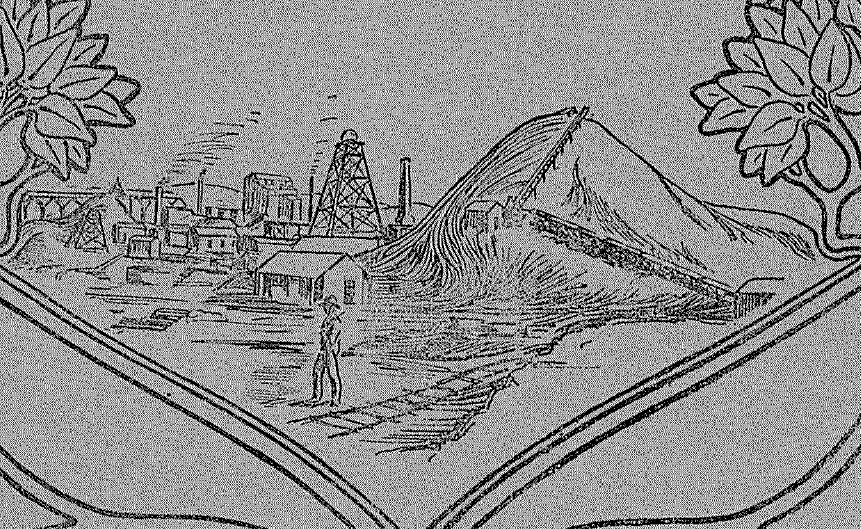
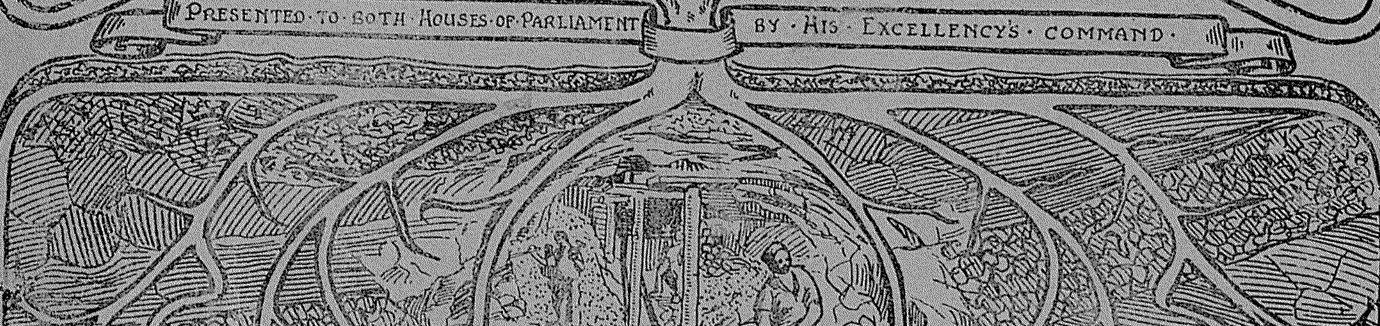
REPORT
OF THE
DEPARTMENT OF MINES
FOR THE YEAR
WESTERN · 1927. · AUSTRALIA



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



1928.

WESTERN AUSTRALIA.

REPORT

OF THE

DEPARTMENT OF MINES

FOR THE YEAR

1927.

Presented to both Houses of Parliament by His Excellency's Command.

[THIRD SESSION OF THE THIRTEENTH PARLIAMENT.]

PERTH:
BY AUTHORITY: FRED. WM. SIMPSON, GOVERNMENT PRINTER.
1928.

F 16/28

ANNUAL REPORT OF THE DEPARTMENT OF MINES, WESTERN AUSTRALIA, 1927.

TABLE OF CONTENTS.

DIVISION I.

TABLE OF CONTENTS—*continued.*

DIVISION II.

TABLE OF CONTENTS—*continued.*

TABLE OF CONTENTS—*continued.*

APPENDIX No. 1.

APPENDIX No. 2.

APPENDIX No. 3.

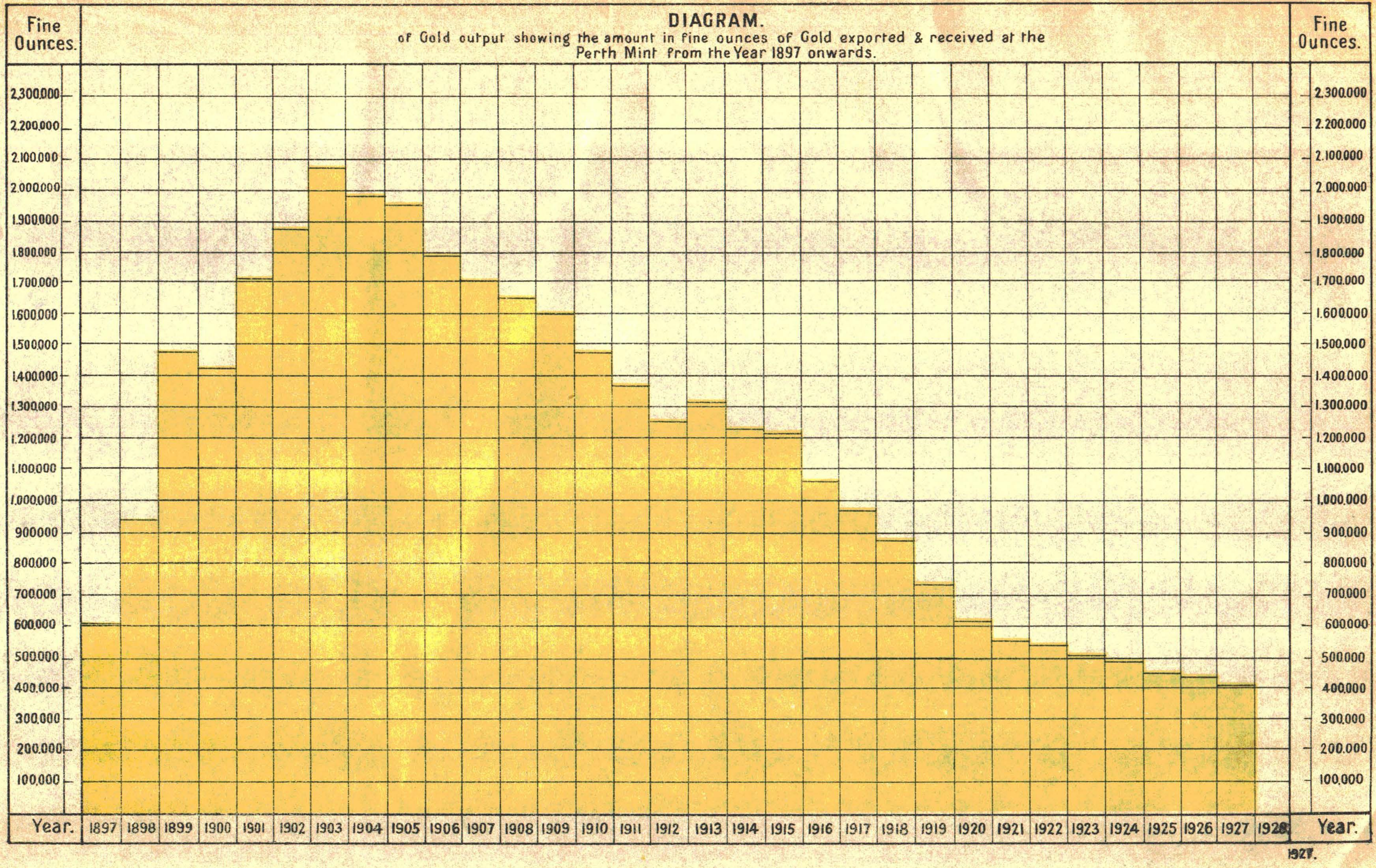


DIAGRAM.
of Gold output showing the amount in fine ounces of Gold exported & received at the Perth Mint from the Year 1897 onwards.

TABLE OF CONTENTS—*continued.*

DIVISION III.

DIVISION IV.

DIVISION V.

DIVISION VI.

DIVISION VII.

DIVISION VIII.

APPENDIX.

STATE OF WESTERN AUSTRALIA.

Report of the Department of Mines for the State of Western Australia for the Year 1927.

To the Hon. the Minister for Mines.

Sir,

I have the honour to submit the Annual Report of the Department for the year 1927, 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, 1928.

DIVISION I.

Summary by the Under Secretary for Mines.

PART I.—GENERAL REMARKS.

The value of the Mineral Output of the State for the year 1927 was £2,202,437, being £169,427 less than that for the previous year. Tin showed an increase, but Copper, Silver and Lead decreases.

The value of the Gold yield was £1,734,571, being 78.75 per cent. of the total output.

The value of the Coal output was £407,967, Silver £5,829, and Tin £13,316.

The Dividends paid by mining companies amounted to £31,250, and in the preceding year £61,479; a decrease of £30,229.

The total Dividends paid to the end of 1927 amounted to £28,698,430. To the same date the total Mineral Production was £168,881,142, and the total Gold Production £157,662,410.

GOLD.

The Gold Yield shows a decline, being 28,990 fine ounces less than in 1926, which was 3,909 fine ounces less than in 1925.

The average value per ton of ore treated in the State as a whole has risen from 45.41 shillings in 1926 to 49.32 shillings in 1927; and in the East Coolgardie Goldfield, which produced over 73 per cent of the State's reported yield, it rose from 47.39 shillings to 53.47 shillings.

Comparing the tonnage of ore treated in 1926 and 1927, there was a decrease of 97,004 tons in the latter year, during which 695,951 tons were treated.

There were increases in Broad Arrow, Dundas Phillip's River, Peak Hill, West Pilbara, and East Murchison of 13,391, 1,553, 256, 142, 20, and 18 tons respectively. All the others treated less tonnage, the largest decreases being in East Coolgardie, Mount Margaret, Murchison, Yalgoo, Yilgarn, and North East Coolgardie of 69,689, 11,823, 9,049, 6,884, 5,244 and 4,717 tons respectively.

There were increases in the production from Ashburton, Broad Arrow, Dundas, East Murchison, Kimberley, Phillip's River, and West Pilbara; the others reported decreases.

The acreage held under mining lease for all minerals is 53,386 acres, being an increase of 1,150 acres when compared with 1926. The area leased for gold mining is less by 327 acres, and for other minerals greater by 1,477 acres.

The area held under prospecting areas is 15,782 acres, including 9,000 acres for coal. This is an increase of 5,914 acres on the area held in 1926, due to the larger acreage held for prospecting for coal.

The number of men engaged in all classes of mining was 5,036, a decrease of 401 on the number employed in 1926. The number of men engaged in mining for minerals other than gold showed an increase of 31, due to improved figures for tin and coal. In lead mining there was a falling off, but for other minerals little alteration. In gold mining there was a decrease of 432.

The average value of gold produced per man employed on gold mines was £410.36 in 1926, and £431.97 in 1927.

The average tonnage raised per man was 175.17 tons, and in the previous year 180.75 tons.

The second periodical examination, under the provisions of the Miners' Phthisis Act, of persons employed in the mines, commenced on the 7th February, 1927, and was completed on the 30th November, 1927. The results are as follow, and for the purpose of comparison the figures for the 1925-26 examination are also given:—

RESULTS OF 1927 EXAMINATION.

Total number of men examined ...				3,728
Suffering from—			per cent.	
Miners' Phthisis—Early ...	381	=	10·2	
„ „ Advanced ...	93	=	2·5	
„ „ plus Tuberculosis	128	=	3·4	
Tuberculosis only	10	=	·3	
Normals	3,116	=	83·6	
	3,728	=	100·0	3,728

RESULTS OF THE 1925-26 EXAMINATIONS.

Total number of men examined ...				4,023
Suffering from—			per cent.	
Miners' Phthisis—Early ...	459	=	11·4	
„ „ Advanced ...	183	=	4·5	
„ „ plus Tuberculosis	131	=	3·3	
Tuberculosis only	11	=	·3	
Normals	3,239	=	80·5	
	4,023	=	100·0	4,023

Of the total number of 4,023 men who were examined during the 1925-26 examinations, 2,781 were re-examined in 1927, of whom 2,290 were classified as normal in 1925-26, and 2,244 in 1927. The results of the 1927 re-examinations revealed that of the 2,290 men who were normal in 1925-26—

30 had advanced to miners' phthisis early.
Nil to miners' phthisis advanced.
13 to miners' phthisis plus tuberculosis, and three to tuberculosis only.

Of the 2,781 men re-examined in 1927—

360 were reported to be suffering from miners' phthisis early in 1925-26, and

348 in 1927.

Sixteen of the 360 men were found to have progressed to miners' phthisis advanced, and 26 to miners' phthisis plus tuberculosis.

One hundred and thirty-one were classified as miners' phthisis advanced in 1925-26, and 85 in 1927.

Sixty-two of the 131 men were found on re-examination to have developed tuberculosis. The number examined for the first time in 1927 was 945, showing—

Miners' phthisis early—33 = 3.5 per cent.
Miners' phthisis advanced—8 = .8 per cent.
Miners' phthisis plus tuberculosis—25 = 2.7 per cent.
Tuberculosis only—7 = .7 per cent.
Normals—872 = 92.3 per cent.

It will be noted from the above figures that the most important fact revealed by the 1927 re-examinations is the predisposition of the miners' phthisis cases to develop tuberculosis. Of 131 men reported to be suffering from miners' phthisis advanced in the 1925-26 examinations, 62 or 47.3 per cent. were, on re-examination in 1927, found to have developed tuberculosis, and of 360 cases of miners' phthisis early 26 or 7.2 per cent. were found to have contracted the disease.

In view of the fact that a considerable proportion of the men who were re-examined in 1927 had been engaged in mining for many years, the results of the 1927 examinations indicate an improvement in the position generally, although the percentages of tuberculosis cases are practically the same.

The immediate removal of the tuberculosis men from the mines, however, should result in greatly diminishing tuberculosis amongst the miners in future, and the results of the 1928 examinations should show a marked improvement in this respect.

Of the total number of 474 men reported in the 1927 examinations to be suffering from miners' phthisis, only 71 were fresh cases, comprising 63 early cases and eight advanced.

The number of beneficiaries in receipt of compensation on the 31st December, 1927, was 215, and the aggregate amount of compensation paid to that date was £43,534. Since the first group of tuberculosis men was withdrawn from the mines on the 27th January, 1926, 50 have died and 115 are permanently incapacitated from work. The number of dependants of the deceased and permanently incapacitated men is 212, comprising 64 wives, 24 widows, and 124 children.

In the East Murchison field there was a small increase.

The Black Range district, excepting a little activity in the Montague centre, from whence was reported the discovery of specimen stone resulting in three good crushings being obtained, was very quiet.

At Sandstone diamond drilling by the Government is being carried out.

In the Lawlers district there was not any improvement.

In the Wiluna district there was a substantial increase and it is expected that there will be a further improvement. Development work was vigorously carried out by the Wiluna Gold Mines, Ltd., and on the completion of the railway from Meekatharra, which has been authorised, it is expected that the erection of considerable plant will be immediately undertaken.

From Cole's Find, Mount Hilda, and Diorite centres good crushings were reported, and a large amount of prospecting was in evidence.

The Murchison field had a decrease.

In the Meekatharra district there was a falling off, but generally speaking there was little change.

In the various centres outside Meekatharra itself a good deal of prospecting was going on.

In the Cue district there was also a decrease, and mining was very quiet. At Reidy's the Mararoa Company continued operations, but development work was suspended pending the carrying out of some diamond drilling shortly, in which the Department is assisting.

At Poona, mining for emeralds was active, and a large number of stones had been shipped to London.

In the Day Dawn district there was a small increase, but production was practically confined to the old Fingall Mine at Day Dawn and the Mainland Consols at Lake Austin.

In the Mount Magnet district there was a small increase. The principal returns were from properties in the vicinity of Mount Magnet. Small returns were reported from Lennonville, Moyagee, and Paynesville, but matters were generally very quiet.

The Mount Margaret field had a decrease.

In the Mount Margaret district there was a falling off consequent on smaller outputs from the King of Creation and Nil Desperandum mines. The chief production was from the Lancefield. Very little prospecting was being done.

In the Mount Morgans district there was also a decrease, and again the chief producers were the Westralia Mount Morgans at Mount Morgans, and the Devon at Linden. A few prospectors were at work.

In the Mount Malcolm district the principal producer was the Sons of Gwalia, but there was a smaller output consequent on operations being hampered by floods in the early part of the year and later on to a reduction in the number of men employed, as a result of the decision of the directors to salvage the mine. This, however, has been varied owing to the Government having decided to render considerable financial help for the carrying out of a developmental policy and the erection of necessary plant, which it is hoped will reduce costs and lengthen the life of the mine. No new finds were reported, and very little prospecting was being done throughout the district.

The Coolgardie field had a small decrease.

In the Kunanalling district matters were very quiet, and the output showed a falling off.

At Gibraltar mining is practically at a standstill, the only mine working being the Carlton.

At Widgiemooltha quite a number of prospectors were at work.

At Burbanks the Government is carrying out a programme of diamond drilling, which is not expected to be completed until the new year.

At St. Ives the Reward mine is being worked on tribute, and a few other mines are working and crushing, but no good developments have been reported.

In the immediate vicinity of Coolgardie only a few prospectors are working.

The North Coolgardie field had a small decrease.

In the vicinity of Menzies a couple of good crushings were got. At Comet Vale the Gladsome-Sand Queen mine was vigorously worked, and is expected to enter the list of regular producers very shortly.

At Goongarrie and Mount Ida only a little prospecting was going on.

In the Ularring district everything was quiet, but work will shortly commence on the old Riverina South, and it is hoped production will follow.

In the Yerilla district a small production was reported, but very little prospecting is going on.

In the Niagara district mining is at a standstill.

The North-East Coolgardie Goldfield had a decrease. This is attributable to a cessation of operations on the Red Hill mine in the Kanowna district, and which is now let on tribute.

In the Kurnalpi district mining is at a standstill, the finds reported last year not having come up to expectations.

The Broad Arrow field had an increase consequent on the resumption of active operations on the Associated Northern Company's mine at Ora Banda. At this centre production was also reported from the Orinda. Other producers were the Tara-Oversight at Broad Arrow, and the Wentworth at Dark Horse. Although a good deal of systematic prospecting was in evidence throughout the field, no new discoveries were reported.

In the East Coolgardie Goldfield the number of men engaged in mining was 1,990, and in 1926, 2,272; a decrease of 282. This goldfield gave employment to over 49 per cent. of the number of men employed in gold mining, and the reported production during the year was 299,256 fine ounces, over 73 per cent. of the total reported yield.

The tonnage treated was 474,153 tons, being 69,689 tons less than in 1926. The yield showed a decrease of 4,781 fine ounces on the preceding year.

The average grade of the ore per ton rose from 47.39 shillings in 1926 to 53.47 shillings in 1927.

The majority of the mines maintained a regular output, but the Oroya Links, unfortunately, closed down in August. Its future policy is not known, and at present its leases are under exemption. The Golden Horseshoe has not yet resumed work, but it is expected to do so shortly. A great number of tributes have been let on several of the mines.

At the North end of the field a large amount of exploratory work was done but nothing of note discovered.

In the Bulong district the chief activity was at Mount Monger, from whence several good crushings were reported.

In the Yilgarn Goldfield there was a decrease, largely the result of the Great Victoria mine at Burbidge having closed down.

At Westonia there was a slight improvement, and a few mines were being actively developed.

At Holleton, formerly known as Hollow's Find, mining was very quiet towards the end of the year, and many prospectors had left. A great drawback to this locality is the absence of an adequate water supply.

At Manxman the Radio was worked throughout the year.

In the immediate vicinity of Southern Cross very little prospecting was going on.

In the Dundas field there was a small increase. A slight revival was noticeable. Crushings were reported from the old Mararoa mine and a few other leases, and several prospecting areas were being actively developed.

The Phillip's River field recorded a small increase consequent on an improvement at Kundip, where the Two Boys mine is again being worked with encouraging prospects. A good deal of prospecting was also being done in the locality. In the vicinity of Ravensthorpe very little gold mining was in evidence, and consequent on the low price ruling for copper and nothing further having transpired regarding the assertions of the Separation Company that it would demonstrate that its flotation process could profitably treat the ores of the field, no copper ore was mined.

In the Northern goldfields, Kimberley, West Kimberley, West Pilbara, Ashburton and Gascoyne, no development of note was reported.

In the Pilbara field there was a small decrease, and gold mining was very quiet.

TIN.

The quantity of Tin exported was 77 tons, valued at £13,316, an increase in tonnage of 10 tons, and in value of £2,866.

The Greenbushes tinfield produced 58.34 tons, valued at £9,544, a decrease in tonnage of 3.07 tons, and in value of £582. The Pilbara field produced 37.44 tons, valued at £6,229, an increase in tonnage of 2.02 tons, and in value of £783. None was produced in any other field.

TANTALITE.

The production of 15.28 tons, valued at £3,808, was reported from the Pilbara field. This is a decrease in tonnage of 4.17 tons, but increase in value of £1,451 on the previous year.

COPPER.

There was no production of this metal reported during the year.

COAL.

The output of Coal was 501,505 tons, being 26,686 tons more than in 1926. All the production was at Collie, where seven collieries were producing. Three of these, the Premier, Griffin, and Stockton only produced for portion of the year. The Premier closed down in July, and the Griffin and Stockton have only recently entered the list of producers.

The known deposits at Wilga remained unworked throughout the year.

At Eradu the Government is still carrying on boring operations.

The number of men employed, 748, is greater by 62 men than in 1926, and the output per man was in 1926, 692 tons, and in 1927, 670 tons.

OIL.

Boring operations, subsidised by the Federal Government, are still in progress on the area held by the Freney Kimberley Oil Company in the North of the State. No boring is being done elsewhere at present.

ASBESTOS.

In the Pilbara field 10.80 tons, valued at £304, were reported, a decrease in tonnage of 80.65 tons, and in value of £2,132 on the previous year. None was produced elsewhere.

OTHER MINERALS.

The quantity of Silver obtained as a by-product and exported was 49,895 ounces, valued at £5,829, and in the preceding year 68,413 ounces, valued at £8,863; a decrease of 18,518 ounces and £3,034.

Arsenical Ore, valued at £819, was exported, also 30 tons of Manganese, valued at £303, and 1,413 tons of Lead and Silver Lead, valued at £24,592; a decrease in tonnage of 2,749 tons and in value of £52,149.

In addition, the production of Gypsum to the extent of 6,675 tons, valued at £9,818, was reported, an increase in tonnage of 2,757 tons, and in value of £4,200; also Emeralds to the amount of 200 carats, valued at £421, and 35 tons of pottery clay, valued at £114.

MINING GENERALLY.

New Zealand had an increase of 5,257 fine ounces of gold, Tasmania 638 fine ounces, and Northern Territory 21 fine ounces, while the remainder of the States of the Commonwealth and also the Territory of Papua recorded decreases.

The Western Australian production was 64.72 per cent. of the total for Australasia, and in the preceding year 68.25 per cent.

The Government has continued unremittingly its efforts to assist the industry in every reasonable direction and thus, if possible, stimulate production and arrest the decline which has been such a regrettable feature of the gold mining industry for some years.

A special relief accorded during the year was the payment on behalf of mine owners of the insurance premium necessary to cover liability for occupational diseases under the Third Schedule of the Workers' Compensation Act. This is operative for a period of one year, the amount involved being approximately £31,000.

A programme of diamond drilling throughout the fields is being carried out in the hope that payable deposits may be located. So far no great success has attended the Departments efforts in this regard, but they will be continued until all the most promising localities have been tested.

Nothing further has eventuated in regard to the offer to assist in providing cheaper power for the Kalgoorlie mines, mentioned in last year's report, as none of the mine owners has indicated to the Department the extent to which such a provision would be utilised.

The concessions in regard to reduced charges for water and for treatment at State batteries have been continued.

The Technical Committee appointed by the Commonwealth Development and Migration Commission submitted a report dealing with the question of assistance to the Kalgoorlie mines, and indicated that a condition precedent to the granting of any financial help was amalgamation of the principal mines into preferably one or possibly two groups, with a view to the carrying out of a comprehensive developmental policy and effecting a substantial reduction in overhead charges. This necessitated action in the suggested direction by the mine owners themselves, but so far nothing has been accomplished. It also recommended the carrying out of special geological investigations, and made available for the purpose a highly trained officer. This work is now proceeding, and he is being assisted by officers of the State Geological Staff. The complete report on the industry generally is not yet available.

Towards the close of the year the Federal Government convened a conference to discuss preliminary arrangements in regard to a scheme for testing in Australia the recently developed methods of geophysical prospecting for minerals, oil and water.

A large sum of money is to be made available for this work by the Empire Marketing Board and the Federal Government will contribute an equal amount. The services of Mr. Broughton Edge, a mining geologist, who is reported to have achieved considerable success in South Africa have, on the advice of a technical committee in England, been secured for the work. The conference will meet at Hobart early in the year, and this State will be represented by two officers.

In mining for base metals, the low prices ruling for many caused diminished outputs.

The assistance to prospectors, by way of sustenance, loans of equipment and transport facilities, was continued. The Board dealing with this matter granted 176 applications, representing 251 men, and approved of 127 extensions of existing cases, affecting 158 men. The expenditure involved was £5,166 8s. The assisted prospectors' operations extended from Hall's Creek, in the North of the State, to Ravensthorpe, in the South, and from Pemberton and Three Springs, in the West, to Karonie, in the East. Several good returns were reported, and in some instances refunds were made of portion of the expenditure incurred.

The area under prospecting areas for gold and minerals, apart from coal, viz., 6,782 acres, although 2,830 acres less than in 1926, indicates that a fair amount of prospecting is still going on.

The expenditure incurred in rendering assistance to mine owners and the industry generally under the provisions of the Mining Development Act totalled £81,686 7s. 11d. Details relative to most of this expenditure are given in the report of the State Mining Engineer, Division II. of this report. In addition, guarantees were given to banks on behalf of several mine owners, the liability of the Government at the close of the year in respect to these being £51,500.

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 1927.

FIG. 1.

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

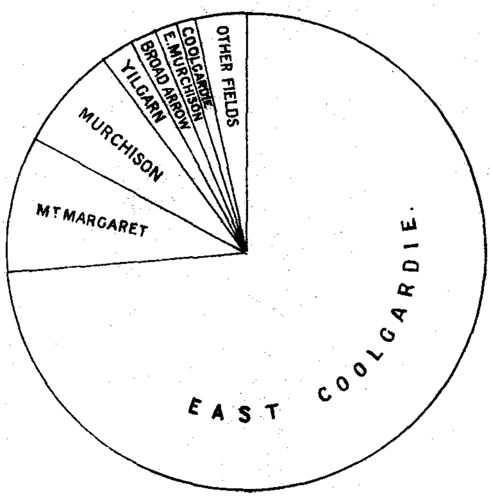


FIG. 2.

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

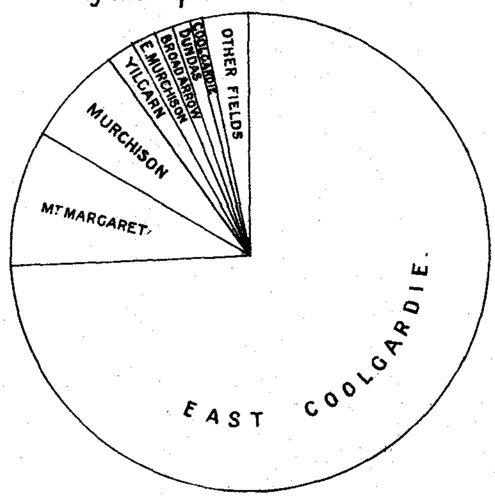


FIG. 3.

Value of Gold and other Minerals.

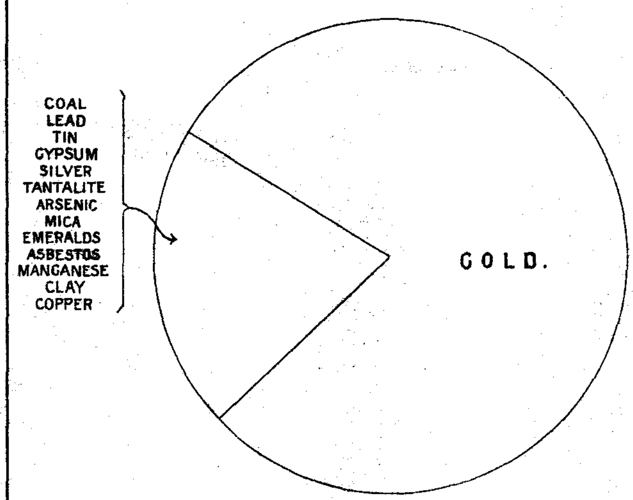


FIG. 4.

Value of Minerals other than Gold.

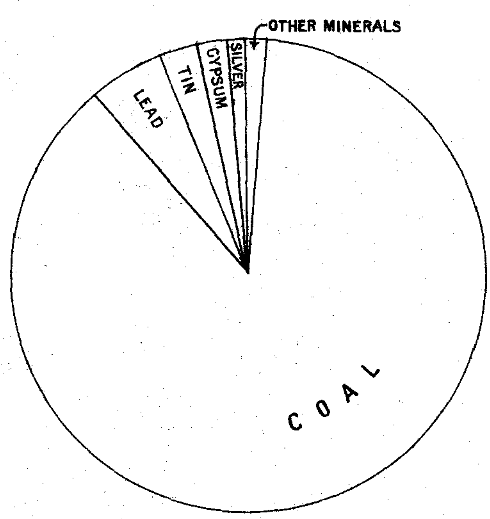


FIG. 5.

Areas of Land leased for Goldmining on various Goldfields.

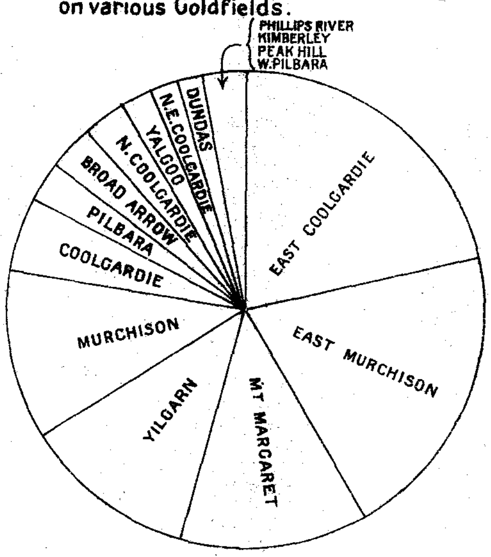
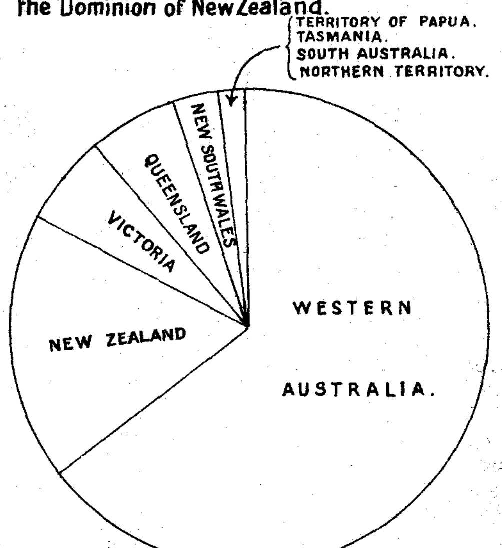


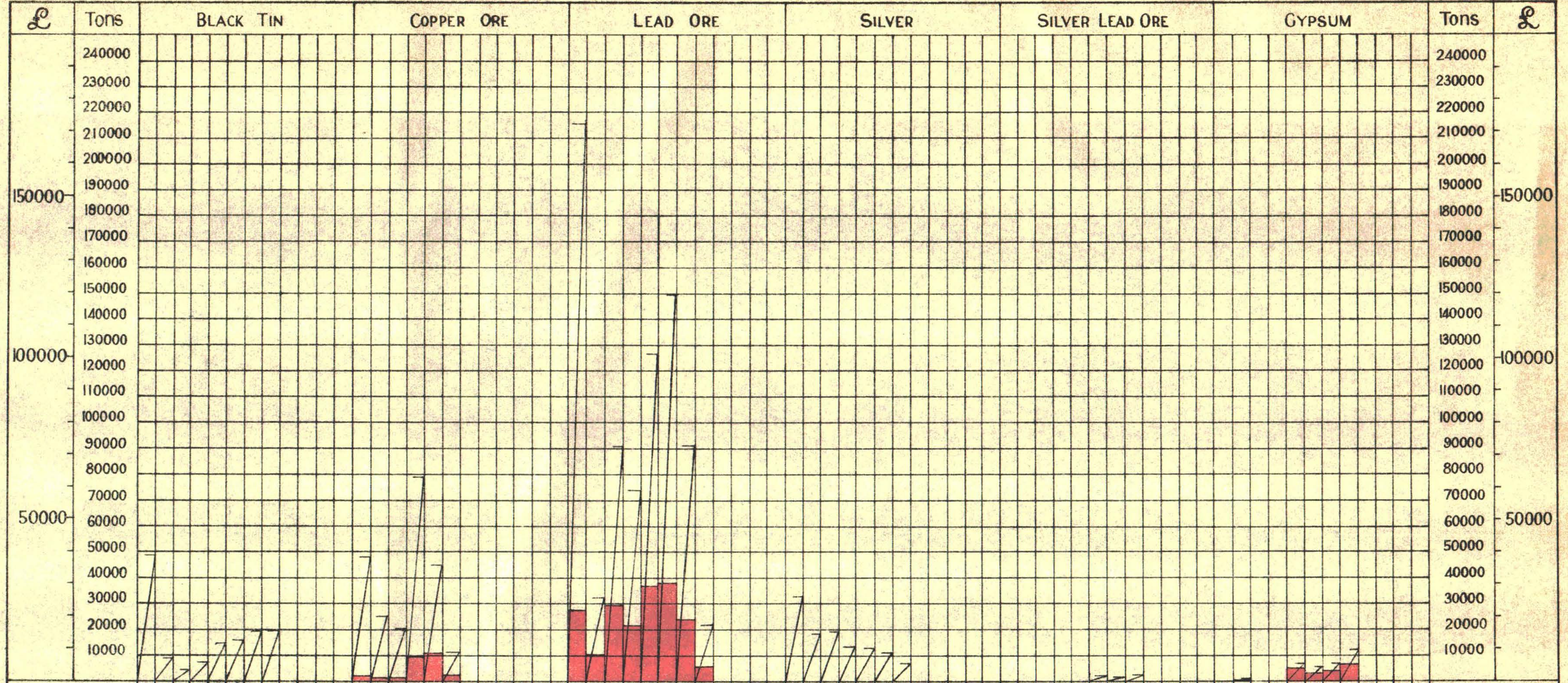
FIG. 6.

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



DIAGRAM

of the Mineral Output - shewing Quantity & Value of Minerals other than Gold & Coal reported to the Mines Dept. from the Year 1920 onwards



Year	Black Tin Value £	Black Tin Quantity Tons	Copper Ore Value £	Copper Ore Quantity Tons	Lead Ore Value £	Lead Ore Quantity Tons	Silver Value £	Silver Quantity Ozs.	Silver Lead Ore Value £	Silver Lead Ore Quantity Tons	Gypsum Value £	Gypsum Quantity Tons
1920	38865	232	37945	1962	172483	27716	26230	95744	NIL	NIL	NIL	NIL
1921	7238	67	20162	1150	25649	10330	14770	89140	NIL	NIL	622	664
1922	3839	41	16133	1195	72338	29603	15172	98050	NIL	NIL	16	63
1923	5984	52	63184	9873	59194	21635	10930	76124	NIL	NIL	NIL	NIL
1924	11517	81	36011	10755	101219	36750	10135	66341	NIL	NIL	5278	4237
1925	12373	79	8952	2470	119299	37866	8736	60529	1898	81	4118	3060
1926	15572	97	NIL	NIL	72872	23973	5710	44263	1305	90	5618	3918
1927	15773	96	NIL	NIL	17347	5809	NIL	NIL	1971	96	9818	6674
1928												
1929												
1930												
1931												

NOTE:- The Pink denotes Quantities produced & Diagonal lines Values thereof

Minerals not shown above

Tantalite 15 tons Value £3808
Asbestos 16 " " £ 304
Emeralds 200 ct. " £ 421

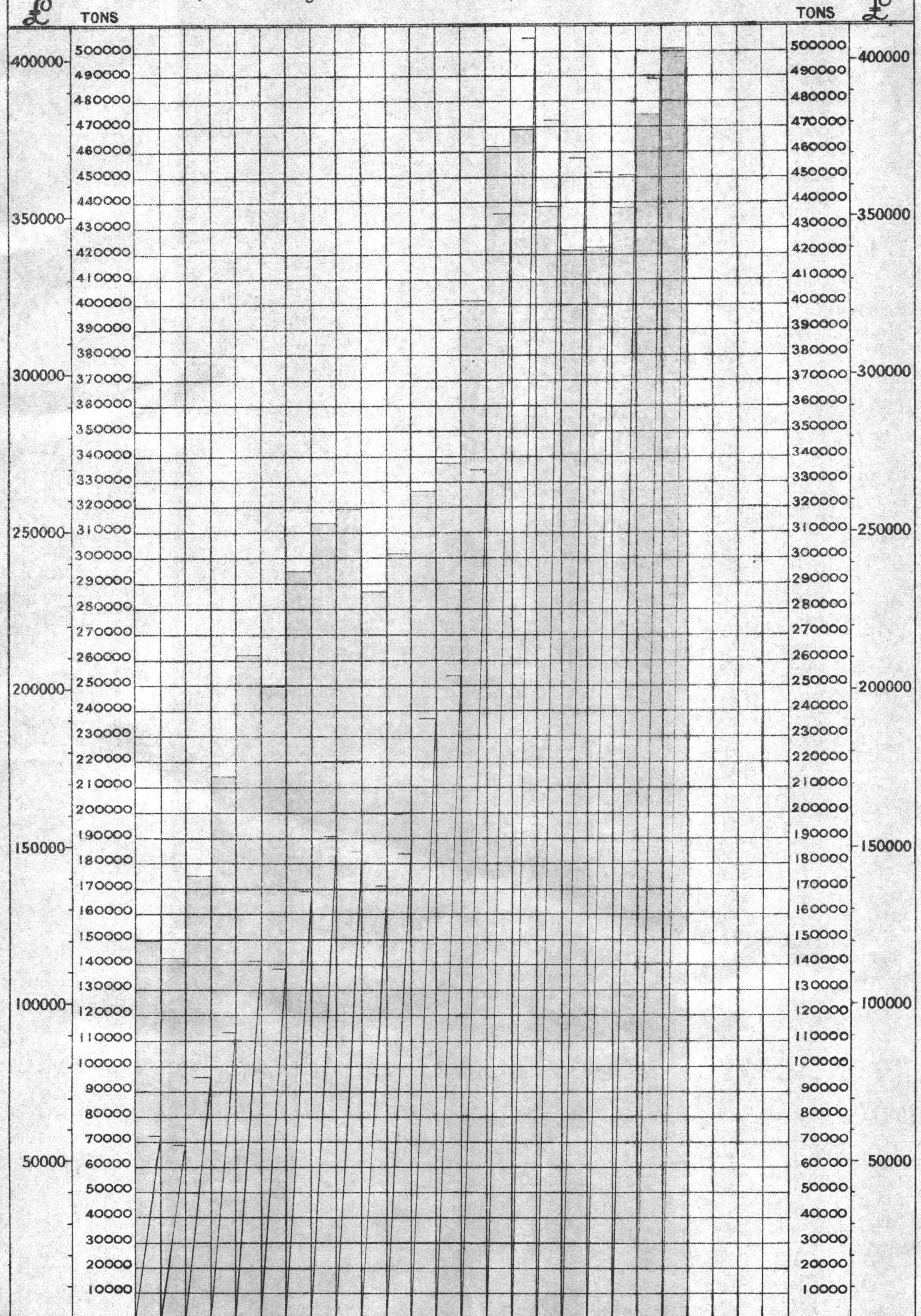
Previous to 1920 the Quantity & Value of various Minerals reported amounted to

Black Tin	16043 Tons	£1,373,883	Silver Lead	2884	£	33,987
Copper	225824 "	1,562,440	Tantalite	102		15,268
Ironstone	57830 "	36,695	Limestone	93706		18,290
Lead	213.451 "	626.604	Silver	2122812 Ozs		280,572
Asbestos	96 "	3,197	Other Minerals			3,905
Pyritic Ore	58,470 "	26,146				

1927.

DIAGRAM

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	1922	1923	1924	1925	1926	1927
Value £	57998	55158	75694	90965	113699	111154	135857	153614	148684	137589	147823	191822	204319	270355	350346	407117	381555	368949	363255	363203	394400	407967
Quantity Tons	149765	142373	175248	214302	262166	249890	295079	313818	319210	286666	301526	326550	337039	401713	462021	468 817	438443	420714	421864	437461	474819	501505

1927.

Part II.—MINERALS RAISED.

Table 1.

Quantity and Value of all the Minerals produced during 1926 and 1927.

Description of Minerals.	1926.		1927.		Increase or Decrease for Year compared with 1926.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
		£		£		£
1. Antimony (exported), statute tons	4½	85	...	...	— 4½	— 85
2. Arsenical ore (exported), statute tons	*	347	*	819	...	+ 472
3. Asbestos (reported), statute tons	105	2,728	11	304	— 94	— 2,424
4. Coal (raised), statute tons	474,819	394,400	501,505	407,967	+ 26,686	+ 13,567
5. Copper — Ore (exported), statute tons	...	...	2	101	+ 2	+ 101
5. Copper — Ingot, Matte, etc. (exported), statute tons	1	84	...	...	— 1	— 84
6. Felspar (exported), statute tons	8	250	...	...	— 8	— 250
7. Gold (exported and minted), fine ounces	437,343	1,857,716	408,353	1,734,571	— 28,990	—123,145
8. Gypsum (reported), statute tons	3,918	5,618	6,675	9,818	+ 2,757	+ 4,200
9. Lead and Silver Lead (exported), statute tons ...	4,162	76,741	1,413	24,592	— 2,749	— 52,149
10. Manganese (exported), statute tons	82	503	30	303	— 52	— 200
11. Mica (exported), statute tons	4	†8,328	4	536	...	— 7,792
12. Pottery Clay (exported), statute tons	...	...	35	114	+ 35	+ 114
13. Silver (exported), fine ounces	68,413	8,863	49,895	5,829	— 18,518	— 3,034
14. Tantalite, (exported) statute tons	24	5,751	17	3,746	— 7	— 2,005
15. Tin (exported), statute tons	67	10,450	77	13,316	+ 10	+ 2,866
16. Emeralds (reported), carats	...	...	200	421	+ 200	+ 421
Total Values	...	2,371,864	...	2,202,437	...	— 169,427

* Contained in Gold ore. † The value stated for Mica in 1926 is that declared by the exporter at the time of shipment, but later information indicates that it was overstated.

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
1922	11,848,025	2,875,402	24·27
1923	11,999,500	3,259,476	27·16
1924	13,808,910	1,424,319	13·24
1925	13,642,852	*173,126	*1·27
1926	14,668,184	1,597,698	10·89
1927	15,805,120	472,041	2·99
Total since 1900 ...	286,490,424	131,163,621	45·78

* The Mineral Exports for 1925 were abnormally low, for the reason that the movement of fine gold bars and gold specie was restricted during the year, probably due to the uncertainty in the London-Australian exchange position, also to the restoration of the gold standard and the opportunity afforded Banks to replenish depleted stocks. The Exports of Minerals other than gold were approximately the same as n the previous year.

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. 1926.	Reported Yield. 1927.	Percentage for each Goldfield. 1926.	Percentage for each Goldfield. 1927.	Average Value of Gold per ton of Ore treated. 1926.	Average Value of Gold per ton of Ore treated. 1927.
	fine ozs.	fine ozs.			shillings.	shillings.
1. Kimberley	65	**194**	·01	**·05**	...	...
2. West Kimberley	...	...	...	...	...	...
3. Pilbara	2,376	**2,023**	·55	**·50**	82·29	**155·11**
4. West Pilbara	29	**53**	·01	**·01**	...	**14·80**
5. Ashburton	10	**15**	·01	**·01**	...	...
6. Gascoyne	85	**79**	·02	**·02**	...	...
7. Peak Hill	2,140	**1,689**	·50	**·41**	82·71	**56·29**
8. East Murchison	5,336	**6,025**	1·24	**1·48**	74·89	**91·49**
9. Murchison	33,487	**27,886**	7·82	**6·86**	47·38	**48·50**
10. Yalgoo	6,382	**2,394**	1·49	**·59**	56·26	**73·83**
11. Mt. Margaret	43,628	**36,698**	10·19	**9·03**	31·05	**29·05**
12. North Coolgardie	2,472	**2,055**	·58	**·51**	162·66	**158·94**
13. Broad Arrow	1,460	**7,570**	·34	**1·86**	89·42	**42·80**
14. North-East Coolgardie	6,199	**2,487**	1·45	**·61**	61·47	**59·21**
15. East Coolgardie	304,037	**299,256**	70·98	**73·62**	47·39	**53·47**
16. Coolgardie	5,998	**5,786**	1·40	**1·42**	55·56	**98·49**
17. Yilgarn	11,792	**9,227**	2·75	**2·27**	31·11	**29·05**
18. Dundas	2,682	**2,739**	·62	**·67**	106·50	**63·50**
19. Phillips River	19	**284**	·01	**·07**	65·47	**86·37**
State generally	133	**10**	·03	**·01**	...	...
Totals and averages	428,330	**406,470**	100·00	**100·00**	45·41	**49·32**

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.

Averages of Gold Ore raised and treated, and Gold produced therefrom, per man employed on the several Goldfields of the State, during 1926 *and* 1927.

Goldfield.	1926. Tons of Gold Ore raised and treated. Per man employed under ground.	1926. Tons of Gold Ore raised and treated. Per man employed above and under ground.	1926. Fine ounces of Gold produced therefrom. Per man employed under ground.	1926. Fine ounces of Gold produced therefrom. Per man employed above and under ground.	1927. Tons of Gold Ore raised and treated. Per man employed under ground.	1927. Tons of Gold Ore raised and treated. Per man employed above and under ground.	1927. Fine ounces of Gold produced therefrom. Per man employed under ground.	1927. Fine ounces of Gold produced therefrom. 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	96·94	61·22	93·92	59·32	**38·37**	**25·58**	**70·03**	**46·69**
4. West Pilbara	...	...	...	...	...	...	...	...
5. Ashburton	...	...	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...	...	...
7. Peak Hill	114·66	62·24	111·66	60·62	**145·00**	**74·84**	**96·08**	**49·59**
8. East Murchison	57·66	25·39	50·84	22·39	**42·39**	**17·85**	**45·65**	**19·23**
9. Murchison	253·05	138·69	141·13	77·35	**253·36**	**132·19**	**144·58**	**75·43**
10. Yalgoo	165·62	84·26	109·68	55·80	**56·70**	**27·03**	**49·28**	**24·39**
11. Mt. Margaret	428·90	233·41	156·73	85·29	**414·65**	**238·26**	**141·80**	**81·48**
12. North Coolgardie	43·72	17·24	83·70	33·01	**51·50**	**15·91**	**96·40**	**29·77**
13. Broad Arrow	17·79	8·09	18·74	8·52	**256·60**	**119·75**	**129·25**	**60·24**
14. North-East Coolgardie ...	182·27	87·17	131·88	63·07	**100·09**	**47·87**	**69·76**	**33·36**
15. East Coolgardie	442·15	242·14	246·65	135·08	**435·82**	**241·05**	**274·28**	**151·71**
16. Coolgardie	71·01	34·07	46·44	22·28	**52·93**	**24·35**	**61·35**	**28·22**
17. Yilgarn	466·16	179·69	170·90	65·88	**420·64**	**186·95**	**143·86**	**63·94**
18. Dundas	58·65	27·78	73·51	34·82	**99·03**	**48·21**	**74·02**	**36·03**
19. Phillips River	5·67	1·42	4·37	1·09	**39·00**	**11·37**	**39·65**	**11·56**
Total Averages	346·57	180·75	185·23	96·61	**335·88**	**175·17**	**194·99**	**101·69**

The average value of gold produced per man above and under ground was £410·36 in 1926 and £431·95 in 1927. The average tonnage of ore raised shows a decrease from 180·75 tons to 175·17 tons. The average tonnage raised per man is highest in the East Coolgardie Goldfield, *viz.*, 241·05 tons, average value £644·42, the next being Mount Margaret Goldfield with 238·26 tons, average value £346·11.

TABLE 5.

Output of Gold from the several States of Australia, the Northern Territory, the Territory of Papua, and the Dominion of New Zealand during 1927.

State.	Output of Gold.	Value.	Percentage of total Output of Australasia.
	Fine ozs.	£	£
1. Western Australia	408,353	1,734,571	64·72
2. Victoria	38,538	163,699	6·11
3. Queensland	37,979	161,321	6·02
4. New South Wales	18,032	76,595	2·86
5. Tasmania...	4,861	20,646	0·77
6. South Australia	418	1,776	0.07
7. Northern Territory	174	741	0·03
8. Territory of Papua	3,729	15,839	0·59
9. New Zealand	118,830	504,756	18·83
Total	630,914	2,679,944	100·00

TABLE 6.

Dividends paid by Western Australian Gold Mining Companies during 1927 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 1927.		Grand Total paid to end of 1927.
						No.	Total Amount.	
		£		£ s. d.	£ s. d.		£	£
Peak Hill ...	Various Companies ...	...	...	...	...	...	...	160,666
East Murchison...	Various Companies ...	...	...	...	...	...	...	437,968
Murchison ...	Various Companies ...	...	...	...	...	...	...	1,992,670
Mt. Margaret ...	Various Companies ...	...	...	...	...	...	...	1,504,701
North Coolgardie	Various Companies ...	...	...	...	...	...	...	575,032
North-East Coolgardie	Various Companies ...	...	...	...	...	...	...	89,854
East Coolgardie...	South Kalgurli Consolidated, Ltd.	150,000	250,007	0 10 0	0 10 0	2	31,250	408,751
Do. ...	Other Companies	...	...	...	...	...	...	22,453,469
Coolgardie ...	Various Companies ...	...	...	...	...	...	...	339,495
Yilgarn	Various Companies ...	...	...	...	...	...	...	513,199
Dundas	Various Companies ...	...	...	...	...	...	...	222,625
	Total Dividends paid during 1927	...	...	...	...	...	31,250	...
	Total Dividends paid to end of 1927	...	...	...	...	...	...	28,698,430

TABLE 7.

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.
	£	£	%	£	%
Previous to 1918	133,888,331	26,718,125	19·95	...	...
1918	3,723,183	368,295	9·81	2,914,325	12·64
1919	3,118,113	338,244	10·85	2,337,433	14·23
1920	2,624,427	429,083	16·35	2,212,711	19·39
1921	2,352,098	306,958	13·05	1,787,721	17·17
1922	2,286,325	191,251	8·36	1,789,879	10·69
1923	2,143,028	73,750	3·44	1,730,712	4·26
1924	2,060,298	124,771	6·06	1,623,588	7·68
1925	1,874,320	55,224	2·94	1,526,248	3·62
1926	1,857,716	61,479	3·31	1,495,388	4·11
1927	1,734,571	31,250	1·80	1,435,572	2·18
Total ...	157,662,410	28,698,430	18·20	*18,853,577	*10·50

* Last ten years only.

TABLE 8.

Quantity and Value of Minerals, other than Gold and Coal, reported to the Mines Department during 1927.

Goldfield, District, or Mineral Field.	1927. Quantity.	1927. Value.	Increase or Decrease for Year compared with 1926. Quantity.	Increase or Decrease for Year compared with 1926. Value.
	tons.	£	tons.	£
BLACK TIN.				
Pilbara Goldfield (Marble Bar District)	37·44	6,229	+ 2·02	+ 783
Greenbushes Mineral Field	58·34	9,544	— 3·07	— 582
Total	95·78	15,773	— 1·05	+ 201
TANTALITE.				
Pilbara Goldfield (Marble Bar District)	15·28	3,808	— 4·17	+ 1,451
LEAD ORE.				
Northampton Mineral Field	5,809·50	17,347	— 18,163·85	— 55,525
SILVER-LEAD ORE.				
Ashburton Goldfield	60·00	1,179	+ 60·00	+ 1,179
Pilbara Goldfield (Marble Bar District)	36·00	792	— 54·50	— 513
Total	96·00	1,971	+ 5·50	+ 666
ASBESTOS.				
Pilbara Goldfield (Nullagine District)	10·80	304	— 80·65	— 2,132
West Pilbara Goldfield	...	...	— 13·89	— 292
Total	10·80	304	— 94·54	— 2,424
GYPSUM.				
Yilgarn Goldfield	698·25	698	+ 559·25	+ 559
State generally	5,976·25	9,120	+ 2,197·49	+ 3,641
Total	6,674·50	9,818	+ 2,756·74	+ 4,200
EMERALDS.				
Murchison Goldfield (Cue District)	Carats (cut). 200·43	421	Carats (cut). + 200·43	+ 421

The output of Black Tin shows a decrease in tonnage of 1.05 tons and an increase in value of £201. The production of Tantalite was 15.28 tons, valued at £3,808, being a decrease in tonnage of 4.17 tons and an increase in value of £1,451 over the previous year. Lead ore shows decreases in tonnage of 18,163.85 tons and in value of £55,525, while Silver Lead ore shows increases in tonnage of 5.50 tons and in value of £666. Asbestos decreased by 94.54 tons and £2,424. Gypsum shows an increase in tonnage of 2,756.74 tons and in value of £4,200. Emeralds were produced in marketable quantities for the first time, and consequently show increases of 200.43 carats, valued at £421.

The production of Tin was again confined to Pilbara and Greenbushes fields, and Tantalite came from Pilbara goldfield. Lead ore came from Northampton mineral field, and Silver Lead ore from Pilbara and Ashburton goldfields. Asbestos came from Pilbara goldfield, and Gypsum from Yilgarn goldfield and from the State generally. Emeralds were produced from Murchison goldfield.

TABLE 9.

Quantity of Coal raised during 1926 and 1927, 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 underground.	Per Man employed above and under ground.
		tons.	£			tons.	tons.
Collie	1926	474,819	394,400	156	530	896	692
	1927	501,505	407,967	177	571	878	670

The number of men employed at collieries has increased by 62, and the output has increased by 26,686 tons, and the value by £13,567.

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

TABLE 10.

Total Number and Acreage of Leases held for Mining on 31st December, 1926 and 1927.

Description of Leases	1926.		1927.	
	No.	Acreage.	No.	Acreage.
Gold mining leases on Crown land	414	6,580	385	6,247
„ „ „ private property	...	...	1	6
Mineral leases on Crown land	247	45,331	262	46,880
„ „ „ private property	11	325	8	253
	672	52,236	656	53,386

The total number of leases held for mining purposes decreased by 16 and the area increased by 1,150 acres, as compared with the year 1926. The number of leases for gold mining decreased by 28 and the area by 327 acres. The number of mineral leases increased by 12 and the area by 1,477 acres.

TABLE 11.

Number and Acreage of Gold Mining Leases in force each year for the Five Years ending the 31st December, 1927.

Goldfield.		District.		1923.		1924.		1925.		1926.		1927.		Percentage of Total Acreage.		Increase or Decrease in Acreage for 1927 compared with 1926.		Goldfield.
Name.	Proclaimed.	Name.	Proclaimed.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	Leases.	Acreage.	1926.	1927.	Increase	Decrease	
West Kimberley ...	19-3-20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	West Kimberley.
Kimberley ...	20-5-86	...	...	...	...	...	...	...	...	...	...	2	**48**	...	**·77**	48	...	Kimberley.
Yilgarn	1-10-88	...	...	45	788	40	665	34	544	33	619	39	**739**	9·41	**11·91**	126	...	Yilgarn.
		(Private Property)	...	...	...	...	...	1	24	...	...	1	**6**					
Pilbara	1-10-88	Marble Bar ...	6-11-96	29	403	17	167	10	85	11	91	10	**98**	1·56	**3·01**	85	...	Pilbara.
		Nullagine ...	6-11-96	3	36	3	30	3	30	2	12	5	**90**					
Ashburton ...	11-12-90	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Ashburton.
Murchison	24-9-91	Cue	7-12-94	10	105	11	149	14	198	10	137	15	**234**	10·06	**11·42**	52	...	Murchison.
		Meekatharra ...	7-12-94	32	501	28	449	22	356	20	310	20	**293**					
		Day Dawn ...	10-1-96	11	122	9	79	7	73	6	64	6	**64**					
		Mount Magnet ...	7-12-94	18	191	11	92	10	91	16	151	12	**123**					
Dundas	31-8-93	...	...	14	159	13	147	8	108	8	90	8	**104**	1·37	**1·66**	14	...	Dundas.
Coolgardie ...	6-4-94	Coolgardie ...	7-12-94	54	965	33	521	30	474	14	250	16	**283**	5·82	**5·25**	...	55	Coolgardie.
		Kunanalling ...	1-9-97	12	140	12	160	10	133	10	133	4	**45**					
East Coolgardie ...	1-10-94	East Coolgardie	7-12-94	121	1,872	123	1,847	112	1,673	87	1,302	86	**1,276**	20·65	**21·32**	...	26	East Coolgardie.
		Bulong	15-4-96	30	629	2	45	3	69	3	57	3	**57**					
Yalgoo	23-1-95	...	...	29	520	18	285	16	239	14	166	11	**146**	2·52	**2·33**	...	20	Yalgoo.
North Coolgardie	28-6-95	Menzies	15-4-96	19	304	20	330	19	295	16	270	9	**94**	5·73	**2·89**	...	196	North Coolgardie.
		Ularring	15-4-96	5	88	3	56	...	...	2	48	3	**60**					
		Yerilla	15-4-96	5	75	10	149	3	51	4	42	2	**27**					
		Niagara	1-4-97	2	36	2	17	2	17	2	17	...	...					
East Murchison ...	28-6-95	Lawlers	1-7-04	11	174	16	248	12	178	8	155	4	**73**	18·69	**19·89**	14	...	East Murchison.
		Black Range ...	1-7-04	36	664	8	165	5	86	6	89	4	**62**					
		Wiluna	1-3-10	22	419	80	1,710	51	1,067	48	986	54	**1,109**					
North-East Coolgardie	15-4-96	Kanowna ...	15-4-96	17	251	16	256	13	165	12	162	9	**116**	3·56	**1·86**	...	118	N.E. Coolgardie.
		Kurnalpi ...	15-4-96	2	17	...	...	1	24	3	72	...	...					
Broad Arrow ...	20-11-96	...	...	22	341	16	257	16	274	13	218	11	**185**	3·31	**2·96**	...	33	Broad Arrow.
Peak Hill ...	1-4-97	...	...	13	142	6	32	8	42	9	55	8	**49**	·84	**·78**	...	6	Peak Hill.
Mount Margaret	1-4-97	Mount Margaret	1-4-97	40	924	12	254	9	182	7	134	7	**134**	11·76	**12·46**	5	...	Mount Margaret.
		Mount Malcolm...	1-4-97	31	617	29	595	25	547	24	529	24	**529**					
		Mount Morgans...	2-4-02	14	250	11	186	6	102	7	111	7	**116**					
West Pilbara ...	1-11-95	...	...	1	6	1	6	1	6	2	30	2	**30**	·46	**·48**	...	...	West Pilbara.
Phillips River ...	14-9-00	...	...	6	88	6	88	7	94	6	88	4	**63**	1·34	**1·01**	...	25	Phillips River.
Other Localities ...	...	...	...	...	...	...	...	9	156	11	192	...	...	2·92	...	...	192	Other Localities.
Gascoyne	15-4-97	...	...	2	12	4	24	2	12	...	...	...	...	...	...	...	...	Gascoyne.
Totals ...	... ...	... ...	...	656	10,839	560	9,009	469	7,395	414	6,580	**386**	**6,253**	100·00	**100·00**	344	671	

Decrease for the Year 1927—Leases 28 ; acres 327. The largest percentage of the area leased for Gold Mining purposes is in the respective order :—East Coolgardie, 21·32 ; East Murchison, 19·89 ; Mt. Margaret, 12·46 ; Yilgarn, 11·91 ; Murchison, 11·42 ; Coolgardie, 5·25.

Table 12.

Number and Acreage of Mineral Leases in force 31st December each year, for the Five Years ending 31st December, 1927.

Mining District. Name.	Mining District. Proclaimed.	Sub-District. Name.	Sub-District. Proclaimed.	1923. Leases.	1923. Acreage.	1924. Leases.	1924. Acreage.	1925. Leases.	1925. Acreage.	1926. Leases.	1926. Acreage.	**1927. Leases.**	**1927. Acreage**	Increase or Decrease in Acreage for 1927, compared with 1926. Increase.	Increase or Decrease in Acreage for 1927, compared with 1926. Decrease.	Mining District.
Ashburton	11-12-90	...	...	1	48	3	87	1	15	3	75	**1**	**15**	...	60	**Ashburton.**
Murchison	24-9-91	Cue	7-12-94	...	...	...	...	...	...	2	42	**14**	**296**	254	...	**Murchison.**
		Meekatharra ...	7-12-94	...	...	...	...	...	...	...	...	...	...			
		Day Dawn ...	10-1-96	...	...	...	...	...	...	...	...	...	...			
		Mt. Magnet ...	7-12-94	...	...	...	...	...	...	...	...	...	...			
Greenbushes ...	7-4-92	...	...	7	146	6	107	5	97	7	152	**8**	**176**	24	...	**Greenbushes..**
Pilbara	16-6-92	Marble Bar ...	16-6-92	10	271	14	447	16	509	27	752	**26**	**561**	...	151	**Pilbara.**
		Nullagine ...	6-11-96	4	34	4	30	3	21	...	...	**1**	**40**			
Yalgoo	23-1-95	...	...	2	96	2	96	...	...	...	...	...	...	...	...	**Yalgoo.**
Yilgarn	22-3-95	...	...	...	...	1	10	...	...	...	...	**1**	**48**	48	...	**Yilgarn.**
Coolgardie	22-3-95	Coolgardie ...	22-3-95	2	28	2	28	2	28	2	28	**2**	**28**	...	...	**Coolgardie.**
		Kunanalling ...	1-9-97	...	...	...	...	...	...	...	...	...	...			
East Coolgardie ...	22-3-95	East Coolgardie	22-3-95	...	...	1	1	1	1	2	13	**1**	**1**	...	12	**East Coolgardie.**
		Bulong	15-4-96	...	...	...	...	...	...	...	...	...	...			
East Murchison ...	28-6-95	Lawlers	17-4-04	...	...	...	...	...	...	...	...	...	...	...	...	**East Murchison.**
		Black Range ...	1-7-04	...	...	...	...	...	...	...	...	...	...			
		Wiluna	1-3-10	...	...	...	...	...	...	...	...	...	...			
North Coolgardie ...	16-8-95	Menzies	15-4-96	1	48	...	...	...	...	...	...	...	...	...	...	**North Coolgardie.**
		Ularring	15-4-96	...	...	...	...	...	...	...	...	...	...			
		Yerilla	15-4-96	...	...	...	...	...	...	...	...	...	...			
		Niagara	1-3-97	...	...	...	...	...	...	...	...	...	...			
West Pilbara ...	1-11-95	...	...	22	826	21	778	14	588	11	476	**14**	**614**	138	...	**West Pilbara.**
Dundas	27-12-95	...	...	...	...	...	...	2	36	2	36	**2**	**36**	...	...	**Dundas.**
Collie	21-2-96	...	...	135	41,108	125	38,059	117	35,619	117	35,619	**126**	**38,379**	2,760	...	Collie.
North-East Coolgardie	15-4-96	Kanowna ...	15-4-96	1	10	1	10	2	106	2	106	**1**	**10**	...	96	**North-East Coolgardie.**
		Kurnalpi ...	15-4-96	...	...	...	...	...	...	...	...	...	...			
Broad Arrow ...	20-11-96	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**Broad Arrow.**
Northampton ...	1-1-97	...	...	12	238	13	278	19	387	19	371	**14**	**292**	...	151	**Northampton.**
		(Private Property)	...	4	167	5	191	8	251	9	275	**6**	**203**			
Peak Hill	1-4-97	...	...	1	48	...	...	...	...	...	...	...	...	...	...	**Peak Hill.**
Mt. Margaret ...	1-4-97	Mt. Margaret ...	1-4-97	...	...	...	...	...	...	...	...	...	...	...	...	**Mt. Margaret.**
		Mt. Malcolm ...	1-4-97	...	...	...	...	...	...	...	...	...	...			
		Mt. Morgans ...	2-4-02	3	69	...	...	...	...	...	...	...	...			
Gascoyne	15-4-97	...	...	...	...	1	48	...	...	...	...	...	...	...	...	Gascoyne..
Phillips River ...	1-7-99	...	...	17	520	17	398	19	373	18	323	**17**	**275**	...	48	**Phillips River.**
Other localities ...	...	...	...	20	5,114	25	6,820	25	6,860	25	6,890	**24**	**5,661**	...	1,229	**Other Localities.**
		(Private Property)	...	6	212	6	166	2	68	2	50	**2**	**50**	...	...	
West Kimberley ...	19-3-20	...	...	10	448	10	448	10	448	10	448	**10**	**448**	...	...	**West Kimberley.**
Totals ...	...	...	...	258	49,431	257	48,002	246	45,407	258	45,656	**270**	**47,133**	3,224	1,747	

In the Collie Mineral Field the largest area is held, viz., 38,379 acres, worked entirely for coal; thus follow West Pilbara, 614 acres, for copper and asbestos; Pilbara, 601 acres, for tin, silver and lead, vanadium, tantalite, lead and manganese; Northampton, 495 acres, for lead and coal; West Kimberley, 448 acres, for iron; Murchison, 296 acres, for emerald; Phillips River, 275 acres, for copper and iron.

TABLE 13.

Number and Acreage of Mineral Leases in force on 31st December, 1927, showing Minerals for which they are worked.

Goldfield or Mineral Field.	District.	Mineral.																					
		Coal.		Tin.		Copper.		Iron.		Emerald.		Ochre.		Silver and Lead.		Asbestos.		Vanadium.		Clay.		Mineral Oil.	
		Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.
Yilgarn	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pilbara	Marble Bar	...	...	13	244	...	...	...	...	...	...	...	...	3	82	...	...	1	48	...	...	...	...
	Nullagine	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Murchison	Cue	...	...	...	...	...	...	...	...	14	296	...	...	...	...	...	...	...	...	...	...	...	...
West Pilbara	...	...	...	...	...	2	64	...	...	...	...	...	...	...	...	12	550	...	...	...	...	...	...
Ashburton	...	...	...	...	...	...	...	...	...	...	...	...	...	1	15	...	...	...	...	...	...	...	...
Dundas	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
East Coolgardie	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...
Coolgardie	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
North-East Coolgardie	Kanowna	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Phillips River	...	...	...	...	...	16	265	1	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Collie	...	126	38,379	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Greenbushes	...	...	...	8	176	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Northampton	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	(Private Property)	1	100	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Outside Proclaimed Fields	...	18	5,440	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	93
	(Private Property)	...	...	...	...	...	...	1	48	...	...	...	...	...	...	...	...	...	...	1	2	...	...
West Kimberley	...	...	...	...	...	...	...	10	448	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Totals ...	145	43,919	21	420	18	329	12	506	14	296	1	1	4	97	12	550	1	48	1	2	3	93

Goldfield or Mineral Field.	District.	Mineral.														Total.	
		Alunite.		Tantalite.		Lead.		Gypsum.		Radium.		Mica.		Manganese.			
		Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.	Leases.	Acres.
Yilgarn	...	...	...	...	...	...	...	...	...	1	48	...	...	...	...	1	48
Pilbara	Marble Bar	...	...	7	91	2	96	...	...	...	...	...	...	...	...	26	561
	Nullagine	...	...	...	...	...	...	...	...	...	...	...	...	1	40	1	40
Murchison	Cue	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	296
West Pilbara	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	614
Ashburton	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	15
Dundas	...	...	...	...	...	...	...	2	36	...	...	...	...	...	...	2	36
East Coolgardie	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
Coolgardie	...	...	...	...	...	...	...	...	...	...	...	2	28	...	...	2	28
North-East Coolgardie	Kanowna	1	10	...	...	...	...	...	...	...	...	...	...	...	...	1	10
Phillips River	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	275
Collie	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	126	38,379
Greenbushes	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	176
Northampton	...	...	...	...	...	14	292	...	...	...	...	...	...	...	...	14	292
	(Private Property)	...	...	...	...	5	103	...	...	...	...	...	...	...	...	6	203
Outside Proclaimed Fields	...	1	40	...	...	...	...	1	40	...	...	...	...	1	48	24	5,661
	(Private Property)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	50
West Kimberley	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	448
	Totals ...	2	50	7	91	21	491	3	76	1	48	2	28	2	88	270	47,133

Table 14.

Number and Acreage of Miscellaneous Leases in force on 31st December, 1927.

Goldfield.	District.	Leases.								Total.	
		Tailings.		Tramway.		Water.		Machinery.			
		No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.	No.	Acres.
West Pilbara	... ...	...	...	2	25	...	...	...	...	2	25
North Coolgardie	Menzies	1	12	...	...	1	5	...	...	2	17
East Coolgardie	... ...	12	245	...	...	...	...	1	1	13	246
Coolgardie	... ...	1	7	...	...	1	13	...	...	2	20
Phillips River	... ...	...	...	3	7	...	...	1	10	4	17
	Total	14	264	5	32	2	18	2	11	23	325

Table 15.

Claims and Authorised Holdings, under "The Mining Act, 1904," and Regulations, existing on 31st December, 1926 and 1927.

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.																							
		1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.
Kimberley	... ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Kimberley ...	... ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Northampton ...	... ...	13	5	222	78	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pilbara	Marble Bar ...	13	27	202	512	2	2	3	25	1	...	1	2	...	6	...	...	...	...	7	8	1	1	1	...	4	5	...	...	...	...
Do.	Nullagine ...	7	10	72	190	1	...	1	...	1	...	...	...	5	5	...	...	3	3	...	...	1	1	...	...	3	3	...	...	...	...
West Pilbara ...	... ...	...	1	...	12	1	1	5	5	...	...	...	...	...	...	...	...	3	3	10	9	2	2	...	...	3	3	...	...	...	...
Ashburton	... ...	4	1	88	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...
Peak Hill	... ...	8	6	132	98	1	1	10	10	...	...	...	...	5	10	...	...	1	1	...	...	...	...	3	3	...	...	...	...	...	...
East Murchison ...	Lawlers	5	1	87	24	6	3	9	6	...	...	...	...	...	...	...	...	...	...	...	...	3	2	8	8	3	1	...	...	...	...
Do.	Wiluna	21	35	425	732	7	7	11	11	...	...	...	...	...	...	...	...	...	1	...	1	...	...	1	1	3	3	...	...	...	...
Do.	Black Range ...	9	10	160	160	...	...	...	...	1	...	...	...	...	...	...	...	34	1	...	...	1	...	...	...	1	1	...	...	...	...
Murchison	Cue	22	12	281	166	4	4	19	19	...	...	...	...	...	3	...	...	5	1	...	...	...	...	...	...	1	1	...	...	...	...
Do.	Meekatharra ...	13	23	214	335	1	1	10	10	...	...	...	...	...	...	...	...	4	4	2	2	1	1	1	1	1	1	...	...	...	...
Do.	Day Dawn ...	7	4	97	40	3	3	4	4	...	...	...	...	...	...	...	...	7	...	...	...	1	1	1	...	...	...	...	...	...	...
Do.	Mt. Magnet ...	25	19	275	213	1	1	1	1	...	...	...	...	...	...	...	...	...	...	1	1	1	1	...	...	5	5	...	...	...	...
Yalgoo	... ...	18	13	280	213	...	...	...	...	...	...	...	...	...	...	...	...	3	3	6	6	2	2	1	1	...	...	...	...	...	...
Mt. Margaret ...	Mt. Morgans ...	5	5	78	60	7	4	16	9	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	2	1	...	...	...	...
Do.	Mt. Malcolm ...	15	3	221	60	18	19	173	174	...	...	...	...	...	...	...	...	...	...	4	3	...	...	1	1	13	11	...	...	...	...
Do.	Mt. Margaret ...	13	7	270	138	10	10	11	11	...	...	...	...	...	...	...	...	4	...	1	1	2	2	...	3	4	4	...	...	...	...
North Coolgardie ...	Menzies	12	10	176	124	4	4	12	12	...	...	...	...	...	...	...	...	3	...	2	...	1	1	...	...	3	3	...	...	...	...
Do.	Ularring	2	1	34	24	5	5	5	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Do.	Niagara	3	1	46	12	1	3	1	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...
Do.	Yerilla	5	1	84	24	4	3	7	4	...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	1	...	...	...	...
Broad Arrow ...	... ...	14	10	181	158	6	4	20	17	...	...	1	...	1	1	...	...	1	1	4	3	1	...	1	1	...	...	...	...	...	...
N.E. Coolgardie ...	Kanowna ...	10	5	145	84	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...	3	1	1	...	4	3	...	...	...	...
Do.	Kurnalpi ...	15	9	226	189	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	...	...
East Coolgardie ...	... ...	44	36	677	577	5	5	19	19	1	1	1	1	...	...	...	...	...	...	...	...	4	4	11	11	18	16	...	...	...	...
Do.	Bulong	2	5	48	108	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Coolgardie	... ...	24	29	423	445	9	9	39	39	...	...	1	1	...	...	...	...	2	2	3	3	1	1	2	2	...	...	...	...	...	...
Do.	Kunanalling ...	11	8	194	114	6	6	40	40	...	...	...	...	...	...	...	...	1	1	2	2	...	...	1	...	...	...	...	...	...	...
Yilgarn	... ...	64	68	1,223	1,449	1	1	2	2	...	...	...	...	...	...	...	...	19	17	15	18	1	1	...	...	...	1	...	...	...	...
Dundas	... ...	7	5	97	78	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	...	...
Phillips River ...	... ...	4	4	58	63	2	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	1	3	3	...	...	...	...
Collie	... ...	...	1	...	3,000	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Greenbushes ...	... ...	...	...	...	...	9	4	13	10	...	...	7	10	...	...	14	13	18	20	...	...	2	2	...	...	15	14	...	...	...	...
Gascoyne	... ...	1	...	48	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...
Outside Proclaimed Fields	... ...	23	13	3,104	6,278	...	...	...	...	...	...	...	...	38	16	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Totals ...	439	388	9,868	15,782	114	100	433	436	4	1	11	16	52	43	16	15	108	61	60	59	34	28	37	35	86	80	...	...	...	...
Increase or Decrease for 1927 compared with 1926		— 51		+ 5,914		— 14		+ 3		— 3		+ 5		— 9		— 1		—47		— 1		— 6		— 2		— 6		...		...	

For the Year 1926 the numbers of prospecting areas held was 439, the total acreage being 9,868, which included 1 area of 256 acres for coal. For the Year 1927 the number held was 388 of a total acreage of 15,782, including 3 areas of 9,000 acres for coal.

Table 16.

Miners' Rights issued during 1926 and 1927.

Place of Issue.	Miners' Rights. 1926.	Miners' Rights. 1927.	Place of Issue.	Miners' Rights 1926	Miners' Rights 1927
Albany	9	2	Narrogin	3	...
Boulder	17	9	Norseman	49	32
Bridgetown	...	6	Northampton	59	27
Broome	2	8	Northam	6	7
Bunbury	1	5	Nullagine	38	16
Busselton	6	6	Onslow	44	13
Carnarvon	62	32	Ora Banda	26	27
Collie	2	3	Payne's Find	1	1
Coolgardie	112	97	Peak Hill	16	25
Cue	99	79	Perth	340	337
Derby	15	12	Port Hedland	13	41
Esperance	1	1	Ravensthorpe	28	43
Geraldton	10	8	Roebourne	23	27
Greenbushes	66	65	Sandstone	33	34
Hall's Creek	32	29	Southern Cross	189	170
Kalgoorlie	461	360	St. Ives	9	5
Laverton	101	107	Wagin	4	6
Lawlers	36	26	Westonia	27	5
Leonora	77	73	Wiluna	51	128
Marble Bar	94	109	Wyndham	...	3
Meekatharra	133	123	Yalgoo	36	47
Menzies	77	62	Yarri	...	2
Merredin	11	8	York	3	...
Mount Magnet	136	106			
Mullewa	5	...	Total	2,655	2,387
Narembeen	92	55			

Table 17.

Number and Acreage of Miners' Homestead Leases in force on 31st December, 1926 and 1927.

Goldfield.	District.	1926. Leases.	1926. Acreage.	1927. Leases.	1927. Acreage.	Increase. Leases.	Increase. Acreage.	Decrease. Leases.	Decrease. Acreage.
West Pilbara	... ...	...	...	...	...	...	...	...	...
Greenbushes	... ...	6	522	6	522	...	...	...	...
Pilbara	Marble Bar ...	...	...	...	...	...	...	...	...
	Nullagine	...	...	...	...	...	...	...	...
Dundas	... ...	21	1,159	18	1,078	...	...	3	81
Broad Arrow	... ...	2	24	1	4	...	...	1	20
Yilgarn	... ...	13	410	14	411	1	1	...	...
Mt. Margaret ...	Mt. Malcolm ...	7	1,260	7	1,260	...	...	...	...
	Mt. Margaret. ...	12	325	12	325				
Murchison ...	Cue	4	1,204	4	1,204	...	...	...	...
	Day Dawn ...	2	25	2	25				
	Meekatharra ...	10	1,665	10	1,665				
	Mt. Magnet ...	1	236	1	236				
Yalgoo	... ...	5	1,204	4	710	...	...	1	494
Coolgardie ...	Coolgardie	21	891	21	891	...	...	...	...
	Kunanalling ...	3	530	3	530				
East Coolgardie ...	... ...	78	2,546	77	2,526	...	...	1	20
Phillips River	... ...	124	17,401	124	17,401	...	...	...	...
Peak Hill	... ...	5	547	5	547	...	...	...	...
North-East Coolgardie ...	Kanowna	12	702	12	702	...	...	...	...
North Coolgardie	Menzies	5	690	5	690	...	...	...	...
	Yerilla	1	10	1	10				
	Niagara	1	20	1	20				
	Ularring	1	20	1	20				
East Murchison. .	Lawlers	6	1,115	6	1,115				
	Black Range ...	1	307	2	327	1	20	...	...
	Wiluna	3	39	3	39				
	Total ...	344	32,852	340	32,258	2	21	6	615

As compared with the Year 1926, the number of leases held has decreased by 4 and the area by 594 acres.

Part IV.—MEN EMPLOYED.

Table 18.

Average number of Men engaged in Mining during 1926 and 1927.

Goldfield.	District.	Reef or Lode. 1926.	Reef or Lode. 1927.	Alluvial. 1926.	Alluvial. 1927.	Total. 1926.	Total. 1927.
1. Kimberley ...	...	...	...	4	**4**	4	**4**
2. West Kimberley ...	...	...	...	...	...	...	...
3. Pilbara	Marble Bar	32	**36**	10	**4**	42	**40**
	Nullagine	6	**6**	1	**1**	7	**7**
4. West Pilbara	...	1	...	2	**2**	3	**2**
5. Ashburton ...	...	...	...	2	**2**	2	**2**
6. Gascoyne ...	...	...	...	2	**2**	2	**2**
7. Peak Hill ...	...	35	**31**	5	**5**	40	**36**
8. East Murchison ...	Lawlers	24	**23**	3	**6**	27	**29**
	Wiluna	145	**236**	...	...	145	**236**
	Black Range	49	**52**	2	**1**	51	**53**
9. Murchison ...	Cue	90	**83**	...	...	90	**83**
	Meekatharra ...	204	**178**	12	**5**	216	**183**
	Day Dawn ...	34	**27**	...	...	34	**27**
	Mt. Magnet ...	88	**80**	2	**2**	90	**82**
10. Yalgoo	...	114	**97**	1	**1**	115	**98**
11. Mt. Margaret	Mt. Morgans ...	74	**61**	...	...	74	**61**
	Mt. Malcolm ...	394	**347**	...	...	394	**347**
	Mt. Margaret	41	**41**	...	...	41	**41**
12. North Coolgardie ...	Menzies	42	**39**	1	**1**	43	**40**
	Ularring	3	**9**	...	...	3	**9**
	Niagara	13	**7**	...	...	13	**7**
	Yerilla	13	**13**	...	**1**	13	**14**
13. Broad Arrow	...	121	**120**	6	**5**	127	**125**
14. North-East Coolgardie ...	Kanowna	71	**52**	3	**3**	74	**55**
	Kurnalpi	21	**17**	1	**1**	22	**18**
15. East Coolgardie ...	East Coolgardie	2,205	**1,928**	23	**21**	2,228	**1,949**
	Bulong	41	**39**	3	**2**	44	**41**
16. Coolgardie ...	Coolgardie	189	**158**	17	**14**	206	**172**
	Kunanalling ...	59	**42**	...	...	59	**42**
17. Yilgarn	...	179	**144**	...	...	179	**144**
18. Dundas	...	76	**76**	...	...	76	**76**
19. Phillips River	...	12	**24**	1	...	13	**24**
State generally	...	11	**7**	...	...	11	**7**
Total—Gold Mining		4,387	**3,973**	101	**83**	4,188	**4,056**
Minerals other than Gold.							
Tantalite	Marble Bar	6	**14**	...	...	6	**14**
Tin	Greenbushes	38	**38**	...	...	38	**38**
	Marble Bar	10	**31**	*30	***37**	40	**68**
Copper	West Pilbara ...	...	...	...	...	...	...
	Phillips River ...	8	**9**	...	...	8	**9**
	Northampton ...	...	...	...	...	...	...
Lead Ore	Northampton ...	129	**41**	...	...	129	**41**
Coal ...	Collie River	686	**748**	...	...	686	**748**
Asbestos	Nullagine	9	**5**	...	...	9	**5**
Gypsum	Yilgarn ...	...	**4**	...	...	...	**4**
	State Generally	24	**21**	...	...	24	**21**
Silver-Lead Ore	Ashburton	...	...	...	...	...	...
	Marble Bar	9	**10**	...	...	9	**10**
Emeralds	Cue	...	**22**	...	...	...	**22**
	Total—Other Minerals	919	**943**	30	**37**	949	**980**
	Grand Total	5,306	**4,916**	131	**120**	5,437	**5,036**

*Classified elsewhere as employed at mines.

TABLE 19.

Average Number of Men employed at Mines during 1927.

Mineral.	Above ground.	Under ground.	Total.	Percentage of total men employed.	Increase or decrease compared with 1926.
Asbestos	1	4	5	·10	— 4
Coal	177	571	748	15·10	+ 62
Copper	5	4	9	·18	+ 1
Gold	1,901	2,072	3,973	80·21	— 414
Gypsum	25	...	25	·55	+ 1
Lead	17	24	41	·82	— 88
Silver-Lead Ore...	5	5	10	·20	+ 1
Tantalite...	12	2	14	·28	+ 8
Tin	*102	4	106	2·12	+ 28
Emeralds	11	11	22	·44	+ 22
Total	2,256	2,697	4,953	100·00	— 383

* 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 20.

Average Number of Men employed at Gold Mines during 1927, 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 1926.	Percentage of total Men employed.	
					1926.	**1927.**
1. Kimberley	...	...	...	...	...	...
2. West Kimberley	...	...	...	...	...	...
3. Pilbara	14	28	42	+ 4	·87	**1·06**
4. West Pilbara	...	...	...	— 1	·02	...
5. Ashburton	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...
7. Peak Hill	15	16	31	— 4	·80	**·78**
8. East Murchison	180	131	311	+ 93	4·97	**7·83**
9. Murchison...	176	192	368	— 48	9·50	**9·26**
10. Yalgoo	49	48	97	— 17	2·60	**2·44**
11. Mt. Margaret	191	258	449	— 60	11·60	**11·30**
12. North Coolgardie	47	21	68	— 3	1·62	**1·71**
13. Broad Arrow	64	56	120	— 1	2·76	**3·02**
14. North-East Coolgardie	36	33	69	— 23	2·10	**1·74**
15. East Coolgardie	879	1,088	1,967	— 279	51·17	**49·51**
16. Coolgardie	108	92	200	— 48	5·65	**5·03**
17. Yilgarn	80	64	144	— 35	4·09	**3·62**
18. Dundas	39	37	76	...	1·73	**1·92**
19. Phillips River	17	7	24	+ 12	·27	**·60**
State generally	6	1	7	— 4	·25	**·18**
Total	1,901	2,072	3,973	— 414	100·00	**100·00**

TABLE 21.

Alluvial Gold Workers.

Goldfield.	1926.	**1927.**	Increase or Decrease compared with 1926.
1. Kimberley	4	**4**	...
2. West Kimberley	...	...	...
3. Pilbara	11	**5**	— 6
4. West Pilbara	2	**2**	...
5. Ashburton	2	**2**	...
6. Gascoyne	2	**2**	...
7. Peak Hill	5	**5**	...
8. East Murchison	5	**7**	+ 2
9. Murchison	14	**7**	— 7
10. Yalgoo	1	**1**	...
11. Mt. Margaret	...	...	...
12. North Coolgardie	1	**2**	+ 1
13. Broad Arrow	6	**5**	— 1
14. North East Coolgardie	4	**4**	...
15. East Coolgardie	26	**23**	— 3
16. Coolgardie	17	**14**	— 3
17. Yilgarn	...	...	...
18. Dundas	...	...	...
19. Phillips River	1	...	— 1
Total	101	**83**	— 18

Table 22.

Table showing Rate of Wages Payable in the Mining Industry at the 31*st December*, 1927.

