150·00	157·31	...
Do. ...	Block 53 ...	Hampton Plains Estate, Ltd. ...	...	...	...	...	...	...	358·42	67·00	112·49	...
Do. ...	Block 59 ...	(Hampton Plains Estate, Ltd.) ...	...	...	...	...	...	...	4·12	8,008·25	7,194·52	...
Do. ...	4556 ...	Lady Carmen ...	...	...	...	...	...	...	74·83	833·38	392·63	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	1,299·02	4,237·04	539,885·78	316,497·14
Do. ...	...	Sundry claims ...	...	131·23	2,780·75	533·46	...	...	86·14	1,999·45	35,522·74	14,092·17
Eundynie ...	...	Voided leases ...	...	...	...	...	...	...	...	29,812·50	14,966·76	1·75
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	117·00	31·11	...
Gibraltar ...	4586 ...	Carlton ...	...	15·28	53·00	27·91	...	...	15·28	362·00	483·43	...
Do. ...	4604 ...	Limerick ...	...	...	37·00	14·70	...	...	...	97·00	37·49	...
Do. ...	4580 ...	Lloyd George ...	...	...	...	...	...	...	...	341·75	289·27	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	970·75	609·91	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	48·55	613·25	358·42	...
Gnarlbine ...	...	Voided leases ...	...	...	...	...	...	...	10·94	1,899·75	1,049·90	...
Do. ...	...	Sundry claims ...	...	...	5·00	1·90	...	...	1·31	189·75	99·26	...
Higginsville ...	...	Voided leases ...	...	...	...	...	...	...	287·26	32,116·00	14,841·36	134·79
Do. ...	...	Sundry claims ...	...	...	52·00	22·51	...	...	16·52	772·90	515·40	...

Londonderry	(4594)	...	Cheapside	...	...	45-00	13-14	...	...	250-50	131-99	...
Do.	4545	...	Royal Standard	...	...	96-94	102-01	...	...	578-69	857-41	...
Do.	...	...	Voided leases	...	...	...	...	...	46-25	26,237-66	17,510-31	...
Do.	...	...	Sundry claims	...	...	48-50	73-91	...	6-00	1,680-85	1,439-97	...
Mungari	...	...	Voided leases	...	...	...	...	...	17-71	735-00	331-78	...
Do.	...	...	Sundry claims	...	...	6-50	4-13	...	107-82	346-51	204-90	...
Paris	4669	...	Coo-ee	...	...	107-50	159-17	...	...	107-50	287-82	...
Do.	4673	...	Saltbush	...	...	...	...	...	4-30	...	...	...
Red Hill	(4609)	...	E.F.G.	...	...	4-20	6-60	...	...	4-20	6-60	...
Do.	...	...	Voided leases	...	...	...	...	...	1,541-48	40,793-20	31,064-05	...
Do.	...	...	Sundry claims	...	...	...	...	...	34-62	160-42	287-90	...
Ryan's Find	5120	...	Undaunted	...	...	7-00	9-14	...	...	7-00	9-14	...
Do.	...	...	Voided leases	...	...	...	...	...	...	47-16	142-55	...
Do.	...	...	Sundry claims	...	...	12-00	6-50	...	44	87-69	226-64	...
St. Ives	(5086)	...	Botinger	...	...	17-50	8-43	...	...	17-50	8-43	...
Do.	4905	...	Brennan's Idough	...	12-18	...	...	...	12-18	...	...	...
Do.	(4849)	...	Guiding Star	...	...	...	...	...	...	...	1-56	...
Do.	(4971)	...	Iolanthe	...	...	...	...	...	1-51	...	...	...
Do.	4732	...	Ives Lake View Reward Junction	...	...	10-00	52-13	...	...	10-00	52-13	...
Do.	(4942)	...	Southern Light	...	...	...	...	...	1-24	...	...	...
Do.	4714	...	Triumph	...	...	25-00	4-46	...	...	25-00	4-46	...
Do.	4638	...	Victory North West	...	...	72-50	67-47	...	...	72-50	67-47	...
Do.	...	...	Sundry claims	...	...	34-00	10-31	...	...	36-17	11-93	...
Widgiemooltha	5108	...	Ada V.	...	20-59	...	...	...	20-59	...	...	...
Do.	4028	...	Flinders	...	9-42	14-00	41-43	...	66-67	532-60	2,686-32	...	
Do.	5000	...	Great Reward	...	...	121-50	134-81	...	...	144-50	146-29	...
Do.	5082	...	Guest	...	...	22-00	90-51	...	...	22-00	90-51	...
Do.	4923	...	Host	...	...	33-00	20-30	...	...	41-60	25-58	...
Do.	(4956)	...	Logan's North	...	...	12-00	3-93	...	...	12-00	3-93	...
Do.	(4694)	...	Mistletoe	...	...	20-20	8-80	...	...	31-45	13-37	...
Do.	(5114)	...	Rebel	...	...	...	...	9-42	10-65	...	...	...
Do.	(5110)	...	Silver Lady	...	...	20-00	4-45	...	...	20-00	4-45	...
Do.	(4904)	...	Yunganjarra	...	...	10-00	6-70	...	...	10-00	6-70	...
Do.	...	...	Voided leases	...	...	...	...	...	763-97	8,678-28	3,656-20	17
Do.	...	...	Sundry claims	...	...	309-36	384-35	...	9-21	64-53	1,747-70	...
<i>From District generally :-</i>													
Sundry Parcels treated at:													
Burbanks Main Lode Works													
Fremantle Trading Co., Ltd., Works													
Highgate Battery													
Imperial Battery													
Lady Robinson Cyanide Works													
State Battery—Coolgardie													
Various Works													
Reported by Banks and Gold Dealers													
				62-78					7,480-45	543-04			
Total				62-78	256-08	7,938-34	4,310-68	...	8,948-72	11,038-40	1,526,178-13	960,379-34	881-79

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued

COOLGARDIE GOLDFIELD—continued.

KUNANALLING DISTRICT.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					TOTAL PRODUCTION						
			Alluvial.	Dolled and Specimens.	Ore treated.	Gold therefrom.	Silver.	Alluvial	Dolled and Specimens.	Ore treated.	Gold therefrom.	Silver.		
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.		
Balgarrie	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Carbine	33s	(Carbine) ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	33s, 710s, 711s, 807s, 863s, 890s	Carbine leases ...	...	...	1,670.00	3,562.05	...	...	...	...	...	...	...	...
Do.	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Carnage	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Cashman's (Siberia)	716s [1289w]	Lady Evelyn ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Chadwin	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Dunnsville	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Jourdie Hills	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Kandana	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Kintore	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
Siberia	...	Voided leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	...	...	...	...	...
25-Mile	696s	(Blue Bell) ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	727s	(Blue Bell Extended) ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	696s, 727s	Blue Bell leases ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	845s	Sadie ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	(871s)	Shamrock ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	645s	Star of Fremantle ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	602s	Sydney Mint ...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	847s	Turn of the Tide ...	...	...	...	...	...	...	...	...	...	...	...	...

Do. ...	...	Voided leases ...	...	...	...	...	...	...	453·30	87,359·49	66,468·64	18·84
Do. ...	...	Sundry claims ...	...	...	17·47	203·50	280·36	...	115·68	6,649·45	3,681·94	...
<i>From District generally:—</i>													
Sundry Parcels treated at:													
		Blue Bell Battery ...	...	...	...	...	47·00	...	3·77	72·00	1,688·62	...
		Stanley Works ...	...	...	...	...	...	...	14·86	402·60	384·93	...
		Various Works ...	...	...	...	...	...	...	9·22	1,276·66	2,006·02	...
		Reported by Banks and Gold Dealers	...	...	...	...	...	...	264·19	1·10	...	...
		Total	77·33	3,295·68	4,840·87	...	731·79	5,113·83	275,053·41	211,009·98	48·67

Yilgarn Goldfield.

Blackbourne...	...	Voided leases ...	...	...	...	...	...	...	...	1,282·50	341·37	...
Bullfinch ...	914, 915, 916, 926, 928, 942, 960	(Bullfinch leases) ...	...	...	...	...	...	...	...	1,027·52	10,958·88	...
Do. ...	914, 915, 916, 926, 928, 930, 942, 960	Bullfinch Proprietary (W.A.), Ltd. ...	...	...	9,465·00	3,042·72	970·00	...	...	477,968·42	166,223·11	27,833·41
Do. ...	...	Voided leases ...	...	...	...	...	...	...	3·57	360·65	364·67	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	55·15	71·29	...
Corinthian ...	896, (934), (946)	Corinthian North G.Ms., Ltd. ...	...	...	...	...	...	...	...	131,222·00	27,795·29	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	...	3,286·00	1,529·54	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	104·50	77·35	...
Ennuin ...	...	Voided leases ...	...	...	...	...	...	...	...	134·56	361·34	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	117·00	72·12	...
Forrestonia ...	2909	Great Southern ...	...	...	428·00	93·57	...	...	...	505·00	151·83	...
Do. ...	3180	Great Southern West G.M. Co., N.L. ...	...	...	96·00	10·01	...	...	...	96·00	10·01	...
Golden Valley	2272	Glide Away ...	...	...	190·00	183·68	...	...	...	1,984·00	2,225·91	...
Do. ...	2948	Greenharp New ...	...	...	110·00	32·97	...	...	...	736·50	839·01	...
Do. ...	2994	Radio ...	...	...	204·80	991·73	...	...	...	1,540·80	4,568·42	...
Do. ...	(3138)	Rona Daphne ...	...	...	...	...	...	...	...	92·00	215·54	...
Do. ...	(2739)	Rosalie ...	...	...	...	...	...	...	...	383·75	253·14	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	18·05	4,718·99	4,751·23	2·00
Do. ...	...	Sundry claims ...	...	...	8·50	12·04	...	...	2·75	1,960·72	1,645·59	...
Greenmount...	3179	Jean Nichol ...	...	...	57·00	60·23	...	...	...	186·00	213·60	...
Do. ...	550	(Sunbeam) ...	...	...	...	...	...	14·00	...	4,472·00	1,427·25	...
Do. ...	550	Sunbeam ...	...	...	...	...	...	...	...	200·00	100·14	...
Do. ...	550, (565)	(Sunbeam leases)	...	...	...	...	...	...	...	3,191·00	816·42	...
Do. ...	536	(Transvaal) ...	...	...	...	...	...	...	...	30,233·00	7,340·62	579·78
Do. ...	536	Transvaal ...	...	...	...	...	...	...	...	3,088·00	830·09	...
Do. ...	536, (1358)	(Transvaal leases)	...	...	...	...	...	...	...	11,924·00	2,891·60	...
Do. ...	3201	Triumph ...	...	...	23·00	29·76	...	...	...	69·50	70·81	...
Do. ...	...	Voided leases ...	...	...	...	...	...	31·99	21·62	70,374·00	17,488·46	364·72
Do. ...	...	Sundry claims ...	...	...	25·00	8·76	...	...	4·12	844·50	312·57	...
Hope's Hill ...	2544	Colleen Bawn ...	...	15·26	...	...	...	...	15·26	360·20	1,570·76	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	56·97	129,884·85	33,899·78	1·00
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	25·38	1,622·50	506·06	...

TABLE IV.—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 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
• Kennyville ...	911, 3170, 3171 ...	Edna May Battler G.M. Co., N.L. ...	...	...	5,050·00	1,195·61	...	...	...	5,850·00	1,296·38	...
Do. ...	570 ...	(Great Leviathan) ...	...	...	...	...	...	...	...	3,821·85	2,948·67	...
Do. ...	570 ...	Great Leviathan ...	...	...	71·00	30·09	...	...	...	5,793·00	3,664·67	50
Do. ...	570 ...	(Great Leviathan: Northern Blocks Syndicate, Ltd.)	...	...	...	...	...	...	...	10,705·00	2,974·64	...
Do. ...	911 ...	(Trafalgar) ...	...	...	...	...	...	...	...	1,984·00	1,499·02	...
Do. ...	3164 ...	Wallace: New Trafalgar G.M. Co., N.L.	...	...	75·00	13·65	...	...	...	75·00	13·65	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	18·76	3,487·50	2,405·25	09
Do. ...	...	Sundry claims ...	...	2·87	254·50	113·30	...	...	2·87	717·50	321·75	...
Koolyanobbing	...	Voided leases ...	...	...	...	...	...	...	...	308·00	116·74	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	55·00	11·24	...
Marvel Loch...	3069 ...	(Banker) ...	...	...	...	...	...	...	...	1,043·00	926·75	...
Do. ...	923 ...	Bohemian ...	...	...	295·00	356·06	...	...	19·66	4,257·00	4,060·50	...
Do. ...	(1689) ...	(Bronco) ...	...	...	...	...	...	...	...	217·00	22·17	...
Do. ...	(1689) ...	Bronco: Bronco Horseshoe Proprietary Mining Co., N.L.	...	...	...	...	...	...	...	2,921·00	847·59	...
Do. ...	3217, 3222 ...	Firelight leases ...	...	...	690·00	204·80	...	...	...	690·00	204·80	...
Do. ...	3069, 3151, 3152, 3157, 3213	Golden Butterfly G.M. Co., N.L.	...	...	4,425·00	2,044·82	...	...	...	4,425·00	2,044·82	...
Do. ...	719 ...	(Great Victoria) ...	...	...	...	...	...	...	...	1,356·00	281·53	...
Do. ...	719, 944, 945, 1227, 1228, 1606	Great Victoria leases	...	...	...	...	...	...	...	128,784·26	17,540·60	...
Do. ...	(3161) ...	Lucky Seven ...	...	...	...	...	...	...	...	58·00	19·11	...
Do. ...	852 ...	May Queen ...	...	...	...	...	...	...	4·07	825·50	4,127·76	...
Do. ...	3186 ...	Never Never ...	...	...	...	...	...	...	...	1,843·00	324·43	...
Do. ...	3225 ...	Research ...	...	...	135·00	37·58	...	...	...	135·00	37·58	...
Do. ...	(1011) ...	Rising Star ...	...	...	...	...	...	...	...	140·00	11·48	...
Do. ...	3143 ...	Scotch Lassie Amalgamated	...	...	125·00	25·01	...	...	...	125·00	25·01	...
Do. ...	2998 ...	St. George ...	...	...	...	...	...	...	...	2,500·00	912·82	...
Do. ...	(3190) ...	Undaunted ...	...	...	...	...	...	...	...	150·00	21·91	...
Do. ...	3011 ...	Victory ...	...	...	274·00	137·54	...	...	...	1,040·00	638·54	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	80·78	233,409·00	82,509·45	771·03
Do. ...	...	Sundry claims ...	...	8·72	270·00	138·52	...	...	7·72	9,711·49	5,002·94	...
Mt. Jackson ...	(2053) ...	Great Unknown ...	...	...	...	...	...	...	37·22	1,394·93	3,608·73	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	77·66	35,791·10	24,067·74	2,305·28
Do. ...	...	Sundry claims ...	...	...	...	...	...	4·42	25·43	1,481·75	1,062·53	...
Mt. Rankin ...	...	Voided leases ...	...	...	...	...	...	3·84	5·20	496·00	122·17	...
Do. ...	...	Sundry claims ...	...	...	...	...	...	...	...	170·00	54·38	...
Parker's Range	2801 ...	Scots Greys ...	...	...	100·00	35·30	...	...	...	901·00	345·04	...