Class of Employee.	Yilgarn, Coolgardie, Broad Arrow, Dundas, E. Coolgardie, N.E. Coolgardie, N. Coolgardie, Mt. Margaret, East Murchison Goldfields, and Northampton Mining District.		Meekatharra and Youanmi Districts.		Cue and Day Dawn Districts.	
	Rate per Shift.		Rate per Shift.		Rate per Shift.	
	s.	d.	s.	d.	s.	d.
Rock Drill Men in Shafts	17	8	18	10	18	1
Rock Drill Men in Rises	17	2	18	4	17	7
Rock Drill Men in Winzes	16	10	18	0	17	8
Rock Drill Men in other places	16	6	17	8	16	11
Hand Miners in Shafts	16	10	18	0	17	3
Hand Miners in Rises	16	4	17	6	16	9
Hand Miners in Winzes	16	0	17	2	16	5
Hand Miners in other places	15	8	16	10	16	1
Shaft Timbermen	17	8	18	0	17	3
Timbermen	16	10	18	0	17	3
Mullockers, Truckers, Shovellers, etc.	14	10	16	0	15	3
Bracemen, Platmen, and Skipmen	15	10	16	6	15	9
Man in charge Explosives Magazine	16	4	...		...	
Platelayer (Underground)	15	10	...		...	
Scalers (Underground)	16	10	...		...	
Sampler	16	0	...		...	
Rock Breaker—Crackermen	15	4	16	6	15	9
Battery Feeders and Mill Hands	14	4	16	0	15	3
Battery—Repairers, etc.	15	10	...		...	
Mechanics' Labourer	14	10	16	0	15	3
Iron Furnacemen	16	4	...		...	
Castings Dresser	14	10	...		...	
Pitman and Pumpman	16	10	...		...	
Fireman, Leading	16	4	...		...	
Fireman, Steam or Roaster	15	4	...		...	
Wood Trimmer	14	10	...		...	
Pumpman on the Surface	15	10	...		...	
Greaser, Cleaner, and Oiler	15	4	...		...	
Motorman	16	2	...		...	
Ball Mill Hand	15	4	...		...	
Boiler Cleaners	16	10	...		...	
Filterpress Filler	16	2	18	0	17	3
Cyanide and Filterpress Men	15	4	16	6	15	9
Amalgamator	16	0	...		...	
Wilfley Tablemen	14	8	...		...	
Grinding Panman	14	10	...		...	
Vacuum Plant Hands (Top)	16	4	18	0	17	3
Vacuum Plant Hands (Bottom)	15	0	16	6	15	9
Timber Dresser, Sawyer, etc.	16	2	...		...	
Jigman	15	1	...		...	
Tool Sharpeners	16	4	18	0	17	3
Holman Hoist (aboveground)	16	2	...		...	
Holman Hoist (underground)	16	8	...		...	
Blacksmith's Striker	14	10	16	4	15	7
Platelayer on Surface	15	4	...		...	
Roper and Rigger	16	4	17	6	16	9
Sailor Gang Men	14	10	...		...	
Conveyor Belt Men	14	4	...		...	
Horse-driver	14	4	16	0	15	3
Sanitary Man	17	8	...		...	
Watchman	15	10	...		...	
Smelter (Gold Room)	16	0	...		...	
General Labourer	14	4	16	0	15	3
Popper Machine Man	16	6	...		...	
Pipe Fitter	16	8	...		...	
Tailings Dam Man	14	4	...		...	
Diamond Drillers	17	0	...		...	
Diamond Drillers' Assistant	15	0	...		...	
Spotters	16	2	...		...	
*Winding Engine-drivers	18	0	As column 1 with Special District Allowance.			
Winch-drivers	17	0				
Other Engine-drivers	16 to 17	6 to 6				
Locomotive-drivers	17	6				

Forty-eight hours on surface (exclusive of crib time) and forty-four hours underground (including crib time) constitute a week's work.

* 6d. per day extra if they raise or lower human beings.

District Allowances.—In addition to the wages as per Column 1, the following allowances are paid to workers in the Districts enumerated hereunder, except those portions situated within a radius of five miles of Kalgoorlie, Coolgardie, and Southern Cross:—

First District—Lying South of Kalgoorlie and comprised within lines starting from Kalgoorlie, thence W.S.W. to Woolgangie, then S.E. to Dundas, then N.E. to a point 10 miles East of Karonie, on the Trans-Australian line, and thence back to Kalgoorlie:

1s. per shift extra for those mines within five miles of the railway and 1s. 6d. per shift for those outside.

Second District—Starting from Kalgoorlie, W.S.W. to Woolgangie, thence N.N.W. to the intersection of the 120 E. meridian with the 30 S. parallel of latitude, thence N.E. by E. to Kookynie, thence back to the point 10 miles East of Karonie on the Trans-Australian line, and thence back to Kalgoorlie:

1s. 3d. per shift extra for those mines within five miles of the railway and 1s. 6d. per shift for those outside.

Third District—Starting from and including Kookynie, then N. by W. to Kurrajong, thence N.E. to Stone's Soak, thence S.E. to and including Burtville, thence S.W. through Pindinnie to Kookynie:

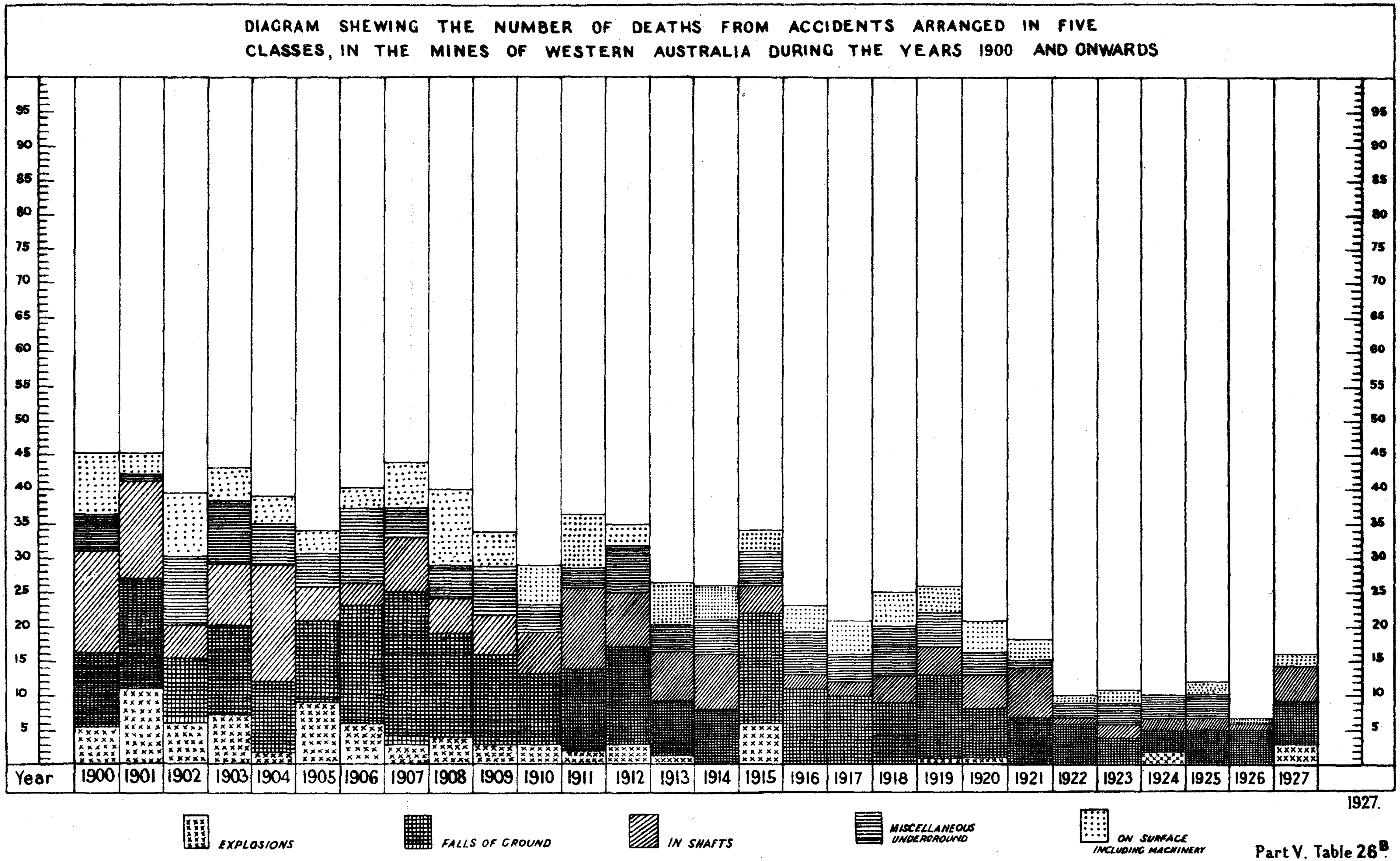
1s. 6d. per shift extra for those mines within five miles of the railway and 1s. 9d. per shift for those outside.

Fourth District—Surrounding Southern Cross within a radius of 30 miles:

1s. per shift extra.

Fifth District—Comprising all mines not specifically defined in foregoing boundaries, but within area comprised in Goldfields enumerated at head of Column 1;

2s. per shift extra.



Part V. Table 28[B].

Part V.—ACCIDENTS.

Table No. 23.

MEN EMPLOYED IN MINES KILLED AND INJURED IN MINING ACCIDENTS DURING 1926 AND 1927.

A.—According to Locality of Accident.

Goldfield.	Killed.		Injured.		Total Killed and Injured.	
	1926.	1927.	1926.	1927.	1926.	1927.
1. Kimberley	...	...	...	...	...	...
2. West Kimberley	...	...	...	...	...	...
3. Pilbara	...	...	...	...	...	...
4. West Pilbara	...	...	...	...	...	...
5. Ashburton	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...
7. Peak Hill	...	...	1	...	1	...
8. East Murchison	...	...	10	5	10	5
9. Murchison	...	3	18	17	18	20
10. Yalgoo	...	...	...	...	...	...
11. Mt. Margaret	...	2	38	40	38	42
12. North Coolgardie	1	...	1	3	2	3
13. N.E. Coolgardie	...	...	...	1	...	1
14. Broad Arrow	...	1	...	...	...	1
15. East Coolgardie	6	7	218	199	224	206
16. Coolgardie	...	1	...	1	...	2
17. Yilgarn	...	1	...	4	...	5
18. Dundas	...	...	...	...	...	...
19. Phillips River	...	...	...	...	...	...
Mining Districts—						
Northampton	...	...	...	1	...	1
Greenbushes	...	...	...	...	...	...
Collie	...	1	89	99	89	100
Swan	...	...	1	1	1	1
Kendenup	...	...	...	...	...	...
Roelands	...	...	...	...	...	...
Total	7	16	376	371	383	387

From the above table it will be seen that the total number of fatal accidents for the year 1927 was 16, as against 7 for 1926. The number injured shows a decrease of 5 as 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.

	1926.		1927.		Comparison with 1926.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1. Explosives	...	6	3	5	+ 3	— 1
2. Falls of Ground	5	41	6	19	+ 1	— 22
3. In Shafts	1	7	5	9	+ 4	+ 2
4. Miscellaneous Underground	...	220	...	242	...	+ 22
5. Surface	1	102	2	96	+ 1	— 6
Total	7	376	16	371	+ 9	— 5

Of the fatal accidents 15 occurred in gold mines and 1 in a coal mine. The death rate per 1,000 men employed in gold mines was 3.78 as against 1.60 in 1926.

TABLE No. 24.

Deaths from Accidents of Persons employed at Mines during 1926 and 1927.

—	1926.						1927.					
	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	...	1·75	1·34
Men employed	(156)	(530)	(686)	...	...	...	(177)	(571)	(748)	...	...	...
Gold Mines	1	6	7	·45	2·62	1·56	2	13	15	1·01	6·27	8·70
Men employed	(2,200)	(2,288)	(4,488)	...	...	...	(1,984)	(2,072)	(4,056)	...	...	...
Other Mines	...	...	...	...	...	...	...	...	...	...	...	...
Men employed	(163)	(100)	(263)	...	...	...	(178)	(54)	(232)	...	...	...
Total for all mines ...	1	6	7	·40	2·06	1·29	2	14	16	·86	5·19	3·18
Total number of men employed	(2,519)	(2,918)	(5,437)	...	...	...	(2,339)	(2,697)	(5,036)	...	...	...

TABLE No. 25.

Deaths from Accidents of Persons employed at Quarries during 1926 and 1927.

Mining District.	Number of Persons employed.				Number of Persons killed.				Death Rate per 1,000 men employed.			
	Above Ground.		Total.		Above Ground.		Total.		Above Ground.		Total.	
	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.	1927.
Swan	291	598	291	598	...	...	...	...	...	...	...	...
Roelands ...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	291	598	291	598	...	...	...	...	...	...	...	...

TABLE No. 26.

Deaths from Accidents of Persons Employed in Gold Mines during 1927, and the Death Rate per 1,000 Men Employed and per 1,000 tons of Gold Ore raised, during 1926 and 1927. (Number of men taken as in Table No. 20, 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.	
	1927.			1927.			1926.	1927.	1926.
	Above Ground.	Under Ground.	Total.	Above Ground.	Under Ground.	Total.	Total.		
1. Kimberley	...	...	...	...	...	...	...	...	...
2. West Kimberley	...	...	...	...	...	...	...	...	...
3. Pilbara	...	...	...	...	...	...	...	...	...
4. West Pilbara	...	...	...	...	...	...	...	...	...
5. Ashburton	...	...	...	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...	...	...	...
7. Peak Hill	...	...	...	...	...	...	...	...	...
8. East Murchison	...	...	...	...	...	...	...	...	...
9. Yalgoo	...	...	...	...	...	...	...	...	...
10. Mt. Margaret	1	1	2	5·24	3·88	4·45	...	·019	...
11. North Coolgardie	...	...	...	...	...	...	14·08	...	·817
12. North-East Coolgardie ...	...	...	...	...	...	...	...	...	...
13. East Coolgardie	...	7	7	...	6·43	3·56	2·67	·015	·011
14. Broad Arrow	1	...	1	15·62	...	8·33	...	·070	...
15. Coolgardie	...	1	1	...	10·87	5·00	...	·205	...
16. Murchison	...	3	3	...	15·62	8·15	...	·062	...
17. Yilgarn	...	1	1	...	15·62	6·94	...	·037	...
18. Dundas	...	...	...	...	...	...	...	...	...
19. Phillips River	...	...	...	...	...	...	...	...	...
Total	2	13	15	1·05	6·27	3·78	1·60	·022	·009

The number of deaths per 1,000 men employed shows an increase from 1·60 in 1926 to 3·78 in 1927, and that 1,000 tons of gold ore raised shows an increase, being ·022 as against ·009 for the preceding year.

Part VI.—STATE AID TO MINING.

The number of State batteries existing at the end of the year was 29.

From inception to the end of 1927 gold and tin to the value of £6,121,196 have been recovered from the State plants. 1,458,042 tons of auriferous ore have been treated, and have produced £4,967,738 by amalgamation, £785,265 by cyanidation, £265,266 worth by slimes treatment, £9,353 worth from residues; and 80,935 tons of tin ore produced tin to the value of £93,000; in addition a sum of £572 was recovered from residues.

During the year the gold ore treated was 21,062 tons for 18,503.43 ounces bullion.

The working expenditure for all plants for the year totalled £29,957 4s. 9d. and the revenue £21,495 12s. 9d., which shows a loss of £8,461 12s. on the year's operations.

The capital expenditure since the inception of the scheme has been £411,329 5s. 3d.; £319,348 3s. 7d. from General Loan Fund and £91,981 1s. 8d. from Consolidated Revenue.

The cost of administration for the year was £3,115 17s. 3d., as against £2,948 10s. 5d. for 1926.

The working expenditure from inception to the end of the year exceeds the revenue by £160,754 18s. 11d.

GEOLOGICAL SURVEY.

The field activities of the Geological Survey for the year 1927 have been confined to a detailed geological survey of the southern portion of the Kalgoorlie field (the Golden Mile) and numerous inspections of mines and mineral deposits more from an economic rather than a purely geological aspect.

The following reports have been furnished:—

1. An interim report on the geology and ore deposits of Kalgoorlie.
2. Report on portions of the South Kalgurli mine, Kalgoorlie
3. Manganese deposits of the Teano Range and Mount Fraser, Peak Hill Goldfield.
4. Manganese deposits of Coppermine Creek, South-West Division.
5. Water supply at Holleton, Yilgarn Goldfield.
6. Water supply at Dartmoor and Balla Balla, Geraldton District.
7. Great Beacon Mine, Holleton, Yilgarn Goldfield.
8. Mararoa and Viking Mines, Norseman.
9. Mining prospects of Grant's Patch, near Hall's Creek, East Kimberley Division.
10. Possibilities for drilling for mineral deposits in the North-West and Kimberley Divisions.
11. Possibilities of mineral oil occurrences in the Esperance District, South-West Division.
12. Possibilities of oil on the Peel Estate.
13. Boring for coal at Eradu, Geraldton District.
14. A reported discovery of argentiferous galena on Speewa Station, East Kimberley Division.
15. Boring for mineral lodes at Meekatharra, Murchison Goldfield.

One alteration in the staff was made when Mr. Esson retired in December, 1926, and was replaced by Mr. Finucane, who was appointed temporarily in February, 1927.

The petrological work has been carried on as usual, and been confined mostly to the investigation of bore cores and samples from the general public.

Both field officers were almost continuously on the Kalgoorlie survey throughout the year, and are now engaged in helping Dr. Stillwell to complete his report on the same area.

ASSISTANCE UNDER MINING DEVELOPMENT ACT, 1902.

The following statement shows the sums advanced during the year 1927, under the Mining Development Act:—

	£	s.	d.
Advanced in aid of mining work and equipment of mines with machinery	14,226	12	0
Subsidies on stone crushed for the public	230	10	0
Providing means of transport and equipment to prospectors	5,088	16	0
	£19,545	18	0

In addition to the above, the Vote was charged with rebates on water as follows:—

	£	s.	d.
Southern Cross eastwards ..	42,394	3	0
Ora Banda	9	18	0
Ingliston Consols	1,576	14	10
	£43,980	15	10

This arrangement dated from 1st July, 1923. Other assistance granted from the Vote during the year on various matters totalled £18,159 14s. 1d.

The subsidies paid on stone crushed for the public amounted to £230 10s., and are subsidies paid to owners of plants crushing for the public, the conditions being that they crush at fixed rates. The ore crushed during the year at these plants totalled 2,051 tons.

The receipts under the Mining Development Act, exclusive of interest payments, amounted to £13,676 17s. 4d., and included:—

	£	s.	d.
Refund of advances	2,577	19	3
Sale of securities	10,888	13	11
Miscellaneous refunds	210	4	2
	£13,676	17	4

Liability on guarantees at end of 1927, £51,500.

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

ASHBURTON GOLDFIELD.

Fifteen fine ounces of gold were reported, and in the preceding year 10 fine ounces.

Sixty tons of Silver Lead ore, valued at £1,179, were also reported.

Practically no gold mining is going on in this field.

BROAD ARROW GOLDFIELD.

The output of gold was 7,570 fine ounces, and in the preceding year 1,460 fine ounces, an increase of 6,110 fine ounces.

This is the result of the resumption of active operations on the Associated Northern Company's mine at Ora Banda. Other producers were the Tara-Oversight at Broad Arrow, the Orinda at Ora Banda, and the Wentworth at Dark Horse.

Although much systematic prospecting was carried out throughout the field, no discoveries were reported.

COLLIE COALFIELD.

The output of Coal was 501,505 tons, and in the preceding year 474,819 tons, an increase of 26,686 tons.

Seven mines were producing during the year, viz., Proprietary, Co-operative, Westralia, Cardiff, Premier, Griffin, and Stockton. The three latter only produced for portion of the year. In July operations ceased on the Premier mine, and the property was acquired by the Amalgamated Collieries, Limited. The Stockton is a new colliery opened up by this same company. The Griffin is also a new mine which has been worked for some time, and has now reached the producing stage.

Nothing definite has yet been accomplished in regard to the proposed power plant, but finality should be reached in the new year. The district is progressive and prosperous.

COOLGARDIE GOLDFIELD.

The output of gold was 5,786 fine ounces, and in the preceding year 5,998 fine ounces; a decrease of 212 fine ounces.

In the Kunanalling district there was a lessened output, and matters were very quiet.

At Gibraltar, mining is practically at a standstill. At Burbanks diamond drilling is being carried out by the Department, and at the close of the year work was still in progress.

At Widgiemooltha a good deal of prospecting was being carried on.

At St. Ives the Reward mine is being worked by tributers. and two or three other shows are working and crushing, but no developments of note have been reported.

In the vicinity of Coolgardie itself a few prospectors are at work.

DUNDAS GOLDFIELD.

The output of gold was 2,739 fine ounces, and in the preceding year 2,682 fine ounces; an increase of 57 fine ounces. There was a slight improvement in this field, and several crushings were reported from the old Mararoa mine. Two or three other mines and a few prospecting areas were being worked.

EAST COOLGARDIE GOLDFIELD.

The output of gold was 299,256 fine ounces, and in the preceding year 304,037 fine ounces; a decrease of 4,781 fine ounces.

The majority of the principal mines maintained a regular output. The position at the Golden Horseshoe remained unchanged, but operations on a smaller scale willl be resumed early in the year, and it is hoped results will have the effect of making it possible to raise the capital necessary to properly work this excellent property.

The technical committee appointed by the Federal Government submitted its report, and suggested that a condition precedent to the granting of assistance was amalgamation into one or possibly two groups of the principal mines. This to ensure proper development and a substantial reduction in overhead charges. So far nothing definite has been accomplished in this direction.

In August the Oroya Links, Limited, ceased operations, and obtained exemption for six months. It is not known what its future policy will be. A very large number of tributes have been let on several of the mines, and many of the tributers are getting good returns.

A considerable amount of exploratory work was carried out at the North end of the field, but no discovery of note was recorded.

In the Bulong district the principal activity was at Mt. Monger, from whence several good crushings were reported.

EAST MURCHISON GOLDFIELD.

The output of gold was 6,025 fine ounces, and in the preceding year 5,336 fine ounces; an increase of 689 fine ounces.

In the Black Range district there was a decrease, and there was very little change excepting in the Montague centre, where a discovery of specimen stone resulted in some activity, and three good crushings were reported.

At Sandstone diamond drilling is still being carried out by the Government.

At Youanmi the position was unchanged.

In the Lawlers district there was no improvement and the production was less, only small outputs being reported from the Lawlers, Mt. Sir Samuel, and Kathleen Valley centres. Very little prospecting was evident.

In the Wiluna district there was a substantial increase, and it is confidently expected that this improvement will be maintained.

At Cole's Find there was a good production, the principal producer being the Black Adder. Unfortunately recent developments in this mine are not encouraging for its future.

At Mt. Hilda a good deal of prospecting work was going on, the principal producer being the Waratah.

At Diorite there was an increased output, the principal producers being the Brilliant and Brilliant North.

At Wiluna active development is being carried out on the property of the Wiluna Gold Mines, Limited. The erection of a plant on this very promising mine will probably await the completion of the railway from Meekatharra, which has been authorised. It is fully expected that the mine will then become a big producer.

In July a new find was reported from a locality about 12 miles west of Wiluna. A great deal of prospecting work was done, but the results were disappointing.

GASCOYNE GOLDFIELD.

Seventy-nine fine ounces were reported, and in the preceding year 85 fine ounces.

No mining is being carried on.

GREENBUSHES MINERAL FIELD.

The output of black tin was 58.34 tons, valued at £9,544, and in the preceding year 61.41 tons, valued at £10,126; a decrease in tonnage of 3.07 tons, and in value of £582.

Prospecting for lode tin was carried on at three properties, but nothing of note discovered.

It is possible that the Department will render assistance in this regard by carrying out some diamond drilling so soon as a drill is available. Several dredges were in active operation, and in addition a good deal of prospecting was in hand.

Generally speaking, however, mining was quiet.

KIMBERLEY GOLDFIELD.

One hundred and ninety-four fine ounces were reported, and in the preceding year 65 fine ounces.

Excepting for a few fossickers working alluvial with only poor results, and one prospecting party who reported a discovery of tin, mining is at a standstill.

MOUNT MARGARET GOLDFIELD.

The output of gold was 36,698 fine ounces, and in the preceding year 43,628 fine ounces; a decrease of 6,930 fine ounces.

In the Mount Margaret district there was a falling off, consequent on lessened production from the King of Creation and Nil Desperandum mines.

The chief output was from the Lancefield.

Very little prospecting was going on.

In the Mount Morgans district there was also a decrease; the chief producers were again the Westralia Mount Morgans at Mount Morgans, and the Devon at Linden. A small amount of prospecting was in evidence throughout the district.

In the Mount Malcolm district there was a decrease due to a smaller output from the Sons of Gwalia mine. This was to some extent caused by a stoppage of operations for a few weeks in the early part of the year, the result of heavy floods; also to restricted operations on account of a decision by the directors to salvage the property. This decision has been varied consequent on the government having decided to render generous financial assistance which should make possible the carrying out of a progressive and economical policy, and thus give many years of productive life to the mine.

No new finds were reported, and only a small amount of prospecting was in hand throughout the district.

MURCHISON GOLDFIELD.

The output of gold was 27,886 fine ounces, and in the preceding year 33,487 fine ounces; a decrease of 5,601 fine ounces. Also emeralds to the amount of 200.43 carats, valued at £421.

In the Meekatharra district there was a decrease, but the general position was not materially changed.

In the outlying centres a good number of prospectors were at work.

In the Cue district there was also a decrease, and gold mining was quiet.

At Reidy's the Mararoa Company was working and producing, but development work was suspended pending the carrying out of some diamond drilling which it is anticipated will be commenced early in the New Year, and in which the Department is assisting.

At Poona a good deal of mining for emeralds was done, and a large quantity of stones shipped to London. At other centres a small amount of prospecting was done, but no finds of note were reported.

In the Day Dawn district there was a small increase, and the reported output was practically entirely from holdings on the old Fingall mine with the exception of a good return from the Mainland Consols, at Lake Austin.

In the Mount Magnet district there was an increase.

The principal returns were from mines in the vicinity of Mount Magnet.

At Lennonville a few men were working, and a small output was reported.

At Moyagee the Moyagee mine was working and producing, but at Paynesville there was only a small output, and mining is very quiet.

NORTHAMPTON MINERAL FIELD.

The output of lead ore was 5,809.50 tons, valued at £17,347, and in the preceding year 23,973.35 tons, valued at £72,872; a decrease in tonnage of 18,163.85 tons, and in value of £55,525.

Consequent on the low price ruling for lead, mining in this field has been at a very low ebb. Any marked advance would result in many properties which are thought capable of producing payable ore being actively developed.

At Ajana a new treatment plant is being erected on Block 7.

At Galena boring operations to test the country at depth are in hand. The results will be of considerable interest to the whole district.

NORTH COOLGARDIE GOLDFIELD.

The output of gold was 2,055 fine ounces, and in the preceding year 2,472 fine ounces; a decrease of 417 fine ounces.

In the Menzies district the Golden Age and Lady Shenton were the principal producers. The former had an excellent output.

At Comet Vale the Sand Queen-Gladsome was actively worked, and is expected to begin crushing shortly.

At Goongarrie and Mount Ida very little prospecting was in evidence.

In the Ularring district very little was done, but it is expected that active work will shortly be recommenced on the Riverina South, and probably early production will follow.

In the Yerilla district there was a small production, but very little mining was being done.

The Niagara district is quite at a standstill.

NORTH-EAST COOLGARDIE GOLDFIELD.

The output of gold was 2,487 fine ounces, and in the preceding year 6,199 fine ounces; a decrease of 3,712 fine ounces. This falling off is attributable to the cessation of operations at the Red Hill mine in the Kanowna district, which is now being worked by a tribute party. Elsewhere there was not any improvement.

In the Kurnalpi district mining is practically at a standstill, discoveries made there not coming up to expectations.

PEAK HILL GOLDFIELD.

The output of gold was 1,689 fine ounces, and in the preceding year 2,140 fine ounces; a decrease of 451 fine ounces.

The principal activity in this field was in the immediate vicinity of Peak Hill, where several shows had crushings. The operations at Mount Egerton referred to in last year's report did not result in any satisfactory discovery.

At Murphy's Well and Yowereema very little work was going on.

The railway to the manganese deposits at Horseshoe was completed, and it is expected that mining on them will be in full swing during the coming year.

PHILLIPS RIVER GOLDFIELD.

The output of gold was 284 fine ounces, and in the preceding year 19 fine ounces; an increase of 265 fine ounces.

This improvement is consequent on a slight revival at Kundip, where the Two Boys is again being worked and the prospects for which are encouraging. A good deal of prospecting was also being carried out in the locality.

In the vicinity of Ravensthorpe very little gold mining was going on.

Owing to the low price ruling for copper none of this ore was mined, and nothing further has been heard of the success or otherwise of the flotation process evolved by the Copper Separation Company, which it was claimed would treat the copper ores of the field profitably.

PILBARA GOLDFIELD.

The output of gold was 2,023 fine ounces, and in the preceding year 2,376 fine ounces; a decrease of 353 fine ounces.

Black tin to the amount of 37.44 tons, valued at £6,229, was raised; an increase on the preceding year in tonnage of 2.02 tons, and in value of £783.

Asbestos to the amount of 10.80 tons, valued at £304, was raised; a decrease on the preceding year in tonnage of 80.65 tons, and in value of £2,132; tantalite to the extent of 15.28 tons, valued at £3,808; a decrease on the preceding year of 4.17 tons, but increase in value of £1,451; and silver lead ore to the amount of 36 tons, valued at £792; a decrease in tonnage of 54.50 tons, and in value of £513.

In gold mining matters were very quiet, but in tin mining there was marked activity, and many areas were taken up.

At Wodgina the tantalite mines were being steadily worked.

In the Lionel centre of the Nullagine district the asbestos deposits were being developed.

At Braeside a programme for thoroughly testing the silver lead deposits by diamond drilling has been arranged, the Government assisting, and will be put into operation at an early date.

Generally speaking, the mining prospects for this field are hopeful.

WEST KIMBERLEY GOLDFIELD.

No gold was reported from this field.

The Freney Kimberley Oil Company is still carrying out boring operations, subsidised by the Federal Government.

The iron deposits at Yampi Sound are still unworked, but there are indications that they may be exploited shortly.

WEST PILBARA GOLDFIELD.

The output of gold was 53 fine ounces, and in the preceding year 29 fine ounces; an increase of 24 fine ounces.

No copper or asbestos was reported.

As mining in this field is principally for copper, the year has been one of almost entire stagnation.

YALGOO GOLDFIELD.

The output of gold was 2,394 fine ounces, and in the preceding year 6,382 fine ounces; a decrease of 3,988 fine ounces. This is largely consequent on reduced outputs from the Gnow's Nest at Messenger's Patch and Brown's Reward at Field's Find. At each of these centres very little is being done outside the two mines mentioned.

At Payne's Find the Lake View had a good crushing, but only a small amount of prospecting was going on. In the other centres there was little change and mining was very quiet.

YILGARN GOLDFIELD.

The output of gold was 9,227 fine ounces, and in the preceding year 11,792 fine ounces; a decrease of 2,565 fine ounces. This is largely the result of a lessened output from the Great Victoria at Burbidge, which closed down.

At Westonia there was an improvement, and one or two properties are being actively developed.

At Holleton, formerly known as Hollow's Find, mining became very quiet towards the end of the year, and many of the prospectors left. A great drawback to this centre is shortage of water.

The principal leases being worked are the Glenelg Queen and Great Beacon.

At Manxman the Radio mine was worked throughout the year.

In the immediate vicinity of Southern Cross very little prospecting was in evidence.

This field also produced 698.25 tons of gypsum, valued at £698; an increase on the preceding year in tonnage of 559.25 tons, and in value of £559.

Table 27.

Value of Mining Machinery and Number of Stamps and other Mills erected on the 31st December, 1927, compared with the previous Year.

Goldfield	District.	Value of Mining Machinery. 1926.	Value of Mining Machinery. 1927.	Batteries, Number of Stamps. 1926.	Batteries, Number of Stamps. 1927.	Mills. 1926. Prospecting.	Mills. 1926. Ball.	Mills. 1926. Griffin.	Mills. 1926. Huntington.	Mills. 1926. Puddlers.	Mills. 1926. Other Crushers.	Mills. 1926. Flint.	Mills. 1926. Grinding Pans.	Mills. 1927. Prospecting.	Mills. 1927. Ball.	Mills. 1927. Griffin	Mills. 1927. Huntington.	Mills. 1927. Puddlers.	Mills. 1927. Other Crushers.	Mills. 1927. Flint.	Mills. 1927. Grinding Pans.
		£	£																		
1. Kimberley	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2. West Kimberley	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3. Pilbara	Marble Bar	12,480	12,550	45	45	...	...	...	1	...	...	...	3	...	...	...	1	...	...	...	3
	Nullagine	2,192	2,090	18	18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4. West Pilbara	...	1,800	...	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5. Ashburton	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6. Gascoyne	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7. Peak Hill	...	3,355	3,068	10	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8. East Murchison	Lawlers	11,147	9,437	30	25	...	...	...	...	...	2	...	2	...	...	...	...	...	1	...	1
	Wiluna	15,387	69,517	23	33	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...
	Black Range	7,093	7,873	25	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9. Murchison	Cue	21,584	14,796	50	30	...	...	...	...	...	...	1	1	...	...	...	...	...	...	1	...
	Meekatharra	36,744	33,070	70	70	...	...	...	...	...	...	...	9	...	...	...	...	...	...	...	10
	Day Dawn	1,000	1,900	3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Mt. Magnet	7,365	5,888	25	20	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	3
10. Yalgoo	...	23,138	17,023	30	30	1	...	...	...	...	1	...	2	1	...	...	...	...	...	...	4
11. Mt. Margaret	Mt. Morgans	5,495	17,102	25	25	...	...	...	...	...	...	...	3	...	...	...	...	1	...	...	5
	Mt. Malcolm	279,615	275,995	70	65	...	...	...	...	...	...	4	...	...	...	...	...	...	...	4	2
	Mt. Margaret	5,977	5,678	30	30	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	6
12. North Coolgardie	Menzies	14,933	13,458	55	25	...	...	...	...	...	...	...	12	...	...	...	...	...	...	...	3
	Ularring	1,672	1,505	20	20	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1
	Niagara	2,045	1,840	15	10	...	1	...	...	...	...	...	3	...	...	...	...	...	...	...	...
	Yerilla	3,995	3,595	20	20	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1
13. Broad Arrow	...	63,181	62,153	35	35	...	1	...	2	3	...	...	10	...	1	...	2	3	...	...	11
14. North-East Coolgardie	Kanowna	7,250	6,950	50	50	1	...	...	1	...	...	...	...	...	...	...	1	...	...	...	1
	Kurnalpi	200	200	5	5	1	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...
15. East Coolgardie	East Coolgardie	680,241	673,005	265	255	1	44	...	3	6	20	25	97	1	46	...	1	6	20	25	94
	Bulong	1,000	1,000	5	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16. Coolgardie	Coolgardie	27,086	25,247	58	45	...	...	...	1	...	...	...	5	...	...	...	1	...	...	...	4
	Kunanalling	6,075	6,300	25	25	1	...	...	...	...	...	...	3	1	...	...	...	...	...	...	2
17. Yilgarn	...	49,060	21,475	110	70	...	...	...	...	...	...	3	7	...	...	...	...	...	...	...	4
18. Dundas	...	4,541	8,653	25	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
19. Phillips River	...	2,425	2,500	30	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
State Generally	...	27,090	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...
Total, Gold-extracting Machinery		1,325,166	1,303,868	1,182	1,049	5	47	...	8	9	24	33	166	4	47	...	6	10	22	30	156
Total, Machinery, other than Gold-extracting		327,876	230,567	...	...	...	5	...	...	1	30	4	1	...	5	...	...	2	30	4	1
Total, Mining Machinery		1,653,042	1,534,435	1,182	1,049	5	52	...	8	10	54	37	167	4	52	...	6	12	52	34	157

PART VIII.—EXISTING LEGISLATION.

At the close of the year the Acts in force relating to mining were:—

1. The Mining Act, 1904 (as reprinted with amendments).
2. Sluicing and Dredging for Gold Act, 1899.
3. Mines Regulation Act, 1906.
4. Coal Mines Regulation Act, 1902-1926.
5. Mining Development Act, 1902-1924.
6. Mines and Machinery Inspection Act, 1911.
7. Gold Buyers Act, 1921.
8. Miners' Phthisis Act, 1922.
9. Miners' Phthisis Act Amendment Act, 1925.

The following alterations, etc., regarding Regulations, were gazetted under the Mining Act, 1904:—

Amendment of Regulation 158.

Mines Regulation Act, 1906—

Amendment of Division 2 of Regulation 15 under Section VIII., relating to Workmen's Inspector of Mines.

Amendment of Districts assigned to various Inspectors of Mines.

Additional Regulations 6e, 6f, 6g, 6h—Inspection and examination of persons likely to be infected with mining diseases as mentioned in Third Schedule of the Workers' Compencation Act, 1912-1924.

Inspection of Machinery Act, 1921—

Amendment of Regulation charges.

Amendment of Regulations 1 and 2 under the heading of Examination and Qualifications of Applicants for the position of Inspector of Machinery.

Coal Mines Regulation Act, 1902-1926—

Amendment of Regulation 9, Clause (c), Subclause (1), under Part I.—Accident Relief Fund.

Mining Development Act, 1902-1924—

Amendment of the Regulations relating to Mining Boards.

Amendment of the Regulations relating to Part I.—Subsidies on the production of Merchantable Mica and Manufactured Mica Goods. Part II.—Subsidies on development work for production of Mica.

PART IX.—INSPECTION OF MACHINERY.

The Acting Chief Inspector of Machinery reports that the number of useful boilers registered at the end of the year totalled 3,422 as against 3,341 for the preceding year, showing an increase, after all adjustments, of 81 boilers.

Of the total of 3,422 useful boilers, 1,816 were out of use at the end of the year; 1,569 thorough and 60 working inspections were made, and 1,557 certificates were issued.

Permanent condemnations totalled 56, and temporary condemnations 39. There were 12 conversions, and 9 boilers were transferred beyond the jurisdiction of the Act.

The total number of machinery groups registered was 6,736 against 6,332 for previous year, showing an increase of 404.

Inspections made total 5,371, and 3,387 certificates were granted.

200 applications for engine-drivers' and boiler attendants' certificates were received and dealt with, and 174 certificates, all classes, were granted as follows:—

Winding competency (including certificates issued under Regulation 40 and Section 60	4
First-class competency (including certificates issued under Regulations 40 and 45, and Sections 60 and 63)	9
Second-class competency (including certificates issued under Regulation 40 and Section 60)	13
Third-class competency (including certificates issued under Regulation 45 and Section 63)	32
Locomotive competency	12
Traction competency	3
Internal combustion competency	16
Crane and hoist competency	10
Boiler attendants' competency	61
Interim	1
Copies	7
Transfers	6
Total ..	174

The total revenue from all sources during the year was £5,451 17s. 1d. as against £5,537 0s. 8d. for the previous year, showing a decrease of £85 3s. 7d.

The total expenditure for the year was £5,829 5s. 8d. as against £6,542 7s. for the previous year, showing a decrease of £713 1s. 4d.

Part X.—SCHOOL OF MINES.

During this, the 24th year of the School's existence, the continued depression in the mining industry combined with the closing down of another of the large mines adversely affected the number of students.

Notwithstanding this, the attendance at all classes was good, and in Geology, Mineralogy, and Petrology was above the average of recent years.

Students and staff did good work, and the results of the annual examinations were satisfactory.

Details will be found in the report of the Director, published as Division V. of this Report.

The system of free assays for prospectors was continued, a total of 238 assays and mineral determinations having been 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 responsible officers, published as Divisions II. to VIII. of this report.

Department of Mines,
Perth, 31st March, 1928.

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

I have, etc.,

M. J. CALANCHINI,
Under Secretary for Mines.

DIVISION II.

Report of the State Mining Engineer for the Year 1927.

Office of the State Mining Engineer,
Perth, 31st January, 1928.

The Under Secretary for Mines, Perth.

Sir,

For the information of the Hon. the Minister for Mines, I have the honour to submit the report hereunder on the work of my Branch for the year 1927.

INSPECTION OF MINES UNDER "THE MINES REGULATION ACT, 1906," AND "THE COAL MINES REGULATION ACT, 1902-1926."

The only alteration in the Inspection Staff during the year was the retirement of Mr. W. F. Greenard. No fresh appointment was made, Inspector Winzar being transferred from Leonora to Kalgoorlie, and the boundaries of the various districts amended.

Workmen's Inspectors of Mines.—An election was held in March for the East Coolgardie District, the period of two years for which the Inspectors were appointed having expired, resulting in the re-appointment of Messrs. L. C. Darcey and R. A. Jones for the Kalgoorlie District. Mr. Byfield, being the only nominee for the Leonora District, was also re-appointed for a further two years from 18th March, 1927.

REPORTS OF INSPECTORS OF MINES.

(The figures of production supplied in the reports of the Inspectors of Mines hereunder are those obtained by themselves from various sources and often do not correspond with the "Mining Statistics," though usually reconcilable with these when all particulars of each record are brought together.)

Report of Mr. W. Phoenix, Inspector of Mines, Kalgoorlie.

I have the honour to submit my Annual Report for 1927.

The mines throughout the district have been regularly inspected and defects remedied as speedily as possible.

Temperatures.

I must emphasise that greater attention should be given to maintenance of as large a difference as is possible between the readings of the wet and dry bulb thermometers. This is a factor of the utmost importance, as the difference indicates the evaporative capacity of the air, and evaporation of moisture is the finest cooling agent we have underground. If we can maintain a considerable distance apart in the readings of the wet and dry bulbs, the solution of our troubles in keeping down the high temperatures in mines is made comparatively easy.

The cooling of the mine by evaporation of water is closely connected with the measures which have to be taken to allay the fine dust which causes miners' phthisis. These involve the use of a large amount of water, but it is to be borne in mind that spraying water into the atmosphere indiscriminately in all parts of the mine serves no useful purpose. It only partially removes the very finest dust carried by the air-currents, which is the most dangerous in causing phthisis, and if used in excess results in the air becoming saturated with moisture and so losing all its effect of cooling by evaporation. Without this cooling effect the reading of the wet bulb soon rises to equality with that of the dry bulb.

We should aim, therefore, at using water where it is most effective in allaying the dust, especially at the places where such dust first originates. I have taken every opportunity of urging the necessity for using water freely on broken ore at the faces and wherever dust is created, and am of opinion that the whole subject of the use of water underground requires very careful consideration by all concerned, and possibly further control by regulations.

In regard to temperature at the respective faces, there is very little variation either in quantity or temperatures of the air at the working faces during the shift.

In development ends, where we have a limited amount of auxiliary ventilation, the conditions are slightly different. This auxiliary air gives rise to local cooling effect.

In the Perseverance Mine, the Manager uses blocks of ice placed where the air passes over it. This has a cooling effect and reduces the temperature. By boosting sufficient air from the main ventilating current from the last holing to the face of development ends by means of larger ventilation blowers, however, we get an equal cooling effect, plus a further dilution of the dust created by boring machines, and this is what every Manager should aim for.

To accomplish dilution of dust and reduction of temperatures in development ends, Venturi or other blowers are required. For "effective cooling," two factors are essential—air movement and evaporative capacity. A cooling agent like ice increases this cooling effect.

Dust.

Dust disease is definitely more frequent among miners working in machine ends, and one has good grounds for suspecting the rock drill machines of being responsible for this. They make some dust even when working properly, but if there is a defective water supply and any interference with the water passage through the water tube, sometimes called "Tube Trouble," the dust given off may be very serious.

The machines in use in our mines are not always so effective as they should be. During the course of some of my observations, I have noted that when a drill is jammed the flow of water is checked and a fog created, due to a greater passage of air down the drill, which results in much fine dust being blown out. This is of frequent occurrence.

The cooling effects underground are closely related to air velocity rates. If the cooling effect is good in proportion to the temperatures, and the air movement is a through current, the dust count are usually found to be good. If the linear velocities exceed 100 feet per minute, the dust returns are also low.

During the year, several dust surveys have been made, altogether about 1,512 samples of dust have been taken. They are as follows:—

	Samples.
South Kalgurli Cons. Ltd.	336
Boulder Perseverance, Limited ..	306
Lake View & Star, Limited	246
Great Boulder Pty. G.M., Ltd. ..	249
Associated G.M. of W.A. (New), Ltd.	156
Oroya Links, Limited	93
Sons of Gwalia, Gwalia	60
Mararoa G.M., Norseman	36
Darling Range Quarry	30

The average number of particles of dust per cubic centimetre for underground working is about 306 and those of the dry crushing plants = 228 p.p.c.c. The counts for each mine are as follows:—

Underground Workings.	Average. p.p.c.c.
Lake View and Ivanhoe Mine ..	277
Associated G.M. of W.A. (New), Ltd.	261
South Kalgurli Cons., Ltd.	337
Oroya Links, Limited	394
Boulder Perseverance, Limited ..	310
Great Boulder Pty. G.M., Ltd. ..	319
Sons of Gwalia, Gwalia	245
	7)2,143
	306.1

Dry Sulphide Mills.	p.p.c.c.
Chaffers Sulphide Mill	265
Associated G.M. of W.A. (New), Ltd.	240
South Kalgurli Cons., Ltd.	245
Oroya Links, Limited	188
Boulder Perseverance Limited ..	188
Great Boulder Propty. G.M., Ltd. ..	243
	6)1,369
	228.1

These results are shown, as follows, with percentages:—

1. Lake View and Star, Ltd., underground—
   68 per cent. under 300 p.p.c.c.
   16 per cent. between 300 and 500 p.p.c.c.
   16 per cent. over 500 p.p.c.c.
   Dry crushing plant:
   80 per cent. under 300 p.p.c.c.
   Nil between 300 and 500 p.p.c.c.
   20 per cent. over 500 p.p.c.c.
2. Associated G.M., W.A. (New) Ltd., underground—
   72 per cent. under 300 p.p.c.c.
   16 per cent. between 300 and 500 p.p.c.c.
   12 per cent. over 500 p.p.c.c.
   Dry crushing plant:
   86 per cent. under 300 p.p.c.c.
   Nil between 300 and 500 p.p.c.c.
   14 per cent. over 500 p.p.c.c.
3. South Kalgurli Cons., Ltd., underground—
   50 per cent. under 300 p.p.c.c.
   26 per cent. between 300 and 500 p.p.c.c.
   24 per cent. over 500 p.pc.c.
   Dry crushing plant:
   73 per cent. under 300 p.p.c.c.
   24 per cent. between 300 and 500 p.p.c.c.
   3 per cent. over 500 p.p.c.c.
4. Oroya Links, Ltd., underground—
   63 per cent. under 300 p.p.c.c.
   10 per cent. between 300 and 500 p.p.c.c.
   27 per cent. over 500 p.p.c.c.
   Dry crushing plant:
   81 per cent. under 300 p.p.c.c.
   19 per cent. between 300 and 500 p.p.c.c.
   Nil over 500 p.p.c.c.
5. Great Boulder Proprietary G.M., Ltd., underground—
   64 per cent. under 300 p.p.c.c.
   23 per cent. between 300 and 500 p.p.c.c.
   13 per cent. over 500 p.p.c.c.
   Dry crushing plant:
   75 per cent. under 300 p.p.c.c.
   19 per cent. between 300 and 500 p.p.c.c.
   6 per cent. over 500 p.p.c.c.
6. Boulder Perseverance, Ltd., underground—
   64 per cent. under 300 p.p.c.c.
   23 per cent. between 300 and 500 p.p.c.c.
   12 per cent. over 500 p.p.c.c.
   Dry crushing plant:
   83 per cent. under 300 p.p.c.c.
   7 per cent. between 300 and 500 p.p.c.c.
   10 per cent. over 500 p.p.c.c.
7. Sons of Gwalia, underground—
   65 per cent. under 300 p.p.c.c.
   30 per cent. between 300 and 500 p.p.c.c.
   5 per cent. over 500 p.p.c.c.
8. Mararoa G.M., Norseman, underground—
   34 per cent. under 300 p.p.c.c.
   33 per cent. between 300 and 500 p.p.c.c.
   33 per cent. over 500 p.p.c.c.
9. Boya Quarry, Darling Range, dry crushing plant—
   55 per cent. under 300 p.p.c.c.
   22.2 per cent. between 300 and 500 p.p.c.c.
   22.3 per cent. over 500 p.p.c.c.

The percentages of each underground result that is over 500 p.p.c.c. are due principally to indiscriminate firing.

It is hoped that the introduction of new regulations will have a marked effect in reducing these percentages that are between 300 and 500 p.p.c.c. and over 500 p.p.c.c.

The above is an improvement on previous years but not to any marked extent.

Ventilation.

During the year close attention has been given to the direction of air currents and air volume. One meets with irregularities in air distribution, particularly where many parallel lodes exist. There is a tendency to lack of supervision over the maintenance of the airways in some of the mines where the tribute system has been introduced. More frequent inspection has been made in order to maintain the flow of air through its proper channels. In most of the mines the resistance of the air flow is very great owing to the small size of the airways. The frictional resistance, due to the small size and crookedness of these airways though ordinarily of secondary importance, may vitally affect the ventilation of a mine. I am constantly bringing under the notice of the manager that obstructions in airways should be eliminated and the sectional area of them enlarged. Difficulties in ventilation are an economic condition incidental to mining and offer a great field for future improvement. These facts have been recognised and great benefits have been gained where airways have been enlarged and all obstructions removed.

The resistance of mine airways to the flow of the ventilating current depends upon many factors, an important one of which is that it varies as the square of the velocity.

Without repeating needlessly statements made in all published works on mine ventilation, it cannot be too strongly emphasised that the minimum mine resistance and maximum ventilating effect constitute the end which we must strive to attain.

Miners' Phthisis.

The prevention of miners' phthisis is a subject of supreme importance that has medical aspects on which I am not in a position to report fully, but there are some matters I would like to mention briefly.

There is evidence that conditions with regard to dust prevention and dust laying have improved, but a further improvement must be made before we can eliminate silicosis from our mines.

There must be no slackening of vigilance and unremitting effort on the part of the mine officials in combating this disease, but I have had cause to complain of laxity in certain instances. Although steady and slow progress has been noted, we have a long way to go to reach the stage of finality.

Regulations that will embrace measures to prevent accumulation of dust will tend to help to eradicate miners' phthisis. Such proceed upon the assumption that injury to a citizen by this disease is an economic injury to this State, entailing reparation for the past and amendment for the future.

Liability for industrial diseases may be looked upon as a portion of the cost of production that should be a charge upon industry. It is apparent that a first duty is to prevent damage to its workmen by any diseases due to the industry. The capacity to bear the burden is, however, an important factor.

Tuberculosis has been made a notifiable infectious disease in Western Australian mines, and it will be possible to compare at no distant date the rate of occurrence of tuberculosis amongst working miners in comparison with persons of other occupations.

Rock Drills.

Rock drills in development ends are particularly liable to cause rapid charging of the air with particles of fine dust unless water is used skilfully and in adequate quantity. Tubular steel drills should be used with a flow of water through them to the cutting edges, but great care must be taken not to allow any air to pass through the drills with the water, as it then becomes impossible to prevent escape of fine dust in the air bubbles. The dust is very fine and not perceptible by the senses of the operator who goes on inhaling it without knowing his danger.

I have met with instances where the tube fitted in the machine to lead the water to the drill has been found to be out of order, resulting in production of an escaping fog of atomised water, which tends soon to raise the humidity of the air at the face to a state of saturation with consequent extreme discomfort to the men working there. The supply and use of a machine defective in this way should be prohibited by regulations under penalties.

I am satisfied that considerable improvement can be effected by remedying the foregoing defects whenever they are found to develop themselves.

Indiscriminate Firing.

In my reports, and verbally during inspections, I have made a practice of pointing out where conditions are or are likely to be unsatisfactory in respect to phthisis-producing dust, and have indicated what steps ought to be taken to ameliorate these conditions.

Tabulated results by the Konimeter method of sampling the underground atmosphere show that dust after firing is extremely bad, yet both the employers and employees have shown little desire to have any regulation of the conditions of firing to control the formation of dust.

I am of opinion that only good can result in facing the present position and ascertaining what conditions are unsatisfactory, and how best they can be improved.

The remedies, to my mind, are simple. They consist of use of safer types of axial water-feed rock drills, dilution and removal of dust by copious air currents in development ends, and regulation of times and methods of firing. If these can be accomplished we shall have mines that would be free from phthisis-producing or dangerous dust.

The medical examination of miners has been progressing steadily throughout the year. Although the percentage of tuberculosis is high, it must not be forgotten that we had, at the beginning of the year, over 500 men that have been in the industry between 21 and 30 years. It is such men who are still mining that make the percentage high, they being especially liable to contract tuberculosis.

These mines can be made safe from a dust point of view. It is only a matter of co-operation and a willingness by all parties to face facts. The remedies are simple and can be applied without much inconvenience or expense.

Dr. Collis, in a lecture at the Carnegie Institute of Technology, referred to experiments which showed how tubercle bacilli multiply in tissues damaged by Silica, but not by any other minerals. "These experiments conclusively prove," he said, "that silica dust exerts its harmful influence by passing into solution and reacting chemically upon the lung tissue."

Accidents.

Accidents will happen continually, even with the utmost precautions against them. If metals have to be won, the dangerous occupation of mining them must continue.

Gold and other metals serve a useful purpose, and are indispensable.

The only thing is to stimulate efforts to make mining safer for the employees.

The Workmen's Inspectors, Messrs. Darcey and Jones, have, during their inspections, taken observations of the general safety of the mines visited, and the methods of securing the ground have also been noted, this being their especial duty.

Accidents occur from very many and very varied causes, but in the great majority of cases their prevention depends mostly upon the judgment and caution exercised by the individual miner, who is in the best position to determine the relative safety of his working place.

It must not be overlooked that we are losing our most experienced miners as time goes on, and I am of opinion the remedy for accidents must be sought along the lines of general education of the young miners.

There seems to be some laxity in this respect, and there does not seem to be the same interest as formerly in the education of beginners, who probably do not know the nature of the ground in which they are working and therefore do not use the same caution because they are not in a position to judge and determine the relative safety of their working faces. The same applies to any branch of mining, such as transit of ore, where a number of minor accidents occur, such as jammed fingers, sprained back, crushed toes, etc., many of which can be avoided by individual care.

There is no reason for thinking that atmospheric conditions under which the mines are working have been responsible for any of our accidents.

There seems to be an increase in accidents of a minor nature which come under the heading of "Miscellaneous Underground."

The Inspectors issue specific notices to rectify defects, and these are recorded in the mine Record Book, or served upon the Manager.

I regret to have to report several fatal accidents, all of which were of a peculiar nature.

Referring to the two fatal accidents due to an explosion caused by the friction of the detonator against the side of the hole while tamping with a wooden rod, these could have been avoided had the detonator been placed lower in the hole instead of being inserted into the plug at or near the collar.

Prosecutions.

There were four prosecutions during the year for non-compliance with the Mines Regulation Act, Regulation 6.

Sanitation and Safety Appliances.

Observations have been made by each Inspector with regard to safety appliances and sanitation during the year.

There were causes for complaints with regard to crib places. This was particularly noticeable in mines where the tribute system has been introduced. Owing to the desire for each party to crib alone, this makes it difficult to keep each crib place in a hygienic condition.

Earth Tremors.

There were a few earth tremors felt in the Boulder belt during the year, but there has been no indication of any damage done to the present workings.

There are slight underground movements in some sections, but there is no evidence of actual movement away from a shear plane or fault. Bursts may occur in old workings unknown to mine officials when tremors have been felt.

There is lack of information as to the extent to which the foot or hanging walls are fractured. There is shattering of the working faces at times which indicates pressure or strained conditions at particular spots. This may be due to compression of rock owing to depth below the surface causing internal strain. When the stress in the rock due to bending becomes too great for its cohesion, shattering takes place.

Flaking is observed where the rock is most silicified or flinty. This is easily explained when the effect of bending is taken into account.

Tremors are not so frequent as they were. This may be due to lack of development at a greater depth and the rock gradually settling on to the filled stopes.

It is usually necessary to bar down any face or back thoroughly where there are signs of shattering. To prevent shattering a stope should be worked with all practical speed until it is depleted, allowing the main weight to come on to the filling, which should be kept as close up to the face as possible. Observations are continually being made with regard to any sign of movement.

General.

Mining, generally, in this district is quiet.

There are indications that the output of last year will be maintained and in some cases increased.

Progress of the development work done has been included in Mr. Inspector Gourley's report, and shows a falling-off in footage developed during the past year.

The tribute system has been introduced in several of the mines. Unless this system is handled systematically it will have a tendency to finally close mines much earlier than under wages work. The tributers cannot make any ore pay (in the sulphide zone) of a value less than 50s. or 60s. per ton. They are therefore bringing an already low grade mine to a much lower grade, which cannot be handled profitably. It seems a national loss to have to bury ore (under the tribute system) less than 50s. per ton. On the other hand a tributer is able to follow a very small vein much more cheaply than a Company can. The tribute system requires careful handling.

The regulations in regard to explosives have been rigidly enforced. All fresh consignments of fuse have been tested, and the rate found to comply with the Act.

Generally speaking, the Mines Regulation Act has been fairly well complied with throughout the district.

Report of Mr. E. J. Gourley, Inspector of Mines, Kalgoorlie.

I have the honour to submit to you my annual report for the year ending December 31st, 1927.

Inspections have been made of the following Mines and Districts:—

Boulder Mines Dry Mills, 4; Coolgardie Bore, 12; Hampton Plains, 10; Great Boulder, 8; North End, 4; South Kalgurli, 7; Williamstown Bore, 9; Croesus Proprietary, 4; Gwalia Mine, 1; Menzies District, 14; Perseverance Mine, 9; St. Ives, 4; Comet Vale, 6; Siberia, 5; Lloyd George, 9; Kalgurli Mine, 4; Horseshoe, 6; Mt. Monger, 2; Norseman, 2; Riverina, 3; Mt. Juglah, 4; Brown Hill, 4; Kanowna, 2; Lake View and Star, 6; Ora Banda, 5; Associated, 4; Hogan's, 2; Bullfinch, 1; Davyhurst, 1; Mulline, 2; Mt. Ida, 1; Broad Arrow, 5.

In connection with the number of visits to the outside districts inspections have been made while on examination for subsidies under the Mining Development Act and for the sale and transfer of machinery owned by the Mines Department.

DEVELOPMENT.

Lake View and Star, Ltd.—No developmental work of any importance has been done with the exception of extending levels, rising for stoping operations, and a few winzes necessary for ventilation purposes. The surface plant has been increased by an additional roaster and a ball mill, and several other alterations for increased efficiency, and to minimise the dust from this dry crushing plant.

Great Boulder Mine.—During the year portion of this mine was let to tributers and some very good blocks of ore have been and are still being mined. 1,227 feet of driving, 97 feet cross-cutting, winzing 746½ feet, rising 123½ feet, and diamond drilling 451½ feet have been done, and a considerable quantity of payable ore has been opened up which places the mine in a better position than at the end of 1926. With the exception of Tracey's Tribute, which has opened up a body of ore at 70 feet on the Horseshoe boundary, which appears to be something new and also difficult to say what this will develop into, for there appear to be no defined walls and the formation which carries values of about 15 dwts. is soft and friable. The surface tributes down to 80 feet have not opened out anything fresh, but some good payable ore has been mined.

Associated Mine.—383 feet of driving, 85 feet cross-cutting, rising and winzing, 163½ feet of development have been done chiefly in the upper levels of the mine, but this work has not opened up anything of special note. Stoping has also been done, so, apparently, some pay values have been discovered On the whole this mine is very low-grade, and it appears to me that only by economical management the mine is kept going.

Boulder Perseverance, Limited.—1,517½ feet of driving, 493 feet crosscutting, 624½ feet winzing, and 90½ feet rising have been done by the company on Lease 66E; and 201 feet driving, and 108½ feet of winzing by the tributers on this lease, also 921 feet of diamond drilling, while on the Bank of England, in which this company is interested, shaft sinking from surface 31 feet, driving 12½ feet, and crosscutting 5 feet have been carried out.

No very rich ore has been opened up, but the tonnage treated and yield have been very consistent throughout the year. Special attention has been paid to keep the temperature in winzes and dead ends below that allowed by regulation, and large quantities of ice have been used both in boxes and loose. The tribute system has been done away with to a great extent.

South Kalgurli Consols, Ltd.—This mine has done a considerable amount of development work during the year and opened up a fair quantity of average grade ore with driving 1,776 feet, crosscutting 1,327 feet, winzing (chiefly for ventilation) 597 feet, and rising for stopes 15 feet. Total 3,715 feet. This work has been done below 1,000 feet from the main shaft out west in most places.

This mine has been a constant producer, showing a good profit on the ore milled. Many improvements have been done to the surface plant, such as an oil furnace for heating the machine drills, and gas producer for roasting the ore with gas, both from Collie coal and wood, but this latter experiment is not yet sufficiently advanced to determine whether all furnaces will be equipped with gas firing. Wet drills are used entirely underground. Venturi blowers, which are used in dead ends by blowing in instead of drawing out, appear to be working satisfactorily.

Golden Horseshoe Mine.—The mine has been kept unwatered and only cleaning up around the treatment plant has been carried on, but a start was made late in the year to recondition a portion of the plant.

Kalgurli Mine.—This mine suspended operations on account of values being too low to pay for the amount of handling on the surface, such as carting the ore in drays from the *Croesus Proprietary* Mine, *Brown Hill* and *Oroya North Blocks*, but in my opinion there is a large amount of ore both in the Croesus Proprietary and Kalgurli Mines that would pay with better handling facilities. In the meantime, the water is being kept out of the North Blocks and the Croesus Proprietary, and the mine is now under the management of the South Kalgurli Company.

North Kalgurli Mine.—The water in this mine is kept down by the South Kalgurli Company, and within the last three months a small air compressor has been installed and a few men employed in prospecting at 150 feet in the eastern ground known as Green's workings. So far, values are low.

Paringa.—The crosscut out in a north-east direction passed through a small run of ore at 150 feet, but this proved to be only a small lens on a fault. This portion of the lease has been let on tribute. A diamond drill hole has been put out 100 feet east from the 400 feet plot with no results.

North End.—There have been a good many men prospecting in different places from the Half-way, Maritana Hill, up to the Hannans North Mine, and small crushings put through at Hunt's Battery, but returns have been low.

Hannan's Reward.—Hunt Bros. discontinued the treatment of slimes on account of low values and are now treating ore obtained from the east side of the big open cut. Values are just about payable and three parties of tributers are working leaders on the Mt. Charlotte lease. These leaders are small but carry payable gold.

Mt. Ida.

I visited this place once, and found that six men were prospecting and breaking ore. The State battery put through a run of 250 tons, but the returns were not better than wages.

Davyhurst, Mulline, Riverina.

There was only one prospector at Davyhurst, two at Mulline, and three men treating residues at the State battery, while at the Riverina South mine, Mr. Forbes was busy putting up a 10-stamp mill with grinding pans and cyanide plant.

St. Ives.

The party of tributers who have been working the *Ives Reward* mine took out four crushings, which should have shown a good profit if they could have got a good run out of the plant. This party have now broken up, and a new one has been formed. It will take some time to get the stopes in order.

Hogans.

I have visited a find made by *Cole and McLelland,* five miles south of the old alluvial workings; being new ground and good loams, it was certainly worth prospecting, but up to date no reef of any payable value has been discovered, but the prospectors are still on the ground.

Mt. Juglah.

Bennit and Jasson.—This party has been assisted to purchase the 5-stamp "Sweet Nell" battery, which is nine miles west of the mine, but the cost of carting, milling, and breaking the ore is too high to show a profit on nine-dwts. ore; last crushing being in December, 100 tons for 44 fine ounces.

Bulong and Balagundi.

There are about 20 prospectors in this district following leaders and contact veins with varying results, but still they persevere as long as they can make enough to keep themselves.

Kanowna.

The *Red Hill* company shut down during the year on account of the good values which were being followed in the underlay shaft being flooded by an influx of water. The mine was let on tribute to the former manager, but they could not make it pay in the shallow ground. The plant and tools have been sold to Mr. J. L. Martin, who proposes to try the mine.

Menzies.

The *Lady Shenton* have sunk a winze to a depth of 103 feet on the underlay and cut the reef struck in the bore hole, but the values are erratic, and the reef small. The mine is now shut down for want of funds.

Collier and Riley picked up a shoot of stone beyond a fault at 100 feet in the old Golden Age mine. It is about 30 feet long and averages 18 inches in width. Values are good, and it appears to have a long life ahead of it.

Sawyer Bros. (6) who work the Warrior mine and do all the public crushing have had a successful year. There are about 12 other men prospecting in different places, but nothing of note has been discovered.

Comet Vale.

The *Sand Queen* mine has been unwatered, and the winze below the bottom level cemented up and a pipe and valve put in position to carry the water up the workings as far as the pressure of 340 lbs. to the square inch will take it. The 10-stamp mill with grinding pans and cyanide plant is in working order and crushing one shift, for it will take some time yet to clean up levels and passes before sufficient faces are opened up to run full time.

The *Lake View* mine (P. Maher) has had two or three men on it breaking ore, but results have been low.

Siberia.

Messrs. McLoughlin and Mate have been working on a contact leader in the old *Bonnie Doon* lease near the *Reward,* and obtained 22 ounces by dollying, and they are still following this contact. Correll is cyaniding the residues from the *Siberia Consols* mine, and about 10 dryblowers are still out there.

Ora Banda.

The *Gimlet* mine has been developing most of the year, but has run the mill for some months and crushed the accumulated ore, and caught up to the stopes underground. The mill is now shut down, and two development ends at the 700 and 500 feet levels are now being worked.

Messrs. Hancock and Sons have had a successful year from the *Wentworth* mine at Dark Horse, and the *Williams Bros.* have had a good return from their claim following contacts. The *Orinda* mine had two fair crushings, but the mine now appears to be worked out above water level.

Broad Arrow.

Barrett and Party on the *Oversight* mine have had some good returns from above the 100 feet level during the year, and it is now proposed to equip the mine with a pump and prospect below water level.

C. Rae has had two small dollying patches from *Reison's Reward.*

There are about 20 other men prospecting, but no returns of any consequence have been reported.

Hampton Plains.

The *White Hope* mine closed down, and its machinery has been sold. There are two men on the *Celebration South,* two on the *Mutooroo,* and two on the *Victory* making a living by small parcels treated in Kalgoorlie.

In conclusion, I have assisted Dr. Stillwell in his examination of the mines on the Golden Mile, especially in those along the fringes of the big mines where we have to climb up and down.

Prospecting, on account of the sandalwood orders, has not been done to the same extent as in previous years, and while mining is quiet, I do not see much difference in this district from 1926.

Report of Mr. A. W. Winzar, Inspector of Mines, Kalgoorlie.

I have the honour to submit my annual report for the year 1927 on the Mt. Margaret portion of the East Murchison, and the North Coolgardie Goldfields.

During the year a change was effected in the district boundaries, the Wiluna portion going into the

Cue district and the Leonora office being shifted to Kalgoorlie.

There is little change to report for the year. The gold yield shows a decrease, and less prospecting is being done than usual. Quite a number of prospectors have followed up well-sinking for the stations.

I regret to report two fatal accidents. The first was due to a fall of ground, and the other to an electric shock. Both were fully inquired into and reported on.

The working conditions of the mines are constantly being improved. All dust-producing places are being well watered and ventilated. Temperatures are carefully watched, and the dust content of the air tested with the konimeter.

The *Sons of Gwalia* mine crushed 95,910 tons of ore for 31,506 ounces and retreated 56,000 tons of old sands. No actual developments took place, but some prospecting about the bottom levels disclosed payable ore, and proves that the mine would respond to good systematic development. The bottom level has been driven south a few feet and a wide body of payable ore exposed. This cannot be stoped until such time as openings are made to the level above for filling and ventilation. Ore was also disclosed in a crosscut put into the footwall below the 23 level. A fair proportion of the monthly output comes from opencuts, and consists of low grade oxidised ore, which is cheaply mined. The average hauling distance for the latter part of the year was 2,000 feet, which shows that a large proportion of the ore is mined from the 25 level.

The mine worked continuously, excepting for a three weeks' stoppage due to heavy rains interfering with their wood supply. The treatment plant worked efficiently, the stamp duty being nearly 14 tons as against 12 tons for 24 hours for 1926. The power portion of the plant is very effective; the generating cost per unit being very low; in fact this company holds the record in Western Australia for cheap power and low cost of treatment.

The granting of financial assistance should give the mine an excellent chance to open up good supplies of ore, and prolong the period of production for some years.

Outside the Gwalia practically no ore was obtained. Some eight prospectors crushed under 100 tons for less than 100 ounces.

From the *King of Creation* mine only 80 ounces were obtained from 149 tons. The mine was idle for a considerable portion of the year. The water supply requires improving. There appears to be a large quantity of payable ore in the mine, and, given an ample supply of water and some working capital, it should pay its way.

About one mile north of the King of Creation, John Nolan, an assisted prospector, is on some good ore on the old *Doris* mine. As he works by himself, he cannot do much to open it out to see its extent.

Dwyer Bros. crushed from their *Baneygo* lease 83 tons for 44 ounces. This is the first ore that has been crushed from this place for some years. They have been granted a small loan to enable them to sink a new shaft and get under the old workings. This is quite a promising line of lode, and they have a good chance of getting on to some payable ore. On this lease, there is an old five-head mill, which is capable of crushing a lot of ore.

At *Duketon,* Cox and party are prospecting at the "Patch." They have sunk two shafts, and are now connecting them at water level. Most of the gold obtained is from dollying patches, and they appear to me to have an excellent chance of getting gold. Apart from Cox and party no other prospecting is now being done about the district, though it appears very favourable country for finding lodes and reefs.

The treatment of residues was continued at the *Lancefield,* and 860 ounces were obtained; whilst Franish is also treating a small quantity of residues on the *Beria South.*

Around *Laverton,* Tasker and mate have been doing a lot of hard work for very little return. They have a lease of the State battery, and have a better chance now of getting some payable ore.

At Burtville, the *"Nil"* owners put through 30 tons for 144 ounces. Owing to the number of men and smallness of the stringers this return is quite unpayable.

At Morgans, the *Westralia* mine worked continuously on ore from the old levels, and treated 10,412 tons for 3,045 ounces. The old stopes are about depleted, and it is likely the mine will not be able to carry on for the whole of the forthcoming year.

At Yundamindera, Messrs. Young Bros. have a holding about the *Big Stone* lease, and have had some very fair crushings, obtaining 99 ounces from 97 tons. The reef is very patchy; as they are mining in the vicinity of old workings they have no idea what quantity of ore to expect. It is probable that they will get some payable ore in future.

At *Linden,* the *Devon* mine kept going for the year with plant construction, and some quantity of ore was crushed. The ore is not amenable to ordinary treatment insofar as it must be roasted. A rough concentration is made for the furnace, and no trouble is experienced in the recovery of the gold, but it is rather costly as the plant consists of only five head of stamps. The value of the milling ore is about 18 dwts, and the residues 2 dwts.

The shaft is down 200 feet only, and most of the ore above this level is depleted. Considerable development is needed if the mine is to keep going.

At the *Great Carbine* a pumping plant has been installed, and the owner intends erecting a battery before unwatering the mine.

A few small crushings were put through the State battery for small returns.

In the *Niagara* and *Yerilla* districts practically nothing was done. A few men were trying to eke out a living at Edjudina.

In the *Lawlers* centre, practically no mining took place. A little prospecting was done about Cue's Patch, but nothing was obtained.

A little work is being done around Sir Samuel by prospectors, and one crushing was put through from *Kathleen Valley.*

From *Corboy's Find* 1,503 tons returned 682 ozs., showing a decrease on last year's return, due to the owners having worked out the easily-mined ore. The water level is about 30 feet, and future yields must be got below the water. The prospects of this place are promising.

The *Waratah* mine was let on option, the owners getting an advance from the company securing the option to do certain development which is now in progress, and the prospects of the mine look very promising. The mine is equipped with a pumping plant. The shaft is now down 98 feet, and 6 feet of ore, which is estimated to be worth 1 ounce per ton, is showing in the bottom.

At *Corboy's Reward North* prospects are encouraging, and should the quartz give place to carbonate ore, as in the adjoining Waratah, the mine has a good chance. The lode in both leases is almost on the contact between the greenstone and granite.

All the easily won stone has been obtained from the *Toscana,* and no work was being done on the lease towards the end of the year.

From Pola's holding about 300 tons were crushed for 150 ounces. The reef, now being worked by Guezzelli, who has secured the lease, looks rather well and the grade is about 10 dwts.

I have not reported on the *Wiluna* centre, as this will be done by the Cue office, also the mines I have visited in the Kalgoorlie centre will be reported on by the inspectors here.

Report of Mr. W. M. Deeble, Inspector of Mines, Cue.

I beg to tender my annual report on mining in the Peak Hill, Murchison and Yalgoo Goldfields, the Black Range District of the East Murchison Goldfield, and the Northampton mineral field for the year 1927.

Peak Hill.

At *Naberu,* situated next to Pinyeringa Pool northeast of Peak Hill, it has been reported several times during the year that rich specimens have been found, but it is unfortunate that the specimens came from small leaders. A parcel of 5 tons brought in to the Peak Hill battery by Mr. S. Lyons returned 21.94 ounces. At the end of the previous year two small crushings were brought in from the same place, one of 19.5 tons returned 83.65 ounces, and the second 19.5 tons 36.46 ounces. There is gold-bearing country from the place north, and several prospectors went out in that direction towards the end of the year.

At Mt. Fraser the old *Mt. Fraser mine,* said to have been worked over twenty years ago, has been taken up by Dunlop and Kilroe. The reef runs nearly East and West and underlies North. The old working on the reef is 200 feet in length, and I was informed 150 feet in depth. I was unable to go to the bottom of the workings. The reef varies from 2 to 4 feet in width, and as there is very little quartz showing on the surface, most of the stone broken must have been crushed.

When this place was worked formerly the ore had to be carted 17 miles to Peak Hill. Since the present holders have had the ground they have milled one lot of 27 tons for 1 ounce per ton, and a second lot of picked ore, saving about one-fourth of the stone broken, gave 2 ounces per ton from 15 tons. At the time of my last visit to the district there was about 8 tons of ore in the dump in which gold could be seen freely.

A crushing of 80.25 tons from the *Wembley* lease, situated 12 miles from Peak Hill and beside the old Peak Hill-Meekatharra Road, gave a yield of 30 ounces of gold. At the end of the year there were 18 men engaged in mining at Peak Hill.

Horseshoe.

Manganese.—The railway line is now laid up to the manganese deposits, and everything should soon be ready to send away ore to the coast. The line was started in June, 1927, and completed to the Horseshoe townsite in October. The work was held up about half of June and July owing to wet weather. From the townsite there was about three or four miles of line to put down to the quarry. When it is said the line was completed, it means that the engine and trucks were running over it from Meekatharra to Horseshoe, but it is still necessary to fix up places at water-courses which at times become flooded, and for which purpose there are girders and concrete pipes at the head of the line. At present it is rather difficult to get suitable water for boiler use, and it is being obtained from Meekatharra and Murphy's Well. Mr. Leslie informs me that it is intended to put a bank at a pool about 58 miles to impound the water and, in addition, a well is being sunk next to the end of the line. At Horseshoe the rail level at face of manganese deposit is 1,992 feet above sea level, and the top of deposit is 2,131 feet above sea level.

I enclose herewith a photo.* showing a man standing nine feet above rail level, from this point a heading will be driven and a flat shoot, or what is known to miners as a "Chinaman shoot" put in, which will make it possible for a rake of trucks to be all filled in one time. As the work of breaking the ore progresses the flat shoot can be extended, and by breaking above it large tonnages can be handled quickly and at a low cost.

Holden's Find.

Waterloo G.M.—This mine, which has been shut down for some time, is now in operation again, the 5-head mill with grinding pan and three curvilinear concentrating tables completed. A 50-ton parcel has been put through for a return of 21.5 ounces of gold. The concentrates have not been dealt with. A type "H" pump throwing water from 130 feet depth, and sometimes up to its full capacity of nearly 3,000 gallons per hour, together with three curvilinear concentrating tables, are driven by a 12 h.p. crude oil engine at a cost, the manager informs me, of 4d. per hour.

Mistletoe.

Munarra G.M.—The work in this mine has had a considerable amount of set back during the year, mostly by breakages of the pumping gear. At the end of the year the syndicate decided to close down for the time being.

Belele.

Messrs. Holden and Williams have been working a reef at a place 37 miles north-west of Meekatharra. The reef shows where worked an average of two feet in width, and up to date 77.5 tons brought in to Meekatharra gave a return of 53 ounces of gold.

Meekatharra.

Ingliston Consols Extended G.M. holds the pride of place in this district, and has employed an average of 123 men during the year. The main shaft is 1,347 feet, and the deepest level 1,215 feet. A main crosscut has been put out 343 feet; at 300 feet

* Not printed.

the lode was cut, values being low. Driving north and south on the lode the values continued low. A winze put through from the level above has made good ventilation from bottom level.

The total output from this mine for the year was 35,759 short tons for bullion £76,307 16s. 10d.

There are a number of smaller shows in the district, some producing highly payable ore, but the quantities dealt with have been small.

Reidy's.

The *Mararoa G.M.* is the only mine in this district doing anything for the year, and for this period 1,636 tons were milled for 324.53 fine ounces, and 2,764 tons of sands treated for 801.88 fine ounces of gold.

Tuckanarra.

There are a few men working shows at this place, but there is only one at present being worked that may develop into a mine. One man working P.A. 1577 has sunk a shaft 70 feet on an ironstone lode which has been worked for 6 feet in width, and from 275 tons obtained 100.24 ounces from the plates. In this class of lode material roughly 50 per cent. of the gold content is extracted by the plates and the remainder by cyanide treatment. One parcel of 28 tons from this district returned 95.60 ounces of gold, but it seems that the gold found around that part only makes in patches in the lode.

Cuddingwarra.

There has been a number of men working in this district throughout the year, but no development worth recording has taken place. Reports state that the Big Bell G.M. will be restarted early this year.

Cue.

Mining has been quiet at this place throughout the year. The *Primrose* mine produced 59.86 ounces from 104.8 tons. A great part of the year was taken up with sinking a new shaft and development work.

Day Dawn.

Outside what is being done by a few prospectors the *South Fingall* is the only mining proposition being worked. During the year this mine produced 1,295.25 tons for 862.72 fine ounces. As the water has risen, the workings which can be operated are limited to 130 feet depth, and the expense of keeping the water down is too heavy for a small party, and consequently there is a limited output.

Tuckabianna.

At this place an average of 15 men have been employed, and 678.50 tons of ore produced for 282,28 fine ounces. The greater part of this came from the *Buttercup* mine, which produced 520.00 tons for 125.62 ounces of gold.

Lake Austin.

There have been about 15 prospectors about this place during the year, but the *Mainland Consols,* owned by Mr. S. Walker, was the only mine worked In January a crushing of 15 tons was milled for a yield of 370.00 ounces from the plates. Owing to illness the owner then closed down the mine and had to go to Perth; on his return, towards the end of the year, the mine was full of water, which took to the end of the year to remove.

Very little has been done outside prospecting either at *Moyagee* or *Lennonville.* At the latter place Grose and Currie worked on a lode about 14 feet in width, and obtained a result of 14 dwts. per ton from a crushing, but there has not been sufficient work done to prove if that standard can be maintained.

Mt. Magnet.

There is a noticeable increase in the gold yield during 1927 over the previous year. The district generally produced 4,901.25 tons for a yield of 4,444.31 fine ounces, an increase of 1,203.54 ounces.

Hill 60 G.M. is mainly responsible for the increase in the district return and during the year milled 3,830 tons for a yield of 2,025.89 ounces of gold, which is an increase of 1,452 tons milled and 1,124.89 ounces of gold. The lode in the mine is worked by means of an open cut and the ore handled through a shaft at end of the open cut, tipped into a bin direct and the sand goes on to a cyanide plant. Roughly half the gold content of the ore is saved by amalgamation and the remainder by cyanide treatment. The gold mentioned above includes both that recovered by amalgamation and cyanide.

The *Royal Consols G.M.* is under option to a company, and by present indications the large lode in that property will have a thorough testing. Mr. Ardagh, who is in charge of operations, has sampled the mine and is now moving machinery on to the mine for erection.

Among the small parties getting gold are Camp and Miller: 95.25 tons for 179.44 ozs.

Yalgoo.

There have been a number of prospectors at *Melville* during the year, and 375 tons were milled for a yield over the plates of 188.51 ozs. Most of this ore came from the *Revival G.M.*, which treated 215 tons for 80.90 ozs.

Gnow's Nest.

Brilliant G.M.—During the year the main shaft was sunk from No. 4 to No. 5 level. This work owing to a very heavy inflow of water, was a slow and costly proceeding. The water was too heavy for the 10in. pump in use, and to cope with the water the pump was driven too fast for its size, which caused it to be continually breaking down. The shaft was opened out at 92ft. below No. 4 level and a cross-cut put in West, and the reef was intersected at 186ft. The reef where cut was 13 feet wide and carried fair values, but it narrowed both ways on driving, and values are now said to be on the low side. During the year an average of 29 men have been employed and 1,154 tons of ore milled for 605.37 fine ozs. of gold.

About one mile South-East of the Brilliant G.M. Mr. C. Grant, holder of *P.A. 740,* obtained some good prospects on the area, and on following it up seems to have found something very good. When I visited the ground a shaft had been sunk 14 feet. In the shaft there is a quartz leader about 10 inches in width, going down about vertical with a slight underlay to the East, and at the back of this fine quartz leaders run out into th ehanging wall. There are about 5 tons of the quartz leader in the dump estimated to contain 5 ounces per ton, and a second dump of from 6 to 8 tons estimated at one ounce per ton. When sinking the shaft two kerosene tins of stone were obtained which dollied 10 ounces of gold.

Field's Find.

The main mine in this district for some time was the *Brown's Reward,* but this got poorer towards the end of the year.

About four miles South-West of Field's Find there is a hill known locally as the "Mount of Millions," the ridge of which consists of jasper, ironstone, and quartz. Although fine gold can be traced almost the whole length where the lode is exposed, trial lots have failed to locate any payable shoot of gold. This ground has been taken up lately and named the "*Mountain Maid,*" and the owner, Mr. E. E. Oliver, intends giving it a fair trial by sending a large tonnage to the mill. I was informed that 60 tons had been carted to the Warriedar mill. Adjoining the Mountain Maid, Moorehead and Wilson are taking out a large parcel, and I was informed that 150 tons are now at the Warriedar mill. When these two crushings are treated it will give a good idea of what the ore in the lode will bulk.

Payne's Find.

Towards the end of the year the *Lake View G.M.* was re-started, and a crushing of 225 tons returned 339.41 ounces from the plates. The reef where it is being worked will average about two feet in width.

Paynesville.

Mining at this place has been very quiet throughout the year. A crushing of 48 tons from the *Elsie G.M.* gave a return of 267.27 fine ounces, but unfortunately the shoot of payable ore cannot be traced downward.

A prospector named N. P. Troode obtained 20.72 ounces from 5 tons of ore.

Youanmi.

Mining has been at a low ebb at this place during the year. Worrington and party worked round the surface of the old Youanmi mine and milled 711 tons for 172.85 fine ounces of gold.

Sandstone.

There is very little to report from this district, and all the mining operations are carried out by miners working their own shows. The *Havilah* mine produced 286 tons for a yield of 312.55 ounces of gold, and the *Waratah* 290 tons for 235.63 ounces fine.

Montague.

About 12 miles N.W. of Montague, at a place known as *Jones' Find,* at a point 7 miles South-West of Mt. Marion and 5 miles North-West of Prominent Hills, two parties are working shows. In the first place Jones found specimen stone at this place and, together with a mate named Shannon, sank a shaft to 60ft., which is 20 feet below water level. Twenty-five tons taken from the shaft yielded 6 ounces per ton over the plates. Later Cornwell and mate took out a crushing of 40 tons from the general lode which gave 2 ozs. 14 dwts. per ton by amalgamation and cyanide. Up to this stage all the stone had to be carted to Sandstone for treatment at a cost of £3 15s. per ton, but arrangement was made to get it taken in by motor truck at £2 15s. per ton. East of Cornwall and mate's show, Lynch, Ryan and Casey have sunk a shaft 35 feet and driven on a reef 30 feet, the reef being 4 feet in width. They expect a return of from 30 to 40 dwts. per ton from the stone broken.

The water level is about 40ft. on an average, and the flow is not strong, as was proved by Jones and Shannon. The water is of good drinking quality.

Wiluna.

The *Wiluna Gold Mines, Limited* have been employing an average of 115 men during the year under review carrying out testing work. The depth of shaft is 300 feet, and then a winze down to 400 feet.

During the year, experimental pilot plant, tube mill, flotation machine, agitators and vacuum filter presses, 180 h.p. 4-cylinder National gas engine, and a 440-volt generator have been erected, and a Cornish lift at the new shaft. The management reports that "they are now awaiting construction of the railway before much more machinery will be erected"; 5,400 feet of development work has been done during the year, all of which was very satisfactory."

The company is now increasing its capital to £1,000,000 for mine equipment and plant, and an extensive working policy will be formed during 1928.

Diorite.

Various crushings from this place total 1,070.50 tons for 977.93 fine ounces. The main producer is the *Brilliant North Mine,* which obtained 717.31 ounces from 392.00 tons by amalgamation, and the assay value of the sand is 2 ozs. 3 dwts. per ton. The bottom level is 100 feet deep. The length of the pay ore is about 110 feet, and the width 1 foot. There are now 60 feet of backs to be worked out without further development.

From *Gum Creek,* situated between Diorite and Nannine, Finch and party brought in to the State Mill at Wiluna 43.25 tons, which gave a result of 24.75 ounces.

In giving the yields from mines it is difficult to give the exact return, as sometimes only the gross return is obtainable, whereas in others the return is in fine ounces. In mines where they have a cyanide plant on the ground the return can be exact, but in dealing with small shows the yield is usually understated, as only the recovery by amalgamation can be given.

Poona.

The miners engaged at this place during the year varied in number from 16 to 25, but the field has been handicapped on account of the shortage of water. During the last six months there has been no water available for washing the gem-bearing ore, as all the water was required for domestic use, and that was procured from a station 12 miles away from the central point of the mining area.

The *Transvaal Trust and Finance Corporation* hold four mineral leases, aggregating 78 acres. Two of these leases have been under exemption since the company began operations. On Mineral Lease 82, where a lot of prospecting has been done, a shaft has been sunk to a depth of 40 feet; crosscuts from this level have been put out 30 feet South and 11 feet North. At the latter point the lode was cut, in which was a shoot disclosing a quantity of beryl and a few emeralds of good quality. The greater number of the emeralds found have been fractured and flawed, and it is considered that until the crystalline zone is entered the gems will not be first-class quality.

On Mineral Lease 87, at a depth of 80 feet, drives have been put along the lode channel. At the No. 2 shaft, at a depth of 30 feet, the lode has been opened, and when driving along a shoot was found said to carry gems of better quality than hitherto discovered.

Star Emerald Syndicate.—A considerable amount of work has been done by the syndicate, but it is unfortunate that we are unable to get any idea of the value of emeralds sent away either from this or any of the others working at Poona.

The Adelaide Emeralds are getting beryl and emeralds from their property, but it is impossible to say what the prospects are until some returns from the material sent away have been received.

Tin.—The ground taken up by Mr. Mandelstam for tin has been prospected at various points and some good prospects obtained, but there has not been sufficient work done to give any reliable estimate of the value.

Northampton.

Owing to a considerable drop in the market value of lead during the year all the mines worked by companies ceased work, and only a few miners working their own shows are there now. On my last visit in October last the *Geraldine South,* P.A. 131, was worked by Mr. Salter and his two sons. The shaft is 60 feet deep, and working from that depth the lode was showing a lot of milling ore, but work is only being done in ore that can be sorted to a high percentage.

The *Norman King,* situated at Norman's Well, nine miles from Northampton, has been taken up by Merrifield and party. There is a lot of good milling grade of ore in this show, and it seems probable that this will be made to pay even with the present low value of lead.

Report of Mr. H. P. Rockett, Inspector of Mines, Southern Cross.

I present to you my annual report for 1927 on Inspector of Mines District No. 2, which includes Yilgarn, Phillips River, Coolgardie, and Dundas Goldfields; Swan, Roelands, and Kendinup Mining Districts, and Greenbushes Mineralfield.

Ventilation.—The mines and quarries in this district were inspected as often as practicable. The ventilation in the gold mines is good; water is used freely in the faces and all the mills crush by the "wet" process. In the rock quarries the ventilation about the treatment plant is, for the most part, bad: the municipal quarry at Darling Range is the least and the State quarry at Boya the greatest offender. It would seem that perhaps the other quarries take their cue from Boya quarry; at least it is reasonably certain that the other quarries cannot in common fairness be compelled to deal efficiently with the dust menace while the State-controlled Boya quarry leads the way in disregard of the health of the workmen.

Accidents.—I regret I have to report two fatal accidents and six serious accidents. The causes and circumstances surrounding each were carefully investigated.

Prosecutions.—Breaches of the Mines Regulation Act were infrequent and of minor importance, and did not call for legal action.

The Yilgarn Goldfield.

The figures for the year are 9,238 fine ounces, as against 11,792 ounces for last year, a falling-off of 2,552 ounces. The decrease of output was general, but it was due more particularly to a curtailment of output from the Radio mine and the gradual failure of the laterite ore bodies of the Great Victoria mine.

Coolgardie Goldfield.

The figures for this goldfield show no great variation in the outputs for 1926 and 1927.

Phillips River Goldfield.

There was very little mining in this goldfield, and the output was of little importance.

Greenbushes.

In this mineral field there was an apparent increase of activity, for which the improved price of tin is responsible. Messrs. Lindsay and Barrymore are each working a barge in Saltwater Gully, while in Westralia Gully barges are being worked by Messrs. Cole, Huitson, Angus, and Lindsay. John's barge in Bunbury End was working during part of the year, but I understand that the overburden became very heavy and work was stopped.

An attempt was made to re-open the *Greenbushes-Cornwall* mine, but after clearing out the shaft and sinking 20 or 30 feet and doing some exploratory work at about 100 feet, the ore was found to be too low grade for profitable working. An attempt to re-open the *Lost and Found* at Bunbury End met with similar bad fortune. Messrs. Fox, Elias, Brown and others have spent much time prospecting, but without success so far.

Mining in General.

Mining in general has been very slack in the Yilgarn Goldfield, the principal producer being the *Great Victoria* mine with 17,651 tons, which yielded 3,433 ounces of gold. Unfortunately, very little can be expected of the mine during 1928, as the known lateritic deposits of payable grade have been worked out, and considerable prospecting may be necessary before other large bodies are located.

The Broncho Horseshoe, later known as the *Resurrection* G.M. was worked for a few months by the Great Victoria Company, who recovered 420 ounces from 2,244 tons of ore, while 1,183 tons raised at the *Just in Time* (Nevoria) yielded 338 ounces.

At Parker's Range the *Spring Hill* plant treated 400 tons for 309 ounces, and Messrs. Simpson and Party obtanied 39 ounces from 95 tons raised from the *White Horseshoe* mine.

Only 15 tons of about ounce grade ore was raised at the *Scots Greys.* There is in this locality at least one laterite deposit, which, so far as I am aware, has not been thoroughly sampled. In fact it would seem that very little careful sampling had been done in this neighbourhood notwithstanding the general similarity between this formation and that at the Great Victoria. At Westonia there has been a noticeable revival. The *Les Trois* syndicate obtained 82 tons of half-ounce ore, and then sold out to an Adelaide company who sunk a new shaft to 130 feet, and are now opening out above water level. At the *Consolidated* 301 ounces were obtained from 371 tons, and it was also sold. The new-comers are doing development work with a view to raising a considerable regular monthly tonnage.

The output from *Holleaton* is disappointing, as only ore of about two-ounce grade will yield a margin of profit after freight to Coolgardie, nearly 240 miles, has been paid. The *Glenelg Queen* sent out 198 tons, and recorded 411 ounces of gold. The new shaft is now down about 150 feet, and it is expected the lode will be met at an early date. At the mine hoisting is being done over a whip-pole, using a motor lorry in place of a horse. Provided efficient signalling appliances be used to maintain communication with the lorry-driver from everywhere throughout the shaft and from the brace at every stage of the haulage, this motive power would appear to have distinct advantages over animal power where water and feed are expensive. The crushing from the *Empress,* 23 tons for 19 ounces, was disappointing. This shaft is now down to 100 feet deep, and the lode is being driven on.

Some exploratory work was done at *Hollow's Reward,* but without exposing any high grade ore. At the *Great Beacon* a progressive policy resulted in opening several hundred feet of drives and crosscuts and shaft sinking. No. 2 shaft was sunk to 100 feet and No. 3 to about 50 feet. No ore is being broken, as it is not sufficiently high grade to leave a profit after paying freight to Coolgardie. A number of P.As. are working in this locality including Penna and party, and Larson and Craddock, at the Rising Sun and Munro's, Hope's, Orrie's, Stewart's, Davidson's and others nearer to the Main Camp.

In the immediate neighbourhood of Southern Cross a little prospecting is being done, but no finds of importance were reported. The *May Queen,* near Lennenberg's Find, raised 300 tons, which yielded 717 ounces. 2½ ounces of dollied gold is all that is reported from *Hope's Hill.* Some excitement was caused through reports of rich finds at the *Hansfordhaven* mine, about seven miles south-east from Bullfinch. Three parcels of ore, comprising 305 tons, were taken to Coolgardie, but the yield, 167 ounces, was not high enough to make the work profitable. There is still a good deal of prospecting going on in that locality. At Manxman the *Radio* continued producing steadily, and yielded 1,895 ounces, obtained from 766 tons. Work at the 300 feet continues to give satisfactory yields, and it would appear that the mine is likely to give very satisfactory returns for some years to come.

A return of 104 ounces from 103 tons from the *Valley Queen,* at Golden Valley, is directing a little attention to that oldest (after Kimberley) of West Australian goldfields. There are now several parties prospecting the locality. At *Ennuin,* Messrs. Oatway and party raised 43 tons which was crushed at Coolgardie and yielded 65 ounces. The *Great Bingin* was working in the early part of the year, but closed down in April. I understand that Mr. Lynch is making another start at an early date.

Returns from Coolgardie and Dundas are not available at this office. In the neighbourhood of the old Camp a number of prospectors were working, but there was no regular producer. Messrs. Paul and Paul working at about 250 feet deep in the *Golden Bell,* were raising payable quantities of good grade ore. Several parties were at work near the Lord Bobs, but no very satisfactory returns are reported. A little prospecting is being done at Greenmount. Several small mines are working in the vicinity of *Kunanalling,* including the *May Prince,* the *Turn of the Tide,* owned by Mrs. Dwyer, and *Mr. De Gracie's P.A.* 645.

At Carbine, Messrs. Crawfords' *Carbine* mine continues to be a regular producer, while a very limited amount of work was done at *La Fortuna* and Dunne's *Eight-Mile.*

Messrs. Bryant and Mundies are working G.M.L. 5209 at *Widgemooltha,* as was Mr. Emes on the *Mt. Morgan* until he was accidentally killed in December.

At Norseman the largest producer is the *Mararoa,* owned by Messrs. Nicholson and party. Here there are between 20 and 30 men employed, and machine drills are employed for drilling. The Mararoa runs a 10-head mill about 12 hours a day.

Messrs. Mathieson Bros. are working the *Mararoa South* with pay ore, said to yield 11 dwts. per ton, by amalgamation over widths varying between 3 feet and 7 feet for a length of over 200 feet. This show should attract the attention of mining investors on the lookout for a small venture with possibilities.

The *O.K.* mine is another show worth examination; here the lode is narrow, not usually over 2 feet wide, but the grade is high, and the mine is being worked very profitably by its owners.

List of Leases and Production during **1927.**

Name.	Tons.	Ounces.
Great Victoria G.M.	17,651·51	3,433·10
May Queen	300·00	717·41
Colleen Bawn	...	2·55
Scots Greys	15·00	14·26
White Horseshoe	95·00	39·68
Radio	766·50	1,895·74
Radio Deeps	85·00	48·59
Just in Time	1,183·00	338·39
Resurrection	2,244·00	419·96
Nevoria	358·00	88·24
Consolidated	371·00	301·37
Les Trois	82·00	43·97
Glenelg Queen	198·75	411·85
Valley Queen Extended	103·50	104·84
Hansfordhaven	305·60	167·54
Empress	23·00	19·35
Easter Gift	158·00	91·17
Royal Flush	38·00	32·49
Spring Hill	400·00	309·05
Howlett's Battery	...	73·44
Andrews, R. B. (P.A. 11 P.P.) ...	70·00	74·76
Prospecting Areas	876·50	605·03

Report of Mr. J. McVee, Inspector of Mines, Collie.

I beg to submit my Annual Report for the year ending 31st December, 1927.

The following mines were producing coal during the year, viz.:—Proprietary, Co-operative, Westralia, Cardiff, Premier, Griffin, and Stockton. The total output for the year was 501,510.65 tons, valued at £407,971, as against 474,818.69 tons, valued at £394,400, for 1926, showing an increase of 26,691.96 tons and £13,571.

The Proprietary, Co-operative, Westralia, and Cardiff Collieries showed increased outputs, but the Premier, Griffin and Stockton collieries only produced coal for portion of the year, as shown by the accompanying tables. The Premier Colliery whose workings had been cut off by faults, had been prospecting through the fault for some time, and although they struck 6 feet of clean coal, the roof and floor of the seam were so soft that it was an unworkable proposition. Permission was given them to split some of the pillars in the top section, and when this work was stopped the colliery was practically finished. The Amalgamated Collieries bought the plant, and on 19th July operations ceased below ground; all machinery and mining material were brought to the surface and the mine allowed to flood with water. The mine plan was brought up to date, and all entrances to the mine made secure, shafts being filled in and tunnel entrances fenced off. The Griffin Colliery was sending coal by motor lorry to Collie from March to August, when they struck a fault which cut off their workings. It was decided to opencut on the top side of the fault, which would be more suitable for their proposed railway, and recover this coal at a later date. The tunnel has been started, and should be producing coal during the ensuing year.

The Amalgamated Collieries have opened another mine about two miles South-West of the Premier Colliery, which they have named the Stockton Colliery, and in December sent away 201 tons of coal. The seam is 9 feet 10 inches thick, and appears to be the hard type of coal.

The working conditions at the mines have been fairly good, and there have been no prosecutions for any breach of the Coal Mines Regulation Act.

Labour troubles have been few, and the only stoppage of any importance was at the Co-operative Colliery during December, when about ten days were lost owing to a dispute over some working places which the men declared deficient owing to the thinness of the bottom coal in comparison with other parts of the pit. This was settled by arbitration, and the places are now working.

There have been no machinery accidents, but 300 accidents were reported during the year. Unfortunately one man was killed and another lost one eye and had the sight of the other eye impaired; both accidents being caused by explosives. The other accidents, 200 of which were minor accidents, were not of such a serious nature as to prohibit men from resuming their work again.

Since my last report the amended Coal Mines Regulation Act has come into operation, and I expect that conditions below ground will be materially improved in compliance with the Act.

Table showing the amount of Coal produced at each Colliery during the years 1926 and 1927.

Colliery.	Output in Tons. 1926.	Output in Tons. 1927.	Employees. 1926.	Employees. 1927.
Proprietary ...	131,556·40	140,341·76	172	177
Co-operative ...	133,343·50	147,074·00	200	225
Westralia ...	114,187·00	121,176·00	170	190
Cardiff ...	56,193·70	81,682·55	80	107
Premier ...	38,850·47	9,571·75	70	46
Griffin	687·62	1,465·33	6	8
Stockton ...	...	201·1	...	44

Government Railway Orders.

Month.	Large. tons	cwt.	qrs.	Nut Coal. tons	cwt.	qrs.	Small Coal. tons	cwt.	qrs.
January ...	22,235	15	0	347	11	2	18	0	0
February ...	21,766	6	3	755	3	1	27	14	1
March ...	23,130	4	2	727	6	3	18	13	2
April ...	26,209	14	0	762	14	3	18	4	1
May ...	22,837	7	3	610	16	0	27	8	1
June ...	22,442	1	1	746	4	1	27	7	2
July ...	29,443	2	0	958	14	1	17	1	1
August ...	21,660	11	2	702	13	3	36	6	2
September	22,770	1	3	764	4	1	9	3	3
October ...	25,521	14	1	874	7	2	36	1	0
November	20,485	14	3	706	11	2	8	16	0
December	25,618	19	0	800	1	2	8	18	1
	284,121	12	2	8,756	9	1	253	14	2

Total Consumption ... 293,131 tons 16 cwt. 1qr.

Report of Mr. R. C. Wilson, B.Sc., B.E., Assistant State Mining Engineer.

I beg to submit herewith my Annual Report for the year ending 31st December, 1927.

During the year a number of applications for assistance under the Mining Development Act were investigated and reported upon. Reports were made upon mineral deposits and the prospects of occurrences of mineral oil.

From August onwards a large amount of time was spent with Dr. F. Stillwell, examining the auriferous deposits at Kalgoorlie and collecting information relating to the distribution of gold values. Under our direction Mr. V. H. R. Murray, of the Golden Horseshoe Estates, is at present preparing a series of composite assay plans of the Kalgoorlie Field. These plans when completed will show, not only the distribution of gold values, but also the principal geological features, and will serve as a guide for future development work.

Brief details of the more important inspections made during the year are as follows:—

In January a visit was made to the Northampton Mineral Field. A proposal by Mr. Meadowcroft to re-start the Narra Tarra Lead Mine at Protheroe was looked into. Inspections were also made of the Springvale Lead Mine, The Two Boys Lead Mine, Thring's Block 7, and other smaller lead mines in the Galena District.

I inspected and reported upon an occurrence 11 miles north of Northampton which Mr. Woodcock thought might be an indication of mineral oil. (Appendix No. 2, page 60.)

In February I investigated the reported indications of mineral oil at Cheyne Beach and submitted a report upon the prospects of petroleum being found there. This report was published in Annual Report for 1926 (pages 85 to 91).

In March a reported new gold discovery at Parkerville was inspected. (Appendix No. 2, page 59.)

An application by the Greenbushes Cornwall Development Co. for assistance to carry out development work at the Cornwall Tin Mine was investigated and reported upon (Appendix No. 2, page 59.) The Lost and Found Mine at Greenbushes was also inspected in connection with a similar application by the owners of this mine.

In April an application by Mr. Ewan Macdonnell, of Bullfinch, for assistance to erect a crushing plant was investigated.

In May sites for bores at the Surprise Lead Mine were selected and marked out on the ground. At the same time an inspection was made of the Galena District. (Appendix No. 2, page 61.)

In June the mining centre of Holleaton was visited and reported upon (Appendix No. 2, page 61.) The Les Trois (Appendiz No. 2, page 65) and the Royal Flush were also inspected.

In July the mica deposits at Kirup and Balingup were inspected and reported upon, as was also a beryl occurrence at Kirup (Appendix No. 2, page 64.) The Cornwall and Lost and Found Tin Mines at Greenbushes were also inspected. During the same month the lead deposits at Mundijong were visited and reported upon.

An application for assistance to carry out development work at the Resurrection G.M. was looked into and reported upon. (Appendix No. 2, page 64.)

In August an application for assistance to carry out development work at the Enterprise G.M. at Kalgoorlie was inquired into and reported upon.

During this month and also during September and October my time was devoted almost entirely to the procuring of information relating to the ore deposits of Kalgoorlie.

In September the La Fortuna Mine was inspected in connection with an application for a treatment plant. (Appendix No. 2, page 65.)

Towards the end of October Bullfinch and Hansfordhaven were again inspected (Appendix No. 2, page 66.) The Great Beacon G.M. was also inspected and reported upon in connection with an application for assistance.

In November Hill's North End Mine was inspected and a report submitted.

The Whim Well Copper Mine was visited and reported upon during the same month in connection with a proposal to assist the company with a very considerable sum of money to instal a leaching plant. (Appendix No. 2, page 67.)

In December I again visited Kalgoorlie and conferred with Dr. Stillwell regarding the preparation of plans. I also looked into the position at the Golden Horseshoe Estates, Ltd.

The State Mining Engineer began his fortnight's leave immediately after Christmas, and I took over his duties during his absence from the office.

ACCIDENTS.

The following table gives the number of fatal accidents reported to this office as having occurred on mines, whether to persons employed on the mines or not, for the last five years:—

—	1923.	1924.	1925.	1926.	1927.
Total fatal accidents on mines reported	11	12	13	8	17
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	1	2	1	1	1
Fatal accidents to men engaged in mining	10	10	12	7	16
Total men engaged in mining (average)	6,497	6,289	6,011	5,437	5,036
Accident death rate per 1,000 men engaged in mining	1·54	1·59	2·00	1·29	3·18
Total fatal accidents on Quarries reported	...	...	...	...	...
Total men engaged in quarrying	326	337	307	291	598
Accident death rate per 1,000 men engaged in quarrying ...	...	...	...	...	...

The mining accidents for the year 1927 are classified in Tables 23, 24, 25, and 26, the previous year's figures being given 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 Division I., Report of the Under Secretary for Mines, 1927.)

In Table 23 the accidents are classified according to causes. In 1927, 16 persons were killed and 371 seriously injured, as compared with 7 persons killed and 376 seriously injured during the previous year. The diagram shows graphically the totals of fatal accidents year by year since 1900. (See Division I., Report of the Under Secretary for Mines, 1927.)

The death rate per 1,000 persons employed on surface and underground in gold, coal, and other mines is shown in Table 24, the general average rate for 1927 being 3.18, as against 1.29 for 1926. The rates per 1,000 are based upon the figures in Table 18 (Annual Report, Under Secretary for Mines, 1927), which shows a grand total for 1927 of 5,036 men employed at mines above and underground, inclusive of alluvial workers.

Table 25 gives the average number of men employed at quarries and the death rate per 1,000 persons employed thereon. The total number of men employed during 1927 was 598, as against 291 for 1926, the death rate for 1927 being nil, as against nil for 1926.

Table 26 summarises all the fatal accidents for 1927 above and below ground in gold mines only, with rates per 1,000 men and per 1,000 tons of ore raised, similar figures for 1926 being given for comparison. The number of men on which these rates are based is taken from Table 20 (Annual Report, Under Secretary for Mines, 1927), and does not include alluvial workers.

The following table comprises all the fatal and serious accidents reported to this office which occurred during 1927, the accidents being classified according to the gold or mineral field in which they happened, and also as to causes; the totals from each cause for 1927 are shown for comparison:—

—	Explosives.		Falls of Ground.		In Shafts.		Miscellaneous Underground.		Surface.		Machinery.		Total.	
	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.	Fatal.	Serious.
1.—East Coolgardie	2	2	1	5	4	7	...	127	...	54	...	4	7	199
2.—Mt. Margaret ...	...	1	1	1	...	...	*1	19	1	15	...	4	3	40
3.—Murchison ...	...	...	3	2	...	...	...	15	...	...	...	...	3	17
4.—East Murchison	...	...	...	...	...	...	...	3	...	2	...	...	...	5
5.—Coolgardie ...	...	...	...	1	1	...	...	...	...	...	...	...	1	1
6.—Yilgarn ...	...	...	1	...	...	2	...	1	...	1	...	...	1	4
7.—N. Coolgardie ...	...	1	...	...	...	...	...	...	...	2	...	...	...	3
8.—N.E. Coolgardie	...	...	...	...	...	...	...	1	...	...	...	...	...	1
9.—Broad Arrow ...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
10.—Dundas ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11.—Pilbara ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12.—Peak Hill ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13.—Yalgoo ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14.—Phillips River...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15.—Collie	1	1	...	9	...	...	...	75	...	14	...	...	1	99
16.—Greenbushes ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17.—Northampton ...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
18.—West Pilbara ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19.—Swan	...	...	...	1	...	...	...	...	...	...	...	...	...	1
20.—Ashburton ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
21.—Roelands ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22.—Kendenup ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23.—State generally	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals for 1927 ...	3	5	6	19	5	9	*1	242	1	88	1	8	17	371
Totals for 1926 ...	...	6	5	41	1	7	...	220	*1	94	1	8	8	376

*Not a "true mining" accident.

FATAL ACCIDENTS.

Brief particulars of each fatal accident reported to this Department for the year 1927 are as follows:—

Explosives.

At the Proprietary Colliery, Collie Coalfield, two men were engaged in road-laying, and each had prepared a shot, but only one went off. One of the men returned to ignite the fuse, which he thought he had been unsuccessful in lighting, when it exploded in his face. Apparently the jute covering had been smouldering without their having noticed it. An inquest was held, and the jury returned a verdict that deceased came to his death as the result of an explosion, no blame being attachable to anyone. (1078/27.)

A very unfortunate accident occurred at the Lake View and Star Mine, East Coolgardie Goldfield, while two men were preparing very light shots for the purpose of cutting hitches for timbering. They were tamping a hole with a wooden rod when an explosion occurred. One man was killed instantaneously and his mate was so badly injured that he died three weeks later. A coroner's inquiry was held, and the jury brought in a verdict of death from injuries received from an accidental explosion. (996/27.)

Falls of Ground.

While two men were working in a stope at the Ingliston Consols Extended G.M., Murchison Goldfield, a large piece of ground weighing about 9 tons fell, killing one man and injuring his mate who had just finished boring with a machine drill. The ground had been examined just prior to the accident, and it appeared safe. A verdict of accidental death with no blame to anyone was returned by the coroner's jury. (163/27.)

Three men were timbering in a drive at the Ingliston Consols Extended G.M. when a piece of rock about 1½ cwt. came away from the roof of the drive, and struck one of the men who was working almost directly under it. At the inquest evidence was given by the other men that they both examined the ground before commencing, and were satisfied it was safe. The coroner's jury returned a verdict that the deceased was killed by a fall of rock, and added a rider that they considered more care should have been taken by the men to test the ground before commencing work. Full inquiry was made by the Inspector of Mines, who reported that the ground would probably fall without giving any warning, and in his opinion it was purely accidental. (174/27.)

A third fatal accident occurred at the Ingliston Consols Extended G.M. through a heavy fall of ground. The men on the previous shift had just fired out the face. After waiting for the smoke to clear, the men going on shift barred down some loose ground and sounded the back. They had just started filling the trucks with broken ore when about ten tons of stone fell, killing one man instantaneously. The firing probably caused the rock to loosen, but owing to the thickness of the rock it would be difficult to detect any looseness by sounding. A verdict of accidental death with no blame attributable to anyone was brought in by the coroner's jury. (1465/27.)

At the Sons of Gwalia G.M., Mt. Margaret Goldfield, a man was fatally injured through a piece of rock falling from the back of the stope and striking him on the back of the head. The machine miner had barred down all loose ground and sounded the back, and was satisfied that it was safe for the shovellers to work in the stope. The coroner's jury brought in a verdict of accidental death, with no blame to any person. (148/27.)

A man was bady injured at the "Broncho" Lease (Great Victoria G.M. Co.), in the Yilgarn Goldfield, through a fall of ground, and he succumbed to his injuries a fortnight later. This accident appears to have been due to a quite unexpected fall, which could not have been foreseen, all reasonable precautions being taken to ensure safety. At the inquest the jury returned a verdict of accidental death, with no blame attributable to any person. (1760/27.)

A fatal accident occurred at the Boulder Perseverance Mine, East Coolgardie Goldfield, when a man who was working in a stope at the 700ft. level was killed by a fall of stone weighing about 1½ tons. From the evidence it is doubtful if the block of ore which caused the accident came down the rill or broke away from the back of the stope. A verdict of accidental death was returned by the Coroner's jury, who added the following rider: "We are of the opinion that where a stope cannot be inspected men should not be permitted to work under it unless it is timbered close to the rill and loaded." The cause of this accident was very carefully investigated by the Inspector of Mines, who is of the opinion that the block of ore came from off the rill and rolled down on to the deceased. (1249/27.)

In Shafts.

An unusual accident occurred at the Mount Morgan Mine, Widgiemooltha, Coolgardie Goldfield. A miner who was working alone, testing an old mine, was missing from his camp, and was afterwards found at the bottom of the shaft, which is 110 feet deep. He was working in the south end of an open-cut about 14 feet from the surface. There appeared to have been a recent fall of earth, and when he was pulling the ladder up to the surface the ground had evidently given way under his feet and carried him down to the bottom of the shaft. At the inquest the jury returned a verdict that deceased met his death by accidentally slipping down a shaft. (1815/27.)

At the Lake View and Star Mine, East Coolgardie Goldfield, a man was repairing skids in a shaft and was leaning over into the adjoining compartment using a hammer and chisel, when some heavy object fell on the back of his head and broke his neck. His mate saved him from falling into the shaft. Nothing could be found in the shaft afterwards, and it could not be ascertained what it was that fell, or how it came to fall. The only other man working in the mine at the time of the accident was the platman, who stated that he could not possibly have knocked anything into the shaft. A verdict of accidental death with no blame to anyone was brought in by the jury. (1709/27.)

A fatal accident occurred at the Great Boulder Proprietary Mine while a man was engaged in retimbering a shaft. He was climbing from the north compartment over the centres to the middle compartment when he slipped and fell down the shaft between the centre and the stage board. The Coroner's jury gave a verdict of death from injuries received by accidentally falling down Edward's shaft, with no blame to any person. (130/27.)

A man was badly injured through being caught between the cage and edge of plat at the 1,000ft. level of the Ivanhoe Mine, East Coolgardie Goldfield, and he died ten days later. Apparently deceased was stepping up on to the plat when the sudden raising of the cage threw him out on to the plat. His legs hung down the shaft and before he could be pulled out he was crushed by the cage, which was swaying. A verdict of accidental death with no blame to anyone was returned by the Coroner's jury. (280/27.)

At the Great Hope Mine, Mt. Monger, East Coolgardie Goldfield, a man was killed through falling down the shaft from the 200ft. to the 300ft. level. Four men were proceeding to their work by the ladders, and deceased was getting off at the 200ft. level with the other men, when he slipped and fell down the shaft. The jury returned a verdict of accidental death, and added a rider that "for future safety a guard railing should be placed at both plats." (1626/27.)

Surface.

At the Sons of Gwalia Mine, Mount Margaret Goldfield, a man was instructed to start an electric motor. The motor shed had become charged with electric current (550 v.), and when he attempted to enter the building he was killed instantaneously. It had been raining heavily, and it is thought that the leakage occurred over the wet porcelain insulators on the supporting post bolted to the building. The coroner's jury brought in a verdict of accidental death, with no blame to any person. (1277/27.)

Surface (Machinery).

A fatal accident occurred at the Associated Northern Blocks (Victorious Leases), Broad Arrow Goldfield. Deceased had assisted to tighten a belt, and was told to stand back while the belt was put on. He probably stood too close, and the corner of his cardigan jacket (which was unbuttoned) caught round the revolving shafting, and his right arm became entangled. His head and body must have come into contact with the beam over the shafting. This accident shows the danger of wearing loose clothing when working near machinery. A verdict of accidental death, with no blame to anyone was returned by the jury. (1243/27.)

Other Accidents.

The following fatal accident was reported, but not classified as a "true mining accident."

At the Sons of Gwalia Mine, Mt. Margaret Goldfield, a man fell into an open-cut which is 200 feet deep. The open-cut was well protected by a wire netting fence. The coroner's jury returned a verdict of death through falling down an open-cut while temporarily deranged. (580/27.)

SERIOUS ACCIDENTS.

All accidents which inflict injuries of such a nature as to incapacitate a person from carrying out his usual work in or about a mine for 14 days or more are classified as "serious."

Of the 371 accidents during 1927, 199 occurred in the East Coolgardie Goldfield, but only 36 were breakages of the larger bones, permanent injury to limbs, or injuries likely to have lasting disabling effects. The balance were injuries of a less serious nature, such as bruises, cuts, strains, burns, smaller dislocations, wrenches, jars, 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.

Five accidents were reported under the above classification during 1927.

In one case a man was tapping a detonator to clean out the sawdust when it exploded. In another case a man had cleaned out a number of old detonators with a splinter of wood when one exploded in his hand. One man received painful injuries to his face, and lost the sight of one eye; after lighting a short hole he put on his coat, and must have stepped back into the bord when the explosion occurred. Serious injuries were received by a man through a piece of dynamite falling into a hole that had been fired, and causing an explosion before he had reached safety. Another man received injuries to his right eye through an explosion which occurred when his mate was tamping a hole.

Falls of Ground.

Nineteen accidents were due to falling ground. In four 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 15 cases the injuries were due to ground falling or through being struck by falling pieces of stone or coal in the workings of the mines.

In Shafts.

Nine accidents were reported during 1927 as having occurred in shafts. One man fainted while ascending a ladder, while another ricked his knee when turning. The cage moved away just as a man was entering it; he was thrown on to the plat sheet and received a broken shoulder blade. In two instances men were timbering a shaft; one had his finger crushed and the other received a poisoned finger. One man was seriously injured by material falling down the shaft. In two other cases men received hand injuries while working in a shaft, and another man received a broken ankle, caused by a man falling on to him when the cage was stopped suddenly.

Miscellaneous Underground.

Two hundred and forty-two accidents were classified under above heading during 1927. In 71 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 being 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 37 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; 19 men were injured handling rock drills, coal-cutting machines, and parts of same. Other falls in the workings from stages, ladders, in rills, passes, and so on caused injury to 28 persons, and 8 were hurt by falling tools and pieces of machinery. Flying splinters of stone and steel were responsible for 23 men being injured, and 10 were hurt while handling timber. The remaining 35 cases were due to various accidental causes, jarring of hands and feet, blows from tools, strains, poisoned cuts, and so on.

Surface (including Machinery).

Ninety-six persons were seriously injured while working on the surface; one man was burnt with hot ashes; 17 sustained injuries from falls in the course of their work; 16 were hurt by trucks and skips being jammed or struck by them, by their capsizing, or by men sustaining strains while working them. Flying splinters and stones injured 5 men, handling firewood and pieces of machinery accounted for 22 cases of injury; 16 cases were caused by machinery in motion, three of these being caused by handling belts in motion; 5 men were hurt by being struck by tools they were using falling or slipping. Other causes of 14 accidents were jarred and jammed hands and feet, poisoned cuts, bruises, strains, etc.

WINDING MACHINERY ACCIDENTS.

(Without serious injury to persons.)

During the year 1927, 14 accidents were reported as occurring to winding machinery; brief particulars are as follows:—

Over-winding.

At the Ingliston Consols Extended G.M., Murchison Goldfield, an engine-driver turned the steam on slightly to warm up the cylinders when the engine moved, with the result that the safety hook went into the ring and the rivet was sheared. (869/27.)

An overwind at the South Kalgurli Consolidated G.M., East Coolgardie Goldfield, was caused by a sack falling from the ventilator on to the engine-driver's head, just as the skip of ore was at the brace. The grippers acted, and hung the skip upside down. A piece was broken out of the pit-head wheel, and one of the sky-skids splintered. The Inspector of Mines ordered that in future the ventilator should not be interfered with. (1482/27.)

At the Ivanhoe G.M., East Coolgardie Goldfield, the number on indicator and the depth of level not agreeing caused the engine-driver momentary confusion and the descending cage hit the bearer, with the result that the bearer was broken and the bottom of cage was bent, also about 30 feet of rope damaged. Notices have been posted instructing employees to call the levels as numbered instead of by their depths. (1507/27.)

Skip Derailments.

Six derailments occurred at the Sons of Gwalia Mine, Mount Margaret Goldfield, during 1927, as follows:—

In one case the cause was unknown, but the rail may have spread at a point and allowed the wheel to drop; the rails were loosened. (497/27.)

In another case the derailment of an empty skip was thought to be due to a piece of rock falling from a previous skip. Several centres were knocked out. (1583/27.)

Two centres were knocked out and 200 feet of rope were coiled up when an empty skip left the rails through some unknown cause. (1683/27.)

The cause of a loaded skip leaving the rails was probably due to a stone falling from the skip; several sill pieces were damaged and five end legs were displaced. (1822/27.)

An empty skip was derailed, and as a result some shaft centres were knocked out. The cause was unknown. (1822/27.)

In another case an empty skip left the rails, and about 20 centres were displaced. A close examination of the skip and track did not disclose any defects, the cause of the derailment being unknown. (1823/27.)

There are usually several cases of derailment of empty skips in the Sons of Gwalia shaft each year, without any assignable reason, and we are always told that such do not happen with skips carrying men, as they are run much more slowly. The obvious inter-ence appears to be that the empty skips are allowed to be rushed through the shaft at speeds which are too close to the margin of safety, resulting in a certain number of them jumping from the rails. Very fortunately, none of these mishaps have caused any very serious damage, but what guarantee can there be that this will always be so? Men go up and down the shaft constantly on the footway, and I certainly should not like to be in the position of one of them who might meet a descending skip which had jumped the track and was banging its way down, knocking out timbers and sending them flying all over the shaft. Even when no men are on the skip itself there is, therefore, some risk that men may be injured by such a skip derailment. If it should happen some time that men are in a skip which becomes derailed there will be a very grave risk that serious and even fatal injuries may be sustained.

For years the Mines Inspection Branch has been urging on the mine to take steps to prevent these derailments, and the reply has all along been that the haulage system is in accordance with the best approved practice, and that it is not practically possible to do anything more to make the work safer; or, if anything can be done, the financial position of the mine does not permit of such being undertaken. The most is made of the fact that it is usually with empty skips that these accidents have occurred. In nearly every case, however, where skips have been derailed, the reports suggest as a probable cause that a piece of ore or rock may have been lying on the track, and one case is on record in which the derailment was plainly due to a long steel drill having been allowed to escape down the shaft and lie on the rails in such a way as to derail the next skip which came along. In cases where derailment is due to any such cause it is evident that the speed of travel of the skip matters little, and that it is a pure matter of chance whether the first skip which comes along and is derailed is one carrying ore only or men. If such obstructions were a principal cause of derailments, these would be just as likely to happen to the skips carrying men as to any others, and the freedom from accidents to men-carrying skips, therefore, gives support to the other explanation that the ore-skips are often allowed to travel too fast.

It might be thought to be a simple matter for the Department to declare that the present practice is dangerous and must not be allowed, but we are at once asked why we are attacking a style of transport which is in almost universal use, and is recognised as good standard practice. If we were to forbid the practice, and prosecute the company for carrying it on thereafter, I am very far from certain that we could succeed in demonstrating to a court that we were reasonable in doing so. The cost of altering the truck-way so as to permit of the Lake Superior method of carrying the skip wheels on the side of the body instead of underneath it would now be very serious in the Sons of Gwalia shaft, so much so as to be out of the question in existing circumstances.

Miscellaneous.

At the South Kalgurli Consolidated G.M. a skip was caught in the shaft through the breaking of the lock shoe. The safety catches acted, but then released the skip, which fell to the bottom of the shaft.

The Inspector of Mines were instructed to give special attention to this shaft and equipment. (1753/27.)

At the same mine an empty skip came out of the skids and jammed. This skip is used only for lowering ore from the upper levels to a bin at bottom of the shaft. No damage was done to the shaft. (1893/27.)

At the Lake View and Star mine, East Coolgardie Goldfield, a descending skip became hung up in the shaft at 250ft., with about 400 feet of slack rope on the top of it. A momentary check in the speed of the cage caused the grippers to act, which may have been due either to a jerky application of the throttle or an obstruction on the runners. The damaged portion of the rope was cut off. (1481/27.)

Ropes.

While baling water at the Brilliant G.M., Yalgoo Goldfield, a balance weight was being used, and the balance rope broke. No one was working in the shaft, and no damage was done. (1814/27.)

At the Chaffers G.M., East Coolgardie Goldfield, the rope broke just above the shackle. The strain on the rope was too great while hauling wet dirt from the 1,400ft. to 1,500ft. levels after the rope had been in use two previous years to the 300ft. level. Permission was given to cut the ropes at 600 feet from the shackle, but the Inspector of Mines ordered that no men be allowed to travel or work in the shaft until new ropes had been installed. (621/27.)

PROSECUTIONS FOR BREACHES OF THE MINES REGULATION ACTS AND REGULATIONS.

Action was taken against the manager of the Sand Queen-Gladsome mines for employing a person who had not first obtained a certificate from a medical practitioner that he was not infected with tuberculosis, contrary to Regulation 6 (b) of "The Mines Regulation Act, 1906." A fine of £1 with 22s. costs was imposed.

The managers of the Lake View and Star, Great Boulder Proprietary, and Boulder Perseverance Gold mines were also proceeded against for having employed persons who had not first obtained a medical certificate from the Commonwealth Health Laboratory that they were not infected with tuberculosis, contrary to Regulation 6 (d) of "The Mines Regulation Act, 1906." In the first two cases fines of £3 with 3s. costs were imposed, and in that of the Boulder Perseverance, Ltd., £2 with £5 3s. 6d. costs.

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

Seven exemption permits were issued during the year, six being for mines in the East Coolgardie Goldfield and one for a mine in the Dundas Goldfield.

No permits were issued without the Inspector of Mines first satisfying himself that the applicants were capable of handling the particular machinery to which the exemption applied, and that it was not reasonably practicable to insist on the employment of a certificated driver.

SUNDAY LABOUR IN MINES.

In the Collie Coalfield permission was granted to work on Sundays on several occasions, as under:—

Three permits were granted to the Co-operative Colliery for relaying No. 2 right flat; altering flat and installing new winch; and cleaning and repairing main haulage road.

The Westralia Colliery was granted three premits: for the purpose of shifting the fan in No. 3 East; relaying portion of main haulage road; and laying inside flat in No. 3 West Section.

Two permits were granted to the Cardiff Colliery for lengthening No. 6 flat, and renewing bars in main tunnel.

In the East Coolgardie Goldfield, on one occasion, permission was granted to the Great Boulder Proprietary G.M. to haul tributers' ore from 100ft. level bin, to enable tributers' furnace to be kept going.

AMENDMENTS AND ADDITIONS DURING 1927 TO THE REGULATIONS UNDER "THE MINES REGULATION ACT, 1906," "THE COAL MINES REGULATION ACT, 1902-1926," AND "THE MINING DEVELOPMENT ACT, 1902-1924."

The Mines Regulation Act, 1906.

Section VIII.: Regulation 15, Part 2.—Cancellation of *Gazette* notice dated 5th February. 1926, and substitution of new districts for Workmen's Inspectors of Mines. (Gazetted 4th February, 1927.)

Amendment of districts and headquarters assigned to various Inspectors of Mines. (Gazetted 10th June, 1927.)

Additional Regulations 6 (e), 6 (f), 6 (g), and 6 (h).—Inspection and examination of persons likely to be infected with mining diseases as mentioned in Third Schedule of "The Workers' Compensation Act, 1912-1924." (Gazetted 14th October, 1927.)

The Coal Mines Regulation Act, 1902-1926.

Reprint of the Regulations with amendments. (Gazetted 18th March, 1927.)

Amendment of Regulation 9, Clause (c), Subclause (1) under Part 1.—Accident Relief Fund.

The Mining Development Act, 1902-1924.

Addition of Regulations relating to the Central Mining Board and the District Mining Boards. (Gazetted 25th February, 1927.)

Extension of operation of regulations relative to the production of merchantable mica and manufactured mica goods for a term of twelve months from 1st January, 1927. (Gazetted 13th April, 1927.)

Cancellation of regulations published in *Government Gazette* of 25th August, 1911, and substitution of regulations relating to Part I.—Subsidies on the production of merchantable mica and manufactured mica goods; and Part II.—Subsidies on development work for the production of mica. (Gazetted 1st July, 1927.)

Cancellation of Regulations published in *Government Gazette* of 25th February, 1927, and substitution of new regulations relating to Mining Boards. (Gazetted 11th November, 1927.)

ADVANCES ON ORES.

The policy of making advances on ores continued during 1927, but owing to the low price of the base metals very little of these was sent away. Several parcels of asbestos, however, were sent to England to be sold. The transactions are tabulated hereunder:—

ADVANCES ON ORES.

STATEMENT OF TRANSACTIONS FOR YEAR 1927.

Miscellaneous Minerals.

Mineral.	File No.	Tonnage.	Amount Advanced.	Shipping Expenses, etc.	Balance of proceeds remitted to Owners.	Total Amount realised during year.	Remarks.
			£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Asbestos	1288/26	1·25	41 0 0	8 16 10	18 11 11	68 8 10	Previously shown incomplete.
Do.	1288/26	1·05	21 0 0	7 10 3	17 5 1	45 15 4	do. do.
Do.	1782/26	6·56	272 0 0	39 6 1	42 0 10	353 6 11	do. do.
Do.	1898/26	1·66	62 0 0	12 3 0	18 7 11	92 10 11	do. do.
Mica	625/26	1·00	650 0 0	3 16 0	...	125 18 5	Incomplete.
Asbestos	2204/26	4·05	173 10 0	26 4 11	47 1 0	246 15 11	Previously shown incomplete.
Do.	2204/26	4·3	42 5 0	20 10 8	47 0 9	109 16 5	do. do.
Do.	2204/26	·85	13 2 6	6 11 7	20 0 7	39 14 8	do. do.
Do, ...	2204/26	·35	2 15 0	1 19 8	3 12 3	8 6 11	do. do.
Do.	2254/26	2·85	114 10 0	17 18 4	36 5 0	168 13 4	do. do.
Do.	2254/26	2·35	23 0 0	7 13 0	20 14 0	51 7 0	do. do.
Do.	291/27	1·975	78 0 0	13 6 6	31 5 7	122 12 1	do. do.
Do.	291/27	2·4	25 0 0	8 13 8	27 14 6	61 8 2	do. do.
Do.	291/27	1·38	41 0 0	9 6 9	23 1 0	73 7 9	do. do.
Do.	291/27	1·17	10 10 0	4 3 4	14 4 10	28 18 2	do. do.
Do.	235/27	·66	22 0 0	5 12 8	11 18 3	39 10 11	
Do.	235/27	·75	8 0 0	3 13 10	7 12 9	19 6 7	
Do.	235/27	·75	22 0 0	5 18 0	0 6 5	28 4 5	
Do.	235/27	·75	7 0 0	3 9 3	9 10 10	20 0 1	
Do.	534/27	·58	25 10 0	4 19 0	4 5 2	34 14 2	
Do.	534/27	·58	6 0 0	2 13 6	6 6 5	14 19 11	
Do.	534/27	1·35	50 8 0	9 1 1	20 10 10	79 19 11	
Do.	534/27	·58	5 0 0	2 7 7	5 8 9	12 16 4	
Do.	911/27	1·35	51 14 3	10 17 5	33 19 1	96 10 9	
Do.	911/27	1·85	18 10 0	6 12 8	19 5 0	44 7 8	
Do.	948/27	·96	35 0 0	7 1 8	8 14 2	50 15 10	
Do.	948/27	2·00	20 0 0	6 14 11	24 3 1	50 18 0	
Do.	1146/27	1·05	39 8 0	7 2 1	10 16 1	57 6 2	
Do.	1146/27	1·25	12 0 0	4 5 3	14 2 5	30 7 8	
Do.	1240/27	1·02	30 10 0	6 1 7	...	...	Incomplete.
Do.	1240/27	1·6	16 0 0	5 10 8	19 2 0	40 12 8	
Do.	1517/27	1·28	47 4 0	7 7 1	...	...	Incomplete.
Do.	1517/27	2·55	25 0 0	7 15 9	...	63 7 2	do.
Do.	1676/27	1·25	50 0 0	...	...	...	do.
Do.	1676/27	2·6	26 0 0	5 5 7	...	...	do.

LOANS AND SUBSIDIES UNDER "THE MINING DEVELOPMENT ACT, 1902-1924," AND FROM THE MINING DEVELOPMENT VOTE.

The transactions under this heading always involve a large amount of investigation and field work, most of which has been carried out by the Assistant State Mining Engineer and the District Inspectors of Mines. A number of the more interesting investigations have been referred to in the foregoing report of Mr. R. C. Wilson, some of which are put up hereunder as Appendix No. 2 to this report. Tabulated statements of the expenditure on transactions for 1927 in aid of mining development are in Appendix No. 1 hereunder.

The following notes on several of the more important cases in which Government assistance has been granted are submitted to show some of the progress made during the year 1927.

BORING.

(i).—*With Calyx Drill for Coal at Eradu.*

Continuing the report in Annual Report for 1926 on the boring operations with a Calyx drill in the Greenough River Valley near Eradu, the No. 1 Bore had been completed just before the end of 1926.

No. 2 Bore was commenced on 20th January, 1927, at a point 30 chains north of No. 1 and 2 feet lower in surface level. A carbonaceous horizon was passed through between 127 and 156 feet consisting, according to the foreman's description, of:—

	ft. in.		ft. in.		ft. in.
Smutty carbonaceous matter	127 0	to	135 0	=	8 0
Grey shale	135 0	„	138 6	=	3 6
Smutty carbonaceous matter	138 6	„	139 6	=	1 0
Grey shale	139 6	„	144 8	=	5 2
Coarse grit with shale bands...	144 8	„	151 6	=	6 10
Dark shale	151 6	„	153 0	=	1 6
Carbonaceous shale or brown coal	153 0	„	156 0	=	3 0
	127 0	„	156 0	=	29 0

This corresponds fairly well with the carbonaceous horizon in No. 1 Bore from 170 feet to 190 feet 3 inches, and if they are the same there would be an apparent southerly dip from No. 2 to No. 1 Bore of 36½ feet in 30 chains; provided that the dip remains constant and no faults occur between the two bore-sites. The coal in No. 2 Bore is little more than a carbonaceous shale, as shown by the analyses:—

Government Lab. No....	992/27.	993/27.	994/27.
Depth	ft. in. 127 0 to 135 0	ft. in. 138 6 to 139 6	ft. in. 153 0 to 156 0
Proximate Analysis—	per cent.	per cent.	per cent.
Moisture	12·20	8·00	9·40
Volatile matter ...	26·89	24·76	21·48
Fixed carbon ...	21·22	22·89	28·52
Ash	39·69	44·35	40·60
	100·00	100·00	100·00
Calorific value, B.T.U. ...	Not determined.	Not determined.	5,699

The material contains far too much ash to be of practical use unless in the pulverised form, when it might possibly be found of service as a fuel in burning Portland cement, in which operation the coal-ash serves as part of the cement-making material. The ash, however, has not yet been analysed to see if it would be usable with any locally available clays and limestones in making a cement mixture.

A hand-bore put down to a depth of 225 feet by the Water Supply Department for water at a site 7 chains west of a point 92 chains due south of No. 1 Calyx Bore (1926) met with carbonaceous mud and shale at 152 feet to 170 feet, and black carbonaceous shale from 170 feet to 189 feet 6 inches, a total thickness of 37 feet 6 inches of more or less carbonaceous material. The proximate analysis of the upper portion, 152 feet to 170 feet, Government Laboratory No. 3762/27, is:—

	per cent.
Moisture	3·05
Volatile	23·13
Fixed Carbon	14·52
Ash (white)	59·30
	100·00

It will be noted that the ratio of fixed carbon to volatile hydrocarbons varies very much in the analyses quoted on the different portions of the seams, a fact which may later on prove to have some significance in correlating them.

The centre of the carbonaceous horizon in this hand-bore is at 171 feet from surface, while that in No. 1 Bore is at 180 feet, and in No. 2 at 142 feet. Unfortunately, the relative surface heights of No. 1 Bore and the hand-bore have not yet been measured, and it cannot yet be seen how the seam in the hand-bore corresponds with that in No. 1 and 2 Bores. If the southerly dip from No. 2 to No. 1 should continue unaltered and without disruption by faulting, the coaly matter at 180 feet in No. 1 Bore would be about 110 feet lower down at the hand-bore, which indicates the desirability of having some deeper boring near this point.

As it was considered that No. 2 Bore was passing through the same strata in which no coal had been found in No. 1 down to 832 feet it was discontinued on 23rd March, 1927, at a depth of 350 feet and the drill removed to the east side of the Greenough River to a site about 18 chains N.N.E. of the Eradu Railway Station, and 61 feet lower in surface level than at No. 1 Bore. This site had been picked as No. 4, but was taken third, and called No. 4 Bore. Boring commenced in this No. 4 Bore on 12th May, 1927, and at 137 feet to 141 feet 3 inches a seam of poor coal was cut, 4 feet 3 inches in thickness, below which were 2 feet 9 inches of dark shale to 144 feet, and then a big seam 19 feet 6 inches thick to 163 feet 6 inches. A further very small seam of coal, only 6 inches thick, was cut at 185 feet 6 inches to 186 feet, below which no more was got down to a depth of 601 feet, at which the bore was stopped on 21st September, 1927.

The proximate analysis of the 4 feet 3 inches seam at 137 feet to 141 feet 3 inches, Government Laboratory No. 1858/27, was:—

	per cent.	
Moisture	16·24	Calorific value 5,742 B.T.U.
Volatile matter ...	24·10	
Fixed carbon ...	31·91	
Ash	27·75	
	100·00	

This was a considerable improvement on any previous results, though still too high in ash for general use. The core from the big seam, 19 feet 6 inches thick at 144 feet to 163 feet 6 inches, was sampled in four equal portions of about three feet each, and proximate analysis returned:—

Government Lab. No.	1588/27	1589/27	1590/27	1591/27
	Top.	Second.	Third.	Bottom.
	per cent.	per cent.	per cent.	per cent.
Moisture	32·23	35·78	32·78	27·58
Volatile matter ...	24·11	22·64	22·51	22·38
Fixed carbon ...	35·64	33·81	32·86	28·08
Ash	8·02	7·77	11·85	21·96
	100·00	100·00	100·00	100·00
Calorific Value—B.T.U.	7,028	6,155	6,310	Not determined

The top half of the seam, except for the high percentage of moisture, is a passably useful coal, and if dried and used in pulverised form would be quite good for steam raising and for roasting furnaces, and though of course the removal of the moisture would increase the percentage of ash in the residue, it would also greatly increase the calorific value. The mean analysis of the top half of the seam is:—

	per cent.	
Moisture ...	34·005	Mean calorific value 6,591 B.T.U.
Volatile ...	23·375	
Fixed Carbon ...	34·725	
Ash	7·895	
	100·000	

and if 90 per cent. of the moisture were evaporated off, the percentages would become:—

	per cent.	
Moisture ...	4·90	and the calorific value would rise to 9,498 B.T.U.
Volatile ...	33·68	
Fixed carbon ...	50·04	
Ash	11·38	
	100·00	

As it is preferable to use pulverised coal in a thoroughly dried condition, this last calculated analysis would represent the approximate fuel value of the coal, used in pulverised form, more truly than the original analysis.

From No. 4 site the drill was removed about 33 chains East-North-Easterly to No. 3 site, 25 feet higher than that of No. 4. Boring was commenced on 24th October, 1927, and at the end of the year had reached a depth of 403 feet. The only carbonaceous material met with was a small seam at 109 feet to 110 feet 6 inches, and the foreman reports the strata in this bore to be quite different from those in the previous ones. The failure to find the big seam of No. 4 Bore in No. 3, and the difference in the country bored through makes it likely that there is a fault between these two bores.

(ii).—*With Diamond Drills on the Gold and Mineral Fields.*

For Gold at Coolgardie.—At the end of 1926 the diamond drill which had been boring at the North End of the Kalgoorlie field had been removed to Coolgardie and started boring on Tindal's Mine, where boring was carried on for the whole of 1927. Petrological description of the rocks passed through and assay values are shown in Dr. Larcombe's Report in the Annual Report elsewhere in this volume of the Government Geologist.

No. 1 Bore was from a point 340 feet east of the centre of the old opencut workings on Tindal's reef at 155 feet north from the centre of the old main shaft. It was put down at a depressed angle of 60 degrees on a course bearing due west. Boring commenced 4th January, 1927, and finished 12th March, 1927, at a depth of 628 feet.

No. 2 Bore was started 250 feet due north of No. 1, also boring due west at depressed angle of 60 degrees. Boring commenced 24th March and finished 14th November, 1927, at a depth of 1,052 feet.

No. 3 Bore, started at a point 100 feet north of No. 2 Bore on a due west course at a depressed angle of 45 degrees, on 24th November, 1927 was down 89 feet at the end of the year.

The total boring at Coolgardie during 1927 was 1,769 feet.

Dr. Larcombe's full report should be referred to for details of the occurrence and assay values of the auriferous dykes of pyrrhotitic aplite which constitute the Tindal's lodes. These are an unusual occurrence of an alaskite type, and some of the contained values shown by assay give much hope that mine working could be carried on successfully. Experiments made at the Kalgoorlie School of Mines plant since the end of 1927 on the ore brought up as cores have shown that the treatment is not difficult, if the stone is very finely crushed in tube mills, amalgamated, and cyanided.

For Gold at Sandstone.—Boring at Sandstone was commenced on 13th October, 1926, and at the end of the year the first bore was down to 624 feet. Boring was carried on throughout 1927, three bores being put down to try the Black Range Reef, and three on the Oroya Black Range Reef. The drill was still on the latter reef at the end of the year. All six bores were vertical. The bores are fully described in the report of the Government Petrologist. The reefs were found very nearly where expected from the mine plans, but were very poor. The lodes, however, are very persistent shear zones in the rock, and it is not at all impossible or even very improbable that values might come in again at greater depths. It might be well worth while to try to cut them again at about say the 1,000 feet level.

No.	Boring began:	Boring finished:	Total depth.	
Bores to cut Black Range Reef—				
			624 feet at end of 1926.	
			ft.	ft.
1	13–10–1926	5–2–1927	852	2,400 bored.
2	12–2–1927	16–4–1927	774	
3	23–4–1927	25–6–1927	774	
Bores to cut Oroya-Black Range Reef—				
1	11–7–1927	22–9–1927	700	1,726 bored.
2	29–9–1927	24–11–1927	753	
3	3–12–1927	Unfinished at end of year at	273	
	Total boring at Sandstone to end of 1927			4,126 feet.
	During 1927			3,502 feet.

(iii).—*For Lead at Galena.*

A third diamond drill was obtained after much delay in September, 1927, and set to work to bore on the Surprise Mine at Galena in search of further bodies of lead ore. Mr. Wilson's report herewith (Appendix 2, page 60) explains the reasons for the boring. No. 1 Bore was started on 12th October, 1927, and was down 677 feet at the end of the year, eventually reaching 922 feet on 7th February, 1928. It was at an angle of depression of 55 degrees and laid out on a course bearing N. 86 degrees E. to cut the centre of the main ore-shoot as seen in the mine workings, allowing for its apparent westerly underlay and southerly pitch, at a vertical depth of 700 feet, requiring a length of boring of 855 feet. The country passed through was garnetiferous granite with pegmatitic and siliceous zones, and a very basic rock for 213 feet at 415 to 628 feet.

This bore was not successful in finding any lode corresponding with those in the mine workings, and a subsequent bore, No. 2 to 450 feet, which will come into the report for 1928, was also quite unsuccessful in finding the lode. Probably the underlay of the lode has changed and the pitch of the ore-shoot also, in which case another set of bores should be put down in the opposite direction to Nos. 1 and 2 to reach about the same points in depth and so give a complete cross-section across all the possible positions of the lode. When this has been located in these two cross-sections, further borings north and south would probably be required to ascertain if the ore-shoots have continued downwards.

This boring is also referred to in the report of the Government Geologist.

MINING.

(i).—*Sons of Gwalia Mine, Leonora.*

Negotiations carried on during 1927 between the Sons of Gwalia Company and the Government, after consultation with the Development and Migration Commission and a report by its Technical Committee, resulted eventually in an arrangement being arrived at that the Government would advance up to £38,000 for further machinery equipment, and up to £40,000 for development, spread over three years, total £78,000, restricted in the first year to £12,000 for machinery and £19,000 for development, in the second year to £14,000 for development, and in the third year £7,000 for development, totalling £40,000 for development, the balance of £26,000 for machinery to be made available when and as in the opinion of the Minister the development of the mine justifies further machinery equipment in the second and third year periods. Documents embodying all the terms and conditions of the agreement were in preparation at the end of 1927, and have since been completed and active work started.

(ii).—*Golden Horseshoe Mine, Boulder.*

Negotiations were continued during 1927 to try to find some method of carrying on the mine. A small amount of revenue continued to be obtained from cleaning up the treatment plant, but by October this source of funds was considered to be exhausted. A scheme was submitted for selective mining at the rate of 3,000 tons of ore a month from several of the stopes of grade above the average and for treatment of a dump of old tailing, and towards end of November a further advance of £5,000 was approved to enable 20 stamps of the mill to be put in order for crushing ore and the mill re-arranged for bromo-cyanide treatment of the finely ground ore, this method having been proved to be applicable by tests on a small working scale made at the Boulder Perseverance mill. This improved treatment was regarded by the Government as being of such importance to the whole field as to justify a trial on a full working scale.

At the end of the year compressed air had been obtained from the Ivanhoe mine and the air-service repaired to enable mining work to be gone on with, and arrangements made for the Lake View and Star Company to drive into their "Chaffers" lease through the Golden Horseshoe mine, while portion of the mine best worked from the Great Boulder mine was let to the latter on tribute.

During 1927 sales of 1,873 tons of ore to other companies, together with 373 tons of concentrates, clean-up dirt, and slags realised £14,520 16s. 4d., while all expenses were £20,554 13s. 7d., a loss for the year of £6,033 17s. 3d., most of which was due to the expense of keeping the mine unwatered and maintaining it. The cost of "Bailing water, protecting assets, clean-up, etc.," was £11,568 5s. 4d., other items in the Expenses Account being, Salaries £3,027 3s. 9d., Office expenses, £677 13s 4d., Insurance £1,138 10s., Bank interest on overdraft £2,926 1s., and smaller items making up the total of £20,554 13s. 7d. The net loss for the year was therefore much less than if nothing had been done but keep the mine unwatered.

(iii).—*Gnow's Nest Mine, Yalgoo Goldfield.*

This mine, held by the Brilliant G.M. Co., No Liability, has had a large amount of loan assistance, the total of authorised loans to end of 1927 being £8,000, of which, however, £1,157 11s. 4d. had been repaid. The mine was carried on during 1927 under great difficulties, and at the end of the year was opening the No. 5 level by a crosscut which had not then quite reached the reef. Since the end of the year the prospects of the enterprise have improved considerably.

(iv).—*Lady Shenton Gold Mining Syndicate, Menzies.*

During 1927 a winze was sunk to 110 feet to cut the reef carrying gold values discovered by diamond drill boring in the previous year. The bore core from 70 to 74 feet gave an assay value of 13 dwts. 19 grs. of gold per ton.

The winze at—	oz.	dwt.	grs.	
60ft. to 65ft. gave...	2	5	19	per ton
80ft. (north end)	2	10	0	„
(south end, over a width of 3ft.)	0	6	8	„
81ft. (north end, over 1½ft.) ...	0	2	0	„
(south end, over 2ft.) ...	0	7	8	„
85ft. (north end)	0	11	14	„
(south end, over a width of 2ft.)	2	16	0	„
89ft. (north end)	0	12	10	„
(south end, over a width of 2ft.)	0	2	19	„
90ft., centre of winze	0	12	5	„
92ft. (north end)	1	18	0	„
(south end)	1	1	6	„
106ft., over 6in. wide	0	3	6	„
110ft., over 8in. wide	3	8	0	„

A crushing of 25 tons of stone from the winze returned gold at the rate of 8 dwt. per ton with 4 dwts. per ton in the residues.

These results are sufficient to indicate that the reef is very well worth a mining trial, and Mr. Inspector of Mines Gourley recommends that the winze be sunk to 122 feet, and a level be then driven on it, to be connected ultimately with either a new level from the Alpha shaft or one of the Lady Shenton levels.

There is a good deal of reason to believe that the gold-bearing reef found may be a continuation of the Lady Shenton ore-shoot which was known to be cut off by a fault, and if this theory be substantiated by further work there is very good hope that the shoot may now be followed downwards in the Alpha lease, previous work in which was all too high up to get it. This would be an important discovery.

At the end of the year work had to be suspended, as all the syndicate's available capital was expended. The prospects of the mine certainly seem to warrant further opening up of the lode.

(v).—*Riverina Proprietary G.M.L. 998U.*

Early in 1922 the Riverina South mine was closed down owing to monetary difficulties arising from the winding-up of the estate of a deceased director who had made large advances to the company then owning it, although the prospects of the mine well warranted going on with the enterprise. About July, 1926, Mr. A. Forbes, late of the Lloyd George mine, interested himself in forming a company to re-open the mine, and after much preliminary negotiation, he was able to do so during 1927, and was granted loan assistance up to £600 on the basis of £1 for £1 for equipment and working costs necessary to enable the mine to be unwatered for sampling purposes, and in July this was increased by a further £300 to maintain the mine in an unwatered condition. A sampling was made by Messrs. Allsop and Don, which showed an average value of 56s. 3d. per ton for 59 samples over 500 feet in length of No. 3 level and stope, confirming the previous company's assay plan, which showed an average of 56s. for the same section. Mr. Blatchford's report in 1921, just before the old company closed down the mine, also gave an average value of 54s. to 56s. per ton recoverable, allowing for 3s. in the residues.

A loan of £4,000 was then made available to the company at the rate of two-thirds of approved expenditure on obtaining and installing mining and treatment equipment, and they were allowed to obtain on hire and purchase terms a quantity of machinery in the hands of the Mines Department without immediate payment. The remainder of 1927 was occupied in procuring and installing the plant, which was not completed at the end of the year.

(vi).—*Sand Queen-Gladsome Mines, No Liability.*

Towards the end of 1926 arrangements were made by Mr. F. A. Moss, a former owner of the Sand Queen mine, for the formation of a company to purchase these mines and start re-opening them. Operations at the mine were started energetically, and by the middle of the year the bottom level of the Sand Queen had been unwatered and the winze below it cemented to shut off the influx of water which formerly had flooded the mine. Much trouble, however, continued to be encountered from bursts of sand and water from the old stopes and early in November the company reported that they had spent over £21,000 on the mine without yet being able to resume crushing during 1927. In December a loan of £2,500 was authorised to assist the company.

(vii).—*Wiluna Gold Mines, Limited.*

This very important enterprise made good progress during 1927, and is described, as seen by me in April and May, 1927, in Appendix No. 3 attached hereto. Development of the mine was continued actively during the whole of 1927, as also were treatment experiments on a working scale both by flotation concentration followed by roasting of the concentrates, and by roasting the whole of the crushed ore without concentration, as is the usual Kalgoorlie practice.

At the end of September the Hon. the Premier announced the decision of the Government to introduce a Bill for the construction of a railway to Wiluna on such a route as might be recommended by the Railway Advisory Board. The Board later on recommended that the railway should be from Meekatharra to Wiluna. The Bill was passed by Parliament before the 1927 session closed.

Very useful work has been done at the Kalgoorlie School of Mines' Research Laboratory on the treatment of Wiluna ores, the results of which are set out in the report of the School of Mines.

(viii).—*Pilbara Copper Fields, Ltd.—Whim Well Mine.*

Following on successful experiments made at the Kalgoorlie School of Mines in 1926 on leaching of oxidised copper ores from this mine with ferrous sulphate and salt solutions, application was made in February, 1927, on behalf of the company for a large loan to assist the company in restarting copper mining on a large scale, the company intimating that it could raise £20,000 if the Government would also contribute £20,000. It was arranged that Mr. Wilson, Assistant State Mining Engineer, should visit the mine and report upon the position, and he did so at end of November, 1927. His report is appended hereto as Appendix 2, Page 67.

(ix).—*Waterloo G.M.—Holden's Find.*

In November, 1926, Mr. Garland, the owner of this mine, returned to it from Melbourne, where he had been recuperating his health and forming a company to purchase it. He resumed erection of the concentrating machinery and obtained a pump with which to unwater the mine. A further loan of £550 was granted in May to obtain and instal an engine and the pump, which were erected and ready to work at end of August. Unwatering of the mine was then put in hand, but not completed till November, and up to the end of the year there had been no crushings.

(x).—*Freney-Kimberley Oil Company, Limited.*

The loan assistance given by the State to this company's oil-boring operations has been as yet limited to loan of boring plant. The operations, however, being of national interest, may well be referred to briefly in this report. During 1927 a deep bore was put down to 1,683 feet, which was reached on 15th November, when operations had to be suspended during the wet season until 17th April, 1928, when the staff returned to Poole Range to resume boring.

(xi).—*Horseshoe Range Manganese Deposit.*

During 1927 the railway from Meekatharra to the Horseshoe Range, a length of 82 miles, was completed, and opening up the deposit for a large output has been commenced. The West Australian Manganese Company, Limited, has been negotiating, it is understood with much success, for sales of its produce, and it is hoped that arrangement will soon be made for facilities for loading the ore on to ships at Geraldton.

I have, etc.,

A. MONTGOMERY, M.A., F.G.S.,
State Mining Engineer.

APPENDIX No. 1.

Summary of Expenditure from Mines Development Vote from 1st January to 31st, December 1927.

Advances in aid of Mining Work and Equipment.

	Plant. £ s. d.	Cash. £ s. d.	Total. £ s. d.
Bennit, Jasson & Bennit	...	289 0 0	289 0 0
Big Bell	...	1,635 5 6	1,635 5 6
Braeside Option... ...	...	505 13 1	505 13 1
Breen, J.	...	100 0 0	100 0 0
Brilliant, G.M.	...	3,500 0 0	3,500 0 0
Caddy & Party ...	...	161 2 9	161 2 9
Crutchett & Party ...	...	19 2 8	19 2 8
Crudace & McFarland ...	...	95 12 6	95 12 6
Cox & Horne	...	117 10 0	117 10 0
Cullen & Domenic ...	...	57 13 3	57 13 3
Elias, John	...	160 17 6	160 17 6
Ellis, S.	...	800 0 0	800 0 0
Farrar & Party ...	79 17 6	14 5 10	94 3 4
Forbes, Alfred	233 3 0	1,610 11 3	1,843 14 3
France, H.	...	183 6 6	183 6 6
Garland, J. P.	...	1,138 14 10	1,138 14 10
Gibbs, W.	80 0 0	...	80 0 0
Great Victoria	83 10 9	301 11 5	385 2 2
Greenbushes Cornwall ...	...	923 2 11	923 2 11
Grist & Hallman ...	...	78 7 3	78 7 3
Kerr, J. C.	...	140 0 0	140 0 0
Krug, C. H.	206 10 0	30 0 10	236 10 10
Jay, C. G.	...	21 10 0	21 10 0
Lady Shenton	...	540 9 3	540 9 3
Lynch, M.	...	121 11 8	121 11 8
Mararoa	...	47 1 10	47 1 10
Moss, F. A.	4,299 17 8	...	4,299 17 8
McMurray & Woodward	...	79 0 0	79 0 0
North White Feather ...	...	444 0 0	444 0 0
Newton, W. & R. ...	...	60 0 0	60 0 0
Polson Bros.	...	28 5 0	28 5 0
Raven	...	450 0 0	450 0 0
Scotson & Martin ...	145 15 10	...	145 15 10
Simmons, R.	...	40 0 0	40 0 0
Tamblyn & Stevens ...	...	12 12 0	12 12 0
Tarcoola Blocks ...	...	150 0 0	150 0 0
Tasker, Wm.	36 0 0	...	36 0 0
Whitting, W. A. ...	...	27 11 3	27 11 3
Harpur & Party ...	...	200 0 0	200 0 0
Job, U. E.	...	42 12 11	42 12 11
	£5,164 14 9	14,226 12 0	19,391 6 9

Boring.

	£ s. d.
Eradu	2,078 10 5
Sandstone	4,325 19 5
Kalgoorlie	200 10 10
Coolgardie	2,038 19 0
Galena	133 9 0
	£8,777 8 8
Providing transport and equipment to prospectors	5,088 16 0

Water Supplies.

	£ s. d.
Reduced price of water—Southern Cross ...	42,394 3 0
Reduced price of water—Ora Banda	9 18 0
Reduced price of water—Ingliston Consols ...	1,576 14 10
Glenelg Hills	1,732 2 4
South Kurnalpi	277 5 1
	£45,990 3 3
Rebates to Prospectors crushing at War Rates ...	750 2 0
Subsidy Development Work	78 16 1

Subsidies to Batteries.

	tons	£ s. d.
McHugh & Corboy ...	1,002·5	97 3 0
Rose, Grant W. ...	505	75 15 0
Nevill, A. M. ...	87	10 17 6
Lang, S. C.	47	5 17 6
Patterson	254	25 14 0
Two Boys	155·5	15 3 0
	2,051·0	£230 10 0

Miscellaneous Expenditure.

	£ s. d.
Sampling Mines	499 1 8
Maintenance of Securities	657 7 1
LeMesurier, C. J.	23 16 10
Cartage Subsidy, Bennit	14 5 0

Miscellaneous Expenditure—contd.

	£ s. d.
Subsidy on freight, Coongan to Fremantle ...	99 8 0
Recoup to P.W.D.—Half rent Boring Plant loaned to Freney Oil Co.	215 0 0
Subsidies carting long distances	5,035 1 4
	£6,543 19 11
Total (according to net Treasury figures for the year)	£81,686 7 11

Refund of Advances.

	£ s. d.
Bastian, Riddle & Bastian	315 4 10
Brilliant G.M. Co.	75 3 11
Bennit & Party	18 4 9
Barker	0 1 0
Crutchett & Party	5 17 1
Cairns & Heydon	191 4 6
Caddy & Party	0 15 0
Doherty & Nicolls	7 0 10
Farrar & Party	40 6 11
Forbes, Alfred	15 0 0
Greenbushes Cornwall	20 8 0
Griffin Syndicate	587 15 7
Grist & Hallman	15 4 2
Hansen & Schachtschabel	13 4 9
Hough, Clark & Pearsall	192 8 7
Job, T. E.	251 8 5
Jay, C.	12 12 0
Krug, C. H.	34 4 0
Kerr, J. C.	4 19 8
Lynch, M.	0 2 6
Mararoa G. M. Co.	233 1 4
Munarra	13 6 8
Nevill, A. M.	9 3 7
Newton, W. & R.	3 18 0
Patterson, W. A.	40 18 4
Prior, R. G.	247 17 6
Raven	10 4 0
Sawyer	11 17 7
Thorley & Fox	16 19 5
Trewhella & Baker	3 14 7
Venture G. M. Co.	33 11 9
Wright, C. R.	152 0 0
	£2,577 19 3

Proceeds Sale of Securities.

	£ s. d.
Arden, A. M.	80 0 0
Bullfinch	4,886 4 9
Bulletin	5 0 0
Big Stone	39 19 0
Big Bell	0 1 1
Daisy Queen	36 1 11
Dreadnought	71 18 6
Edna May Battler	8 0 0
Fraser's Central	5 19 2
Gladsome-Sand Queen	2,349 18 10
Golden Hope	54 5 7
Hunt Bros.	10 0 0
Hard Up	25 0 0
Lalla Rookh	18 11 0
Lloyd George	62 0 0
Lake View Reward	25 0 0
Menzies Consolidated	2,407 5 2
Mindoolah	5 0 0
Mopoke	145 15 10
Mt. Rankin	11 14 10
Mt. Zion	23 0 0
Murrin Queen...	10 0 0
Myrtle Central	363 7 6
Oates & Party	100 0 0
Pearl	5 0 0
Pinder, A.	36 0 0
Red Guard	20 0 0
Resurrection	83 10 9
	£10,888 13 11
Miscellaneous Refunds	15 5 8
Prospecting	194 18 6

The Mining Development Act, 1902—Advances written off to 31st December, 1927 :—

	£ s. d.
Previously reported	43,461 0 4
Year 1927	929 8 10
	£44,390 9 2

MINING DEVELOPMENT EXPENDITURE.

Advances Outstanding, 31st December, 1927.

Name of Lease, Mine, or Borrower.	Name of Lease.	No. of Lease.	District.	Amount authorised.	Principal Moneys advanced: Previously to 1927.	Principal Moneys advanced: During 1927.	Principal Moneys: Repaid, including Sale of Securities, etc.	Principal Moneys: Balance outstanding.	Interest: Paid.	Interest: Outstanding.	Total Principal and Interest outstanding at 31st December 1927.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Aiana Lead Mines	Three Sisters	153	Northampton	1,500 0 0	1,380 5 10	...	...	1,380 5 10	138 2 9	77 13 6	1,457 19 4
Barker, W. E.	Gossan Hill	M.L. 294	Marble Bar	250 0 0	91 0 0	...	0 1 0	90 19 0	...	7 10 5	98 9 5
Bastian, Riddle & Bastian	South Fingall	G.M. 56D	Day Dawn	1,750 0 0	1,750 0 0	...	405 16 7	1,344 3 5	232 10 1	46 19 10	1,391 3 3
Bennit, Jason & Bennit	Transville	G.M.L. 8Y	Bulong	360 0 0	200 0 0	64 0 0	18 4 9	245 15 3	10 13 7	8 5 5	254 0 8
Bennit, Jason & Bennit, No. 2 Account	Sweet Nell	G.M.L. 1191Y, 1198Y	do.	225 0 0	...	225 0 0	...	225 0 0	...	3 4 8	228 4 8
Big Bell	...	2057/9	do.	1,635 5 6	...	1,635 5 6	0 1 1	1,635 4 5	...	...	1,635 4 5
Bordoni, J.	...	P.A. 531S	Coolgardie	525 0 0	460 19 2	...	...	460 19 2	...	18 9 7	479 8 9
Braeside Option Syndicate	Ragged Hill	M.L. 288	Pilbarra	1,176 10 0	...	505 13 1	...	505 13 1	4 6 11	16 4 1	521 17 2
Braeside Option Syndicate, No. 2 Account	do.	...	do.	500 0 0	176 10 0	...	...	176 10 0	9 0 4	5 15 7	182 5 7
Breen, J.	Yank Lennon	M.L. 171	do.	100 0 0	...	100 0 0	...	100 0 0	...	4 16 2	104 16 2
Brilliant G.M. Co., No. 1 Account	Gnow's Nest	G.M.L. 880, 897	Yalgoo	2,000 0 0	2,000 0 0	...	1,157 11 4	842 8 8	253 19 3	28 0 5	870 9 1
Brilliant G.M. Co., No. 2 do.	do.	G.M.L. 880, 897	do.	1,000 0 0	1,000 0 0	...	...	1,000 0 0	130 0 0	32 15 4	1,032 15 4
Brilliant G.M. Co., No. 3 do.	do.	G.M.L. 880, 897	do.	1,000 0 0	1,000 0 0	...	...	1,000 0 0	127 18 4	32 15 4	1,032 15 4
Brilliant G.M. Co., No. 4 do.	do.	G.M.L. 880, 897	do.	2,500 0 0	...	2,500 0 0	...	2,500 0 0	36 10 2	81 18 4	2,581 18 4
Brilliant G.M. Co., No. 5 do.	do.	G.M.L. 880, 897	do.	1,000 0 0	...	1,000 0 0	...	1,000 0 0	...	29 18 3	1,029 18 3
Bullfinch Proprietary (0919), Ltd.	...	1517Z, 1576Z	Yundaga	3,000 0 0	3,000 0 0	...	1,886 17 1	1,113 2 11	...	62 16 9	1,175 19 8
Brown & Party	Southern Cross Leases	1076Y, 1067Y	Bulong	1,000 0 0	1,000 0 0	...	770 15 3	229 4 9	78 9 6	155 11 10	384 16 7
Bertram & Party	...	1518	Mindoolah	300 0 0	198 17 0	...	15 0 0	183 17 0	...	8 1 1	191 18 1
Burt & Others	Globe	912N	Nannine	500 0 0	444 12 9	...	171 1 6	273 11 3	77 17 10	15 8 1	288 19 4
Byass, T. R.	Bulleton	795	Marble Bar	600 0 0	456 1 0	...	31 18 10	424 2 2	50 5 2	96 19 10	521 2 0
Bickerton, G.	Bickerton	378	Phillips River	150 0 0	148 12 6	...	...	148 12 6	...	14 18 2	163 10 8
Bryant & Party, No. 1	Ard Patrick	197	do.	1,331 16 4	1,331 16 4	...	...	1,331 16 4	...	105 11 11	1,437 8 3
Bryant & Party, No. 2	do.	197	do.	270 0 0	268 8 8	...	...	268 8 8	...	32 4 9	300 13 5
Baudinette, C. C.	...	P.A. 2040E	Kalgoorlie	100 0 0	100 0 0	...	...	100 0 0	0 3 0	2 16 4	102 16 4
Caddy & Party	Munarra	1502N	...	500 0 0	100 0 0	161 2 9	14 1 8	247 1 1	0 13 4	13 4 2	260 5 3
Christie, J. M.	...	D.D.A., W1	Waverley	100 0 0	100 0 0	...	...	100 0 0	10 0 0	22 10 4	122 10 4
Coombes & Ring	Lake Violet Deeps	589J	Wiluna	60 0 0	60 0 0	...	...	60 0 0	...	8 19 5	68 19 5
Copper Separation, No. 1	...	Mach. Lease No. 11	Phillips River	4,000 0 0	4,000 0 0	...	...	4,000 0 0	...	888 15 4	4,888 15 4
Copper Separation, No. 2	...	Mach. Lease, No. 11	do.	400 0 0	400 0 0	...	...	400 0 0	...	59 19 5	459 19 5
Copper Separation, No. 3	...	Mach. Lease, No. 11	do.	1,000 0 0	1,000 0 0	...	...	1,000 0 0	...	148 3 3	1.148 3 3
Crutchett & Party	Rose Doreen	G.M.L. 5210	Coolgardie	175 0 0	50 0 0	19 2 8	5 17 1	63 5 7	0 11 11	3 12 0	66 17 7
Crudace & McFarland	...	P.A. 1531W	...	240 0 0	...	95 12 6	...	95 12 6	...	3 3 0	98 15 6
Cox & Horne	...	P.A. 1179T	Mt. Margaret	175 0 0	...	117 10 0	...	117 10 0	...	0 10 0	118 0 0
Cullen & Domenic	...	P.A. 1333W	Broad Arrow	150 0 0	...	57 13 3	...	57 13 3	...	0 3 11	57 17 2
Cassey, Charles	Pearl	1095M	Mt. Magnet	76 0 0	76 0 0	...	5 0 0	71 0 0	...	24 18 2	95 18 2
Clarkson & Son	...	P.A. 186	Ravensthorpe	150 0 0	119 7 6	...	...	119 7 6	...	16 19 8	136 7 2
Clegg & Gatley	Lady Carmen	4555, 4556	Coolgardie	500 0 0	500 0 0	...	95 0 0	405 0 0	12 19 1	46 12 2	451 12 2
Cook, Harse & Wakefield	Dreadnought	4561, 5190	do.	750 0 0	720 14 2	...	148 6 9	572 7 5	24 0 5	20 18 8	593 6 1
Daisy Queen G.M. Co.	"The Queen"	1212, 1221	Lawlers	4,000 0 0	4,000 0 0	...	1,008 11 0	2,991 9 0	...	245 16 4	3,237 5 4
Dalzelle, John	...	P.A. 1527	Yilgarn	100 0 0	100 0 0	...	...	100 0 0	4 0 0	10 3 6	110 3 6
DeGracie, John	Sydney Mint	895S	Kunanalling	200 0 0	170 11 2	...	10 0 0	160 11 2	4 12 3	16 13 5	177 4 7
Doherty & Nicholls	Shamrock	219L	Nullagine	100 0 0	70 10 0	...	17 9 5	53 0 7	7 19 2	1 17 11	54 18 6
Duffy, J. G.	...	P.A. 1018M	Lennonville	100 0 0	89 0 0	...	...	89 0 0	0 12 2	11 9 5	100 9 5
Dwyer, John	Baneygo North	2113T	Laverton	200 15 0	200 15 0	...	...	200 15 0	14 5 3	69 14 10	270 9 10
Daniels & Party	Surprise	342	Ravensthorpe	600 0 0	327 4 1	...	11 9 0	315 15 1	1 5 1	28 5 0	344 0 1
Deerness, J. A.	Dawn of Hope	1504C	Leonora	100 0 0	100 0 0	...	...	100 0 0	0 3 11	...	100 0 0
East Collie Coal Mining Briquetting Co.	...	294/299, 300/303	Collie	1,000 0 0	790 5 2	...	...	790 5 2	98 15 6	222 11 7	1,012 16 9
Edna May Battler	...	3170	Yilgarn	3,000 0 0	2,539 12 9	...	21 6 8	2,518 6 1	62 8 11	310 5 5	2,828 11 6
Elias, John	...	P.A. 41	Greenbushes	200 0 0	...	138 7 6	...	138 7 6	...	4 6 5	142 13 11
Elias, John	...	M.L. 631	do.	40 0 0	...	22 10 0	...	22 10 0	...	0 0 11	22 10 11
Elliott & Richards	Lake View Extended	4536E	Kalgoorlie	1,050 0 0	892 15 5	...	803 0 0	89 15 5	...	54 11 1	144 6 6
Ellis, S.	Viking, No.1	G.M.L. 990	Dundas	1,600 0 0	...	800 0 0	...	800 0 0	...	1 11 4	801 11 4
Emily G.M. Syndicate	...	1510	Cue	400 0 0	372 1 9	...	...	372 1 9	...	44 7 10	416 9 7
Egan & Sadlier	...	P.A. 1959E	Kalgoorlie	100 0 0	100 0 0	...	...	100 0 0	...	1 7 5	101 7 5
Farrar & Party	...	P.A. 131	Galena	100 0 0	21 4 2	94 3 4	40 6 11	75 0 7	3 19 7	2 9 2	77 9 9
Forbes, Alfred	"Riverina"	998/9U	North Coolgardie	600 0 0	...	600 0 0	...	600 0 0	...	19 10 2	619 10 2
Forbes, Alfred, No. 2	do.	998/9U	do.	233 3 0	...	233 3 0	15 0 0	218 3 0	...	...	218 3 0
Forbes, Alfred, No. 3	...	998/9U	do.	300 0 0	...	159 13 1	...	159 13 1	...	2 10 10	162 3 11
Forbes, Alfred, No. 4	...	998/9U	do.	4,000 0 0	...	850 18 2	...	850 18 2	...	3 18 10	854 17 0
France, Harold	...	...	...	200 0 0	...	183 6 6	...	183 6 6	...	5 19 11	189 6 5
Gallagher, H. J.	Mary Springs	M.L. 145	Northampton	50 0 0	25 0 0	...	...	25 0 0	9 17 1	3 18 2	28 18 2
Gibbs, Wallace	...	P.A. 2169E	...	81 2 7	...	80 0 0	...	80 0 0	...	4 18 10	84 18 10

Golden Hope G.M. Co., N.L.	...	63, 86	Hampton Plains	2,000 0 0	2,000 0 0	...	604 5 7	1,395 14 5	310 11 5	87 12 3	1,483 6 8
Greenbushes Cornwall T.M. Co.	Cornwall	M.L. 627	Greenbushes	2,000 0 0	733 17 4	923 2 11	...	1,657 0 3	45 2 10	52 14 9	1,709 15 0
Greenbushes Cornwall T.M. Co., No. 2	do.	M.L. 627	do.	60 0 0	60 0 0	...	37 1 4	22 18 8	...	0 7 3	23 5 11
Griffiths, John...	Griffiths Gold Mine	G.M.L. 4567	Coolgardie	1,000 0 0	1,000 0 0	...	...	1,000 0 0	10 2 4	283 16 3	1,283 16 3
Grist & Hallman	Carnation	M.L. 878	Yalgoo	300 0 0	150 0 0	78 7 3	15 4 2	213 3 1	5 15 10	5 8 0	218 11 1
Goss, Darling & Party	Wheal May	Loc. 6	Northampton	302 4 6	302 4 6	...	50 0 0	252 4 6	5 15 9	14 9 8	266 14 2
Grant, C.	Mt. Iron	198	Kundip	200 0 0	194 0 0	...	...	194 0 0	...	35 3 7	229 3 7
Green & Party	Victory	P.A. 1382	Marvel Loch	26 13 4	26 13 4	...	...	26 13 4	...	...	26 13 4
Grant & Edwards	Flag Tributers	136/8	Phillips River	450 0 0	450 0 0	...	0 13 1	449 6 11	15 8 0	38 13 1	488 0 0
Grant & Edwards, No. 2	do.	136/8	do.	150 0 0	148 16 10	...	16 12 3	132 4 7	1 2 9	4 7 6	136 12 1
Greenhills G.M. Co.	Greenhills	383F	Linden	350 0 0	286 0 8	...	5 10 0	280 10 8	15 3 10	18 1 9	298 12 5
Greenhills G.M. Co.	do.	383F	do.	225 0 0	171 10 0	...	...	171 10 0	...	4 3 5	175 13 5
Greenhill, F. C.	Venture	5160	Coolgardie	100 0 0	59 4 2	...	33 11 9	25 12 5	0 3 1	3 13 10	29 6 3
Goddard & Dawe	...	P.A. 1100Z	Menzies	200 0 0	194 8 11	...	1 10 3	192 18 8	...	4 2 6	197 1 2
Graham & Crain	Hard Up	5370E	Kalgoorlie	210 0 0	179 18 10	...	26 7 3	153 11 7	2 14 6	17 6 9	170 18 4
Hansen & Schachtschabel	Viking	851	Pilbarra	175 0 0	148 10 0	...	19 4 9	129 5 3	2 5 3	8 8 7	137 13 10
Henderson & Balmer	Unexpected	G.M.L 5480/1Z	Mt. Ida	644 15 0	644 15 0	...	15 4 0	629 11 0	193 0 8	44 3 2	673 14 2
Hill, W. C. J.	...	4632E	Kalgoorlie	150 0 0	149 5 0	...	...	149 5 0	...	57 0 8	206 5 8
Holzman & Korsunski	Mt. Zion	1113M, 1183M, 1189W	Mt. Magnet	2,000 0 0	1,959 13 1	...	481 3 0	1,478 10 1	82 2 7	172 5 5	1,650 15 6
Holzman & Kornsunski	...	1113, 1183, 1189W	...	500 0 0	500 0 0	...	...	500 0 0	9 15 9	45 18 8	545 18 8
Hough, Clark & Pearsal	Hill Co.	1215M	Mt. Magnet	660 0 0	660 0 0	...	80 13 7	579 6 5	3 19 10	8 14 0	588 0 5
Hough, Clark & Pearsal, No. 2	do.	1215M	do.	150 0 0	150 0 0	...	93 15 0	56 5 0	5 11 0	2 13 9	58 18 9
Hough, Clark & Pearsal, No. 3	do.	1215M	do.	28 15 0	28 15 0	...	18 0 0	10 15 0	1 2 6	0 7 3	11 2 3
Hamblin, W. J.	"Alicia"	254F...	Mt. Morgans	245 0 0	195 0 0	...	...	195 0 0	4 2 6	54 14 8	249 14 8
Hodges & Party, No. 1	Great Southern	2909	Yilgarn	630 0 0	630 0 0	...	100 0 0	530 0 0	9 18 5	181 15 10	711 15 10
Hodges & Party, No. 3	do.	2909	do.	500 0 0	500 0 0	...	...	500 0 0	...	58 19 0	558 19 0
Hodges & Party, No. 4	do.	2909	do.	800 0 0	761 3 4	...	...	761 3 4	...	51 11 0	812 14 4
Harbour View Gold and Copper Co.	Harbour View	M.L. 52–94	Kundit	2,886 11 0	2,886 11 0	...	74 16 7	2,811 14 5	8 18 11	620 18 3	3,432 12 8
Hamilton & Congdon	Tributers Flag Mine...	136/7/8	Phillips River	150 0 0	150 0 0	...	...	150 0 0	...	13 3 8	163 3 8
Humerston, O A.	...	P.A. 184	Ravensthorpe	100 0 0	100 0 0	...	...	100 0 0	...	...	100 0 0
Hobby & Party	United...	514B	Youanmi...	125 0 0	117 15 10	...	11 0 0	106 15 10	...	...	106 15 10
Humphries & Reid	...	E.D. Area	Bulong	100 0 0	100 0 0	...	...	100 0 0	4 4 0	9 16 1	109 16 1
Hancey & Richardson	Golden Lizard	1067R	Edjudina	366 7 4	366 7 4	...	...	366 7 4	45 18 6	35 17 8	402 5 0
Heydon & Laws	Amaythas	2040	Cue	150 0 0	56 5 0	...	...	56 5 0	0 17 2	5 9 9	61 14 9
Ives Reward Gold Mine	Lake View Reward	4720/1/2, 453/415 W.R.	St. Ives	5,675 0 0	5,630 11 5	...	127 14 9	5,502 16 8	152 6 10	1,263 19 5	6,766 16 1
Ives Reward Gold Mine, No. 2	do.	4720/1/2, 453/4/5 W.R.	do.	1,000 0 0	1,000 0 0	...	...	1,000 0 0	...	201 15 1	1,201 15 1
Ives Reward Gold Mine, No. 3	do.	4720/1/2, 453/4/5 W.R.	do	918 12 7	918 12 7	...	461 14 3	456 18 4	...	59 4 7	516 2 11
Imlah, Derrick	Garden Gully	5147/8	Coolgardie	300 0 0	112 10 0	...	...	112 10 0	...	16 12 2	129 2 2
Jay, C. G.	...	P.A. 922B	Sandstone	65 0 0	...	21 10 0	12 12 0	8 18 0	...	...	8 18 0
Jenkin Syndicate	Lady Sampson	M.L. 27PP	Northern Gully	700 0 0	617 7 0	...	1 9 3	615 17 9	8 10 9	55 7 5	671 5 2
Jewell & Bartholomew	...	P.A. 1024M	Mt. Magnet	187 10 0	164 0 0	...	...	164 0 0	...	18 1 6	182 1 6
Johnston, D. T.	...	P.A. 198	Ravensthorpe	150 0 0	150 0 0	...	0 17 3	149 2 9	17 14 2	4 12 8	153 15 5
Kerr, J. C.	"Lost and Found"...	M.L. 628	Greenbushes	200 0 0	...	140 0 0	4 19 8	135 0 4	0 0 4	4 0 0	139 0 4
Klondyke Boulder G.M. Co.	"Klondyke" "Boulder"	604	Pilbarra	1,000 0 0	999 10 7	...	187 5 6	812 5 1	34 5 4	150 12 7	962 17 8
Kuhlmann & Buckie...	(Tributors) "Ironclad"	Reserve 196H	Ravensthorpe	300 0 0	263 8 0	...	...	263 8 0	18 8 0	2 17 3	266 5 3
		Reserve 196H	do.	403 17 3	403 17 3	...	6 1 0	397 16 3	...	...	397 16 3
Kays, Alfred	...	438H	...	100 0 0	100 0 0	...	...	100 0 0	...	...	100 0 0
Lady Shenton G.M. Syndicate, Menzies, N.L.	...	5423Z, 5485Z	Menzies	1,000 0 0	959 10 9	40 9 3	...	1,000 0 0	8 16 4	152 12 10	1,152 12 10
Lady Shenton G.M. Syndicate, Menzies, N.L. No. 2	...	5423Z, 5485Z	do.	90 0 0	90 0 0	...	22 10 0	67 10 0	...	8 7 4	75 17 4
Lady Shenton G.M. Syndicate, Menzies, N.L. No. 3	...	5423Z, 5485Z	do.	250 0 0	...	250 0 0	...	250 0 0	...	8 2 0	258 2 0
Lady Shenton G.M. Syndicate, Menzies, N.L. No. 4	...	5423Z, 5485Z	do.	250 0 0	...	250 0 0	...	250 0 0	...	2 14 4	252 14 4
Laver, J.	"Pioneer"	P.A. 2152E...	Kalgoorlie	282 12 10	282 12 10	...	...	282 12 10	...	27 12 1	310 4 11
Lynch, M.	Great Bingen...	G.M.L. 3311	Yilgarn	400 0 0	210 14 8	121 11 8	0 2 6	332 3 10	2 1 9	16 8 10	348 12 8
Lewis & Party	Champion, South	817N, 1039N	Nannine	400 0 0	400 0 0	...	358 0 0	42 0 0	29 11 8	19 19 8	61 19 8
Lloyd George G.M. Co., N.L.	...	4580, 4726/7	Coolgardie	1,750 0 0	1,750 0 0	...	865 18 9	884 1 3	346 7 10	98 0 3	982 1 6
Lloyd George G.M. Co., N.L., No. 2	...	4580, 4726/7	do.	2,000 0 0	1,624 19 11	...	...	1,624 19 11	8 3 1	147 0 6	1,772 0 5
Lynas, W. J.	Chrysotile	274/5	Pilbarra	250 0 0	250 0 0	...	50 3 4	199 16 8	7 16 5	60 10 2	260 6 10
Laver, E. B.	British Flag	5310, 5316, 5324	Kalgoorlie	750 0 0	750 0 0	...	282 12 10	467 7 2	3 13 1	138 11 11	605 19 1
Lillis & Davey	Great Empress of Coolgardie	5197	Coolgardie	140 0 0	140 0 0	...	...	140 0 0	1 10 7	6 0 2	146 0 2
Lonsdale & Howard	...	1822E	Kalgoorlie	100 0 0	100 0 0	...	0 19 10	99 0 2	0 9 11	6 3 10	105 4 0
Maher, P.	Lake View	G.M.L. 5410Z	Comet Vale	100 0 0	100 0 0	...	...	100 0 0	...	30 4 2	130 4 2
Mararoa G.M. Co., N.L.	...	1977, 1981, 2030, 2033, 2038, 2044/5	Cue	900 0 0	900 0 0	...	430 19 9	469 0 3	110 4 4	16 19 4	485 19 7
Mararoa G.M. Co., N.L., No. 3	...	...	Wiluna (Boring)	1,000 0 0	710 2 10	...	...	710 2 10	112 0 5	23 5 4	733 8 2

MINING DEVELOPMENT EXPENDITURE—*Advances Outstanding 31st December, 1927*—continued.