Do.	724	(Spring Hill)								3,232.00	607.21			
Do.	724 (760)	(Spring Hill leases)								8,910.00	2,215.59			
Do.	724, 2633, (2793)	Spring Hill G.M. Co., N.L.								1,288.00	215.87			
Do.	2951	White Horseshoe			56.00	15.32				1,770.50	1,633.24			
Do.		Voided leases			112.00	113.86				13,686.25	10,013.04			
Do.		Sundry claims							105.14	1,908.75	1,305.51			
Southern Cross		Voided leases							2.13	211.22	433,160.20	211,594.62	364.41	
Do.		Sundry claims			900.00	5.72			5.50	595.45	3,835.10	1,161.99		
Weston's	2180	(Edna May)									581.00	919.27		
Do.	2291, 2585, 2615	Edna May Central G.M.s, N.L.			1,694.00	3,102.07					138,351.00	62,658.75	19.38	
Do.	2570, (2617), 2644	Edna May Consolidated G.M. Co., N.L.			218.00	426.71	2.20				22,559.00	9,448.51	2.20	
Do.	2168, 2238, 2777	Edna May Deep Levels G.M. Co., N.L.			7,900.00	5,278.10					42,748.00	32,388.88		
Do.	(2608), (2716), (2831)	Edna May Golden Point, N.L.			270.00	241.88					846.00	829.36		
Do.	2180, (2605)	Edna May G.M. Co., N.L.			169.00	147.32					191,993.00	171,472.76		
Do.	3097	Le Trois			45.00	42.77					177.00	169.42		
Do.	2291	(Myrtle Central)									751.00	243.96		
Do.	2168, 2238	(Myrtle Consols leases)									4,009.00	3,696.32		
Do.	2570	(Myrtle East)									202.00	116.12	20	
Do.	(2816)	Pertha M.			55.00	50.85					1,076.00	842.58		
Do.	3226	Royal Flush			149.00	89.99					149.00	89.99		
Do.		Voided leases								4.06	13,347.02	7,590.53		
Do.		Sundry claims		40.74	200.00	182.38				52.91	1,038.75	1,045.95		
<i>From Goldfield generally :-</i>														
Sundry Parcels treated at :														
		Fremantle Trading Co., Ltd., Works									21.28	592.34	33.90	
		Glide Away Battery				110.99						110.99		
		Great Victoria Cyanide Works				15.36						5,847.54		
		Greenfinch Proprietary G.M. Works										2,387.29		
		Hainault Sulphide Plant, Kalgoorlie										18.58		
		Howlett's Battery				118.50						357.64		
		Marvel Loch Mining Co., N.L.										4,711.07		
		Never Never Works				129.74						1,512.64		
		Spring Hill Works				154.99						773.10		
		Sunbeam Battery				23.17					8.00	6,354.02		
		Violet Works				29.66						998.34		
		Various Works										97.00	18,377.75	2.64
		Reported by Banks and Gold Dealers							22.05	3.53				
		Total			67.59	33,342.80	19,173.91	972.20	91.65	1,469.21	2,236,432.34	1,016,296.96	32,280.54	

Dundas Goldfield.

Buldan		Voided leases								3.02	846.05	708.99	
Do.		Sundry claims								36.53	341.27	519.77	
Dundas		Voided leases									4,543.23	2,208.48	
Do.		Sundry claims								385.37	182.50	143.88	
Killaloe		Voided leases									20.65	6.88	
Norseman	1294	Esperanto			10.00	3.00					10.00	3.00	
Do.	903, 1138, 1253...	Great Boulder Proprietary G.M.s., Ltd.			148.63	268.82					148.63	268.82	
Do.	(1277)	Hardy Junction			49.75	68.54					132.75	169.25	
Do.	1209	Hoffmann's Gold Mines			248.50	66.38					1,204.75	751.66	

TABLE IV.—Production of Gold and Silver from all sources, etc.—continued.

PHILLIPS RIVER GOLDFIELD—continued.

MINING CENTRE.	NUMBER OF LEASE.	REGISTERED NAME OF COMPANY OR LEASE.	TOTAL FOR 1921.					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 (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Ravensthorpe	M.L. 16 ...	Marion Martin ...	...	...	...	...	...	...	...	240·70	...
Do.	M.L. 16 ...	(Marion Martin: Phillips River Gold and Copper Co., Ltd.)	...	...	...	...	...	...	...	275·33	205·97
Do.	M.L. 15 ...	(Mt. Cattlin)	...	...	...	...	...	49	200·00	85·50	...
Do.	M.L. 15 ...	Mt. Cattlin	...	...	...	...	...	...	...	789·34	...
Do.	M.L. 15 ...	(Mt. Cattlin: Mt. Cattlin Copper Mining Co., Ltd.)	...	...	...	...	...	...	...	1,496·92	52·92
Do.	M.L. 15 ...	(Mt. Cattlin: Phillips River Gold and Copper Co., Ltd.)	...	...	...	...	...	...	...	387·33	...
Do.	M.L. 15 ...	(Mt. Cattlin: Phillips River Gold and Copper Co., Ltd.)	...	...	...	...	...	...	...	3,077·08	3,814·45
Do.	M.L. 342 ...	Surprise ...	...	...	...	...	...	...	...	32·55	...
Do.	...	Voided leases ...	...	...	...	...	...	141·31	21,716·76	18,731·63	310·73
Do.	...	Sundry claims	38·00	{ 14·53 * 10·66 }	...	157·82	6·60	2,035·18	1,264·33	20·65
West River	...	Voided leases ...	...	...	...	...	...	...	...	10·34	31·06
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	3·29	3·44
<i>From Goldfield generally:—</i>												
Sundry Parcels treated at:												
Gem Battery	138·89	...
Phillips River Smelter	385·96	493·66
Two Boys Works	100·95	...
Various Works	4·76	...
Reported by Banks and Gold Dealers			...	...	...	...	...	122·05	...	...	...
Total	1,072·22	865·75	...	472·20	781·93	90,869·29	86,676·37	15,688·17

* From Copper Ore.

† Donnybrook Goldfield.

Donnybrook	...	Voided leases ...	...	...	...	...	...	23·24	...	1,613·30	816·23	...
Do.	...	Sundry claims ...	...	...	...	...	...	...	...	40·00	2·29	...
Total ...			...	...	...	...	...	23·24	...	1,653·30	818·52	...

State generally.

Coobana Creek	...	Voided leases ...	...	...	...	...	...	...	53·66	...	...	...
	Sundry Parcels treated at:											
		Fremantle Trading Co., Ltd., Fremantle	...	...	...	99·85	87·77	...	...	...	3,019·56	9,435·22
		Hainault Sulphide Plant, Kalgoorlie	...	...	...	...	...	...	...	...	21·28	...
		State Smelter, Ravensthorpe	...	...	...	...	...	...	...	...	41·20	...
		Various Works	...	...	...	...	...	...	...	27·00	4,411·14	481·77
		Sundry Specimens	...	...	...	...	...	...	2·87	...	...	...
		Reported by Banks and Gold Dealers	...	...	...	...	...	124·89	153·03	...	...	...
		Total	...	...	...	99·85	87·77	124·89	209·56	27·00	7,493·18	9,916·99

† Abolished 4th March, 1908.

TABLE VI.

COMPARATIVE RETURN OF GOLD BULLION ENTERED FOR EXPORT AND RECEIVED AT THE PERTH BRANCH OF THE ROYAL MINT, DURING THE YEARS 1919, 1920, AND 1921, SHOWING IN FINE OUNCES THE QUANTITY RECORDED EACH MONTH, AND ITS VALUE.

MONTHS AND QUARTERS.	1919.				1920.				1921.			
	EXPORT.	MINT.	TOTAL.	VALUE.	EXPORT.	MINT.	TOTAL.	VALUE.	EXPORT.	MINT.	TOTAL.	VALUE.
	fine ozs.	fine ozs.	fine ozs.	£ s. d.	fine ozs.	fine ozs.	fine ozs.	£ s. d.	fine ozs.	fine ozs.	fine ozs.	£ s. d.
JANUARY ... ..	...	69,953·61	69,953·61	297,144 0 11½	836·72	25,670·66	26,507·38	112,596 3 10½	523·90	50,934·68	51,458·58	218,582 3 1
FEBRUARY	733·10	66,310·48	67,043·58	284,733 0 6½	1,927·85	49,452·81	51,380·66	218,251 3 5	684·87	26,872·92	27,557·79	117,058 1 0½
MARCH ... ..	...	66,158·54	66,158·54	281,023 12 3½	...	54,020·93	54,020·93	229,466 6 6	10·83	47,875·64	47,886·47	203,408 15 10½
1st January to 31st March ...	733·10	202,422·63	203,155·73	862,950 13 9½	2,764·57	129,144·40	131,908·97	560,313 13 9½	1,219·60	125,683·24	126,902·84	539,049 0 0
APRIL	32·96	63,464·81	63,497·77	269,721 7 7½	835·05	56,256·47	57,091·52	242,509 7 2½	670·94	46,602·38	47,273·32	200,804 6 0
MAY	524·99	63,654·55	69,179·54	293,856 0 1½	227·15	50,976·12	51,203·27	217,497 13 3½	474·94	47,638·48	48,113·42	204,372 16 4½
JUNE	1,050·48	73,546·47	74,596·95	316,867 14 0½	502·15	56,679·78	57,181·93	242,893 8 0	153·91	28,194·14	28,348·05	120,414 17 3
1st January to 30th June ...	2,341·53	408,088·46	410,429·99	1,743,395 15 7½	4,323·92	293,056·77	297,385·69	1,263,214 2 4	2,519·39	248,118·24	250,637·63	1,064,640 19 7½
JULY	680·07	68,028·11	68,708·18	291,853 15 11½	...	48,341·22	48,341·22	205,340 9 0	1,641·31	44,917·02	46,558·33	197,767 4 3½
AUGUST	835·49	58,117·09	58,952·58	250,414 12 10½	167·61	54,258·14	54,425·75	231,185 17 9½	110·97	51,731·26	51,842·23	220,211 15 11
SEPTEMBER ... ..	...	36,241·61	36,241·61	153,944 11 5½	141·25	54,798·76	54,940·01	233,370 6 7	380·43	50,728·16	51,108·59	217,095 9 9½
1st January to 30th September ...	3,857·09	570,475·27	574,332·36	2,439,608 15 10½	4,637·78	450,454·89	455,092·67	1,933,110 15 8½	4,652·10	395,494·68	400,146·78	1,699,715 9 7½
OCTOBER	585·71	64,987·11	65,572·82	278,535 12 8½	174·15	53,801·21	53,975·36	229,272 15 1½	1,910·42	51,286·91	53,197·33	225,967 17 10½
NOVEMBER	1,171·33	64,823·40	65,994·73	280,327 15 10½	128·09	54,729·33	54,857·42	233,019 10 2	156·75	46,429·46	46,586·21	197,885 12 10
DECEMBER	831·76	27,334·12	28,165·88	119,641 1 0½	321·11	53,595·57	53,916·68	229,023 9 11½	451·47	53,348·87	53,800·34	228,529 6 4½
Total	6,445·89	727,619·90	734,065·79	3,118,113 5 6½	5,261·13	612,581·00	617,842·13	2,624,426 11 0	7,170·74	546,559·92	553,730·66	2,352,098 6 8½

TABLE VII.

MONTHLY RETURN OF GOLD, CONTAINED IN BULLION, FURNACE PRODUCTS, AND ORE, ENTERED FOR EXPORT DURING 1921.

MONTH.	UNITED KINGDOM.			VICTORIA.			NEW SOUTH WALES.			SOUTH AUSTRALIA.			TOTALS.			Minted Gold Exported*
	Bullion.	Furnace Products.	Ore.	Bullion.	Furnace Products.	Ore.	Bullion.	Furnace Products.	Ore.	Bullion.	Furnace Products.	Ore.	Bullion.	Furnace Products.	Ore.	
1921.	Fine ozs.	Estimated fine ozs.	Estimated fine ozs.	Fine ozs.	Estimated fine ozs.	Estimated fine ozs.	Fine ozs.	Estimated fine ozs.	Estimated fine ozs.	Fine ozs.	Estimated fine ozs.	Estimated fine ozs.	Fine ozs.	Estimated fine ozs.	Estimated fine ozs.	Fine ozs.
January	97·65	...	426·25	...	...	...	...	...	426·25	97·65	...
February	362·65	125·16	...	...	197·06	...	...	...	...	362·65	322·22	...	66·00
March	10·83	...	...	...	...	...	...	...	...	10·83	44·47
April	4·89	...	...	...	...	...	666·05	...	...	...	...	...	670·94	...	...
May	16·65	...	...	...	...	458·29	...	...	...	...	...	458·29	16·65	40·68
June	153·91	...	...	...	...	...	153·91	...	...
July	1,641·31	...	...	...	...	...	1,641·31	...	...
August	110·97	...	...	...	...	...	110·97	...	29·34
September	380·43	...	...	...	...	...	380·43	...	...
October	1,910·42	...	...	...	...	...	1,910·42	...	...
November	156·75	...	...	...	...	...	156·75	...	41·70
December	451·47	...	...	...	...	...	451·47	...	...
TOTALS	4·89	16·65	362·65	125·16	108·48	...	6,552·91	...	...	...	...	362·65	6,682·96	125·13	222·19

*When considering the total production of gold for this State, these amounts must be disregarded, having been already recorded in the total receipts of gold at the Mint.

TABLE VIII.

RETURN OF GOLD BULLION RECEIVED AT THE PERTH BRANCH OF THE ROYAL MINT FROM MAY, 1899, TO THE 31ST DECEMBER, 1921, SHOWING IN GROSS OUNCES THE QUANTITY OBTAINED FROM THE RESPECTIVE GOLDFIELDS AND OTHER COUNTRIES, AND THE ACTUAL VALUE THEREOF.

Year.	Kimberley.	Pilbara.	West Pilbara.	Ashburton.	Gascoyne.	Peak Hill.	East Murchison.	Murchison.	Yalgoos.
	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.
1899 ...	308·45	529·80	...	281·80	85·65	16,274·00	3,758·07	24,675·64	5,190·05
1900 ...	644·02	7,493·88	137·33	474·26	86·10	18,019·08	32,049·74	48,540·12	8,851·52
1901 ...	663·37	11,279·93	394·38	55·42	18·56	21,351·67	44,746·88	43,024·65	9,191·01
1902 ...	439·93	10,706·03	3,284·37	...	124·86	32,637·17	62,357·98	47,628·18	5,116·94
1903 ...	511·75	14,217·53	6,481·58	135·30	36·29	34,684·27	77,089·29	64,127·18	1,687·99
1904 ...	37·69	8,293·58	5,170·06	150·73	13·10	20,909·99	77,237·31	63,037·71	3,345·82
1905 ...	656·34	16,053·42	1,400·46	50·54	25·65	16,075·36	107,295·17	111,493·34	5,469·06
1906 ...	785·23	6,007·79	915·63	168·30	95·43	2,471·21	115,363·22	133,264·79	5,919·37
1907 ...	431·72	4,924·97	396·22	49·89	10·06	7,057·22	140,382·15	137,713·43	3,815·06
1908 ...	400·19	9,676·11	1,292·97	54·32	37·68	11,679·58	162,243·76	132,066·00	2,625·14
1909 ...	203·59	6,662·82	1,682·49	274·93	8·89	8,823·58	164,652·43	129,139·74	755·31
1910 ...	586·44	7,094·46	1,670·20	208·31	31·67	3,679·72	165,123·37	134,098·94	873·58
1911 ...	183·78	6,033·33	1,014·60	334·38	9·78	165·36	119,267·86	135,342·96	363·85
1912 ...	361·11	7,674·55	912·60	47·77	8·09	237·96	110,585·25	128,679·43	1,410·49
1913 ...	319·55	5,048·77	1,491·66	47·37	...	564·67	96,270·04	139,021·56	3,410·52
1914 ...	238·83	6,750·56	1,538·31	56·09	5·00	104·45	79,785·02	135,990·48	1,705·85
1915 ...	270·76	9,084·52	1,540·93	20·50	81·05	550·77	65,111·82	118,861·14	5,208·56
1916 ...	306·92	8,265·75	692·68	38·34	74·07	190·21	37,169·30	95,071·24	5,320·33
1917 ...	133·03	5,770·70	683·84	25·85	...	...	9,660·88	115,360·36	1,366·18
1918 ...	144·31	3,643·49	339·36	7·87	...	...	949·78	93,501·94	1,090·10
1919 ...	293·46	4,813·34	29·62	4·10	...	71·92	958·91	79,921·84	806·04
1920 ...	164·07	6,589·24	137·59	3·79	4·03	22·62	121·47	70,428·05	307·48
1921 ...	62·45	1,772·78	201·52	28·42	9·39	1·58	97·40	63,808·17	235·89
Total ...	8,146·99	168,387·35	31,408·40	2,518·28	765·35	195,572·39	1,672,277·10	2,244,796·89	74,066·14