Name of Lease, Borrower, or Mine.	Name of Lease.	No. of Lease.	District.	Amount authorised.	Principal Moneys advanced: Previously to 1927.	Principal Moneys advanced: During 1927.	Principal Moneys: Repaid, including Sale of Securities, etc.	Principal Moneys: Balance outstanding.	Interest: Paid.	Interest: Outstanding.	Total Principal and Interest outstanding at 31st December, 1927.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Mararoa G.M. Co., N.L., No. 4	...	1977, 1981, 2030, 2033, 2038, 2044/5	Cue	1,000 0 0	369 17 1	47 1 10	...	416 18 11	23 13 8	13 13 3	430 12 2
Matthews & Party	"Manganese Knob"	321H	...	250 0 0	...	100 0 0	...	100 0 0	...	5 19 10	105 19 10
Menzies Consolidated G.M., Ltd.	...	4931Z, 4934/5/6Z, 5074/5Z, 5260/1Z, 5315Z; Garden Area 25 and 35Z, Tailing Area 55Z	Yundaga	5,000 0 0	3,357 1 10	...	2,518 9 4	838 12 6	167 0 11	314 1 6	1,152 14 0
Menzies Consolidated G.M., Ltd., No. 2	...	do.	do.	4,000 0 0	2,839 5 0	...	...	2,839 5 0	...	101 4 8	2,940 9 8
Mohr, John	...	P.A. 1522E	Kalgoorlie	150 0 0	143 5 7	...	...	143 5 7	0 7 6	55 19 11	199 5 6
Moss, F. A.	Gladsome-Sand Queen	G.M.L. 5217Z, 5476Z	Comet Vale	4,299 17 8	...	4,299 17 8	2,349 18 10	1,949 18 10	...	95 16 10	2,045 15 8
McEwan & Richards	Wheal Ina	P.P. 23	Galena	200 0 0	112 3 6	...	52 13 9	59 9 9	2 17 0	10 14 1	70 3 10
McMurray & Woodward	...	P.A. 2205	Coolgardie	100 0 0	21 0 0	79 0 0	...	100 0 0	0 1 4	5 9 4	105 9 4
McRankin G.M. Co., N.L.	Dawn	3135/6	Yilgarn	1,000 0 0	911 19 9	...	171 2 6	740 17 3	...	47 8 4	788 5 7
Munn & Hodgson	Melba	1053R	Yerilla	575 0 0	496 18 10	...	90 0 0	406 18 10	...	43 2 9	450 1 7
Mott & Matthews	Lower Nicol	P.A. 164	Roebourne	750 0 0	483 6 6	...	98 15 11	384 10 7	1 1 10	45 10 7	430 1 2
Mt. Magnet Prospecting Development Syndicate	Patagonia	1190M	Mt. Magnet	250 0 0	122 5 6	...	6 15 6	115 10 0	7 11 0	3 12 9	119 2 9
Mooney & Osborn	Fire Light and Undaunted	3217/22	Yilgarn	464 11 0	391 10 3	...	0 5 0	391 5 3	3 2 0	64 1 0	455 6 3
Mayman, G.	Central	5251E	Kalgoorlie	1,000 0 0	1,000 0 0	...	210 6 2	789 13 10	132 15 9	31 18 2	821 12 0
Murrin Propty. G.M. Co., N.L.	...	372F	Mt. Morgans	550 0 0	550 0 0	...	231 1 0	318 19 0	...	54 8 6	373 7 6
Murrin Propty. G.M. Co., N.L., No. 2	...	...	do.	413 3 6	413 3 6	...	85 1 6	328 2 0	...	36 11 6	364 13 6
McCarthy, John	Pyx	789B	Sandstone	600 0 0	571 4 8	...	87 10 7	483 14 1	12 14 5	24 15 0	508 9 1
McAuley, J.	Diggers Luck	P.A. 1243W	Canegrass	175 0 0	174 0 8	...	76 6 8	97 14 0	1 8 10	...	97 14 0
McLelland, Rowe & Hehir	...	P.A. 2162	Coolgardie	60 0 0	60 0 0	...	...	60 0 0	...	1 5 0	61 5 0
McKiernan, J.	...	P.A. 1149C	Leonora	40 0 0	40 0 0	...	...	40 0 0	...	1 12 7	41 12 7
North White Feather G.M. Co.	Golden Cement	12X, 13X, 1438X, 1443X	Kanowna	2,500 0 0	1,908 13 3	444 0 0	6 8 9	2,346 4 6	228 12 11	73 14 4	2,419 18 10
Newton, W. and R.	...	P.A. 1601	Murchison	120 0 0	...	60 0 0	3 18 0	56 2 0	...	0 12 8	56 14 8
North, Hartley & Borwick	Norma	1640N	Nannine	220 0 0	220 0 0	...	44 14 7	175 5 5	15 7 3	22 4 10	197 10 3
O'Connor & Hayes	Surprise	M.L. 148, 150, 150, 158, 20PP	Northampton	25,000 0 0	20,000 0 0	...	...	20,000 0 0	5,812 13 2	217 5 3	20,217 5 3
O'Dea, E. C.	Britannia	953M	Mt. Magnet	150 0 0	114 12 6	...	43 10 0	71 2 6	...	9 4 6	80 7 0
Oates & Party	...	P.A. 1022Z	Menzies	90 0 0	90 0 0	...	104 19 6	Cr. 14 19 6	...	...	Cr. 14 19 6
Owen & Brown	Good Luck	M.L. 184	West Pilbarra	100 0 0	60 19 0	...	24 15 3	36 3 9	9 10 5	2 3 5	38 7 2
Orr & Richards	Joke	3249	Yilgarn	50 0 0	50 0 0	...	...	50 0 0	...	1 1 4	51 1 4
Polsen Bros., No 1	"Scots Greys"	G.M.L. 2801	do.	200 0 0	200 0 0	...	...	200 0 0	20 12 0	86 17 3	286 17 3
Polsen Bros., No. 2	do.	do.	do.	200 0 0	200 0 0	...	...	200 0 0	...	112 7 3	312 7 3
Polsen Bros., No. 3	do.	do.	do.	120 10 0	101 15 0	18 15 0	0 10 0	120 0 0	...	23 1 8	143 1 8
Polsen Bros., No. 4	do.	do.	do.	50 0 0	40 10 0	9 10 0	...	50 0 0	...	6 17 3	56 17 3
Pilgrims Rest G.M. Co., Ltd.	"Bellandona"	165 M.A.	West Pilbarra	1,500 0 0	503 12 6	...	503 12 6	...	...	102 18 6	102 18 6
Prosser, C. R.	New Victory	5159	St. Ives	300 0 0	150 10 0	...	...	150 10 0	...	6 13 10	157 3 10
Prosser, C. R., No. 2	do.	do.	do.	115 0 0	93 15 5	...	...	93 15 5	...	3 9 9	97 5 2
Purdy & Purdy	Main Lode, South	5208	Coolgardie	150 0 0	150 0 0	...	4 16 10	145 3 2	0 17 11	7 4 8	152 7 10
Perry, Binge & Harrop	Eclipse	1047X	Giendalbie	498 19 1	498 19 1	...	267 5 0	231 14 1	62 8 11	...	231 14 1
Phillips & Barrymore	South Cornwall	M.L. 567	Greenbushes	1,170 2 0	1,170 2 0	...	154 0 0	1,016 2 0	...	...	1,016 2 0
Pinder, A.	...	2102T	Duketon	100 0 0	100 0 0	...	38 2 0	61 18 0	...	28 9 0	90 7 0
Peterzen, C. G.	...	P.A. 1109C	Malcolm	20 0 0	20 0 0	...	10 4 6	9 15 6	2 9 7	0 18 2	10 13 8
Pearce, J. A.	...	P.A. 1315	Yilgarn	60 0 0	60 0 0	...	...	60 0 0	0 13 0	9 15 4	69 15 4
Ray & Halls	Elsie Marma	P.A. 1986E	Kalgoorlie	150 0 0	101 0 0	...	4 12 11	96 7 1	0 15 9	12 12 9	108 19 10
Reeve, A.	North Harbour View	M.L. 370	Phillips River	100 0 0	100 0 0	...	...	100 0 0	6 8 1	40 1 4	140 1 4
Reynolds & Scott	"Gem"	184	do.	500 0 0	500 0 0	...	52 9 5	447 10 7	84 14 8	126 14 0	574 4 7
Robinson & Home	...	...	Galena	60 0 0	60 0 0	...	...	60 0 0	...	4 16 8	64 16 8
Raven, H. C.	King and Queen of Creation	2141T, 2145T	Mt. Margaret	450 0 0	...	450 0 0	10 4 0	439 16 0	...	7 17 3	447 13 3
Rollo & Gregor	Stanley	1271X	Kanowna	150 0 0	112 0 0	...	...	112 0 0	2 6 0	39 14 8	151 14 8
Rainbow G.M. Co., N.L.	...	5091	Coolgardie	230 0 0	182 10 0	...	1 8 4	181 1 8	6 1 7	38 13 0	219 14 8
Rich & Wigglesworth (Sub Leases)	...	863/4B, 942/3B	Black Range	2,500 0 0	500 0 0	...	...	500 0 0	...	7 6 0	507 6 0
Sawyer, C. E.	"Warrior"	548LZ	Menzies	200 0 0	200 0 0	...	74 19 7	125 0 5	22 16 2	7 7 0	132 7 5
Scotson & Martin	"Mopoke"	P.A. 1320W	Broad Arrow	145 15 10	...	145 15 10	...	145 15 10	2 0 2	4 4 1	149 19 11
Simmons, R.	Oakover	M.L. 297	...	125 0 0	...	40 0 0	...	40 0 0	...	1 18 5	41 18 5
Sonnenschein, F.	Havilah	345B	East Murchison	600 0 0	553 2 1	...	465 10 10	87 11 3	181 14 2	11 0 4	98 11 7
Sonnenschein, F., No. 2	do.	345B, 203B	do.	500 0 0	495 19 6	...	...	495 19 6	85 6 4	78 3 8	574 3 2
Swan, Moxam & Carey	Vanadium Syndicate	M.L. 291	Pilbarra	100 0 0	30 0 0	...	...	30 0 0	...	2 2 3	32 2 3

Sons of Gwalia	...	...	...	1,736 1 3	1,736 1 3	...	...	1,736 1 3	...	165 4 8	1,901 5 11
Spear, R. C.	Kingdom Come	M.L. 112	Northampton	204 14 0	204 14 0	...	110 0 0	94 14 0	5 8 0	15 11 0	110 5 0
Snelgrove & Mendis	...	P.A. 1880	Widgiemooltha	100 0 0	100 0 0	...	...	100 0 0	...	0 10 4	100 10 4
Sheridan & Party	Bull Oak	1179Y	Bulong	60 0 0	27 2 6	...	...	27 2 6	...	2 1 7	29 4 1
Stevens & Party	Tributers Red, White and Blue	...	Curran's Find	1,285 0 0	1,253 12 7	...	465 0 0	788 12 7	22 0 3	90 17 7	879 10 2
Stevens & Party, No. 2	do. do.	...	do.	1,047 13 0	1,047 13 0	...	...	1,047 13 0	17 3 10	119 3 9	1,166 16 9
Stevens & Party, No. 3	do. do.	...	do.	200 0 0	200 0 0	...	49 6 8	150 13 4	26 0 0	...	150 13 4
Sparks, C.	Bayley's Reward	5127	Coolgardie	100 0 0	99 9 10	...	...	99 9 10	1 18 10	6 8 0	105 17 10
Stahl, F. H.	Invincible	5358E	Kalgoorlie	75 0 0	75 0 0	...	7 1 1	67 18 11	1 16 7	6 15 1	74 14 0
** Tamblyn & Stephens	Prohibition, South	1532M	...	180 0 0	133 15 9	12 12 0	...	146 7 9	3 0 0	9 13 11	156 1 8
Tarcoola Blocks	Spring Vale	24 P.P.	Northampton	1,500 0 0	1,350 0 0	150 0 0	...	1,500 0 0	7 16 7	96 19 3	1,596 19 3
Thorley & Fox	Kapanga	M.L. 515	Greenbushes	80 0 0	60 0 0	...	43 10 5	16 9 7	11 7 10	0 13 10	17 3 5
Tovin, P.	Field's Find Extended	G.M.L. 902	Yalgoo	361 2 3	361 2 3	...	99 19 0	261 3 3	22 8 3	90 16 8	351 19 11
Tasker, Wm.	Pinnacles	G.M.L. 2200T	...	36 0 0	...	36 0 0	...	36 0 0	...	...	36 0 0
Thompson & Party	Hawk	725 G.	Desdemona	120 0 0	116 12 2	...	22 5 11	94 6 3	3 7 10	...	94 6 3
Thomas & McDonald	Tributers Rising Sun	P.A. 1663	Kalgoorlie	40 0 0	35 0 0	...	...	35 0 0	...	3 10 9	38 10 9
Thorn, A.	...	P.A. 1913	Widgiemooltha	50 0 0	50 0 0	...	...	50 0 0	1 13 10	1 11 6	51 11 6
Trippitt & Winter	...	P.A. 1452	Tuckiabianna	150 0 0	141 0 0	...	...	141 0 0	0 13 11	2 10 0	143 10 0
Trippitt & Winter, No. 2	...	P.A. 1452	do.	75 0 0	75 0 0	...	...	75 0 0	...	...	75 0 0
Wooster, G. W.	"Redemption"	5212/3	Coolgardie	1,003 8 6	1,003 8 6	...	...	1,003 8 6	...	66 19 7	1.070 8 1
Wilga Pty. Coal Prospecting Co., Ltd.	Wilga	406H	Wilga	1,000 0 0	734 8 4	...	...	734 8 4	158 16 5	47 14 8	782 3 0
Whitting, W. A.	The Empress	3,334	Yilgarn	150 0 0	...	27 11 3	...	27 11 3	...	0 1 1	27 12 4
Wearmouth & Paull	...	P.A. 2131	Coolgardie	120 0 0	120 0 0	...	...	120 0 0	...	2 3 8	122 3 8
Yews, Bennetts, & Carlisle	Golden Promise	P.A. 2053	do.	300 0 0	300 0 0	...	...	300 0 0	...	40 4 7	340 4 7
V's United G.M. Co.	...	271F	Mt. Morgans	500 0 0	406 14 1	...	...	406 14 1	1 11 2	25 7 9	432 1 10
V's United G.M. Co., No. 2	...	271F	do.	172 2 0	172 2 0	...	170 0 0	2 2 0	...	9 6 4	11 8 4
Williamson & Pender	Sunset	...	...	180 0 0	180 0 0	...	...	180 0 0	7 0 0	12 18 1	192 18 1
Wilson & Son	...	P.A. 1103W	Broad Arrow	26 0 0	26 0 0	...	...	26 0 0	...	0 16 0	26 16 0
Total	...	...	...	158,257 11 4	117,254 16 8	17,388 6 0	19,913 1 0	114,730 1 8	10,242 14 6	10,568 2 7	125,298 4 3
ASSISTANCE IN ERECTING BATTERIES AND TREATMENT PLANTS.											
Atkins & Party	Lalla Rookh	112, 786, T.A. 10...	Marble Bar	3,176 1 6	3,176 1 6	...	478 4 11	2,697 16 7	622 10 6	234 3 3	2,931 19 10
Bellchambers & Martin	Red White and Blue	641B	Curran's Find	2,676 9 0	2,676 9 0	...	1,216 5 2	1,460 3 10	856 18 10	121 10 1	1,581 13 11
Butcher Bird Syndicate	Butcher Bird	1933	Yilgarn	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
Cox, E. A.	do. (Tributers)	1933	do.	76 8 4	76 8 4	...	26 4 9	50 3 7	...	...	50 3 7
Crockford, Alfred	...	1933	Yaloginda	350 0 0	350 0 0	...	38 0 0	312 0 0	12 2 0	21 14 1	333 14 1
Faraday & Tasker, No. 1	Fraser's Central	3228, 3232	Yilgarn	2,976 16 4	2,976 16 4	...	50 19 2	2,925 17 2	44 12 2	468 16 8	3,394 13 10
Faraday & Tasker, No. 2	do.	3228, 3232	do.	636 17 8	636 17 8	...	...	636 17 8	...	83 6 11	720 4 7
Faraday & Tasker, No. 3	do.	3228, 3232	do.	891 6 0	891 6 0	...	...	891 6 0	...	47 13 7	938 19 7
Faraday & Tasker, No. 4	do.	3228, 3232	do.	650 0 0	650 0 0	...	8 3 10	641 16 2	...	8 16 5	650 12 7
Great Victoria G.M's., No. 1 (No Liability)	...	719, 944, 945, 1227	do.	2,000 0 0	1,643 3 0	...	243 3 0	1,400 0 0	152 17 1	35 5 10	1,435 5 10
Great Victoria G.M's., No. 2 (No Liability)	Resurrection	G.M.L. 3281	do.	591 14 11	...	385 2 2	...	385 2 2	0 12 9	15 2 5	400 4 7
Garland, J. P.	Waterloo	G.M.L 1291M	Holden's Find	1,800 0 0	404 13 5	1,138 14 10	...	1,543 8 3	...	80 14 11	1,624 3 2
Howlett, G. H.	Donovan's Find	G.M.L. 768	Yilgarn	1,000 10 0	1,000 10 0	...	306 4 3	694 5 9	647 3 4	52 3 10	746 9 7
Howlett, G. H., No. 2	do.	G.M.L. 768	do.	150 0 0	150 0 0	...	...	150 0 0	65 5 9	14 2 0	164 2 0
Howlett, G. H., No. 3	do.	G.M.L. 768	do.	433 0 0	433 0 0	...	...	433 0 0	123 1 10	56 12 2	489 12 2
Howlett, G. H., No. 4	do.	G.M.L. 768	do.	100 0 0	78 0 9	...	...	78 0 9	17 14 5	12 4 2	90 4 11
Hodder, E.	...	M.A. 54Y	Bulong	253 3 2	253 3 2	...	148 13 0	104 10 2	6 8 4	35 11 3	140 1 5
Hassell & Party	The Flag	136/7/8	Phillips River	3,500 0 0	3,080 18 9	...	408 3 9	2,672 15 0	...	177 9 6	2,850 4 6
Hodges & Party	Great Southern	2909	Yilgarn	3,977 12 7	3,977 12 7	...	...	3,977 12 7	13 0 0	926 3 6	4,903 16 1
Juett & Party	Triplicate	1914	Tuckabiana	730 0 0	608 17 7	...	171 13 10	437 3 9	51 0 8	39 14 7	476 18 4
Jones & Party	(Tributers) Butcher Bird	1933	Yilgarn	12 0 3	12 0 3	...	...	12 0 3	...	...	12 0 3
Krug, C. H.	Consolidated	1933	Westonia	243 10 0	...	236 10 10	34 4 0	202 6 10	...	6 11 6	208 18 0
Leitch, John	Big Stone	357F, 369F	Yundamindera	1,438 0 0	1,438 0 0	...	938 15 0	499 5 0	...	384 6 3	883 11 3
Leitch, John	do.	357F, 369F	do.	500 0 0	484 2 1	...	1 6 2	482 15 11	37 18 0	60 11 10	543 7 9
Mandelstam, A. S.	Neta	1011R	Edjudina	200 0 0	200 0 0	...	17 11 7	182 8 5	44 19 2	76 14 5	259 2 10
Malcolm Prospecting Co.	North Star	1175C	Mt. Malcolm	1,550 0 0	1,550 0 0	...	15 0 0	1,535 0 0	410 6 10	723 4 9	2,258 4 9

MINING DEVELOPMENT EXPENDITURE—*Advances Outstanding 31st December, 1927*—continued.

Name of Lease Mine, or Borrower.	Name of Lease.	No. of Lease.	District.	Amount Authorised.	Principal Moneys advanced. Previously to 1927.	Principal Moneys advanced. During 1927.	Principal Moneys. Repaid, including Sale of Securities, etc.	Principal Moneys. Balance outstanding.	Interest. Paid.	Interest. Outstanding.	Total Principal and Interest outstanding at 31st December, 1927.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
McCahon & Party	... ...	... ...	Mt. Ida	400 0 0	400 0 0	...	7 0 0	393 0 0	...	27 14 5	420 14 5
McDermott & Soanes	Chunderloo	148N	Nannine	2,032 12 0	1,730 10 2	...	671 4 2	1,059 6 0	...	218 16 2	1,278 2 2
Nevill, A. M.	Revival	G.M.L. 953 ...	Yalgoo	67 10 0	67 10 0	...	60 2 8	7 7 4	7 17 3	0 16 3	8 3 7
Norman and Others	Phoenix	622N	Quinn's	250 0 0	250 0 0	...	39 12 0	210 8 0	17 12 1	17 5 11	227 13 11
Ogden & James	Tributers, Butcher Bird	1933	Yilgarn	26 4 9	26 4 9	...	...	26 4 9	...	...	26 4 9
Paterson, W. A.	Spring Hill	G.M.L. 724 ...	Parker's Range	655 16 5	655 16 5	...	600 9 2	55 7 3	595 0 11	1 10 2	56 17 5
Ravensthorpe Battery Co.	... ...	... ...	Ravensthorpe ...	1,300 0 0	1,038 8 2	...	125 0 0	913 8 2	...	326 1 2	1,239 9 4
Smith, G. N. B.	Myrtle, Central ...	3269, 3271	Yilgarn	519 7 4	519 7 4	...	454 18 11	64 8 5	18 8 3	25 17 10	90 6 3
Trude, F. B.	Randwick	978C	Mt. Malcolm ...	584 14 0	577 3 5	...	54 4 6	522 18 11	...	45 3 5	568 2 4
Thring Bros. & Dwyer	Kirton's South ...	M.L. 127	Northampton ...	2,050 0 0	2,028 12 9	...	730 12 4	1,298 0 5	537 3 10	146 3 0	1,444 3 5
Thring Bros. & Dwyer, No. 2	do.	M.L. 127	do. ...	200 0 0	200 0 0	...	...	200 0 0	15 8 5	14 19 9	214 19 9
Thring Bros. & Dwyer. No. 3	do.	M.L. 127	do. ...	500 0 0	500 0 0	...	...	500 0 0	8 14 1	46 16 8	546 16 8
Hunt, H. W.	... ...	... ...	Kalgoorlie ...	500 0 0	500 0 0	...	10 0 0	490 0 0	...	32 10 0	522 10 0
Hunt, H. W.. No. 2	... ...	... ...	... ...	295 0 0	295 0 0	...	36 17 6	258 2 6	12 5 8	16 15 5	274 17 11
Total	... ...	... ...	... ...	41,158 8 5	37,400 7 7	1,760 7 10	6,910 9 10	32,250 5 7	4,491 6 0	4,692 10 6	36,942 16 1
MISCELLANEOUS.											
Duggan, Flynn & Worrington	... ...	PA 890b.	Youanmi... ...	150 0 0	150 0 0	...	54 11 4	95 8 8	...	...	95 8 8
Griffin Coal Mining Co.	... ...	... ...	Collie	100 0 0	100 0 0	...	...	100 0 0	15 2 11	...	100 0 0
Ives, Bray & Millett...	Sandy Creek	... ...	Nullagine ...	513 15 0	513 15 0	...	513 15 0	...	...	25 17 1	25 17 1
Prior, R. G.	... ...	Mineral Claims 1/5	Pilbara	550 0 0	...	45 0 0	...	45 0 0	...	0 3 6	45 3 6
Total	... ...	... ...	... ...	1,313 15 0	763 15 0	45 0 0	568 6 4	240 8 8	15 2 11	26 0 7	266 9 3
D.—BORING.											
Irwin River	... ...	... ...	... ...	3,817 5 10	3,817 5 10	...	...	3,817 5 10	...	...	3,817 5 10
Wilga	... ...	... ...	... ...	6,037 12 5	6,037 12 5	...	...	6,037 12 5	...	...	6,037 12 5
Golden Mile Ore Channel Extended ...	... ...	... ...	Kalgoorlie ...	3,471 11 5	3,471 11 5	...	...	3,471 11 5	...	...	3,471 11 5
Williams, A. H. "Lady of the Lake" ...	... ...	... ...	... ...	1,100 0 0	1,000 0 0	...	...	1,100 0 0	...	...	1,100 0 0
Total	... ...	... ...	... ...	14,426 9 8	14,426 9 8	...	...	14,426 9 8	...	...	14,426 9 8
A.—PIONEER MINING AND PROSPECTING ...	... ...	... ...	... ...	158,257 11 4	117,254 16 8	17,388 6 0	19,913 1 0	114,730 1 8	10,242 14 6	10,568 2 7	125,298 4 3
B.—ASSISTANCE, ERECTING BATTERIES, ETC.	... ...	... ...	... ...	41,158 8 5	37,400 7 7	1,760 7 10	6,910 9 10	32,250 5 7	4,491 6 0	4,692 10 6	36,942 16 1
C.—MISCELLANEOUS	... ...	... ...	... ...	1,313 15 0	763 15 0	45 0 0	568 6 4	240 8 8	15 2 11	26 0 7	266 9 3
D.—BORING	... ...	... ...	... ...	14,426 9 8	14,426 9 8	...	...	14,426 9 8	...	...	14,426 9 8
Total	... ...	... ...	... ...	215,156 4 5	169,845 8 11	19,193 13 10	27,391 17 2	161,647 5 7	14,749 3 5	15,286 13 8	176,933 19 3

APPENDIX No. 2.

Sundry Reports by R. C. Wilson, Esq., B.Sc., B.E., Assistant State Mining Engineer.

These are mostly excerpts from reports on the various mines to which reference is made, which have been examined in connection with applications for loan assistance under the Mining Development Act. The portions published are such as give information as to the mines which may be of public interest.

1.—REPORTED GOLD FIND AT PARKERVILLE.

(3/3/1927.)

I beg to report having paid a visit to a well in Mr. F. J. White's orchard at Parkerville, where auriferous material assaying nearly 2 ounces per ton was reported to have been met with at a depth of 40 feet.

The well, which is situated about 90 chains south west of Parkerville railway station, has been sunk in a soft white gritty kaolin resembling a decomposed granite. I found on my arrival that the reported auriferous material at the bottom of the well could not be inspected, as it was completely covered with a soft white clay which was oozing into the shaft under the bottom timber. An effort by Mr. Armstrong to clean this out was only partly successful. He succeeded, however, in digging out some lumps of heavier ferruginous material containing a certain amount of quartz, which I collected and sent to Dr. Simpson for analysis, with the following result:—Gold, 14 grains per ton. Too much importance should not be attached to this result.

No idea of the thickness of the auriferous material could be formed, and the sample taken may not be a representative one. Mr. Armstrong has promised to timber the shaft more securely, and to sink it far enough to admit of the deposit being inspected and sampled satisfactorily. Until this has been done I prefer not to express any opinion as to the value of the find.

2.—REPORTED GOLD FIND AT PARKERVILLE.

(17/3/1927.)

As arranged, I paid a second visit to White's well at Parkerville on the 14th March. The owners of the mine had sunk the shaft a further 5 feet, making a total depth of 45 feet, and on my arrival had the well cleaned out in good order for inspection and sampling.

As stated in my previous report the country has the appearance of a much decomposed granite. Through this country are lens-shaped portions heavily charged with brown oxide of iron. In White's shaft these have a north and south trend, and are nearly vertical.

Similar ironstone formation was found on the dump at Collet's well some 200 yards further north, and at Alderdice's well between Collet's well and the railway line.

Four samples were taken from White's well at a depth of 45 feet, with the following disappointing result:—

Sample No.	Description.	Width.	Value.
		inches.	
1	Sample across lode formation on south side of well	36	*Nil*
2	Check sample	36	*Nil*
3	Sample picked from ironstone veins	...	*Nil*
4	Check sample	...	*Nil*

3.—CORNWALL TIN MINE.

(18/3/1927.)

As instructed, I visited this mine on the 10th March, and have to report as follows:—

The main vertical shaft, I was informed, has been sunk 27 feet, making the total depth 131 feet 6 inches. There was too much water in the shaft for me to inspect the bottom, but the lumps dumped at surface show that it is being sunk in a close-grained hornblende gneiss rather too hard for hand labour, and I was informed by the present manager that it does not shoot well; that is to say a hole when fired will not break out much ground.

For this reason, among others such as pump troubles, the shaft sinking has been very slow and very costly.

90 feet Level Workings.—This level, which is usually called the 100ft. level, could be inspected and was in fairly good order considering the long period that it has been under water. The following is a brief description of what could be seen:—

Three lodes are met with in the main east crosscut. A lode, which I have called No. 1 east lode, is met with at a distance of 6 feet from the shaft. On the north side of the crosscut this is about 18 inches in width; on the south side it has nearly pinched out. This lode dips towards, and is said to enter the shaft 10 feet below the 90ft. level and to be 2 feet in width.

A second lode, which I have called No. 2 east lode, is met with 50 feet from the shaft. A certain amount of driving and stoping had been done north of the crosscut. A few feet of driving only appeared to have been done south of the crosscut, and no stoping, neither faces could be reached.

A third lode, which I have called No. 3 east lode, is met with 105 feet from the shaft. A north drive has been driven on this lode 15 feet, and the ore above the timber has apparently been stoped out. In the face the lode is about 15 inches. The south drive is full of dirt, but is thought to connect with a shaft some 25 or 30 feet from the crosscut.

Present policy.—It was the intention of the company to sink the shaft to a depth of 156 feet, and then to crosscut east and west at a depth of 150 feet, but now that it has become evident that their funds will be exhausted before the shaft is completed, the secretary of the company has put up the proposal that the shaft be stopped and the balance of the loan money be spent in crosscutting east at the 125 feet level to cut the lodes met with at the 90 feet level. It is thought that the No. 2 east lode is dipping towards the shaft, and will be met with before many feet of crosscutting have been done, and that if this is of payable grade more capital can be procured to go on with the original proposal.

Recommendation.—The present financial position is such that if the shaft is continued funds will soon be exhausted and nothing proved. In consequence, I feel reluctantly compelled to recommend the course proposed by the company that an east crosscut be now put out at the 125 feet level.

4.—SUPPOSED OIL FIND.

(12/4/1927.)

On January 1st I visited Mr. Woodcock's farm, Loc. 3566, situated about 11 miles north of Northampton, to inspect an occurrence which Mr. Woodcock thought might be an indication of oil.

I found on arrival that a fine yellow mud was oozing up from the bed of a dried-up creek, and at several points extending over a length of perhaps 100 yards, and had formed small mud volcanoes about 18 inches high and 4 to 5 feet across. These had to be covered over to prevent sheep walking into them and getting bogged.

The frequency of the outcrops of gneiss which is the bed rock of this district precluded the possibility of this occurrence being an indication of the presence of mineral oil.

I have seen similar occurrences elsewhere in the State, and am of opinion that they are formed when a small spring of water passes through a bed of clay and brings it to the surface.

A quantity of salt was noticeable in the creek bed which proved on examination by the Government Mineralogist and Anaylst to consist of quartz, common salt, gypsum, epsomite, felspar, garnet, ilmenite, limonite, leucoxene, and organic matter.

A sample of mud from the mud spring when air-dried and extracted with ether yielded 0.005 per cent. of extract.

Treatment with alcoholic potash left a residue of unsaponifiable matter equal to .003 per cent., consisting of a clear resin soluble in acetic anhydride.

This is undoubtedly of vegetable origin and is therefore no indication of the presence of petroleum or its residuums.

5.—NORTHAMPTON DISTRICT.

(17/6/1927.)

The object of my visit to this district was primarily to survey the site for a deep bore at the Surprise Lead Mine to test the lode below the impoverished zone, and to report upon an application for a loan from the Two Boys Lead Mine to be expended on development work. While in the district, I also visited Springvale Lead Mine and Thring's Block 7 at Ajana, and Merrifield's P.A. at Norman's Well and have to report as follows:—

Surprise Lead Mine.—On this mine the main lode was taken out for a length of 250 feet and a width of 10 feet down to a depth of about 230 feet. Below this depth the lead contents were too low to admit of profitable mining.

A site was selected for an inclined bore hole which will cut the lode at a vertical depth of 700 feet, a little to the south of the present workings, as the shoots of ore in this mine pitch in that direction. The object of the bore is to ascertain if the lode has become permanently impoverished below a depth of 230 feet or whether a poor zone only has been met with, below which better values will again be met with.

Two Boys Lead Mine.—This mine is not operating at present. The ore won from the open cut was 8,203 tons, yielding 1,097 tons of concentrates valued at £25,000. The results of development work at the 120 feet level have, up to date, been disappointing. The company are applying for assistance to carry out further development work.

The ore body, which is of very considerable size, consists of crushed gneiss in which the cracks have been filled with vein material often nearly pure galena.

The ore has been won by open cutting. The ore body in the open cut was taken out for a width of 50 feet and a length of 80 feet.

A well defined wall, which appears to be the footwall of the lode, has a north-easterly strike, and dips to the north-west.

At the north-east end of the cut the lode ends against another wall having a north-easterly strike and a dip to the south-west. This appears to be a fault plane. Some ore is showing at both ends of the open cut at the points where it is proposed to drive at the 47ft. level. Milling ore is also showing underfoot in the open cut, but this becomes unpayable before the bottom of the winze is reached.

At the 120ft. level the west crosscut was in lode material of low value for practically the whole distance, and the two north drives from this crosscut were driven at points where the best value was met with.

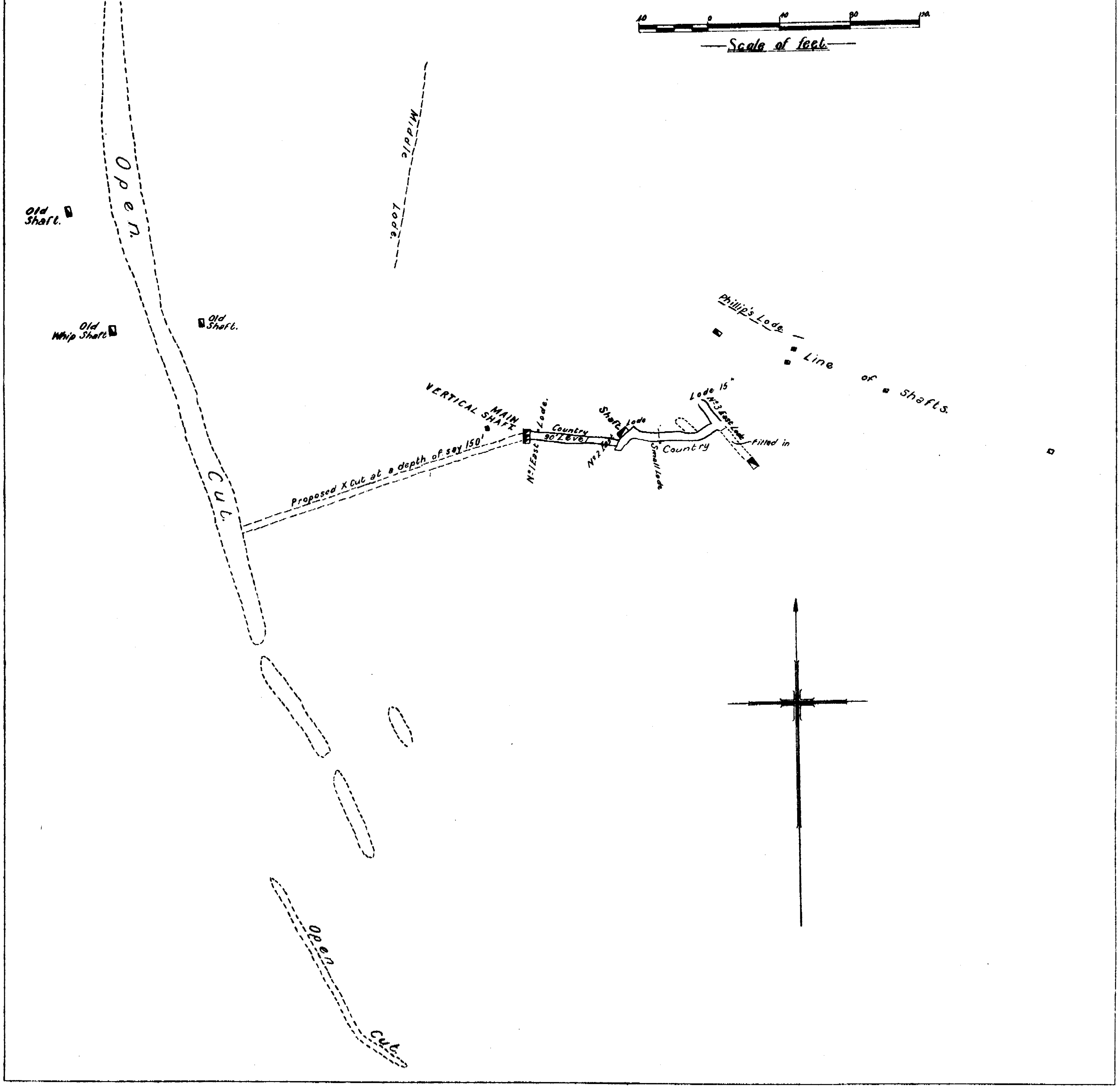
The winze, it will be noted, is a long way on the footwall side of these drives. Apart from the possibility of developing more ore it is necessary to complete the winze and connect with the north drive at the 120ft. level to enable the remaining ore below the 47ft. level to be taken out.

The proposed drives at the 47ft. level are also necessary to prove the extension of the ore body at this level.

Thring's Block 7.—This mine presented an attractive appearance. At the surface there was a heap of high grade concentrates estimated at 350 tons. The owners are holding them for a rise in the market price of lead. Even at the present low market price of £25 per ton these would realise over £4,000.

THE CORNWALL TIN MINING LEASE

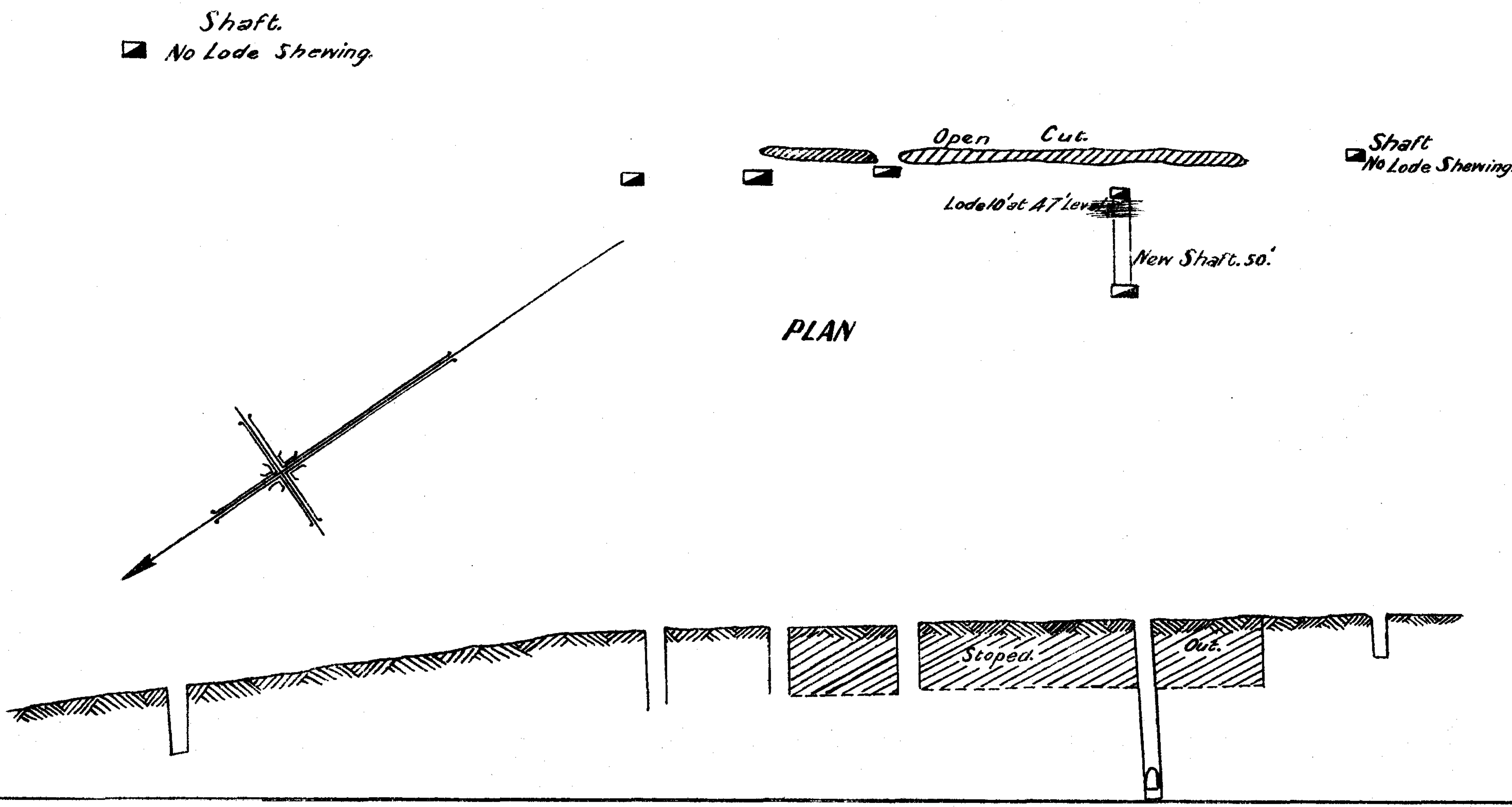
Plan Shewing Position of Principal Lodes.



MERRIFIELDS P.A. *(OLD NORMAN KING.)*

PLAN & LONGITUDINAL SECTION.

Scale: 40 ft = 1 inch.



A prospecting shaft has been started 190 feet north of the main shaft and is following down a small rich leader about 12 inches in width.

At the 90ft. level, the south drive has been driven 600 feet south of the main shaft, and Mr. Thring informs me that it was in payable ore for the whole of this distance.

This is a very promising mine and should be equipped with a treatment plant. At present only high grade ore can be profitably mined.

Springvale Lead Mine.—On this mine the new plant has been running since January, and up to the end of April had treated 2,482 tons of ore having an extractable value of 9.5 per cent. lead.

As will be seen from the figures given me by Mr. R. A. Anderson, the working costs have been very good, and had lead remained at £30 per ton, profits would have been realised. The total costs for April including development were 32s. 0½d. per ton. With lead at £27 17s. 6d., the revenue would have met the expenditure, but with lead at £25 a small loss resulted.

I am indebted to Mr. Anderson for the following figures:—

Month.	Tons.	Costs in Shillings.						Payable Value of Lead.
		Mining.	Dev.	Milling.	Transport.	General Expenses.	Total.	
							£ s. d.	£ s. d.
January	502	20·217	6·106	9·921	2·586	0·808	1 19 6½	29 15 1
February	650	17·230	8·010	9·690	2·900	·710	1 18 6½	29 14 0
March	680	19·790	3·130	8·880	2·880	·930	1 15 7	28 2 0
April	650	19·020	1·800	8·460	2·130	·610	1 12 0½	27 17 6

During the period the lead values extracted were 9.46 per cent., 9.77 per cent., 9.82 per cent. and 8.77 per cent. respectively.

Ore of this grade can be profitably mined and treated with lead £28 per ton or better, but is not payable at the present price of £25 per ton.

Norman King Mine.—Merrifield and Party have taken up the old Norman King Mine at Norman's Well and have sunk a shaft to 50 feet and crosscut to cut the lode. This was said to be 10 feet wide and of good milling grade. As the water was up, it could not be inspected. Judging by the old workings, they should have a shoot of ore about 120 feet long.

The party have erected a cracker and small jig, and have just begun to crush some ore. Power is supplied by a 30 H.P. McCormack Deering Tractor borrowed, I understand, from a neighbouring farmer.

As regards water, the shaft is said to make 5,000 gallons of water from 9 p.m. to 6 a.m. the following morning.

6.—GLENELG HILLS.

(22/7/1927.)

As instructed, I visited Glenelg Hills, arriving on the afternoon of the 21st June, and leaving on the morning of the 24th.

The object of this visit was to look into the general position and to ascertain the manner in which the Department could best assist the development of this field. My conclusions are set out at the end of this report. The following is a brief description of the principal mines operating:

The Glenelg Queen G.M.L. 3312.—This is the most important mine in the district, and is situated a little west of north from the townsite and about a mile distant.

The ore body is a quartz reef, averaging about 4 feet in width. The strike is a little east of north and dips to the east at an angle of about 45 degrees from the horizontal. An underlay shaft, known as the air shaft, was sunk on the reef in high-grade ore down to a vertical depth of about 50 feet, the width of the reef being about 4ft. 6in. At this depth a north drive was driven 100 feet in high grade ore. A south drive was also driven about 100 feet. High values were met with for the first 30 feet, beyond which values were on the low side. The drives prove a shoot of ore at this level approximately 130 feet and 3ft. 6in. in width.

At the surface two other shorter shoots of ore occur, which it is hoped will be met with at the 50ft. level by continuing the south drive. Two winzes are, I understand, now to be sunk on the reef, below the 50ft. level, one on each side of the air shaft. These will be watched with interest, as it is important to ascertain if the high values met with persist in depth.

Up to the present three crushings have been sent to the State Battery at Coolgardie with the following results:—

Crushing.	Date.	Tons.	Yield per ton by amalgamation.
			oz. dwt. grs.
No. 1	October, 1926...	12½	7 9 3
No. 2	May, 1927 ...	72	2 7 5
No. 3	June, 1927 ...	72	2 14 20

It is claimed that the second and third crushings should be fairly representative. I am informed that the second was taken from Brophy's shaft, Pott's shaft, and the air shaft; and the third from No. 1 costean, No. 2 costean, and the hanging wall stripping of the air shaft.

Personally, I hardly expect to see quite such a high average maintained, but it would appear from sampling results that about 3,000 tons of ore worth, say, 30 dwts. per ton could be obtained without further development.

Hollow and Heaton's Reward Lease No. 3280.—This lease is situated a little under half a mile south-west of the townsite. A persistent quartz reef can be traced, trending for the most part in a north-westerly direction and dipping to the north-east at an angle of less than 45 degrees from the horizontal. At the north end of the lease, however, the reef appears to make a sharp turn and strikes nearly north.

The new shaft has been sunk vertically to 50 feet, at which depth the shaft cut the reef, and thereafter was carried down on the underlay. After following it for perhaps 20 or 30 feet, the reef was cut off by a pegmatite dyke, and efforts to locate its continuation on the other side of the dyke have not proved successful up to the present, but should, I think, be continued. In the Yilgarn district, these pegmatite dykes are usually younger than the reefs and cut through them without displacing them materially. The average width of the reef would be about 12 inches. A few dump samples were sufficient to show the variable values in the quartz. These varied from 1 dwt. 18 grs. to 3 oz. 9 dwts. 10 grs. per ton.

In the absence of detailed sampling results, I was not able to ascertain details regarding the distribution of values, but I gathered that high values were confined to narrow widths and that the shoots of ore were somewhat short.

A crushing of 21½ tons of ore sent to the State Battery at Coolgardie in November, 1926, yielded no less than 6 oz. 12 dwts. 22 grains per ton over the plates and 8 dwts. in the tailings.

The Great Beacon G.M.—This mine is situated about a mile and a half north-east of the townsite. The lode, which has a general strike of N. 60 degrees W. and an underlay to the south-west, has been driven on at the 50ft. level for a length of approximately 160 feet. The drives have followed a lode formation, but values, I understand, are confined to a quartz vein. The shoot of payable ore is said to be 50 feet in length and to average well over an ounce per ton in value for a width of about 12 inches.

The reef in the winze 15 feet below the level had widened out to 24 inches. My sampling gave an assay value of 1 oz. 19 dwts. 20 grs. per ton.

A new shaft is being sunk at the south-east end of the mine, as it is considered that the shoot of ore pitches in this direction.

It is encouraging to note that the reef is widest and richest at the deepest point that has been exposed.

Hale's G.M.L. 3318.—This lease is situated about three-quarters of a mile south of the townsite. A good strong quartz reef which strikes north-west and south-east has been exposed at intervals for a length of 250 feet. The shaft unfortunately was inaccessible. Grab samples of the ore at surface gave the following results:—

——	Sample.	Assay Value.			Representing
	No.	oz.	dwt.	grs.	tons.
Ore at grass at— Shaft	3	0	0	21	about 12
No. 1 North Pothole	4	0	13	2	„ 4
No. 2 North Pothole	5	0	2	4	„ 4
South Costean ...	6	0	1	15	„ 5

A sample of the material from a large dump at the shaft, apparently seconds or discarded quartz, assayed 2 dwts. 4 grains per ton in value. It was thought that this ore might be good enough to crush if a battery were close at hand. My samples indicate that the heap of 4 tons at No. 1 north pothole would pay to treat at a local battery, but that the balance is too poor to treat under any circumstances.

Smith's P.A. 1512.—This prospecting area adjoins Hollow and Heaton's Reward Lease on the south-east side. A shaft has been sunk vertically for 30 feet, then on the underlay for 20 feet, following a strong lode in fairly hard country. Assay results are as follows:—

Sample No.	Location.	Width.	Assay Value.		
		inches.	oz.	dwt.	gr.
11	Face of shaft (North end)	60	0	1	7
12	5ft. from face (South end)	42	0	3	19
13	6ft. from face (North end)	42	0	11	23

These three samples average 5 dwts. 3 grains per ton in value.

Thornett's P.A. 1585.—This P.A. is situated about 20 chains south of Hollow and Heaton's Reward Lease. A good deal of work at a shallow depth appears to have been done along a schist lode having a north-westerly strike. The most westerly shaft has been sunk 40 feet, and 10 feet of driving has been done each way from it. Low values only are said to have been met with. The middle shaft has also been sunk 40 feet, and a south-east drive driven 12 feet. Two samples of the lode at the bottom of this shaft averaged 1 dwt. 1 gr. per ton over a width of 72 inches.

A sample of his dump assayed 21 grains per ton. The owner hoped that these samples would give a payable average. Apparently the payable values are confined to small leaders.

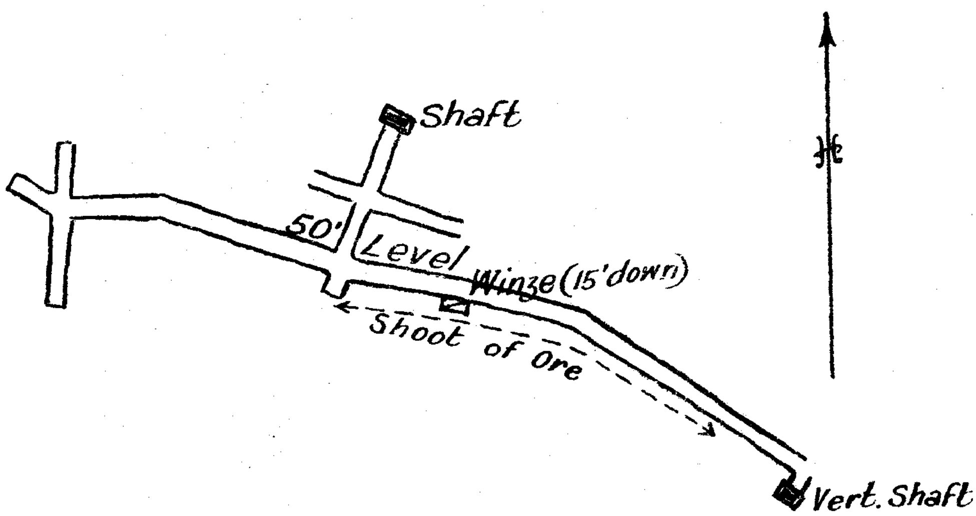
Bowman and Mead's P.A. 1544 (formerly Robertson's P.A.).—On this P.A. an underlay shaft is being sunk following a quartz vein having the appearance of a dyke which strikes nearly north and south and dips to the east at a flat angle. Values are said to be low.

McDonald and Hackett's P.A.—This P.A. is situated to the south-west of Bowman and Mead's P.A., and is about 1½ miles south-west of the townsite. No work is at present in progress. Two shafts said to be about 40 feet deep have been sunk in soft schist material having a strike of N. 72 degrees E. This schist crosses a gully and appears to be one of the possibilities of a water supply. The P.A. has apparently been abandoned.

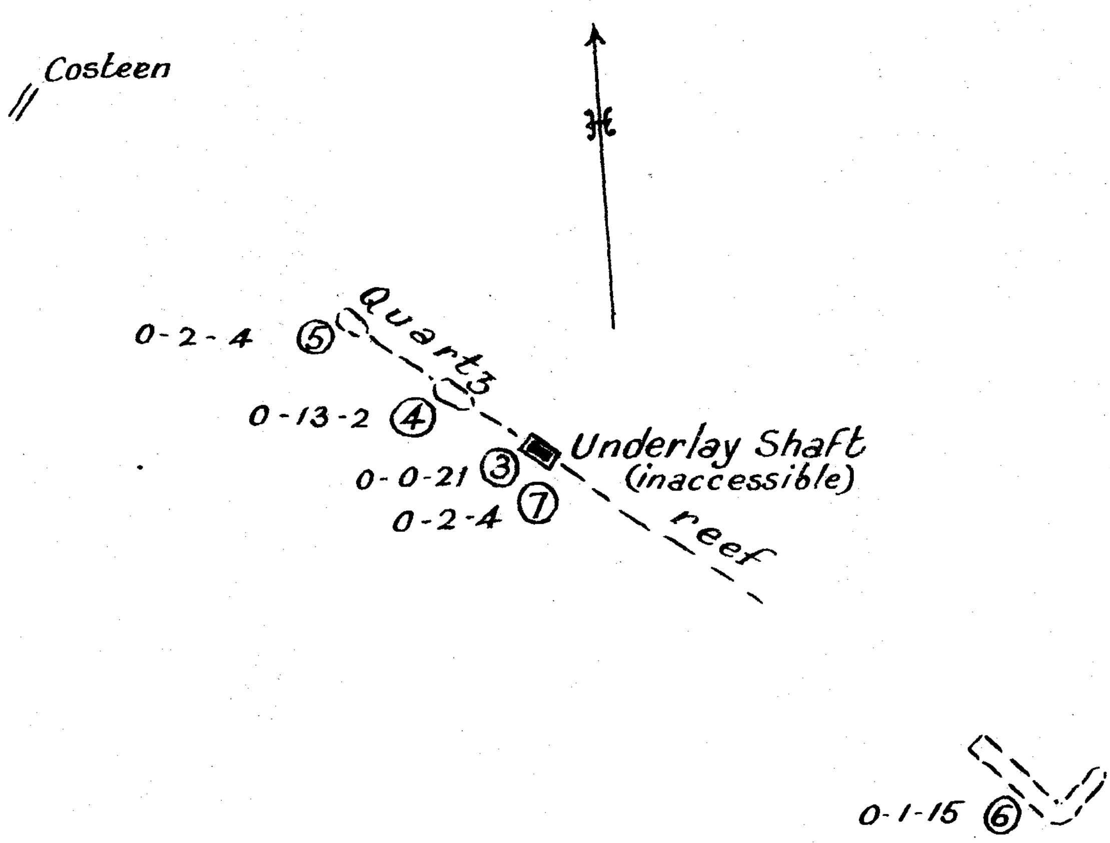
The Empress G.M., G.M.L. 3334.—On this lease, which is situated about half a mile north of the townsite. Whitting has driven 66 feet on a small quartz vein, from which he has extracted and bagged about 12 tons of ore. From another part of the lease he has obtained a further 6 tons of ore, also from a small vein, which, I understand, he is sending to the State Battery at Coolgardie.

Balmes P.A. 1537 and *Orrie's G.M.L.* 3320 lie to the east of Whitting's, and were briefly inspected. I understand from Inspector Rockett that nothing

Great Beacon G.M.
Sketch Plan
Scale 40' to an Inch



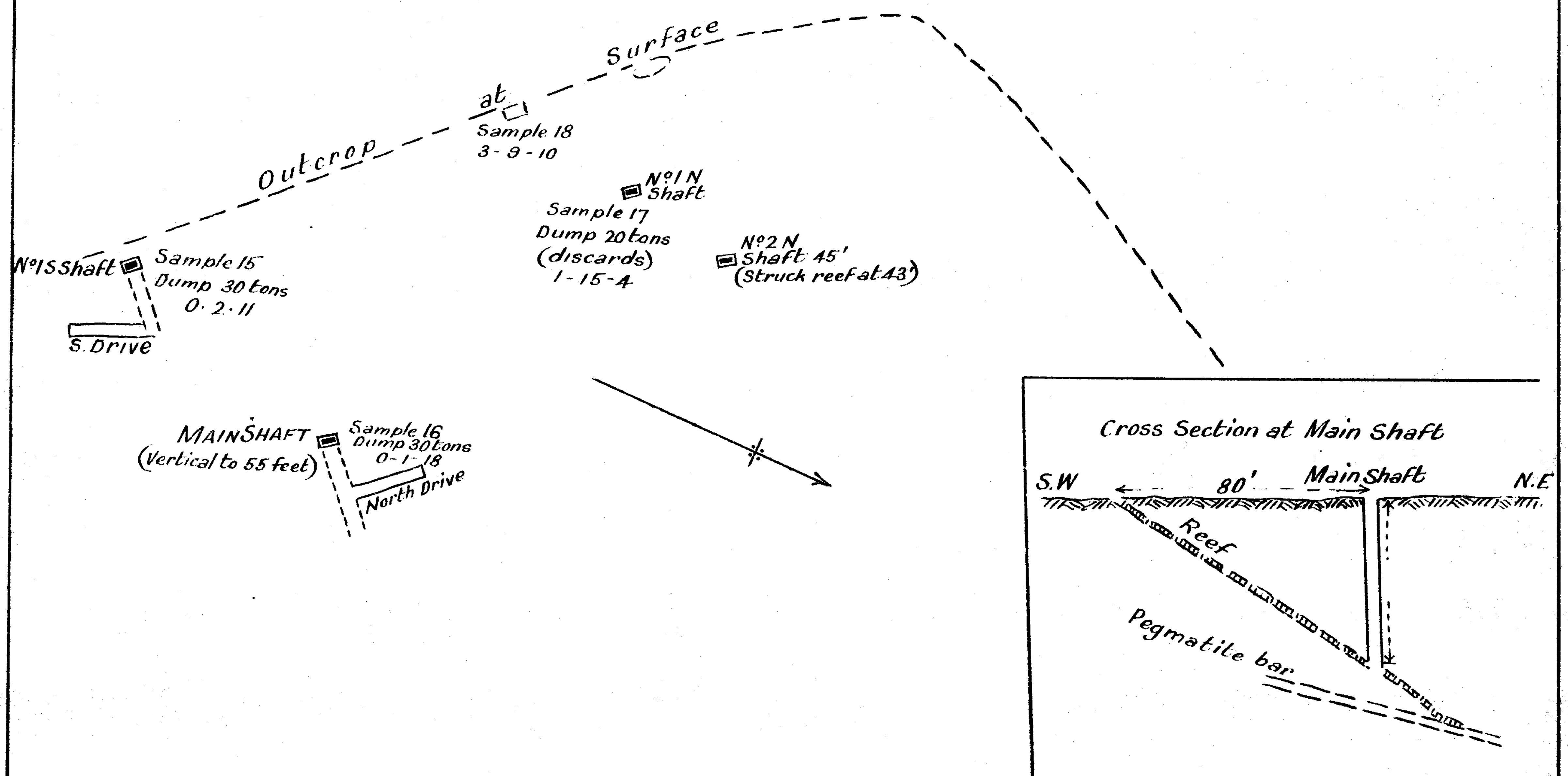
Hale's M.L. 3318
Sketch Plan



Hollow & Heaton's Reward Lease

Plan of Workings

Scale 40 feet to an Inch



of any consequence has been found on them. At the Manfred shaft the ladders have been removed. There were about 5 tons of ore at grass.

Coventry's P.A. 1602.—On this prospecting area Coventry was working out a short shoot of ore. He sank a shaft to 40 feet and drove east 12 feet on a quartz vein carrying low values. Better values were met with going west, but at 7 feet a fault was met with, and Mr. Coventry informed me that, he crosscut 60 feet north and 40 feet south on the other side of the fault without finding the continuation of the reef.

The Rising Sun.—Le Feuvre has just abandoned this lease. He advised me that at the 50ft. level good values were met with where the reef was cut, but that these became poor on driving.

Penna and Smith's P.A.—On this P.A. small leaders have been found carrying visible gold, but nothing of any size.

The Captain Mack, P.A. 1630.—This was formerly known as the Blarney Stone, and I understand from Inspector Rockett that very little work has been done since Mr. Blatchford reported on it in December, 1925, as follows:—

"*McDonald and Davidson* (Blarney Stone).—This P.A. is situated about 300 yards east of the main camp. The work on the property consists of an irregular underlay shaft sunk to a depth on the underlay to 85 feet. There is nothing defined, but irregular gold values have been found in a lode formation which may possibly improve on further development. Samples were taken from several sections in the shaft and gave the following results:—

	oz.	dwt.	grs
In a short crosscut at the 75 ft. level over 4ft. 6in.	0	1	18
Footwall section opposite crosscut at 75ft. level over 2ft. of lode material	1	8	20
South face, bottom of shaft over 18in. ...	0	4	19
Special sample (one piece) taken at Mr. McDonald's request from bottom of shaft ...	0	19	19

"From above it will be seen that the payable gold values are very erratic, and a sampling across the whole width is unpayable. This is verified by a grab sample of the dump, which yielded 4 dwts. 19 grs.

"With the exception of a limited amount of costeaning, there has been no other work done on the field, except Smith, who has sunk a shaft 20 feet deep, and a sample across a very indefinite lode formation gave a result of 2 dwts. 18 grs. per ton. Several of the prospectors, however, are hopeful of finding payable reefs, for they have found "floaters" which have yielded quite high gold values. At present all that can be written of the field is that there are possibilities of finding payable gold by future prospecting."

Griffith's P.A.—This prospecting area adjoins Smith's P.A. on the southern side, the owners following down a lode formation nearly vertically for a depth of 36 feet, at which depth it turned over to a nearly horizontal position. The lode formation, which trends a little north of west, consists of hornblende schist and includes a sheared quartz vein which appears to be an acid dyke. A sample of the lode formation at the surface gave an assay value of 5 dwts. 11 grs. per ton.

Mineral Lease No. 28 *for Radium.*—A mineral lease for radium has been taken up about three miles south-east of Glenelg townsite and embracing portion of Mt. Lookout. It has been ascertained that the biotite mica, which is fairly plentiful in a pegmatite dyke, contained traces of radium. This pegmatite is in greenstone country almost at its junction with the granite. I understand from Dr. Simpson that the biotite contains about 1 per cent. of a mineral known as xenotime, which is a phosphate of yttrium. This mineral in its turn contains a small percentage of uranium, which is always accompanied by traces of radium.

There is nothing to indicate that this is a commercial proposition, and I cannot encourage the owners to go on with it.

Water Supply.—The water question, both for battery purposes and for domestic supply, was discussed at a meeting of the Progress Association called during my visit.

(a) *Battery Water Supply.*—It was urged that the field could make no progress if prospectors had to send their ore to Coolgardie at a freight cost of approximately £3 13s. 8d. per ton, even though the Mines Department gave a rebate of 25s. per ton, and that no local battery was possible till a water supply had been obtained. The representatives of the Progress Association expressed the opinion that Mr. Howlett would move his battery to Glenelg Hills and crush for the public as soon as a water supply was assured.

In this regard, I note that Mr. Howlett has written to the Under Secretary as follows:—

"As soon as I find the prospectors and prospects warrant a public battery, I will get into communication with the Department with a view to shifting Donovan's battery over."

I am inclined to agree that the Department should endeavour to locate a battery water supply, and I think that boring operations should be undertaken with that object in view. A battery water supply will, however, be of no benefit if there is no battery to make use of it and, as will be seen elsewhere in this report, I consider that the position now justifies the Glenelg Queen G.M. Co. in putting up a battery of their own, and it is to be hoped that satisfactory arrangements will be able to be made with this Company to crush for the public.

(b) *Domestic Water Supply.*—The trouble about the domestic water supply seemed to be that as the local people have no means of storing water special trips for small amounts have been made to the dam 5 miles away for each individual, and in consequence the water is costing them 10s. per 100 gallons. I understand that a request has been made for permission to move a 500-gallon tank, belonging to the Water Supply Department, up to the boarding-house where Mrs. Johnson will look after the water, and that if they are allowed to do this, a contractor named McCarthy will put water into the tank for 5s. per 100 gallons. Unless the tank is particularly wanted for some other purpose, I think that the request might be granted.

SUMMARY AND CONCLUSIONS.

My impressions gained from a brief visit to the field may be summarised as follows:—

The Glenelg Queen is the principal mine in the district. The ore body consists of a quartz reef averaging about 4 feet in width. Three payable shoots of ore have been located at the surface. The principal shoot has been driven on at the 55ft. level (vertical) for 200 feet, and at this depth has proved to be 130 feet in length. A tonnage of perhaps 3,000 tons of high-grade ore may be expected from this shoot between the 55ft. level and the surface.

The Reward Lease and the Great Beacon appear to be next in importance. The payable veins in each case, however, are comparatively small. At the Reward Lease some very rich ore has been crushed, but I gathered these high values were confined to narrow widths. At the Great Beacon a shoot of high grade ore 50 feet long and about a foot wide was met with at the 50ft. level, and it is encouraging to note that in the winze below this level the vein has widened out to 24 inches, assaying just under 2 ounces per ton in value.

Mr. Blatchford considers that the Captain Mack taken over the full width of the lode is too low grade to be profitably mined. He, however, obtained some good, if somewhat erratic values. Small parcels might be expected from this and from some of the other mines if crushing facilities were available.

The district is, without doubt, at a great disadvantage in being so far from the nearest battery, as, even with the cartage subsidy granted by the Department, only the richest ore pays to crush under present conditions.

Furthermore, no water supply for treatment purposes has yet been located, and until this is done a local battery is out of the question. In this respect, I consider the Department might legitimately help the district. The quickest method of locating water would probably be by boring, and I recommend that this be taken in hand.

7.—MICA AND BERYL NEAR KIRUP AND MULLALYUP.
(8/8/1927.)

As instructed, I paid a visit to this district and inspected two reported deposits of mica and one of beryl.

White and Smith's Mica Mine.—This mica deposit is situated about 2 miles N.N.W. of Mullalyup station, and is about equal distance East-South-East of Kirup. It has been known of for many years, and its position is shown on Lands Litho. 414C/40. The mica is of the muscovite variety, and occurs as usual in the form of books in a pegmatite vein which in this instance is about 12 inches in width. This vein is nearly vertical, and has a north-easterly strike. The present holders have sunk a small prospecting shaft on it to a depth of about 25 feet.

Small mica only was showing at the bottom of the shaft. Better sizes were obtainable from a small opencut a little to the north-east of the shaft.

The prospectors had taken out from two to three cwt. of rough mica from which a smaller quantity of good quality mica had been picked out and cut into sizes of from 3in. x 2in. to 5in. x 4in. To ascertain its market value in the various sizes, samples of this mica were sent by the Department to the Agent General, London. The Hecla Electrics Proprietary, Limited, Melbourne, and Commonwealth Mica Company, Melbourne, and Messrs. Lee & Giles, Sydney. Up to the present there has been a reply from one firm only, viz., the Hecla Electrics Proprietary, Limited. This firm evidently requires mica of three sizes only. They are prepared to purchase it cut to the following sizes or of such a size as would cut to these sizes:—6in. x 1¼in., 5¾in. x 1¼in., 5½in. x 1⅛in.

For mica of regular cut and of size sufficiently large to be cut to these sizes they are offering 9s. per lb., f.o.b., Perth. For mica cut to the required sizes they offer 12s. per lb.

Samples of the pegmatite and of the mica schist alongside the pegmatite were sent to Dr. Simpson, Government Mineralogist and Analyst for examination. His report is as follows:—

"(2) *Micaceous pegmatite.*—Quartz, muscovite mica, felspar, limonite and kaolin with stainings of manganese oxides. A concentration test gave 0.5 per cent. concentrates containing spessartite (manganese garnet), tourmaline, haematite, magnetite and zircon.

(3) Gneiss country of pegmatite.—Quartz, mica, felspar, limonite and kaolin stained with manganese oxides. A concentration test gave 6 per cent. of concentrate consisting mainly of spessartite with some tourmaline, magnetitic and a little zircon."

Oliver's Mica Mine.—An old mica mine about ¾ mile south-west of Mullalyup station has been taken up by Oliver. The occurrence would seem to be generally similar to that of White and Smith's, but little inspection was possible as the principal opencut was full of water. In this case the pegmatite carrying the mica was perhaps two feet or a little more in width. As in the former case the vein was a north-easterly one.

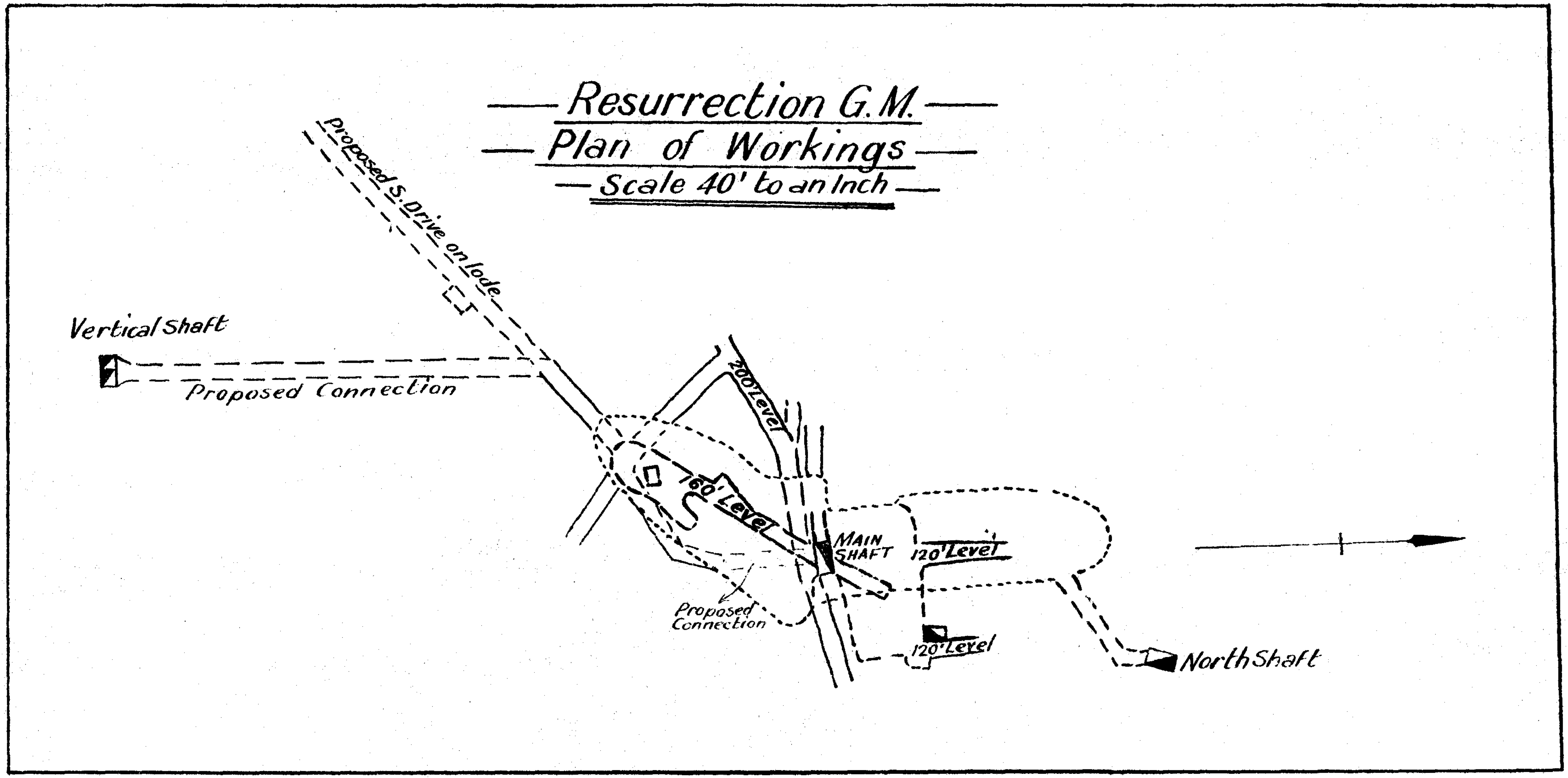
Beryl at Kirup.—Beryl occurs about 2½ miles west of Kirup in several small pegmatite veins. It was thought by the prospector that the beryl might be in sufficient quantities to be profitably mined. An inspection showed that the beryl was not very plentiful. It occurred as crystals of a pale yellow greenish tint, the largest seen being a few inches in length. In all instances noted these were embedded in white quartz. This occurrence is interesting, but of no commercial importance.

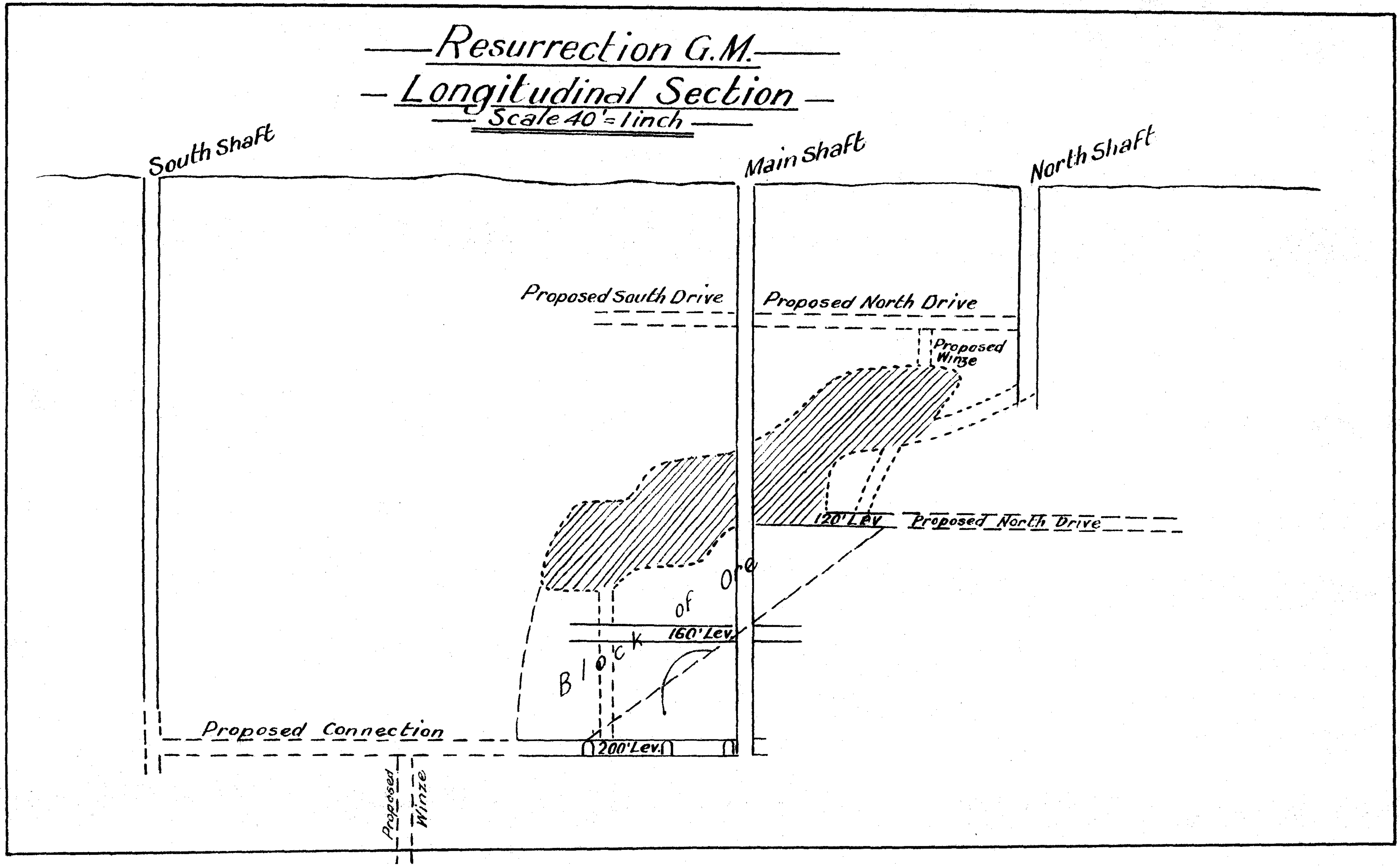
8.—RESURRECTION GOLD MINE.
(4/8/27.)

As instructed I inspected this mine in connection with an application for a loan to carry out certain development, and have to report as follows:—

Geology.

The ore body is of an interesting type geologically, in that it occurs in very ancient sediments. A ferruginous quartzite lode would seem to have been crushed and shattered and enriched by later gold-bearing solutions. The lode is now of the nature of a quartz and quartzite breccia, having very little structure and containing nodules of concretionary ironstone. In places the quartz is now in the form of running sand; elsewhere it occurs as shattered pieces, which can be squeezed to a sand between the

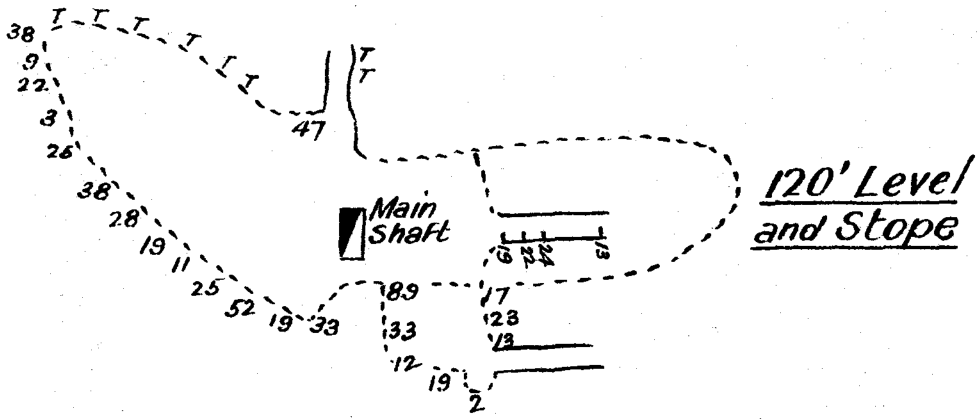

Resurrection G.M.
Plan of Workings
Scale 40' to an Inch
Proposed S. Drive on lode
Vertical Shaft
Proposed Connection
200' Level
160' Level
MAIN SHAFT
120' Level
Proposed Connection
120' Level
North Shaft

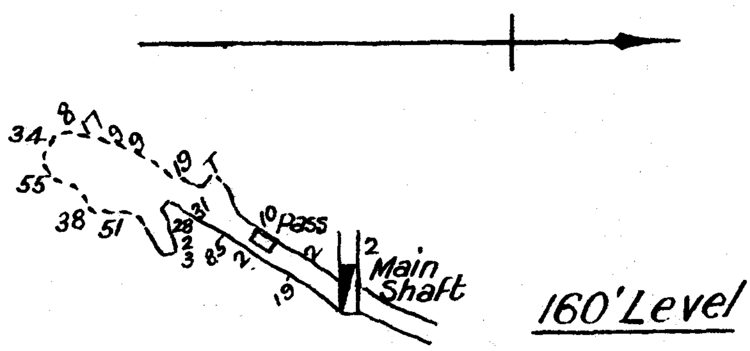

Resurrection G.M.
Longitudinal Section
Scale 40' = 1 inch
South Shaft
Main Shaft
North Shaft
Proposed South Drive
Proposed North Drive
Proposed Winze
120' Lev
Proposed North Drive
Block of Ore
160' Lev.
Proposed Connection
200' Lev.
Proposed Winze

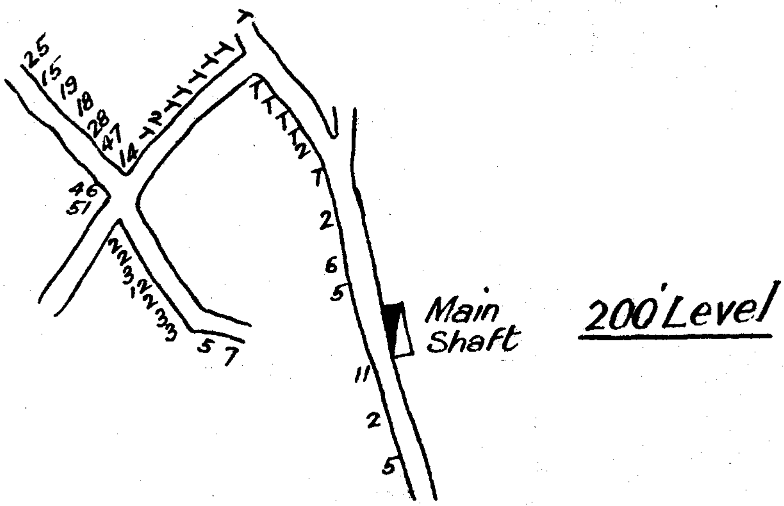
— Resurrection G.M. —

— Assay Plan — Scale 40' = 1 inch —

— Values in Shillings per ton —

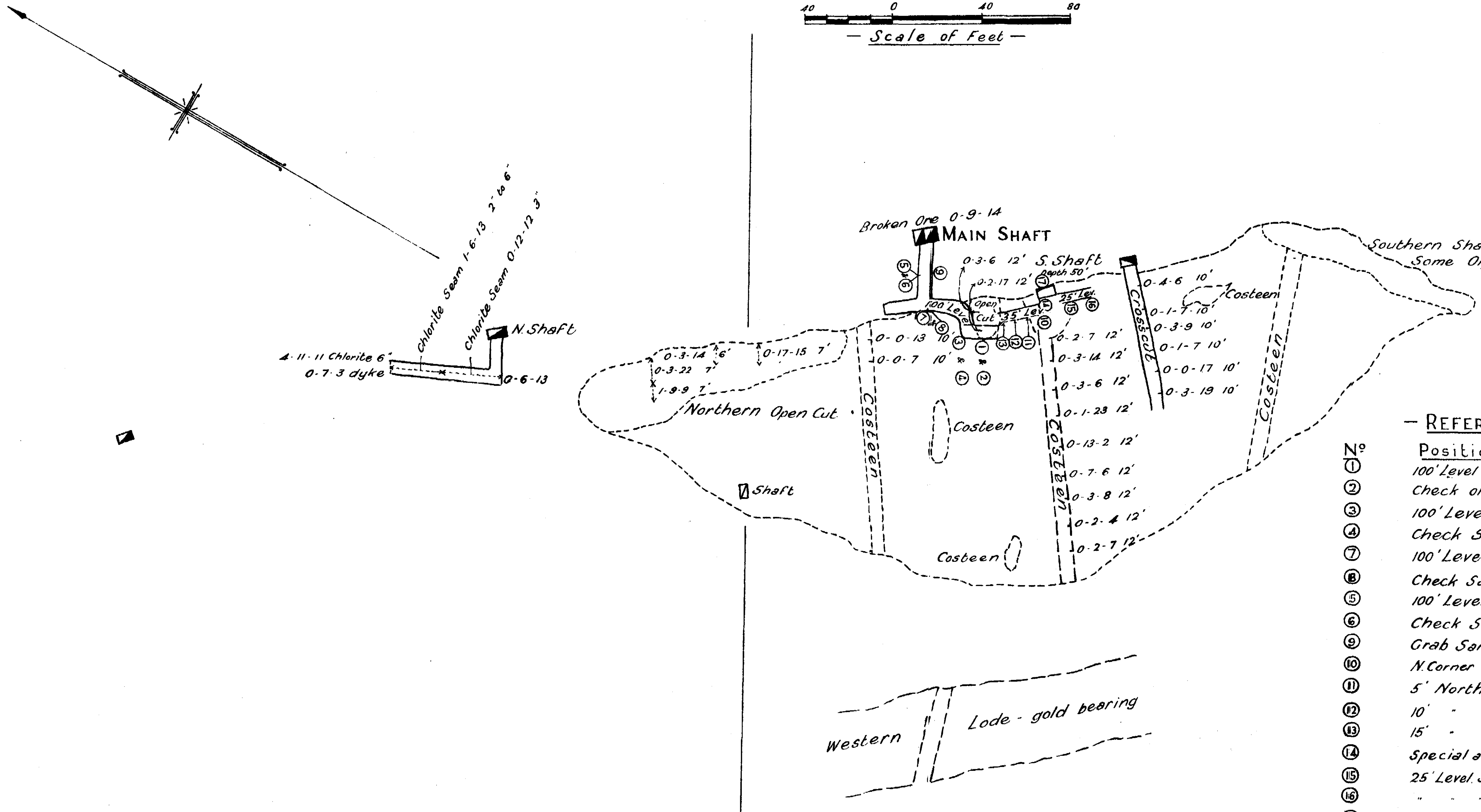






ASSAY PLAN

LA FORTUNA GOLD MINE



— Reference to Numbers —

Nº	Position of Samples	Values
1	100' Level S. Drive 7' from face 12"	0-1-0
2	Check of Nº1	0-0-10
3	100' Level S. Drive at bend 15"	0-0-10
4	Check Sample	0-0-10
7	100' Level at Main Xcut 48"	0-1-2
8	Check Sample	0-1-2
5	100' Level Grab Sample broken Ore	0-1-7
6	Check Sample	0-1-15
9	Grab Sample of Chlorite Ore	0-9-14
10	N. Corner Nº1 S. Shaft 35' Level N Drive 48"	0-13-5
11	5' North " " " 48"	0-1-23
12	10' " " " " 42"	0-2-21
13	15' " " " " 36"	0-1-18
14	Special at N. corner F.W. 18"	0-3-1
15	25' Level S. Drive 5' N 48"	0-4-3
16	" " " 10' N 48"	0-1-0
17	Special by Mr Vale 4'-10' below surface 5' W of Shaft	0-9-3

fingers. The lode which is practically vertical has a north-easterly strike. There are no defined walls. Values extend over considerable width. In places the lode has been mined for a width of over 40 feet. The best values seem to occur in a shoot of ore which pitches to the south at an angle of about 45 degrees.

Grade of Ore.

The returns show that 3,149 tons of ore have been treated from this mine, yielding 924.36 fine ounces of gold, or an average value of 5.86 dwts. per ton, or 24s. 11d. per ton.

The mine samples indicate that very little ore of any value has been left on the western side of the stope, but the samples along the eastern side of the stope and in the drives at the 120ft. level average 22s. 8d. per ton. The samples at the 160 feet level average 23s. 3d. per ton. At the 200ft. level no payable values are met with in the workings north of the crosscut 60 feet south of the main shaft, but in the south drive from this crosscut, which has been driven 35 feet, the assays average 23s. 8d. per ton, and the face is worth 25s. 0d. per ton.

Proposed Development Work.

The development programme in the official application is as follows:—

—		Estimated Cost per Foot.	Total Cost.
	ft.	s. d.	£
Driving at 200ft. level ...	200	30 0	300
Sinking No. 1 Shaft 100ft. ...	100	80 0	400
300ft. level, driving and crosscutting	200	30 0	300
300ft. level, winzing	80	35 0	140
	580	...	£1,140

While at the mine, however, Mr. Graham submitted to me the following amended programme of development work:—

—		Estimated Cost per Foot.	Estimated Total Cost.
	ft.	£ s. d.	£ s. d.
1.—50ft. level, driving South	50	1 5 0	62 10 0
2.—50ft. level, winzing ...	30	1 10 0	45 0 0
3.—100ft. level, driving North	100	1 5 0	125 0 0
4.—Sinking new shaft to 200ft. level	30	5 0 0	150 0 0
5.—200ft. level, North drive to connect	130	2 10 0	325 0 0
6.—200ft. level, drive to main shaft from old drives	30	1 5 0	37 10 0
7.—200ft. level, driving South on lode ...	100	1 10 0	150 0 0
8.—200ft. level, winzing ...	50	2 10 0	125 0 0
			£1,020 0 0

While all the development work proposed may be described as useful, the most important work is to convert the south shaft into a main haulage shaft. The present main shaft is right in the centre of the ore body and is not in a good state of repair. Furthermore, the shoot of ore appears to be dipping south. In consequence the south shaft, which is in a fairly good state of repair, is the better shaft to convert into the main haulage shaft.

The working costs at the Great Victoria Mine were, I understand, from 12s. to 15s. per ton. They should not be more than 20s. on the Resurrection provided that the whole lode can be mined.

I consider, therefore, that there is quite a reasonable chance that this mine can be profitably operated.

9.—LES TROIS G.M. SYNDICATE.

(21/9/1927.)

This mine is situated about three miles west of Westonia townsite.

The ore body consists of quartz veins having a strike a little west of north and dipping to the east at an angle of about 60 degrees. The quartz veins occur in greenstone country and are associated with pegmatite dykes. An underlay shaft has been sunk to a depth of 160 feet, on either side of which a short shoot of ore has been worked out. I am informed that only the best of the ore was taken out.

At the 160ft. level the North Drive has been driven 27 feet on a footwall vein, and the south drive 33 feet on a hanging-wall vein.

Between these veins is about 12 feet of mixed country and quartz leaders. The owners are of opinion that it will pay to take out the whole of this ground. In March last a crushing was taken out above the south drive and for a few feet under it, giving a return of 44 ounces from 82 tons of ore crushed. The total output is 594 tons for 505.41 ounces. As no sampling was done, I am not able to indicate the distribution of values.

10.—LA FORTUNA G.M.

(24/10/1927.)

As instructed by the Hon. Minister, I again looked into Mr. Vale's application for assistance to put up a plant on the La Fortuna G.M.

My previous report on this mine will be found on page 58 of Annual Report for 1924. The only work that has been done since then is about 50 feet of driving at the 100ft. level. This driving was done on a chloritic seam along the main ore body. This has, however, been exposed at two places in the south drive for 12 inches and 15 inches respectively, and for a width of 48 inches opposite the main crosscut. Two grab samples of the ore broken from this level assayed 1 dwt. 7 grs. and 1 dwt. 15 grs. respectively. The faces from which this ore was broken averaged a little under 1 dwt. per ton. A north drive off a shaft a little to the south of the main shaft at a depth of 35 feet (which on my previous visit was inaccessible) was sampled and averaged 4 dwts. 22grs. per ton in value over a width of 43 inches. A south drive off this shaft at a depth of 25 feet averaged 2 dwts. 13 grs. per ton for a width of 48 inches. Two special samples taken by Mr. Vale assayed 3 dwt. 1 gr. and 9 dwts.. 3 grs. respectively.

The results of this sampling do not improve the general position. I am still of opinion that when bulked this ore will prove to be a little too low grade to admit of profitable working.

The results of my previous sampling were, however, sufficiently encouraging to warrant some expenditure on approved development work.

I would also be prepared to recommend the breaking and crushing at the State Battery, Ora Banda, of a trial crushing broken under the supervision of the Inspector of Mines.

11.—CRUSHING FACILITIES FOR BULLFINCH.

(8/12/1927.)

As instructed, I again visited Bullfinch to look into the claims of the ore-producers to local crushing facilities.

Ewan MacDonnell's P.A. 1398.—On this Prospecting Area my previous sampling showed payable values in an open-cut over a width of approximately 50 feet. (See plan, page 82 of 170/25.) MacDonnell has increased the width of the face by 8 feet. This portion of the lode proved unpayable, however, the ore averaging 1 dwt. 17 grs. per ton in value.

Although little ore can be said to be developed, there are reasonable prospects of a considerable tonnage of ore being obtained here.

No estimate can be made, however, as the amount of ore obtained will depend entirely on how far payable values continue past the present face.

Cooper's G.M.L. 3337.—Cooper has been working a footwall make of ore along the western side of an open-cut, as indicated in the attached sketch.* This footwall make of ore has now been proved for a length of about 100 feet. Cooper's crushings have been obtained from the northern end, the present face of which gave assay values of 11 dwts. 10 grs. and 13 dwts. 23 grs. over a width of 66 inches. Fair values were met with in a footwall crosscut at a depth of 35 feet below surface further south. An underlay shaft might, with advantage, now be sunk on the exposed body of ore to ascertain to what depth values are maintained and also whether this make of ore joins up with the main body.

Like MacDonnell's Prospecting Area, there are indications that further development work might open up quite a considerable tonnage of ore.

Pritchard and Parker, P.A. 1600, have sunk a number of shafts in an opencut and are getting out small tonnages.

Lord has sunk a shaft about 30 feet deep, and I am informed, had met with a rich patch. No driving had been done from the shaft. I understand that since my visit he has found another rich patch.

Hansford Haven G.M.L. 3340.—At Hansford Haven a strong quartz reef has been exposed by shallow shafts and costeans for a length of over 600 feet. My sampling indicated, however, that values were restricted to one short shoot which the owners have been working out. Other shoots of ore may be found, but outside of the shoots of ore this quartz reef is poor and unpayable, and consequently no great tonnage is to be expected from it.

Orr's P.A. 1687.—This prospecting area is situated about half a mile north of Hansford Haven. No one was present during my visit. A shallow shaft has been sunk on a quartz reef, 7 feet wide, having a strike of N. 62 deg. W., and about 6 feet of driving done.

During the year 110 tons of ore were crushed averaging 6 dwts. 20 grs. per ton in value.

J. Burnett's P.A. 1736.—Burnett was working a quartz reef having a strike of 300 deg. and dipping to the south. At the bottom the vein was 18 inches in width. Burnett obtained good dish prospects while I was there. My two samples, however, carried traces only of gold. It is evidently patchy.

Output.

The ore sent from this district to the State Battery at Coolgardie was as follows:—

——	Date of Crushing.	Tons Crushed.	Yield per ton.			Tailings Allowed.	Yield per ton.	
			oz.	dwt.	grs.	tons.	dwt.	grs.
Orr & Taylor, P.A. 1687	February ...	24	0	3	22	10½	1	0
	June	56	0	3	12	49	1	10
	September ...	30¼	0	8	12	25½	2	6
Cooper, "Easter Gift," G.M.L. 3337	February ...	38½	0	15	2	32½	3	16
	May	95½	0	10	7	81	1	19
	August ...	18½	2	0	9	15¾	4	14
	October ...	44	0	11	22	37½	2	16
Carlsen, "Hansford Haven," G.M.L. 3340 ...	August ...	75	0	14	15	63¾	2	16
	October ...	69½	0	6	10	59	1	22
Lord, P.A. 1646	March	36½	1	2	14	31	6	5
	May	18¾	0	14	22	14	4	21
	October ...	26	0	16	1	22	4	14
Parker & Pritchard, P.A. 1600	February ...	26	0	19	11	22	10	9
	May	28¾	0	7	6	24½	3	20
	November ...	21½	1	11	8	18¼	13	22
E. MacDonnell, ...	February ...	37	0	9	23	...	3	5
Total	... ...	645¾	...			...	...	

*Not reproduced.

General Remarks and Recommendation.

The position at Bullfinch, as I see it, is that Cooper and MacDonnell's holdings give promise of being able to produce fair tonnages of ore, and other producers of smaller amounts. The tonnage crushed at the State Battery this year amounted to 645¾ tons. The amount of ore reasonably to be expected does not seem to justify the erection of a State Battery with all its accessories. A better solution seems to me to be the erection of a plant on one of the holdings and sale to the owner on the hire purchase system conditionally upon his crushing for the public on equitable terms.

12.—PROPOSED HEAP LEACHING AT WHIM WELL COPPER MINE.

(27/2/1928.)

Acting upon official instructions I visited the Whim Well Copper Mine, arriving on the 25th and leaving on the 29th November, 1927, to investigate a proposal for a substantial loan to instal a heap leaching plant at the mine.

A fairly comprehensive report on this mine and its prospects by Mr. T. Blatchford was published in pamphlet form in 1921. This report should be read in conjunction with the present one, as very little work has been done since it was written, and in consequence my own conclusions are based largely on the information it contains, and which it seems unnecessary for me to repeat except in a very general way.

Locality.

As stated in the above-mentioned report the Whim Well Mine is situated about 50 miles east of Roebourne and 13 miles south of Balla Balla, where a small wharf has been erected in a salt water creek from which it might here be mentioned it is proposed to pump salt water to the mine for leaching purposes.

Balla Balla is connected with the mine by a tram line, which carries a light locomotive and a rake of trucks. From the wharf the ore is lightered to large vessels which anchor under the shelter of Depuch Island.

Geology and Nature of Ore Body.

The geology of the district is adequately described in Mr. Blatchford's report. Suffice it to say that the ore body occurs in a sedimentary series of slates of more or less undetermined geological age. From their lithological structure, Mr. Blatchford concluded that they do not belong to the Mosquito Creek series, but are more likely to belong to the Nullagine (younger) or an intermediate series.

The ore body is essentially of the lode type, and consists of sheared and altered slate which has been impregnated by copper-bearing solutions.

As is usual with ore bodies of this type, there are no defined walls. The copper contents often extend over a big width, and there is a gradual transition from the lode proper to pure country rock. This is indicated by the assay results obtained in the bore holes set out in detail in Mr. Blatchford's report.

Another feature of the lode is its flatness being inclined at an angle of about 25 degrees only from the horizontal. This flatness combined with the fact that the lode occurs in hilly country causes the outcrop to be a very irregularly shaped line.

The flatness of the lode is also responsible for another important fact, namely, that here is much greater tonnage of oxidised ore than would have been the case had the lode been vertical or inclined at a steep angle.

As will be noted by reference to the mine plan accompanying this report, the workings extend over an area of 840,000 square feet, roughly, viz., 1,200 feet in an east and west direction along the strike by 700 feet in the opposite direction. The lode has in most places been mined for widths of from 6 to 12 feet but, in places, up to 35 and 40 feet. The average width mined might be about 10 feet.

This does not represent the full width of the lode, but merely the width which could profitably be mined under the conditions existing at the time it was taken out.

Ore production.

Since the commencement of operations the ore shipped amounts to 75,213.25 tons, containing 9,918.20 tons of copper valued at £650,588, or an average value of 13.2 per cent. of copper per ton.

Ore reserves.

Upon the all-important question of ore reserves, Mr. Blatchford writes as follows:—

> "From the nature of the deposit and the inability to treat low grade copper ore at Whim Well, the mine workings, as has already been explained, are such that no ore reserves except the pillars exist in the mine, taking ore reserves in the strict meaning of the term. It is quite likely that there never were any ore reserves of any considerable quantity ever blocked but since the mine was first opened up. Yet since 1906 123,500 tons of ore were mined, not including ore broken and lying in the mine workings, up to the beginning of the year 1914, from which 55,724 tons of 15 per cent. ore were hand picked, and still the mine goes on producing high grade copper ore by the same methods of mining. If anyone asks the question, what ore is left in the floor and roofs of the old stopes, there is no reply, for no one knows; how far does the ore extend east and west? No one knows, except that copper is found on the surface in shallow workings near the surface over a distance of 2,700 feet. In discussing ore reserves quantities must be mere conjecture, and ore reserves can be merely guessed at by taking into consideration past experiences."

The writer regards the above as being a correct statement of the present position which, however, is rather unsatisfactory, and has arisen from the following causes:—

(1) Development has been allowed to get behind hand.

(2) The mine has not been systematically sampled, and the results recorded on an assay plan.

An indication at least of the value of the ore in the floors and roofs of the old stopes would have been afforded us had all shafts and adits been carefully sampled in sections. In justice to the management, it should be stated, however, that at the time the mine was being operated high grade ore only could be profitably mined, and the necessity to record all information with regard to the low grade ore was not so apparent as it is to day. As things are, no estimate of the ore left in the walls can be made until a number of exposures are made by shafts, rises and winzes or the walls have been tested by systematic boring.

From the nature of the deposit, however, when we consider that the ore body is a very wide one. and contains ore of all grades from the poorest to the richest, and that over 75,213 tons of ore averaging over 13.2 per cent. of copper have been won, it does seem reasonable to suppose that there is a very much greater tonnage of ore ranging from 3 per cent. to 7 per cent. left in the mine. Six samples taken during my visit in exposures at shallow depths where the ore is readily accessible bear out this contention, the results being as follows:—

Sample No.	Description.	Value Cu.
		per cent.
1	West end sample taken along pillars every 10 ft. for a length of 50ft. Average height 7ft.	9·36
2	West end top stope sample, represents cuts every 12ft. for a length of 120ft. Height 6ft.	5·25
3	West end bottom stope, one cut taken diagonally length of cut 50ft. ...	6·23
4	Trig. Hill bottom cutting sample of bottom (*i.e.*, footwall) for 30ft. every 5ft. width 3ft.	7·88
5	Top of Trig. Hill sample taken on both sides of cutting every 10ft. for 70ft. long, height 6ft.	9·02
6	North stope open cut sample taken around faces and pillars every 10ft. for about 200ft. and 8ft. high ...	17·40

The information afforded by four composite samples taken by Mr. Sleeman is also favourable. In order to secure representative samples for experimental purposes, he took about 120 cuts across the lode in the positions indicated on a plan attached and made four samples of them, with the following results:—

——	No. of cuts.	Value Cu.
		per cent.
No. 1.—Central bottom	37	6·21
No. 2.—Central intermediate ...	33	4·85
No. 3—Central surface	29	5·96
No. 4.—West end	21	5·62

These samples were not taken with the object of arriving at the average grade of the ore, but to secure a sample having the general characteristics of the ore in various parts of the mine, nevertheless, they do indicate that the pillars left in the mine have an average value between 5 per cent. and 6 per cent. of copper.

Broken Ore.

The broken ore in the dumps at the surface was estimated by Major Beesley in October, 1923, at 60,206 tons, as follows:—

Dump.	Location.	Tonnage.	Copper.	Remarks.
			%	Average of—
1	Main mill ...	20,787	3·382	20 samples
2	Shaft	4,313	3·636	4 "
3	West end fines	5,199	4·830	6 "
4	Rejects ...	3,674	2·150	
5	East end fines	3,110	6·890	3 "
6	Incline coarse	6,020	4·530	5 "
7	Adit, coarse ...	4,013	2·388	5 "
		47,116	3·762	
1	Main mill ...	13,090	...	Partially leached not sampled.
		60,206		

In addition to the above there are miscellaneous heaps at surface and underground, estimated by Mr. Sleeman at 20,000 tons, making a total of 80,000 tons.

Mr. Sleeman gives the average value of the whole of this broken ore as approximately 4 per cent. His estimate is based to some extent on the value of the ore rejected when it was necessary to select the best ore for shipment. Based on Major Beesley's figures, an average of about 3.5 per cent. seems to be about what can reasonably be relied upon.

Our information regarding available ore supplies may therefore be summed up as follows:—

There is a large area of unproven ground which may be expected to supply low grade ore as well as possibly, ore of equal grade to that already mined. Where ore has been mined the richest portions of the lode only have been taken leaving the poorer grade of ore still standing in the walls. These operations produced over 75,000 tons of dressed ore averaging 13.2 Cu.

Mr. Sleeman, writing to his directors, stated that in his opinion 1,000,000 tons of low grade ore would be obtainable. There is in my opinion the possibility that a tonnage of some such dimensions may be obtainable, but at present there is not sufficient information available to admit of an estimate being made on which any reliance can be placed.

In addition to the ore in the mine there is an estimated amount of 80,000 tons of broken ore available for treatment. This in itself at the rate of 200 tons per day will afford a supply of ore for 15 months.

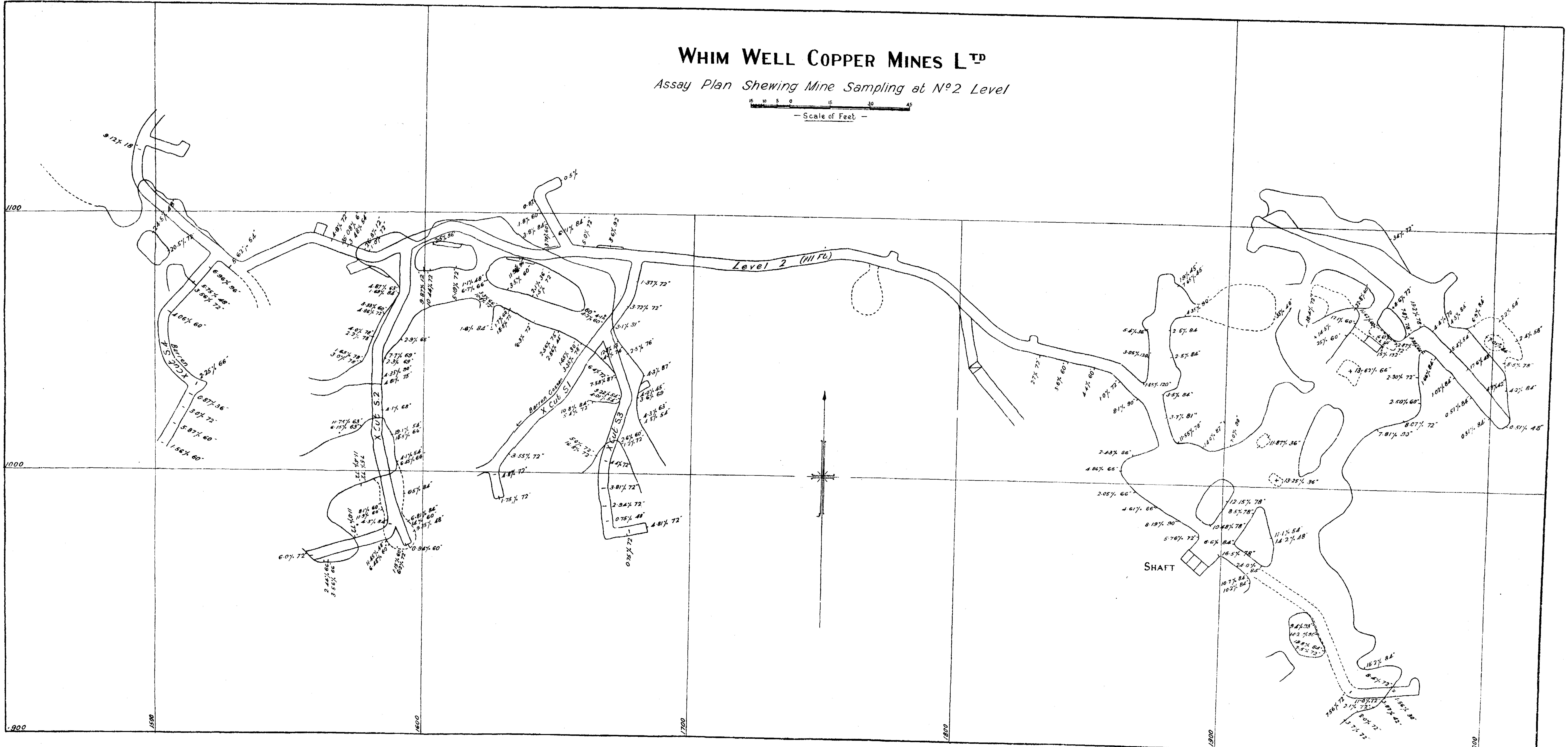
It does not look, therefore, at all likely that there will be a shortage of ore supplies for some considerable time to come on a leaching scheme based on a tonnage of 200 tons per day.

Proposed Treatment.

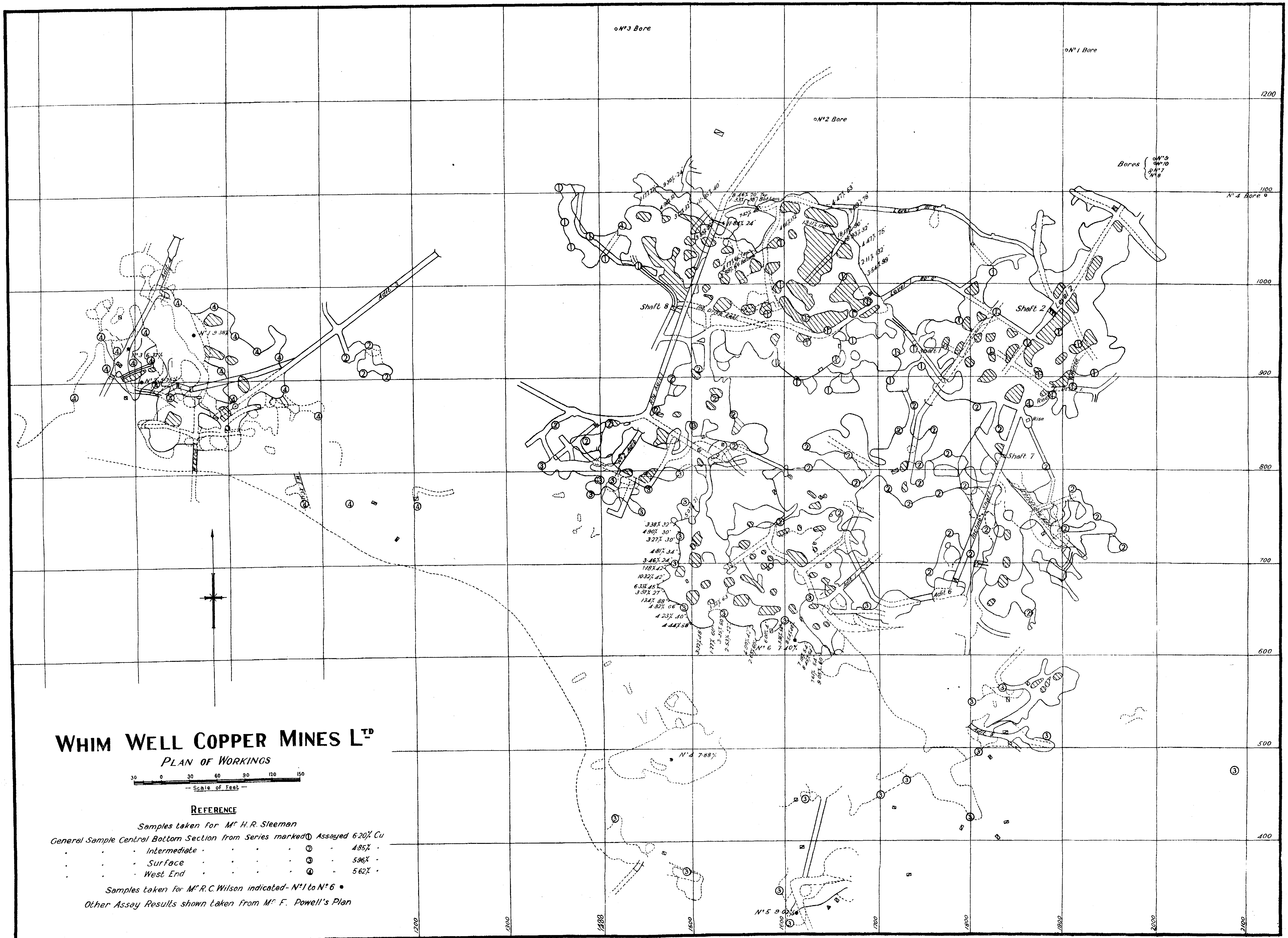
It is proposed to begin operations by treating the ore already broken at surface as follows:—

(1) Ore to be crushed to a size which will give best results by leaching; about ½-inch diameter or thereabouts is suggested.

(2) Crushed ore is to be discharged on to a prepared floor, probably of cement. The height of the heap to be at least 20 feet and its initial size about 6,000 tons.



WHIM WELL COPPER MINES LTD
Assay Plan Shewing Mine Sampling at No 2 Level
15 10 5 0 15 30 45
— Scale of Feet —
Level 2 (111 Ft)
X Cut S1
X Cut S2
X Cut S3
X Cut S4
Barren
Barren Gossan
SHAFT
1100
1000
900
1500
1600
1700
1800
1900
2000


WHIM WELL COPPER MINES L^TD
PLAN OF WORKINGS
30 0 30 60 90 120 150
Scale of Feet
REFERENCE
Samples taken for Mr H.R. Sleeman
General Sample Central Bottom Section from Series marked ① Assayed 6.20% Cu
" " " Intermediate " " " " ② " 4.85% "
" " " Surface " " " " ③ " 5.96% "
" " " West End " " " " ④ " 5.62% "
Samples taken for Mr R.C. Wilson indicated - No 1 to No 6 ●
Other Assay Results shown taken from Mr F. Powell's Plan
No 3 Bore
No 1 Bore
No 2 Bore
No 4 Bore
Bores No 9 No 10 No 7 No 8
Shaft 8
Shaft 2
Shaft 7
Adit 6
Rise
1200
1100
1000
900
800
700
600
500
400
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
No 4 7.88%
No 5 8.02%
No 6 7.40%
No 1 9.38%
No 3 6.32%

(3) The heap to be divided into sections and leached with either of the following solutions:

(a) Sea water charged with SO_2; or

(b) Sea water + Commercial H_2SO_4; or

(c) Sea water with $FeSO_4$ in solution.

(4) The solution to drain into a sump and to be pumped to the cementation plant, where the copper is precipitated on scrap iron.

(5) The solution to be brought up to the required strength again by charging it with SO_2.

A certain amount of experimental work has been carried out by Mr. Sleeman. This is described in detail in a paper entitled "The use of Ferrous Salts and of Heap Leaching for the extraction of copper from oxidised ore." He reported extremely satisfactory results, and at his request some experimental work was carried out at the School of Mines, Kalgoorlie, on the lines suggested by him. Messrs. Moore and Winter, who conducted the experiments, reported that in the sample submitted to them the copper was present as Malachite $CuCO_3$, $Cu(OH)_2$, Azurite $2CuCO_3$, $Cu(OH)_2$, and Chrysocolla, CuO, SiO_2, $2H_2O$. The total copper content was 4.8 per cent., of which 3.68 was soluble in acetic acid. Solubility in acetic acid was assumed to indicate the amount of copper present as carbonates and oxide, the insoluble portion being considered to be present in the form of chrysocolla, which is not attacked by that acid. Their experiments went to show that chryscolla was also insoluble in a solution of ferrous chloride and sulphate, and that for the purpose of leaching with such a solution the actual value of the ore was 3.68 per cent. copper. Messrs. Moore and Winter's conclusions were as follows:—

1. Heap leaching of Whim Creek ore with ferrous sulphate or ferrous chloride solution offers no difficulty.
2. Intermittent leaching yields more rapid extraction than continuous leaching.
3. Ferrous chloride is a more efficient solvent than ferrous sulphate for oxidised copper ores.
4. The rate of solution of the copper increases with the temperature.
5. Aeration of the heap by allowing it to stand for certain periods increases the rate of solution of the copper.
6. Aeration of the liquor results in no appreciable increase in rate of solution.
7. Deposition of ferric hydroxide in the heap normally causes no trouble.
8. Precipitation by means of metallic iron is rapid and complete and yields a high-grade cement copper.
9. Apparently, complete precipitation of the copper from the solution does not result in diminished rate of extraction of copper from the ore.
10. The presence of copper sulphate in the liquor entering the heap does not increase the rate of solution of copper from the ore.
11. Chrysocolla is not attacked by solutions of ferrous sulphate or chloride, either cold or hot.

These results must be regarded as being very satisfactory as far as they go, but it must be borne in mind that they were confined to the action of ferrous sulphate and chloride solutions and that no work has been done to test the efficiency of the weakened solutions, charged with SO_2 in order to bring them up to the required strength again.

This portion of the process is so similar to the Pechey process that one would naturally expect equally satisfactory results. Precise information regarding the results obtained at Mt. Hope is, unfortunately, not obtainable.

When it is borne in mind that chryscolla, although insoluble in ferrous chloride and sulphate solutions, is nevertheless soluble in a solution of SO_2, it might easily turn out that the cementation tail solution, when charged with SO_2, is a better solvent than the original. One of the objections to SO_2 leaching is the danger of forming insoluble cuprous compounds. In this connection, Barneveld * and Leaver, in an article on "Leaching non-sulphide copper ores with Sulphur Dioxide," have expressed themselves as follows:—

"In the method of leaching described in this paper, care is taken to supply enough oxygen, in the form of air, to insure the rapid and complete oxidation of all sulphites as they are formed; the bisulphite would not be likely to form. The main reactions to be considered are as follows:—

"(Malachite) $CuCO_3CuOH_2O + 2SO_2 + H_2O = 2CuSO_3 + CO_2 + 2H_2O$.

"(Chrysocolla) $CuSiO_32H_2O + SO_2 + H_2O = CuSO_3 + H_2SiO_3 + 2H_2O$.

"(Cuprite) $Cu_2O + 2SO_2 + H_2O = 2CuSO_3 + H_2O$.

"Contact between cupric sulphite ($CuSO_3$) solutions and the mineral CuO results in the formation of both cupric sulphate ($CuSO_4$) and cupro-cupric sulphite ($Cu_2SO_3CuSO_3$),

$3CuSO_3 + CuO = Cu_2SO_3CuSO_3 + CuSO_4$.

"This double salt will remain dissolved in very weak sulphurous acid. When the excess SO_2 necessary to maintain sulphites in solution is expelled by aeration or by the application of heat or a vacuum, any copper in solution which has not been oxidised to sulphate will precipitate as cupro-cupric sulphite, a heavy dark red crystalline compound that settles readily. Once precipitated, this double salt is only slightly soluble in weak sulphurous acid, a 1 per cent. solution having practically no effect. As the SO_2 content of a solution increases its solvent action increases, and in a 5 per cent. solution the cupro-cupric sulphite is completely soluble."

Further on in the same article the authors write as follows:—

"Copper sulphites are very unstable; it is difficult to keep them in solution and to control their precipitation; moreover, they are quite easily oxidised to sulphates, and it is almost impossible to prevent some oxidation. Then why not eliminate sulphite precipitation by leaching with a large excess of SO_2 and enough air to insure prompt oxidation to the stable sulphate?

Vadner, writing in the Engineering and Mining Journal Press in June, 1924, states that common salt (NaCl) solution is a solvent for this precipitate and, used in conjunction with SO_2 gas and water, prevents the formation of the precipitate.

* Bureau of Mines, Washington, Technical Paper 312 published 1923.

This statement makes the process look quite hopeful.

I have arranged with the Government Mineralogist and Analyst to carry out some further experimental work which will enable us to speak with greater certainty on the point. He will test the efficiency as a solvent of—

(1) An original solution of ferrous sulphate in sea water.

(2) Cementation tail solution charged with SO_2 gas.

PROPOSED PLANT.

The existing plant with minor alterations will be used to crush the ore to the required size. The ore in the heaps at surface will be trucked to a small bin at the foot of the hill on which the plant is situated. From this bin it will be taken to the plant by means of an endless belt.

The ore after being crushed will be taken by means of another belt to a prepared floor on which the heap leaching is to be carried out. Brief details of the plant are as follows:—

From this ore bin the ore passes to a coarse rock-breaker. This is a "Sturtevant" of the jaw breaker type, stated to have a capacity of 12 tons per hour or more. This breaker will reduce the ore to a maximum size of about 2 inches.

From the coarse rock-breaker the ore goes over a screen and thence to a second rock-breaker which will reduce it to a maximum size of perhaps three-quarters of an inch. From this rock-breaker the ore is elevated to hammer screens, from which it passes on to three Sturtevant rolls. These crush it to the final size. Any dust formed is to be removed by means of a suction fan. From here the ore passes to a crushed ore storage bin, from which it goes to the heap to be leached.

The plant is driven by means of a Campbell gas engine for which Denny Bros. are the agents. Its maximum horse-power is stated to be 420. It is a double cylinder engine, and each can be run separately if desired.

The Heap.—The heap is to be on a prepared water-tight floor, and to be at least 20 feet in depth. The surface of the heap will be divided into sections, so that solution may be pumped on to any desired portion of it.

WATER SUPPLY.

No adequate water supply is known of in the vicinity of the mine. It is proposed to obtain a supply by pumping from the fresh and salt water pools in the Balla Balla River, about 9½ miles from the mine.

Amount of Water required.—Mr. Sleeman's experimental work went to show that for a heap 20 feet deep—

(1) 140 gallons of solution will pass through each square foot per day.

(2) 80 per cent. extraction is obtainable for 22 days' leaching.

It follows that 20 cubic feet of ore, or one short ton, is treated for one day by 140 gallons, and that one long ton of ore is treated by 140 x 1.12 gallons of solution. Since the mill will be crushing 200 tons per day, if treatment takes 22 days, it follows that it will be necessary to leach 200 x 22 or 4,400 tons daily to keep pace with the mill.

In order to leach 4,400 tons daily it will be necessary to circulate 4,400 x 140 x 1.12 or 700,000 gallons of solution per day.

If treatment for 31 days is found necessary, it will be necessary to treat 6,200 tons daily and to circulate approximately 1,000,000 gallons of solution daily. As this seems quite possible, these figures will be used as a basis for calculations.

The consumption of water will be the amount lost by evaporation and the amount left in the heap after the completion of leaching operations. There may be in addition a soakage loss, but every effort should be made to avoid it.

On the goldfields I understand that the evaporation loss is about 8 feet per annum. Assuming 12 feet as the rate at Whim Well the evaporation per day works out to 0.4 inches per day, and will depend on the surface exposed to the atmosphere. The size of the dams, etc., is not yet known, but the following figures may be used tentatively:—

	Gallons per day.
Dams, surface, 200ft. x 200ft., at ·4 inches per day	8,300
Heap, surface, 100ft. x 60ft., " " "	1,250
Cementation plant, launders, etc., say	1,250
Total evaporation loss	10,800
50 tons water left in heap to saturate 200 tons ore ...	18,000
Additional water owing to intermittent leaching ...	1,000
	29,800

The water consumption per day would appear therefore to be somewhere in the vicinity of 30,000 gallons.

Mr. O'Brien estimates the cost of installing a pumping plant capable of pumping 50,000 gallons of water per 8 hours at £14,088, the principal item being the cost of the pipes estimated at £11,938.

The fuel cost to pump 50,000 gallons daily if a Diesel engine and oil are used, he estimates at £288 per annum (see 2507/20, p. 168). These figures show that while the first cost of the pumping plant will be heavy the running cost will be comparatively light.

Prospects of Success.

When considering the grade of ore which might be profitably treated, it is interesting to note that the average yield of copper per ton of ore for the entire United States during 1926 was but 1.5 per cent. Mechanical improvements in mine and mill methods have enabled companies to make a profit from ores hitherto considered waste and this profit was obtained despite higher cost of wages, supplies, and equipment.

They work, of course, on a very large scale. For instance, the Inspiration Co. treats five million tons of sulphide ore a year averaging 1.4 per cent. copper.

Until the mine has been systematically sampled by boring, no one can say what quantities of ore of this grade are obtainable at Whim Well, but judging by the nature of the ore body where it is exposed, the results obtained in the bore holes published in Mr. Blatchford's report, the tonnage would be very considerable, and quite possibly comparable with the tonnages of gold ore available at the Wiluna Mine. One bore No. 7 gave quite a remarkable result, viz.—

From 94ft. to 142ft. the average value was 9·4 % Cu.
and
From 142ft. to 158ft. the average value was 2·32 % Cu.

The general average from 94 feet to 216 feet—a width of 122 feet—was 4.7 per cent. copper. This bore is in sulphide ore and has no doubt gone through a portion of the lode wider and higher grade than the average. It may be in the zone of secondary enrichment. Still, it shows the possibility of obtaining large tonnages of ore.

On the whole, I agree with Mr. Blatchford that there is ample oxidised ore to warrant the expenditure of installing a water supply adequate for the running of a leaching process on an extensive scale.

With the information at present at my disposal, it looks as if easily procurable ore averaging 3 per cent. recoverable copper or over should be capable of being profitably treated under existing conditions, and considerably lower grade ore could be treated if operations were carried out on a larger scale.

Working on copper ore of 3 per cent. recoverable copper, treating 200 tons per day, costs and output might be somewhat as follows:—

—	Costs per ton of Ore treated.	
	Mined.	From dump.
	£ s. d.	£ s. d.
*Mining 1·1 tons to get 1 ton ...	0 6 7	0 2 2
Treatment	0 10 0	0 10 0
Scrap iron 0·03 tons at £9 ...	0 5 5	0 5 5
Sulphur 0·005 tons at £9 ...	0 0 11	0 0 11
	1 2 11	0 18 6
200 tons at 22s. 11d. = ...	229 0 0	
200 tons at 18s. 6d. = ...	185 0 0	

Value of 1 ton cement copper, 70 per cent. Cu., with copper at £60 per ton, 70 % of £60 =	£ 42
Returning charge, deductions, freight, bags, etc. ... ... =	10
	£32

200 tons of ore containing 6 tons metallic copper will yield 8·57 tons cement copper at £32 =	£ 274 0 0
Hence 1 ton yields ·0428 tons cement copper worth	1 7 5
Estimated profit per ton of ore treated from dump	0 8 11
Estimated profit per ton of ore treated from mine	0 4 6
Estimated profit per day (200 tons from dump	89 0 0
" " " " mine	45 0 0

* 10 per cent. dust to be removed after crushing.

Mr. Sleeman working on a somewhat different basis estimated the cost per ton of ore treated at 20s. if mined, and 15s. 7d. if obtained from dumps. Working on these figures, and assuming that the cement copper would be smelted to blister copper at the mine, he estimated a profit of 8s. 8d. per ton on ore treated from the mine having a recoverable copper content of 3 per cent., and 13s. 2d. per ton on ore of equal grade from dumps.

The actual cost of mining and treatment will naturally depend largely on the efficiency of the management and the plant.

I have little doubt that a considerable saving could be effected by smelting of the cement copper to blister copper locally, but for the present, at least, this is not contemplated, and consequently my own estimate has been made on the assumption that the cement copper will be bagged and shipped.

Preliminary test under working conditions.

Before deciding to support the project we should I think test out the treatment preferably on the spot, more thoroughly than has yet been done.

I suggest that a wooden structure be built of dimensions 24 feet by 4 feet by 4 feet, which will allow a 20 feet column of ore to be leached under as nearly working conditions as possible.

The solution after passing through the heap will be passed over scrap iron to precipitate its copper content as cement copper, and will then be charged with a known amount of SO_2, and put on the heap again.

The sides of the structure should be water tight to make sure that the solution passes through the whole of the heap, and does not escape through the sides.

Reliable information should be obtainable concerning:—

(1) The rate of percolation.
(2) The length of treatment.
(3) Percentage of copper extractable.
(4) Grade of cement copper obtainable.
(5) Consumption of iron and sulphur.

This test will best be carried out by our Experimental Metallurgist from the School of Mines. It will take perhaps three months of his time, and cost in addition £500 to £600.

I do not think, however, that he could be better employed, as the copper mining industry is at present practically dead, and successful leaching would give it quite a revival.

Summary and Conclusions.

(1) It does look as if heap leaching at Whim Well can be profitably carried out.

(2) Messrs. Moore and Winter's experiments show that ferrous sulphate and chloride solutions will dissolve copper from oxidised ore, and that it can be precipitated from such solutions on scrap iron as

cement copper, but no experiments have yet been made to prove whether the tail solution from the cementation plant, when charged with SO_2 gas, will be an equally effective solvent.

(3) Information is required regarding the amount of solvent necessary to bring the cementation tail solution up to the required strength.

(4) Information is required regarding the best size to crush the ore, the amount of dust which must be removed to prevent any clogging of the leaching solutions, and also with regard to the duration of leaching operations necessary to obtain a satisfactory percentage of extraction.

(5) The lode which dips to the south at an angle of about 25 degrees from the horizontal only consists of sheared and altered slate which has been impregnated by copper bearing solutions over a width of 100 feet or more. In such a deposit I would expect to find ore of all grades and a large tonnage of low grade ore.

(6) Ore reserves cannot be estimated owing to lack of development and lack of sampling; systematic boring and sampling would allow an estimate to be made.

(7) Such information as is available suggests that a very large tonnage of low grade oxidised ore can probably be obtained. Boreholes point to there being, in addition, large tonnages of sulphide ore which, however, it is not proposed to treat at present. The venture, therefore, is one with big possibilities.

(8) In addition to any ore in the mine, the ore heaps of broken ore are estimated at 80,000 tons, averaging from 3.5 to 4 per cent. of copper.

(9) Provided that the proposed leaching test bears out the results assumed, I estimate that, with copper at £60 per ton, all easily obtainable ore containing 3 per cent. extractable copper can be profitably, worked.

APPENDIX No. 3.

Report on the request of the Wiluna Gold Mines, Limited, for Railway Connection of Wiluna with the State Railway System.

By A. Montgomery, M.A., F.G.S., State Mining Engineer.

30/7/1927.

Under instructions from the Hon. the Minister for Mines, I left Perth on 23rd April last to examine the operations of the Wiluna Gold Mines, Limited, at Wiluna, for the purpose of considering how far the progress of this company's mines and the prospects of the Wiluna district in general might justify compliance with the request made by the chairman of the company that a railway should be made forthwith to connect Wiluna with the State railway system. The company have been opening up their mines very energetically since 1924, and now claim that they have proved that these are worthy of working on a scale of output of some 300,000 to 350,000 tons per annum, or say, 1,000 tons per day. They further claim that operations on this scale will justify the construction of a railway to Wiluna, and that this should be made at the earliest possible date, in order to minimise the heavy expenditure for transport which must otherwise be incurred if the large amount of plant and equipment necessary for working the mines has all to be brought on to the ground by cartage from the rail-heads at Meekatharra and Leonora, and also to minimise the working expenses by enabling all operating costs to be reduced to the level prevailing in districts provided with railway facilities in place of the very high rates ruling in a very isolated outlying district as at present. An output of 300,000 tons of ore per annum will probably require a working force on the Wiluna mines of not less than 800 men, which would mean a settled population in the district of probably 3,000 to 5,000 persons, which would be increased if several other mines were also working in this mining centre. The company urge that the traffic requirements of such a population would justify railway communication.

The earlier stages in the development and equipment with treatment machinery of a large mine in an out-back locality are characterised by very heavy working costs of all sorts, the transport expenses of machinery in particular being very serious, and if construction of a railway could be gone on with at once, not only would it cause a very material lowering of permanent working expenses of the mining work, but also it would give the railway its best harvest in freights on the large amount of material required for mining and treatment plant, and building and domestic material for the needs of a large and sudden influx of population. It is an obvious mistake to miss this rich harvest by delay in putting in the railway until most of the construction work has been done, once its necessity is recognised.

Ordinary prudence, however, demands that a work of this magnitude should be guaranteed by preliminary proof that the district for which the railway is to be constructed is in possession of mining resources which can be relied upon to maintain an output of payable ore commensurate with the magnitude of the State's investment in the railway. The Wiluna Gold Mines, Limited, claim that they have given this, the chairman stating at their annual meeting on 7th April last that they had spent for the year ended 31st December, 1926, a sum of £34,338 14s. on mine development, and £21,222 18s. 5d. on plant and machinery, and had developed 329,600 short tons of ore, averaging 39s. 4d. per ton assay value. My examination of the mine was for the purpose of checking the company's estimates of value as far as practicable so as to see how far their reckoning of the size and gold contents of the lode could be confirmed, and in addition to ascertain their proposals as to methods of working the mine and treating the ore therefrom, so as to see if there is a reliable prospect of the work being carried on profitably.

It being clearly impracticable to make a complete resampling of the whole mine without much larger expenditure of time and money than seemed justified, the next best way of verifying the results obtained by the company was to check a considerable portion of the work already done by its management, enough to make certain that their published statements of values were not overstated. If the recorded results were found to be confirmed by independent check sampling and assays in a reasonably large number of cases, the whole of them might be accepted as reliable, and taken at full face value.

I had the very efficient and valuable assistance underground of the District Inspector of Mines, Mr. A. W. Winzar, and two good samplers, and as the samples were brought to surface they were taken to the Wiluna State Battery and there prepared for assay, and assayed in duplicate by Mr. A. E. M. Kildahl, of the Government Mineralogist and Analyst's Department, and his assistant, Mr. Armstrong. I am much indebted to all these gentlemen for their able and untiring assistance. The ore is very hard and flinty, and difficult and slow to work both in cutting samples underground and in grinding to assay fineness on surface.

After consultation with the management, it was decided that the best check on the mine sampling and assays would be to repeat it in the sulphide zone in as many as practicable of the crosscuts which have been made at frequent intervals across the ore-bearing ground. The sampling cuts were made, as far as possible, across the faces of ore cut through by the crosscuts at the same places at which the mine samplers had taken their cuts. The mine sampling system was found to be very complete, tests being taken from the faces of the drives and crosscuts every two feet as the work progressed, and repeated later on at two-feet intervals and in two-feet widths by cutting chip samples across the drives. In the crosscuts the mine samplers take cuts in two-feet widths on both sides of the crosscut, but in checking we usually took only the south side of each crosscut. The tests of the west lode were over two-feet widths, but in the east lode, pressure of time made us take them in three-feet widths. The method of chip sampling is the one almost universally used throughout the large mines of the State, and gives excellent results when the tests are averaged over a considerable number of samples, but it is usual to find quite large discrepancies between individual samplings taken along the same sampling cuts, due to the small amount of ore broken out and its great variability in value. The greater the number of tests taken, however, the more concurrence can be relied upon in the average results, and in comparing the tabulated comparisons in the appendices to this report of my sampling and that of the mine, more importance should be given to agreement of averages than to the assay results of individual samples. The latter frequently show large differences in tests taken at the same points, but it will be seen that it is sometimes the one and sometimes the other sampling which gives the higher results, and that the more they are combined and averaged the more closely do they agree. The final summary of 133 assays happens to result in exactly the same total average figure of value in both series of tests, viz., 33s. 0d. per short ton. The short ton is taken, and values to the nearest shilling, to agree with the practice which has been followed by the mine on its assay plans. A table is also appended, however, showing our individual assay results in ozs. dwts. and grs. per standard ton of 2,240 lbs., as returned by the Government laboratory. The value of fine gold has been taken at full mint parity when expressing it in money, viz., one ounce fine is equal to £4.24473, as in the State Gold and Mineral Statistics, and a return of one ounce fine per standard ton of 2,240 lbs. is equal to £3.7926 (= £3 15s. 10d.) per short ton of 2,000 lbs.

It does not follow that because the comparison of our assays in the crosscuts has agreed with the mine in the average result of 33s. 0d. per short ton, that such figure represents the actual value of the ore-reserves in the mine as a whole. It is only the average of the portions sampled in the crosscuts, taken over various widths, which give a general average of 21 to 22 feet in such crosscuts. In addition to the crosscuts we have to take into account the values in the drives themselves, which have usually been made to follow the main veins of ore, and may often give a higher average value than the crosscuts. The comparison was simply to test a proportion of the mine results to show if they could be accepted *in toto,* and having proved that this is so, we can therefore now take the mine assay figures right through as being entirely reliable, and work upon them in estimating the ore reserves, and this has been done throughout the remainder of this report.

The main crosscut from the new shaft on the East lode at the 290 feet level was not resampled, as this had been already done some time ago by Mr. Blatchford, Assistant State Mining Engineer, whose samples averaged a value of 40s. 9d. per ton over a width of 44 feet, agreeing very closely with the mine result of 40s. 0d. over 42 feet. Addition of this crosscut brings the total average figures for all the crosscuts sampled up to 34s. 0d. per short ton instead of 33s. 0d.

In Appendix No. 1 herewith, Section (A), details have been given of the sampling and assay results shown on the mine assay plans to 18th May, 1927, together with detailed calculations of the ore tonnages which have been more or less thoroughly opened up, and their average value. The sum total of ore developed by the new work of the company above the 200 feet level on the West lode and the 290 feet level on the East lode are taken at—

West lode—59,600 tons at 38s. 0d. per short ton = £114,410.

East lode—403,882 tons at 34s. 3d. per short ton = £692,350.

Total—463,482 tons at 34s. 10d. per short ton = £806,760.

(Total values are taken from details in Appendix I (A), the values per ton being arrived at from fuller figures than those here summarised. The apparent errors in extensions in the summary are due to disregarded fractions.)

In Appendix 1 (A), it will be seen that the management's estimate of the ore reserves as at 18th May, 1927, is considerably higher than the above, being 686,460 short tons of assay value 40s. 3d. per ton, and it is fully explained that the apparent discrepancy between these figures and those calculated by me is mainly due to the mine estimate taking in an allowance for ore below the lowest levels. The mine figures can quite well be accepted and confirmed on this basis. When the levels have been extended throughout the whole length of the lodes known to be ore-bearing, there will probably be not less than 1,000,000 tons of ore above the levels on the West and East lodes at 290 and 200 feet respectively of somewhere about 40s. 0d. value per short ton.

The old workings above the 100 feet level are recorded officially to have yielded to end of 1926 340,710.57 standard tons of ore, from which were extracted 133,154.51 ounces of fine gold, of value £565,604, being a recovery of 33s. 2d. per standard ton. For comparison with the foregoing figures on the basis of short tons, this tonnage is 381,596 short tons, returning 29s. 7d. per short ton. Allowing for loss in tailing, the value of the ore in the oxidised ground worked by opencut is very much the same as that of the sulphide ore.

In Appendix 1 (B) herewith, the assay returns obtained in my check sampling are scheduled in two columns, the first giving the assay value in ozs. dwts. grs. per standard ton, as returned in the Government Mineralogist and Analyst's report, and the second the equivalent value in £ s. d. per short ton of 2,000 lbs. for easy comparison with the mine figures, which are all on the basis of shillings per short ton.

Appendix I. (C) gives details of the comparison of my sampling with the corresponding figures on the mine assay plans. The discrepancies are seen to be often very considerable, but as the groups of assays become more and more summarised it is seen that the averages agree more and more closely until the final result is agreement within a shilling per ton.

In Appendix II. (A) the report of the Acting Government Petrologist, Dr. Larcombe, is quoted on the black dyke rock which penetrates the West lode, and is struck in the 200 feet level from the "Central" shaft at 290 feet North from the crosscut, and in (B) his report on some fragments of the sulphide ore from the workings from the "New" shaft. Section (C) contains a list of references to earlier departmental publications on the Wiluna field, which give considerable information as to its geological structure and earlier mining work on the Wiluna field generally. These will serve, if required, to give a general description of the Wiluna district, which is not attempted in the present report.

To further illustrate this report, the following plans, kindly given to me by the company, are also submitted:—

Western lode—Assay plan of 200 feet level.

Eastern lode—Assay plan of 290 feet level.

*Eastern lode—Assay plan of 140 feet level.

Plan showing old workings of Eastern and Western lodes, with positions of diamond drill bores.

Sections (2) of diamond drill bores.

FUTURE WORKING POLICY.

The company's general manager, Mr. H. E. Vail, has under consideration a scheme of working both East and West lodes from one main shaft, from which crosscuts would be driven to the lodes at 200 to 300 feet intervals, at which main haulage levels would be made and equipped with, probably, electric haulage equipment. They would be connected by frequent winzes, and intermediate levels would permit of ordinary hand trucking to main ore-passes with only short runs for the truckers. This would greatly facilitate the handling of the ore underground and the rejection of unpayable blocks of ground.

The lodes are very wide in parts, and the filling of worked-out stopes will be an essential part of the mining operations. I would strongly recommend that provision be made from the first for using the wet-filling method, using oxidised schist and surface soil as the filling material, working from the open cuts, and employing excavating machinery to obtain it. This would ensure the solid and immovable filling required to keep the wall rock from crushing in as the ore is removed. The stopes will be of great length, and if not filled solidly very numerous pillars will have to be left to support the walls, leading to loss of the ore in them. The wet-filling system is a cheap one if begun early in the history of a mine and carried on systematically, as in the Mt. Lyell mines, in Tasmania, where it has been very successful. A description of this method has come to hand since the above paragraph was written, explaining the practice at Mt. Lyell as described by the underground manager of the North Mt. Lyell mine, Mr. E. Barkley, at the meeting in May last of the Australasian Institute of Mining and Metallurgy, and now published in the "Chemical Engineering and Mining Review" of 5th July, 1927, page 357.

In the large stopes of this mine it will probably pay well to use some of the modern methods now practised in Broken Hill, South Africa, and elsewhere, of using electrically-driven shovelling, scraping, and loading machines, which in suitably large stopes are rapidly gaining ground in substitution of a large proportion of the manual labour otherwise required, with excellent economical results.

The power equipment of the mine should be on a very liberal scale, to enable machinery to take the place of manual work wherever practicable. Working on the proposed scale of 1,000 tons a day, which should be easily practicable in these large and long ore-bodies, there is great economy in using machinery which would not be justified for a small output of ore.

ORE SUPPLIES FROM THE COMPANY'S OTHER LEASES.

The Wiluna mines leases are not confined to those containing the above-mentioned mining excavations, and extend for over a mile north of them, turning more and more to the east as they are followed northward through the "Happy Jack" and "Bulletin" holdings, on both of which there are strong lodes from which a considerable amount of ore has already been raised, and no doubt a quite large output could be obtained when mines upon them have been opened and equipped with winding and pumping plant. To end of 1926 the "Happy Jack" is recorded as producing 743 standard tons of ore, giving 236.41 ounces of fine gold, and the "Bulletin" 11,392 standard tons, yielding 3,572.63 ounces of fine gold. It should be simple to arrange for treatment of the ore at the company's main mill. It is very probable that the lodes running through the company's holdings will be found to contain workable ore at various points along their length, which might add considerably to the available ore supplies.

PERSISTENCE OF ORE IN DEPTH—DIAMOND DRILL BORING.

The 290 feet level from new shaft is as yet the deepest in the company's mine, and it is seen from the foregoing part of this report that there has been very little, if any, difference in the value of the lodestuff there as compared with that formerly worked above 100 feet level. There are good geological reasons for concluding that the ore now being worked was originally formed at a great depth from surface, and therefore that it may be reasonably expected to maintain a considerable degree of constancy of value in depth. The diamond-drill boring which has been done is not so conclusive as we should like it to be on this aspect of the subject, but shows that the lodes give frequent good assay values as far down as they have yet been tested, about 750 feet vertically. Details of the boring are given in Appendix No. III. On the whole the bores may be said to confirm the evidence of the levels, and show that like values exist to the lowest depths attained by them, so that the conclusions as to size and value of the ore-bodies in the proved levels may be expected to hold good to seven or eight hundred feet at any rate, giving a reasonable probability of life for the mine at an output of 300,000 tons annually above the 800 feet level for something like ten years. There is no reason apparent why the lodes should not persist to like depths as at Kalgoorlie without much diminution of average values.

METALLURGICAL TREATMENT.

Notes on this aspect of the subject are put up herewith in Appendix No. IV., and it is to be understood that a decision is still pending between two

* The assay plans printed herewith have been posted up to end of September, 1927, and are therefore ahead of the letterpress.—A.M.

methods of treatment, the choice between which must be determined by trials as to which will give the better economical result, when all factors are taken into consideration. The concentration by the flotation method has not yet given quite satisfactory results on a working scale of 30 tons of ore per day, but laboratory experiments make it fairly certain that the extraction of gold can still be very materially improved. Failing this, however, the standard dry-crushing and all-roasting treatment, usual in Kalgoorlie practice, is capable of securing a very satisfactory rate of extraction at a reasonably low cost. There is not much room for reduction of the treatment costs of the standard practice in the best new mills at Kalgoorlie by any other method of treatment which has been suggested, but there is still very much hope that the flotation method will enable some reduction of total working costs to be made, together with a very considerable reduction in capital costs of the treatment plant required, with concomitant advantages in doing away with the necessity for dry-crushing all the ore, with consequent formation of much dangerous dust which is difficult to remove thoroughly. The roasting of concentrates high in sulphur and arsenic also affords much better opportunity for eventual utilisation of by-products than when the whole of the ore has to be roasted.

COSTS AND PROFITS.

It has been shown in the foregoing portion of this report that the average value of the ore bodies of the Wiluna Gold Mines Limited, may be taken at about 40s. 0d. per short ton, from which it should be possible to obtain an extraction of about 36s. 0d. per ton. Allowing 4s. 0d. per ton for new development work to maintain the ore reserves well ahead of supplies for the mill, we should have 32s. 0d. per short ton to pay working costs, inclusive of redemption of capital and profits, and comparison with costs of other mines working in this State shows that it will be very far from easy to conduct all necessary operations within that sum with any margin of profit while conditions of transport to the mine remain as they are. Railway connection, however, would put a very different complexion on the problem, making working conditions very similar to those prevailing at Kalgoorlie, Leonora, and Meekatharra. If the Wiluna mines were at any of these centres, the advantages they possess in the comparatively shallow depth at which they would be worked for quite ten years to come, and the great length and width of the ore bodies would permit them to be operated far more cheaply than any of the large mines now working at these centres, all of which are raising most of their ore from depths well over 1,000 feet. The modernised plants of the Lake View and Star and Sons of Gwalia mines have shown that it is possible to work these mines successfully on a grade of ore lower than that of the Wiluna gold mines, even though it is obtained largely from below 2,000 feet in depth. I have been given to understand that in the case of the Wiluna mines finance has been arranged so that it will be possible to put up a mining and treatment equipment of the most efficient and up-to-date character, and if this be so, there should be no difficulty in getting lower figures of costs per ton for many years to come than prevail in any of our large and deep mines at present. There is very great advantage, really, in the circumstances that the whole mining and treatment equipment have to be provided *de novo*, as there will be no excuse for putting in any but the most economically efficient machinery.

INFLUENCE OF TRANSPORT CHARGES ON MINING COSTS.

In my 1909 report on the Wiluna Mines, page 22, it was shown that in 1907 and nine months of 1908 transport charges on the mine supplies were respectively 8.40 and 12.06 per cent. of the total working costs of the Gwalia Consolidated company (now the Wiluna Gold Mines Limited). For 21 months they amounted to £6,400 altogether, on an ore tonnage treated of 76,700 tons, equal to 1s. 8d. per ton (standard). The cartage from Nannine to Wiluna amounted to £4,217, being nearly double the rail freight to Nannine, which was £2,183, giving an indication of the difference between freights by road and rail. Most of the material would come from Perth and Geraldton, 576 and 310 miles by railway respectively, while the cartage distance was 117 miles. These figures are nearly 20 years old, but the proportionate relation between road and rail costs is not greatly different now.

The Wiluna Mines Company's office has informed me that a total of 470 tons of material arrived on the mine from March 1926, to April 1927, without taking into account about 30 tons of explosives, motor spirit, fodder, etc., purchased locally, and cost for motor lorry transport from the railhead £2,888 4s., or £6 2s. 6d. per ton. Most of this came from Meekatharra, a distance taken for freight purposes at 100 miles. The same goods if they had been carried by rail at usual rates would have cost £1,059 1s., being a saving on this section of the transport of £1,829 3s., or £3 17s. 10d. per ton.

To show the amount of railway freight accruing from the requirements of a large mine, we may quote from page 2 of the evidence in Mr. C. Kingsley Thomas's report of the Royal Commission on the Mining Industry 1925, on which are shown the freights paid during one year to end of February 1925, by the Sons of Gwalia Company at Leonora, a mine whose requirements of operating supplies and general conditions of locality and working are very closely similar to those to be expected in the Wiluna mines. The total was £6,919 12s. 10d., while the ore-tonnage treated was roundly 90,000 tons (standard) in the same period, equal to a cost of 1s. 6d. per ton treated. This was for a period during which there was no abnormal construction work on the mine, and the cost may therefore be taken as representative of ordinary current requirements. At the same rate 300,000 tons of ore treated per annum would require railway freight of £22,500 per annum to Leonora, or proportionally to mileage (which is near enough to correctness for rough estimate purposes) we get—

Fremantle to Leonora, 548 miles—£22,500;

Fremantle to Meekatharra, 612 miles—£25,128;

Geraldton to Meekatharra, 334 miles—£13,713,

to which would be added, to get total railway freight through to Wiluna, 110 miles from Meekatharra to

Wiluna, or 180 miles from Leonora to Wiluna, respectively, £4,516 and £7,391, giving total railway freights—

Fremantle to Wiluna, via Leonora—728 miles.

	£	
	22,500	
	+ 7,391	
	———	£29,891

Fremantle to Wiluna, via Meekatharra—722 miles.

	£	
	25,128	
	+ 4,516	
	———	£29,644

Geraldton to Wiluna, via Meekatharra—444 miles.

	£	
	13,713	
	+ 4,516	
	———	£18,229

If the railway be made from the Western system to Wiluna it is therefore seen that there would be a very appreciable advantage to the Wiluna Gold Mines Limited, in getting their imported supplies from the port of Geraldton rather than from Fremantle, but, naturally, some portion of the supplies would be best procured from Perth and Kalgoorlie. Those from the latter centre would have already paid railway freight from Fremantle to Kalgoorlie, so all imported Wiluna supplies brought into the country by way of Fremantle may be taken as chargeable with full freight from Fremantle to Wiluna, which is seen to be practically identical by either route. The amount of freight and passenger revenue returnable to the Railway Department for the traffic due to the requirements of a town of say, 4,000 inhabitants would, of course, be additional to that for mining supplies to the company's mines, and so also would be the revenue for mining supplies to other mines in the district, many of which will doubtless be opened up if the principal mines become well established.

These considerable accretions to the railway revenue would of course be mainly credited to already existing lines, and not entirely to the new connection with Wiluna, but in one sense they would be due entirely to the new line, as unless this be made the mines are unlikely to be worked at all, and the additional revenue in the older portions of the railway would not eventuate.

A very important factor in mining costs at Wiluna is that of costs of fuel and mining timber. The timber suitable for firewood has been mostly well cut out in previous years to a distance of about 12 miles from Wiluna and firewood is now costing 21s. 6d. per ton stacked at the mine, and must be expected to become rapidly scarcer and more expensive as the mines get into full working order. There is a considerable amount of mulga firewood still obtainable from the local forest, but when the mine reaches its full output of ore dependence will soon have to be upon supplies brought in by the railway from distances beyond the possibility of reasonable cartage rates. The railway may therefore expect a considerable amount of traffic from carrying the necessary supplies of fuel for the Wiluna centre. The Sons of Gwalia and Kalgoorlie figures in Mr. Kingsley Thomas's report may serve as some indication of the magnitude of the probable fuel requirements. On 18th May, 1925 (p. XXIV. of Report), Mr. W. N. Hedges estimated somewhat roundly the grand total of firewood supplied to the Kalgoorlie town and mines as 15,189,712 tons. To the end of 1924 the Kalgoorlie and Boulder centres have a recorded tonnage of ore amounting to 29,979,745 tons, or quite closely two tons of ore to every ton of wood used, or half a ton of wood per ton of ore. This, of course, includes domestic supplies of firewood, those used for the tramways and lighting systems and all other uses; but as the whole Kalgoorlie community in the end depends on the ore raised, it is probably as good a way as any of arriving at an estimate of wood to be used at Wiluna to charge the whole of the Kalgoorlie wood at per ton of ore treated, and reckon thereon the amount which Wiluna would need for all similar purposes. Quite a similar result is obtained for the year 1924 when Mr. Hedges' evidence on page 159 of the Royal Commission's Report gave 282,241 tons of firewood as the supply for the full requirements of the mines. The Kalgoorlie and Boulder tonnage of ore treated in the same year was 568,735 tons, or again very closely a general average of half a ton of firewood used per ton of ore treated. On this basis the expected output of 300,000 tons of ore annually would mean a supply to Wiluna of about 150,000 tons of wood per annum. It should not be assumed, however, that the fuel for generating power in the mines will average half a ton for every ton of ore treated, the figure which we are trying to arrive at being a general one to cover all the firewood necessary to be supplied to the mining centre to meet all its demands for fuel so as to have some indication of the amount of firewood likely to be carried on a railway. The figures supplied by the Great Boulder Proprietary Company for 1924 on page 29 of the Royal Commission's Report show more exactly how the firewood is used. 52,596 tons 12 cwt. of firewood at 15s. 8.51d. per ton equal to a value of £41,312 8s. 9d. were used in the treatment of 111,514 tons of ore, quite near to the average figure of half a ton of wood per ton of ore, but of this the firewood used for power generation was 36,138 tons, of value £28,385 11s. 3d., or 5s. 1.09d. per ton of ore treated, and 16,457¾ tons, of value £12,926 17s. 6d., for the roasting furnaces, equal to 2s. 3.82d. per ton of ore. It is to be expected, however, that the new modern plant to be put in by the Wiluna Mines Ltd., will have a much less consumption of fuel for power per ton of ore treated than in the older plants at Kalgoorlie, the high power cost at which has been unfavourably commented upon both by Mr. Kingsley Thomas and the Technical Committee of the Development and Migration Commission. The fuel used in the new plant at the Sons of Gwalia mine should be a better guide. Figures supplied to the Power Committee in June, 1926, for the performance of their new Premier Alternator showed its working costs, without redemption of capital cost, to be 0.706 pence per unit (Kilowatt-hour), and the consumption of fuel for this generator to have been 1,324.43 tons for four months, February to May, 1926, at a cost at the producers of 16s. 10d. per ton. As this machine, however, generated only portion of the power used by the mine, its fuel consumption is quoted only to show the low cost figure now obtainable. More complete figures for 13 months to February, 1925, are given in the Royal Commission Report, from which we find that the average consumption of firewood during 13 months to February, 1925, was 1,549 tons per month, costing £1,207 4s. 2d., or 15s. 7d. per ton, equal to a total of 20,137 tons in the 13 months, costing £15,694. The tonnage of ore treated in the same period was roundly 90,000 tons, or say 4½ tons of ore per ton of firewood required. On this footing an output of 300,000 tons of ore per annum would require about 67,000 tons of firewood. The railway rate for firewood carried 13 miles is 2s. 7d., 25 miles 3s. 7d., 50 miles 6s. 2d., and 100 miles 8s. 3d. a ton. Taking it at an average of 5s. per ton, the annual freight would be £16,750.

The Royal Commission Report also gives an average expenditure per month by the Sons of Gwalia mine for round mining timber of £160 19s. 8d., indicating a use of about 46 tons a month or 552 tons per annum. Wiluna is badly supplied with large round timber for mine purposes, and most of it would probably have to be carried over 200 miles by rail. The freight for 200 miles is 16s. 2d. per ton, equal to £446 for the mining timber tonnage, bringing annual freight on all bush timber for the mines to about £17,200.

It will be seen, therefore, that when there is an output of 300,000 tons of ore per annum from the mines at Wiluna, it will be reasonable to expect increase in railway receipts by some such annual amounts as follow:—

	£		£
Mining Stores and Maintenance of Plants	29,750*	...	18,330†
Firewood and Mining Timber	17,200	...	17,200
	£46,950	...	£35,530

* If all from Fremantle. † If all from Geraldton.

It is too early yet to estimate except very roughly the freight which would be earned on the large amount of machinery and plant which will be required for the full equipment of the mines. The new milling plant of the Sons of Gwalia mine cost (Royal Commission Report of evidence, page 15) £74,000 for an output of now about 12,000 tons a month, and a like one to treat two and a half times as much ore at Wiluna might well run to £150,000 at least. The railway freights would probably amount to not less than £30,000 of this, at a very conservative estimate.

According to Appendix No. 1 to the Annual Report to end of 1926 of the Commissioner of Railways, the average tonnage of goods and livestock carried by the railways per head of the State's population, taken at the mean figure of 371,604 persons, was 8.71 tons. It may serve to give some approximation to the probable traffic which would be due to the establishment of a population of 4,000 persons at Wiluna if we assume that they would require the average tonnage of materials of all sorts or about 34,800 tons annually. As the grand totals on which the Railways' figures are based include all the special freights to the mines on the goldfields for all mining purposes, the general average of 8.71 tons must include the foregoing items on which we have been estimating as due to the Wiluna mines' requirements alone, and any estimate on this basis is therefore inclusive of the figures already given. The Railway Rate Book shows the following rates of freights to Wiluna for different classes of goods:—

—	Fremantle to Wiluna *via* Leonora.	Fremantle to Wiluna *via* Meekatharra.	Geraldton to Wiluna *via* Meekatharra.
Distance ...	728 miles	722 miles	444 miles
	s. d.	s. d.	s. d.
Miscellaneous ...	39 0	38 9	27 2
Class A	59 6	59 2	41 9
Class B	81 10	81 4	57 10
Class C	120 11	120 2	84 11
First Class ...	192 1	190 11	138 7
Second Class ...	251 9	250 4	181 10
Third Class ...	311 0	309 2	224 4

Of these the first class rates are the most generally applicable, and we can probably take it as fairly correct for estimate purposes that the costs of freight from Fremantle to Wiluna by either route average not less than £8 per ton and from Geraldton £6 per ton. Supposing equal quantities to go from Fremantle and Geraldton, the average rate of freight would be £7 per ton, and the above 34,800 tons of goods per annum would bring in a railway revenue of £243,600 per annum. Another figure given in the Railways' report, Appendix M, is that the railway revenue per head of population amounts to £8.98 on the average, which would give an annual revenue from 4,000 persons of £35,920, but it cannot be assumed that the population of Wiluna at the extreme outer end of the railway system will pay anything like the general average share per head of the railway costs. Both their freights and passenger fares must be far more per head than those paid by the great majority of people nearer to the capital. The figure of £35,920 arrived at on an average basis per head of population need not in the least conflict with the previous estimate of a railway revenue from Wiluna of £243,600 on a basis of tonnage requirements. Fortunately for the country it is only a very small percentage of the total population who have to pay an average rate of about £7 per ton for all their supplies carried by rail.

The whole matter of probable costs of construction of a railway to Wiluna, working costs, and probable revenue should be investigated closely by Railway Department officers specially conversant with all the factors involved, assuming say 300,000 tons per annum as the ore to be treated at Wiluna and a population of 4,000 people, and it would be for them to say what profit could be made over the bare working costs, including maintenance and proper share of capital charges, which could be credited to the new line against interest and sinking fund on its cost of construction. On general aspects there appears to be quite a good case for expecting the railway to be remunerative to the State. Judging by the life of the Kalgoorlie mines it seems reasonable to expect an active working existence for those at Wiluna of not less than twenty-five years. In that time the general development of the country will no doubt have gone very far ahead of its present condition and will provide other sources of support for the railway. The expansion in recent years of the pastoral industry in the Murchison and East Murchison Goldfields has been extraordinarily vigorous, and as the railways are prolonged northwards still more increase in pastoral settlement may confidently be expected. Whether the railway route to Wiluna goes from the Geraldton to Meekatharra system or from Leonora, Wiluna in either case is well situated to become a rail-head from which to open up country to the northward on the Main Trunk Line which must eventually be carried centrally through to the Northern parts of the State.

RAILWAY ROUTE.

If a railway be made to Wiluna, it may be either from the Eastern Goldfields railway system at Leonora, or from the Northern one, via Sandstone, Nannine, or Meekatharra. The Leonora route gives direct connection with Kalgoorlie, and the others with the nearest seaport at Geraldton. Both routes are about the same distance to Fremantle. The distances scaled from a large-scale map from the rail-heads mentioned to Wiluna are:—

Leonora to Wiluna—180 miles.
Meekatharra to Wiluna—110 miles.
Nannine to Wiluna—117 miles.
Sandstone to Wiluna—115 miles.

As no surveys have yet been made these distances are approximate only, and liable to slight alteration when actually surveyed.

Some of the existing distances, which may be useful in considering this question, are the following:—

Fremantle to Kalgoorlie—387 miles.
Kalgoorlie to Leonora—161 miles.
Fremantle to Leonora—548 miles.
Kalgoorlie to Esperance—258 miles.
Leonora to Esperance—419 miles.
Fremantle to Meekatharra, via Wongan Hills—612 miles.
Fremantle to Meekatharra, via Midland Railway—636 miles.
Fremantle to Nannine, via Wongan Hills—588 miles.
Fremantle to Nannine, via Midland Railway—612 miles.
Fremantle to Sandstone, via Wongan Hills—587 miles.
Fremantle to Sandstone, via Midland Railway—611 miles.
Fremantle to Mullewa, via Wongan Hills—313 miles.
Fremantle to Geraldton, via Midland Railway—318 miles.
Fremantle to Narngulu, via Midland Railway—310 miles.
Geraldton to Narngulu—8 miles.
Geraldton to Mullewa—65 miles.
Geraldton to Meekatharra—334 miles.
Geraldton to Nannine—310 miles.
Geraldton to Sandstone—309 miles.

From these we see that the routes from Esperance, Fremantle, and Geraldton compare in length as follows:—

Esperance to Wiluna—599 miles.
Fremantle to Wiluna, via Kalgoorlie and Leonora—728 miles.
Fremantle to Wiluna, via Midland Railway and Meekatharra—746 miles.
Fremantle to Wiluna, via Wongan Hills and Meekatharra—722 miles.
Fremantle to Wiluna, via Midland Railway and Nannine—729 miles.
Fremantle to Wiluna, via Wongan Hills and Nannine—705 miles.
Fremantle to Wiluna, via Midland Railway and Sandstone—726 miles.
Fremantle to Wiluna, via Wongan Hills and Sandstone—702 miles.
Geraldton to Wiluna, via Meekatharra—444 miles.
Geraldton to Wiluna, via Nannine—427 miles.
Geraldton to Wiluna, via Sandstone—424 miles.

Little consideration need be given to connection of Wiluna with the sea-board at Esperance (and similarly Albany). The distance from Fremantle to Wiluna via Leonora is 728 miles, as against the alternative routes via Wongan Hills and Meekatharra, 746 miles, Nannine 722 miles, and Sandstone 702 miles. The last named rail-head, Sandstone, is not only the nearest to both Fremantle (587 miles) and Geraldton (309 miles), but also the shortest through line to Wiluna, from Fremantle (702 miles), and Geraldton (424 miles), but would involve five miles more construction of new line (115 miles in all) than if the line were made from Meekatharra (110 miles in all). For connection of Wiluna with the Northern Railway System, the choice seems to lie between the routes via Meekatharra and Sandstone, as the Nannine route has no advantages over that by Sandstone. As regards opening up of auriferous country the Sandstone route would traverse more or less auriferous country near Paynesville, at Black Range, Birrigrin, and Montagu, and reach the Wiluna Mines Limited, leases about two miles before coming to the Wiluna township, and would serve auriferous country at Kingston, Mt. Keith, and New England to some extent. It is also of considerable service to the Youanmi district, which is one quite likely to be resuscitated. The Nannine route serves some auriferous country at Gabanintha and Gum Creek, and would help the mines at Diorite about equally well as the line by Meekatharra. This last line, though the most direct immediate connection with Wiluna, would pass, so far as is yet known, through country which is not auriferous, except for a few miles at each end. As a mining development line it is much inferior to either the Nannine or the Sandstone one, the last being much the best of these three in this respect. All three lines seem to me to be much the same as regards making available supplies of mulga firewood for the mines at Wiluna, there being patches of good scrub along all of them, and probably also there would be little difference between them in regard of opening up pastoral country. On the merits of the three lines for service to the Wiluna mines, and mining and pastoral development, the bulk of advantages appears to me to lie decidedly with the Sandstone route, which is also the shortest to the coast. That Meekatharra is at present the most important mining and business centre on the Northern Railways does not appear to me to be a factor of any permanent importance in deciding at which point the connection with Wiluna should be made, except in one regard, which may be of some importance to the Railway Department, namely, that it would suit them better to have empty trucks from Wiluna returned to the trunk line at Meekatharra rather than at Mt. Magnet, if the expected large output of manganese from the Horseshoe deposit should require the returning "empties" for carrying the loads of that mineral to the coast.

The route *via* Leonora has great advantages from the mining development point of view to put against its much greater length and cost of construction. It can be taken almost all the way through more or less mining country in which there are large possibilities of development. It would assist greatly in the development of the known mining centres of Diorite King, Mt. Clifford, Wilson's Patch, Lake Darlot, Lawlers, Mt. Sir Samuel, Kathleen Valley, Mt. Keith, and New England before it reaches Wiluna. The Lawlers and Mt. Sir Samuel districts have been very large producers of gold and would be very greatly assisted in again becoming busy centres if they had railway communication and consequent reduced working costs. From the point of view of the development of mining along its route, a railway by Leonora to Wiluna is unquestionably far superior to one by any of the suggested lines running westward. This line would connect the Wiluna district with Leonora and Kalgoorlie in 180 and 341 miles respectively, which might have some advantages in getting supplies of labour, machinery, and mining stores. The Chairman of the Wiluna Mines, Ltd., has asked for the railway to be constructed from both trunk line rail-heads to Wiluna, which would involve, say, 290 miles of new railway construction instead of 110 from Meetkatharra or 115 from Sandstone. Both lines are very desirable sooner or later, and if the mines at Wiluna turn out as expected it is quite probable that the older centres between Wiluna and Leonora will be resuscitated and may warrant a railway through them. Practical considerations of cost and efficiency of service to Wiluna seem to me to demand that the connection *via* Sandstone or Meekatharra be made first, leaving completion of the connection with Leonora to await success of the Wiluna enterprise. It is very important for this that Wiluna should have the most direct and shortest possible connection with the coastal railways and ports, and particularly with Geraldton, which would enable Wiluna to obtain all imported stores, machinery, and supplies, with 424 miles of railage *via* Sandstone or 444 miles *via* Meekatharra, putting it into nearly as favourable a position for freights as Kalgoorlie, with 387 miles from Fremantle. The Geraldton connection would be much more to the interests of Wiluna than the Leonora one in respect—

(1) of all sea-borne freightage, including possibilities of use of crude oil-fuel and local or imported coal for power;

(2) of supplies of large round timber for mining purposes; and

(3) of carriage of concentrates to the coast for treatment in the event of its being found that the sulphur and arsenic constituents can be economically recovered or utilised.

The question of crude-oil fuel for power has already had considerable attention from the management, and the minimum of transport charges would be a considerable factor in deciding whether oil could be used advantageously. The mining timber supplies for the Murchison mines up to Meekatharra have for years past been obtained from the coastal forests, especially round Arrino and Three Springs. The large Wiluna lodes will require much large and heavy mining timber, very difficult to obtain except from the Kalgoorlie supplies if the only railway connection were to Leonora. The coal at Irwin River and the recently discovered large seam at Eradu may quite likely make a very considerable change before long in the fuel position of all the Murchison and East Murchison mines.

The possibility of there being advantage in taking concentrates to the coast for treatment and there using the sulphur for production of sulphuric acid and superphosphate is not at all a remote one, if the concentrates could be sent to the coast at back-loading rates. The arsenic also would be utilised.

If the needs of Wiluna for all possible reductions of mining and treatment costs be kept in the forefront of consideration, and there can be no doubt that at the present stage it is all-important to establish profitable mining at Wiluna as the first step to a mining revival all along the line from Leonora to Wiluna, it appears to me that there is no other conclusion possible than that the first necessity is to connect Wiluna by rail with Geraldton, leaving the Leonora connection for later consideration.

COST OF RAILWAY.

Until surveys are made, the route is decided, and the class of line to be laid down is determined, no more than very approximate estimates can be made of the cost of the railway connection. The average capital cost of all the State lines now open is given in the Report of the Railway Department to 30th June, 1926, page 5, as £5,440 per mile. If old railway stock be available the lightest class of line which would serve the purpose might perhaps be put in for £3,000 a mile, but I do not think that it would be practicable to reduce this estimate materially:—

110 miles new line from Meekatharra at £3,000 a mile	£330,000
115 miles new line from Sandstone at £3,000 a mile	£345,000
180 miles new line from Leonora at £3,000 a mile	£540,000

The line by way of Sandstone in my opinion is the one with the most advantages.

SUMMARY.

(1) The Wiluna Mines Limited's proposition has now been well proved. The lodes are long and wide. They have provided 340,711 tons of ore from above the 100 feet level, returning £565,604 worth of gold and it is now proved that good ore extends beyond the limits of the older workings, so that there is strong probability that the output from the first 100 feet will be not less than 400,000 tons. The work at 140 feet, 200 feet, and 290 feet levels has shown that the lodes maintain size and value similar to those above the 100 feet level, leading to a very reasonable expectation of a like amount and value of ore being obtainable from each 100 feet in depth down to 300 feet, while the diamond drill boring which has been done gives good grounds for believing that the size and value will continue much the

same for another 500 feet in depth. There is no visible geological reason why they should not continue to like depths as the Kalgoorlie lodes, and have a similar life of not less than, say, 25 years.

(2) Other mines at Wiluna, not at present working, have produced to end of 1926, a further amount of 197,974 tons of ore, returning 122,065 fine ounces of gold of value £518,133 bringing the total production of the field to 538,685 tons of ore returning 225,220 ounces of fine gold, of value £1,083,737, showing that the Company's mines are not by any means the only ones in the district and that if the field be revived there is great promise that a further large production of gold will come from leases other than those of the Wiluna Mines Limited.

(3) A proportion of the mine sampling and assays on which the valuation of the ore-reserves has been made has been checked, with the result that the mine returns of assay values may be accepted as entirely reliable. The estimates of tonnage and total value more or less "in sight" may also be accepted as quite reasonable, although as explained in Appendix I. (A), I should personally prefer not to include any tonnage below the lowest levels on the lodes. The mine estimate of ore reserves as at 18th May, 1927 is 686,460 short tons of average assay value 40s. 3d. per short ton. There appears to be every reason to expect a long life for the mine, say 25 years at least, at the estimated output of 1,000 short tons per working day.

(4) There is no reason to fear any unusual metallurgical difficulty in getting a quite satisfactory extraction of gold from the Wiluna ore. It is expected that concentration by flotation followed by roasting and cyaniding of the concentrates can be made to give an even better and cheaper economical result than the standard sulphide treatment by roasting the whole of the ore before cyaniding, but the latter can be relied on for very satisfactory results if flotation should not come up to expectations.

(5) The Company is understood to have very strong financial support able to provide development and equipment of the mines in the most efficient manner, provided that the Government will give connection with the State Railway System.