Year.	Mt. Margaret.	North Coolgardie.	Broad Arrow.	North-East Coolgardie.	East Coolgardie.	Coolgardie.	Yilgarn.	Dundas.	*Phillips River.
	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.
1899 ...	16,911·54	44,779·38	8,503·50	16,700·90	33,051·33	27,611·24	9,070·70	473·63	...
1900 ...	67,748·45	88,688·14	14,376·10	40,503·12	139,845·60	51,607·26	28,648·51	31,583·20	...
1901 ...	126,703·91	135,493·31	18,829·13	43,055·63	263,514·75	78,026·07	29,433·84	32,825·75	...
1902 ...	144,663·12	182,543·06	15,903·42	53,901·58	636,536·52	94,134·17	25,873·68	31,088·91	5,146·80
1903 ...	148,006·49	197,229·08	21,528·20	42,649·25	685,289·82	82,218·79	26,856·28	40,006·39	6,420·09
1904 ...	143,453·51	166,939·82	24,721·53	39,799·55	699,475·35	73,076·66	35,854·87	37,508·11	2,450·73
1905 ...	184,178·87	175,057·14	18,394·17	48,352·22	737,065·14	74,615·36	30,404·65	32,953·56	1,753·32
1906 ...	166,097·63	130,784·00	20,415·43	37,509·91	742,525·99	73,307·24	30,996·76	24,484·65	1,744·38
1907 ...	183,693·29	86,685·09	16,228·85	30,285·39	766,846·83	73,532·99	27,795·35	27,222·21	1,806·30
1908 ...	175,092·47	90,815·08	9,408·64	28,300·91	779,009·10	48,524·18	22,835·58	48,785·54	4,299·19
1909 ...	163,781·55	80,293·29	5,860·66	29,603·84	747,856·04	43,756·68	25,255·30	43,254·22	4,345·04
1910 ...	158,847·24	73,283·66	386·84	22,967·23	786,209·41	46,054·82	28,945·68	52,068·70	6,056·08
1911 ...	162,319·77	74,536·34	346·78	22,917·38	848,725·06	41,861·54	18,190·20	59,831·49	5,242·16
1912 ...	124,123·10	61,018·13	5·32	17,705·86	876,900·05	51,732·78	33,429·29	52,220·76	4,026·32
1913 ...	107,391·67	73,160·41	10,814·52	13,452·90	867,887·30	42,738·63	76,581·73	47,535·02	4,221·40
1914 ...	125,937·60	89,904·49	3,727·56	6,318·12	824,280·77	26,696·51	99,410·57	47,487·27	480·65
1915 ...	132,819·64	69,318·34	17,810·14	10,808·78	872,406·66	21,593·44	111,539·75	42,283·16	324·48
1916 ...	136,731·10	48,799·86	8,415·40	2,441·68	780,354·90	15,238·33	104,136·12	36,653·26	221·89
1917 ...	136,343·74	34,650·24	11,300·38	936·97	737,833·22	7,968·62	91,168·91	34,685·39	238·50
1918 ...	118,132·80	37,572·67	3,087·67	179·83	695,564·50	8,338·10	84,297·45	29,649·05	494·27
1919 ...	117,763·53	26,692·84	3,455·12	144·34	569,081·41	4,866·10	74,493·69	20,346·85	434·47
1920 ...	103,788·16	14,038·70	6,997·95	440·84	507,113·25	5,035·18	45,007·22	9,865·14	43·29
1921 ...	35,134·85	12,492·59	206·82	54·75	543,397·61	273·77	27,844·76	6,259·31	413·29
Total ...	2,979,664·03	1,994,776·26	240,724·13	509,030·98	15,140,770·61	992,808·46	1,088,070·89	789,071·57	50,162·65

Year.	†Donnybrook.	State generally.	TOTAL.						GRAND TOTAL.		
			Western Australia.			Other Countries.			Quantity.		Actual Value.
			Quantity.	Actual Value.	£ s. d.	Quantity.	Actual Value.	£ s. d.	Quantity.	Actual Value.	£ s. d.
1899 ...	196·17	904·39	209,306·24	762,546 11 6	103·46	336 18 3	209,409·70	762,883 9 9	...		
1900 ...	265·55	1,620·93	581,182·91	2,096,212 14 2	17·49	44 15 7	581,200·40	2,096,257 9 9	...		
1901 ...	4·64	1,667·79	860,280·69	3,033,311 0 4	92·25	297 5 8	860,372·94	3,033,608 6 0	...		
1902 ...	67·08	2,461·98	1,354,615·78	4,791,303 18 1	16·27	38 10 2	1,354,632·05	4,791,342 8 3	...		
1903 ...	97·52	3,350·32	1,452,624·11	5,139,852 11 9	294·78	703 14 10	1,452,918·89	5,140,556 6 7	...		
1904 ...	...	1,608·47	1,403,083·89	4,955,870 9 0	263·05	614 11 9	1,403,346·94	4,956,485 0 9	...	
1905 ...	...	1,821·99	1,563,115·76	5,475,841 2 10	525·80	1,491 0 7	1,563,641·56	5,477,332 3 5	...	
1906 ...	...	925·10	1,493,782·66	5,330,245 12 1	413·86	974 16 0	1,494,196·52	5,331,220 8 1	...	
1907 ...	...	340·39	1,509,217·41	5,416,812 0 7	640·51	1,663 4 3	1,509,857·92	5,418,475 4 10	...	
1908 ...	...	2,080·42	1,529,226·86	5,386,858 15 8	1,313·84	3,885 2 3	1,530,540·70	5,390,743 17 11	...	
1909 ...	...	548·71	1,456,759·11	5,143,035 17 1	882·56	1,109 6 7	1,457,641·67	5,144,145 3 8	...	
1910 ...	...	268·26	1,488,454·61	5,163,100 17 11	2,251·71	1,670 11 7	1,490,706·32	5,164,771 9 6	...	
1911 ...	...	159·90	1,496,846·52	5,143,795 10 5	452·22	915 19 4	1,497,298·74	5,144,711 9 9	...	
1912 ...	...	174·26	1,471,253·12	5,106,466 9 1	641·47	1,527 8 0	1,471,894·59	5,107,993 17 1	...	
1913 ...	...	277·70	1,490,235·42	5,204,738 18 3	697·50	1,247 12 7	1,490,932·92	5,205,986 10 10	...	
1914 ...	...	350·48	1,450,768·61	5,016,905 19 0	915·24	1,726 5 1	1,451,683·85	5,018,632 4 1	...	
1915 ...	...	392·28	1,480,026·72	5,060,196 7 6	1,260·07	2,610 8 11	1,481,266·79	5,062,806 16 5	...	
1916 ...	...	437·33	1,280,558·71	4,405,278 13 10	1,059·26	2,060 6 9	1,281,617·97	4,407,339 0 7	...	
1917 ...	...	264·27	1,188,391·08	4,074,112 6 7	1,016·70	1,905 17 7	1,189,407·78	4,076,018 4 2	...	
1918 ...	...	705·32	1,077,698·51	3,655,942 4 5	1,468·02	2,476 6 11	1,079,166·53	3,658,418 11 4	...	
1919 ...	...	109·08	904,286·66	3,089,243 3 1	1,358·71	2,611 16 1	905,645·37	3,091,854 19 2	...	
1920 ...	...	161·46	770,269·53	2,595,167 17 9	1,375·73	1,531 18 5	771,645·26	2,596,699 16 2	...	
1921 ...	...	86·45	692,381·80	2,322,697 14 1	1,563·59	2,206 15 8	693,945·39	2,324,904 9 9	...	
Total ...	630·96	20,717·28	28,204,366·71	98,369,536 15 0	18,624·09	33,650 12 10	28,222,990·80	98,403,187 7 10	...		

* Prior to 1902 included in State generally.

† Abolished 4th March, 1908.

PART II.—MINERALS OTHER THAN GOLD.

TABLE IX.—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 1921, AND PREVIOUS YEARS.

Period.	BLACK TIN.												
	Pilbara Goldfield—Marble Bar District.				Greenbushes Mineral Field.				Total.				
	Quantity.			Value.	Quantity.			Value.	Quantity.			Value.	
	Lode.	Stream.	Total.		Lode.	Stream.	Total.		Lode.	Stream.	Total.		
Previous to 1899	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	tons.	tons.	£	
1899	...	75.45	75.45	4,419	...	1,590.33	1,590.33	60,108	...	1,665.78	1,665.78	70,527	
1900	...	57.50	57.50	3,612	...	277.32	277.32	21,658	...	334.82	334.82	25,720	
1901	...	387.87	387.87	27,174	...	435.62	435.62	29,528	...	823.49	823.49	56,702	
1902	...	412.98	412.98	21,148	...	321.34	321.34	18,852	...	734.32	734.32	40,000	
1903	...	216.35	216.35	15,103	...	403.21	403.21	24,680	...	619.56	619.56	39,783	
1904	...	292.11	292.11	21,528	...	524.94	524.94	34,362	...	817.05	817.05	55,890	
1905	...	320.86	320.86	24,355	...	533.64	533.64	34,462	...	854.50	854.50	58,817	
1906	...	435.74	435.74	33,880	...	643.52	643.52	52,960	...	1,079.26	1,079.26	86,840	
1907	...	36.59	711.65	78,449	26.18	757.10	778.28	79,195	02.77	1,432.16	1,494.93	157,644	
1908	...	104.13	749.56	85,603	40.40	729.60	770.00	73,045	144.58	1,479.16	1,623.69	158,648	
1909	...	31.00	372.03	30,636	13.90	562.43	576.33	41,046	44.90	884.46	979.36	71,682	
1910	...	81.75	212.21	22,431	44.40	414.35	458.75	34,786	126.15	*828.08	*754.23	†57,335	
1911	...	33.75	119.75	12,899	25.06	292.65	317.71	27,974	58.81	412.40	471.21	40,873	
1912	...	27.35	121.30	16,064	27.82	385.30	411.12	44,638	55.17	504.60	559.77	60,702	
1913	...	10.25	113.13	14,993	14.90	415.55	430.45	50,166	25.15	528.68	553.83	65,159	
1914	...	14.15	124.95	139.10	16,506	29.06	429.42	458.48	50,954	43.21	†600.93	†67,717	
1915	...	12.35	75.05	87.40	8,168	5.32	239.22	244.54	21,145	17.07	314.27	331.94	29,313
1916	...	5.05	73.60	78.65	7,633	7.55	239.78	247.33	21,431	12.60	313.38	325.98	29,064
1917	...	6.50	146.67	153.17	9,339	9.94	271.80	281.74	27,319	16.44	418.47	434.81	43,268
1918	...	4.05	65.00	99.50	20,964	50.52	226.74	237.92	29,928	15.23	291.74	306.97	39,192
1919	...	5.70	93.80	99.50	5,871	23.66	245.28	295.80	57,653	56.22	339.08	395.30	78,637
1920	36.70	36.70	5,871	23.66	220.95	244.61	34,959	23.06	257.65	281.31	40,830
1921	41.50	41.50	7,616	10.25	179.84	190.09	31,249	10.25	221.34	231.59	35,855
1921	14.50	14.50	1,460	7.00	45.87	52.87	5,773	7.00	60.37	67.37	7,238
Total	372.62	5,233.67	5,606.29	505,735	347.14	10,383.80	10,730.94	913,876	719.76	15,622.34	16,342.10	1,419,986	

* Includes tons 1.52, the produce of Cue District. † Includes £118, value of tons 1.52, the produce of Cue District. ‡ Includes tons 3.20, the produce of Cue District and tons .15 of Coolgardie District. § Includes £242, value of tons 3.20 the produce of Cue District, and £15, value of .15 tons of Coolgardie District.

Period.	TANTALITE.											
	Pilbara Goldfield—Marble Bar District.				Greenbushes Mineral Field.				Total.			
	Quantity.			Value.	Quantity.			Value.	Quantity.			Value.
	Lode.	Stream.	Total.		Lode.	Stream.	Total.		Lode.	Stream.	Total.	
Previous to 1899	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	tons.	tons.	£
1899	...	...	...	...	...	...	...	...	...	...	...	...
1905	...	70.95	70.95	8,925	...	2.34	2.34	1,590	...	73.29	73.29	10,515
1906	...	1.80	12.85	2,644	...	...	...	...	...	12.85	14.65	2,644
1909	...	.45	...	113	...	.85	.85	214	...	.85	1.30	327
1917	...	...	12.50	1,782	...	...	...	...	...	12.50	12.50	1,782
Total	2.25	96.80	98.55	13,464	3.19	3.19	1,804	2.25	99.49	101.74	15,268	

Period.	PYRRHIC ORE.				COPPER ORE.											
	Mt. Margaret G.F.		West Kimberley Goldfield	Value.	Pilbara Goldfield.				West Pilbara Gf.		Ashburton Gf.		Peak Hill Gf.		E. Murchison Gf.	
	Mt. Morgans D.				Marble Bar D.		Nullagine D.		Lawlers D.							
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Previous to 1899	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
1899	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1902	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1911	9,988.92	3,529	...	...	25.10	196	5.00	120	...	...	...	...	...	...	...	...
1912	7,625.80	2,543	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1913	10,216.18	3,658	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1914	9,758.83	3,485	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1915	6,557.62	2,368	38.50	426	...	...	...	...	...	...	...	...	...	...	...	...
1916	4,409.22	2,263	67.55	1,247	...	...	...	...	...	...	...	...	...	...	...	...
1917	3,575.46	1,752	3.47	36	...	...	...	...	...	...	...	...	...	...	...	...
1918	3,251.81	1,620	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1919	4,135.93	4,910	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1920	6,019.98	7,276	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1921	6,116.66	7,871	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	70,806.41	41,293	109.52	1,709	32.87	886	14.00	480	82,236.45	741,089	851.07	6,408	1,015.11	32,212	238.56	4,364

|| Represents the value of the sulphur only, the copper contents not having been treated yet.

TABLE IX.—Minerals other than Gold, etc.—continued.

Period.	COPPER ORE—continued.													
	Murchison Gf.				Yalgoo Gf.		Northampton Mf.		Yandanooka Mf.		Mt. Margaret Goldfield.			
	Meekatharra D.		Day Dawn D.								Mt. Morgans District.		Mt. Margaret District.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	
Previous to 1899	
1899	98-00	1,715	38-00	407	273-00	4,338	
1900	5-15	91	...	...	...	...	...	...	...	4,539-00	30,718	
1901	10-50	76	...	...	...	38-50	277	...	...	7,660-00	40,738	
1902	1,954-00	6,852	
1903	18,965-00	45,557	
1904	500-00	900	
1905	60-00	674	
1906	...	138-50	2,816	...	...	13-91	91	...	...	...	...	4,361-05	21,934
1907	31-71	274	10-00	130	...	...	...	...	5,141-52	58,888	
1908	9-50	97	...	...	133-55	1,482	4,404-10	20,221	
1909	...	608-00	2,823	...	...	...	...	...	...	...	...	...	...
1910	
1911	
1912	4-80	54	...	...	...	...	...	...	...	...
1913	
1914	...	15-19	248	3-40	27	...	...	...	...	...	...	...	...
1915	...	33-70	492	...	...	4-99	95	...	...	...	...	...	...
1916	
1917	...	82-92	2,164	...	...	...	...	...	...	...	...	...	...
1918	...	78-34	1,794	...	...	...	...	...	...	...	...	...	...
1919	...	16-81	377	...	...	...	...	...	...	...	...	...	...
1920	
1921	
Total	988-46	10,714	55-56	522	38-40	413	136-50	1,992	171-55	1,889	47,857-67	230,820	2-85	26

Period.	COPPER ORE—continued.										GYPSUM.		
	North Coolgardie Goldfield.		East Coolgardie Goldfield.		Phillips River Goldfield.		State generally.		Total.		State generally.		
	Menzies District.		E. Coolgardie D.										
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£		
Previous to 1899		
1899	7,018-00	55,270	...	...
1900	2,964-00	35,938	...	...
1901	6,183-15	43,673	...	...
1902	9,960-14	69,900	...	...
1903	2,262-25	8,090	...	...
1904	3,468-89	25,180	...	...
1905	2,329-04	16,266	...	...
1906	...	4-70	33	...	...	2,885-00	25,270	13-50	193	7,411-66	50,337	...	...
1907	...	1-42	18	...	...	10,414-57	57,273	3-08	40	18,978-42	180,887	...	...
1908	50-67	330	2,015-71	9,233	...	...	8,294-30	51,434	...	...
1909	7,330-70	29,815	...	...	15,084-95	95,344	...	...
1910	25,871-65	96,745	...	...	34,351-45	161,606	...	...
1911	13,569-68	46,862	...	...	22,675-80	116,818	...	...
1912	1,318-38	15,815	...	...	13,607-20	120,158	...	...
1913	806-95	9,737	...	...	13,428-68	86,615	...	...
1914	4,841-15	37,524	...	...	12,775-12	81,241	...	...
1915	3,681-03	24,093	2-03	16	4,498-56	40,998	...	...
1916	5,428-08	48,618	...	...	6,697-38	74,376	...	...
1917	5,255-57	66,868	...	...	6,488-65	93,711	...	...
1918	2,901-66	42,978	...	...	4,982-91	77,527	...	...
1919	215-02	4,998	...	...	1,277-00	21,530	...	...
1920	217-27	4,125	...	...	1,962-16	37,945	...	...
1921	95-34	1,207	...	...	1,150-34	20,162	664-50	622
Total	6-12	51	50-67	330	95,632-41	586,893	18-61	249	228,936-88	1,620-547	664-50	622	

Period.	IRONSTONE.								LEAD ORE.					
	W. Pilbara Gf.		E. Coolgardie Gf.		State generally.		Total.		Northampton Mf.		West Pilbara Gf.		Total.	
			E. Coolgardie D.											
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	
Previous to 1899	100-00	300	...	...	...	...	...	100-00	300	...	...	...	...
1899	12,852-00	8,939	12,852-00	8,939	82-75	912	...	...	82-75	912
1900	12,251-00	9,258	12,251-00	9,258	268-00	533	...	...	268-00	533
1901	450-00	247	20,119-00	12,999	20,569-00	13,246	...	...	...	...	...	...
1902	4,800-00	2,040	4,800-00	2,040	...	...	...	...	...	...
1903	220-00	88	220-00	88	...	...	...	...	...	...
1904	1,441-50	577	1,441-50	577	...	...	...	...	...	...
1905	3,212-60	1,285	3,212-60	1,285	...	...	...	...	...	...
1906	1,279-87	512	1,279-87	512	...	...	...	...	...	...
1907	1,093-53	438	1,093-53	438	10-00	128	...	...	10-00	128
1908	57-00	461	...	...	57-00	461
1909
1910	† 10-50	† 12	10-50	12	185-10	1,777	...	...	185-10	1,777
1911	8,194-76	17,663	...	...	8,194-76	17,663
1912	11,098-50	24,412	...	...	11,098-50	24,412
1913	26,589-53	50,474	...	...	26,589-53	50,474
1914	15,334-62	38,351	...	...	15,334-62	38,351
1915	15,678-30	29,396	...	...	15,678-30	29,396
1916	34,578-34	110,872	44-00	770	34,622-34	111,642
1917	46,801-97	143,925	62-57	759	46,864-54	144,684
1918	47,079-68	176,330	...	...	47,079-68	176,330
1919	7,385-70	29,841	...	...	7,385-70	29,841
1920	27,716-40	172,483	...	...	27,716-40	172,483
1921	10,330-43	25,649	...	...	10,330-43	25,649
Total	100-00	300	450-00	247	57,280-00	36,148	57,830-00	36,695	251,391-08	823,207	106-57	1,529	251,497-65	824,736

† Iron ore from Koolan Island, Yampi Sound.