(6) The Company's operations will require employment of about 800 men, and will give the town of Wiluna a population of about 4,000 persons.

(7) The freights for the mines and passenger and goods traffic for 4,000 people should make a railway to Wiluna a profitable addition to the State Railway System.

(8) The connection with the railway system most serviceable to the Wiluna district, not only immediately but permanently also, would be to Sandstone or Meekatharra, the former for preference in my opinion. This line would also be much cheaper to construct and work than that to Leonora. The Leonora connection will eventually be very desirable but must depend greatly on a revival of mining along its route. If Wiluna succeeds, extension of the railway to the Southward towards Leonora would be rather better carried out from the Wiluna end than the Leonora one.

(9) In my opinion the prospects of the Wiluna Field urgently demand very early construction of a railway to it, the earlier the better, and there is a very good prospect that the line will make a substantial improvement in railway revenue and be profitable to the State.

APPENDIX I.—(A).

Sampling and Assay Results shown on the Mine Assay Plans to 18th May, 1927, and Estimates of Tonnage and Value of Ore Reserves based thereon.

Western Lode—200 feet Level.

This is at present the bottom level from the "Central" shaft. From the shaft a crosscut has been made east for 114 feet to the centre of the main drive on the lode, and is then carried 64 feet further East without meeting with any values. There appears to be a considerable blank in the lode opposite the Central shaft, no cause for which has yet been ascertained.

North Drive.—Driving north along the lode, values began to be found at about 100 feet north, and a crosscut put in to the East at 106 feet N. went through 21 feet of ore averaging 41s. per ton according to the mine assay summaries. The crosscut was carried on to 130 feet in, turning in the end to the North-East, and cutting small values at 60 feet (3s., 12s.), and 110 feet (28s.), which may be worth following later on as possible indications of other lodes in the vicinity of the main one.

In endeavouring to arrive at an estimate of the quantity of ore opened up by the 200 feet level, we do not know yet how far back towards the shaft the ore extends which is seen in the crosscut at 106 feet North, and it is not safe to reckon on its existence in the East wall of the drive for any considerable distance beyond where it has been proved. I am taking it, for ore estimation purposes, as beginning at 90 feet and having the same width and value there as in the crosscut 16 feet further on, which would be more or less equivalent to the ore-body being a good deal longer and wedging out to the South. The values appear not to have come in to the main North drive till 150 feet distance was reached, and from 150 to 172 feet they averaged 36s. over a width of 64 inches. At this point the values fell off, being only 16s. over a width of 60 inches in the drive from 172 to 227 feet. Crosscuts East and West, however, at 200 feet north show 8 feet of ore of 30s. assay in the East side of the drive, and 10 feet more, averaging 62s., at 20 to 30 feet in, and in the West crosscut there are 4 feet of 23s. ore in the West side of the drive and 4 feet of 45s. at 16 to 20 feet in. The assay of the drive itself at this crosscut is given as 28s. over 54 inches. The lode at this crosscut therefore has a width of 16½ feet of 28s. average assay, with a parallel western vein of 4 feet of 45s. ore, and an eastern one of 10 feet at 62s., or in all, 30½ feet in width of ore of average value 41s.

At 227 to 234 feet the main drive North shows 5 feet of 45s. ore, but from 234 to 266 feet it is very poor, averaging only 6s. for five feet in width. The drive is, however, probably between two veins of ore, a crosscut East at 250 feet North showing 32s. value for 8 feet at 39 to 47 feet in, and another East and West at 292 feet North giving values on both sides of the drive. From 266 to 290 feet the drive averages 38s. for 57 inches in width, and at the crosscut there are 8 feet of ore on the West side at 42s., making a total width of 12.8 feet averaging 41s. In the same crosscut East at 44 to 66 feet in, the eastern lode or branch seen in the two preceding crosscuts at 200 and 250 feet North is found to be much stronger than before, being 22 feet wide of 54s. ore.

The crosscut at 292 feet north is along the southern wall of a large black dyke which here cuts through the lode almost at right angles, and which has been determined by the Government Petrologist, Dr. Larcombe, to be an altered dolerite, carbonated and chloritised. (Petrologist's report quoted in Appendix IIA.) Values in the main drive terminate for the time being against this dyke at 290 feet, but come in again on the other side of it.

Taking the portion of the North drive from the assumed start at 90 feet North to the dyke at 290 feet, the crosscuts (inclusive of the drive) show the following widths and average values of ore in the main lode:—

——	Distance N. in Drive. Total Feet.	Distance N. in Drive. Between Crosscuts. Feet.	Product Length × Mean Width sampled.	Width of Lode Sampled feet. Mean.	Width of Lode Sampled feet.	Assay Value per Short Ton. shillings.	Product Width × Assay.
Start taken as at 90 feet	90	...	...	...	21	41	861
		16	336	21			
Crosscut at	106	...	...	...	21	41	861
		94	1763	18·75			
Crosscut at	200	...	...	...	16·5	28	462
		50	538	10·75			
Crosscut at	250	...	...	...	5	6	30
		42	356	8·9			
Crosscut at	290	...	...	...	12·8	41	525
	...	200	2993 ÷ 200 = 15ft. mean width		76·3	= 36s. per ton mean assay	2739 ÷ 76·3

e.—Average width of ore in crosscuts through the main lode is 15 feet for a distance of 200 feet in length and average value is 36s. per ton.

WILUNA COLD MINES LIMITED

WILUNA E. MURCHISON C. F.

LONCITUDINAL SECTIONS

M. E. Vail General Manager
R Banks Surveyor

North

WESTERN LODE

— Scale —
— 40 Feet to an Inch. —

EASTERN LODE

The poor cross-section at 250 feet North is included, as most probably when the ground comes to be stoped out, it will not be possible to leave the poor ore as a pillar, as would otherwise be desirable, but the whole of the ground will have to be taken out, probably at a higher average value than shown by this particular crosscut. For the same reason the poor parts should be included in making out the average value of the level itself. The figures of this are:—

North.	Length.	Width.	Average Assay.	Product.
Feet.	Feet.	Feet.	s. d.	
150 to 172 ...	22	$5\frac{1}{3}$	36 0	4224
172 to 227 ...	55	5	16 0	4400
227 to 234 ...	7	5	45 0	1575
234 to 266 ...	32	5	6 0	960
266 to 290 ...	24	$4\frac{3}{4}$	38 0	4332
	140	Mean 5	22 0	15,491

The drive has two poor places in it for a total length of 87 feet out of the total of 140 feet, and these bring down the general average value. It is quite uncertain how best to make a fair average of the value of the lode as estimated from the crosscuts and the drive. The latter does not keep to one position in the ore-body, but is sometimes on or towards one side or the other of it, passing diagonally from side to side at small angles to its general course. The drive gives therefore more or less of a fair sample of the whole area of the ore-body at its particular level, but this sample may easily be above or below the true average. Crosscuts through the ore-body at frequent intervals give a much more reliable sample, and if they are at short intervals apart their average return can be taken as correct, but much depends on the distances between them. In the particular case before us the average of the crosscuts seems likely to be more to be depended upon than the average value obtained from the drive. The computer of ore-reserves has to exercise his judgment in such cases as to the weight to be placed on each set of results, and it seems to me that in this instance it would probably be a fairly close approximation to the truth to average the results of the drive and crosscuts in proportion to the area of ore (*i.e.*, tonnage per foot in thickness) actually sampled. In the above tables we had 2,993 square feet as the area sampled by crosscuts, and 700 square feet as that tested in the drive, and, averaging the assay results accordingly, we get—

Crosscuts ...	2993 × 36s. 0d.	=	107,748
Drive ...	700 × 22s. 0d.	=	15,400
	3693 × 33·34	=	123,148

or 33s. 0d. per short ton.

We have, however, one other considerable set of measurements and assays in this block of ground which could fairly be taken into a general average of the available assay evidence, namely, the winze at 134 feet North from the 100 to the 200 feet level, with an average value of 38s. over a width of 41 inches for 93 feet:—

$3\frac{5}{12}$ feet × 93 feet gives product 318 × 38s. 0d. = 12,084
bringing above total figures to 123,148 3693
Plus 12,084 + 318

135,232 ÷ 4,011 = 34s. 0d.
to nearest shilling.

The total block of ore on the main lode above the 200 feet level North from 90 feet to 290 feet North, therefore had best be estimated on the figures available to contain—

Length. Width. Height.

$$\frac{200 \text{ ft.} \times 15 \text{ ft.} \times 100 \text{ ft.}}{12 \text{ cubic feet per short ton}} = 25{,}000 \text{ short tons.}$$

of assay value 34s. per ton. This block of ore cannot be said to be proved "ore in sight," but the figures available indicate that something of the order of the quantity and assay value stated may be expected in it from the main lode.

From the foregoing description it is seen, however, that there is a considerable amount of ore revealed by the crosscuts to the East, seemingly belonging to an Eastern Branch which originates somewhere between the crosscuts at 106 N. and 200 N., and then runs rather more to the East of North than the main branch. It is seen in the crosscuts at 250 feet and 292 feet, but then would be cut through by the dolerite dyke which intersects the lode system at this point.

This eastern branch ore-body is seen for 110 feet in length, but only in the crosscuts, nothing being proved as to its continuation upwards to the old workings overhead above the 100 feet level in which it was followed in the East branch drive. Ore was worked in the open cut for about 700 feet north of this point, and the lode was wide, with several more or less parallel branches; so there is practical certainty that this Eastern branch ore-body extends to the 100 feet level.

At 200 feet N. there are 10 feet of ore at 20 to 30 feet in, averaging 62s. 0d.

At 250 feet N. there are 8 feet of ore at 39 to 47 feet in, averaging 32s. 0d.

At 290 feet N. there are 22 feet of ore at 44 to 66 feet in, averaging 54s. 0d.

These figures give an average of 50s. for 13 feet in width and a length of about 100 feet, and the block between 100 and 200 feet levels at these dimensions would contain some 10,800 tons. This body, however, is too little proved to be acceptable as more than "probable" ore, and its value could not be taken safely at so high a figure as 50s., so for purposes of our summary is being taken at 34s., the same as the main lode.

The dolerite dyke which intersects the lode at the 292 feet crosscut appears to be about 40 feet in width, and it is not very clear yet whether there is any faulting of the lode on it, or whether it has not merely wedged aside the country through which it penetrates without vertical or horizontal displacement of the segments of the lode. Small values begin to come in again at 332 feet North, but can hardly be regarded as of importance until 366 feet North is reached, where the assay plan shows 43s. for 11 feet over a width of 60 inches. The lode, however, is very poor to 413 feet, and no stoping ground can be regarded as yet opened up between 290 feet North and 409 feet North. At the latter distance a crosscut was put in East and West.

In the East crosscut no values were found in the first 55 feet, and then small assays (4s., 21s.) were obtained for 4 feet, succeeded by 12 feet of no values. From 71 to 92 feet there were mostly small and unpayable values, though three assays are recorded of 34s., 65s., and 77s. per ton. These may correspond with the Eastern branch lode found in the crosscuts East at 200, 250, and 292 feet North, and the crosscut might have been continued East with some hope of finding a larger ore body. The drive, however, followed a sort of lode in a northerly direction for 75 feet with little more than traces of gold by assay.

The crosscut West at 409 feet North showed values from 0 to 6 feet of 20s., 25s., and 56s., but then became poor to 20 feet in, where better values again came in for 17 feet, from 20 to 37 feet, averaging 52s. From the assay plan it seems very likely that these values may run South to join the main drive at about 332 feet, on the North side of the dolerite dyke.

The main drive North was then resumed, the measurements now being from the crosscut as their starting point, and good values were obtained for 157 feet, the first 73 feet from 0 to 73 feet returning 49s. over a width of 56 inches, and 84 feet from 73 to 157 feet, giving 62s. over 49 inches width. Crosscuts East at 50 and 150 feet North show that good values extend about 3 feet into the eastern side of the drive. From 157 feet to the end of the drive at 262 feet North the gold values disappear almost entirely, and a crosscut East for 86 feet at 260 feet North has not been successful in recovering them, though small assay values have been returned from the last 46 feet of this crosscut. These correspond in position with values in crosscuts East at 200 feet and 150 feet North, which seem to show that the drive has gone too far to the West, and that the lode has gone into the East side of the drive at about 157 feet North. As payable ore is shown as having been got in the opencut and 100 feet level for 300 feet still further North, it is of importance to continue driving in this direction, with the old workings as a guide.

Taking the width and value of the lode as shown in the crosscuts, we find that at the crosscut at 409 feet North, there are 17 feet of 52s. ore; at 50 feet North the drive shows 4 feet at 39s., and the crosscut East 6 feet at 61s., or a total width of 10 feet at 55s. At the crosscut East at 150 feet North the drive shows 43s. for 5 feet, and the crosscut 12 feet at 24s., or total 17 feet at 29s. in all. In the crosscut at 200 feet North the drive has left the lode and the latter is 33 feet in, assays across 7 feet of it, averaging 47s. on account of one high one of 200s., and therefore best reduced to 33s. Values may be taken as extending about 220 feet along the level at the widths and assays stated, viz.:—

—	Feet.	Width.	Assay.	Product.
			s. d.	
Crosscut at ...	0 North	17	52 0	884
Do. ...	50 ,,	10	55 0	550
Do. ...	150 ,,	17	29 0	493
Do. ...	200 ,,	7	33 0	231
		51 Average 13 feet		2158 ÷ 51 = 42s. 0d.

The assays along the drive itself average 56s., thus—

—		Width.	Assay.	Product.
		Feet.	s. d.	
0 feet to 73 ft. =	73	$4\frac{2}{3}$	49 0	16,709
73 feet to 157 ft. =	84	$4\frac{1}{12}$	62 0	21,266
	157	4·4	...	31,975
		÷ by 157 × 4·4 = 56s. 0d.		

Averaging the assays across the lode in the crosscuts with those along it in the drive, these being all that are available, we get—

Crosscuts ...	220 ft. × 13 ft. × 42s. 0d. =	120,120
Drive ...	157 ft. × 4·4 ft. × 56s. 0d. =	38,685
		158,805
	÷ 3,551 = 45s. 0d. average value.	

Assuming that the ore continues of the same value up to the 100 feet level, the tonnage and assay value of the block on the western branch North of the crosscut at 409 feet North would be—

$\frac{220 \text{ ft.} \times 13 \text{ ft.} \times 100 \text{ ft.}}{12}$ = 23,800 short tons of average value, 45s. 0d. per ton.

Summarising the above ore estimates in the parts of the 200 feet level of the Western lode North of the Central shaft we get, above the 200 feet to the 100 feet level—

	Short tons.		s. d.		£
Main Lode, 0ft. to 290ft. N.	25,000	at	34 0	=	42,500
Eastern Branch	10,800	,,	34 0	=	18,360
Main Lode, 290ft. N. to 669ft. N.	23,800	,,	45 0	=	53,550
	59,600	,,	38 0	=	114,410

Main South Drive—200 feet Level—West Lode.

Going South from the crosscut from the Central shaft the drive on the main lode has been carried a distance of 205 feet with a crosscut East and West at 102 feet, and another West at 152 feet. No values were got in the drive for the first 130 feet, after which they came in for 52 feet, averaging 30s. for 5 feet wide, but from 182 feet to the end of the drive they were again lost. The crosscut East at 102 feet found no values, but that to the West averaged 10s. for 18 feet, and the first 6 feet of this gave 37s. In the crosscut at 152 feet South, 6 feet at 20 to 26 feet in, returned assays averaging 50s. While these better values indicate that further development is advisable, the results South of the Central shaft are, on the whole, so poor that no allowance can yet be made for ore reserves in this end of the mine.

Ore Reserves in West Lode.

An estimate of ore-reserves on the West lode given to me by the management, dated 25th January, 1927, claims a total developed tonnage between the 100 and 200 feet levels of 96,900 tons of average value 38s. 7d. per ton, but the foregoing calculations, on information in the mine assay plans to 18th May, 1927, do not appear to me to justify an expectation of more than 59,600 tons of average value 38s. per ton. An allowance for some ore below the 200 feet level has probably been made by the mine, which is reasonable enough in the circumstances.

East Lode—140 feet Level from new shaft.

Two levels have been driven from the new shaft on the East lode at depths of 140 feet and 290 feet. The former workings on this lode were by opencuts from surface, and a level at 100 feet from the South shaft, above which most of the ore has been taken out for a length of about 920 feet. I have not been able to obtain any figures as to the assay values in the floor of the 100 feet level, but as the 140 feet level is no great depth below it, and the opencut work is believed to have given at least as good average values as are found at 140 feet, it seems reasonable to average the whole block above the 290 feet level as not less than 190 feet in depth at the average size and value shown by the sampling of both 140 and 290 feet levels.

The results obtained are easily expressed in tabulated form without detailed description:—

140 *Feet Level—Crosscuts (including portion in Drive at start of Crosscut).*

—	Distance.		Width.	Sampled.	Product Length × Mean Width.	Assay Value per Short Ton.	Product Width × Assay.
	In Drive.	Between Crosscuts.					
	Feet.	Feet.	Feet.	Mean feet.		Shillings.	
Main Crosscut from new shaft ...	0	...	14	...	...	34	476
	...	102	...	15½	1,581		
	102 North	...	17	...	...	23	391
	0	...	14				
	...	102	...	12½	1,275		
	102 South	...	11	...	...	51	561
	...	113	...	16	1,808		
	215 „	...	21	...	...	21	441
	...	117	...	21½	2,515½		
	332 „	...	22	...	...	37	814
	...	96	...	18½	1,776		
	428 „	...	15	...	...	36	540
	...	94	...	16½	1,551		
	522 „	...	18	...	...	22	396
	...	162	...	26	4,212		
	684 „	...	34	...	...	52	1,768
	...	37	...	31	1,147		
	721 „	...	28	...	...	51	1,428
	...	823	180	157½	15,865½	...	6,815

$$\frac{15865\frac{1}{2}}{823} = 19{\cdot}2 \text{ ft. mean width.}$$

$$\frac{6815}{180} = 38\text{s. } 0\text{d. mean assay.}$$

140 *Feet Level—North Drive.*

Distance.	Length.	Width.	Assay.		Product Length × Width × Assay.
Feet.	Feet.	Feet.	Shillings.		
North Drive.					
0 to 20 ...	20	5⅓	29	0	3,093
20 „ 60 ...	40	4¾	32	0	6,080
60 „ 75 ...	15	5	9	0	675
75 „ 88 ...	13	5	28	0	1,820
88 „ 98 ...	10	3¾	18	0	675
98 „ 103 ...	5	5	11	0	275
103 „ 119 ...	16	5	47	0	3,760
119 „ 140 ...	21	4¼	17	0	1,517
140 „ 156 ...	16	4⅔	46	0	3,435
156 „ 231 ...	Valueless, not taken into account.				
Total North Drive	156	4¾	29	0	21,330

Distance.	Length.	Width.	Assay.		Product Length × Width × Assay.
Feet.	Feet.	Feet.	Shillings.		
South Drive.					
0 to 21 ...	21	5½	43	0	4,966·5
21 „ 40 ...	19	5¼	46	0	4,588·5
40 „ 66 ...	26	5	21	0	2,730·0
66 „ 86 ...	20	4¾	52	0	4,940·0
86 „ 100 ...	14	4⅔	68	0	4,442·7
100 „ 130 ...	30	4½	83	0	11,205·0
130 „ 191 ...	61	5	72	0	21,960·0
191 „ 274 ...	83	4½	21	0	7,843·5
274 „ 285 ...	11	4½	52	0	2,574·0
285 „ 371 ...	86	4½	43	0	16,641·0
371 „ 422 ...	51	4⅔	8	0	1,904·0
422 „ 483 ...	61	4½	23	0	6,313·5
483 „ 516 ...	33	5	39	0	6,435·0
516 „ 588 ...	72	5	12	0	4,320·0
588 „ 606 ...	18	4	*Nil*		...
606 „ 631 ...	25	4½	9	0	1,012·5
631 „ 686 ...	55	4⅓	48	0	11,440·0
686 „ 695 ...	9	4	46	0	1,656·0
695 „ 722 ...	27	4⅓	7	0	819·0
722 „ 735 ...	13	4⅔	51	0	3,094·0
735 „ 752 ...	17	4⅔	48	0	3,808·0
	752	4⅔	35	0	122,693·2
North and South Drives ...	908	4·7	34	0	144,023·2

Taking the determinations of the values of the lode as shown by the crosscuts and the drives, the former give an average of 38s. a ton and the latter of 34s., but some lengths of very poor material have been included which may not be mined when the lodes are actually worked. The arithmetical mean of both sets of determinations may be fairly taken in this instance as indicating in this level an assay value of 36s. a ton over a length of 908 feet of lode of average width 19 feet.

$$\frac{908 \times 19}{12} = 1{,}438 \text{ tons for each foot in depth.}$$

East Lode—290 feet Level from East Shaft.

Taking the crosscuts and drives in the 290 feetlevel in the same way we get figures as follows:—

290 Feet Level—Crosscuts.

—	Distance.		Width sampled.		Product length × mean width.	Assay value per short ton.	Product width sampled × assay.
	In drive.	Between crosscuts.	—	Mean of block.			
	Feet.	Feet.	Feet.	Feet.		shillings.	
Main Crosscut from new shaft ...	0	...	42	...	...	40	840
		129	...	30	3,870		
	North 129	...	18	...	...	12	216
		102	...	19	1,938		
	„ 231	...	20	...	...	24	480
		55	...	15½	853		
	„ 286	...	11	...	...	47	517
		55	...	13	715		
	„ 341	...	15	...	...	42	630
		62	...	10	620		
	„ 403	...	5	...	...	21	105
	0	...	(42)				
		123	...	27¼	3,352		
	South 123	...	12½	...	...	31	387
		103	...	22¼	2,292		
	„ 226	...	32	...	...	43	1,376
		102	...	29½	3,009		
	„ 328	...	27	...	...	47	1,269
		105	...	35	3,675		
	„ 433	...	43	...	...	41	1,763
		96	...	49	4,704		
	„ 529	...	55	...	...	21	1,155
		107	...	48	5,136		
	„ 636	...	41	...	...	23	943
		93	...	35½	3,302		
	„ 729	...	30	...	...	32	960
		91	...	32½	2,957		
	„ 820	...	35	...	...	49	1,715
		1,223	386½	366½	36,423	...	12.356

Length, 1,223 feet.

$$\text{Average width, } \frac{36{,}423}{1{,}223} = 30 \text{ feet.}$$

$$\text{Average assay } \frac{12{,}356}{386\frac{1}{2}} = 32\text{s. } 0\text{d.}$$

WILUNA GOLD MINES LIMITED

WILUNA — E. MURCHISON C. F.

EASTERN LODE

ASSAY PLAN

290 LEVEL

Scale
40 Feet to an Inch

H. E. Vail General Manager
R. Banks. Surveyor

Date. [redacted]

No [redacted]

290 Feet Level—Drives.

Distance.	Length.	Width.	Length × width.	Assay.	Length × width × assay.
North. Feet.	Feet.	Feet.		s. d.	
0 to 17	17	5	55	39 0	2,145
17 ,, 43	26	5½	143	31 0	4,433
43 ,, 108	65	5	325	30 0	9,750
108 ,, 145	37	5⅓	197	18 0	3,546
145 ,, 167	22	4⅚	106	13 0	3,498
167 ,, 179	12	5	60	17 0	1,020
179 ,, 233	54	5	270	32 0	8,640
233 ,, 239	6	4	24	5 0	120
239 ,, 245	6	5	30	13 0	390
245 ,, 263	18	5	90	38 0	3,420
263 ,, 291	28	5	140	12 0	1,680
291 ,, 297	6	5	30	32 0	960
297 ,, 329	32	4¾	152	15 0	2,280
329 ,, 345	16	5	80	50 0	4,000
345 ,, 371	26	5	130	45 0	5,850
371 ,, 390	19	5	95	36 0	3,420
390 ,, 401	11	5	55	20 0	1,100
401 ,, 416	15	5	75	17 0	1,275
416 ,, 442	26	4⅚	126	9 0	1,134
442 ,, 446	4	5	20	29 0	580
	446	...	2,203	...	59,241
	Average width 5ft. Average value 27s. 0d.				
South.				s. d.	
0 to 17	17	5	85·00	47 0	3,995
17 ,, 42	25	5½	137·50	57 0	7,838
42 ,, 109	67	5¼	351·75	32 0	11,256
109 ,, 116	7	4½	31·50	6 0	189
116 ,, 127	11	4 7/12	50·40	28 0	1,411
127 ,, 131	4	6	24·00	6 0	144
131 ,, 166	35	4¾	166·25	45 0	7,481
166 ,, 234	68	5⅙	351·33	48 0	16,864
234 ,, 245	11	5	55·00	43 0	2,365
245 ,, 275	30	5	150·00	45 0	6,750
275 ,, 329	54	5	270·00	37 0	9,990
329 ,, 366	37	5	185·00	45 0	8,325
366 ,, 430	64	4⅚	259·33	51 0	13,226
430 ,, 516	86	4⅚	415·66	49 0	20,368
516 ,, 584	68	4⅚	328·66	27 0	8,874
584 ,, 636	52	4½	234·00	40 0	9,360
636 ,, 718	82	4⅔	382·66	40 0	15,307
718 ,, 827	109	5	545·00	44 0	23,980
827 ,, 877	50	4⅔	233·33	39 0	9,100
	877	...	4256·37	...	176,823
	Average width, 4·9ft. Average value, 42s. 0d				
Total, North and South	1,323	...	6459·4	...	235,564
	Average width, 4·9ft. Average value, 36s. 0d.				

Winzes and Rises.

Distance.	Length.	Width.	Length × width.	Assay.	Length × width × assay.
Feet.	Feet.	Feet.		s. d.	
Winze 60ft. N.:					
0 ,, 20 ...	20	5	100	36 0	3,600
20 ,, 32 ...	12	4	48	4 0	192
32 ,, 44 ...	12	4	48	4 0	192
44 ,, 60 ...	16	4	64	14 0	896
Winze 341ft. N.:					
0 to 32 ...	32	4	128	49 0	6,272
Rise 68ft. S.:					
0 to 8 ...	8	4	32	38 0	1,216
8 ,, 20 ...	12	3½	42	25 0	1,050
Rise 226ft. S.:					
0 to 18 ...	18	3½	66	50 0	3,300
18 ,, 26 ...	8	5½	44	9 0	396
26 ,, 58 ...	32	4	128	45 0	5,760
Winze 433ft. S.:					
0 to 36 ...	36	4	144	46 0	6,624
Rise 460ft. S.:					
0 to 37 ...	37	4½	166½	32 0	5,328
37 ,, 53 ...	16	4	64	17 0	1,088
Winze from 140ft. Level, 230ft. S.:					
0 to 16 ...	16	4¼	68	20 0	1,360
16 ,, 24 ...	8	3	24	49 0	1,176
24 ,, 48 ...	24	4	96	19 0	1,824
48 ,, 56 ...	8	3	24	14 0	336
	315	4ft. Average	1,286½	32 0 Average	40,610

East Lode—Summary of Assay Values, 290 feet Level.

As the drive has carried values for 1323 feet I am taking this as the length of the ore body for estimating the quantity of ore, and 30 feet as the average width, at average assay 32s. per ton. The drives show an average assay of 36s. for a width of 4.9 feet, and the winzes and rises 32s. for a width of 4 feet. Averaging these determinations in accordance with the area sampled we get:—

		Sq. ft.		
Crosscuts ...	1,323 × 30 =	39,690	× 32s. 0d. =	1,270,080
Drives ...	1,323 × 4·9 =	6,483	× 36s. 0d. =	233,388
Winzes and Rises	315 × 4 =	1,260	× 32s. 0d. =	40,320
		47,433		1,543,788

Average Assay ... $\frac{1,543,788}{47,433}$ = **33s. 0d. to nearest shilling.**

East Lode—Ore Reserves above 290 *feet Level.*

Taking both 140 feet and 290 feet levels together, their assay value may be averaged thus:—

	Length. Feet.		Width. Feet.		Square Feet.	Assay.	
140 *Feet Level:*							
	908	×	19	=	17,252	× 36s. 0d. =	621,072
290 *Feet Level:*							
	1,323	×	30	=	39,690	× 33s. 0d. =	1,309,770
	2,231		49				
Mean	1,115·5		24·5		56,942		1,930,842
Middle area = 27,330 sq. feet					Average Assay—34s. 0d. per short ton, to nearest shilling.		

Cubic Contents 140–190ft.	17,252
	39,690
	109,320
	166,262
÷ 6 =	27,710
× 150 =	4,156,500 cub. ft.
÷ 12 cub. ft. per short ton =	346,375 tons.

The block above the 140 feet level up to the old 100 feet level had best be taken at the value and dimensions seen in the 140 feet level, viz.:—

$$\frac{908 \text{ ft.} \times 19 \text{ ft.} \times 40 \text{ ft.}}{12} = 57,507 \text{ tons.}$$

The whole block developed above the 290 feet level to 18th May, 1927, may therefore be summed up:—

346,375	tons at	34s. 0d.	=	£588,837
57,507	"	36s. 0d.	=	£103,513
403,882	"	34s. 3d.	=	£692,350
		Average		

East and West Lodes.

West ...	59,600	tons at	38s. 0d.	=	£114,410
East ...	403,882	"	34s. 3d.	=	£692,350
	463,482	"	34s. 10d.	=	£806,760

In reply to my request the company's manager has supplied me on 29th July with an estimate of the ore reserves computed in his office as at 18th May, 1927, the date of the assay plans previously supplied to me, and on which my estimates have been worked out, viz.:—

	Tons.		Average value
West Lode	106,900	...	39s. 7d.
East Lode to 290ft. Level	425,860	...	39s. 0d.
East Lode below 290ft. Level	153,700	...	44s. 0d.
	686,460	...	40s. 3d.

These results differ so materially from my reckoning, though both are founded on exactly the same data of measurements and assays, that it is important to ascertain and explain wherein the difference lies.

In my estimates of the West lode tonnage, I have made no allowance for ore still left above the 100 feet level, of which there must still be a very considerable quantity, but of which the data before me did not permit of any estimate being formed on a basis of proved figures, nor have I counted in any tonnage below the 200 feet level, as such has been proved only on the top side. As the company's estimate for the East lode includes ore below the 290 feet level, the lowest on it, it may be assumed that the one for the West lode has also taken in some ore lying similarly below the 200 feet level, which is the lowest one thereon. In the case of ore which is not proved fully "in sight" by being exposed on all four sides by levels and winzes, it is a matter of judgment of the computer how much partially proved ground he may estimate upon as reasonably well proved, and there is a good deal of difference in the practice of different mining engineers in this respect. In my own calculations I have adopted, as shown in the foregoing pages, a fairly rigid rule of ~~not going beyond the amounts~~ of ore which are pretty thoroughly proved, but am prepared to admit that it is quite reasonable to take in a very considerable amount more of tonnage which is reasonably safe to be counted upon. The total of 686,460 tons, given by the mine staff, is quite justifiable on the data, and I do not in the least take exception to it, though temperamentally preferring a more conservative basis. I have not taken any ore below the bottom levels on the two lodes into my estimates of ore reserves, preferring to leave such to be taken in when the next lower level is actually opened up. This difference in method of computation easily accounts for the difference in the total tonnages estimated. It turns out, also, that the mine estimates are based on 11 cubic feet of ore in the solid to the short ton, this being stated to be from direct determinations, while I have taken the more usual figure of 12 cubic feet. For comparison of my tonnages with those of the mine my ore totals should have 9.1 per cent., or 1/11th added to them.

The difference in the figures of value adopted by the mine and myself, 40s. 3d. per short ton as against 34s. 10d., depends on somewhat similar considerations and differences in the methods of computation. The mine calculations have been made by dividing the stopable area into a number of blocks of what appear to be the more payable values, rejecting portions which seem to be below a payable grade. This is quite the correct and usual method when the ore has been fully developed, by winzing and rising as well as by levels; but it does not appear to me that the development in this particular case is yet far enough forward to allow of it being applied with any certainty as to the positions of the richer and poorer portions. I have therefore adopted the method of averaging the information obtained at the different levels, leaving out only parts which are palpably off the values, and then have taken the blocks between levels at the average of the latter. This involves including a good many poor places in the general averages which would be left unbroken in the mine if, on further development, they did not improve. But just as some parts of the probable stoping area appear on present available data to be too poor to work, yet may prove quite good when better opened up, so also some of the apparently good ground may change for the worse when more fully developed. I have therefore thought it best to take in the poorer blocks which approach payable values as a corrective to the figures of the apparently richer ones, in the belief that a truer average may thus be obtained. The full length and depth of the apparently ore-bearing ground and the average widths exposed in the crosscuts have therefore been taken in averaging the values obtained in each level which results in taking the lode, a body subject to very considerable variations in size and value, as if it were a continuous and uniform slab of ore of equivalent size. Obviously some discount should be made on such an estimate to allow for poor ore which would be left unbroken in the stopes or if broken simply left in them for filling, and it depends on the grade of ore rejected how much the average of the remainder is raised. For example ore of, say, average value of 34s. 10d. a ton might be separated into 23.5 per cent. of stuff averaging 18s., which would be best left in the mine, and 76.5 per cent. of ore averaging 40s. per ton. A discount of 23½ per cent. on the quantity of ore estimated as a continuous body would be by no means an unreasonable one to allow for rejected low grade ore below the value acceptable for treatment. The mine valuation has been made at 40s. 3d. in another way, by leaving out of the estimate the blocks which appear to be poor, and consequently shows a higher average.

It is very clear that the quantities of ore to be expected from the mine are very much larger than the foregoing reckoning, for the present company's workings have yet to be extended hundreds of feet both North and South before they correspond in length with the older workings in the opencuts from surface and the 100 feet level. According to our statistical returns, these older workings to end of 1926 yielded 340,710.57 standard tons of ore, from which were extracted 133,154.51 ounces of fine gold of value £565,604, being a recovery of 33s. 2d. per standard ton. Putting these figures on the basis of short tons as used in the foregoing tables, the tonnage is 381,596. and the average return 29s. 7d. per short ton. The return includes the gold from a large quantity of re-treated tailings, but it may be taken as pretty certain that the original assay value of the ore as raised from the mine must have averaged at least 35s. per short ton. By rejecting unpayable ore when stoping, the average value above the 190 feet level in the new workings above described could no doubt be brought to a higher grade at the expense of more or less reduction of the tonnage in the ore reserves. The extent to which this may be possible and economical cannot be calculated beforehand, there being many practical working considerations involved, the effect of which can be estimated only after a good deal of actual experience of working the particular proposition.

With large ore-bodies, as in this case, at a shallow depth, the grade of 34s. 10d., or say 35s. assay value above estimated should be workable profitably once Wiluna is connected with the State railway system. The ore milled could readily be kept to a 40s. average.

The old plans of the "Gwalia Consolidated Ltd." to end of 1910 show that at the 100 feet level on the West lode the opencut workings extended about 865 feet North of the "Central" shaft, and 135 feet South of it, but that for 260 feet in the middle of the northern part a good deal of ground was left untouched, presumably as being too poor to be milled. One of these poor places is due to the intersection of the lode by the big dolerite dyke struck at 202 feet North in the North drive at 200 feet, above described. At the 100 feet level there are two distinct branches of the lode: the western, known as "A" Drive, and the eastern as "B," which diverge until they are over 80 feet apart, and then gradually converge and come together again in the North end of the mine. The drive North at 200 feet has followed the western branch, and there should still be a large block of ore to be reached by this drive as it is extended, probably quite 300 feet in length of ore. The ore estimated above the 200 feet level on the West lode is therefore likely to be very much larger than has been taken in the foregoing estimates.

On the East lode the opencut workings extend for 182 feet North of the crosscut from the "New" shaft, and 1,155 feet South from it. The South shaft, from which most of the work on this lode has been done, is 842 feet South of the "New" one and the end of the North drive from it at the 100 feet level is still 314 feet from the crosscut at 290 feet from the "New" shaft. To 25th May, 1927, the drive south from the "New" shaft at 290 feet level had been extended 877 feet from the crosscut, and is therefore about 35 feet past the "South shaft." The latter, however, is on the branch lode lying east of the main one, which itself is in two branches followed in "Y" drive and the "West" drive. The crosscut East and West from 'South' shaft at the 100 feet level cuts "Z" lode about 40 feet East of the shaft, "No. 1" lode at the shaft, "Y" lode at 65 feet West, and West drive at 175 feet West of the shaft. The "Y" and West lodes going North converge to a junction about 310 feet North of the crosscut, forming a large lens of ore apparently worked up to 80 feet in width, according to the plans. The bend to the west which begins at 433 feet South in the 290 feet level from "New" shaft corresponds better with "Y" drive than with the "West" one which, according to the 100 feet level workings, should continue straight on. It seems very advisable to extend the West crosscut at 820 feet South quite 150 feet to make sure of reaching the West lode, and from the experience at the 100 feet level there would be a good chance of passing through a very large body of ore.

This drive South from the "New" shaft at 290 feet level has to go about 315 feet before it comes under the North end of the drive North from the "South" shaft, and about 200 feet further, say 515 feet, before it is under the North end of the large ore body at the junction of the "Y" and "West" branches of the lode. At 877 feet therefore it has gone under the 100 feet level stopes for about 362 feet, and has still a probability of ore for another 300 feet in length, according to the stoping in the 100 feet level.

It will be seen that the newly developed ground above the 140 feet and 290 feet levels in the East lode shows a great extension northward, about 960 feet, of values along the lode as previously worked from the South shaft 100 feet level, although the shallower opencut workings showed the presence of the lode up to 182 feet North of the "New" shaft. The North drive at 290 feet level is driven 446 feet on ore, and is still on a strong lode.

There is therefore much reason for confidence that the workable ore reserves above the 290 feet level may easily reach 1,000,000 tons when fully opened up, equal to an output of 1,000 tons a day for 1,000 days, or about three years. This would give sufficient time for further deeper development which should enable the supplies of ore to be kept well ahead of the milling demands. It may be noted that the older workings on the lodes have actually yielded 340,711 ton of ore in the first 100 feet in depth, and that the developments warrant expectation that the next two blocks of 100 feet going downwards will each produce more rather than less per 100 feet, indicating a probability of say 700,000 tons in them.

APPENDIX No. 1 (B).

Wiluna Gold Mines' Assays.

West Lode.

No.	Per long ton.	Per short ton.	No.	Per long ton.	Per short ton.
	oz. dwt. gr.	£ s. d.		oz. dwt. gr.	£ s. d.
1	0 3 4	0 12 1	26	0 2 18	0 10 5
2	0 2 9	0 9 0	27	0 13 19	2 12 4
3	0 12 18	2 8 4	28	0 4 3	0 15 8
4	0 15 11	2 18 8	29	0 2 7	0 8 8
5	0 1 18	0 6 8	30	0 7 3	1 7 1
6	0 18 22	3 11 9	31	0 18 3	3 8 9
7	0 7 18	1 9 5	32	0 8 22	1 13 10
8	1 6 1	4 18 9	33	0 6 18	1 5 7
9	0 18 0	3 8 3	34	0 4 14	0 17 5
10	0 17 23	3 8 2	35	0 8 22	1 13 10
11	0 10 0	1 17 11	36	0 12 9	2 6 11
12	1 6 13	5 0 8	37	0 1 18	0 6 8
13	1 3 7	4 8 4	38	0 1 21	0 7 2
13*a*	0 16 8	3 1 11	39	0 9 3	1 14 8
14	0 17 15	3 6 10	40	0 2 14	0 9 10
15	1 18 0	7 4 1	41	0 16 11	3 2 5
16	0 4 19	0 18 2	42	1 1 5	4 0 5
17	0 4 19	0 18 2	43	0 13 12	2 11 3
18	0 3 22	0 14 11	44	1 4 4	4 11 8
19	0 8 7	1 11 5	45	0 16 6	3 1 7
20	0 7 3	1 7 1	46	0 16 11	3 2 5
21	0 0 5	0 0 9	47	0 10 21	2 1 3
22	0 2 17	0 10 3	48	0 8 1	1 10 6
23	0 8 4	1 11 0	49	0 15 11	2 18 8
24	0 7 23	1 10 3	50	0 11 23	2 5 5
25	0 2 4	0 8 3			

Wiluna Gold Mines' Assays.

East Lode.

No.	Per long ton.	Per short ton.	No.	Per long ton.	Per short ton.
	oz. dwt gr.	£ s. d.		oz. dwt. gr.	£ s. d.
51	0 3 11	0 13 2	92	0 3 1	0 11 7
52	0 1 12	0 5 9	93	0 4 14	0 17 5
53	0 9 7	1 15 3	94	0 4 22	0 18 8
54	0 8 4	1 11 0	95	0 9 3	1 14 8
55	0 12 23	2 9 2	96	0 5 16	1 1 6
56	0 5 21	1 2 4	97	0 3 9	0 12 10
57	0 8 1	1 10 6	98	0 7 6	1 7 6
58	0 1 12	0 5 9	99	0 7 15	1 8 11
59	0 2 21	0 10 11	100	0 4 19	0 18 2
60	0 5 9	1 0 5	101	0 8 17	1 13 0
61	0 11 5	2 2 6	102	0 1 15	0 6 2
62	0 10 21	2 1 3	103	0 2 4	0 8 3
63	0 15 20	3 0 1	104	0 0 21	0 3 4
64	0 13 7	2 10 5	105	0 4 3	0 15 8
65	0 10 21	2 1 3	106	0 5 2	0 19 4
66	0 11 18	2 4 7	107	0 2 4	0 8 3
67	0 10 16	2 0 5	108	0 7 18	1 9 5
68	0 11 11	2 3 6	109	0 8 12	1 12 3
69	0 13 16	2 11 10	110	0 1 23	0 7 6
70	1 3 7	4 8 4	111	0 10 8	1 19 2
71	0 12 4	2 6 2	112	0 15 6	2 17 10
72	0 7 15	1 8 11	113	0 9 14	1 16 5
73	0 10 16	2 0 5	114	0 9 7	1 15 3
74	0 8 17	1 13 0	115	0 6 18	1 5 7
75	0 13 7	2 10 5	116	0 16 18	3 3 6
76	0 10 11	1 19 8	117	0 2 21	0 10 11
77	0 14 12	2 15 0	118	0 2 9	0 9 0
78	0 8 7	1 11 5	119	0 3 11	0 13 2
79	0 4 12	0 17 1	120	0 0 17	0 2 8
80	0 13 15	2 11 8	121	0 6 13	1 4 10
81	0 15 20	3 0 1	122	0 14 12	2 15 0
82	0 11 2	2 2 1	123	0 9 7	1 15 3
83	1 0 7	3 16 11	124	0 5 14	1 1 3
84	0 4 3	0 15 8	125	0 19 19	3 15 1
85	0 4 9	0 16 7	126	0 14 7	2 14 2
86	0 7 10	1 8 2	127	0 13 2	2 9 8
87	0 4 1	0 15 4	128	0 11 10	2 3 4
88	0 2 2	0 7 11	129	0 11 18	2 4 7
89	0 6 21	1 6 1	130	0 4 22	0 18 8
90	0 9 19	1 17 2	131	0 4 23	0 18 10
91	0 4 12	0 17 1	132	0 1 10	0 5 5
			133	0 2 9	0 9 0

APPENDIX No. 1 (C).

West Lode—200 Feet Level—North Drive.

(Distances measured from centre of drive, taken as 0 ft.)

Crosscut at 106 feet North.

—	No. of samples.	Mines Department assays, over 2ft. sections unless otherwise shown.			Mine assays over 2 feet sections.		
		Samples taken on South side of crosscut, unless otherwise shown.				South side of crosscut.	North side of crosscut.
		Distance.	Assay Value per short ton of 2,000lbs. in shillings.		Distance.	Assay Value per short ton of 2,000lbs. in shillings.	
		Feet.	South side. shillings.	North side. shillings.	Feet.	shillings.	shillings.
East ...	1, 15	6 to 8	12	144	6 to 8	45	68
	2, 14	8 „ 10	9	67	8 „ 10	76	64
	4, 13	10 „ 12	59	88	10 „ 12	43	51
	6, 12	12 „ 14	72	101	12 „ 14	41	trace.
	8, 9	14 „ 16	99	68	14 „ 16	47	47
	10, 7	16 „ 18	68	29	16 „ 18	24	16
	11, 5	18 „ 20	38	7	18 „ 20	trace.	trace.
	13*a*, 3	20 „ 21½	62	48	20 „ 22	*Nil*	*Nil*
	.. 16	21½ „ 23½	...	18			
	17 ..	21½ „ 27½	18				
Width sampled ...	...	21½ft.	...	...	16ft.		
Average assay ...	...	...	43	63	...	35	31
			$\underbrace{\qquad\qquad}_{52}$			$\underbrace{\qquad\qquad}_{33}$	

WILUNA GOLD MINES LIMITED
WILUNA
E. MURCHISON G.F.
WESTERN LODE
ASSAY PLAN
200 LEVEL
Scale
50 feet to an inch
General Manager
Surveyor
Date. [redacted]
No [redacted]
T.N.
North Drive
South Drive
Winze 134'N.
200 Level
Central Shaft.
194J
6J
262J


WILUNA GOLD MINES LIMITED
WILUNA
E. MURCHISON C. F.
EASTERN LODE
ASSAY PLAN
140 LEVEL
Scale
30 Feet to an Inch
General Manager
R. Banks. Surveyor
Date [redacted]
Nº [redacted]
New Shaft
Rise 45S
Winze 230'S
T. M.

Crosscut at 200 feet North.

—	No. of samples.	Mines Department assays, over 2ft. sections unless otherwise shown. Samples taken on South side of crosscut, unless otherwise shown. Distance.	Assay Value per short ton of 2,000lbs. in shillings.	Mine assays over 2 feet sections. Distance.	South side of crosscut. Assay Value per short ton of 2,000lbs. in shillings.	North side of crosscut.
		Feet in level.		Feet.	mean	
East ...	18	0 to 2W	15	0 to 2W	20 (17)	14
	19	0 „ 2E	31	0 „ 2E	35 (40)	44
	20	2 „ 4E	27	2 „ 4E	... (taken in average).	36
		E. Crosscut.	North side of Crosscut.			
	21	26 to 28	1	26 to 28	...	45
	22	28 „ 30	10	28 „ 30	...	64
	23	30 „ 32	31	30 „ 32	...	89
	24	32 „ 34	30	32 „ 34	...	57
				34 „ 36	...	55
Width sampled		14 feet	...	16 feet.		
Average Assay ...		...	21	...	50	

Crosscut at 250 feet North.

—	No. of samples.	Distance.	Assay Value.	Distance.	South side of crosscut.	North side of crosscut.
			North side of Crosscut.			
East ...	25	43 to 45	8	43 to 45	6	5
	26	45 „ 47	10	45 „ 47	38	28
	27	47 „ 49	52	47 „ 49	87	48
				49 „ 51	47	trace.
Width sampled		6 feet	...	8 feet		
					45	20
Average assay		...	23	...	33	

Crosscut at 292 feet North.

—	No. of samples.	Distance.	Assay Value.		Distance.	Assay Value.	
		South side of crosscut.					
West ...	28	2½ to 4½	16		2½ to 4½	63	
	29	4½ „ 6½	9		4½ „ 6½	39	
	30	6½ „ 8½	27	30	6½ „ 8½	26	42
	31	8½ „ 10½	69		8½ „ 10½	41	
East ...	32	2½ „ 4½	34		2½ „ 4½	31	
	33	4½ „ 6½	26		4½ „ 6½	48	
	34	6½ „ 8½	17		6½ „ 8½	17	
	35	8½ „ 10½	34		8½ „ 10½	56	
	36	10½ „ 12½	47	24	10½ „ 12½	14	30
	37	12½ „ 14½	7		12½ „ 14½	32	
	38	14½ „ 16½	7		14½ „ 16½	10	
	39	16½ „ 18½	35		16½ „ 18½	33	
	40	18½ „ 20½	10		18½ „ 20½	25	
	41	46½ „ 48½	62		46½ „ 48½	21	
	42	48½ „ 50½	80		48½ „ 50½	47	
	43	50½ „ 52½	51		50½ „ 52½	88	
	44	52½ „ 54½	92		52½ .. 54½	67	
	45	54½ „ 56½	62		54½ „ 56½	69	
	46	56½ „ 58½	62	58	56½ „ 58½	57	54
	47	58½ „ 60½	41		58½ „ 60½	63	
	48	60½ „ 62½	31		60½ „ 62½	66	
	49	62½ „ 64½	59		62½ „ 64½	50	
	50	64½ „ 67½ (3 feet)	45		64½ „ 66½	41	
					66½ „ 68½	28	
Width sampled ...		47 feet			48 feet		
Average assay		...	40		...	43	

East Lode—290 feet Level—South Drive.

(Distances measured from centre of level, taken as 0 feet).

Crosscut at 123 feet South.

——	No. of samples.	Mines Department assays, over 3ft. sections unless otherwise shown.		Mine assays over 2 feet sections.		
		Samples taken on South side of crosscut, unless otherwise shown.		Distance.	South side of crosscut.	North side of crosscut.
		Distance.	Assay Value per short ton of 2,000lbs. in shillings.		Assay Value per short ton of 2,000lbs. in shillings.	
		Feet.		Feet.		
East ...	51	0 to 3	13	E. 0 to 2	5	trace
	52	3 „ 6	6	2 „ 4	20	17
West ...	53	0 „ 3	35	4 „ 6	41	8
	54	3 „ 6	31	6 „ 8	...	4
				W. 0 „ 2	14	18
				2 „ 4	41	17
				4 „ 6	22	44
				6 „ 8	...	29
Width sampled		12 feet	...	16 feet		
					24	17
Average assay ...		...	21	...	21	

Crosscut at 226 feet South.

East ...	55	0 to 3	49	E. 0 to 2	55	...
	56	3 „ 6	22	2 „ 4	26	32
	57	6 „ 9	31	4 „ 6	39	10
	58	9 „ 12	6	6 „ 8	35	29
	59	12 „ 15	11	8 „ 10	trace	10
	60	15 „ 17	20	10 „ 12	24	15
				12 „ 14	29	35
				14 „ 16	trace	16
				16 „ 18	trace	trace
Width sampled		17 feet	...	18 feet		
					23	18
Average assay		...	23	...	21	

Crosscut at 328 feet South.

East ...	61	0 to 3	43	E. 0 to 2	42	53
	62	3 „ 6	41	2 „ 4	Not accessible	44
	63	6 „ 9	60	4 „ 6	...	55
	64	9 „ 12	50	6 „ 8	...	40
	65	12 „ 15	41	8 „ 10	...	56
	66	15 „ 18	45	10 „ 12	...	53
	67	18 „ 21	40	12 „ 14	...	48
				14 „ 16	...	49
West ...	68	0 „ 3	44	16 „ 18	39	32
	69	3 „ 6½	52	18 „ 20	26	27
				W. 0 „ 2	42	not recorded
				2 „ 4	43	„
				4 „ 6	70	„
Width sampled		27½ feet	...	26 feet		
Average assay		...	49	...	...	45

Crosscut at 433 feet South.

—	No. of samples.	Mines Department assays, over 2ft. sections unless otherwise shown. Samples taken on South side of crosscut, unless otherwise shown. Distance.	Assay Value per short, ton of 2,000lbs. in shillings.	Mine assays over 2 feet sections. Distance.	South side of crosscut. Assay Value per short ton of 2,000lbs. in shillings.	North side of crosscut.
		Feet.		Feet.		
East ...	70	0 to 3	88	E. 0 to 2	37	105
	71	3 „ 6	46	2 „ 4	96	58
	72	6 „ 9	29	4 „ 6	23	46
	73	9 „ 12	40	6 „ 8	46	46
	74	12 „ 15	53	8 „ 10	51	91
	75	15 „ 18	50	10 „ 12	70	42
	76	18 „ 21	40	12 „ 14	40	38
	77	21 „ 24	55	14 „ 16	44	40
	78	24 „ 27	31	16 „ 18	47	32
	79	27 „ 30	17	18 „ 20	73	35
	80	30 „ 33	52	20 „ 22	31	36
	81	33 „ 36	60	22 „ 24	60	24
	82	36 „ 39	42	24 „ 26	45	16
				26 „ 28	19	27
				28 „ 30	20	30
				30 „ 32	55	10
				32 „ 34	58	57
				34 „ 36	30	44
				36 „ 38	24	23
West ...	83	0 „ 2	77	W. 0 „ 2	42	7
				2 „ 4	3	25
Width sampled ...	...	41 feet	...	42 feet		
Average assay	...	...	48	..	44	40
					42	

Crosscut at 529 feet South

East ...	84	0 to 3	16	E. 0 to 2	17	18
	85	3 „ 6	17	2 „ 4	24	18
	86	6 „ 9	28	4 „ 6	19	40
	87	9 „ 12	15	6 „ 8	30	29
	88	12 „ 15	8	8 „ 10	25	20
	89	15 „ 18	26	10 „ 12	25	16
	90	18 „ 21	37	12 „ 14	6	20
	91	21 „ 24	17	14 „ 16	9	20
	92	24 „ 27	12	16 „ 18	25	8
	93	27 „ 30	17	18 „ 20	25	39
	94	30 „ 33	19	20 „ 22	20	20
	95	33 „ 36	35	22 „ 24	15	17
	96	36 „ 39	22	24 „ 26	18	12
	97	39 „ 42	13	26 „ 28	21	20
	98	42 „ 44	28	28 „ 30	21	20
				30 „ 32	25	21
				32 „ 34	27	27
				34 „ 36	41	23
				36 „ 38	22	42
				38 „ 40	14	18
				40 „ 42	11	23
				42 „ 44	trace	25
				44 „ 46	trace	18
West ...	99	0 „ 4	29	W. 0 „ 2	17	6
				2 „ 4	23	18
				4 „ 6	18	32
Width sampled ...	...	48 feet	...	52 feet		
Average assay	...	...	21	...	19	22
					21	

Crosscut at 636 feet South.

—	No. of samples.	Mines Department assays, over 2ft. sections unless otherwise shown.		Mine assays over 2 feet sections.		
		Samples taken on South side of crosscut, unless otherwise shown.		Distance.	South side of crosscut.	North side of crosscut.
		Distance.	Assay Value per short ton of 2,000lbs. in shillings.		Assay Value per short ton of 2,000lbs. in shillings.	
		Feet.		Feet.		
East ...	100	0 to 3	18	E. 0 to 2	19	17
	101	3 ,, 6	33	2 ,, 4	10	trace
	102	6 ,, 9	6	4 ,, 6	33	trace
	103	9 ,, 12	8	6 ,, 8	19	18
	104	12 ,, 15	3	8 ,, 10	12	8
	105	15 ,, 18	16	10 ,, 12	8	13
	106	18 ,, 21	19	12 ,, 14	9	15
	107	21 ,, 24	8	14 ,, 16	10	12
	108	24 ,, 27	29	16 ,, 18	10	29
	109	27 ,, 30	32	18 ,, 20	30	17
	110	30 ,, 32	8	20 ,, 22	24	17
				22 ,, 24	14	17
				24 ,, 26	23	19
				26 ,, 28	38	10
				28 ,, 30	35	10
				30 ,, 32	4	25
				32 ,, 34	trace	7
West ...	111	0 ,, 4½	39	W. 0 ,, 2	57	57
				2 ,, 4	15	46
Width sampled		36½ feet	...	38 feet	...	...
Average assay		...	18	...	20	18
					19	

Crosscut at 729 feet South.

East ...	112	0 to 3	58	E. 0 to 2	34	89
	113	3 ,, 6	36	2 ,, 4	49	19
	114	6 ,, 9	35	4 ,, 6	77	12
	115	9 ,, 12	26	6 ,, 8	49	63
				8 ,, 10	48	109
				10 ,, 12	13	84
				12 ,, 14	trace	29
West ...	116	0 ,, 3	64	W. 0 ,, 2	56	107
				2 ,, 4	...	5
Width sampled ...		15 feet	...	18 feet	...	...
Average assay		...	44	...	41	57
					50	

290 feet Level—North Drive.

Crosscut at 128 feet North.

East ...	117	0 to 3	11	E. 0 to 2	6	10
	118	3 ,, 6	9	2 ,, 4	12	8
				4 ,, 6	28	9
West ...	119	0 ,, 3	13	W. 0 ,, 2	8	6
	120	3 ,, 6	3	2 ,, 4	54	44
				4 ,, 6	4	17
Width sampled ...		12 feet	...	12 feet		
Average assay ...		...	9	...	19	16
					17	

Crosscut at 231 feet North.

—	No. of samples.	Mines Department assays, over 2ft. sections unless otherwise shown. Samples taken on South side of crosscut, unless otherwise shown. Distance.	Mines Department assays: Assay Value per short ton of 2,000lbs. in shillings.	Mine assays over 2 feet sections. Distance.	South side of crosscut. Assay Value per short ton of 2,000lbs. in shillings.	North side of crosscut. Assay Value per short ton of 2,000lbs. in shillings.
		Feet.		Feet.		
West ...	121	0 to 3	25	0 to 2	31	29
	122	3 ,, 6	55	2 ,, 4	53	58
	123	6 ,, 8½	35	4 ,, 6	51	65
				6 ,, 8	15	34
				8 ,, 10	trace	21
Width sampled		8½ feet	...	10 feet		
Average assay		...	39	...	30	41
					36	
Crosscut at 286 feet North						
East ...	124	4 to 7	21	4 to 6	56	55
	125	7 ,, 10	75	6 ,, 8	69	60
	126	10 ,, 15	54	8 ,, 10	30	45
				10 ,, 12	63	41
				12 ,, 15	20	9
Width sampled		11 feet	...	11 feet		
Average assay		...	51	...	48	42
					45	
Crosscut at 341 feet North.						
East ...	127	0 to 3	50	E. 0 to 2	43	47
	128	3 ,, 6	43	2 ,, 4	43	26
				4 ,, 6	43	16
West ...	129	0 ,, 4	45	W. 0 ,, 2	44	41
	130	4 ,, 8	19	2 ,, 4	28	47
				4 ,, 6	29	47
				6 ,, 8	16	16
Width sampled		14 feet	...	14 feet		
Average assay		...	38	...	35	34
					35	
Crosscut at 403 feet North.						
		0 = West wall of drive				
East ...	131	0 to 3	19	0 to 2	17	17
	132	3 ,, 6	5	2 ,, 4	24	21
	133	6 ,, 10	9	4 ,, 6	16	8
				6 ,, 8	7	7
				8 ,, 10	trace	trace
Width sampled		10 feet	...	10 feet		
Average assay		...	11	...	13	11
					12	

Summary of Crosscuts—East Lode.

—	Mines Department Sampling.				Mine Sampling.		
	Nos. of Samples.	Width Sampled.	Average Assay.	Product Width × Assay.	Width Sampled.	Average Assay.	Product Width × Assay.
Feet.		Feet.	Shillings.		Feet.	Shillings.	
South Drive—123 ...	51 to 54	12	21	252	16	21	336
226 ...	55 „ 60	17	23	391	18	21	378
328 ...	61 „ 69	27½	49	1,348	26	45	1,170
433 ...	70 „ 83	41	48	1,968	42	42	1,764
529 ...	84 „ 99	48	21	1,008	52	21	1,092
636 ...	100 „ 111	36½	18	657	36	19	684
729 ...	112 „ 116	15	44	660	18	50	900
North Drive—128 ...	117 „ 120	12	9	108	12	17	204
231 ...	121 „ 123	8½	39	331	10	36	360
286 ...	124 „ 126	11	51	561	11	45	495
341 ...	127 „ 130	14	38	532	14	35	490
403 ...	130 „ 133	10	11	110	10	12	120
Total	...	252½	...	7,926	265	...	7,993
Average Width sampled in Crosscuts ...	...	21 feet	...	...	22 feet	...	...
Average Value of all Ore sampled	...	...	31s.	...	...	30s.	...

Summary of Crosscuts—West Lode.

—	Mines Department Sampling.				Mine Sampling.		
	Nos. of Samples.	Width Sampled.	Average Assay.	Product Width × Assay.	Width Sampled.	Average Assay.	Product Width × Assay.
Feet.		Feet.	Shillings.		Feet.	Shillings.	
Crosscut at—							
106 ft. N. ...	1 to 17	21½	52	1,118	16	33	528
200 „ ...	18 „ 24	14	21	294	16	50	800
250 „ ...	25 „ 27	6	23	138	8	33	264
292 „ ...	28 „ 50	47	40	1,880	48	43	2,064
	50	88½	...	3,430	88	...	3,656
Average Width sampled ...	...	22	...	...	22	...	...
Average Assay	...	...	39	...	...	42	...

Summary—Both Lodes.

—	Mines Department Sampling.				Mine Sampling.		
	Nos. of Samples.	Width Sampled.	Average Assay.	Product Width × Assay.	Width Sampled.	Average Assay.	Product Width × Assay.
		Feet.	Shillings.		Feet.	Shillings.	
West Lode	50	88½	39	3,430	88	42	3,656
East Lode	83	252½	31	7,926	265	30	7,993
Total	133	341	...	11,356	353	...	11,649
Average Width sampled n Crosscuts	...	21	...	...	22	...	...
Average Assay Value ...	...	...	33	...	...	33	...

APPENDIX No. II. (A).

Report of Dr. Larcombe, Acting Government Petrologist, on Black Dyke rock from West Lode, Wiluna Gold Mines, Limited, dated 17th June, 1927:—

This is a dense black aphanitic rock with a somewhat blocky tendency. In places the rock is peppered with minute white specks of what proved microscopically to be leucoxene. Many small cleavage facets of felspar are scattered throughout the specimen.

Under the microscope it is seen to be made up of a mass of small and more or less clear plagioclase felspars lying in all azimuths. The ferromagnesian constituents have disappeared: they have been replaced by patches of carbonates and pale green chlorite, both minerals being distributed interstitially between the felspars. The slide is peppered with small grains and patches of leucoxenised ilmenite. The rock may be termed a carbonated chloritised dolerite.

APPENDIX No. II. (B).

Report by Dr. Larcombe, Acting Government Petrologist, on fragments of lodestuff from East Lode, Wiluna Gold Mines, Limited, dated 17th June, 1927:—

Seven pieces of stone were received. These have all been sectioned and examined microscopically. (R/I. 4138 to I. 4144, and S. 4828 to 4834.)

The seven samples submitted may be separated lithologically into:—

"(a) Dark greenish rock heavily impregnated with fine-grained iron pyrites. This rock is easily scratched with a knife. One piece has a "blotchy" appearance caused by secondary silica. The ore is powerfully carbonated. I/4139 has patches of dirty green chlorite, with which the grains of pyrites are closely associated. The quartz appears in flecks amongst the carbonates. Some of the quartz represents the residual material left after the almost complete metasomatism of the original quartz in the quartz dolerite greenstone. Carbonation was the chief process by which the quartz became absorbed. The rest of the quartz is secondary, but not of metasomatic origin. The leucoxene has been almost completely ground out of existence."

"(b) A siliceous flinty type that is virtually a dark gray jasper. This ore is hard, but in spite of its flinty appearance and siliceous nature it is seen under the microscope to consist of a mosaic of silica with carbonates. Distinct and separate veinlets of quartz and carbonates of later origin than the main lodestuff cut one another without displacement. This flinty ore contains small amounts of iron pyrites and traces of mispickel. (I/4141 showed relics of leucoxene.)"

"(c) A dense pale green aphanitic type traversed by quartz veinlets, and impregnated with fine-grained iron pyrites together with needles of mispickel. Carbonates of lime and magnesia in shapeless patches make up the larger part of the rock. There is a fair sprinkling of residual shapeless quartz, and a few wisps of sericite. Some residual plagioclase is also present."

Concluding remarks and suggestions:—

"It is not possible finally to give a conclusive opinion regarding the positive genesis and origin of the Wiluna ore deposits on the specimens submitted.

The ore submitted certainly presents all the features of highly metasomatised material. It probably came from that part of the lode near where the quartz dolerite contacts with the calc schist, and consequently near the most favourable line in the trunk channel suited to great alteration.

The maximum silification is represented by the flinty type, and if there is much of this type it will make the ore hard to crush. Mr. Moore tells me that the Wiluna ore is not easy to crush; this may be due to a mixture of the flinty type with the "blotched" type, I/4140, which contains patches of white silica, due possibly to desilication of the silicates in the original rock—helped by the primary ore solutions.

A remarkable feature is that there is no great evidence of schisting or shearing. The maceration, alteration, and reconstruction of the original rock is so great and thorough that your conception of a shatter zone is very suggestive. The general microscopic evidence is in favour of mashing rather than shearing.

It would appear that concomitant with, or slightly subsequent to the mashing process in the shattered zone, the rock mass was invaded by siliceous carbonated alkaline sulphidic and auriferous solutions at high temperatures and pressures, with resultant metasomatism and reconstruction of the quartz dolerite greenstone into its present form of lodestuff. The granular sulphide of iron and prismatic forms of mispickel are without doubt of primary origin.

All the ore submitted is apparently metasomatised quartz dolerite greenstone. Quite a lot of ore is known to be metasomatised calc schist (see my report, Annual Report Mines Department, pp. 129-131, 1925), but little or none of this ore was included amongst the samples received.

In regard to the remark:—"but though the ore is very hard and flinty, in the oxidised zone it becomes very clayey, leading to the inference that felspars and their derivatives and ferromagnesian minerals are largely present as well as silica," I am inclined to the opinion that the decomposition of the ore in the oxidised zone is rendered easy by the large amount of carbonate. The original felspathic and ferromagnesian constituents have suffered intense carbonation. A little of the felspar—which would form clay—is left. It is probable that there is more chlorite in some of the ore than these sections show, and this would make clay, while the ferrous iron would produce hydrated iron oxide in the surface zone—assisted by the iron from the sulphides. It has already been pointed out that the flinty ore contains strong evidence of carbonates that may well help in its disintegration at the surface. If it were pure jasper, i.e., entirely cryptocrystalline silica, it would still be hard and relatively undecomposed in the zone of oxidation.

APPENDIX II.—(C).

Earlier Departmental publications on the Wiluna Field.

Bulletin No. 34 of Geological Survey of Western Australia—

Report upon the Auriferous Deposits of Barrambie and Erroll's (Cue District) and Emu Creek (Nannine District) in the Murchison Goldfield, also Wiluna (Lawlers District) in the East Murchison Goldfield, by Chas. G. Gibson, B.E., Assistant Geologist, 1908, pages 17 to 43.

Bulletin—Report on the Progress of Mining in the Districts between Leonora and Wiluna, by A. Montgomery, M.A., F.G.S., State Mining Engineer, dated 11th March, 1909, pages 4 to 25.

Annual Report of the Department of Mines, 1925—

(a) Report by Dr. Larcombe, Acting Government Petrologist, on "A Petrological Investigation into the cores from Nos. 1, 2, and 3 New Bores put down on Leases 6J, 7J, 271J, and 280J, by the Wiluna Development Syndicate, Wiluna, East Murchison Goldfield." Pages 126 to 133.

(b) Reports of Analysis of Wiluna Sulphide Ore, page 169.

APPENDIX No. III.

Diamond Drill Boring.

Two sets of diamond-drill bores have been made, one by the Gwalia Consolidated Company some 16 years ago, and one by the Wiluna Development Syndicate in 1924. The latter are fully described in the Annual Report of the Mines Department for 1925, pages 126 to 132.

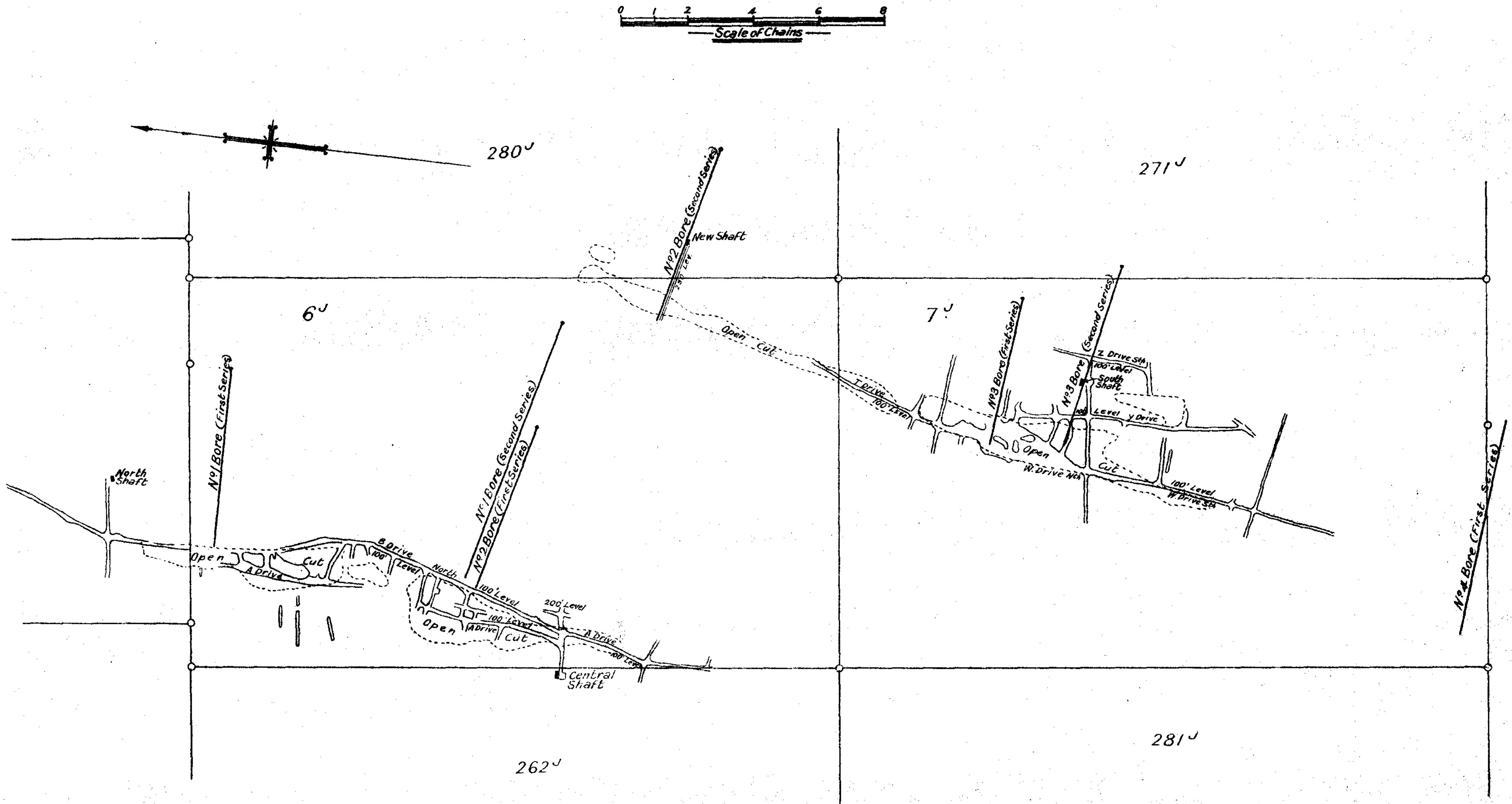
The No. 1 bore of the first series was put down from a point 723 feet N. and 547 feet E. of the "Central" shaft to cut through the Western lode at a distance corresponding to about 750 feet N. from the main crosscut in the Nos. 1 and 2 levels, but at a vertical depth of about 370 to 420 feet. It would therefore cut the lode about 80 feet North of the end of the drive North at the 200 feet level. The bore was put down due West at an angle of 50 degrees to the horizontal, to a depth of 560 feet, equal to a vertical depth of 429 feet and horizontal measurement of 360 feet. From 479 to 542½ feet in the bore, sulphide lode material was passed through, of which 47½ feet from 484 to 530½ feet gave an average assay value of 30s. 8d. per short ton, and 21 feet from 484 to 505 feet averaged 40s. 5d. These distances correspond to 36 and 16 feet across the lode at right angles respectively. From the mine plans it is now most probable that this lode is the Eastern branch seen at 100 feet and 200 feet levels, and it may either have joined up again with the Western branch, or the bore did not go far enough to cut the latter. The size of the ore body suggests that it may be near a junction of the lodes. The important point is that there is a big and valuable lode at this point, at a vertical depth of 400 feet carrying 40s. values together with some 20 feet more in width of a grade which could quite possibly be taken for the mill also. This body lies North of any important earlier workings on this lode.

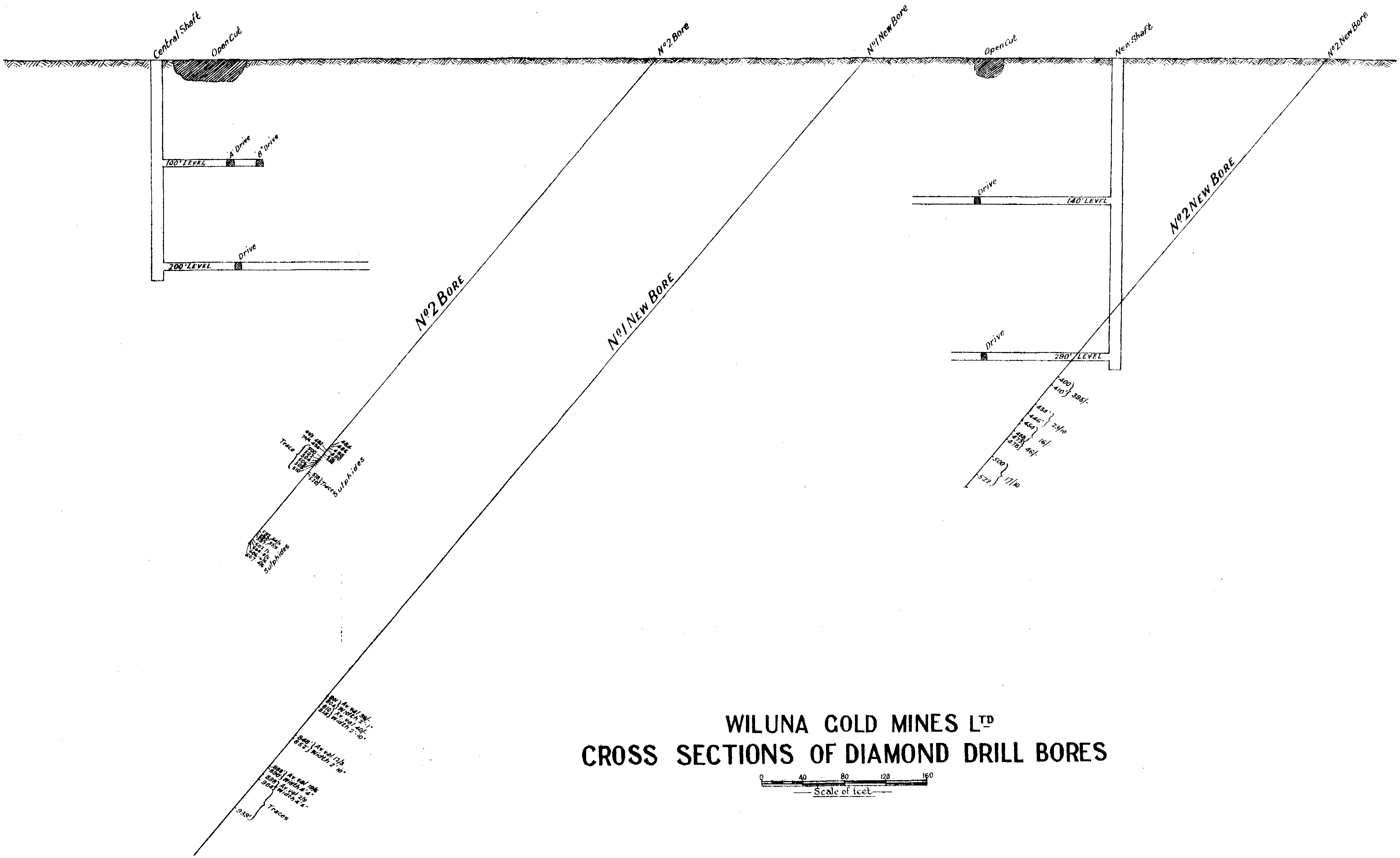
No. 2 bore of the earlier series is started 497 feet East from the "Central" shaft and 95 feet North of it, and runs N. 75½ degrees W. at an angle of depression of 50 degrees. It ends under the workings on the East branch of the Western lode about 176 feet N. of the 200 feet level crosscut. The length of the bore was 607 feet, equal to 465 feet vertical and 390 feet horizontal measurement. Sulphide ore was cut at 484 to 496 feet in the bore, these 12 feet assaying 57s. 7d. per ton, equal to a width of vein of 9 feet 3 inches at right angles to the plane of the ore body. At 592 to 597 feet, 5 feet of core assayed 46s. 10d. per ton, the true width of this vein being 3¾ feet, and for another 10 feet to 607 feet (true width of ore body 7 feet 7 inches) there was ore-stuff but very poor, assaying only 3s. 5d. per ton. This bore was still in low grade ore when it was stopped. The crosscut at 200 feet North at the 200 feet level is nearly over this bore, and shows three more or less parallel veins corresponding fairly well with those in the bore, but the latter are 170 to 260 feet deeper down. The lode therefore seems to be holding its size and value quite well at this point for at least 200 feet deeper than the 200 feet level.

No. 1 Bore of the 1924 series is close to No. 2 of the old series but begins over 200 feet further East and therefore gives a considerably deeper section of the lode. It starts 711 feet East and 64 feet North of the "central shaft" and runs N. 75½ degrees W. at an angle of depression of 50 degrees for a length of 1,002 feet, equal to a vertical depth of 768 feet and horizontal measurement of 644 feet. Taking for the sake of uniformity and comparison the mine figures rather than those given in the Annual Report of the Mines Department for 1925 (pages 126-132), average values of 38s. per short ton were obtained

WILUNA GOLD MINES L^TD

Plan showing old workings of the Gwalia Consolidated L^td and position of its Diamond Drill Boreholes Nos 1, 2, 3 and 4 (First Series); also Nos 1, 2 and 3 (Second Series) put down by the Wiluna Development Syndicate.





WILUNA GOLD MINES LTD

CROSS SECTIONS OF DIAMOND DRILL BORES

0 40 80 120 160

Scale of feet

for 2 feet 1 inch (true width) from 801 to 804 feet and 40s. for 2 feet 10 inches (true width) from 810 to 814 feet, 19s. 6d. for 1 foot 5 inches at 880 to 890 feet, 21s. 9d. for 4 feet 4 inches from 898 to 904 feet, and traces of values from 904 to 939 feet. These veins correspond in position fairly well with those in the above-cited No. 2 Bore of the older series but are at 600 to 750 feet vertical depth. It is not certain that either of these bores has gone far enough to be sure of having cut through the western branch of the lode system seen at 100 and 200 feet levels. Dr. Larcombe's report (page 127 of Annual Report Mines Department 1925) shows that there was a change of country in the last 32 feet of this bore from calc schist to porphyrite, a change which may or may not prove to have economic significance. Porphyrite was not met with in any of the other bores. In this bore the lode has not given at all a promising section, the veins having become very small in comparison with the large ore-bodies seen elsewhere in the mine, but no very great significance can be attached to this as they vary quite largely in size and value within short distances in the workings in the higher levels.

About 107 feet south from No. 1 bore of the 1924 series the cross-section of the lodes in this vicinity is continued eastward by workings from the "new" shaft and the No. 2 Bore of 1924. No. 2 Bore starts 200 feet S. 75 degrees E. from the "new" shaft on the east lode which is 145 feet from the centre of the old workings on the outcrop of the east lode. It goes N. 75 degrees W. at an angle of 50 degrees depression to a depth of 544 feet, equal to 417 feet vertical depth, and 350 feet horizontal measurement. The shaft is shown on the mine drawings as sunk with its northern edge along the line of the bore, but owing to the plats and crosscuts being on the south side of the shaft, the crosscuts are 7 to 15 feet south of the line of the bore up to their intersection with the main drive, which is almost over the line of the bore. If the bore has not deflected seriously, which is unlikely in its short distance, there is some difficulty in reconciling the section shown by the bore with that given by the 290 feet level crosscut close above it. At 400 to 410 feet the bore passed through some rich values, gold being visible in some of the core. A detailed section from his examination of the cores in this bore is given in Dr. Larcombe's report previously cited, at page 128 of the 1925 Annual Report of the Mines Department, and in the drawing opposite same page. This section shows that quartz dolerite greenstone forms the country east of the lode at this point and that the lode itself is formed of transmuted quartz dolerite rock, but in the end passes into calc-schist, which is the country of the West Lode. There is some appearance of the East Lode being more or less on the contact of the calc schist and quartz dolerite. The section shows five bands in the core containing gold values, 400 to 402 feet and 406 to 408 feet being very high grade, 434 feet to 446 feet about 24s. per short ton, poor ore from 446 to 472 feet and 46s. per short ton from 472 to 478 feet. From 500 to 522 feet there is another length of poor values, about 18s. per short ton on the average. There are values more or less from 400 feet to 478 feet, and again from 500 to 522 feet. These lengths of core would be taken at an angle across the lode, not at right angles to it, the true width being about three-fourths of the lengths bored through. Had the plat and crosscut been on the North side of the shaft instead of the South one they should have found the bore, if there had been no deflection, and the difference in the bore section of the lode from that given by the crosscut is rather puzzling. In the crosscut at the 290 feet level a slight break in the rock about 50 feet from the shaft possibly corresponds with the rich veins at 400 to 410 feet in the bore, but gave no values. At 72 to 76 feet from the shaft 4 feet gave 44s. 3d. assays, 76 to 85 feet 16s., and 85 to 90 feet 71s., all per short ton, followed by 90 to 105 feet nil, 105 to 110 feet 11s. 3d., and 110 to 115 feet 23s. 4d. From 115 feet to 157 feet, a width of 42 feet in the crosscut, the assay returns average 39s. 6d. per short ton. The crosscut was then carried to 166 feet from the shaft in country. Assuming that the rich veins at 400 to 410 feet in the bore were not met with in the crosscut, but lie to the North side of it, the other veins in the bore correspond fairly well in position with those in the crosscut 50 to 100 feet higher up, a distance sufficient to account for considerable change in the ore body, and it seems to me that this is more likely to be the true state of the case than that the bore has deflected upwards to a position in which the good vein at 72 to 76 feet in the crosscut would be that seen at 400 to 410 feet in the bore. The end of the crosscut would then be only about 60 feet above the bore at 510 feet, and the change from the big ore body from 115 to 157 feet in the crosscut to the much smaller and relatively poor veins in the bore would be a very sudden one. If the bore be not deflected, the cross-section shows considerable probability that boring was stopped too soon, and would have been better carried on another 100 feet. The regular development of the lode by mining work below the 290 feet level will, however, soon resolve all difficulties in understanding the position much more thoroughly and satisfactorily than by more boring. The want of close correspondence of the ore-veins in this bore with the ore-body in the crosscut, however, emphasises the variability in the occurrence of values in these lodes which appears to be very characteristic of them, and which is very apparent when sampling the veins, successive samples from the same cuts differing often in assay value quite widely.

No. 3 bore of the earlier series, and No. 3 of 1924, are through the East lode near the South shaft, about 160 feet apart.

The No. 3 earlier bore commenced at a point 138 feet North and 160 feet East of the South shaft, and was bored on a line running N. 83 degrees W., at an angle of depression of 50 degrees to a depth of 498 feet (scaled from company's drawings), equal to 381 feet vertical depth and 320 feet horizontal measurement. It finishes almost vertically under the West drive at a point about 205 feet North of the West crosscut at 100 feet level from the South shaft, and has evidently been intended to cut the big ore-body worked above the 100 feet level towards the junction of the West and Y drives North. The mine summary shows:—

					Average Assay.
Quartz Stringers—					
264½ to 277ft.	=	12½ft.	=	11ft. across Lode	16s. 0d.
305 „ 317½ft.	=	12½ft.	=	11ft. „ „	10s. 0d.
321 „ 324ft.	=	3ft.	=	2½ft. „ „	29s. 9d.
Oxidised—					
345½ „ 384ft.	=	39½ft.	=	35ft. „ „	30s. 3d.
Sulphide—					
348 „ 368ft.	=	20ft.	=	18ft. „ „	45s. 7d.

It is worth noting that in this bore oxidised ore was found in the bore to a depth of 384 feet, or 300 feet vertically from surface. Sulphide ore was passed through from 348 to 368 feet and then changed to red oxidised ore to 384 feet. Deep oxidation of the lode-stuff is also seen on the west lode, where it goes below the 200 feet level in parts of the north drive. Throughout the mine oxidation of the ore to 100 feet depth is usually complete and that from 100 feet to 200 feet is partly oxidised, but to find oxidation to 300 feet is unexpected. As the present water level is quite shallow this deep oxidation is doubtless the result of changes in the water level during past time. The present surface is pretty certainly only a short depth below the old surface to which the ground had been worn down prior to the deposition of the Nullagine (Cambrian) beds seen only a few miles away in the Finlayson Range.

As the old No. 3 Bore passes through the Y Lode between the 200 and 300 feet levels and the 290 feet level from the "new" shaft appears to be following the same branch, the ground proved by the bore should now be in process of being opened up by the level. It seems probable that neither bore nor level have yet cut the west branch in this part of the mine.

The 1924 No. 3 Bore starts from a point 240 feet S. 77½ degrees E. from the south shaft and goes down on a bearing of N. 77½ degrees W. at an angle of depression of 50 degrees for a depth of 620 feet (scaled from Company's section), equal to 475 feet vertical depth and 399 feet horizontal measurement. It is fully described in Dr. Larcombe's report on p. 129 of 1925 Annual Report of the Mines Department, which shows that to 356 feet it passed through quartz dolerite greenstone and lode-stuff derived therefrom, from 356 to 358 feet a white quartz vein, probably one of the later series of white quartz reefs common in the district and which pass through the lodes, from 356 to 386 feet a dyke of felsite (keratophyre) carrying small values in gold, and then to 620 feet into fine-grained calc-schist greenstone. At 170 to 172 feet a vein 1½ feet wide was cut, assaying 25s. 6d. per short ton. This does not appear to correspond with any vein which has been worked or seen previously. At 286 to 290 feet 2 feet 11 inches of core carried an average value of 48s. This seems to correspond in position with the lode seen in the Z drive at the 100 feet level. From 325 to 376 feet was more or less lode matter, corresponding very well in position with the lode seen on the plans at the 30 feet level, and the opencut lying a short distance South of the South shaft. This lode seems much too far to the East to be either the Y or West branch of the lode. From it were obtained assays, as follows:—

Feet.	True Width.	Average Value per Short Ton.	
325 to 327	1ft. 6in.	42s. 6d.	Average 39s. 2d.
329 „ 333	2ft. 11in.	30s. 0d.	
335 „ 339	2ft. 11in.	59s. 0d.	
344 „ 348	2ft. 11in.	27s. 0d.	
350 „ 376	19ft. 4in.	4s. 0d. to 18s. 0d.	
51 feet	29ft. 3in.		

Values came into the bore again at 500 to 502 feet of 40s. for a true width of 1½ feet. The position of this vein coincides well with that of the Y drive at 100 feet, and if this be correct the bore did not go quite far enough West to cut the West branch, which it should reach in about another 50 feet.

The No. 4 Bore of the old series was put down about 868 feet South and 16 feet East of the South shaft in direction North 83½ degrees West and angle of depression 50 degrees to a depth of 687 feet (scaled from Company's sections), equal to 526 feet vertical and 442 feet horizontal measurement. This bore is nearly 300 feet South of the furthest South workings on the lode and is well placed for cutting any continuation of the lode to the Southward, but as no values were obtained in it, it would seem that the lode has come to an end in this direction or that some as yet undiscovered dislocation has taken place by faulting or intrusion of a dyke. Prospecting further South along the lode at 140 or 290 feet level would probably be the best way of testing this end of the mine further.

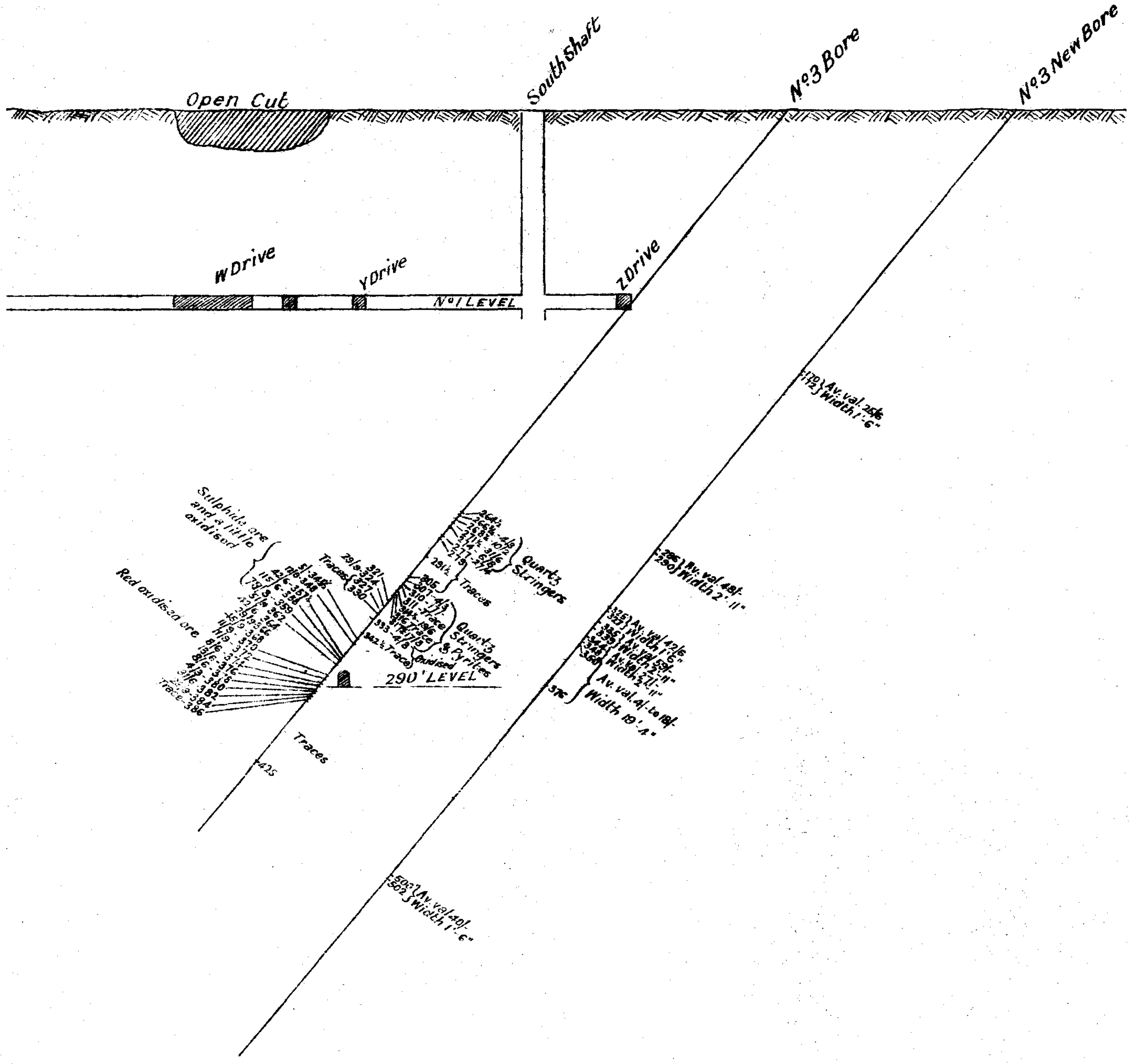
Now that a large amount of underground development has been done on the Western and Eastern lodes it is easily seen that the diamond drill bores might have been carried deeper with some advantage, and that somewhat different sites would probably have been chosen for them if the underground information now available had been so when the boring was decided upon.

APPENDIX No. IV.

Metallurgical Treatment.

The earlier operations on these mines were entirely on the weathered or oxidised portions of the ore-bodies, and the experience has been that ordinary battery and cyanide treatment has not been satisfactory in obtaining a good extraction of the gold. Most of the tailing, however, has been retreated with good results by finer grinding and again cyaniding, and it would appear that the gold in the ore is mostly in very minute particles, liable to remain sealed up in the larger particles of the lode-matter, and requiring very fine grinding before it can be set free.

The oxidised ore is also of a very clayey nature and makes much sticky slime which is difficult to treat by filtration processes. Owing to the mines



WILUNA GOLD MINES LTD
CROSS SECTIONS OF DIAMOND DRILL BORES

0 40 80 120 160
Scale of feet

of the Wiluna District often containing antimony ores, as stibnite and stibiconite, it has often been stated that the difficulties in ore treatment were due to the presence of antimony in the lodes, but more extended investigation has shown that this is not usually the case. Seventeen analyses by the Government Analyst are quoted on page 169 of the Annual Report of the Department of Mines for 1925 in which antimony was specially searched for, but found to be absent, but in every case but that of three tests from the No. 3 bore, a good deal of arsenopyrite was found in the sulphide ore from the 1924 bores. The antimony sulphide veins seen in some of the mines of this district appear to be of a much later date of origin than the auriferous lodes, and often run right through the older ore-bodies in definite veins. Where such veins are encountered it is obvious that a certain amount of antimony must get into the battery residues, but in practice it has not been difficult to pick out a great deal of the antimonial veinstuff before it is crushed at all. The arsenopyrite, however, is very closely associated with the gold contents of the ore, and even prolonged treatment with cyanide solutions and very fine grinding have been unsuccessful in obtaining a satisfactory gold extraction. It has been found, therefore, that roasting of the arsenical sulphide ores is a practical necessity in order to get a good extraction of the gold. It is still a matter of balancing of costs to ascertain whether it will pay best to dry-crush and roast the whole of the ore as is the most usual treatment in vogue at Kalgoorlie, with subsequent regrinding, amalgamation and cyaniding of the roasted ore, or to adopt the alternative of wet-crushing and concentration, with roasting of the concentrates. The Company are working out data to enable a decision to be arrived at on a scale of about 30 tons of ore per day. Ten stamps of the old Gwalia Consolidated Battery have been put into action again, crushing 30 tons of ore per day. The crushed ore is pumped up to an elevated drag classifier, the overflow slimes from which go into de-watering tanks, the separated water from which returns to the mill supply. The sands from the classifier go to a tube-mill where they are finely ground, only about 12 per cent. remaining on a 150 mesh sieve, and the ground effluent is pumped up to the de-watering tanks. From these the thickened slime runs to a set of 8 Minerals Separation Company's cells, where it is strongly agitated and the sulphides separate with the floating froth forming on top of the cells. Eucalyptus and other oils are added to the tube-mill feed, and again in the cells, and a little potassium xanthate as a conditioner. The mine salt water is used in the mill, and is very dense, having a specific gravity of 1.114 and containing no less than 18.45 per cent. of various salts in solution. The Ivanhoe G.M. water at Kalgoorlie contains only 4.85 per cent. of dissolved salts. The specific gravity of the ore is taken as averaging 2.9, making a pulp of from 1.22 to 1.40 specific gravity. The specific gravity of the floated concentrate is taken at 3.75.

The quantity of oil used is about 1/4 to 1/2 lb. per ton of ore treated, and of potassium xanthate 3/20ths to 1/4 lb. At the time of my visit the final practice had not been settled, and variations in reagents, oils, speed, density of pulp, salinity of solutions, and other factors were being systematically tried out in order to arrive at the best treatment.

The following figures were given to me as an example of the progress being attained:—

Head Value of Ore being treated, 36s. 0d. per short ton.
Tailing „ „ „ 10s. 0d. „ „

Cell.	Percentage of Total Recovery.	Assay Value of Concentrates, Shillings per Short Ton.	Product.
1	61·2	× 300	= 18,360·0
2	17·5	× 191	= 3,342·5
3	7·9	× 98	= 774·2
4	5·0	× 99	= 495·0
5	2·6	× 50	= 130·0
6	2·0	× 31	= 62·0
7	1·3	× 25	= 32·5
8	2·0	× 19	= 38·0
	99·5	Average 233·5	23,234·2
Adjustment ...	·5	...	= 116·8
	100·0	...	= 23,351·0
	Average: 233·51.		

The average assay value of the ore treated being 36s. 0d. per ton, concentrates 233.51s., and tailing 10s. 0d., the percentage of concentrates works out, to balance, at 11.633 per cent. and of tailing 88.367 per cent., thus:—

	%		s.	d.				%
Concentrates ...	11·633	at	233·51	0	=	2,716·4	=	75·5
Tailing ...	88·367	„	10	0	=	883·6	=	24·5
Ore	100·000	„	36	0	=	3,600·0	=	100·0

The concentrates in this case thus contained 75.5 per cent. of the original value of the ore, and the tailing 24.5 per cent., and the proportion of the original ore value saved in each cell works out as follows:—

Cell.	1	2	3	4	5	6	7	8	Total.
Percentage of total recovered value...	% 61·2	% 17·5	% 7·9	% 5·0	% 2·6	% 2·0	% 1·3	% 2·0	% 99·5
Percentage of original ore value ...	46·2	13·2	6·0	3·8	2·0	1·5	1·0	1·5	75·5

The loss in tailing of 10s. per ton of tailing (say 9s. of original ore) is still too high, and efforts are being made to reduce it. In experimental work on a small scale, it has been found possible to reduce tailing assays below 4s. per ton, and I do not think that it will be very long before means are devised of getting even better results than this by the flotation method on a working scale.

The assay value of the concentrates at the time of my visit was given to me as averaging 220s. to 280s. per short ton. It will be seen from the above tabulated results that the concentrate from the first cell or hutch is much richer in gold than from any subsequent one, the values falling with each successive hutch. It is usual to take the float from the first four hutches (amounting in the above example to 91.6 per cent. of the total recovered value) as finished concentrate and return the product of the last four hutches to the mill circuit again.

The amount of concentrate obtained is averaging about 10 per cent. of the weight of ore milled, and contains about 9.40 per cent. of metallic arsenic, equal to 20.43 per cent. of arsenopyrite. The total sulphur in the crude ore was given to me as 3.43 per cent. Sixteen analyses of bore cores in Dr. Simpson's tables, on page 169 of the Annual Report of the Department for Mines for 1925, give the following average results:—

Bore.	No. of Analyses.	Arsenic.	Sulphur.	Arsenopyrite.	Pyrite.
		%	%	%	%
No. 1 ...	4	0·593	2·105	1·283	3·4675
No. 2 ...	7	0·900	2·150	1·950	3·2900
No. 3 ...	5	0·084	0·612	0·184	1·0840
Weighted Average ...	16	0·57	1·66	1·23	2·65

The average ratio of sulphur to the mixed sulphides arsenopyrite and pyrite in these results is 1.66 to 3.88 or 1 to 2.337, and on this basis the 3.43 per cent. of sulphur in the crude ore treated at the mill would correspond to 7.69 per cent. of the combined sulphides, made up of 2.44 per cent. arsenopyrite and 5.24 per cent. pyrite. The 20.43 per cent. of arsenopyrite in the concentrates would mean 44.01 per cent. of pyrite, or 64.44 per cent. of the combined sulphides, if the two sulphides concentrate equally well, which may or may not be the case. In the absence of direct analyses of the ore milled and the concentrates, it would seem therefore from such other figures as we have in hand that the concentrate is likely to be about 64 per cent. sulphides and 36 per cent. gangue, which would be a fairly normal figure for concentrates. The ratio of crude ore to concentrates is taken roundly to be about 10 to 1, but in the foregoing calculations it was found that 11.633 per cent. of concentrates were required to balance the assay results, which is a concentration of only 8.6 to 1. Taking the ratio of concentration as 8.6 to 1, the 7.69 per cent. of mixed sulphides taken to be in the crude ore would account for 7.69 x 8.6 = 66.1 per cent. of sulphides in the product, if *all* the sulphides were saved. No doubt more complete and exact figures will soon be available which will enable it to be seen more precisely what proportions of the sulphides and gold in the original ore are recovered in the concentrate, and to what extent the unrecovered gold is locked up in the earthy part of the tailing and in the sulphides left therein respectively. The treatment by flotation is still largely in an experimental stage, and it is too early to found conclusions as to its final success on the results as yet available.

The sulphide concentrate is being roasted in an Edwards' roasting furnace, and the manager has informed me that this part of the treatment operation is going on very successfully, giving a well oxidised product from which the gold is readily obtainable by cyaniding.

If it should prove that the flotation treatment does not suceed in making a high enough extraction of the gold, the alternative is always open of dry-crushing the ore and roasting it as a whole before finally crushing to slime and extracting the gold by cyanide treatment, with or without amalgamation. This is the existing standard Kalgoorlie method, and can be relied upon for a satisfactory gold extraction at costs comparable with those of the mills there. The first cost of this style of plant, however, will be very much greater than that for flotation treatment of the total ore, followed by treatment of a greatly reduced quantity of concentrates, say, about a tenth only of the original tonnage, and it will require close analysis of all costs of both processes to enable it to be finally determined which method will be the greater economical success when all cost factors are taken into consideration. With the trial plant at Wiluna testing the flotation method on a scale of 30 tons a day, Mr. Vail will be in a position before long to make close comparison of all these factors with his results at Kalgoorlie in the Lake View and Star Company's new mill by the standard Kalgoorlie method.

Whichever method of treatment be adopted there will be a large quantity of oxide of arsenic produced by the roasting of the arsenopyrite, and of sulphur dioxide from the sulphur in both the pyrite and arsenopyrite. The sulphur dioxide in the furnace fumes soon combines with moisture and oxidises in the air to sulphuric acid which must be expected, particularly when associated with arsenic, to have a very destructive effect on all vegetation in the vicinity, and a strong corrosive effect an all unprotected iron in buildings and machinery. Taking the sulphides in the crude ore as 2.44 per cent. of arsenopyrite and 5.24 per cent. of pyrite, it may readily be calculated what a serious amount of these poisonous products will be produced.

Arsenopyrite contains 75/163 of its weight of metallic arsenic and 32/163 of sulphur, and 2.44 per cent. of arsenopyrite would, therefore, mean 1.12 per cent. of metallic arsenic and 0.48 per cent. of sulphur per ton of crude ore. Pyrite contains 8/15 of its weight of sulphur. So 5.24 per cent. of pyrite in the ore would correspond with 2.79 per cent. of sulphur, making a total of 3.27 per cent. of sulphur in it from both minerals.

Twenty-five parts by weight of metallic arsenic oxidise to form 33 parts of arsenious oxide (white arsenic). So 1.12 per cent. of arsenic in the ore would increase to 1.48 per cent. of white arsenic; 32 parts of sulphur make 98 parts of absolute sulphuric acid (H_2SO_4), so the 3.27 per cent. of sulphur in the ore would yield 10.01 per cent. of H_2SO_4. Every hundred tons of ore roasted, therefore, would put out 1.48 tons of white arsenic into the atmosphere and 10.01 tons of absolute sulphuric acid. It is expected that the mine will treat about 1,000 tons of ore a day, which would involve the discharge from the furnaces daily of 14.8 tons of white arsenic and 100.1 tons of sulphuric acid. The London quotation for white arsenic of May 17th, 1927, was £16 a ton, and at this price the daily production of white arsenic, if it could all be saved, would be worth £237 equal to 4s. 9d. per ton of ore treated. The expenses of putting white arsenic on the market would, however, be heavy, and probably a production of nearly 15 tons a day would depress the price materially and would be difficult for the market to absorb. The figures are, however, useful as a reminder that the arsenic content is of considerable value and that Cottrell precipitation of arsenic from the furnace fumes, besides being necessary for the health of residents in the vicinity of the mine, would probably more than pay for its cost.

There unfortunately is little hope that the large quantities of sulphuric acid formed by the roasting can yet be recovered economically by any proved process from the furnace fumes at such a place as Wiluna, which is very unfavourably situated for distribution or utilisation of such a product.

If the sulphide values can be concentrated successfully by flotation or gravity process into a product very clean from intermixed sand and other earthy matter, it may nevertheless be found possible to carry the concentrates to a coastal port for roasting and final treatment, at which both arsenic and sulphuric acid could be recovered as commercial products and utilised. The residue after extraction of the gold would also be of value for making red hematite paint or as an iron ore. Obviously any scheme of treatment of, say, 60 or more tons of sulphides per day in this way would only be possible if there were railway communication from the mine to the coast. The same problem will arise at Kalgoorlie also if the concentration of sulphides be generally adopted, and it is a matter of considerable national importance that valuable substances such as sulphur and arsenic should not be wasted.

The Eustis process of extracting sulphur in a free state from pyrites will be worth serious consideration in this connection, the end products being gold, electrolytic iron, free sulphur, and white arsenic.

So long as the sulphides are treated at the mines by simple roasting, with waste of the sulphur and arsenic, the principal precautions for health purposes which can be taken practically are to condense as much white arsenic as possible in fume chambers, and to discharge the gaseous fumes at as high a level as possible from tall chimney stacks so as to dissipate them as much as possible through the atmosphere.

Annual Report of the Board of Examiners for Colliery Managers' and Under-Managers' Certificates under "The Coal Mines Regulation Act, 1902-1926."

Office of the State Mining Engineer,
Mines Department,
Perth, 23rd April, 1928.

The Under Secretary for Mines, Perth,

Sir,

The Annual Report of the Board of Examiners for the year 1927 is submitted for the information of the Hon. the Minister for Mines.

Two Board meetings were held during the year under review; the first being held on the 7th April instead of the 28th April, owing to the absence from Perth of the Chairman on the latter date; and the second on 26th October, 1927.

EXAMINATIONS.

April.—Examinations for First and Second Class Certificates of Competency were advertised to be held in April, but no applications were received.

October.—In response to the advertised examinations to be held on the 6th, 7th, and 8th October, only one candidate sat for the examination for Second Class Certificate of Competency. As this candidate failed to gain the requisite number of marks for a pass, the Board decided that it could not grant a certificate. Copy of examination papers herewith.

Mr. McVee, Inspector of Mines, Collie, supervised the examination, both written and oral.

We have the honour, etc.,

A. MONTGOMERY,
State Mining Engineer.

T. BLATCHFORD,
Government Geologist.

JAS. McVEE,
Inspector of Mines.

V. RUSSELL,
Acting Secretary.

THE COAL MINES REGULATION ACT, 1902-1926.

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

SUBJECT: VENTILATION AND DANGEROUS GASES.

Wednesday, 5th October, 1927, 10 a.m. to 11.30 a.m.

Possible Marks.

50. 1. The Deputy reports that two of the sixteen places in a ventilating district are fouled with firedamp which he has failed to remove. Safety lamps are used, and the fourteen places commence work. What directions would you give regarding the district?

50. 2. There are fifteen parallel bords driven up to a fault situated 40 yards from the innermost line of cut-throughs; the seam gives off a little C.H4. Is there anything you would do before abandoning the district? If so, show on a sketch how and where you would do it.

50. 3. In a hard coal seam, dry and dusty, there is no water to damp the dust before shot firing. What will you do, and how?

50. 4. Show how you would ventilate the workings on the accompanying plan.

50. 5. In the absence of firedamp how might an explosion occur in a dusty mine? What would be the chief factors contributing to the above? How would you minimise the possibilities?

50. 6. An airway is 6ft. 9in. high and 13 feet wide. The anemometer registers the velocity of the air at 6 feet per second. Calculate the quantity of air passing in cubic feet per minute.

300

THE COAL MINES REGULATION ACT, 1902-1926.

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

SUBJECT: MINING OF COAL.

Wednesday, 5th October, 1927, 11.30 a.m. to 1 p.m.

Possible Marks.

50. 1. It is proposed to run a feeder of water through a stopping sealing off a dip district. How can this be done so that the efficiency of the sealing off stopping is not impaired?

50. 2. A pillar working place 8 yards wide and 12 yards long has just finished and the timber has to be drawn. Sketch the place and show how you would start and continue drawing the timber.

50. 3. What are the principal points to keep in view in introducing coal cutting machinery into a colliery so as to obtain the best results? State what rules you would consider it advisable to put in force for the guidance of those employed at machine cutting.

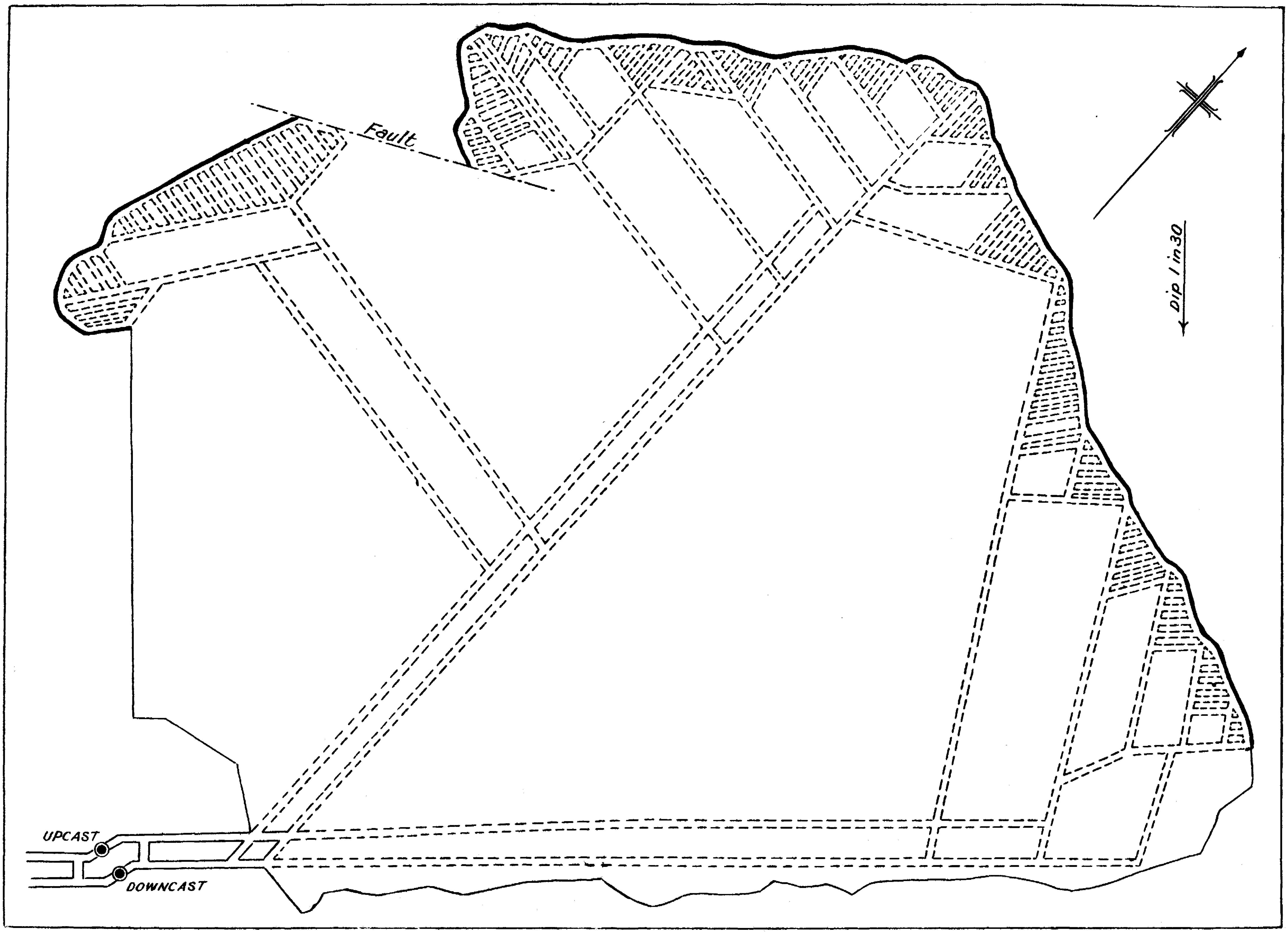
50. 4. Compare the "longwall" and "bord and pillar" methods of working a seam of coal and give the ideal condition for each system.

50. 5. The brushing of a long wall working consists of hard slicken sided shale, which when built into the pack walls is liable to be squeezed out on to the gateways. Explain how this trouble can be lessened by any means.

50. 6. Large areas of coal have been lost owing to creep and crush in bord and pillar workings. Describe and illustrate "creep and crush" and give your opinion as to their cause and occurrence.

300

The open working faces requiring to be ventilated are distinguished by a thick black line; the open airways and haulage roads by two parallel dotted lines. All the rest of the space within the edge of the solid coal is filled with stowing. There are to be four air-crossings and five splits of air.



THE COAL MINES REGULATION ACT, 1902-1926.

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

SUBJECT: ARITHMETIC.

Wednesday, 5th October, 1927, 2 p.m. to 3 p.m.

Possible Marks.		
16.	1.	Work out the quantity of coal contained in 20 acres of a seam of the following section:—

	ft.	in.
Coal ..	2	6
Band ..	0	9
Coal ..	2	9

The specific gravity of the coal is 1.28. If 7 per cent. is allowed for waste what is the quantity available for use?

17. 2. A pump in a mine delivers 510 gallons per minute. Owing to a breakdown the pump stands for four hours; after repairs it is necessary to run the pump for 12 hours before the water is reduced to the same level as before the breakdown. What is the feeder of water per minute?

16. 3. The miners are paid 4/3d. per ton for "pick coal," 3/1d. for "machine coal," and 3/3d. for "tops," 35 per cent. of the output is "pick coal," 55 per cent. "machine cut coal," and 10 per cent. is "tops." Find the average price per ton paid to the miners.

17. 4. Bords are 6 yards wide and one chain apart centres, and cut throughs 4 yards and 2 chains apart centres. The thickness of the seam is 8 feet. Taking the specific gravity of the coal to be 1.28, what is the percentage of coal lost in a pillar if 1,560 tons are got out in its extraction?

17. 5. A shaft having an internal finished diameter of 20 feet is lined with brickwork 18 inches thick. What is the area of the brickwork?

17. 6. Water is delivered into a cistern 14 feet in diameter at the rate of 10 gallons per minute. How long would it take to fill the tank to a depth of 6 feet? At what rate would the water rise up the side of the cistern?

100

THE COAL MINES REGULATION ACT, 1902-1926.

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

SUBJECT: ROADWAYS.

Wednesday, 5th October, 1927, 3 p.m. to 4 p.m.

Possible Marks.

50. 1. What are "self-acting inclines?" Assume that one has been designed and will not work. Give the possible cause or causes.

50. 2. With endless rope haulage up a grade of 1 in 6, what precautions would you take to guard against accidents by clips slipping, breakages of ropes, etc.?

50. 3. Describe with sketches how you would replace broken timber in a roadway which is heavily weighted.

50. 4. Show by sketches how you would work a main and tail rope with two branches.

50. 5. An undulating roadway has to be prepared for endless rope haulage. Explain in sequence the necessary work to be done.

50. 6. The haulage roads of a deep and dry mine are exceedingly dusty. What practical method would you suggest as to dealing with the dust?

300

THE COAL MINES REGULATION ACT, 1902-1926.

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

SUBJECT: THE COAL MINES REGULATION ACT, 1902-1926.

Wednesday, 5th October, 1927, 4 p.m. to 5 p.m.

Possible Marks.

16. 1. What are the provisions of the Coal Mines Regulations Act in reference to the employment of boys in and about coal mines?

16. 2. What are the requirements of the General Rules with reference to travelling on haulage roads?

17. 3. What are the provisions as to signalling in shafts and on planes?

17. 4. What is meant by the terms "ventilating district" and "Main haulage road" as stated in General Rule 11 (k)?

17. 5. If a dry and dusty place forms part of a "main haulage road" or is contiguous thereto, what are the requirements of General Rule 11?

17. 6. What does the Act say about the construction of a safety lamp? When and where ought safety lamps to be used?

100

DIVISION III.

REPORT OF THE SUPERINTENDENT OF STATE BATTERIES.

Department of Mines,
State Batteries Branch,
Perth, 25th May, 1928.

The Under Secretary for Mines.

Sir,

I herewith submit my Report on State Battery operations for the year ended 31st December, 1927, for the information of the Hon. the Minister for Mines.

This is the thirtieth report.

MILLING.

I am pleased to report that the tonnage crushed at State batteries shows an increase of 3,957¾ tons over that of the preceding year, and is the highest since 1923, which was the last year in which appreciable quantities of lode material were supplied by the Wiluna leases.

Tonnage.—Three 10-stamp and fourteen 5-stamp mills crushed 451 parcels of customers' ore, aggregating 21,157¼ tons, as against 379 parcels totalling 17,104½ tons in 1926.

Batteries crushing over 1,500 tons were:—Cue, 3,373.25 tons; Coolgardie, 3,088.5 tons; Peak Hill, 2,320 tons; Wiluna, 1,979.5 tons; Ora Banda, 1,714 tons; Meekatharra, 1,535 tons.

Return by Amalgamation.—18,503.43 ounces of bullion, estimated to contain 15,684.5 fine ounces, were recovered, the net value being £66,612.52, or 62.96 shillings per ton.

The gross value of the ore was estimated to be worth 87s. 10d. per ton, giving an extraction of 71.62 per cent., or 3.30 per cent. less than for the preceding year.

Stamp Duty.—The average duty per stamp per 24 hours was 4.4 tons for 5-stamp mills and 3.56 tons for 10-stamp mills. The duty for the 5-stamp mill is good when it is considered that no secondary grinding plant is used, and the screen used is mostly 30-mesh.

Fuel Consumption and Power Costs.—Considering some of our plants have been forced to work two shifts and the rounds of crushings are small, necessitating frequent starting up, the fuel consumption has been good.

For Steam-driven Plants.—Yarri gave the best result, with a consumption of 8.06 lbs. of firewood and a cost of .77 pence per h.p.h.

For Charcoal Producer Plants the best results were obtained at Boogardie, .89 lbs. of charcoal and .47 pence per h.p.h.; and Cue, .63 lbs. of charcoal and .95 pence per h.p.h.

For Wood Producer Plants excellent results were obtained at all plants, Norseman giving the best figures of 2.88 lbs. and .25 pence per h.p.h.

Repairs and Renewals.—The cost of milling repairs and renewals show a satisfactory decrease compared with the preceding year's figures due to general overhaul and reconstruction of a number of our plants. £1,962 15s. 6d. was expended under this heading, equal to 1s. 10d. per ton, as against 4s. 1d. in 1926.

Revenue.—£10,710 6s. 8d. was received, equal to 10s. 2.04d. per ton, as against 9s. 7.56d. per ton for 1926. The increase is due to the collection of approximately £800 for water sold to the Victorious Mine at Ora Banda.

Expenditure and Cost per Ton.—The expenditure amounted to £21,252 18s. 10d., or 20s. 2.7d. per ton, a reduction on the cost of the previous year of 3s. 8.04d. per ton, due to the increased tonnage and reconstruction of our plants.

Rebates and Subsidies.—Rebates paid from the Mines Development Vote deducted from charges for crushing low-grade ores amounted to £739 10s. 3d., whilst cartage subsidies were allowed on 6,863¼ tons, amounting to £4,283 14s. 7d.

Loss on Working.—The loss on milling was £10,542 12s. 2d.

Tailing Purchase.—From the 21,157.25 tons milled 14,256¼ tons of payable tailing were purchased for a gross return to owners of £17,803 and a net return of £12,814. Figures on Schedule 7 represent actual payments per Treasury books, including some tailing produced late in the preceding year.

Return to Owners.—21,157.25 tons milled produced £66,612.52 by amalgamation, equalling 62.96 shillings per ton crushed.

14,256.25 tons of payable tailing were purchased for £17,803, or 19.11 shillings per ton crushed.

The gross value of ore was 87.83 shillings, and the gross return to owners 82.07 shillings. The average crushing charge per ton was 8.96 shillings, and tailing treatment 7 shillings per ton, so that the net return to owners, after paying 15.96 shillings for milling and tailing treatment was 66.11 shillings per ton.

Summary—

Gross value of ore—87.96 shillings per ton.

Amount paid to owners inclusive of charges—82.07 shillings per ton, or 93.44 per cent.

Amount paid to owners exclusive of charges—66.11 shillings per ton, or 75.25 per cent.

TAILING TREATMENT.

14,256¼ tons of payable tailing and 3,575 tons of unpayable tailing were produced, and 16,915 tons of accumulated tailing were treated at twelve of our plants.

The average head value was 7.427 dwts. and the tail value 1.448 dwts., giving an extraction of 80.50 per cent.

The tonnage treated was 976 tons in excess of that of the previous year, whilst the average value was .554 dwts. lower.

A good extraction has been maintained when the varied nature of the tailing is taken into consideration, the actual results being slightly higher than the theoretical call, which was £21,290.

Revenue.—From the 16,915 tons treated the amount taken to revenue was £10,741 3s. 2d., equal to 12s. 8.40d. per ton, a falling off of nearly 1s. per ton from the 1926 figures, due partly to the lower value of the tailing treated.

Expenditure.—The total expenditure on tailing treatment was £8,605 13s. 4d., or 10s. 2.08d. a ton, a reduction of 1s. 3.68d. per ton.

Profit.—Revenue exceeded expenditure by £2,135 9s. 10d.

TAILING TREATMENT.

Showing Values and Details of Extraction for 12 months ended 31st December, 1927.

Plant.	Tons.	Head value.	Contents.	Tails.	Contents.	Extraction.
		dwts.	dwts.	dwts.	dwts.	%
Bamboo Creek	240	15·42	3,700	2·25	540	85·4
Boogardie	1,352	12·64	17,088	2·25	3,051	82·2
Cue	2,964	5·98	17,753	1·36	4,050	77·25
Coolgardie	1,920	5·195	9,976	1·214	2,332	76·4
Meekatharra	1,508	8·09	12,213	1·29	1,859	84·05
Ora Banda	837	4·62	3,869	·83	697	82·03
Payne's Find	150	2·83	363	1·0	150	64·66
Peak Hill	1,340	6·22	8,337	1·16	1,560	81·35
Sandstone	78	10·3	790	1·14	124	84·34
St. Ives	3,132	4·33	13,574	1·2	3,756	72·36
Warriedar	1,144	6·87	7,870	1·48	1,699	78·45
Wiluna	2,250	13·38	30,107·5	2·08	4,677	84·45
	16,915	7·427	125,640	1·448	24,495	80·503

COMPARATIVE SYNOPSIS.

	1927.	1926.
Tons treated	16,915	15,939
Head value	7·427 dwts.	8·081 dwts.
Tail value	1·448	1·524
Value of call	£21,290	£22,199
Estimated extraction	80·50%	81·14%
Actual extraction	82·00%	82·11%

TIN TREATMENT.

Our Greenbushes plant, which was idle during the whole of 1926, was re-opened for a short run during the year. An officer was sent from Perth, but notwithstanding the good price of tin only 207 loads were treated. The expenditure was £98 12s. 7d., or 9s. 6.33d. per ton, and the receipts £44 2s. 11d., or 4s. 3.16d. per ton.

TOTAL OPERATIONS.

Increases in all sections resulted in 38,184¼ tons being handled at a cost of £29,957 4s. 9d., or 15s. 8.25d. per ton, compared with 33,266½ tons at a cost of 17s. 10.15d. per ton in 1926.

The loss for the year was £8,461 12s. 10d., as against £10,379 2s. 1d. in 1926, a general improvement all round being noticeable, details of which will be found in the following synopsis:—

COMPARATIVE SYNOPSIS OF RESULTS AT STATE BATTERIES FOR 12 MONTHS ENDED 31ST DECEMBER, 1926 and 1927.

——	1927.			1926.		
	Tonnage.	Expenditure.	Revenue.	Tonnage.	Expenditure.	Revenue.
		s. d.	s. d.		s. d.	s. d.
Milling	21,062¼	20 2·17	10 2·04	17,104½	23 10·08	9 7·56
Tailing treatment	16,915	10 2·08	12 8·40	16,122	11 5·76	13 8·25
Tin treatment	207	9 6·33	4 3·16	...	...	...

RECEIPTS AND EXPENDITURE.

——	Tonnage.	Expenditure.	Revenue.	Profit.	Loss.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.
Milling	21,062¼	21,252 18 10	10,710 6 8	...	10,542 12 2
Tailing treatment	16,915	8,605 13 4	10,741 3 2	2,135 9 10	...
Tin treatment	207	98 12 7	44 2 11	...	54 9 8
	38,184¼	29,957 4 9	21,495 12 9	2,135 9 10	10,597 1 10
			Less Profit		£2,135 9 10
			Net Loss		£8,461 12 0

OUTPUT SINCE INCEPTION.

Tons of gold ore milled, 1,458,042	
Production—	£
By Amalgamation	4,967,738
,, Tailing treatment	785,265
,, Slime treatment	265,266
,, Residue treatment	9,353
Tons of tin ore treated, 80,935.	
Production—	
By Black Tin	93,572
Total	£6,121,194

STAFF.

The appointment of the Superintendent to the charge of the Machinery Branch as well as State Batteries was the only alteration to the Head Office staff, and the change, together with reconstruction work at several plants, has kept this section of the staff very busily occupied.

Manager G. N. B. Smith retired from the service in March, and no new appointment was made; the services of Manager Prosser, of the North-West circuit, being requisitioned for part of the time to fill the gap.

With the increased tonnage treated the remaining managers have had a very busy time and, as reflected in the cost of treatment, they have done excellent work, and I am pleased to put this fact on record.

The cost of administration, including salaries and all office expenditure, was £3,115 17s. 3d., compared with £2,948 10s. 5d. in 1926.

GENERAL REMARKS.

The year has been the brightest we have had for a long time, the tonnage milled being 3,957¾ tons greater than in 1926, and the best since 1923.

The tonnage treated in our tailings plants, namely, 16,915 tons, showed an increase of 976 tons, and costs in milling and tailings treatment showed a reduction of 3s. 8.04d. and 1s. 3.68d. per ton respectively.

This reduction in costs is due to the increased tonnage handled and the greatly reduced expenditure on repairs and renewals, as a result of a comprehensive policy of reconstruction and repair work, including the reinforcing with concrete of our tanks and tailing vats, part of which has been charged against working.

The value of the ore treated dropped from 94.16 shillings, the figure for 1926, to 87.83 shillings, the falling-off being reflected in the amount of low grade rebates allowed, which increased from £635 15s. 1d. to £739 10s. 3d.

Customers had their ore crushed and cyanided for an average charge of 15.96 shillings per ton, and after paying charges received 66.11 shillings per ton, a net return of 75.25 per cent., the gross return being 93.44 per cent.

The policy of putting rail sidings in at Cue and Coolgardie has been amply justified, as both batteries crushed over 3,000 tons for the year, which were the largest tonnages handled.

Customers took full advantage of the concessions granted for carting long distances, and subsidies increased from £3,454 18s. in 1926 to £4,283 14s. 7d., the tonnage on which the subsidy was paid being 6,863¼ tons, against 6,464¼ tons in 1926.

Low grade rebates and cartage subsidies are not paid from Working, and erection expenses are charged against Loan. The cost of the assistance granted to owners through State batteries for the year is as follows:—

	£ s. d.
Loss on Working ..	8,461 12 10
Renewals from Loan ..	2,885 7 7
Cartage subsidies ..	4,283 14 7
Low grade rebates ..	739 10 3
Total	£16,370 5 3

The above amount does not include interest on capital, and is £3,321 less than was expended in 1926 under the same headings.

D. F. BROWNE,
Acting Superintendent of State Batteries.

Schedule 1.

Return showing the number of tons crushed, Gold Yield, Average per Ton in Shillings, and Total Value for Year ended 31st December, 1927.

Battery.	Tons crushed.	Gold Yield, Bullion.	Average per ton in shillings.	Yield Value.
				£
Bamboo Creek ...	611·5	1,184·65	139·48	4,264·74
Boogardie	1,001·25	1,534·80	110·36	5,525·28
Coolgardie	3,088·5	3,690·10	86·02	13,284·36
Cue	3,378·25	2,519·35	53·14	9,069·66
Marble Bar	189·00	309·00	117·72	1,112·40
Meekatharra	1,535·00	1,508·45	70·76	5,430·42
Mt. Ida	191·00	161·65	60·92	581·94
Norseman	964·00	774·80	57·86	2,789·28
Ora Banda	1,714·5	960·45	40·32	3,457·62
Payne's Find ...	439·00	726·40	119·14	2,615·04
Peak Hill	2,320·00	875·95	27·18	3,153·42
Sandstone	1,206·25	1,450·45	82·80	5,221·62
St. Ives	745·00	359·15	34·70	1,292·94
Warriedar	505·50	204·50	29·12	736·20
Wiluna	1,979·5	1,825·05	66·38	6,570·18
Yarri	355·00	181·73	36·86	654·22
Youanme	844·00	236·95	20·21	853·20
	21,062·25	18,503·43	62·96	66,612·52

Schedule 2.

Return showing the Number of Tons crushed, Gold Yield, and Value since inception to the 31st December, 1927.

Plant.	Total Tonnage.	Total Yield.	Total Value.
		ozs.	£
Bamboo Creek	12,938·00	22,808·51	82,110·64
Boogardie	72,995·40	53,031·51	192,296·81
Coolgardie	128,045·75	88,418·29	318,359·48
Cue	22,010·25	23,405·15	84,258·53
Darlot	33,210·00	37,637·74	138,928·25
Laverton	19,336·75	21,578·63	78,854·79
Leonora	56,753·45	62,817·90	229,618·76
Linden	19,783·00	22,531·70	81,114·21
Marble Bar	13,445·25	17,206·45	61,943·37
Meekatharra	84,779·25	100,308·66	363,790·56
Mt. Egerton	7,893·25	4,084·86	13,972·32
Mt. Ida	43,639·15	54,963·16	201,169·55
Mt. Keith	9,787·00	8,618·75	31,027·50
Mt. Sir Samuel	9,681·25	7,505·97	27,021·48
Mulline	77,008·45	98,573·64	354,035·25
Niagara	64,866·00	57,770·81	210,163·11
Norseman	68,709·70	78,014·16	284,033·44
Ora Banda	25,801·50	14,531·30	52,312·61
Payne's Find	28,946·75	36,215·51	130,375·83
Peak Hill	29,435·80	26,938·54	98,131·98
Sandstone	77,199·15	79,592·07	286,726·78
Siberia	16,024·00	16,625·59	59,777·45
20–M. Sandy	12,184·15	19,055·77	68,930·34
St. Ives	9,307·25	6,172·49	22,220·96
Tuckanarra	15,476·85	21,276·06	78,217·53
Warriedar	10,504·50	5,913·20	21,287·52
Wiluna	62,827·25	36,170·22	130,357·96
Yarri	49,689·25	33,127·44	119,258·59
Youanme	34,463·00	11,326·99	40,777·15
Batteries Closed	259,629·34	270,313·31	981,998·47
	1,376,370·69	1,336,534·38	4,843,071·22
Wiluna (Lode)	81,671·75	34,540·18	124,667·40
Total	1,458,042·44	1,371,074·56	4,967,738·62
Ore-Dressing Plant.			
Coolgardie	475·00	...	1,082·94
Tin Plants.		Tons Black Tin.	
Greenbushes	1,658·25	9·673	...
Plants closed	79,276·75	969·276	...

Milling.

	tons.	ozs.		tons.	ozs.
Up to 1901 (3 yrs.)	68,791 ...	75,553	1915	49,595 ...	39,095
1902	39,517 ...	57,255	1916	47,330 ...	31,734
1903	49,233 ...	58,305	1917	42,947 ...	38,015
1904	71,616 ...	78,309	1918	39,329 ...	33,523
1905	85,018 ...	92,327	1919	40,291 ...	27,027
1906	95,831 ...	94,187	1920	46,494 ...	28,450
1907	95,280 ...	97,962	1921	34,761 ...	24,035
1908	95,624 ...	89,875	1922	35,722 ...	32,736
1909	94,218 ...	83,127	1923	29,715 ...	21,876
1910	89,278 ...	80,074	1924	18,063 ...	18,515
1911	59,373 ...	56,265	1925	18,093 ...	19,300
1912	56,636 ...	53,888	1926	17,104 ...	16,669
1913	60,573 ...	52,515	1927	21,157 ...	18,503
1914	56,570 ...	45,641			

Sand Treatment.	Tons.	*Tailing Treatment.*	Tons.
Up to 1902	29,255	1913	13,078
1903	33,369	1914	32,723
1904	42,559	1915	31,887
1905	54,420	1916	34,725
1906	60,422	1917	24,890
1907	63,778	1918	24,364
1908	62,081	1919	15,764
1909	61,265	1920	15,437
1910	43,915	1921	19,763
1911	27,444	1922	24,234
1912	18,599	1923	14,307
1913	18,300	1924	19,767
1914	6,219	1925	14,289
		1926	16,122
		1927	16,915

Slime Treatment.

	Tons.		Tons.
Up to 1904	691	1915	3,454
1905	7,028	1916	15,536
1906	...	1917	13,086
1907	8,220	1918	11,892
1908	5,818	1919	12,780
1908	16,848	1920	11,525
1910	28,819	1921	7,370
1911.	20,821	1922	7,492
1912	8,085	1923	8,848
1913	6,089	1924	4,615
1914	6,246		

Schedule 3.

Tailing Treatment, 1927.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Bamboo Creek	240	160·48	681·58
Boogardie	1,352	762·60	3,238·83
Coolgardie	1,920	376·61	1,599·54
Cue	2,964	742·01	3,151·32
Meekatharra	1,508	487·54	2,070·61
Ora Banda	837	92·06	391·00
Payne's Find	150	11·27	47·89
Peak Hill	1,340	377·22	1,602·08
Sandstone	78	12·00	51·00
St. Ives	3,132	456·49	1,938·79
Warriedar	1,144	298·39	1,267·30
Wiluna	2,250	1,238·60	5,260·37
	16,915	5,015·27	21,300·31

Schedule 4.

Sand and Tailing Treatment from Inception to 31st December, 1927.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Bamboo Creek	10,818	4,271·68	18,156·44
Boogardie	56,626	15,652·80	65,898·28
Burtville	16,788·75	5,464·13	22,793·76
Coolgardie	78,087	12,223·67	51,758·88
Cue	17,982	3,939·73	16,719·34
Laverton	18,016	3,239·29	13,563·90
Leonora	41,313·5	10,026·18	41,817·21
Linden	18,150	6,054·21	25,731·89
Meekatharra	59,429	12,509·68	52,961·86
Mt. Keith	7,053	816·70	3,468·72
Mt. Sir Samuel	5,988	1,367·56	5,809·39
Mulline	44,794·5	12,261·27	49,863·24
Mulwarrie	23,809·25	4,675·53	19,220·11
Naigara	44,828	6,839·37	28,471·79
Norseman	51,943·5	12,336·66	51,691·41
Ora Banda	13,371	3,039·45	12,910·77
Payne's Find	19,497	2,082·51	8,932·86
Peak Hill	3,699	1,029·50	4,372·15
Quinn s	7,486	686·56	2,916·43
Sandy Creek	11,496·25	3,512·53	14,639·07
Sandstone	50,741	14,890·57	62,965·69
St. Ives	5,918	961·78	4,084·68
Siberia	5,550	1,201·56	5,105·20
Warriedar	8,734	3,979·34	16,900·19
Wiluna	22,399	10,647·48	45,128·73
Yarri	47,555	4,790·81	20,086·57
Youanme	13,602	3,730·98	15,844·76
Batteries Closed	134,971·5	25,074·55	103,894·38
	840,646·25	187,306 08	785,707·70

Residue Treatment since Inception to 31st December, 1927.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Linden	670	95·14	349·84
Menzies	24,270	1,579·26	6,679·01
Mulwarrie	4,618	546·85	2,325·02
	29,558	2,221·25	9,353·37

Slime Treatment since Inception to 31st December, 1927.

Battery.	Tons.	Yield.	Value.
		Fine ozs.	£
Mulwarrie	4,733·5	751·79	3,194·22
Wiluna	96,784	37,665·46	159,961·27
Slime Plants closed ...	111,196·25	25,088·87	102,110·62
	212,713·75	63,506·12	265,266·11

Tin Residue Treatment since Inception to 31st December, 1927.

	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 1927.

No. of Parcels Crushed.	Battery.	Tons.	Yield by Amalgamation. Bullion.	Yield by Amalgamation. Fine Gold.	Gross Contents of Tailings. Fine Gold.	Total Contents of Ore. Fine Gold.	Average per ton. Fine Gold.	Gross Value of Ore.
			ozs. dwt. grs.	ozs. dwt. grs.	ozs. dwt. grs.	ozs. dwt. grs.	dwt. grs.	£ s. d.
13	Bamboo Creek	611½	1,184 13 0	1,004 3 13	268 1 3	1,272 4 16	41 14	8 16 8
36	Boogardie	1,001¼	1,534 16 0	1,300 19 16	382 10 5	1,683 9 21	33 14	7 2 9
118	Coolgardie	3,088½	3,690 2 0	3,127 18 19	657 16 14	3,785 15 9	24 12	5 4 1
76	Cue	3,413¼	2,519 7 0	2,135 10 19	674 10 23	2,810 1 18	16 11	3 9 11
50	Meekatharra	1,535	1,508 9 0	1,278 12 19	575 13 12	1,854 6 7	24 4	5 2 8
6	Mt. Ida	191	161 13 0	137 0 9	...	137 0 9	14 8	3 0 11
18	Norseman	964	774 16 0	656 15 4	290 7 21	947 3 1	19 15	4 3 4
13	Ora Banda	1,714½	960 9 0	814 2 14	263 4 6	1,077 6 20	12 13	2 13 3
3	Payne's Find	439	726 8 0	615 14 19	41 6 12	657 1 7	29 22	6 7 2
25	Peak Hill	2,320	875 19 0	742 10 2	407 9 3	1,149 19 5	9 22	2 2 2
20	Sandstone	1,261¼	1,450 9 0	1,229 9 14	559 4 16	1,788 14 6	28 8	6 0 5
9	St. Ives	745	359 3 0	304 8 14	113 2 12	417 11 2	11 5	2 7 7
16	Warriedar	505½	204 10 0	173 7 0	146 10 16	319 17 16	12 15	2 13 8
33	Wiluna	1,979½	1,825 1 0	1,547 0 4	1,612 13 1	3,159 13 5	31 22	6 15 7
6	Yarri	355	181 14 17	154 0 19	56 5 21	210 6 16	11 20	2 10 3
9	Youanme	844	236 19 0	200 17 0	164 4 15	365 1 15	8 15	1 16 8
5	Marble Bar	189	309 0 0	261 18 9	...	261 18 9	27 17	5 17 9
451		21,157¼	18,503 8 17	15,684 10 2	6,213 1 12	21,897 11 14	20 16	4 7 10
	Less tonnage not cleaned up, 31st December, 1926	95						
		21,062¼						

Schedule 6.

Expenditure from Consolidated Revenue Vote and Loan Expenditure Fund on Erection of State Batteries for Year 1927, and Totals since Inception.

Battery.	From Revenue.	From Loan.
	£ s. d.	£ s. d.
Wiluna	...	648 9 4
Youanme	...	719 18 0
Meekatharra	...	506 10 6
Peak Hill	...	199 14 9
Coolgardie	...	369 5 6
Purchase of truck, etc.	...	450 11 1
Sandstone	...	Cr. 9 1 7
		2,885 7 7
Erection of State Batteries—Expenditure to 31st December, 1907	91,981 1 8	...
Loan Expenditure to 31st December, 1926	...	316,462 16 0
	91,981 1 8	319,348 3 7
Total	£411,329 5 3	

Schedule 7.

Direct Purchase of Tailings for Year 1927.

Battery.	Tons.	Amount.
		£ s. d.
Bamboo Creek	391½	668 7 5
Boogardie	1,002¼	1,047 6 10
Coolgardie	1,938	982 8 4
Cue	2,550	1,147 9 1
Meekatharra	1,046	1,341 18 4
Norseman	373¾	338 10 11
Ora Banda	1,197¾	332 9 6
Payne's Find	29	2 18 0
Peak Hill	1,559¼	983 4 9
Sandstone	1,374¼	1,669 0 1
St. Ives	212¼	229 2 1
Warriedar	201½	186 18 0
Wiluna	1,704	4,375 8 0
Yarri	198¾	79 15 2
Youanme	649¾	260 2 2
	14,428	£13,644 18 8

Schedule 7a.

Return showing Tailing payable and unpayable and Gross Contents for 1927.

Battery.	Tailing payable. Tons.	Tailing payable. Gross Contents.	Tailing Unpayable. Tons.	Tailing Unpayable. Gross Contents.	Totals. Tons.	Totals. Gross Contents.
		ozs. dwt. grs.		ozs. dwt. grs.		ozs. dwt. qrs.
Bamboo Creek	391½	268 1 3	...	...	391½	268 1 3
Boogardie	850¾	382 10 5	...	...	850¾	382 10 5
Coolgardie	2,053¼	617 5 15	491¾	40 10 23	2,545	657 16 14
Cue	2,427¼	645 6 10	475¼	29 4 13	2,902½	674 10 23
Marble Bar	259	68 3 16	...	...	259	68 3 16
Meekatharra	1,025¼	548 11 14	279¼	27 1 22	1,304½	575 13 12
Mt. Ida	154¾	29 14 12	8½	0 16 16	163¼	30 11 4
Norseman	626¼	274 9 10	192½	15 18 11	818¾	290 7 21
Ora Banda	1,136½	242 11 18	311½	20 12 12	1,448	263 4 6
Payne's Find	29	4 7 0	344¼	36 19 12	373¼	41 6 12
Peak Hill	992½	319 2 20	979¼	88 6 7	1,971¾	407 9 3
Sandstone	1,057	558 6 21	15¼	0 17 19	1,072¼	559 4 16
St. Ives	393¾	93 2 11	239¾	20 0 1	633½	113 2 12
Warriedar	335	137 10 6	94½	9 0 10	429½	146 10 16
Wiluna	1,676	1,612 6 0	6½	0 7 1	1,682½	1,612 13 1
Yarri	198¾	49 15 12	103	6 10 9	301¾	56 5 21
Youanme	649¾	162 10 7	34	1 14 8	683¾	164 4 15
	14,256¼	6,013 15 12	3,575¼	298 0 20	17,831½	6,311 16 8

Schedule 8.

Statement of Receipts and Expenditure for the Year ended 31st December, 1927.

MILLING AND TIN.

Plant.	Tonnage.	Management.	Wages.	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.
Bamboo Creek	611·5	115 7 7	357 17 2	189 1 6	662 6 3	21 7·94	33 17 6	101 0 9	797 4 6	26 0·72	349 10 0	11 5·16	...	447 14 6
Boogardie	1,001·25	151 12 8	299 5 0	202 14 7	653 12 3	13 0·67	45 5 3	129 16 2	828 13 8	16 6·62	446 13 4	8 11·06	...	382 0 4
Coolgardie	3,088·5	362 10 2	783 19 0	887 19 6	2,034 8 8	13 2·08	247 11 10	436 12 6	2,718 13 0	17 7·24	1,582 0 11	10 2·92	...	1,136 12 1
Cue	3,373·25	814 10 10	950 15 6	866 10 4	2,131 16 8	12 7·67	76 16 11	378 16 4	2,587 9 11	15 4·22	1,644 1 10	9 10·39	...	923 8 1
Laverton	...	...	6 6 0	113 5 4	119 11 4	...	...	20 16 4	140 7 8	...	12 9 6	...	...	127 18 2
Leonora	...	11 0 0	...	0 4 6	11 4 6	...	...	24 13 7	35 18 1	...	0 15 0	...	...	35 3 1
Linden	...	...	...	9 8 3	9 8 3	...	...	1 12 6	11 0 9	...	8 13 6	...	...	2 7 3
Marble Bar	189	124 9 0	227 13 0	133 5 8	485 7 8	51 4·32	168 7 2	233 7 11	887 2 9	93 10·51	108 7 9	11 5·64	...	778 15 0
Meekatharra	1,535	131 1 2	555 6 5	527 1 7	1,213 9 2	15 9·72	94 7 8	146 3 5	1,454 0 3	18 11·32	629 9 6	8 2·42	...	824 10 9
Mt. Ida	191	260 13 3	105 14 0	56 3 8	422 10 11	44 2·95	18 5 9	23 1 3	463 17 11	48 6·72	100 5 6	10 6·00	...	363 12 5
Mt. Sir Samuel	...	...	...	0 10 6	0 10 6	...	...	...	0 10 6	...	11 8 11	...	10 18 5	...
Norseman	964	185 3 2	489 0 1	396 12 7	1,070 15 10	22 2·59	114 9 8	174 19 7	1,360 5 1	28 2·65	508 2 11	10 6·5	...	852 2 2
Ora Banda	1,714·5	398 15 8	621 16 2	515 8 1	1,535 19 11	17 10·94	214 9 10	248 0 4	1,998 10 1	23 3·74	1,445 2 2	16 10·29	...	553 7 11
Payne's Find	439	56 15 11	160 19 0	197 8 9	415 3 8	18 10·96	79 8 3	43 8 4	538 0 3	24 6·12	230 9 6	10 6·00	...	307 10 9
Peak Hill	2,320	136 9 10	626 0 3	333 12 0	1,096 2 1	9 5·37	141 9 0	327 0 5	1,564 11 6	13 5·85	895 13 9	7 8·65	...	668 17 9
Sandstone	1,206·25	301 10 4	508 19 0	400 3 8	1,210 13 0	20 0·86	92 9 2	161 8 8	1,464 10 10	24 3·36	626 19 10	10 4·72	...	837 11 0
Sandy Creek	...	12 0 0	...	...	12 0 0	...	...	17 2 6	29 2 6	...	...	...	...	29 2 6
Siberia	...	...	...	...	...	...	...	...	...	...	3 0 0	...	3 0 0	...
St. Ives	745	113 18 11	286 8 4	254 6 10	654 14 1	17 6·91	88 4 10	118 11 2	861 10 1	23 1·53	340 9 10	9 1·68	...	521 0 3
Tuckanarra	...	...	...	...	...	...	...	...	...	...	20 8 0	...	20 8 0	...
Warriedar	505·5	65 12 2	192 16 0	167 14 3	426 2 5	16 10·32	126 19 10	109 12 2	662 14 5	26 2·64	266 1 11	10 6·33	...	396 12 6
Wiluna	1,979·5	185 3 1	552 1 7	341 4 2	1,078 8 10	10 10·75	333 2 2	259 0 3	1,670 11 3	16 10·33	999 5 0	10 11·52	...	671 6 3
Yarri	355	61 14 4	205 13 6	131 16 9	399 4 7	22 5·90	28 9 7	90 12 4	518 6 6	29 2·41	171 5 0	9 7·77	...	347 1 6
Youanme	844	49 17 6	270 3 2	181 2 3	501 2 11	11 10·51	59 1 1	99 13 4	659 17 4	15 7·63	289 13 0	6 10·36	...	370 4 4
	21,062·25	3,038 5 7	7,200 13 2	5,905 14 9	16,144 13 6	15 3·96	1,962 15 6	3,145 9 10	21,252 18 10	20 2·17	10,710 6 8	10 2·04	34 6 5	10,576 18 7
Tin Plant.														
Greenbushes	207	29 9 9	33 17 7	26 8 1	89 15 5	8 8·08	...	8 17 2	98 12 7	9 6·33	44 2 11	4 3·16	...	54 9 8
	21,269·25	3,067 15 4	7,234 10 9	5,932 2 10	16,234 8 11	15 3·16	1,962 15 6	3,154 7 0	21,351 11 5	20 0·91	10,754 9 7	10 1·34	34 6 5	10,631 8 3

Schedule 9.

Statement of Receipts and Expenditnre for Year ended 31st December, 1927.

TAILING.

Plant.	Tonnage.	Management.	Wages.	Assays.	Stores.	Total Working Expenses.	Cost per ton.	Repairs and 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 ...	240	28 10 5	81 0 0	9 3 7	53 1 8	171 15 8	14 3·79	7 0 0	15 16 3	194 11 11	16 2·59	265 7 10	22 1·39	70 15 11	...
Boogardie	1,352	96 15 11	232 9 11	28 4 7	222 0 5	579 10 10	8 6·86	2 10 0	117 17 1	699 17 11	10 4·22	1,692 4 7	25 0·38	992 6 8	...
Coolgardie	1,920	37 19 8	365 10 8	33 5 8	117 3 3	553 19 3	5 9·24	1 5 0	186 6 10	741 11 1	6 8·68	820 10 1	8 6·55	78 19 0	...
Cue	2,964	118 13 11	511 0 9	25 12 11	187 6 1	842 13 8	5 8·23	2 3 9	219 16 9	1,064 14 2	7 2·20	1,997 2 0	13 5·71	932 7 10	...
Leonora	...	...	...	...	...	...	...	...	...	...	...	9 9 5	...	9 9 5	...
Meekatharra... ...	1,508	70 14 8	363 4 10	26 14 0	81 1 6	541 15 0	7 2·20	22 1 7	196 19 8	760 16 3	10 1·08	784 0 0	10 4·77	23 3 9	...
Norseman	...	...	...	...	10 13 6	10 13 6	...	...	1 6 9	12 0 3	...	...	...	...	12 0 3
Ora Banda ...	837	54 11 10	191 9 8	2 4 2	98 5 8	346 11 4	8 3·37	176 14 5	110 0 3	633 6 0	15 1·58	391 0 0	9 4·10	...	242 6 0
Payne's Find ...	150	5 0 0	18 2 6	8 11 8	8 0 0	39 14 2	5 3·52	...	14 7 1	54 1 3	7 2·49	47 8 4	6 3·86	...	6 12 11
Peak Hill ...	1,340	94 19 1	314 3 11	2 13 9	106 5 9	518 2 6	7 8·78	2 10 0	112 15 5	633 7 11	9 5·44	665 8 9	9 11·18	32 0 10	...
Sandstone	78	...	32 15 0	1 19 5	29 10 3	64 4 8	16 5·64	22 4 6	19 4 5	105 13 7	27 1·15	51 0 0	13 0·91	...	54 13 7
St. Ives	3,132	197 0 7	641 19 1	70 11 5	327 11 7	1,237 2 8	7 10·80	28 2 2	251 2 5	1,516 7 3	9 8·18	975 12 1	6 2·76	...	540 15 2
Warriedar	1,144	57 8 1	227 15 2	52 17 4	185 19 7	524 0 2	9 1·93	11 10 9	83 15 9	619 6 8	10 9·93	434 15 9	7 7·21	...	184 10 11
Wiluna	2,250	179 4 4	495 3 6	76 4 3	261 10 2	1,012 2 3	8 11·95	304 10 7	236 2 3	1,552 15 1	13 9·62	1,607 4 4	14 3·43	54 9 3	...
Yarri	...	...	9 17 0	...	...	9 17 0	...	7 7 0	...	17 4 0	...	...	...	...	17 4 0
Transfer from Revenue Suspense Account	...	...	...	...	...	...	...	...	...	...	...	1,000 0 0	...	1,000 0 0	...
	16,915	940 18 6	3,484 12 0	338 2 9	1,688 9 5	6,452 2 8	7 7·53	587 19 9	1,565 10 11	8,605 13 4	10 2·08	10,741 3 2	12 8·40	3,193 12 8	1,058 2 10

Schedule 10.

Balance Sheet—31st December, 1927.

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Capital Expenditure :—			By Batteries Tailing and Slime Plants	411,329 5 3	
From General Loan Fund ...	319,348 3 7		Less Depreciation	352,754 13 10	
„ Consolidated Revenue	91,981 1 8				
		411,329 5 3			58,574 11 5
To Treasury		172,968 12 0	By Stores		10,263 3 8
„ Interest and Sinking Fund		411,329 5 3	„ Sundry Debtors		4,168 0 0
„ Sundry Creditors		2,217 10 7	„ Profit and Loss Account		924,838 18 0
		£997,844 13 1			£997,844 13 1

Profit and Loss Account.

	£ s. d.		£ s. d.
To Expenditure	1,502,785 5 4	By Revenue	1,342,030 6 5
		„ Loss on working carried down ...	160,754 18 11
			£1,502,785 5 4
„ Loss on Working brought down ...	160,754 18 11		
„ Interest at 3½% and Sinking Fund at 1¼% on Capital Expenditure ...	411,329 5 3		
„ Depreciation	352,754 13 10		
	£924,838 18 0	By Gross Loss	£924,838 18 0

Schedule 11.

Working Profit and Loss Account for Year ended 31st December, 1927.

	£ s. d.		£ s. d.
To Working Expenditure—		By Revenue—	
„ Batteries and Tin Plants	21,351 11 5	„ Batteries and Tin Plants	10,754 9 7
„ Tailing Plants	8,605 13 4	„ Tailing Plants	10,741 3 2
		„ Loss on Year's Operations	8,461 12 0
	£29,957 4 9		£29,957 4 9

Schedule 12.

State Battery Statistics from Inception to 31st December, 1927.

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 ...	40,290¾	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 ...	46,494¼	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
1922 ...	35,722	16 11·8	9 2·3	13,862	24,234	9 11·7	15 8·9	6,988	7,492	11 10·5	8 5·8	1,271	...	...	...	55	8,200
1923 ...	29,714	17 0·4	9 6·8	11,044	14,307	11 5·5	14 2·1	1,943	8,848	11 1·3	8 11·7	945	...	...	...	26	10,072
1924 ...	18,063	21 0·1	10 9·5	9,231	19,767	10 8·6	10 7·8	§69	4,615	12 4·1	8 7·6	854	392	13 4·8	3 7·7	192	10,346
1925 ...	18,361¼	22 7·4	10 8·5	10,768	14,289	11 6·6	16 2·1	3,301	...	...	...	...	268	12 6·5	3 8·6	118	7,585
1926 ...	17,104½	23 9·3	9 7·5	12,113	16,122	11 5·7	13 8·2	1,780	...	...	...	...	...	...	...	46	10,379
1927 ...	21,062¼	20 2·1	10 2·0	10,543	16,915	10 2·0	12 8·4	2,135	...	...	...	...	207	9 6·3	4 3·1	54	8,462

* Tailing Treatment commenced 1913. † Profit. ‡ Details of Ore dressing and Residue Treatment not shown, but financial result included in the figure of this column. § Loss.

DIVISION IV.

ANNUAL PROGRESS REPORT

OF THE

GEOLOGICAL SURVEY

FOR THE

YEAR 1927.

With Eleven Plates and Eleven Figures.

TABLE OF CONTENTS.

LIST OF FIGURES.

LIST OF PLATES.

Annual Progress Report of the Geological Survey for the Year ending 31st December, 1927.

The field activities of the Geological Survey for the year ending 31st December, 1927, have been confined to a detailed geological survey of the southern portion of the Kalgoorlie Field (the Golden Mile); a special report on the South Kalgurli Mine; and numerous inspections of mines, mineral deposits and water supplies, made more from an economic rather than a purely geological aspect.

THE STAFF.

One alteration was made in the staff by the retirement of Mr. A. G. D. Esson, M.A., in December, 1926, and the temporary appointment of Mr. K. J. Finucane, B.Sc., as Assistant Field Geologist, in February, 1927.

FIELD WORK.

T. Blatchford, B.A., Acting Government Geologist.

In addition to the usual office routine, which included the editing of Bulletins Nos. 84, 85, 86, 87, 90, and 93, as well as the Atlas of Maps for Bulletin 83 (already published), much of my time was occupied in the field in making inspections and writing reports on various mines, mineral deposits and water supplies. Such inspections, however, incurred much travelling, and consequently considerable time. As some are merely progress reports, compiled purely for departmental purposes, they have been withheld from publication.

F. R. Feldtmann, Field Geologist.

After his return from long service leave, Mr. Feldtmann resumed duties on the 10th of January. On the completion of maps for the Annual Progress Report for 1926, revising the maps for Bulletin 87, and preparing certain maps necessary for the Kalgoorlie survey, he left for Kalgoorlie on the 31st January. Towards the end of April he was recalled to Perth to prepare further maps for the Kalgoorlie survey, to revise maps for Bulletin 83, and to attend to the office routine during my absence on annual leave. He returned to Kalgoorlie at the latter end of June, remaining there until the 21st of December, when he was recalled to Perth for the Christmas vacation. The results of his work are included in the accompanying reports.

K. J. Finucane, B.Sc., Assistant Field Geologist.

Mr. Finucane, since his appointment in February, has been wholly occupied on the Kalgoorlie survey as Mr. Feldtmann's assistant.

Both these officers are now engaged on the Kalgoorlie survey, assisting Dr. Stillwell to complete his report on that area.

PETROLOGY.

C. O. G. Larcombe, D.Sc., Acting Petrologist.

The petrological work, as during the previous year, has been carried on by Dr. Larcombe mainly at the School of Mines, Kalgoorlie, and for only a small portion of the year in Perth. The work included the determination of bore cores; Kalgoorlie rocks collected by Mr. Feldtmann; and samples of rocks received from the general public.

PUBLICATIONS.

During the year the following publications have been issued, and are now available for the public, viz.:—

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 Mining Centres of Rothesay and Goodingnow (Payne's Find): by E. de C. Clarke, Field Geologist.

Bulletin 87.—A Geological Reconnaissance in the Central and Eastern Divisions between 122° 30′ and 123° 30′ E. Long. and 25° 30′ and 28° 15′ S. Lat.: by H. W. B. Talbot, Field Geologist.

Bulletin 90.—The Geology of a portion of the East Coolgardie and North-East Coolgardie Goldfields, including the Mining Centres of Monger and St. Ives: by E. de C. Clarke, Field Geologist.

Bulletin 93.—The Geology of portions of the Kimberley Division, with Special Reference to the Fitzroy Basin and the Possibility of the Occurrence of Mineral Oil: by T. Blatchford, Assistant State Mining Engineer.

Atlas of Maps to accompany Bulletin 83 (previously published), entitled "The Geology and Mineral Resources of the North-West, Central and Eastern Divisions, between Long. 119° and 122° E., and Lat. 22° and 28° S.": by H. W. B. Talbot, Field Geologist.

Annual Progress Report for the year 1926.

T. Blatchford

Acting Government Geologist.

1.—MANGANESE DEPOSITS OF THE TEANO RANGE AND MOUNT FRASER, PEAK HILL GOLDFIELD.

(T. Blatchford, B.A., Acting Government Geologist.)

Location.—Mineral Claims 7P and 8P, applied for by W. H. Berry, join one another, and are situated at the southern end of the Teano Range. They probably lie in the north-eastern corner of 3083/96 (Lands Plan 79/300). I was unable to fix the locality exactly, due to magnetic variation and the indefinite location on the map of the hills suitable for sighting.

General Description.—The two claims have been pegged to include the manganese deposits on a low ridge which runs east and west. The manganese occurs in sediments, probably of the Nullagine Series, and in this respect they resemble those found on the eastern flank of the Braeside Mineral Belt. The strike of the sediments is slightly north of west with a dip at a fairly high angle to the north. Several varieties of sediments were noted, the main beds consisting of shales, sandstones, fine-grained quartz conglomerates, coarse to fine-grained grits, and a rather conspicuous bed of limestone. As far as could be ascertained the manganese occurs in the finer-grained shale beds. The position of the limestone is relatively different here from that at Braeside, where it underlies the manganese. In these deposits it overlies the manganiferous beds. As a whole the strata has not been subjected to violent earth movements, the tilting being caused by gradual folding. Buckling in the strata was entirely absent.

Manganese.—When approaching the claims, at first sight there appears to be a very large amount of manganese ore scattered over the surface of the slopes of the ridge and around the base, particularly on the southern side. On close inspection, however, the amount proves to be more apparent than real, for many of the black nodules are merely ironstone crusted with manganese oxide, and therefore worthless. Large blocks of fairly pure ironstone (mostly limonitic) are also to be found in considerable quantity.

Where in solid formation it is apparent that the manganese only occurs *in situ* in comparatively narrow lens-shaped outcrops of no great length, though the individual outcrops extend over a considerable distance.

The occurrence has every appearance of being a series of at least three parallel manganiferous zones, in each of which occur a succession of short lenses of ore. As a rule the ore in these lenses is far from being marketable manganese, limonite and other impurities being of common occurrence.

Manganese Ore.—Practically all grades of manganese ore can be found in the deposits, some of the pieces broken being equal to any to be found in the Horseshoe deposit, and could be well classed as high-grade chemical ore.

Quantity of Ore.—I make no pretence to estimate the quantity of ore in these deposits, except to state that in my opinion thousands of tons of marketable ore could be picked up on the surface or broken from the outcrops. Without spending a considerable time in thoroughly sampling it, it would be impossible to form an accurate estimate. Manganese ore is proverbial for its erratic nature in any deposit. The origin of the mineral would suggest such.

On this recent trip I have taken what seemed to be magnificent ore on the surface, only to find that inside the broken boulder the iron contents were such as to render the whole piece worthless. I have seen practically all the important deposits in this State, and this erratic nature of the manganese contents can be noticed in them all, and without proper mining development, in my opinion, it is not safe to estimate quantities except very approximately.

Value of the Deposit.—Notwithstanding the adverse criticism I have made of these deposits, they would be of value as manganese producers if the location was not so unfavourable, for they are unfortunately, by themselves, not large enough to warrant the construction of a railway line, which is no doubt the cheapest mode of transport. They would be worthy of consideration, however, if at any time a railway built for other purposes passed close by them, or a series of similar deposits was discovered in the neighbourhood, particularly so if the price of manganese was to increase above the present rate of 1s. 8d. to 1s. 9d. per unit. Pending these conditions the deposits have no present value.

While inspecting Berry's manganese deposits it was brought under my notice that Messrs. Bain and party had pegged another similar deposit some 15 miles east of the former.

On inspection, these deposits turned out to be similar to Berry's in all geological respects, and what I have already written about Berry's applies almost equally to Bain's. The manganese is formed on the southern slopes of a low range, and lenses of ore can be traced by their outcrops over a length of from 2½ to 3 miles. There are at least three series of these outcrops. None of the lenses is of any great size, but there is quite a considerable quantity of high grade ore scattered over the slopes of the hills and in the outcrops. The deposit is distinctly of the fissure lode type. Compared with the ore in sight on Mineral Leases 7P and 8P there is, I should consider, an equal or greater tonnage of commercial ore available here, but the absence of cheap transport and insufficient quantity of ore cause this deposit to be worthless at present.

Small quantities of manganese were also inspected 10 miles south of Milligan Station and near the Fraser Range.

2.—WATER SUPPLY AT HOLLERTON, YILGARN GOLDFIELD.

(T. Blatchford, B.A., Acting Government Geologist.)

General Remarks on the occurrence of Underground Water.—Underground water supplies occur under the following conditions:—

(a) In weathered zones, particularly if low-lying and where the weathering has reached a considerable depth.
(b) Any foliated or fractured unweathered rock mass.
(c) Porous sedimentary strata.
(d) Porous superficial deposits occuring in low-lying country into which there is surface drainage.

Geology of the Hollerton Area.—From the aspect of an underground water supply, the geology of the Hollerton area is as follows:—

A narrow belt of greenstone striking west by north and east by south forms the higher ground, though the elevation is not great. This greenstone ridge is bounded on the north and south by massive granite. Though slightly foliated in places the greenstone as a whole is massive. There are, however, fractured or foliated zones which have been invaded by subsequent granite intrusives, and the reefs and lodes are intimately associated with these intrusions.

The granite is for the most part massive, though a gneissic structure was observed in certain areas.

Water Supply: (a) *Weathered Zones.*—As far as can be seen in the mine workings the weathered zone does not appear to reach any great depth. In the Great Beacon there is clear evidence that the unweathered rock occurs at the 84-feet level, and sulphides are found in the 100-feet crosscut. The mine is quite free of water, not even showing evidence of moisture.

The Glenelg Queen, which has reached a depth of 120 feet vertical, is still in partially weathered rock. This mine lies at a higher point than the Great Beacon, and will probably not reach the sulphide or water level for some time yet.

Number 1 Bore, lying between the Great Beacon and the townsite, bottomed on greenstone at a depth of 140 feet, and was dry. This bore was on low-lying ground, and reached a considerably greater depth than the workings on the two mines mentioned above.

There does not appear to be much chance, therefore, of finding a water supply in the weathered zone of the greenstones.

With regard to the granite, the unweathered zones are invariably covered with a mantle of surface detritus, and will be referred to later on.

(b) *Foliated or fractured unweathered Rock Masses.*—With the exception of the Great Beacon mine, the sulphide zone has not been reached in any of the mine workings. In this instance there is no evidence in favour of water being found, as is so often the case when the sulphide zone has been reached. The main drive at the bottom level has followed a pronounced shear plane quite suitable for holding water, but is quite dry.

The main shaft at the Glenelg Queen is in fractured country, but the sulphide zone has not been reached. There is a chance here, when the ore channel is cut in this shaft, that water will be found, but at the present rate it will be a considerable time before the shaft reaches the lode.

All the other workings on the field are shallow and dry.

(c) *Sedimentary strata* are absent.

(d) *Porous superficial Deposits.*—Superficial deposits have collected to some extent, and now occupy the two valleys lying between the main greenstone ridge and the granite outcrops. These valleys have a fall towards the west and form the drainage channels of the rain waters.

The boring operations of the Public Works Department have partially tested these two valleys, the details of the bores being as follow:—

No. 1 *Bore.*—This bore lies between the Great Beacon and the townsite, and was sunk to a depth of 140 feet. It bottomed on greenstone, and was dry.

No. 2 *Bore.*—Situated about one mile north from Mount Lookout. The bore struck water at about 120 feet, which rose to 114 feet, but the supply was negligible. The bore passed through granitic material, and bottomed in weathered granite.

Nos. 4 *and* 5 *Bores.*—These were sunk further down the southern valley: one opposite the 50-mile post, the other adjacent to the 51-mile post. The first reached hard material at a depth of 37 feet and was abandoned. The second was in progress, and had reached a depth of 47 feet in red clays.

No. 3 *Bore.*—This is in the northern valley, and lies about one mile east of the 47-mile peg. It reached a depth of 147 feet, bottomed on granitic material, and was dry.

Summary.—The probability of finding a shallow underground water supply appears to be a remote one. Further boring in the two valleys referred to, further down their fall, *i.e.*, west of the Rabbit-proof Fence, might meet with success, but it would entail considerable expense in a long pipe line and pumping plant. The sinking of the main shaft on the Glenelg Queen might solve the problem for the one mine. To bore other ore channels, such as Davidson's or Smith's, might equally result in water being discovered, but the expense of sinking shafts in the event of success would be costly and take considerable time.

There was local talk of the Scheme water being extended down the Fence to serve the new settlers. Whether this is correct I am not certain. If so, it would be the best way out of the difficulty. Failing this, if it is the policy to continue searching for surface water, I recommend that the valleys be further prospected down their fall, and that they be systematically tested right across with a series of holes.

3.—WATER SUPPLY AT BALLA AND DARTMOOR, GERALDTON DISTRICT.

(T. Blatchford, B.A., Acting Government Geologist.)

In accordance with instructions, I visited the Balla-Dartmoor areas, and my report on the possibility of obtaining underground water supplies by boring is as follows:—

Before discussing the water question of the Balla-Dartmoor areas, the existing conditions of the underground water supply of the artesian basins lying to the north and south will be briefly referred to in-so far as they affect the question at issue. Such a course is rendered necessary in view of the fact that practically no surface evidence is procurable in either centre which has a direct bearing on the underground water supply.

General Geology of the Two Areas.—The Balla-Dartmoor centres lie in an extensive area occupied by sediments of Carboniferous age (Geological Map of Western Australia). These strata outcrop as far north as the Lyndon River, and extend south to the Irwin River. They probably continue much farther south, but do not outcrop. Their greatest surface development is in the basins of the Gascoyne and Wooramel Rivers.

More recent beds of Jurassic age overlie the west edge of the Carboniferous strata north of Hamelin Pool, and almost completely cover them south of that point. A narrow coastal belt of Tertiary and Post-Tertiary strata overlies the Jurassic. The strata of all these ages are marine sediments.

Immediately east of Northampton there is a pronounced necking of both the Jurassic and Carboniferous beds. This is caused by the granite massif, which outcrops as far as the Geraldine mine on the north, and extends south to the Greenough River. This necking is important as regards fresh water artesian supply, and will be referred to later on.

The dip of the strata in the Gascoyne area is to the west. In the Murchison area no dips were recorded.

In the vicinity of Eradu the dip west of the Greenough is to the west; that east of the river is to the east. This is probably due to faulting.

Artesian Supplies in the Areas previously referred to.—Extensive artesian supplies of fresh and stock water have been found in the Gascoyne and Wooramel basins (Artesian Bores of Western Australia, Appendix N, Interstate Conference Report, 1921).

Apparently no deep boring has been done in the Murchison basin, though it seems highly probable that similar geological conditions exist as far south. In the vicinity of Eradu several bores have been sunk, mostly on the east side of the river. The record of these bores as regards water is that they were either dry holes or struck salt water. Immediately west of the river, at Eradu Siding, the recent bores prove the existence of a probable sub-artesian supply of stock water (total solids 227 and 95).

Further to the south a bore at Geraldton yielded a supply of salt water. The same occurred in the deep bore at Dongara, while at Yardarino a large supply of good stock water (artesian) was struck. As far as I can ascertain the deep bore at Mingenew, which lies farther to the east, was a dry hole. This hole apparently did not bottom.

When considering the possibilities of artesian water being fresh or salt one of the main points is whether the underground water is circulating or more or less stagnant. If there is opportunity for the water to circulate, the salt contained in the strata is eventually all leached out, the reverse being the case in basins or areas without an outlet.

As already stated the strata in the northern areas dip seaward, and have therefore an outlet; hence the artesian water is more or less free from soluble salts. The same applies to the waters west of the Greenough River at Eradu. The probable reason for the Geraldton and Dongara bores being salt is their proximity to the ocean. The Yardarino bore is situated in a strata in which the water is circulating seaward, while the waters further to the east are in a water-locked area, and are consequently salt.

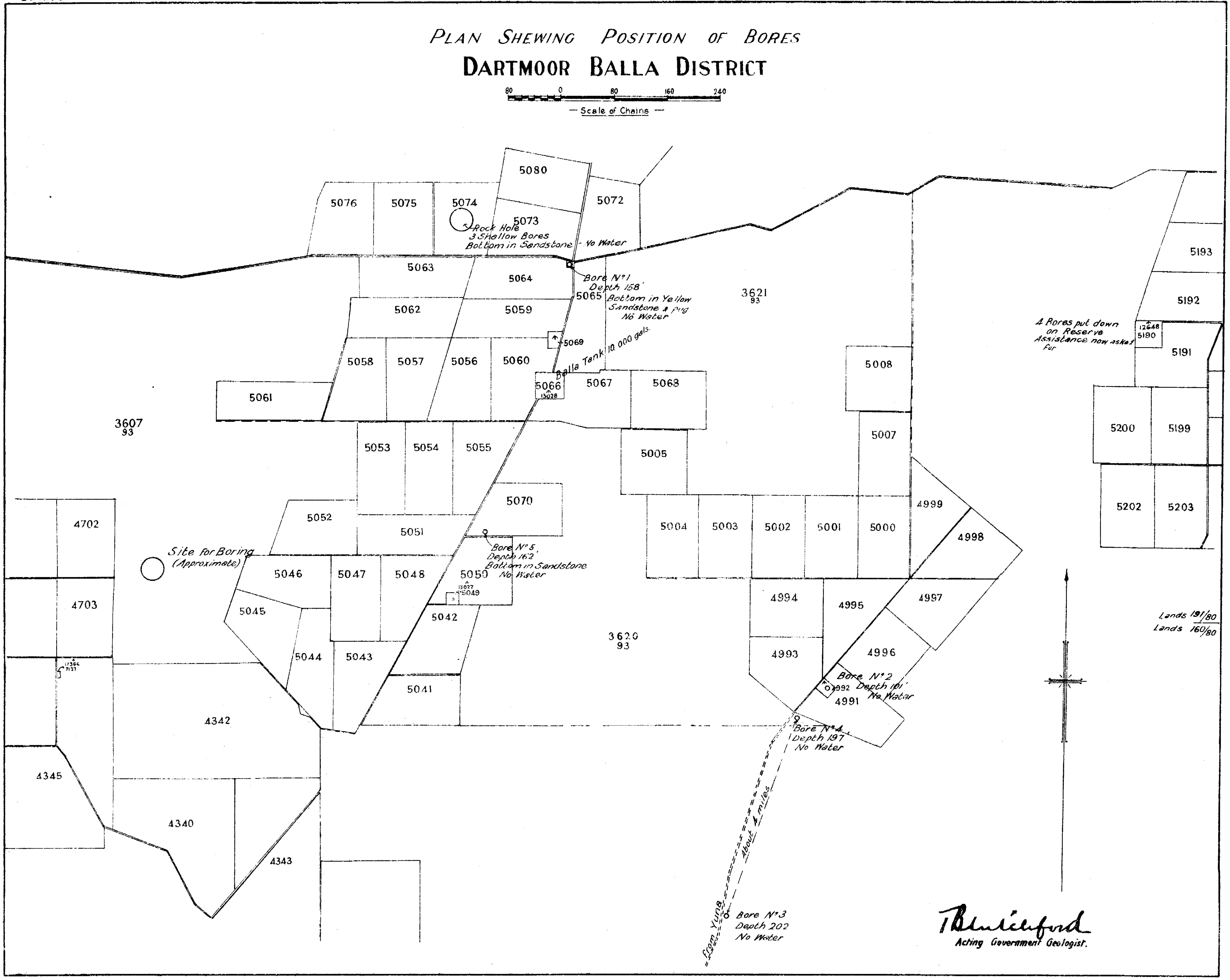
The Balla-Dartmoor Areas.

Geology.—The Balla-Dartmoor areas proper consist of fairly heavily timbered belts of first-class agricultural land surrounded by undulating sand plains. From a geological point of view the country is most uninteresting, for outcrops of the underlying rocks and evidence of structure are almost totally absent. At the Balla Tank (5066/13028) an excavation has been blasted out in a finegrained sandstone of sedimentary origin. Patches of what are locally known as limestone occur frequently in the high-class land. These limestones have been proved to owe their origin to the presence of dark-coloured calcareous marls, which are typical sediments. At the 95-mile well, on the Rabbit-proof Fence, pebbles of granite porphyry, etc., are abundantly scattered over the surface. Some of these pebbles are distinctly smoothed by glacial action, and probably correspond to the glacial beds of the Irwin River. All the hand bores passed through sedimentary deposits, and in no instance was an igneous or a metamorphic rock reported. The evidence for the occurrence of sediments has been stressed on account of a map which was published in 1908, which would lead any reader to form the conclusion that the area was occupied by granites, but which is evidently not the case.