TABLE IX.—Minerals other than Gold, etc.—continued.

Period.	SILVER LEAD ORE.		TUNGSTEN ORES.											
	Ashburton Gf.		WOLFRAM.				SHEELITE.							
			State generally.		North Coolgardie Gf.		Broad Arrow Goldfield.		Coolgardie Gf.		Dundas Gold field.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Q'ty.	Value.	Quantity.	Value.	Q'ty.	Value.		
tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	
Previous to 1899	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1899	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1900	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1901	21-05	152	...	...	...	...	...	...	...	...	...	...	...	...
1902	35-85	277	...	...	...	...	...	...	...	...	...	...	...	...
1903	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1908	727-25	6,914	...	...	...	...	...	...	...	...	...	...	...	...
1909	440-00	3,520	...	...	...	...	...	...	...	...	...	...	...	...
1910	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1911	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1912	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1913	125-50	1,757	...	...	...	...	...	...	...	...	...	...	...	...
1914	715-10	9,807	...	...	...	...	...	...	...	...	...	...	...	...
1915	298-96	4,429	...	...	...	...	...	...	...	...	...	...	...	...
1916	67-83	554	...	...	...	...	...	...	...	...	...	...	...	...
1917	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1918	237-48	3,461	...	...	...	...	...	...	...	...	...	...	...	...
1919	214-76	3,116	...	...	...	...	...	...	...	...	...	...	...	...
1920	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1921	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	2,883-78	33,987	265-89	1,295	407-81	942	3-85	175	85-71	155	-41	10	496-78	1,282

Period.	COAL.		FIRECLAY.		GADOLINITE.		ASBESTOS.						
	Collie Mf.		Collie Mf.		Pilbara Gf.		Pilbara Gf.						
							Marble Bar D.		Marble Bar D.		Nullagine D.		Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Previous to 1899	3,508-00	1,761	...	...	...	...	...	...	...	...	...	...	...
1899	54,336-00	25,951	...	...	...	...	...	...	...	...	...	...	...
1900	118,410-10	54,835	...	...	...	...	...	...	...	...	...	...	...
1901	117,835-80	68,561	...	...	...	...	...	...	...	...	...	...	...
1902	140,883-80	86,188	...	...	...	...	...	...	...	...	...	...	...
1903	133,426-62	69,128	...	...	...	...	...	...	...	...	...	...	...
1904	138,550-04	67,174	...	...	...	...	...	...	...	...	...	...	...
1905	127,364-06	55,312	...	...	...	...	...	...	...	...	...	...	...
1906	149,765-27	57,998	...	...	...	...	...	...	...	...	...	...	...
1907	142,372-54	55,158	...	...	...	...	...	...	...	...	...	...	...
1908	175,247-92	75,694	...	...	...	...	...	...	...	...	...	...	...
1909	214,301-98	90,965	...	...	...	...	...	...	...	...	...	...	...
1910	262,166-06	113,699	...	...	...	...	...	...	...	...	...	...	...
1911	249,899-15	111,154	...	...	...	...	...	...	...	...	...	...	...
1912	295,078-91	135,857	...	...	...	...	...	...	...	...	...	...	...
1913	313,817-96	153,614	...	...	...	...	...	...	...	...	...	...	...
1914	319,210-32	148,684	...	...	1-00	112	...	...	...	...	...	...	...
1915	286,666-35	137,859	...	...	...	...	...	...	...	...	...	...	...
1916	301,525-97	147,823	...	...	...	...	...	...	...	...	...	...	...
1917	326,550-07	191,822	...	...	...	...	...	...	...	...	...	...	...
1918	337,039-24	204,319	...	...	...	...	...	...	...	...	...	...	...
1919	401,713-18	270,355	...	...	...	...	...	...	...	...	...	...	...
1920	462,020-78	350,346	...	...	...	...	...	...	...	...	...	...	...
1921	468,816-65	407,117	677-80	646	...	...	...	...	...	...	...	...	...
Total	5,540,496-87	3,081,374	677-80	646	1-00	112	107-43	5,014	380-25	19,050	487-68	24,064	

Period.	LIMESTONE.						DIAMONDS.		MAGNESITE.		ANTIMONY.		
	Murchison Gf.		Yalgarn Goldfield.		State generally.		Total.		Pilbara Gf.		East Coolgardie Goldfield.		
	Cue District.				Nullagine District.		Bulong District.		West Pilbara Goldfield.				
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.			Quantity.	Value.	Quantity.	Value.
tons.	£	tons.	£	tons.	£	tons.	£	carats.	£	tons.	£	tons.	£
Previous to 1899
1899
1900
1901
1902
1903
1904
1905
1906
1907	298-00	772	...	...	...	...	...	...	...	...	...	...	...
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
Total	298-00	772	2,548-85	1,607	90,858-88	15,911	93,705-73	18,290	24	824-75	1,053	20-78	491

* Produced within the West Kimberley Goldfield. † Tons 22-00, value £30, the produce of West Kimberley, and tons 20-00, value £85, the produce of Cue. ‡ The produce of Cue District. § Weight unknown. ** The produce of Yalgarn Goldfield.

NOTE.—As the collection of Statistics of Minerals other than Gold commenced during 1899, the total production from the different localities can only be approximately estimated by the Customs Records, the latest available returns of which are to be found in Table XXVII., pages 78-83.

TABLE XIII.—Quantity and Value of COPPER ORE, etc.—continued.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.			TOTALS TO DATE.		
			Quantity.		Value.	Quantity.		Value.
			Ore.	Metallic Copper.		Ore.	Metallic Copper.	
			tons.	tons.	£	tons.	tons.	£
ASHBURTON GOLDFIELD.								
Ashburton ...	...	Sundry claims ...	...	...	...	6.32	.79	94
Red Hill ...	...	Voided leases ...	...	...	...	175.50	33.85	2,126
Uaroo ...	...	Voided leases ...	...	...	...	169.25	62.49	4,188
		Totals ...				351.07	97.13	6,408
PEAK HILL GOLDFIELD.								
Peak Hill ...	M.L. (35P) ...	Burra Copper Mines, Ltd. ...	...	...	...	25.84	8.85	943
Do. ...	M.Ls. 37P, 38P ...	Sonia leases ...	...	...	...	135.04	47.26	4,807
Do. ...	M.L. 9P ...	Sons of Gwalia ...	...	...	...	458.49	169.89	15,680
Do. ...	M.Ls. (29P), (30P) (31P) ...	(Two Sisters leases) ...	...	...	...	64.04	30.93	1,466
Do. ...	M.L. (31P) ...	Two Sisters North... ..	...	...	...	115.76	31.40	3,594
Do. ...	...	Voided leases ...	...	...	...	153.91	43.02	3,885
Do. ...	...	Sundry claims ...	...	...	...	62.03	21.96	1,837
		Totals ...				1,015.11	353.31	32,212
EAST MURCHISON GOLDFIELD.								
LAWLERS DISTRICT.								
Kathleen Valley ...	M.L. (12) ...	Shepherd ...	...	...	...	6.77	1.32	69
Lawlers ...	M.L. (29) ...	Bungarra ...	...	...	...	157.44	23.85	2,837
Do. ...	...	Sundry claims ...	...	...	...	74.35	13.25	1,458
		Totals ...				238.56	38.42	4,364
MURCHISON GOLDFIELD.								
MEEKATHARRA DISTRICT.								
Gabanintha ...	...	Voided leases ...	...	...	...	920.56	119.84	9,381
Do. ...	...	Sundry claims ...	...	...	...	34.42	9.23	1,072
Holden's Find... ..	...	Sundry claims ...	...	...	...	6.72	1.11	111
Yaloginda ...	...	Sundry claims ...	...	...	...	6.76	1.41	150
		Totals ...				968.46	131.59	10,714
DAY DAWN DISTRICT.								
Day Dawn ...	...	Voided leases ...	...	...	...	26.95	5.17	305
Do. ...	...	Sundry claims ...	...	...	...	28.61	2.93	217
		Totals ...				55.56	8.10	522
YALGOO GOLDFIELD.								
Mount Gibson ...	...	Sundry claims ...	...	...	...	4.99	1.10	95
Twin Peaks ...	...	Sundry claims ...	...	...	...	19.50	3.49	237
Wadgingarra ...	M.L. (6) ...	Olive Queen ...	...	...	...	13.91	.98	91
		Totals ...				38.40	5.57	413
NORTHAMPTON MINERAL FIELD.								
Geraldine ...	M.Ls. (10), (11) ...	Geraldine leases ...	...	...	...	136.50	36.05	1,992
		Totals ...				136.50	36.05	1,992
YANDANOOKA MINERAL FIELD.								
Arrino ...	...	Sundry claims ...	...	...	...	126.05	18.48	1,386
Yandanooka ...	Freehold Gd. ...	Muggawa Copper Mines ...	...	...	...	7.50	1.20	96
Do. ...	...	Voided leases ...	...	...	...	38.00	7.95	407
		Totals ...				171.55	27.63	1,889
MOUNT MARGARET GOLDFIELD.								
MOUNT MORGANS DISTRICT.								
Eulaminna ...	[10c, 11c], 4F, 5F (12c, 37c) ...	(Mt. Malcolm Copper Mine leases) ...	...	...	...	13,516.00	1,001.98	70,754
Do. ...	[10c, 11c], 4F, 5F ...	(Mt. Malcolm Copper Mine leases) ...	...	...	...	3,839.00	418.00	17,065
Do. ...	[10c, 11c], 4F, 5F (12c, 37c) ...	(Murrin Copper Mines, Ltd.) ...	...	...	...	19,165.00	798.50	45,817
Do. ...	4F, 5F(11F)(12F) ...	West Australian Copper Co., Ltd. ...	...	...	...	9,794.05	1,976.08	80,199
Mt. Margaret ...	G.M.L. (66P) ...	Mt. Morven ...	...	...	...	11.53	2.40	163
Murrin Murrin... ..	18F ...	Nangeroo: Nangeroo Mines, Ltd. ...	...	...	...	6.80	3.00	160
Do. ...	...	Voided leases ...	...	...	...	1,525.29	248.04	16,662
		Totals ...				47,857.67	4,448.00	230,820

TABLE XIII.—Quantity and Value of COPPER ORE, etc.—continued.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.			TOTALS TO DATE.		
			Quantity.		Value.	Quantity.		Value.
			Ore.	Metallic Copper.		Ore.	Metallic Copper.	
			tons.	tons.	£	tons.	tons.	£
MOUNT MARGARET GOLDFIELD—continued.								
MOUNT MARGARET DISTRICT.								
Burtville	M.L. (16r)	Dreadnought	...	...	...	2.85	.29	26
		Totals	...	...	...	2.85	.29	26
NORTH COOLGARDIE GOLDFIELD.								
MENZIES DISTRICT.								
Goongarrie	M.L. (13z)	Providence Copper Mining Syndicate, Ltd.	...	...	...	4.70	.42	33
Do.	...	Sundry claims	...	...	...	1.42	.40	18
		Totals	...	...	...	6.12	.82	51
EAST COOLGARDIE GOLDFIELD.								
EAST COOLGARDIE DISTRICT.								
Boorara	M.L. (100E)	Premier Copper Mine	...	...	...	50.67	6.22	330
		Totals	...	...	...	50.67	6.22	330
PHILLIPS RIVER GOLDFIELD.								
Kundip	G.M.L. (197)	Ard Patrick	2.49	.27	19	2.49	.27	19
Do.	G.M.Ls. 147, 179	Fair Play leases	...	...	...	130.09	131.30	11,975
Do.	G.M.L. 184	Gem	...	63	43	90.98	21.32	2,314
Do.	G.M.L. 151, 156	Gem Consolidated leases	...	...	...	48.00	76.75	8,327
Do.	M.Ls. 52, 94	Harbour View Gold & Copper Co., Ltd.	...	...	...	1,204.65	89.81	8,215
Do.	M.Ls. 52, 94	(Harbour View leases)	...	...	...	604.36	76.80	4,524
Do.	M.Ls. 52, 94	(Harbour View leases)	...	...	...	508.27	64.66	3,642
Do.	G.M.L. 98	Hillsborough	...	32	22	692.84	57.11	4,710
Do.	M.L. 370	North Harbour View	...	...	...	13.80	.80	99
Do.	M.Ls. 52, 94	(Ravensthorpe G.M. Syndicate, N.L.)	...	...	...	132.56	24.36	1,382
Do.	G.M.L. 74	Two Boys	...	...	...	...	28.80	3,249
Do.	...	Voided leases	...	...	...	3,428.18	290.75	19,180
Do.	...	Sundry claims	5.88	.67	45	92.94	15.15	1,242
Mt. Desmond	M.L. 208	British Flag: Phillips River Gold & Copper Co., Ltd.	...	...	...	19.90	3.64	250
Do.	M.L. 208	Desmond	...	...	...	1,392.85	164.82	16,993
Do.	M.L. 208	(Desmond: Phillips River Gold & Copper Co., Ltd.)	...	...	...	1,234.05	215.74	14,956
Do.	M.L. 95	Elverdton	...	...	...	7,418.57	675.84	67,229
Do.	M.L. 95	(Elverdton)	...	...	...	130.00	5.70	570
Do.	M.L. 95	(Elverdton: Phillips River Gold & Copper Co., Ltd.)	...	...	...	30,574.23	2,186.64	124,252
Do.	M.L. 95	(Elverdton: Phillips River Option Syndicate, N.L.)	...	...	...	2,946.02	401.43	22,657
Do.	M.L. 168	Elverton South: Phillips River Gold & Copper Co., Ltd.	...	...	...	15.73	1.46	92
Do.	M.L. 168	(Elverton South)	...	...	...	18.48	2.39	119
Do.	M.L. 109	Mt. Desmond: Phillips River Gold & Copper Co., Ltd.	...	...	...	1,762.22	216.76	18,128
Do.	M.L. 109	(Mt. Desmond)	...	...	...	198.87	30.77	1,640
Do.	M.L. 199	P.L.P.: Phillips River Gold & Copper Co., Ltd.	...	...	...	17.56	1.88	121
Do.	M.L. 199	(P.L.P.)	...	...	...	208.66	33.69	2,277
Do.	...	Voided Leases	...	...	...	1,015.17	166.71	9,770
Do.	...	Sundry claims	...	...	...	140.25	25.17	1,901
Ravensthorpe	M.L. (379)	Ballarat	...	...	...	9.71	1.41	137
Do.	M.L. 378	Bickerton	...	...	...	2.45	.30	81
Do.	M.L. 16	Marion Martin	...	...	...	2,270.63	256.94	26,496
Do.	M.L. 16	(Marion Martin)	...	...	...	865.69	130.61	6,650
Do.	M.L. 16	(Marion Martin: Phillips River Gold & Copper Co., Ltd.)	...	...	...	2,855.36	375.44	23,506
Do.	M.L. 15	Mount Cattlin	...	...	...	2,178.01	142.64	15,296
Do.	M.L. 15	(Mount Cattlin)	...	...	...	231.56	31.35	1,716
Do.	M.L. 15	(Mount Cattlin: Mount Cattlin Copper Mining Co., Ltd.)	...	...	...	6,608.76	333.59	28,841
Do.	M.L. 15	(Mount Cattlin: Phillips River Gold & Copper Co., Ltd.)	...	...	...	1,263.76	80.26	7,646
Do.	M.L. 15	(Mount Cattlin: Phillips River Gold & Copper Co., Ltd.)	...	...	...	14,432.25	714.90	40,313
Do.	M.L. 342	Surprise	...	...	...	885.05	157.92	11,914
Do.	...	Voided leases	...	...	...	6,983.65	826.92	51,347
Do.	...	Sundry claims	87.47	15.70	1,078	1,121.20	125.19	10,982
West River	...	Voided leases	...	...	...	44.04	7.41	414
Do.	...	Sundry claims	...	...	...	150.69	25.84	2,061
		From Goldfield generally	...	...	...	1,637.88	128.64	9,760
		Totals	95.34	17.59	1,207	95,632.41	8,349.88	586,993
STATE GENERALLY.								
...	...	Voided leases	...	...	...	5.11	1.54	56
...	...	Sundry claims	...	...	...	13.50	2.27	193
		Totals	...	...	...	18.61	3.81	249

TABLE XIV.

QUANTITY AND VALUE OF IRONSTONE REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
WEST PILBARA GOLDFIELD.						
Whim Creek ...	(17), (18), (21)	Whim Well Copper Mines ... ..	...	...	100-00	300
		Totals ... ..	...	...	100-00	300
EAST COOLGARDIE GOLDFIELD.						
EAST COOLGARDIE DISTRICT.						
Boulder ...	(1490E) ...	Mt. Ferrum ... ..	...	...	450-00	247
		Totals ... ..	...	...	450-00	247
STATE GENERALLY.						
		Avon ... ..	...	...	22,223-00	16,241
		Clackline ... ..	...	...	18,253-50	8,789
		Coates' Paddock ... ..	...	...	4,712-00	3,277
		Greenbushes ... ..	...	...	7,481-00	4,629
		Koolan Island—Yampi Sound ... ..	...	...	10-50	12
		Werribee ... ..	...	...	4,600-00	3,200
		Totals ... ..	...	...	57,280-00	36,148

TABLE XV.

QUANTITY AND VALUE OF LEAD ORE REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.			TOTALS TO DATE.		
			Lead Ore.	Metal therefrom.	Value.	Lead Ore.	Metal therefrom.	Value.
			tons.	tons.	£	tons.	tons.	£
NORTHAMPTON MINERAL FIELD.								
Geraldine ...	Loc. 1 ...	Geraldine Mine ... ..	...	...	...	774-59	257-13	5,139
Do. ...	M.L. 150 ...	Surprise	3,288-10	499-87	10,333	14,249-53	5,319-07	156,287
Do. ...	M.L. 158 ...	Surprise South ... ..	...	...	...	14-00	5-41	170
Do. ...	M.L. 153 ...	Three Sisters ... ..	...	...	...	6-25	3-94	112
Do. ...	M.L. (159) ...	Welcome Lead Mine ... ..	...	...	...	5-74	3-59	68
Do. ...	M.L. 19PP ...	Wheat Lily	6-49	4-25	89	44-75	30-79	742
Do. ...	Loc. 7 ...	Thring & Green	173-44	104-46	2,096	173-44	104-46	2,096
Do. ...	...	Voided leases ... ..	...	...	...	57-00	41-61	481
Do. ...	...	Sundry claims ... ..	...	...	...	327-04	175-65	3,403
Narra Tarra ...	Loc. 833 ...	Narra Tarra: Fremantle Trading Co., Ltd. ...	6,862-40	588-85	13,131	97,687-65	10,058-38	297,058
Do. ...	Loc. 118, 119 ...	Lauder & Raven (Tributers) ...	...	...	...	106-21	60-02	1,345
Do. ...	...	Sundry claims ... ..	...	...	...	238-16	34-18	442
Northampton ...	Loc. 1472 ...	Baddera: Fremantle Trading Co., Ltd. ...	...	...	...	129,264-56	13,888-33	317,631
Do. ...	Loc. 436 ...	Fortune Exploration Co., N.L. ...	...	...	...	123-38	51-17	1,316
Do. ...	M.Ls., 127, 128, 129	Kirtons leases ... ..	...	...	...	2,136-76	379-89	7,572
Do. ...	Loc. 1146 ...	Wheat Ellen: Fremantle Trading Co., Ltd. ...	...	...	...	4,685-08	647-58	18,939
Do. ...	Loc. 436 ...	(Wheat of Fortune Extended Syndicate) ...	...	...	...	125-82	43-13	793
Do. ...	...	Voided leases ... ..	...	...	...	1,130-00	343-24	6,757
Do. ...	...	Sundry claims ... ..	...	...	...	222-12	132-14	2,679
Victoria ...	M.L. (51) ...	Alma ... ..	...	...	...	19-00	12-54	212
		Totals	10,330-43	1,197-43	25,649	251,391-08	31,592-25	823,207
WEST PILBARA GOLDFIELD.								
Roebourne ...	...	Sundry claims ... ..	...	...	...	2-57	1-36	39
Whim Creek ...	M.L. (172) ...	Cumstock ... ..	...	...	...	104-00	46-00	1,490
		Totals ... ..	...	...	...	106-57	47-36	1,529

TABLE XVI.

QUANTITY AND VALUE OF SILVER-LEAD ORE REPORTED TO THE MINES DEPARTMENT DURING 1921,
AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
ASHBURTON GOLDFIELD.						
Ashburton ...	M.L. (3) ...	Rainbow ...	...	...	56.90	429
Do. ...	...	Sundry claims ...	...	...	2.83	40
Uaroo ...	M.Ls. (43), (49), (84)	Uaroo Silver Lead Mines, Ltd.	...	...	2,824.05	33,518
Totals ...			...	...	2,883.78	33,987

TABLE XVII.

QUANTITY AND VALUE OF COAL REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
COLLIE RIVER MINERAL FIELD.						
Collie ...	197, etc. ...	Amalgamated Collieries of W.A., Ltd. (Cardiff leases) ...	109,210.51	89,147	127,731.51	103,957
Do. ...	244, etc. ...	Amalgamated Collieries of W.A., Ltd. (Co-operative leases) ...	91,491.99	79,230	183,406.99	152,500
Do. ...	85, etc. ...	Amalgamated Collieries of W.A., Ltd. (Proprietary leases) ...	133,571.46	114,541	177,324.38	151,568
Do. ...	151, etc. ...	Amalgamated Collieries of W.A., Ltd. (Scottish leases) ...	...	...	380.00	251
Do. ...	197, etc. ...	(Cardiff Coal Mining Co., Ltd.) ...	...	...	976,824.78	471,417
Do. ...	151, etc. ...	(Collie Boulder Coal Co., Ltd.) ...	...	...	71,512.70	26,139
Do. ...	244, etc. ...	(Collie Co-operative Collieries, Ltd.) ...	...	...	970,044.30	511,862
Do. ...	88 (part of) ...	(Collie Proprietary Coalfields of W.A., Ltd.) ...	...	...	477,781.55	242,918
Do. ...	85-100 ...	(Collie Proprietary Coalfields of W.A., Ltd.) ...	...	...	580,392.15	289,246
Do. ...	260-6, 271 ...	Premier Coal Mining Co., Ltd. ...	42,893.74	37,124	236,246.55	148,754
Do. ...	151, etc. ...	(Scottish Collieries, Ltd.) ...	...	...	2,314.51	1,210
Do. ...	151, etc. ...	(Scottish Co-operative Collieries Co., Ltd.) ...	...	...	430,796.95	171,303
Do. ...	85-100, 267 ...	(The Proprietary Coal Mines of W.A., Ltd.) ...	...	...	693,045.34	413,755
Do. ...	88 (part of) ...	(The Proprietary Coal Mines of W.A., Ltd.) ...	...	...	109.00	54
Do. ...	250, etc. ...	(Westralian Coal Mining Co., Ltd.) ...	12,016.75	11,478	507,384.11	307,913
Do. ...	250, etc. ...	Westralia Black Diamond Collieries, Ltd. ...	79,632.20	75,597	79,632.20	75,597
Do. ...	...	Voided leases ...	...	...	25,569.85	12,930
Totals ...			468,816.65	407,117	5,540,496.87	3,081,374

TABLE XVIII.

QUANTITY AND VALUE OF FIRECLAY REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF AREA, LEASE, CLAIM,	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
COLLIE MINERAL FIELD.						
Collie ...	87 ...	Amalgamated Collieries of W.A., Ltd. (Proprietary lease) ...	677.80	646	677.80	646
Totals ...			677.80	646	677.80	646

TABLE XIX.

QUANTITY AND VALUE OF LIMESTONE REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
MURCHISON GOLDFIELD.						
CUE DISTRICT.						
Cuddingwarra ...	M.L. (3) ...	Linella ... ..	...	...	298·00	772
		Totals ... ..	...	...	298·00	772
YILGARN GOLDFIELD.						
Southern Cross ...	... ..	Voided leases ... ..	...	...	2,548·85	1,607
		Totals ... ..	...	...	2,548·85	1,607
STATE GENERALLY.						
Fremantle ... ..	... ..	... ..	...	...	90,858·88	15,911
		Totals ... ..	...	...	90,858·88	15,911

TABLE XX.

QUANTITY AND VALUE OF ASBESTOS REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
PILBARA GOLDFIELD.						
MARBLE BAR DISTRICT.						
Cooglegong ...	M.Ls. 274, 275 ...	Chrysotile No. 1 and 2	32·60	1,360	64·60	3,260
Soanesville ...	M.Ls. (155 etc.) ...	Pilbara Asbestos Co., Ltd. ... ..	...	...	42·83	1,754
		Total	32·60	1,360	107·43	5,014
NULLAGINE DISTRICT.						
Lionel	M.Ls. 18L, 19L, 20L ...	Barnett Bros., Ltd	140·00	8,600	141·00	8,850
Do.	M.Ls. 21L, 22L ...	Barnett Bros., Ltd.	25·00	2,000	25·00	2,000
Do.	M.L. 28	Barnett Bros., Ltd.	2·50	200	2·50	200
Do.	M.Ls. 18L, 19L, 20L ...	(Barnett's Asbestos Nos. 1, 2, and 3) ... ..	...	...	163·00	5,793
Do.	M.L. (16L)	Marjorie ... ..	...	...	4·00	100
Do.	M.Ls. 21L, 22L ...	(Nullagine Nos. 1 and 2) ... ..	...	...	7·00	526
Do.	M.L. 29L	Toledo	14·50	616	14·50	616
Do. ... ..	... ..	Sundry claims	20·75	805	23·25	965
		Totals	202·75	12,221	380·25	19,050

TABLE XXI.

QUANTITY AND VALUE OF GADOLINITE REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
PILBARA GOLDFIELD.						
MARBLE BAR DISTRICT.						
Cooglegong ...	(M.L. 254) ...	Iverna ... ..	...	...	1·00	112
		Totals ... ..	...	...	1·00	112

TABLE XXII.

QUANTITY AND VALUE OF TUNGSTEN ORES REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

SCHEELITE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.			TOTALS TO DATE.		
			Ore.	Contents Tungstic Trioxide.	Value.	Ore.	Contents Tungstic Trioxide.	Value.
			tons.	units.	£	tons.	units.	£
NORTH COOLGARDIE GOLDFIELD.								
MENZIES DISTRICT.								
Comet Vale ...	G.M.L. 5410Z...	Lake View ...	...	...	...	380.84	338.39	818
Do. ...	...	Sundry claims ...	...	...	...	26.47	47.38	124
		Totals ...	...	...	...	407.31	385.77	942
BROAD ARROW GOLDFIELD.								
Ora Banda ...	...	Sundry claims ...	...	...	...	3.35	66.50	175
		Totals ...	...	...	...	3.35	66.50	175
COOLGARDIE GOLDFIELD.								
COOLGARDIE DISTRICT.								
Higginsville ...	...	Sundry claims ...	...	...	...	85.71	59.07	155
		Totals ...	...	...	...	85.71	59.07	155
DUNDAS GOLDFIELD.								
Norseman ...	...	Sundry claims ...	...	...	...	.41	3.98	10
		Totals ...	...	...	...	.41	3.98	10
WOLFRAM.								
LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.			TOTALS TO DATE.		
			Ore.	Metallic contents.	Value.	Ore.	Metallic contents.	Value.
			tons.	tons.	£	tons.	tons.	£
MURCHISON GOLDFIELD.								
CUE DISTRICT.								
Calle Spring ...	M.L. (11) ...	Socialist ...	...	...	...	194.00	6.11	577
Do. ...	...	Sundry claims ...	...	...	...	44.64	2.30	271
		Totals ...	...	...	...	238.64	8.41	1,148
YALGOO GOLDFIELD.								
Yalgoo ...	M.L. (36) ...	Yandanoo King North ...	...	...	...	.25	.12	27
		Totals ...	...	...	...	.25	.12	27
STATE GENERALLY.								
Derby ...	(146H) ...	Taylor's Wolfram Reward ...	...	...	...	27.00	2.00	120
		Totals ...	...	...	...	27.00	2.00	120

TABLE XXIII.

QUANTITY AND VALUE OF MAGNESITE REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
EAST COOLGARDLE GOLDFIELD.						
BULONG DISTRICT.						
Bulong	Sundry claims ...	...	...	824.75	1,053
		Totals ...	...	...	824.75	1,053

TABLE XXIV.

QUANTITY AND VALUE OF ANTIMONY REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.			TOTALS TO DATE.		
			Ore.	Metallic contents.	Value.	Ore.	Metallic contents.	Value.
			tons.	tons.	£	tons.	tons.	£
WEST PILBARA GOLDFIELD.								
Balla Balla ...	M.L. (185) ...	Star ...	...	...	...	20.78	11.58	491
		Totals ...	...	...	...	20.78	11.58	491

TABLE XXV.

QUANTITY AND VALUE OF GYPSUM REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
		STATE GENERALLY.	tons.	£	tons.	£
Koorda ...	M.L. 280H ...	White Cross	664·50	622	664·50	622
		Totals	664·50	622	664·50	622

TABLE XXVI.

QUANTITY AND VALUE OF DIAMONDS REPORTED TO THE MINES DEPARTMENT DURING 1921, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1921.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			carats.	£	carats.	£
		PILBARA GOLDFIELD. NULLAGINE DISTRICT.				
Nullagine ...	M.R.C. (6L) ...	Morgans, A. E. ... ..	...	...	...	24
		Totals ... ..	...	...	...	24

RETURN OF ORE AND MINERALS OTHER THAN GOLD

YEAR.	COPPER.												Total Value of Copper Exported.		
	COPPER ORE.										COPPER INGOT, MATTE, ETC.				
	West Pilbara Gf.		Northampton Mf.		Phillips River Gf.		State generally.		Total.		State generally.				
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.			
tons.		£		tons.		£		tons.		£		tons.		£	
1850
1
2
3
4
5	2	26	...	...	...	2	26	...	...	...	...	26
6	57	1,018	...	...	...	57	1,018	...	...	...	...	1,018
7	80	1,920	...	...	...	80	1,920	...	...	...	...	1,920
8	433	9,531	...	...	...	433	9,531	...	...	...	...	9,531
9	941	14,122	...	...	...	941	14,122	...	...	...	...	14,122
1860	517	8,021	...	...	...	517	8,021	...	...	...	...	8,021
1	409	6,339	...	...	...	409	6,339	...	...	...	...	6,339
2	783	12,536	...	...	...	783	12,536	...	...	...	...	12,536
3	763	12,208	...	...	...	763	12,208	...	...	...	...	12,208
4	1,076	17,216	...	...	...	1,076	17,216	...	...	...	...	17,216
5	886	13,290	...	...	...	886	13,290	...	...	...	...	13,290
6	557	8,362	...	...	...	557	8,362	...	...	...	...	8,362
7	337	5,055	...	...	...	337	5,055	...	...	...	...	5,055
8	83	1,245	...	...	...	83	1,245	...	...	...	...	1,245
9	155	2,325	...	...	...	155	2,325	...	...	...	...	2,325
1870	6	90	...	...	...	6	90	...	...	...	...	90
1
2
3	56	848	...	...	...	56	848	...	...	...	...	848
4	67	998	...	...	...	67	998	...	...	...	...	998
5	205	3,071	...	...	...	205	3,071	...	...	...	...	3,071
6	279	4,185	...	...	...	279	4,185	...	...	...	...	4,185
7	54	803	...	...	...	54	803	...	...	...	...	803
8	9	135	...	...	...	9	135	...	...	...	...	135
9
1880	8	120	...	...	...	8	120	...	...	...	...	120
1
2	2	23	...	...	...	2	23	...	...	...	...	23
3	5	75	...	...	...	5	75	...	...	...	...	75
4	118	1,770	...	...	...	118	1,770	...	...	...	...	1,770
5	120	1,793	...	...	...	120	1,793	...	...	...	...	1,793
6	249	3,735	...	...	...	249	3,735	...	...	...	...	3,735
7	23	345	...	...	...	23	345	...	...	...	...	345
8	88	1,488	...	...	...	88	1,488	...	...	...	...	1,488
9	112	1,904	...	...	...	112	1,904	...	...	...	...	1,904
1890	8	136	...	...	...	8	136	...	...	...	...	136
1	263	4,462	...	...	...	...	...	...	263	4,462	...	...	...	...	4,462
2	1,412	6,319	155	2,377	...	...	...	...	567	8,696	...	...	...	...	8,696
3	50	606	...	...	...	...	...	...	50	606	...	...	...	...	606
4
5	802	12,832	24	120	...	...	...	...	826	12,952	...	...	...	...	12,952
6	6	100	...	...	...	...	...	...	6	100	...	...	...	...	100
7	65	731	21	302	...	...	...	...	86	1,033	...	...	...	...	1,033
8	281	3,334	75	932	...	...	...	...	356	4,266	...	...	...	...	4,266
9	1,404	31,979	587	9,473	...	...	...	...	1,991	41,452	...	...	...	...	41,452
1900	544	10,696	...	...	105	2,411	197	3,355	846	16,462	249	17,475	...	...	33,937
1	1,058	26,464	1	10	1,205	22,107	397	6,322	2,661	54,903	880	55,866	...	...	110,769
2	68	1,698	20	330	162	2,469	33	489	283	4,986	175	7,918	...	...	12,904
3	4	180	25	460	302	3,538	15	349	346	4,527	1,075	33,288	...	...	37,815
4	50	500	...	...	11	154	310	3,378	371	4,032	102	3,827	...	...	7,859
5	80	2,808	713	8,576	793	11,384	794	53,867	...	...	65,251
6	112	323	...	...	...	...	...	...	224	2,930	336	6,162	343	30,367	36,529
7	3,727	61,493	3,727	61,493	1,602	141,883	203,376
8	2,503	29,272	2,503	29,272	479	27,819	57,091
9	6,959	59,541	6,959	59,541	833	45,100	104,641
1910	6,309	27,271	6,309	27,271	1,281	68,657	95,928
1	9,825	33,709	9,825	33,709	828	44,409	78,118
2	9,536	58,688	9,536	58,688	28	1,136	59,824
3	4,339	136,472	4,339	136,472	82	5,891	142,363
4	3,913	33,654	3,913	33,654	183	4,520	38,174
5	737	13,768	737	13,768	946	77,401	91,169
6	650	14,971	650	14,971	457	49,862	64,833
7	966	20,878	966	20,878	535	64,860	85,738
8	1,643	24,877	1,643	24,877	478	41,269	66,146
9	455	9,740	455	9,740	4	365	10,105
1920	1,511	22,467	1,511	22,467	137	2,698	25,165
1921	1,040	16,153	1,040	16,153	206	8,448	24,601
Total	72,382	873,717	11,697	786,926	...	1,660,64

†See Woodward's Mining Handbook, Perth : By Authority, 1895 ; page 123.

‡Weight not stated.

XXVII.

ENTERED FOR EXPORT FROM 1850 TO 1921, INCLUSIVE.

TIN.											YEAR.
BLACK TIN (Dressed Tin ore).								TIN INGOT.		Total Value of Tin Exported.	
Pilbara Gf.		Greenbushes Mf.		State generally.		Total.		Greenbushes Mf.			
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	£	
...	1850
...	1
...	2
...	3
...	4
...	5
...	6
...	7
...	8
...	9
...	1860
...	1
...	2
...	3
...	4
...	5
...	6
...	7
...	8
...	9
...	1870
...	1
...	2
...	3
...	4
...	5
...	6
...	7
...	8
...	9
...	1880
...	1
...	2
...	3
...	4
...	5
...	6
...	7
...	8
...	9
...	...	5	300	...	...	5	300	...	...	300	1890
...	...	68	5,400	...	...	68	5,400	...	...	5,400	1
...	...	204	10,200	...	...	204	10,200	...	...	10,200	2
...	...	265	13,843	...	...	265	13,843	...	...	13,843	3
...	...	171	7,664	...	...	228	11,134	...	...	11,134	4
57	3,470	371	14,325	...	...	390	15,274	...	...	15,274	5
19	949	277	9,703	...	...	277	9,703	...	...	9,703	6
...	...	137	4,338	...	...	137	4,338	...	...	4,338	7
...	...	96	3,275	...	...	96	3,275	...	...	3,275	8
...	...	68	2,760	...	...	68	2,760	...	...	2,760	9
30	2,025	278	21,138	...	...	308	23,163	...	...	23,163	1900
368	30,146	102	8,032	...	...	470	38,178	142	18,872	57,050	1
439	34,600	68	4,895	...	...	507	39,495	97	12,607	52,102	2
248	19,698	31	2,870	...	...	279	22,568	141	16,830	39,398	3
267	20,988	25	1,868	...	...	292	22,856	235	29,277	52,133	4
64	4,932	24	1,389	379	20,797	467	27,118	129	16,155	43,273	5
188	16,853	119	8,177	666	51,748	973	76,778	2†	1	76,779	6
29	28,375	444	46,254	624	64,005	1,397	138,634	45	8,746	147,380	7
...	1,424	151,414	1,424	151,414	78	14,725	166,139	8
...	1,093	83,294	1,093	83,594	2†	1	83,595	9
...	698	62,989	698	62,989	...	...	62,989	1910
...	500	45,129	500	45,129	...	...	45,129	1
...	495	55,220	495	55,220	...	...	55,220	2
...	651	79,738	651	79,738	...	...	79,738	3
...	484	72,142	484	72,142	...	...	72,142	4
...	363	35,649	363	35,649	...	...	35,649	5
...	429	41,391	429	41,391	...	...	41,391	6
...	463	49,101	463	49,101	...	...	49,101	7
...	383	45,288	383	45,288	...	...	45,288	8
...	415	76,952	415	76,952	...	...	76,952	9
...	318	47,269	318	47,269	...	...	47,269	1920
...	243	49,449	243	49,449	...	...	49,449	1
...	67	6,485	67	6,485	...	...	6,485	2
...	14,457	1,366,827	867	117,214	1,484,041	Total

2†Weight not stated.

3†Probably the produce of Pilbara Goldfield and Greenbushes Mineral Field.

TABLE XXVII.—Return of Ore and Minerals other than Gold

YEAR.	SILVER.		‡ LEAD.		‡ LEAD AND SILVER-LEAD.		PIG LEAD.		ZINC INGOTS AND CONCENTRATES.	
	State generally.		Northampton Mf.		State generally.		State generally.		State generally.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	ozs.	£	tons.	£	tons.	£	tons.	£	tons.	£
1850	...	...	5	55	...	...	...	...	...	...
1	...	...	...	...	...	...	...	...	...	...
2	...	...	...	...	...	...	...	...	...	...
3	...	...	2†	4	...	...	55	1,200	...	...
4	...	...	...	...	...	...	122	2,440	...	...
5	...	...	25	250	...	...	134	2,675	...	...
6	...	...	...	...	...	...	60	1,200	...	...
7	...	...	...	...	...	...	120	2,410	...	...
8	...	...	...	...	...	...	61	1,220	...	...
9	...	...	13	135	...	...	25	495	...	...
1860	...	...	98	985	...	...	...	...	...	...
1	...	...	79	790	...	...	...	...	...	...
2	...	...	9	90	...	...	...	...	...	...
3	...	...	230	2,300	...	...	...	...	...	...
4	...	...	80	800	...	...	...	...	...	...
5	...	...	703	8,436	...	...	...	...	...	...
6	...	...	273	3,282	...	...	...	...	...	...
7	...	...	902	10,824	...	...	4†3	50	...	...
8	...	...	1,100	13,206	...	...	...	...	...	...
9	...	...	699	8,394	...	...	...	...	...	...
1870	...	...	1,209	14,514	...	...	...	...	...	...
1	...	...	420	5,040	...	...	...	...	...	...
2	...	...	364	4,368	...	...	...	...	...	...
3	...	...	965	11,586	...	...	...	...	...	...
4	...	...	2,144	25,725	...	...	...	...	...	...
5	...	...	2,289	27,468	...	...	4	89	...	...
6	...	...	2,192	26,298	...	...	4†7	155	...	...
7	...	...	3,956	47,466	...	...	4†1	15	...	...
8	...	...	3,618	43,410	...	...	...	...	...	...
9	...	...	2,775	33,300	...	...	...	...	...	...
1880	...	...	1,921	15,368	...	...	4†5	89	...	...
1	...	...	1,401	11,204	...	...	4†1	20	...	...
2	...	...	1,794	14,348	...	...	...	...	...	...
3	...	...	1,038	7,266	...	...	...	...	...	...
4	...	...	696	4,872	...	...	...	...	...	...
5	...	...	465	3,255	...	...	...	...	...	...
6	...	...	611	4,277	...	...	...	...	...	...
7	...	...	471	4,710	...	...	4†6	120	...	...
8	...	...	532	5,320	...	...	4†2	40	...	...
9	...	...	250	2,500	...	...	...	...	...	...
1890	...	...	214	2,135	...	...	...	...	...	...
1	...	...	25	250	...	...	...	...	...	...
2	...	...	30	150	...	...	...	...	...	...
3	...	...	...	...	...	...	...	...	...	...
4	...	...	...	...	...	...	...	...	...	...
5	...	...	...	...	...	...	...	...	...	...
6	...	...	...	...	...	...	...	...	...	...
7	...	...	2†	4	...	...	4†1	11	...	...
8	...	...	5	33	...	...	...	...	...	...
9	...	...	16	96	...	...	77	1,077	...	...
1900	28,749	3,594	27	242	...	...	...	...	...	...
1	60,869	7,609	...	...	...	...	...	...	...	...
2	83,293	9,190	...	...	...	...	...	...	...	...
3	168,113	19,153	...	...	...	...	...	...	...	...
4	399,190	45,912	...	...	...	...	...	...	...	...
5	359,744	44,278	...	...	...	...	...	...	...	...
6	282,145	37,612	...	...	...	...	...	...	...	...
7	189,265	25,382	...	...	211	1,866	...	...	73	3,390
8	168,455	18,877	...	...	518	5,006	...	...	11	98
9	176,843	18,778	...	...	211	1,199	...	...	19	244
1910	176,139	18,777	248	1,433	...	...	...	...	12	147
1	169,043	18,333	1,549	15,002	...	...	...	...	12	189
2	165,371	19,725	1,868	22,270	...	...	...	...	14	217
3	188,020	23,420	3,169	59,002	...	...	...	...	...	...
4	193,057	23,227	3,554	46,285	...	...	...	...	22	379
5	222,159	24,295	...	...	2,883	39,032	13	302	7	143
6	173,012	22,258	...	...	428	12,033	3,523	74,930	14	630
7	222,075	38,339	...	...	22	593	4,661	139,940	...	...
8	109,830	22,711	...	...	282	3,045	5,489	163,880	...	...
9	223,332	55,342	...	...	248	3,704	1,780	48,462	...	...
1920	130,692	36,605	...	...	3,427	84,743	1,930	69,136	...	...
1921	116,151	18,658	...	...	...	...	2,156	48,863	...	...
Total	4,005,547	552,075	44,032	508,748	8,230	151,221	20,236	558,819	184	5,437

2†Weight not stated.

4†Estimated.

†Ore and Concentrates.

TABLE XXVII.—Return of Ore and Minerals other than Gold

YEAR.	NON-METALLIC MINERALS—continued.						MINERALS NOT ELSEWHERE INCLUDED.		Total Value of Minerals other than Gold exported to Date.	YEAR.
	ASBESTOS.		COAL.		MICA.					
	State generally.		Collie River Mf.		State generally.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	tons.	£	tons.	£	tons.	£	tons.	£	£	
1850	55	1850
1	1
2	2
3	1,211	3
4	2,440	4
5	2,951	5
6	2,218	6
7	4,330	7
8	10,751	8
9	14,752	9
1860	9,006	1860
1	7,129	1
2	12,626	2
3	14,508	3
4	18,016	4
5	21,726	5
6	11,644	6
7	15,929	7
8	14,451	8
9	10,719	9
1870	14,604	1870
1	5,040	1
2	4,368	2
3	12,434	3
4	26,723	4
5	30,628	5
6	30,638	6
7	43,284	7
8	43,545	8
9	33,300	9
1880	15,577	1880
1	11,224	1
2	14,371	2
3	7,341	3
4	6,642	4
5	5,048	5
6	8,012	6
7	5,175	7
8	6,848	8
9	4,704	9
Carried forward	508,968	

entered for EXPORT from 1850 to 1921, inclusive—continued.

YEAR.	NON-METALLIC MINERALS—continued.						MINERALS NOT ELSEWHERE INCLUDED.		Total Value of Minerals other than Gold exported to Date.	YEAR.
	ASBESTOS.		COAL.		MICA.					
	State generally.		Collie River Mf.		State generally.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	tons.	£	tons.	£	tons.	£	tons	£	£	
Brought forward	508,968	1890
1890	7,871	1
1	14,912	2
2	2†	25	...	...	22,714	3
3	2†	4	...	...	11,744	4
4	15,274	5
5	2†	3	...	...	22,658	6
6	4,438	7
7	2†	209	...	...	4,532	8
8	1	1	...	...	...	...	7,060	9
9	...	2†	1	798	772	2†	50	...	66,811	1900
1900	355	350	2†	3	5	85	1
1	971	969	...	...	...	4	2
2	12	12	...	...	6† 2	41	3
3	...	5†	10	110	127	...	...	7† 22	230	4
4	11	7	...	...	...	81	5
5	108	87	...	...	...	127	6
6	86	65	...	...	10	1,035	7
7	26	28	...	...	8† 96	1,447	8
8	...	2†	1,242	*1,447	1,138	...	...	...	...	9
9	13	11	...	...	...	...	1910
1910	*9,612	7,747	2†	10	42	2,750	1
1	353	183	...	...	...	735	2
2	*85,647	93,781	...	...	9† 263	735	3
3	3	2	...	...	...	100	4
4	*48,876	38,400	...	...	...	100	5
5	*40,063	29,344	...	...	10† 14	407	6
6	6	6	...	...	11†	8	7
7	*4,2602	30,721	...	...	...	17	8
8	*54,228	39,125	...	...	12† 5	635	9
9	*54,416	38,244	4	323	12† 9	635	1920
1920	1,667	1,513	2†	26	13†	115	1
1	*26,167	19,288	...	...	...	...	2
2	2,447	1,857	...	...	...	...	3
3	*37,590	28,387	2†	10	14†	713	4
4	*31,951	29,359	...	...	15†	440	5
5	*23,238	24,424	...	...	16† 5	97	6
6	...	1	25	*69,708	76,924	...	...	...	116	7
7	...	36	752	*78,788	104,665	18†	514	17†	223	8
8	...	31	2,525	*116,993	188,686	...	120	19†	223	9
9	...	141	6,205	...	...	...	...	20†	257	1921
1921	293,771	1
Total	...	10,760	728,293	756,223	...	1,297	...	9,663	5,730,744	Total

* Bunker Coal. † Weight not stated. ‡ † 4 cwt. † Cobalt ore.
 † Includes—
 Antimony ore, 25 tons = £630
 N.E.I., 71 tons ... = 817
 Total£1,447

† Includes—
 Iron ore, 9 tons ... = £7
 Ores, N.E.I., 5 tons ... = 400
 Total£407

† Antimony ore. † Bismuth.
 † Includes—
 Bismuth, 1 ton ... = £37
 Fireclay, 12 tons ... = 75
 Manganese, 3 cwt. ... = 3
 Total£115

† Molybdenite, † 7 cwt.
 † Includes—
 Antimony, 12 tons ... = £258
 Bismuth, 9 cwt. ... = 24
 Molybdenite, 14 tons ... = 158
 Total£440

† Includes—
 Other Concentrates, 29 tons = £108
 N.E.I., 234 tons ... = 627
 Total£735

† Includes—
 Manganese, 2 tons ... = £4
 N.E.I. = 4
 Total£8

† Includes—
 Antimony, 27 tons ... = £580
 Bismuth, 4 cwt. ... = 133
 Total£713

† Includes—
 Bismuth, 1 cwt. ... = £15
 Corundum, 1 ton ... = 1
 Molybdenite, 7 tons ... = 100
 Total£116

† Includes—
 Antimony, 2½ tons ... £45
 Clay, 6 cwt. ... 6
 Gadolinite, 1 ton ... 150
 Iron Concentrates, 1 ton ... 17
 Molybdenite, 10 cwt. ... 5
 Total£223

† Includes—
 Barytes, 2 cwt. ... £18
 Corundum, ½ cwt. ... 2
 Felspar, 1 ton ... 47
 Jarosite, 12 cwt. ... 5
 Manganese, 16 tons ... 145
 Pottery clay, 3½ tons ... 40
 Total£257

PART III.—ALL MINES.

TABLE XXVIII.

MILLING AND CYANIDING PLANTS ERECTED IN THE RESPECTIVE GOLDFIELDS, DISTRICTS, AND MINERAL FIELDS ON THE 31ST DECEMBER, 1921, AND THE TOTAL VALUE OF MINING MACHINERY.

Mining Centre and Lease or Area.	Name of Mine, Company, or Works.	MILLING.							CYANIDING.			Value of all Mining Machinery.	
		Batteries.	Other Mills.						Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.		
			Number of Heads of Stampers.	Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.					Other Crushers.	Flint Mills.	Grinding Pans.
PILBARA GOLDFIELD.													
MARBLE BAR DISTRICT.													
<i>Bamboo Creek.</i>	Bulletin	10	...	...	...	...	...	...	...	...	...	...	...
795	State Battery, Bamboo Creek	5	...	...	...	...	...	...	1	5	...	...	...
^													
<i>Elsie.</i>	Trio	3	...	...	...	...	...	...	...	...	...	...	...
M.A. 36	Lalla Rookh	10	...	...	...	...	...	...	...	4	...	...	...
<i>Lalla Rookh.</i>													
R.C. 112	Ironclad	10	...	...	...	...	...	...	...	...	...	...	...
<i>Marble Bar.</i>	Jo Jo	5	...	...	...	...	...	...	...	...	...	...	...
815	State Battery, Marble Bar	5	...	...	...	...	...	...	...	...	...	...	...
694													
^													
	Total	48							1	9			£11,490
NULLAGINE DISTRICT.													
<i>Eastern Creek.</i>	Doherty's Works	10	...	...	...	...	...	...	...	4	...	...	...
M.A. 11L	Barton	10	...	...	...	...	...	...	1	6	...	...	...
<i>Middle Creek.</i>													
212L	State Battery, 20-Mile Sandy	5	...	...	...	...	...	...	1	6	...	...	...
<i>20-Mile Sandy.</i>													
^													
	Total	25							2	16			£3,752
WEST PILBARA GOLDFIELD.													
<i>Pilbara.</i>	Black Prince ... ..	...	1	...	...	...	...	...	...	...	...	...	...
(168)	Belladonna	10	...	...	...	...	...	...	...	...	...	...	...
<i>Station Peak.</i>	Porteminna	10	...	...	...	...	...	...	...	...	...	...	...
M.A. 14													
<i>Weerianna.</i>													
M.A. 12													
	Total	20	1										£2,650
PEAK HILL GOLDFIELD.													
<i>Mt. Egerton.</i>	State Battery, Mt. Egerton	5	...	...	...	...	...	...	...	...	...	...	...
^	Connelly's Battery	10	...	...	...	...	...	...	2	...	...	...	...
<i>Peak Hill.</i>	Purcell's Works ... ..	...	...	...	...	...	...	...	...	5	...	...	...
M.A. 14P	State Battery, Peak Hill	5	...	...	...	...	...	...	1	...	...	...	...
^													
	Total	20							3	5			£8,575
EAST MURCHISON GOLDFIELD.													
LAWLERS DISTRICT.													
<i>Kathleen Valley.</i>	Yellow Aster	10	...	...	...	...	...	...	...	4	...	...	...
382	Daisy Queen G.M. Co., N.L.	5	...	...	...	...	...	...	...	5	...	...	...
<i>Lawlers.</i>	Great Eastern	5	...	...	...	...	...	...	1	5	...	...	...
1212	Sands Retreatment Works ... ..	...	...	...	...	...	...	...	...	4	...	...	...
1171	Try It	5	...	...	...	...	...	...	...	4	...	...	...
T.A. 11	Waronga G.M. Co., Ltd.	10	...	...	...	...	...	...	...	4	...	...	...
(1188)													
58, etc.	State Battery, Sir Samuel	5	...	...	...	...	...	...	...	3	...	...	...
<i>Sir Samuel.</i>													
^													
	Total	40							1	25			£13,090
WILUNA DISTRICT.													
<i>Gum Creek.</i>	Alma May	5	...	...	...	...	...	...	...	4	...	...	...
(2261)	State Battery, Mt. Keith	5	...	...	...	...	...	...	1	4	...	...	...
<i>Mt. Keith.</i>													
^	State Battery, Wiluna	10	...	...	...	...	...	1	1	...	3	1	...
<i>Wiluna.</i>	Western Machinery Co., Ltd.	30	...	...	...	...	...	...	4	...	...	2	...
6J, etc.	Wiluna Gold Mines, Ltd.	15	...	...	...	...	...	...	...	...	...	...	...
4J, etc.													
	Total	65						1	1	5	8	3	£24,989
BLACK RANGE DISTRICT.													
<i>Curran's Find.</i>	Red White and Blue	5	...	...	...	...	...	...	...	6	...	...	...
641B	Havilah	10	...	...	...	...	...	...	1	2	...	...	...
<i>Maninga</i>	Yuanni G.Ms., Ltd.	20	...	...	...	...	...	...	2	5	...	2	...
<i>Marley.</i>	State Battery, Black Range	10	...	...	...	...	...	...	...	...	...	...	...
203B													
<i>Sandstone.</i>	State Battery, Youanmi	5	...	...	...	...	...	...	...	2	...	...	...
M.A. 13B	Yuanni G.Ms., Ltd.	20	...	...	...	...	...	...	1	2	...	3	...
^													
<i>Youanmi.</i>													
^													
863B, etc.													
	Total	70		1					1	5	21	3	£95,333

TABLE XXVIII.—Milling and Cyaniding Plants erected in the respective Goldfields, Districts, etc.—continued.

Mining Centre and Lease or Area.	Name of Mine, Company, or Works.	MILLING.								CYANIDING.			Value of all Mining Machinery.	
		Batteries.	Other Mills.							Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.		
			Number of Heads of Stampers.	Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.					Flint Mills.	Grinding Pans.
MURCHISON GOLDFIELD.														
CUE DISTRICT.														
<i>Cuddingwarra.</i> 1860 Cue (1833) 203 (1839) 1143, etc.	Big Bell	10	...	...	...	...	...	...	...	1	12	...	...	...
<i>Reedy's Find.</i> 1977	Agamemnon	5	...	...	...	...	...	...	...	...	4	...	...	...
<i>Tuckabianna.</i> (1914)	Cue No. 1	20	...	...	...	...	...	...	...	1	...	...	...	...
<i>Tuckanarra.</i> ^	Gem of Cue Extended	15	...	...	...	...	...	...	...	...	6	...	...	...
	Mararoa G.M. Co., N.L. State Battery, Cue	5	...	...	...	...	2	...	...	...	3	...	...	...
	Emu ... ..	...	...	...	...	...	...	...	...	...	2	...	...	...
	Triplicate ... ..	...	...	...	...	...	...	...	...	...	3	...	...	...
	State Battery, Tuckanarra	10	...	...	...	...	...	...	...	2	3	...	...	...
	Total	65	...	...	...	...	2	...	...	4	35	...	...	£35,773
MEEKATHARRA DISTRICT.														
<i>Gabanintha.</i> (1324N)	Hamburg Belle	5	...	...	...	...	...	...	...	...	3	...	...	...
<i>T.L. 202H.</i>	B. S. Moore ... ..	...	...	...	...	...	...	...	...	...	3	...	...	...
<i>Holden's Find.</i> 1291N	Waterloo	5	...	...	...	...	...	...	...	...	...	...	...	...
<i>Meekatharra.</i> 477N	Fenian	15	...	...	...	...	2	...	...	8	...	1	1	...
	Ingliston	10	...	...	...	...	...	...	...	1	6	...	...	...
	Ingliston Consols Extended	15	...	...	...	...	...	...	...	1	6	...	...	...
	Ingliston Extended ... ..	...	...	...	...	...	...	...	...	2	2	2	1	...
	Marmont	10	...	...	...	...	...	...	...	...	...	...	...	...
	Queenhills G.Ms., Ltd. State Battery, Meekatharra	2 5	...	...	...	...	...	...	...	1 6	6	...	1	...
<i>Nannine.</i> 166N	Nannine	10	...	...	...	...	...	...	...	2	3	...	...	...
	Total	77	...	...	...	...	2	...	...	14	23	3	3	£87,000
DAY DAWN DISTRICT.														
<i>Day Dawn.</i> 1D, etc. (138D)	Great Fingall Consolidated, Ltd. Murchison Associated	40 10	...	...	...	...	3	...	...	6	14	8	...	...
	Total	50	...	...	...	...	3	...	...	6	14	8	...	£5,200
MT. MAGNET DISTRICT.														
<i>Lennonville.</i> 964M ^	Empress	5	...	...	...	...	...	...	...	1	...	...	2	...
<i>Mt. Magnet.</i> 1156M 1013M 1075M ^	State Battery, Lennonville ... ..	...	...	...	...	...	...	...	...	...	3	...	...	...
	Leap Year	5	...	...	...	...	...	...	...	...	8	...	...	...
	Mars ... ..	...	...	1	...	...	...	...	...	...	3	...	...	...
	New Havelock	5	...	...	...	...	...	...	...	...	5	...	...	...
	State Battery, Boogardie	5	...	...	...	...	...	...	...	1	5	...	...	...
	Total	20	...	1	...	...	...	...	...	2	19	...	2	£14,105
YALGOO GOLDFIELD.														
<i>Field's Find.</i> (850)	Commodore	3	...	...	...	...	...	...	...	...	...	...	...	...
<i>Goodingnow.</i> ^	State Battery, Payne's Find	5	...	...	...	...	...	...	...	1	5	...	...	...
<i>Nyounda.</i> 880	Gnow's Nest	10	...	...	...	...	1	...	...	2	8	...	...	...
<i>Warriedar.</i> (708) ^	Mug's Luck	10	...	...	...	...	...	...	...	...	2	5	...	...
<i>Yalgoo.</i> M.A., 17 Yuin. 712	State Battery, Warriedar	5	...	...	...	...	...	...	...	...	6	...	...	...
	Ivanhoe	5	...	...	...	...	...	...	...	...	...	...	...	...
	Bullrush Gold Estates, N.L.	20	...	...	...	...	...	...	...	5	...	...	...	...
	Total	58	...	...	...	...	1	...	...	8	21	5	...	£32,732
MT. MARGARET GOLDFIELD.														
MT. MORGANS DISTRICT.														
<i>Linden.</i> 344F [998R] ^	Bindah	5	...	...	...	...	...	...	...	...	3	...	...	...
<i>Mt. Margaret.</i> (314F) ^	State Battery, Linden	10	...	...	...	...	...	...	...	2	6	...	...	...
<i>Mt. Morgans.</i> (325F) 5F Yunjermindera. 357F	Torquay	5	...	...	...	...	...	...	...	1	4	2	...	...
	Mt. Morven	5	...	...	...	...	...	...	...	...	3	...	...	...
	Millionaire	5	...	...	...	...	...	...	...	...	...	...	...	...
	Westralia Mt. Morgans Mines, N.L.	10	...	...	...	...	...	...	...	3	...	2	1	...
	Big Stone	5	...	...	...	...	...	...	...	...	...	...	...	...
	Total	45	...	...	...	...	...	...	...	6	16	4	1	£11,337

TABLE XXVIII.—Milling and Cyaniding Plants erected in the respective Goldfields, Districts, etc.—continued.

Mining Centre and Lease or Area.	Name of Mine, Company, or Works.	MILLING.								CYANIDING.			Value of all Mining Machinery
		Batteries.	Other Mills.							Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	
			Number of Heads of Stampers.	Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.					Flint Mills.	Grinding Fans.
MT. MALCOLM DISTRICT.													
<i>Lake Darlot.</i> Λ	State Battery, Lake Darlot	10	...	...	...	...	...	...	2	...	...	...	...
<i>Leonora.</i> (1473C) 263C	Chaffers G.M. Co. (1916), Ltd.	5	...	...	...	...	...	...	...	...	...	...	...
1530C	Gwalia Central G.Ms., Ltd.	5	...	...	...	...	...	...	...	...	1	...	...
190C, etc.	Leonora Gold Blocks	10	...	...	...	...	...	...	...	...	...	...	...
198C, etc.	Sons of Gwalia, Ltd.	10	...	...	...	...	...	4	9	...	...	1	...
Λ	Sons of Gwalia, Ltd. (South Leases)... ..	10	...	...	...	...	...	...	2	...	...	...	...
<i>Mt. Clifford.</i> 1829C	State Battery, Leonora	10	...	...	...	...	...	...	...	...	...	...	...
<i>Mt. Malcolm.</i> (1175C)	Victory No. 1	5	...	...	...	...	...	...	...	...	...	...	...
<i>Pig Well.</i> (1295C)	North Star: Malcolm Prospecting Co., N.L.	10	...	...	...	...	...	...	...	...	...	...	...
	Starlight G.M. Syndicate, N.L.	10	...	...	...	...	...	...	...	...	...	...	...
	Total	75	...	...	...	...	...	4	13	1	...	1	£234,121
MT. MARGARET DISTRICT.													
<i>Burtville.</i> 2138T	NH Desperandum ... ..	...	...	1	...	...	...	...	1	...	...	...	...
<i>Duketon.</i> M.A., 22T	Mulga Queen Consols	10	...	...	...	...	...	...	...	4	...	...	...
<i>Euro.</i> (1984T)	Lone Star	10	...	...	...	...	...	...	...	6	...	...	...
<i>Laverton.</i> 715T, etc.	Lancefield G.Ms., Ltd. ... ..	...	...	5	...	...	...	1	8	...	6	3	...
(1897T)	Mary Mac G.M. Co., N.L.	10	...	...	...	...	...	...	4	3	1	...	...
Λ	State Battery, Laverton	10	...	...	...	...	...	...	1	5	...	...	...
	Total	40	...	6	...	...	...	1	14	18	7	3	£33,343
NORTH COOLGARDIE GOLDFIELD.													
MENZIES DISTRICT.													
<i>Comet Vale.</i> 5217Z	Gladsome	10	...	...	...	...	...	...	3	9	...	...	...
<i>Goongarrie.</i> (5414Z)	New Boddington G.M. Syndicate, Ltd.	10	...	...	...	...	...	...	...	...	...	...	...
<i>Menzies.</i> (5354Z)	Balkis	5	...	...	...	...	...	...	...	1	...	...	...
M.A., 60Z	Lady Harriet	5	...	...	...	...	...	...	...	4	...	...	...
4931Z, etc.	Menzies Consolidated G.Ms., Ltd.	20	...	...	...	...	...	...	9	14	4	1	...
(3100Z, etc.)	Menzies Mining & Exploration Corp'n, Ltd.	10	...	...	...	...	...	...	...	8	...	1	...
T.A., 47Z.	Gidney's Works ... ..	...	...	...	...	...	...	...	...	8	...	...	...
<i>Mt. Ida.</i> Λ	State Battery, Mt. Ida	5	...	...	...	...	...	...	1	...	...	...	...
	Total	65	...	...	...	...	...	...	13	44	4	2	£27,752
ULARRING DISTRICT.													
<i>Mulline.</i> 324U	Riverina South G.M. Co., N.L.	10	...	...	...	...	1	1	2	...	4	...	...
Λ	State Battery, Mulline	10	...	...	...	...	...	...	2	5	...	...	...
	Total	20	...	...	...	...	1	1	4	5	4	...	£26,856
NIAGARA DISTRICT.													
<i>Kookynie.</i> 769G	Two D's. ... ..	...	...	1	...	...	...	...	3	2	...	12	...
<i>Niagara.</i> Λ	State Battery, Niagara	10	...	...	...	...	...	...	2	5	...	...	...
<i>Tampa.</i> M.A., 59G	Grafter	5	...	...	...	...	...	...	1	2	...	...	...
	Total	15	...	1	...	...	...	...	6	9	...	12	£3,481
YERILLA DISTRICT.													
<i>Edjudina</i> 1011R	Neta	10	...	...	...	...	...	...	1	...	...	...	...
<i>Yarri.</i> Λ	State Battery, Yarri	10	...	...	...	...	...	...	1	6	...	...	...
	Total	20	...	...	...	...	...	...	2	6	...	...	£3,488
BROAD ARROW GOLDFIELD.													
<i>Bardoc.</i> 1835W	Zoroastrian	5	...	...	...	...	1	...	...	...	...	...	...
<i>Carnage</i> M.A., 22W	Carnage	10	...	...	...	...	...	...	...	2	...	...	...
<i>Siberia.</i> 1899W, etc.	Associated Northern Blocks (W.A.), Ltd. ... ..	...	...	1	...	2	3	1	10	7	...	2	...
1371W	Gimblet South	10	...	...	...	...	...	...	...	...	...	...	...
1289W	Lady Evelyn	5	...	...	...	...	...	...	...	...	...	...	...
(1736W)	Pole	5	...	...	...	...	...	...	...	...	...	...	...
Λ	State Battery, Ora Banda	5	...	...	...	...	...	...	1	6	...	...	...
	State Battery, Siberia	5	...	...	...	...	...	...	1	5	...	...	...
	Total	45	...	1	...	2	3	2	12	20	...	2	£64,126

TABLE XXVIII.—Milling and Cyaniding Plants erected in the respective Goldfields, Districts, etc.—continued.

Mining Centre and Lease or Area.	Name of Mine, Company, or Works.	MILLING.								CYANIDING.			Value of all Mining Machinery	
		Batteries.	Other Mills.							Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.		
			Number of Heads of Stampers.	Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.					Flint Mills.	Grinding Pans.
NORTH-EAST COOLGARDIE GOLDFIELD.														
KANOWNA DISTRICT.														
<i>Gordon.</i> 1385X	Pride of the Morning ... ..	...	...	...	...	1	...	...	...	...	...	...	...	...
<i>Kanowna.</i> 1389X.	Golden Valley	5	...	...	...	...	...	...	...	...	...	...	...	...
M.A., 19X	Martin's Battery	15	...	...	...	...	...	...	...	...	...	...	...	...
12X, etc.	North White Feather G.Ms., Ltd.	20	...	...	...	...	...	...	...	1	...	...	...	...
<i>Mulgarrrie.</i> 1426X	Palm ... ..	...	...	...	...	1	...	...	...	...	...	...	...	...
	Total	40	...	...	...	2	...	...	...	1	...	...	...	£9,135
KURNALPI DISTRICT.														
<i>Kurnalpi.</i> M.A., 5K	Success	5	...	...	...	...	...	...	...	...	...	...	...	...
<i>Mulgabbie.</i> M.A., 4K	Simmons' Battery ... ..	...	1	...	...	...	...	...	...	...	...	...	...	...
	Total	5	1	...	...	...	...	...	...	...	...	...	...	£180
EAST COOLGARDIE GOLDFIELD.														
EAST COOLGARDIE DISTRICT.														
<i>Boulder.</i> 38E, etc.	Associated G.Ms. of W.A., Ltd. ... ..	...	...	9	...	...	...	1	...	20	...	6	7	...
35E	Eureka ... ..	...	...	...	...	1	...	...	...	1	...	...	...	...
351E, etc.	Golden Horseshoe Estates Co., Ltd.	140	...	1	...	...	3	...	6	15	24	20	22	20
50E	Great Boulder No. 1, Ltd.	10	...	...	...	...	...	...	...	...	...	...	...	...
66E	Great Boulder Perseverance G.M. Co., Ltd. ... ..	...	...	8	...	...	...	4	...	2	17	...	24	13
16E, etc.	Great Boulder Proprietary G.Ms., Ltd. ... ..	...	1	6	13	...	...	2	9	...	20	...	23	7
94E	Ironstides North	10	...	...	...	...	...	...	...	...	1	3	...	...
31E	Ivanhoe Gold Corporation, Ltd.	100	...	...	...	...	...	3	...	2	25	32	13	3
15E, etc.	Lake View and Star, Ltd.	75	...	1	...	...	...	7	...	8	21	...	27	17
281E, etc.	North Kalgurli (1912), Ltd.	20	...	...	...	...	...	...	...	...	...	4	3	1
6E, etc.	Oroya Links, Ltd.	55	...	11	...	...	3	10	5	20	33	35	12	...
120E, etc.	South Kalgurli Consolidated, Ltd.	40	...	4	...	...	...	2	...	15	34	11	10	...
<i>Kalgoorlie.</i> 790E	Bonnie Lass (Raven's Battery)	10	...	...	...	...	...	...	...	...	10	...	...	...
3643E	Hainault Sulphide Plant ... ..	...	...	1	...	...	...	...	...	...	7	2	...	...
M.A., 7E	Hannans Central	20	...	...	...	...	...	1	...	1	8	4	...	2
4540E, etc.	Hannans Reward, Ltd.	5	...	...	...	...	...	...	...	...	3	...	...	...
L.C., 353E	Lone Hand ... ..	...	...	...	...	1	...	...	...	...	7	...	...	...
<i>Wombola.</i> 4770E	Great Hope North	10	...	...	...	...	...	...	...	...	4	...	...	...
	Total	495	1	41	13	2	8	43	38	166	165	170	92	£1,224,742
COOLGARDIE GOLDFIELD.														
COOLGARDIE DISTRICT.														
<i>Burbanks.</i> (134), etc.	Burbanks Birthday G.Ms., Ltd. ... ..	...	...	...	...	...	...	...	...	1	9	...	...	...
M.A., 77	Burbanks Main Lode	10	...	...	...	...	...	1	...	...	...	4	...	...
(2160)	Lady Robinson	10	...	...	...	...	...	...	...	...	...	...	...	...
<i>Coolgardie.</i> 5135	Coolgardie Redemption	10	...	...	...	...	...	...	...	...	...	...	...	...
4567	Griffiths Gold Mine	10	...	...	...	...	...	...	...	...	6	...	...	...
M.A., 11	New Bayley's Mine, Ltd.	10	...	...	...	...	...	...	...	...	1	4	...	...
	State Battery, Coolgardie	10	...	...	...	...	...	2	...	1	7	...	...	...
<i>Gibraltar.</i> 4580	Lloyd George ... ..	...	...	...	1	...	...	...	...	1	...	...	...	...
4603	Reform	5	...	...	...	...	...	...	...	...	...	...	...	...
<i>St. Ives.</i> Widgiemooltha.	State Battery, St. Ives	5	...	...	...	...	...	...	...	1	...	...	...	...
M.A., 63	Highgate	3	...	...	...	...	...	...	...	1	...	...	...	...
M.A., 280	Imperial	5	...	...	...	...	...	...	...	...	...	...	...	...
	Total	78	...	...	...	1	...	3	...	5	23	8	...	£24,922
KUNANALLING DISTRICT.														
<i>Carbine.</i> 33S	Carbine	10	...	...	...	...	...	...	...	2	...	...	...	...
25-Mile.	Blue Bell	5	...	...	...	...	...	...	...	...	7	...	...	...
696S	Shamrock	5	...	...	...	...	...	...	...	...	...	...	...	...
(871S)	Star of Fremantle	10	...	...	...	...	...	...	...	...	4	...	...	...
645S		...	...	...	...	...	...	...	...	...	...	...	...	...
	Total	30	...	...	...	...	...	...	...	2	11	...	...	£7,650

TABLE XXVIII.—Milling and Cyaniding Plants erected in the respective Goldfields, Districts, etc.—continued.

GOLDFIELD.	DISTRICT.	MILLING.								CYANIDING.			Total Value of all Mining Machinery.	
		Batteries. Number of Heads of Stampers.	Other Mills.							Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.		
			Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.	Flint Mills.					Grinding Pans.
GOLD MINING.													£	
KIMBERLEY	Marble Bar	48								1	9			11,490
PILBARA	Nullagine	25									16			3,752
WEST PILBARA ... ..	... ..	20	1											2,650
ASHBURTON ... ..	... ..												
GASCOYNE ... ..	... ..												
PEAK HILL ... ..	... ..	20												8,575
EAST MURCHISON	Lawlers	40								1	25			13,090
	Wiltuna	65						1		1	8	3	3	24,989
	Black Range	70		1							21	3	3	95,333
	Cue	65								1	35		2	35,773
	Meekatharra	77						2			4			67,000
MURCHISON	Day Dawn	50									23	3	3	14,105
	Mt. Magnet	20		1							14	8		5,200
	... ..	58						3			6		2	14,105
YALGOO	Mt. Morgans	45							1		8	5		32,732
	Mt. Malcolm	75									6	4	1	11,337
MT. MARGARET	Mt. Margaret	40		6				1		4	13	1		234,121
	Menzies	65									14	7	3	33,843
	Ularring	20									13	4	2	27,752
NORTH COOLGARDIE	Niagara	15		1					1	1	4	4		26,856
	Yerilla	20									6	9	2	3,481
BROAD ARROW ... ..	... ..	45		1							2	6		3,438
N.E. COOLGARDIE	Kanowna	40				2	3				12	20	2	64,126
	Kurnalpi	5	1			2					1			9,135
EAST COOLGARDIE	East Coolgardie	495	1	41	13	2	8	43	33	166	165	170	92	1,224,742
	Bulong													
COOLGARDIE	Coolgardie	78				1		3			5	23	8	24,922
	Kunanalling	30									2	11		7,650
YILGARN ... ..	... ..	155				2		2	2	13	55	4	3	101,515
DUNDAS ... ..	... ..	17								1	10			29,537
PHILLIPS RIVER ... ..	... ..	45												10,250
STATE GENERALLY ... ..	... ..			1				1						30,000
	Total, Gold Mining Machinery	1,748	3	52	13	9	11	62	42	309	579	223	126	£2,157,074
LEAD MINING.														
NORTHAMPTON, M.F. ... ..	... ..							6						28,500
	Total, Lead Mining Machinery							6						£28,500
TIN MINING.														
PILBARA	Marble Bar					1		2						25,300
GREENBUSHES TINFIELD ... ..	... ..					1		4						17,997
	Total, Tin Mining Machinery					2		6						£43,297
COPPER MINING.														
WEST PILBARA ... ..	... ..							5	2	1				73,500
MT. MARGARET	Mt. Morgans									2				4,250
PHILLIPS RIVER ... ..	... ..							10	2	2				71,250
	Total, Copper Mining Machinery							15	4	3				£149,000
COAL MINING.														
COLLIE RIVER COALFIELD ... ..	... ..													133,761
	Total, Coal Mining Machinery													£133,761
ASBESTOS MINING.														
PILBARA	Nullagine													2,750
	Total, Asbestos Mining Machinery													£2,750
	Total Machinery other than Gold Mining					2		27	4	3				£357,308
	Total, all Mining Machinery	1,748	3	52	13	11	11	89	46	312	579	223	126	£2,514,382

APPENDIX.

ROYAL MINT, PERTH BRANCH.

Subject to the Regulations, any person may deposit gold at the Mint in his own name. Those who cannot attend personally for the purpose may send the gold by an agent, under Police escort, or by Post.

A circular can be obtained from the Deputy Master of the Mint giving all necessary information for intending depositors, conditions of the Escort Service, Coining Regulations, etc., etc.

An Escort Service is provided by the Police Department for parcels of all sizes. The consignor pays for the carriage by coach or train, but the escort charges may be collected by the Mint.

Forms for use in connection with gold sent to the Mint by post or under Police escort can be obtained at the Mint.

Charges for Assaying, Refining, and Coinage.

Gross Weight of Deposit in ounces.	Mint Charge.	Gross Weight of Deposit in ounces.	Mint Charge.	Gross Weight of Deposit in ounces.	Mint Charge.
Up to and including—	£ s. d.	Up to and including—	£ s. d.	Up to and including—	£ s. d.
24	0 5 0	400	4 3 4	1,300	10 4 2
30	0 6 3	410	4 5 5	1,400	10 16 8
40	0 8 4	420	4 7 6	1,500	11 9 2
50	0 10 5	430	4 9 7	1,600	12 1 8
60	0 12 6	440	4 11 8	1,700	12 14 2
70	0 14 7	450	4 13 9	1,800	13 6 8
80	0 16 8	460	4 15 10	1,900	13 19 2
90	0 18 9	470	4 17 11	2,000	14 11 8
100	1 0 10	480	5 0 0	2,100	15 4 2
110	1 2 11	490	5 2 1	2,200	15 16 8
120	1 5 0	500	5 4 2	2,300	16 9 2
130	1 7 1	520	5 6 8	2,400	17 1 8
140	1 9 2	540	5 9 2	2,500	17 14 2
150	1 11 3	560	5 11 8	2,600	18 6 8
160	1 13 4	580	5 14 2	2,700	18 19 2
170	1 15 5	600	5 16 8	2,800	19 11 8
180	1 17 6	620	5 19 2	2,900	20 4 2
190	1 19 7	640	6 1 8	3,000	20 16 8
200	2 1 8	660	6 4 2	3,100	21 9 2
210	2 3 9	680	6 6 8	3,200	22 1 8
220	2 5 10	700	6 9 2	3,300	22 14 2
230	2 7 11	720	6 11 8	3,400	23 6 8
240	2 10 0	740	6 14 2	3,500	23 19 2
250	2 12 1	760	6 16 8	3,600	24 11 8
260	2 14 2	780	6 19 2	3,700	25 4 2
270	2 16 3	800	7 1 8	3,800	25 16 8
280	2 18 4	820	7 4 2	3,900	26 9 2
290	3 0 5	840	7 6 8	4,000	27 1 8
300	3 2 6	860	7 9 2	4,100	27 14 2
310	3 4 7	880	7 11 8	4,200	28 6 8
320	3 6 8	900	7 14 2	4,300	28 19 2
330	3 8 9	920	7 16 8	4,400	29 11 8
340	3 10 10	940	7 19 2	4,500	30 4 2
350	3 12 11	960	8 1 8	4,600	30 16 8
360	3 15 0	980	8 4 2	4,700	31 9 2
370	3 17 1	1,000	8 6 8	4,800	32 1 8
380	3 19 2	1,100	8 19 2	4,900	32 14 2
390	4 1 3	1,200	9 11 8	5,000	33 6 8

For every additional 100ozs. the charge is increased by 12s. 6d.

NOTE.—Additional charges (see Regulation No. 6) are collected when base metals in a deposit exceed 2 per cent. of its weight.

The following table illustrates the operation of these charges in case of gold of the value of £3 17s. 10½d. an ounce:—

Weight of Deposit.	Rate of Charge per ounce.	Amount of Charge.	Net Value of Deposit.
ozs.	d.	£ s. d.	£ s. d.
50	2.5	0 10 5	194 3 4
100	2.5	1 0 10	388 6 8
600	2.3	5 16 8	2,330 8 4
1,000	2.0	8 6 8	3,885 8 4
5,000	1.6	33 6 8	19,435 8 4
10,000	1.55	64 11 8	38,872 18 4

NOTE.—A proportion of silver in deposits of gold is paid for by the Mint as follows:—

In deposits under 1,000ozs. gross: all silver in excess of 8 per cent. of the weight of the deposit after melting.

” from 1,000 ” to 5,000 ” ” 6 ” ” ” ”

” ” 5,000 ” ” 10,000 ” ” 5 ” ” ” ”

” ” 10,000 ” upwards ” ” 4 ” ” ” ”

The rate at which payment for silver is made is liable to fluctuation.

GOLD ESCORT SERVICE.**RATES.**

Actual Cost, plus 20 per cent.

RATES FOR CARRIAGE OF GOLD ON GOVERNMENT RAILWAYS.

	Distance not over—									
	10 miles	25 miles.	50 miles.	100 miles.	150 miles.	200 miles.	250 miles.	300 miles.	400 miles.	500 miles
Bullion or unmanufactured Gold, per 100ozs.	s. d. 3 9	s. d. 4 6	s. d. 5 3	s. d. 6 9	s. d. 8 3	s. d. 9 9	s. d. 11 3	s. d. 12 9	s. d. 15 0	s. d. 17 3

1s. 6d. per 100ozs. for every additional 100 miles, or part thereof.

To find the value per ounce of gold sent from a mine to the Mint.—Divide the standard gold by the weight before melting, and multiply the result by £3 17s. 10½d. For instance, supposing the Mint return to show:—

Weight before melting	..	..	..	..	..	..	Ozs. 47.41
Standard gold	..	..	..	..	..	..	38.19

The calculation would be as follows:—

4741)3819.0(.805
3792.8

26200
23705

2495

.805 × £3 17s. 10½d. =
.805 × £3.894

.805

19470
311520

£3.134(670)
20

s. 2.680
12

d. 8.160 = £3 2s. 8d., value per ounce of gold as
produced from the mine.