Water—Artesian and Sub-Artesian Supplies.—From the available data there are fairly strong reasons for suggesting that artesian or sub-artesian water would be struck by deep boring. The evidence as to whether the water would be fresh or salt is not so positive. If the prevailing dip of the strata in the northern proved artesian area be maintained as far south as Balla and Dartmoor; or if the westerly dip of the strata west of the Greenough River, in the vicinity of Eradu, comes as far north, there would be every reason for assuming that the water would be fresh, or at worst good stock water. If deep boring is decided upon the bore, in my opinion, should be placed as far north as possible to get away from the narrow neck of strata opposite Northampton, in which circulation is probably not so free, and consequently the underground waters more likely to be salt. There are no data on which to calculate the probable depth of water-bearing strata, but on general principles the depth where water will be struck will vary directly with the distance on the dip from the intake. Assuming the dip to be westerly, the depth of the bore in this case would vary inversely with the distance eastward, and should therefore be located as far to the east as not to unduly increase the cost of boring.

Shallow Waters.—Generally speaking there is no definite evidence on the surface to guide sinking or boring for surface waters. In the Balla area a certain amount of success has been met with, and stock and domestic waters have been located in wells and bores along what appears to a water-bearing zone, which strikes diagonally across the road from Balla to Bininu. The continuation of this zone to the southeast has apparently been tested by Bores Nos. 3 and 4 without success. I can make no better suggestion than that further boring be done along this line, and consider the position marked on the plan (Plate I.) to be quite a good spot to test. At Balla Tank there is apparently a good hard catchment which would fill a much larger reservoir than the present one. One bore sunk on Tank Reserve 5071, three miles north of Balla Tank on the Rabbit-proof Fence, failed to strike water down to 158 feet. Unless this hole has fallen in it would be advisable to sink it further, at least until the clay or "pug" has been passed through. If this hole is successful the shallow holes to the west might be continued. Failing to find water in either of these localities, it seems useless to continue a shallow boring policy.

Dartmoor.—At Dartmoor No. 1 Area one hole has been bored to a depth of 101 feet on W/R 13152, and No. 4 Bore to a depth of 197 feet. Successful boring seems to be hopeless in this locality.


PLAN SHEWING POSITION OF BORES
DARTMOOR BALLA DISTRICT
80 0 80 160 240
Scale of Chains
Rock Hole
3 Shallow Bores
Bottom in Sandstone - No Water
Bore No 1
Depth 158'
Bottom in Yellow Sandstone & pug
No Water
Balla Tank 10,000 gals.
Bore No 5
Depth 162'
Bottom in Sandstone
No Water
Site for Boring
(Approximate)
Bore No 2
Depth 191'
No Water
Bore No 4
Depth 197
No Water
Bore No 3
Depth 202
No Water
from Yuna
About 4 miles
4 Bores put down
on Reserve
Assistance now asked for
Lands 191/80
Lands 160/80
3607 93
3621 93
3620 93
Acting Government Geologist.

In Dartmoor No. 2 Area two localities in which boring might be successful are: (a) Continue the hole on Reserve 12648, and (b) stand off to the west and test the country south of Reserve 17940 at the 95-mile. In the first case the hole bottomed on a boulder bed, which should be a good reservoir for water overlying a clay or other impervious bed. In addition the present bore site is in low-lying ground. The second position (anywhere in the vicinity of the south-western peg of 3823/93), though some distance from the farming blocks, offers a reasonable chance of success on account of the coarse nature of the surface sands and the fact that water has been found at a shallow depth at the well at the 95-mile.

In conclusion, if shallow boring is to be resorted to for water supply in either of these centres, my recommendation, other than that already expressed, is first to try and locate water where most wanted and then endeavour to follow up the water-bearing horizon by systematic boring. In any case attempts to find water in these areas by shallow bores will be more or less controlled by a considerable element of chance, for it will be to a large extent mere stabbing in the dark.

4.—MINING PROSPECTS OF GRANT'S PATCH, NEAR HALL'S CREEK; KIMBERLEY DIVISION.

(T. Blatchford, B.A., Acting Government Geologist.)

Grant's Patch.—Grant's Patch is situated some 300 chains east by south of the 175-mile peg on the Hall's Creek-Turkey Creek telegraph line and 50 miles northnortheast of Hall's Creek. The name was taken from one of the original prospectors, who discovered gold in the later eighties.

Geology.—Briefly the main geological features are more or less foliated fine-grained greenstones invaded by later pegmatite dykes, classified in the State Geological Map under the general name of metamorphics. The country from a mining point of view resembles much of our Eastern goldfields. Striking through the greenstones in a general north by west direction (340°) are several parallel lines of quartz reefs. These reefs as a rule run parallel to one another, and with but few exceptions do they show a greater thickness than a few inches. The dip of the reefs is either vertical or slightly to the east. Traces and occasionally irregular patches of lead sulphide (galena) are of frequent occurrence in the quartz veins. There is little doubt that the silver contents occur in this galena.

Mine Working.—As would naturally be expected most of the old mine workings have either partly or completely fallen in. They are fairly numerous, and give the appearance that the original prospectors must have located payable values to have persisted in their prospecting. It is also obvious that much of the quartz that was raised has been taken away, possibly to the Hall's Creek battery, which was then in existence. Unfortunately I can find no record of any crushings.

Mr. George has done a little development on his lease, and from the vein of quartz, about 12 inches thick, which he had exposed to a depth of about 12 feet, I took three samples (1-3). These contain 1½ to 4½ ounces of silver, but only traces of gold. A little galena was showing in this reef, which probably accounts for the silver contents.

Some half a mile northeast from George's workings a shaft had been sunk to a shallow depth in a conspicuous quartz outcrop occurring in a parallel vein. A sample broken across two feet of solid quartz in the shaft, or rather trench, yielded 1 dwt. 15 grs. of gold and a trace of silver (No. 4). At a distance of half a mile, still to the northeast, is another parallel line of quartz reef on which quite a considerable amount of prospecting has been done, though the workings have since collapsed. A sample from stone scattered on the surface, and which contained a fair amount of galena, yielded a trace of gold and 2 ozs. 19 dwts. 11 grs. of silver (Sample No. 5). Two more samples were taken from the surface of outcrops lying slightly to the west of George's mine, and yielded respectively a trace of gold and 1 oz. 19 dwts. 5 grs. of silver and 2 dwts. 21 grs. of gold and 13 ozs. 3 dwts. 21 grs. of silver (Samples 6 and 7). A sample taken from a narrow quartz leader at the well yielded a trace of gold and 5 dwts. 14 grs. of silver. The well is supposed to yield a good supply of water.

General Remarks.—The results of the eight samples are in my opinion very discouraging, particularly as the previous samples were much higher and the fact that the veins are small. The numerous workings which were made when prospectors were at fever heat in their search for gold might naturally suggest that there might be payable reefs abandoned, but the samples taken do not indicate such conditions, and I am afraid that the chance of success in this area is very remote. The silver contents, though considerable, are in my opinion worthless without appreciable gold values.

5.—POSSIBILITIES OF MINERAL OIL OCCURRENCES IN THE ESPERANCE DISTRICT; EUCLA DIVISION.

(T. Blatchford, B.A., Acting Government Geologist.)

In Mr. Hancock's company I inspected the localities in the vicinity of Esperance, in which he assumes there are indications of mineral oil.

Geology.—Though covered over in many places by shallow deposits, granite is the prevailing rock in the vicinity of Esperance, and may be found extending far inland towards Norseman and out to sea to a distance of 30 to 40 miles, where it outcrops into numerous islands. A long line of outcrops may be found along the seashore, and frequent outcrops occur at a distance of not more than six miles in from the coast. Running parallel with the sea shore, and at a mean distance inland of some two to three miles, is a long line of salt lakes or lagoons, the most noted of which is the Pink Lake, from which considerable quantities of marketable salt have been obtained. Mr. Hancock contends that this lagoon area is a deep depression which has been filled with sediments which are oil-bearing.

There is no doubt that the granite area as far north as Norseman, and probably considerably further north, was underlying the ocean in Miocene times.

Scattered remnants of sediments such as found at Norseman and near St. Ives carry fossil remains of that age. The Plantagenet beds further west, which occupy a considerable area in the vicinity of Albany and extend as far east as the Hamersley River, were also laid down in a Miocene sea. None of these beds has proved to be of any appreciable thickness.

Since Miocene times the country has gradually risen, and probably continues to do so, as evidenced by the raised sea beaches found along the coast which contain shells of the same species as exist at the present day.

Some 40 miles south of Esperance the ocean soundings suddenly increase from 40-50 fathoms to 120-600 fathoms, showing a very sudden fall, and indicating the probability of a pronounced fault scarp. The uplifting area probably extends as far south as this.

With regard to the depression in which the lagoons occur, this can be easily explained by the fact that sand dunes and recent lime-bearing sandstones are naturally forming along the seaboard, and the sea and other waters have been cut off from the ocean and become impounded. This is no phenomenon but a common occurrence on many seaboards, governed to a large extent by prevailing winds, inland drainage, and sometimes ocean currents. There is no evidence that the deposits underlying the lagoons have any great depth, and they will probably prove if bored to be merely shallow typical coastal calcareous sandstone beds, with probably thin irregular beds of mudstone.

Indications of Oil.

Page's Farm.—At Mr. Page's farm, some 10 miles north of Esperance, there is a fine example of iridescence, due to the oxidation of soluble ferrous salts brought to the surface in spring waters. The water apparently comes from a saturated layer lying near the surface, for the top of a low-lying ridge is quite spongy over a considerable area. Attempts have been made to drain this ridge, but so far have not been successful. There is probably quite a quantity of the soluble iron salts in the water, for in the drains the heavy precipitation of iron oxide is very evident. The iridescence is very marked, but is in no way similar to that produced by a film of mineral oil.

McCarthy's and Cole's Farms.—These two farms adjoin and are situated near Myrrup, further to the east. Geologically they lie partly in granite and partly in recent sediments, as witnessed by modern sea shells which may be picked up in the wheat fields. The oil phenomena consisted of some fresh water and mud springs, which so often occur under similar conditions, and are in no way associated with mineral oil occurrence. On McCarthy's block are some rather remarkable cracks in the sediments (contraction cracks) which extend for a considerable distance, probably 150 yards, and contain fresh water. There is no sign of hade, but simply the earth has cracked, due probably to a rearrangement of underground drainage. There was no sign of mineral oil in the water in the cracks.

In conclusion, I am thoroughly convinced that there is no geological evidence nor oil indications in favour of finding mineral oil in the vicinity of Esperance.

6.—POSSIBILITIES OF OIL IN THE PEEL ESTATE, FREMANTLE DISTRICT.

(T. Blatchford, B.A., Acting Government Geologist.)

I visited the Peel Estate with Mr. A. E. Green, and examined his bore on Block 333.

This bore is situated in low-lying country, in which are numerous patches of swampy ground. The bore is practically in a swamp, though the ground where the bore is situated was dry at the time of my visit. The sample taken was from the borings at a depth of 80 feet. Mr. Green assured me that at times there was a strong smell of oils in the borings from this hole, and that he had extracted traces of mineral oil from the borings.

The sample (264) on analysis yielded a small percentage of waxy residue, which Dr. Simpson considers is probably of a vegetable nature and does not resemble petroleum or its residuums.

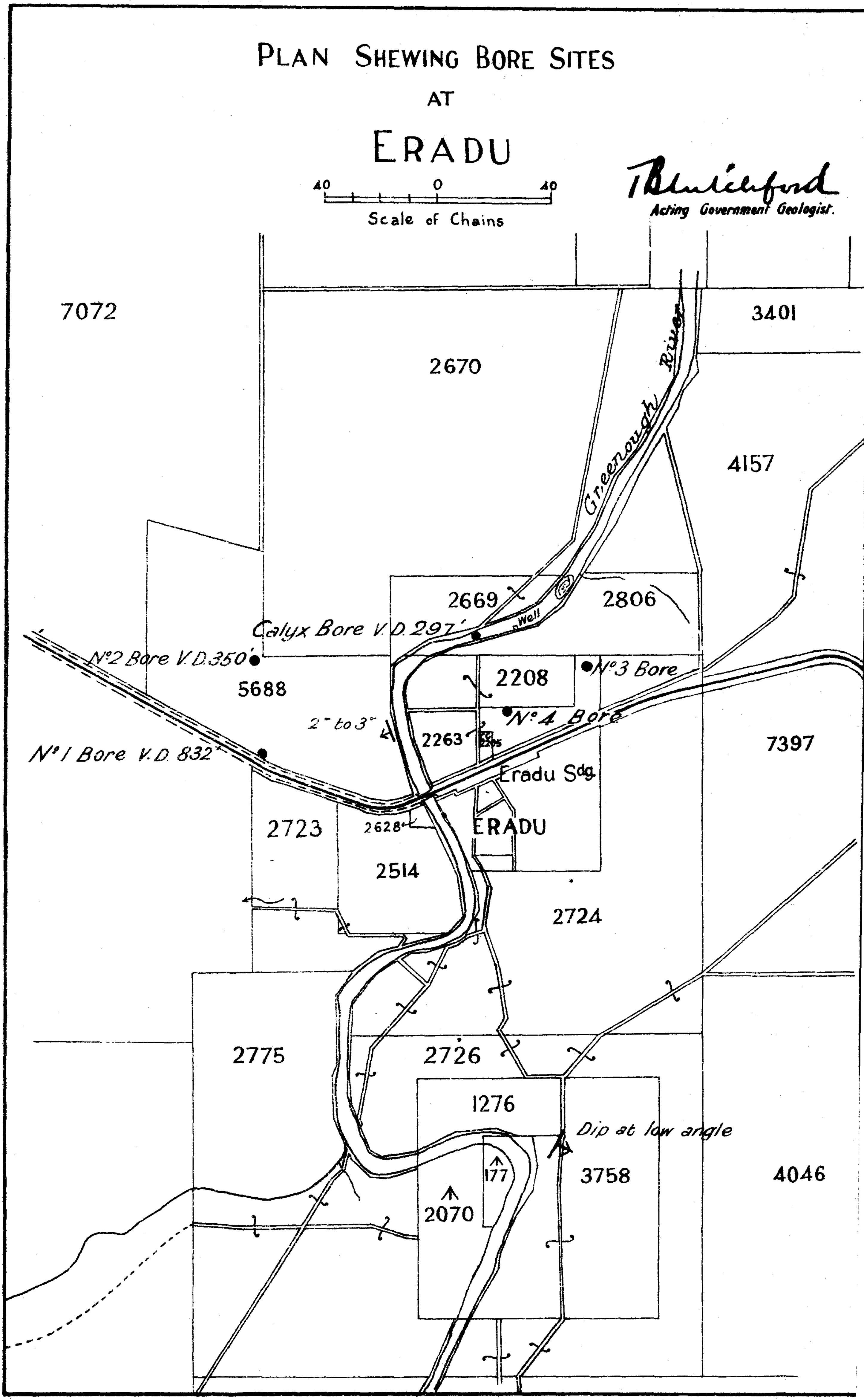
Where Mr. Green is boring is in country which was at one time low-lying, but has since been filled in probably only to a comparatively very shallow depth in very recent geological times. There is no evidence of suitable structure or genuine oil seepage, or in fact any indication favourable to the occurrence of mineral oil. I regard boring for oil in this locality as mere stabbing in the dark.

A sample (262) was taken at a spot near a swamp about 1½ miles south of Block 333 of sandy loam, which was supposed to have a peculiar smell and an extractable quantity of mineral oil. Here again a yellowish-white waxy product was extracted, but Dr. Simpson comments that "such extracts have been found to be common in soils in this State, and are probably of recent vegetable origin, not indicating the presence of any petroleum or its residuums."

In "Kerosene Lane," on Mr. E. F. Wall's block, there is a patch of ground the top three to four inches of which are darker than the underlying sand. Samples were taken of the top layer and the underlying sand. The top sample (263) "yielded an oil extract of 1.09 per cent. oily extract. Of this .863 per cent. was a brown hydrocarbon oil resembling a refined medium-grade lubricating mineral oil. Direct distillation of the soil yielded a similar oil without any lighter fractions."

The second sample (265), taken from immediately underneath the first, yielded only the white waxy residue, which is according to Dr. Simpson "probably of vegetable origin, and does not resemble petroleum or its residuums."

The origin of the oil in the top layer could be either that (1) it was accidentally spilt from a motor car, etc., or leaked from oil drums; (2) that there is an oil seepage nearby, and that oil has spread from this seepage over the surface. Owing to the configuration and nature of the spot where the samples were taken, which is on the east side of a long sand dune of recent geological age, I fail to see how the oil could come from a genuine oil seepage. On the other hand there is certainly no indication of oil having been stored on the spot, nor is there any apparent reason which would lead to the conclusion that the oil came from a leaky motor vehicle. The statement was made to me that there were more of these "oily patches," and as the occurrence is interesting, I would


PLAN SHEWING BORE SITES
AT
ERADU
40 0 40
Scale of Chains
Acting Government Geologist.
7072
2670
3401
Greenough River
4157
2669
2806
Well
Calyx Bore V.D. 297'
No 2 Bore V.D. 350'
2208
No 3 Bore
5688
No 4 Bore
2" to 3"
2263
2265
7397
No 1 Bore V.D. 832'
Eradu Sdg.
2723
2628
ERADU
2514
2724
2775
2726
1276
Dip at low angle
177
3758
4046
2070

like to make another inspection and clear up any doubt.

[Since the above report was written fresh samples have been taken and these, with one exception, gave negative results for mineral oil. The conclusion arrived at is that the first results were due to mineral oil having been spilt at the surface either from a motor tractor or oil drums.]

7.—BORING FOR COAL AT ERADU, GERALDTON DISTRICT.

(T. Blatchford, B.A., Acting Government Geologist.)

The following is my report on the cores obtained from the No. 1 Calyx Bore at Eradu, situated one mile west of Eradu railway station on the Railway reserve, with notes on the geological features observed in the locality.

Cores.—Much of the core apparently broke up during boring operations, and reached the surface in the form of mud or sand. The attached log has been compiled from the actual cores, typical pieces of which have been registered for future reference. Analyses of the coal seams are attached.

Geology.—In the immediate vicinity of Eradu the country can be conveniently divided into two classes: (1) Narrow alluvial river flats; (2) low-lying hills, for the most part covered with lateritic ironstone and sand and overgrown with dense scrub. At the crest of some of the hills typical "breakaways" occur. As may be expected, exposures of the underlying strata are rare, and only occur in the river banks and "breakaways." I was only able to find two exposures in which the dips and strikes could be measured with any degree of accuracy. At a point about 20 chains north of the railway bridge beds of argillaceous sandstones and narrow beds of conglomerates are exposed on the western bank of the river. These beds dip at an angle of two to three degrees to the west.

In this vicinity a considerable amount of boring has been done—one calyx and four hand bores. A 6ft. seam of coal was struck in the calyx bore at a depth of 118 feet. Mr. Campbell, who investigated this discovery, came to the conclusion that the coal seam and beds had a strike of approximately north and south and a dip of 5° 33′ to the east (94°).* If both observations are correct, it is apparent that there must be a fault in the river bed, the beds on the west side dipping west and those on the east side of the river dipping east, in which case there can be no connection between the 6ft. coal seam of the river bore and the seams found in the No. 1 calyx bore just completed.

Furthermore, there is a difference of elevation between the surface of the calyx bores of some 120 feet (aneroid readings only). The 6ft. seam was struck at 118 feet below the river bed, *i.e.*, 238 feet below the surface of No. 1 calyx bore, or 68 feet below the coal seams in that bore. If the strata in the river bore dipped west at an angle of three degrees, it should have been intersected at the No. 1 calyx bore at a depth of 514 =

118 feet depth of coal seam in river bore;

120 feet difference in elevation of surface at two bores;

276 feet due to dip.

For the coal seam in the river bore to have been missed in the No. 1 calyx bore, a dip to the west of six to seven degrees would be necessary, and this seems highly improbable.

Finally the easterly dip described by Mr. Campbell is further confirmed by a dip observed at Eradu Pool, some two miles south of the railway line. On the eastern bank of the pool the dip is undoubtedly easterly (eastsoutheast) at a low angle.

On the evidence it appears reasonably safe to assume that the coal seams in the two calyx bores are not the same seam.

Assuming they are not, if further prospecting by boring is to be done to test the two coal seams, the sites must be chosen accordingly.

As the water line is already laid for a considerable distance (for a site to prove the seams in the No. 1 calyx bore), I suggest as a second site a spot 30 chains north of No. 1 calyx bore. This hole need only go down far enough to re-sample the seams, and at the same time it should settle the important question of the strike of the beds. A bore 250 to 300 feet will probably suffice.

To prospect the 6ft. seam found in the old calyx hole, which in my opinion is by far the most important, I have chosen two new sites which with the old calyx bore will form a more or less equilateral triangle. If the seam is struck in the two holes suggested, we will have all the information we require about this seam. There is in my opinion quite a reasonable chance of workable coal being located in this locality.

If Mr. Campbell's dip is accurate, I would expect the southern hole (No. 4) to strike the coal horizon at approximately the same depth as in the river bore, *i.e.*, 140-150 feet, for it will be on the strike, and allowance has been made for the bore site being on the higher river bank.

No. 3 Bore would be required to go down at least 300 feet before there would be any chance of reaching the coal, and preferably another, say, 500 feet of boring should be done in this hole to prospect the lower strata for other seams of coal.

There may be some little difficulty about the site chosen for No. 4 Bore, as the ground was under crop last year. If there is any strong objection, the site could be moved a little further to the west on to the road as indicated. Water supply for both Nos. 3 and 4 Bores can be obtained without trouble from the same supply as is being used at present for No. 2 calyx bore, the connection being made at the main at the railway siding. There will be ample pipes available to connect with either bore site.

The positions of the suggested bore sites are shown on the accompanying lithograph (Plate II.).

The programme mapped out above will entail at least 800 feet of boring, and if the No. 3 hole is carried down as recommended, a total of 1,300 feet of boring will be required.

* G.S.W.A., Bull. 38, p. 33.

LOG OF BORE CORES RAISED FROM No. 1 CALYX BORE AT ERADU, ONE MILE WEST FROM ERADU SIDING, ON RAILWAY RESERVE.

No. of sample.	Depth of core.		Description.
	ft. in.	ft. in.	
1	30 0	64 0	White gritty sandstone.
2	64 0	75 0	Finer grained yellow sandstone.
3	75 0	98 0	Similar to No. 1 sample.
4	130 0	140 0	Fine-grained argillaceous sandstone.
5	140 0	157 0	Coarse-grained red sandstone.
6	159 0	170 0	Micaceous shale.
7	164 0	166 0	A band of darker shale.
	170 0	180 3	Coal.
	181 6	183 0	Coal.
8	183 0	188 4	Grey shale.
	188 4	190 3	Coal.
9	190 3	199 0	Grey shale.
10	199 0	204 0	Coarse sandstone.
	207 0	240 0	Conglomerate.
11	240 0	244 0	Shale. Contains organic matter—possibly plant remains.
12	244 0	344 0	Soft sandstone. Practically no core.
13	344 0	345 0	Shale.
14	408 0	464 0	Friable sandstone.
	464 0	470 0	Soft friable shale.
15	470 0	544 0	Friable sandstone with minor bands of shale similar to 464–470.
16	544 0	550 0	Shale.
	550 0	580 0	Similar to 16.
	580 0	587 0	do.
	587 0	637 0	No core. Sandstone.
17	637 0	640 0	Dark shale.
18	640 0	663 9	Sandstone with shale bands (sample of shale).
	663 9	668 0	Dark shale similar to shale bands in 18.
	668 0	686 0	Soft friable sandstone with minor bands of shale.
	686 0	695 0	Shale similar to 18.
	695 0	803 9	Sandstones with minor bands of shale.
20	803 9	804 1	Band of pyrite.
19	804 1	832 0	Fine grey shale to bottom of hole

Analysis.

No.	3096/26	3097/26	3098/26
Depth	ft. in. ft in. 170 0–180 3	ft. in. ft. in. 181 6–183 0	ft. in. ft. in. 188 4–190 3
Proximate analysis—	per cent.	per cent.	per cent.
Moisture ...	13·66	10·67	7·78
Volatile matter	36·41	31·32	26·65
Fixed carbon...	24·74	30·69	29·00
Ash	25·19	27·32	36·57
	100·00	100·00	100·00
Calorific Value— B.T.U. ...	...	5493	...
Colour of Ash ...	Light brown	Dirty white	Brownish white

8.—GEOLOGICAL OBSERVATIONS MADE WHILST TRAVELLING IN WEST KIMBERLEY UP THE VALLEYS LYING BETWEEN THE PENTECOST AND KING RIVERS, THEN EASTWARD ACROSS THE DENHAM AND ORD RIVERS AS FAR AS ARGYLE STATION ON THE BEHN RIVER.

(Including a Report on the reported discovery of Argentiferous Galena on Speewah Station.)

(T. BLATCHFORD, B.A., Acting Government Geologist.)

Introductory.—In view of the fact that high grade samples of silverlead ore were received from the manager of Speewah Station, on the Denham River. and that these samples were reported to have come from a lode of considerable dimensions occurring in country hitherto unknown to be mineral-bearing, the writer was commissioned to visit the locality and report on the possibilities of the discovery. Availing himself of the opportunity of personally seeing at least some portions of the Kimberleys, Mr. Clarke, Lecturer in Geology at the University, accompanied the party.

We left Fremantle by the State boat "Koolinda" on 28th July, 1927, arriving at Wyndham on the 10th August. Here we were met by Mr. M. P. Durack, who not only provided us with an excellent plant of riding horses and packs, but also acted as our guide for the journey as far as Argyle Station. At this point we left the horses and journeyed by motor transport back to Derby. The expedition with which the journey was made, particularly the section between Wyndham and Argyle, was mainly due to Mr. Durack's organisation and bushmanship, for much of the country we passed through was rough and trackless, in which a stranger might easily meet with considerable difficulty in finding suitable crossings.

One of our main difficulties was plotting our course with any degree of accuracy. In addition to the irregular course we were forced to follow, we found extremely few land marks fixed by survey, and on the other hand we came across many features which were not on the maps we carried. However, the track followed, as plotted on the accompanying plan (Plate III.), should be sufficiently accurate to show approximately the position of the main points of interest referred to in the following pages.

Fortunately the season had been a good one, and little trouble was experienced in finding water and feed for the horses and mules at convenient stages for camping.

Physiographic Features.—No authentic descriptions from actual personal observations has been published regarding the physiography of the Kimberley Division. Jutson (Bull. 61, Geol. Survey of W.A.) refers to the Kimberley area in general as an elevated tableland, probably an uplifted peneplain, connected by a narrow fringe to an outer low-lying peneplain, which extends far to the south and east. He describes the inland tableland as an area occupied by a labyrinth of hills and ridges with intervening low-lying plains well watered by numerous streams.

The surface features of the section we traversed correspond very closely to Jutson's description, and may be summarised as a succession of narrow flat-topped ranges, usually of considerable length, with occasional disconnected irregular ridges and isolated hills. The main ranges are separated by narrow valleys, seldom exceeding from three to four miles in width.

We found strong evidence that the sedimentary beds had been uplifted to at least 1,500 feet above sea level, and during the period of uplift they had been folded, the major axes of the folds having a prevailing north and south strike. Denuding agencies subsequently planed the crests of the folds down to the base of the sediments, forming valleys which are now separated by the remnants of the flanks of the folds, which occurred usually as long narrow ranges. These ranges and ridges can therefore be regarded as the remnants of the old plateau, and stand out in bold relief to the valleys lying between them.

Owing mainly to their uniform geological structure, which consists of extensive beds of hard compact sandstones or quartzites overlying softer shales, tuffs, etc., the sides of the ranges are usually precipitous near the top, with a long talus extending from the bottom of the cliffs to the base (Fig. 2). This cliff structure is very characteristic, and is evidently due to the weathering of the underlying shales or tuffs being more rapid than that of the harder overlying standstones and quartzites. Undermined, the top beds break off in large masses rather than fret away gradually. No doubt vertical jointing adds largely to the process.

The valleys lying between the hills are as a rule covered with volcanic soils which apparently produce excellent pastures, particularly for cattle and horses. In most of the valleys the natural water supply is good, for in addition to the main streams, permanent springs are fairly plentiful.

After crossing the Ord the hills and valleys cease, and are replaced by extensive black soil plains which extend far away to the eastward. These plains, though extremely fertile in ordinary seasons, lack permanent water supplies, and on this account do not carry the number of stock they should. There is much to be achieved in establishing artificial supplies by boring, sinking wells, or surface catchments. Timber, chiefly eucalypti, is fairly plentiful in the valleys and particularly near the water-courses, and though not of first-class quality is ample for general station purposes.

Geology.

General Remarks.—Practically no detailed geological descriptions of the inland plateau of Kimberley are to be found in the published records of past observers, though there are certain occasional references to the main structural features. This may be accounted for by the fact that previous observers such as E. T. Hardman, 1885[1]; H. P. Woodward, 1891[2]; Dr. Logan Jack, 1906[3]; Herbert Basedow, 1916-1917[4]; and Dr. Arthur Wade, 1925,[5] were all engaged on special missions which held them to investigating more or less definite sections of the fringe of the plateau rather than any portion of its interior.

Gibb Maitland in 1901 certainly traversed the section lying to the west of the Chamberlain River, but his report refers more to the structural than the detailed aspect.[6]

The following are short and usually disconnected descriptions of points of interest which were examined when travelling from Wyndham down the valley lying between the Pentecost and King Rivers and across to the Ord. They were made on a single traverse, and must be considered merely as casual observations along the road rather than having any pretence to a thorough geological description. When possible specimens of the various rock types were collected and petrological descriptions of some of these rocks will be added. Photographs of striking features were taken where opportunity offered, and some of these will also be attached to illustrate the salient features.

From the observations we made it became obvious, however, that many of the geological problems of this interesting section of the State will require much careful study before they can be satisfactorily solved, and in addition much mapping will also be necessary.

Wyndham.—The most conspicuous geological feature in the vicinity of the township of Wyndham is an irregular semi-detached series of hills, the highest point of which is West Mount Bastian (Fig. 1), which rises to an elevation of 1,079 feet above the surrounding country. These hills are composed of a top bed of sandstones, underlain by extensive shale beds. The prevailing dip of the beds is to the south-east at an angle of about seven degrees. Boring in the townsite has proved that the shale beds extend a further 1,197 feet below the surface, and lie on a second sandstone horizon proved to a depth of at least 1,320, when boring operations were suspended. A search was made for organic remains in the shales, but was unsuccessful.

The possibility of obtaining artesian water in the series has been dealt with in detail by Dr. R. Logan Jack in his report on the possibilities of artesian water in Kimberley, published in 1906.[1]

At the "Three-Mile," *i.e.*, three miles from Wyndham on the Hall's Creek Road, an interesting outcrop of basalt was noted. There was insufficient evidence to form a definite opinion as to whether this occurrence was a basaltic flow or intrusion. The rock is a dense basaltic type, showing occasional small facets of cleavable felspar.

..Under the microscope it is a mass of felspar microlites lying in all azimuths, with numerous grains and small prisms of augite. Distinct idiomorphic phenocrysts of plagioclase and augite may in places be noted. Irregular grains of magnetite are common.[2]

In many respects the rock resembles the basalts of the Antrim Plateau and the basalts of the Argyle Area.

Leaving Wyndham and the "Three-Mile" we travelled for 22 miles in a general south-easterly to southerly direction to the Wyndham Meatworks Pumping Station, on the King River, which lies almost opposite North Mount Cockburn. On the left hand we passed broken ridges consisting of sandstones, but as these were similar to the beds at Wyndham they were not examined.

North Mount Cockburn and Cockburn Range.—North Mount Cockburn is almost a replica of the Bastian with a greater development of the overlying sandstones, which have a thickness of about 200 feet. These beds show signs of ripple marking and current bedding (Fig. 3). They are underlain with shales, partly calcareous near their base, and con-

---

1 Report on the Geology of the Kimberley District. Parliamentary Paper, No. 34 of 1885.
2 Report on the Goldfields of the Kimberley District. Parliamentary Paper, No. 18 of 1891.
3 The Prospects of obtaining Artesian Water in the Kimberley District. W.A. Geol. Survey, Bull. 25, 1906.
4 Narrative of an expedition of Exploration in North-Western Australia: Trans. Roy. Geog. Soc. Aust., S. Aus. Branch, Vol. XVIII., 1916-17.
5 Petroleum Prospects in Kimberley: Parl. Aust., 1924, No. 142.
6 W.A. Geol. Survey, Ann. Prog. Rept., 1901.

1 The Prospects of obtaining Artesian Water in Kimberley: By Logan Jack. W.A. Geol. Survey, Bull. 25, Perth 1906.
2 Petrological Description by Dr. C. O. G. Larcombe.

taining concretions of black calcite, which had been mistaken for bitumen. The series is undulating, but in the main dips westerly at low angles. To the east of the pumping station the dip of the beds is to the east. After leaving the pumping station the course turned slightly to the southwest and followed up Cockburn Creek, in a gorge occupied by it, for a distance of some eight miles, when the first "jump up" was crossed. A "jump up" is the local name for a cross ridge or saddle in a valley or gorge. This particular example consists of much broken and disturbed sandstone or quartzite, and probably represents a sheared zone, which, owing to secondary mineralisation or silicification, offers more resistance to denudation than the main formation. "Jump ups" are not uncommon in the ravines and valleys of the Kimberley plateaux, and are particularly detrimental to wheel traffic, often rendering impassable for vehicles what might otherwise be quite a good roadway.

At three places in the bed of Cockburn Creek more steeply dipping rocks occur. First, near the mouth of the ravine a quartz vein, four feet wide, outcrops in micaceous shales, striking at 165 degrees and dipping west at 70 degrees. Two miles further up the ravine alternating beds of quartzites and shales strike at 210 degrees, and dip west at 30 degrees; and at a pool eight miles farther on, indurated thin bedded shales and quartzites have a strike of 20 degrees, and dip east at 70 degrees.

After descending the "jump up" on the south side, the track followed Gap Creek to the juction of a small tributary of the Pentecost River. Turning sharply to the left we followed up this creek until we reached Fish Pool, distant about 20 miles from the pumping station. The hills lying to the west of the pool dip to the west, and are either sandstones or quartzites.

Travelling from Fish Pool in a general southerly direction we passed over quartzites and shales. About two miles past Fish Pool these beds dip to the north at an angle of 30 degrees, these steep dips persisting for some distance about this spot. In the bed of a small watercourse a breccia of vesicular volcanic rock was seen well exposed and cemented in a few spots by quartzite. The volcanic rock appears to be contemporaneous with the quartzite beds.

In addition, the series has been invaded by basic igneous rocks. One occurrence was observed some seven miles south of Fish Pool where red-banded shales, which are very friable, are overlain by a dense fine-grained basic igneous rock. As these red shales could be seen extending for a considerable distance to the northwest, it is more than probable that the sill also has a wide extent. Under the microscope it is—

"Made up of small lath-shaped plagioclase and angular augite with some black oxide of iron. The slide shows a considerable staining by red oxide of iron. The rock is a somewhat ferruginous basalt."[1]

A second and much more extensive invasion of igneous rock occurs about 9 to 10 miles south of Fish Pool. Here a mass of coarsely crystalline massive gabbro extends in a westsouthwesterly direction for at least five miles, when it turned to the east away from our course; but it could be seen extending at least four to five miles further on. Where we examined it the mass was at least one mile wide, and wherever seen the sediments dip away from it at angles of at least 25 degrees. The mass is probably a laccolith, as in no instance was it observed cutting through the overlying sediments. The gabbro itself is, however, invaded by a finer-grained basic rock, in places up to two chains in width.

"Under the microscope the gabbro is found to be a holocrystalline aggregate of comparatively fresh plagioclase near labadorite and beautiful plates of very pale brownish cleaved and well twinned augite arranged ophitically with regard to the felspar. A little of the augite is diallagic. Patches of black oxide of iron are present, but are not abundant. This rock is an ophitic gabbro."*

The intrusive dyke under the microscope shows—

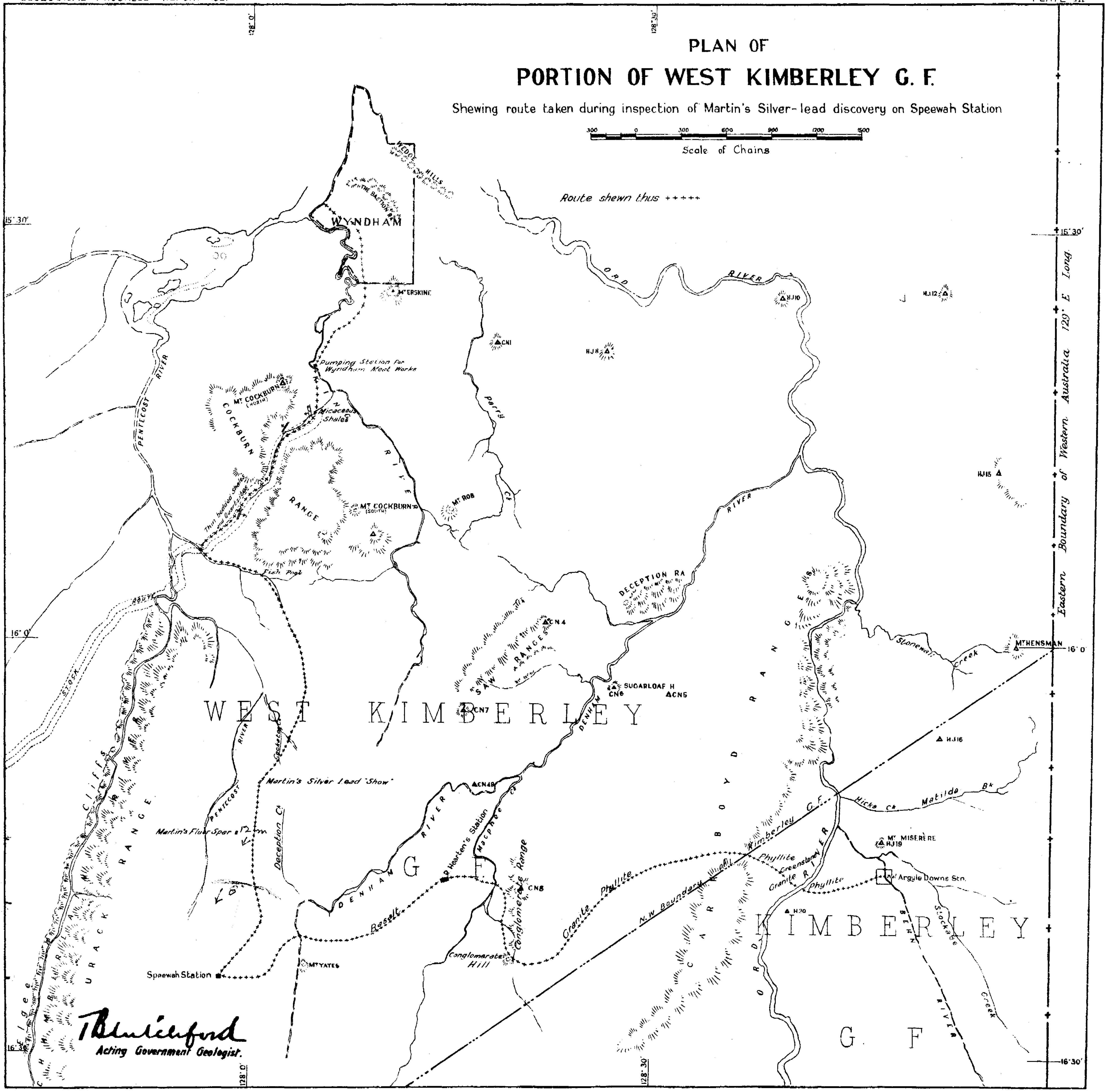
"Lath-shaped plagioclase intimately intergrown with grains and prisms of augite and contains grains and patches of black oxide of iron. A few bright green patches of chlorite were noted. The rock is a dolerite."*

The last three or four miles of the journey before reaching Martin's silver-lead mine were down a valley (Fig. 4), bordered on the eastern side by cliffs 300 to 500 feet in height. These cliffs consist of an uppermost layer at least 50 feet thick of a whitish quartzite, which in places shows signs of current bedding. Interbedded with this bed near its base is a 4-foot seam of tuff. Beneath this tuff bed and perfectly conformable to it are 40 feet of coarse tuff. Beneath this again is a series which probably forms the remainder of the cliff but is largely obscured by talus of fine-grained tuffaceous rock which breaks up into small and large fragments. In one of these was noted a small half-inch seam of quartz lying parallel to the bedding planes. A few more or less vertical faults, probably with a maximum throw of 40 feet, traverse the series.

Martin's Silver-Lead Show.—Martin's silver-lead show occurs on the extreme eastern slope of a low ridge, similar in form to a river terrace, which is separated from the cliffs by an alluvial flat about one mile wide. The lead deposit, which consists mainly of quartz mixed with a minor quantity of lode material, strikes north and south along this slope and dips at a very low angle to the east, the dip corresponding almost to the slope of the ridge. There is practically no overburden to the lode. The footwall is a coarse-grained granitic rock which can be followed in a low range of broken hills extending for several miles to the southwest. This footwall rock is probably a second laccolith from which the roof of sediments has been completely denuded with the exception of a thin scale of baked sandstone and shale or tuff, fragments of which are fairly plentiful on the surface of the ridge. The laccolith shows a vertical range, in character from coarse, through finer-grained, up to fine-grained. A sample of the rock, taken from the footwall of the rock, showed the following characteristics when examined under the microscope.*

1 Petrological description by Dr. C. O. G. Larcombe.

* Petrological descriptions by Dr. C. O. G. Larcombe.


PLAN OF
PORTION OF WEST KIMBERLEY G. F.
Shewing route taken during inspection of Martin's Silver-lead discovery on Speewah Station
Scale of Chains
Route shewn thus +++++
WYNDHAM
ORD RIVER
PENTECOST RIVER
COCKBURN RANGE
Mt COCKBURN (NORTH)
Mt COCKBURN (SOUTH)
Pumping Station for Wyndham Meat Works
Micaceous Shales
Mt ERSKINE
Mt ROB
Parry Ck
DECEPTION RA
SAW RANGES
SUGARLOAF H
WEST KIMBERLEY
DENHAM RIVER
Martin's Silver Lead 'Show'
Martin's Fluor Spar
Deception Ck
Hearten's Station
Conglomerate Range
Conglomerate Hill
Basalt
Granite
Phyllite
Greenstone
N.W. Boundary Kimberley G. F.
BOYD RANGE
CARR BOYD RANGE
Speewah Station
Mt YATES
Stonewall Creek
Mt HENSMAN
Hicks Ck
Matilda Bk
Mt MISERERE
Argyle Downs Stn.
BEHN RIVER
Stockade Creek
KIMBERLEY
G. F.
Eastern Boundary of Western Australia 129° E Long
Acting Government Geologist.

"A crystalline mass of clouded felspar, some of which is certainly plagioclase graphically intergrown with the quartz in many places. Apatite rods are common in the quartz. All the ferromagnesian mineral has gone. It is now represented by bright green chlorite. A feature of this rock is the large plates of partially leucoxenised ilmenite. The rock is a basic chloritised granophyric type of granite."

A second sample broken on one of the hills to the southwest showed sufficient pyroxene to warrant the rock being classified as a granophyric pyroxene granite. There is no evidence of foliation in this rock mass, neither were any later intrusions of basic dykes noted.

The lead deposit was first exploited by cutting several shallow costeans, which were not sunk deep enough to reach the footwall, and as these workings showed considerable widths of lode material, as they naturally would, it was not unreasonable for the prospector to form an optimistic opinion of his discovery. However, when the costeans were deepened and the footwall was exposed there seemed little doubt that the deposit was merely the remnant of a flattish mineral segregation lying on the top of the laccolith. The greatest thickness in any of the costeans is three feet six inches. Galena, cerussite, malachite and azurite occur in scattered patches in the quartz, and native silver associated with the copper minerals was also noted in some quantities.

Four samples, broken from the lode where exposed in the costeans, yielded the following results:—

No. of sample.	Description.	Lead.	Silver.	Copper.	Gold.
		per cent.	ozs. dwt. grs.	per cent.	dwt. grs.
1	Centre costean, bottom section over 2ft. ...	3·87	23 4 6	3·03	0 5
2	Centre costean, top section over 1ft. 6in. ...	0·09	3 4 19	0·72	0 21
3	North costean over 2ft.	4·61	5 3 9	Trace	1 15
4	South costean over 1ft. 6in.	2·53	18 3 15	1·94	1 15

From Martin's camp we journeyed up the valley in a general southerly direction for about nine miles, and then turned a short distance off our course to the east to inspect some deposits of fluorite. The country rock passed over for this distance was mostly a coarse-grained greenstone, probably a continuation of the laccolith forming the footwall of the silver-lead lode. The only other rock noted was a very fine-grained dyke, about nine inches thick, striking east and west. The fluorite occurs in parallel veins with a north and south strike and a vertical dip. They apparently occur in a brecciated zone of a finer-grained basic rock.

"Under the microscope it consists of beautiful plagioclase showing carlsbad, albite and pericline twinning, the latter being very noticeable. Some of the felspars are cracked and contain dusty patches of alteration. The augite is pale brown, partially schillerised, and strongly twinned. It occurs in large irregular-shaped patches with a strong prismatic tendency, and in places has undergone slight chloritisation. There are some patches of black oxide of iron. A little quartz is present, some of it in the form of micropegmatite. This rock is a micropegmatitic quartz gabbro."*

Striking parallel with the vein is a narrow very fine-grained basic dyke evidently intrusive and probably intimately connected with the brecciation. The widths of the fluorite veins vary from 10 to 24 inches and the colour from semi-transparent and glassy to opaque white and light blue. Patches of galena frequently occur in some of the veins. Otherwise much of the fluorite is free from contamination, and would be of commercial value if more accessible.

Three more fluorite veins occur about seven miles southsouthwest of the first deposits and 2½ miles northwest of Speewah homestead. These veins likewise strike along north and south lines in a brecciated zone, similarly to the first deposits.

Though persistent in length, the veins are narrow and contain appreciable quantities of galena as an impurity. On the other hand some of the fluorspar is of high-grade quality and free from galena. Owing to the distance from the market the deposit is of no commercial value at present.

From Martin's silver-lead mine the country traversed was similar in topographical features to the previous stage. The rocks were for the most part coarse-grained greenstones.

Travelling from Speewah Homestead to Hearten's Homestead.—The first part of the route after leaving Speewah homestead was over basic igneous rocks, but near the south end of the laccolith a very good section was passed showing thin bedded tuffs. These tuffs are held up by long vertical lines of silicification (with crustification) and resemble those lying on top of the laccolith at Martin's silver-lead show. They dip south at the south end and east at the southeast end of the laccolith. After passing over these, a distance of about four miles, the route lay over quartzites which have a generally westerly dip and continue past the Denham River to within five miles of Hearten's homestead, where basic igneous flows of the same character as the breccias seen near Fish Pool come in and occupy the valley almost as far as the Conglomerate Range. Lying about three miles south of the Denham River crossing, Mount Yates (Fig. 10) makes a conspicuous landmark. The mount is really a text-book example of a volcanic "plug," rising through the quartzite 400 feet above the level of the river. The rock is fine-grained and of reddish colour, but unfortunately was too far weathered for accurate petrological determination.

"A fine-grained soft greenstone with a brownish streak. It is traversed by veinlets of glassy quartz. Under the microscope it is a mass of black and red oxide of iron with some greenish alteration material. Quartz veinlets are distinct. This is a ferruginous chloritic greenstone. It is almost surely of igneous origin, but it is so rotten that there is no positive evidence."*

The eastern side of the "plug" has been denuded by the river. On the western side the quartzite can be seen lying up against the wall of the neck where their gentle dip is unmistakably reversed. They have quite a different appearance from the ordinary quartzites although no distinct contact alteration minerals were noted.

* Petrology by Dr. C. O. G. Larcombe.

The next rock, the marginal rock of the plug proper, with inclusions of quartzite, is intensely silicified. Quartz veins, some vuggy with well-developed pyramids of quartz, form a regular network. Nearer the centre of the plug, which is at least 300 yards in diameter, the rock is less seamed with quartz veins and resembles the fine-grained igneous rocks previously referred to.

Between Hearten's homestead and Conglomerate Range the country rock is basalt, which near Hearten's weathers into a black friable soil quite different from the red soil of the more crystalline igneous rocks.

Conglomerate or Ragged Range (Figs. 5 and 7) owes its striking outline to the fact that its western side is composed of alternating bands of conglomerate and red sandstone. The sandstone is usually quite soft and pulverulent except where locally slightly more cemented patches occur and break away in great slabs. The conglomerate itself is composed essentially of pebbles, ranging from the size of marbles up to boulders a foot in diameter, perfectly rounded and apparently all quartzite. In this respect they resemble the Nullagine conglomerates. Two bands of conglomerate, 50 feet thick, are seen on the west side of the range, but proceeding eastward the conglomerate rapidly thickens till, in Conglomerate Bluff (Fig. 6), it attains a thickness of about 600 feet. Scattered through the conglomerate there are small lenses of sandstone. Further to the east of Conglomerate Bluff the conglomerate apparently thins out again and is replaced by sandstones very similar in appearance to the Upper Carboniferous sandstone series of the Fitzroy area. To decide whether these conglomerates should be classified as Nullagine beds or whether they are replicas of the conglomerates found embedded in the Carboniferous series will require much further study. Though far more massive in structure they certainly resemble very closely some of the conglomerate beds found in the vicinity of Mount Wynne and other localities in the Fitzroy area.

Shortly after passing Conglomerate Hill, medium-grained to coarsely-porphyritic granite is crossed. This granite is intrusive into the phyllites which are highly dipping, now east, now west, and strike east of north. These phyllites extend as far east as Prospect Creek (Fig. 8), which we followed down through the Carr-Boyd Range practically to the Ord River. The base of these ranges, in my opinion, consists of phyllites representing the metamorphic series as described by E. T. Hardman and others occurring in various localities on the outer fringe of the plateau, notably Hall's Creek, where the overlying sediments have been denuded down to their base.

After crossing the phyllites and on the eastern flanks of the Carr-Boyd Range, we find a strip of granite about half a mile wide. This granite appears to be sheared along its western edge, but this is a fluxion structure, for further in it becomes massive. In certain sections it is coarsely porphyritic, in others medium, even-grained with xenoliths of phyllites, proving that it has intruded the latter. On the eastern edge of the granite is a zone of a few hundred feet of intensely brecciated fine-grained flinty rock which may be a sediment or may be a highly altered greenstone.

After passing over this zone the same rock is found in a more massive condition, then an area of perhaps three-quarters of a mile of intensely sheared greenstone. The shearing planes in this greenstone strike in a general northeasterly direction and, like the phyllites, dip now east, now west. They are traversed by a few quartz reefs which have a generally parallel strike with the shear planes, but a discordant, generally steeper dip. East of the greenstone belt there are three miles of granite country, when the Ord River is reached. After crossing the river a few hills of silky phyllite were noted and a curiously coloured sedimentary rock outcropping in a low ridge about three miles southwest of Argyle homestead. The general strike of this outcrop is north and south, with an almost vertical dip.

No fossil remains could be found in the immediate vicinity of the ridge, but limestone beds containing abundant remains of *Salterella* outcrop a short distance to the east. It is probable that the beds in question are the tilted edges along a fault of a bed underlying the limestones. The colouring of one band of rock is either red or grey, or both, distributed sometimes in a most regular banding, at others as a grey background on which are red oval spots partially or completely detached (Fig. 11). At times both the banding and the spacing of the red spots are almost perfect, though such is not always the case.

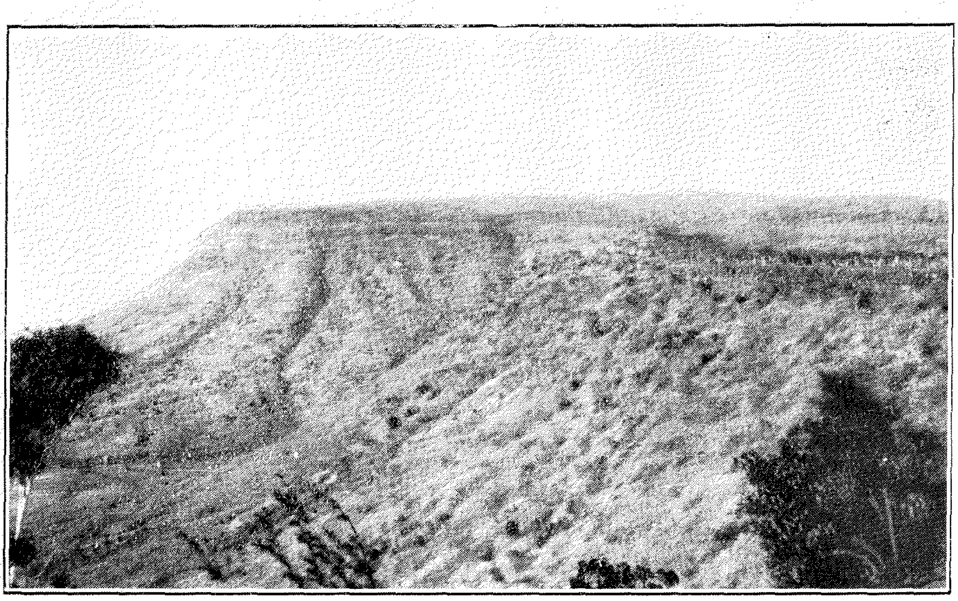
Under the microscope the rock shows an almost uniform composition of fine angular quartz grains cemented with aluminous material, the red colouring being due to a small percentage of iron oxide. In some specimens the rock is almost wholly grey with just a few remaining portions of the red spots; in others the rock is almost entirely red with the grey bands just appearing. What the true reason is for the extraordinary regular colouring is obscure, but I agree with Clarke that it is probably due to the leaching out of the iron oxide; but why in such regularity is not evident.

Similar rock has been picked up by the writer in the vicinity of Braeside Station on the Oakover River, but it has not been found occurring *in situ* in that locality.

Black soil plains (Fig. 9), probably underlain by the basalt flows which are exposed at the surface further to the east, extend to Argyle Station and spread out far away to the north and east.

Conclusions.—From a mineral point of view the country traversed does not give the impression of being favourable for the occurrence of either gold, mineral, or base metal deposits. The sandstones, shales, and interbedded tuffs, although of Pre-Cambrian age, show no signs of mineralisation. Small veins of fluorspar containing galena were certainly found in the underlying basic rocks in the Speewah valley, but only where a slight shearing of the rocks had taken place due to a local intrusion. On the whole the basic rocks are massive and are therefore not likely to be metalliferous.

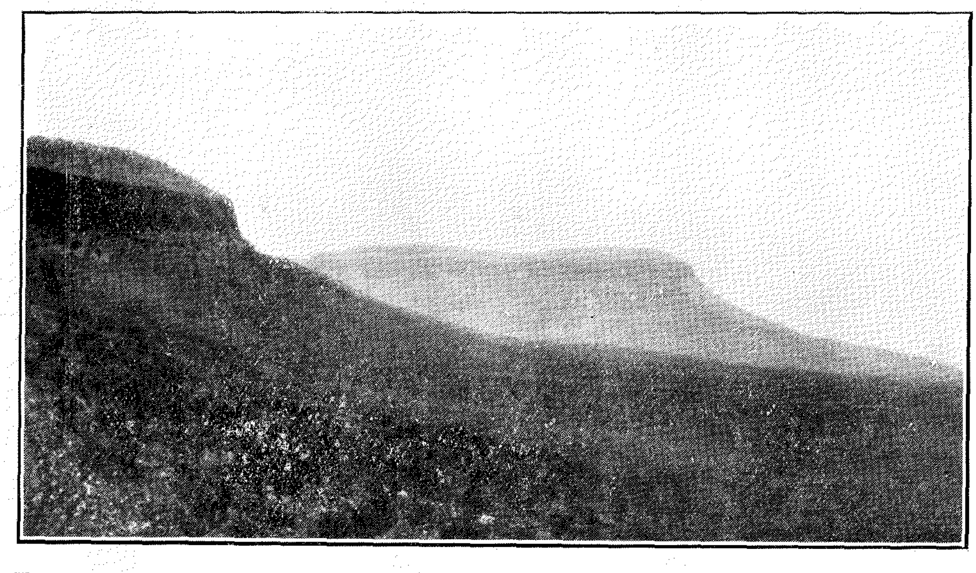
Fig. 1.



F. 345.

The Bastion, near Wyndham.

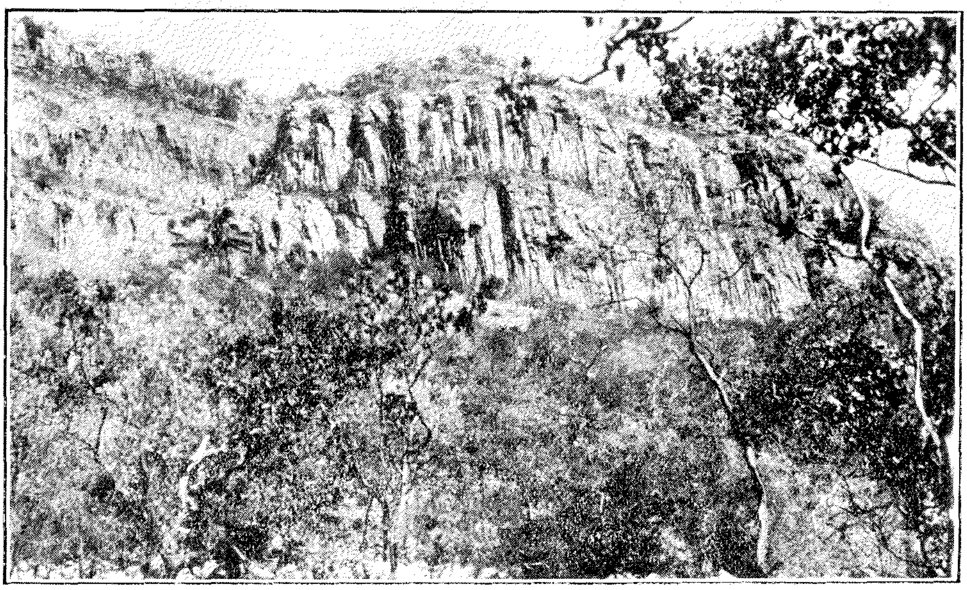
Fig. 2.



F. 357.

Western side of Cockburn Valley, with Mount Cockburn in the far distance.

Fig. 3.



F. 363.

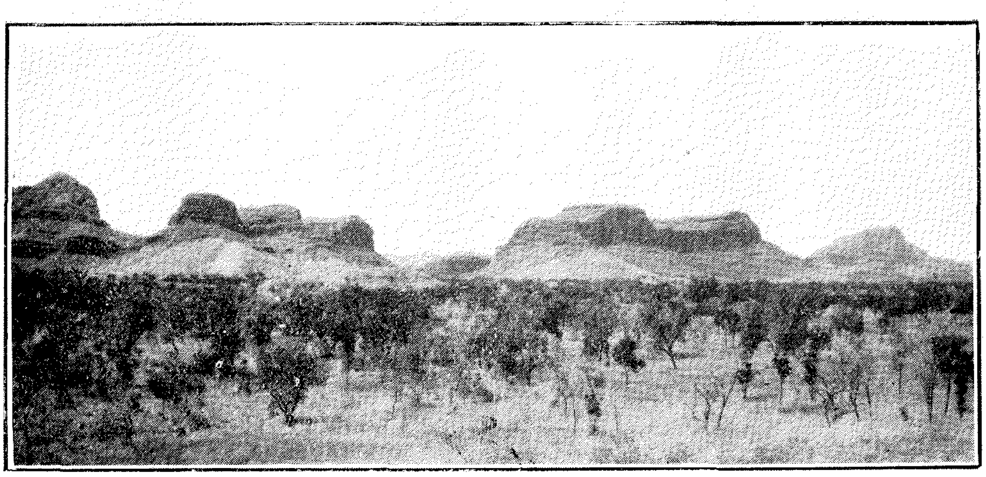
Quartzite Cliff, eastern side of Mount Cockburn.

Fig. 4.

Neg. 1856.

Looking northeast up Speewah Valley, from near Martin's Silver-lead show.

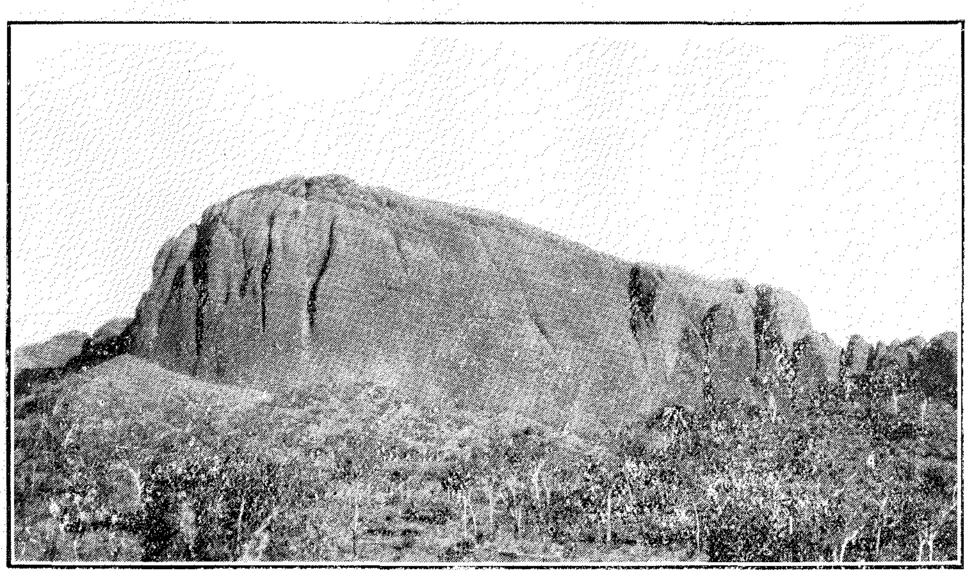
Fig. 5.



F. 344.

Eastern flank of Conglomerate Range.

Fig. 6.



F. 339.

Conglomerate Hill: portion of Conglomerate Range.

Fig. 7.

F. 342.
Showing pebbles in conglomerate beds at base of Conglomerate Range.

Fig. 8.

F. 341.
Looking northwest from top of "Jump up" in Prospect Gorge.

Fig. 9.

Neg. 1855.

Black soil plains of Ord River, Mount Elder in far distance.

Fig. 10.

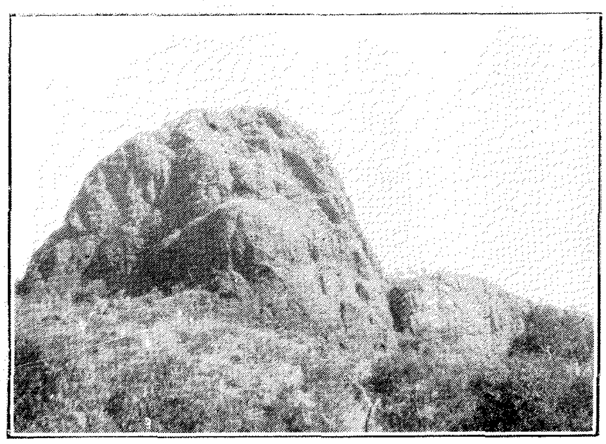
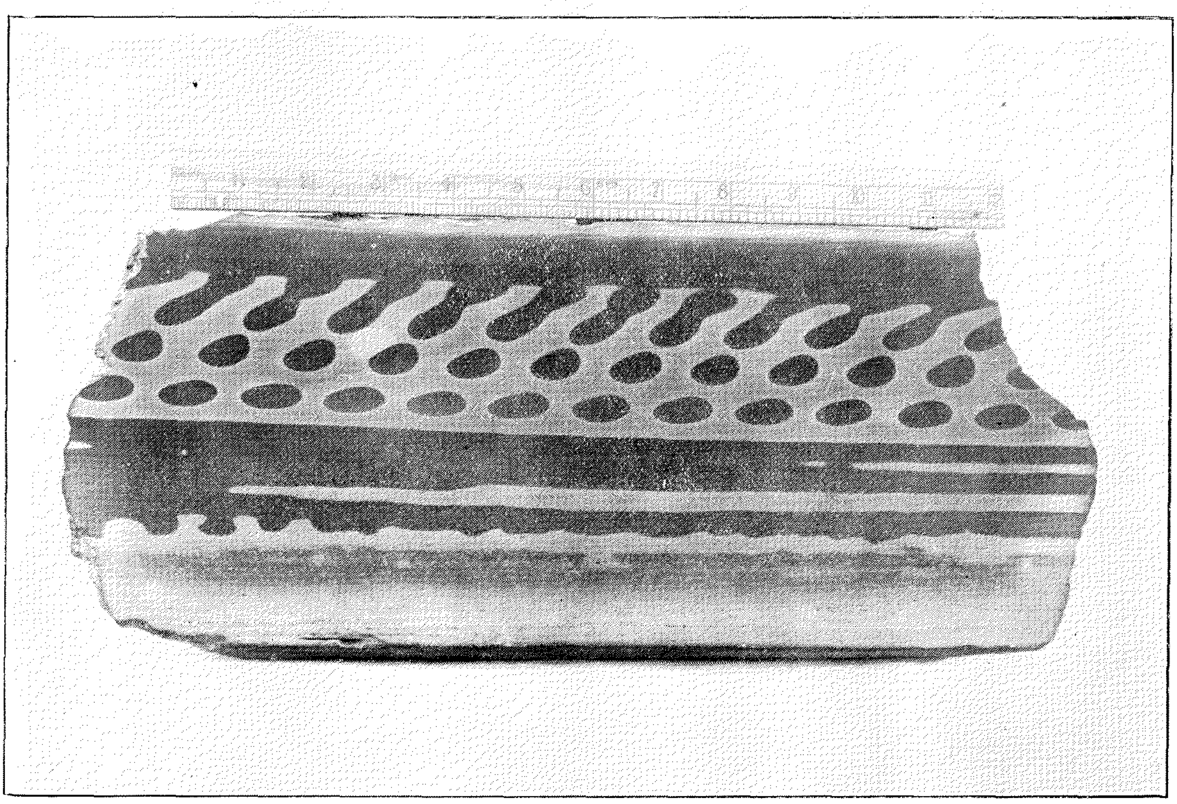


Photo.: E. de C. Clarke.

Mount Yates, Volcanic plug.

Fig. 11.



Neg. 1857.

"Zebra" rock, from three miles southwest of Argyle Station.

As explained in the previous pages of this report, the silver-lead deposit at Speewah was more than probably a local enrichment at the contact with the basic rocks and the sediments.

In Prospect Gorge the basic rocks are more favourable than elsewhere, as they are intensely sheared and foliated, but the scope for prospecting would be more or less limited to where these rocks were exposed in the gorges. They were seldom seen at the surface elsewhere.

The country down the Pentecost and as far east as the Ord River, particularly the numerous valleys, appears eminently suitable for raising and fattening stock, especially horses and cattle, and with an improved water supply should carry far more than at present. The lack of water supply is still more pronounced on the black soil plains east of the Ord, and the same applies not only to the Ord River basin, but also to the great portion of the Fitzroy valley, and I am confident that in many places artesian or sub-artesian water could be found by comparatively shallow boring in many portions of these areas.

9.—BORING FOR MINERAL LODES AT MEEKATHARRA, MURCHISON GOLDFIELD.

(T. BLATCHFORD, B.A., Acting Government Geologist.)

In accordance with Ministerial instructions I visited Meekatharra and chose three boring sites which I consider to be the most suitable for exploiting at depth one of the most important ore channels.

In the month of June, 1925, a deputation from the Meekatharra Roads Board waited on the Hon. the Minister for Mines and suggested the following boring programme:—

1. To bore the north and south ends of Paddy's Flat.
2. Assist a deep bore in the Fenian Mine on the £ for £ basis.

I interviewed Mr. Roberts, the general manager of the Ingliston Consols Extended and Fenian Mines, who was one of the deputation, and he assured me his company do not wish to bore in the Fenian Mine. The boring suggested in the north end of Paddy's Flat was really intended to test the Ingliston Consols Extended lode at a depth of 1,500 feet. Since the request was made the main shaft on this mine has been sunk and a lode opened out at the 1,100-feet level. Mr. Roberts is of opinion that deep boring in the north end is not necessary now as the continuation of the lode at depth has been proved.

The original programme has thus been reduced to boring on the south end of Paddy's Flat.

As my instructions did not limit me to choosing sites on Paddy's Flat only, inquiries were made locally as to whether there were more suitable sites. I found, with two exceptions, that all the old large gold-producing mines had ceased operations and are now flooded and, more or less, abandoned, and that mining at Meekatharra was at a very low ebb, the Ingliston Consols and Fenian being the only two of the important mines of the early days which showed any real activity.

Fortunately a very complete survey of the district and mines of Meekatharra had been made by Mr. E. de C. Clarke in 1916, and with a few exceptions little development had since taken place, so that his report stands good for the present. I have discussed the present idea of boring with him and he agrees with the members of the Roads Board that the south end of Paddy's Flat would be the most likely locality to yield satisfactory results, particularly on the Ingliston Consols-Fenian-Marmont line of lode and particularly in that section lying between the Marmont and Gwalia Extended.

The geology and description of the "Consols" group is set out in detail in Clarke's Bulletin 68 (pages 155-159) and are briefly as follows:—

"**Geology.**—The rocks consist of two groups derived either from dolerites or peridotites and two intrusives of quartz porphyry and basaltic dolerite. High-grade mines have been found in both groups, but only in the vicinity of the quartz porphyry, with which they apparently have a close connection. The richest of the mines are found in the first group, and comprise the Fenian, Ingliston Extended, and Marmont. With regard to their position in respect to the quartz porphyry, we find the lodes lie either to the east or west of the dykes and in one particular case, the Ingliston Consols group, the dyke is found crossing from the hanging to the footwall of the lode. The broken nature of the lode in this mine may probably account for greater circulation of gold-bearing solutions and corresponding higher gold contents in this section."

South of the Marmont only limited prospecting has been carred out. On the Gwalia Extended the lode was located and worked to a depth of 200 feet, some 9,600 ozs. being recovered from 4,300 tons of ore crushed. Most of the gold, I am informed, was in the rich gold leaders which cut through the lode material in all directions. The same lode has apparently been located in the Micky Doolan and Marmont Extended leases and, though there is some doubt as to whether it is a continuation of the Fenian Consols line, it will probably be found to be a continuation.

Generally speaking the richer portions of the lodes in the Consols area appear to occur in "shoots" which dip to the north. A notable instance of this may be seen in the Fenian mine, where practically all the payable ore has pitched into the Ingliston Consols below the 1,100-feet level.

Having this in mind I have endeavoured to place the bore holes a little to the north of where gold has been found near the surface. With regard to the depth at which the lodes would best be cut in the bores, it is recognised that in the upper levels of the adjoining mines the regular ore body was not found until a depth of from 150 to 200 feet vertical was reached.

I suggest, therefore, and have acted accordingly, that the bores be placed and declined so as to strike the ore body at about 350 feet, allowing for the dip of the lode to the east to be normal, viz., 30 feet in each 100 feet vertical.

The three sites chosen are on Crown lands and I would suggest that these areas be reserved until such time as the boring is completed.

10.—INTERIM REPORT ON THE GEOLOGY AND ORE DEPOSITS OF KALGOORLIE.

(F. R. Feldtmann, Field Geologist.)

INTRODUCTION.

The detailed underground survey of the Golden Mile was commenced at the beginning of February. Early in the same month I was joined by Mr. Finucane, Assistant Geologist, who assisted in carrying out the survey during the remainder of the year.

Owing to the disadvantages and difficulties of preparation of a surface map of the area it was decided to adopt a plan on a horizontal plane 1,100 feet above sea level, this plane taking in all the mines. The preparation of such a plan has one disadvantage, namely, that where the plane adopted does not correspond with the levels of the mine workings, the various geological features have to be projected.

The programme adopted also included the preparation of a series of cross sections, and also of longitudinal sections of the principal lodes, the latter showing, where possible, the distribution of the rich shoots and payable and unpayable ore.

The determination of the positions of rock boundaries, lodes and other geological features involves the examination not only of accessible mine workings, but also of such additional data as are available in bore cores and mine plans and records. During the year, in addition to the survey of underground workings, 2,720 feet of bore cores were examined. The preparation of helios of mine plans and sections and the examination of assay records also occupied a portion of Mr. Finucane's time.

The number of original rocks and the intense alteration that they have undergone over wide areas, and the complexity of the structural features, have necessitated a great deal of careful preliminary investigation into the relationships of the rocks, the degrees and types of alteration and their bearing on ore deposition, and the number and relative ages of structural features such as faulting and shearing and their effects on the lodes. Much careful examination was necessary to enable one to distinguish between the altered forms of even such originally widely different rocks as the quartz dolerite and albite porphyrite.

During the year the survey was mainly confined to the western portion of the belt, particularly the Ivanhoe and Golden Horsehoe Mines, but the general survey was interrupted by a detailed examination of the lower levels of the South Kalgurli mine, consequent on a request from the manager. This mine forms the subject of a separate report.

In addition to the examination of the upper levels of the Ivanhoe and Golden Horseshoe mines it was considered advisable to examine the lowest accessible levels of the Ivanhoe mine, and, in view of the uncertainty regarding the Golden Horseshoe, to take advantage of such times as it was possible to descend that mine to examine those accessible levels that it was thought would afford most information.

Thanks are due to the managers and staffs of the mines visited for the courtesy shown in facilitating the work in every way, and particularly for the valuable information supplied.

GENERAL GEOLOGY.

The rocks of the Kalgoorlie auriferous area, in particular those of the North End, were described in detail in Geological Survey Bulletin 69, and it is unnecessary to give more than a brief description except as regards those features that occur only, or to a far greater extent, in the Golden Mile. As, however, no entirely satisfactory brief description has been published of the geology and geological history of the auriferous area, a brief account of the sequence of events is included in this report.

The rocks of the auriferous area are separable, in order of age, into three main divisions—the Older Greenstones, the Younger Greenstones, and the Albite Porphyrite Dykes. A broad belt of hornblende porphyrite, from which the albite porphyrite dykes are probably apophyses, occupies a large part of the valley west of the towns of Kalgoorlie and Boulder, but as, so far as known, this rock does not occur within the mining area, it is not described here. For the same reason the sediments forming a wide belt some distance east of the mining area are not described in this report.

The Older Greenstones are as a rule much finer in grain than the Younger Greenstones, though medium-grained facies occur, and were most probably originally basaltic dolerites extruded as lava flows. Possibly beds of volcanic ashes alternated with the flows in places, but this has not been definitely established.

The Younger Greenstones intruded the older series as large dykes, of which the most important, economically, occupies the greater part of the main ridge east of Kalgoorlie and Boulder, along which the main portion of the mining area is situated. The northern and southern limits of this dyke have not been determined. At the North End its maximum width is rather more than a mile, but its average width in that portion of the field is a little under three-quarters of a mile. South of Mount Gleddon it narrows considerably, but widens out again north of the Golden Mile. On the Golden Mile its maximum width is likewise rather more than a mile.

Like the older series, the Younger Greenstones vary in texture, but are usually of medium coarse grain. They have a much wider range in composition than the older series, ranging from sub-basic to ultrabasic. The original rocks consisted of quartz dolerites and quartz gabbros, dolerites, hornblende dolerites, pyroxenites, and peridotites. The greatest variation is at the North End, where representatives of all these facies, with the exception of the hornblende dolerites, occur. Peridotite derivatives occupy a fairly wide area west of Hannans Lake. On the Golden Mile the original rocks were more constant in composition, and consisted almost wholly of quartz dolerite. There was, however, some variation in the relative proportions of the felspars and pyroxenes of the original rocks.

Prior to the introduction of the gold-bearing solutions and possibly prior to the intrusion of the rocks by the albite porphyrites, both Older and Younger Greenstones were uralitised by pressure, *i.e.,* the pyroxenes of the original rocks were altered to hornblende, the dolerites being converted into epidiorites and amphibolites and the proxenites into hornblendites. A varying degree of schistosity was possibly also developed at this period, the planes of schistosity dipping at a slightly flatter angle than those formed by subsequent shearing.

The albite porphyrites intruded both Older and Younger Greenstones as dykes, prior to gold deposition. These rocks were composed mainly of albite felspar with a little quartz. Phenocrystal and non-phenocrystal varieties occur. In a few dykes, mainly at the North End, phenocrysts of hornblende occur in addition to felspar, linking these rocks with the hornblende-quartz porphyrite of the valley west of Kalgoorlie and Boulder. The dykes have a wide range in size. Among the most important are one, a mile and a half in length and nearly 600 feet in maximum width, which runs through the middle of the Younger Greenstone dyke in the northern portion of the North End, ending a little north of Williamstown; one running through the Hainault, South Kalgurli, and Associated mines; and a third, running through the Great Boulder, and passing into the Ivanhoe mine at depth. This last dyke has a maximum width of about 300 feet. It probably runs south to join a large mass of porphyrite south of the Golden Mile. The strike of these dykes ranges from northwest to northnorthwest, and the dip is usually southwest at steep angles. The general effect of these dykes on the lodes is to cause impoverishment where the lodes are within the dykes, though rich patches have occurred at the junctions of the dykes and the greenstones.

Subsequently to the intrusion of the albite porphyrites pressure from a southwesterly direction resulted in the formation of a series of overthrust faults, striking approximately northwest and dipping southwest at flat but varying angles. These faults appear to be few in number and to be confined to the eastern margin of the main quartz dolerite dyke. They affected the margin of the dyke at its junction with the older rocks now represented by calc schists, and also the adjacent albite porphyrite dykes.

The faulting of the eastern margin of the main quartz dolerite dyke was followed by intense and widespread shearing, due to pressure from a south-southeasterly direction, which probably extended over a long period with intervals of relaxation. The pressure resulted in the formation of a number of main shear zones, mostly striking northnorthwest, but in places northwest, and dipping southwesterly at steep but varying angles. The movement appears to have been nearly horizontal, the rock on the hanging-wall side of the shear zones being thrust in a northwesterly direction relatively to that on the footwall side. In places there was a slight upward component of the movement.

Although the shearing mainly preceded the introduction of the mineralising solutions, it overlapped mineralisation and the pressure found relief along different lines at different times, the shear zones and planes formed at one period not necessarily coinciding with those of another, though lying in the same general zones of weakness.

At one period not long preceding that of ore deposition a series of steeply dipping fissures at right angles to the main shear zones was formed, mainly in the western half of the Younger Greenstone dyke at the North End. At another period, less deep-seated pressure from the north alternated with that from the south and resulted in the formation, at the North End, of a series of shallow-dipping overthrust faults striking nearly due east. The fissures of both series were subsequently filled with auriferous vein quartz.

Widespread vein-alteration of the rocks by mineralising solutions succeeded the shearing, although, as stated, the two apparently overlapped. The mineralising solutions most probably arose from the magma from which the porphyrites were previously derived. The most widespread effect was carbonation over extensive areas, but the degree of alteration varied, becoming progressively less as the distance from the lines of weakness along which the solutions travelled increased.

The carbonation affected the greater part of the Younger Greenstone dyke in the vicinity of the Golden Mile, a comparatively narrow strip on the western side remaining unaltered, as well as a few small areas near the middle of the dyke. One such area of unaltered amphibolite, about 160 feet in width, is exposed in the main west crosscut at the 1,800ft. level of the South Kalgurli mine, between the Lake View East and Lake View lodes. The central portion of the dyke, between the Golden Mile and the North End was altered though not over as great a width or to as great a degree as the Golden Mile. The Older Greenstones east of the main quartz dolerite dyke were also highly altered, the alteration being widest and most complete east and immediately north of the Golden Mile.

The widespread alteration, by carbonating solutions, of the epidorites and amphibolites of both series gave rise to chlorite-carbonate rocks (greenstones) somewhat similar in appearance to the original rocks, but usually with the composing minerals less distinguishable in the hand specimen. At the North End, the ultrabasic hornblendites and serpentines were altered to talc-chlorite-ankerite and talc-mesitite rocks. Where the alteration was most intense, bleached white, reddish, or gray rocks were formed, composed mainly of carbonates, with some quartz and varying quantities of sericite, and, in the Younger Greenstones, usually containing leucoxene derived from the original ilmenite, but with either magnetite or pyrite formed at the expense of the original ferro-magnesians.

The determination and delineation of the limits of the vein-altered rocks, particularly those of the Younger Greenstones, is of the highest importance, as it may be laid down as a general rule that the payable lodes are confined to the vein-altered rocks and do not occur in the epidiorites and amphibolites. On the Golden Mile, the western limit of the quartz dolerite greenstone is a short distance west of the western boundaries of the main Ivanhoe and Golden Horseshoe leases at the surface, and has a slight westerly dip.

Among the Older Greenstones the most highly altered forms are the rocks to which MacLaren has applied the term "calc-schist," although in places the structure is sheeted and jointed rather than schistose. These rocks are characterised by their very fine grain and even texture, palish-gray colour, and fairly smooth fracture, and, where less sheared, by a blocky structure, due to jointing. In some of the rocks included for convenience under the general field term of calc-schist, chlorite is present in small quantities, linking the rocks with the fine-grained greenstones.

The bleached rocks resulting from the intense alteration of the quartz dolerite epidiorites and amphibolites are more varied in appearance. As with the calc-shists, some of the rocks contain small quantities of chlorite and may be termed semi-bleached greenstones. Two varieties of semi-bleached greenstone were noted, one an almost white rock with pale green flecks of chlorite, visible to the naked eye. the other a pale grayish, more or less massive, slightly pyritic rock in which white lath-shaped forms representing former felspars are visible to the naked eye. Rock of the second type occurs at the 1,700ft. level of the South Kalgurli mine, near the junction of crosscut 94 feet south and south drive 20ft. west.

Another variety of bleached quartz dolerite greenstone is the gray bleached type. These are somewhat bluish gray, fine-grained, usually sheeted or slightly schistose rocks, composed of sericite, carbonates and some quartz, and containing grains of magnetite, in places distinctly noticeable to the naked eye, giving the rock the appearance of a knotted schist.

The typically bleached rocks are almost white or pale reddish in colour, and contain varying quantities of pyrite or magnetite crystals, or both, and in places arsenopyrite, visible to the naked eye. The grain is usually fairly coarse, though fine-grained facies occur, and a schistose structure is present in many places. A fairly wide area of the magnetite-bearing variety was observed in the main west crosscut at the 1,300ft. level of the Golden Horseshoe mine, but the pyritic variety is more common. The coarser varieties of these rocks have, except for the pyrite usually present, some resemblance in the hand specimen to granite for which they were mistaken by some of the earlier observers. The coarser-grained reddish variety is commonly known as "corned beef rock" among the miners.

The distribution of the bleached rocks is irregular. Small areas of these rocks occur along some of the minor lode channels, but the larger areas appear to be mainly confined to the vicinity of the main lode channels. Even here their distribution is very irregular and as a general rule bleaching appears to be most noticeable in the vicinity of the albite porphyrite dykes. In some instances the apparent great width of the bleached zones exposed in the crosscuts is misleading. In the main west crosscuts at the 1,300ft. level of the Golden Horseshoe and the 2,720ft. level of the Ivanhoe, cross vein systems of quartz were noticed associated with the bleached or partly bleached rock, and the apparent width of the bleached zones is really more nearly their length, their width being probably only a few feet on either side of the cross veins. In the western portion of the North End, bleaching is almost entirely confined to a few inches on either side of cross quartz veins.

The carbonation and sericitisation are not confined to the greenstones. The albite porphyrite dykes have also been carbonated and sericitised in places at their junctions with the greenstones and in the vicinity of the lodes. The resulting rock is difficult to distinguish, in some places indistinguishable, from the bleached or aphanitic greenstones. In some of the dykes, however, the presence of small angular green flakes of chloritic and, in places, probably fuchsitic material serves to distinguish them from the altered greenstones. The origin of the green flakes is somewhat doubtful. Three alternatives exist, namely, either that they are xenoliths, representing fragments of greenstone caught up in the dykes during their intrusion; secondly, that they represent fragments of greenstone torn into the dykes by shearing; and thirdly, that they represent former phenocrysts of hornblende in the dykes themselves. Against the first and second alternatives are the facts that they occur in so many of the dykes, both at the North End and the Golden Mile; that they are found in some of the larger dykes at some distance from the greenstones; that their range in size is not great; and that their maximum length is probably less than an inch and the average considerably less than half an inch. Against the third alternative is the fact that no hornblende has as yet been detected in the less altered dykes of the Golden Mile, although it occurs as phenocrysts in some dykes at the North End. The balance of evidence appears to favour the third alternative.*

There is reason for supposing that carbonation extended over a period of time considerably greater than the relatively short period of ore deposition. The absence of bleaching from some of the highly sheared portions of the lodes, and its presence in places where no defined lodes exist indicates that the channels available for the passage of the bleaching solutions did not coincide with those available for the gold-bearing solutions. In places where both bleaching and lode veins occur together, the lode veins appear to be distinctly younger. It is probable, therefore, that much of the bleaching took place prior to gold-deposition. On the other hand some of the cross quartz veins with which bleaching is also associated appear to be slightly younger than the lodes, suggesting that bleaching took place both before and after gold deposition.

A table showing the original rocks of the Kalgoorlie district and their altered forms is given below. The sediments, the relative chronological position of which is doubtful, are omitted from this table.

* Evidence obtained since the above was written indicates that the green flakes are of two distinct types. Some of the flakes recently observed are much larger than those hitherto discovered and undoubtedly represent former fragments of greenstone. On the other hand, the comparatively even distribution and size, and in some cases the shape, of most of the small flakes indicate their origin from former hornblende phenocrysts.—F.R.F.

TABLE SHOWING THE ORIGINAL ROCKS OF THE KALGOORLIE DISTRICT AND THEIR ALTERED FORMS.

Original rocks.		*Altered forms of rocks.*		
Lavas (Older Greenstones)	Basaltic dolerites	Fine-grained epidiorites and amphibolites	Fine-grained greenstones	Calc-schists
Older intrusives—sub-basic to ultrabasic (Younger Greenstones)	Quartz dolerites and quartz gabbros	Coarse-grained epidiorites and amphibolites, including some actinolite-zoisite amphibolites	Quartz dolerite greenstones	Bleached greenstones.
	Dolerites	Actinolite-zoisite amphibolites	Dolerite greenstones	Bleached dolerite greenstones and possibly some fuchsite-carbonate-quartz rocks
	Hornblende dolerites	Lustre-mottled amphibolites		
	Pyroxenites	Hornblendites	Talc-chlorite-ankerite rocks	Some fuchsite-carbonate-quartz rocks
	Peridotites	Serpentines	Talc-mesitite rocks	Some fuchsite-carbonate quartz rocks and carbonated serpentine of Hannan's Lake
Younger intrusives—intermediate to acid	Hornblende-quartz porphyrites			
	Albite porphyrites or quartz keratophyres		Carbonated sericitised albite porphyrites	

A geological feature common not only at Kalgoorlie but at other centres of the goldfields should be mentioned here, namely, the jaspers and graphitic schists. These rocks occur as bands up to 50 feet in width and, though usually comparatively short in the Kalgoorlie area, may extend for several miles in length. They occur both in the Older and Younger Greenstones and in the albite porphyrites. They consist at the surface of highly siliceous rock with a laminated ribbon-like structure and may be pale yellowish-gray in colour or consist of alternating bands of gray or yellow and dark-brown colour, the latter due to the presence of iron ore. The iron staining is usually most marked near the surface. Some of these rocks become less siliceous a few feet below the surface, appearing as sheeted zones of clayey material.

Below the oxidised zone the more typical of these rocks occur as laminated siliceous bands of dark gray or black colour, due to the presence of graphite, or, in the albite porphyrites, as bands of black graphitic schist. Iron sulphides are commonly present, usually as grains of pyrite, but in places as nodules, of elliptical shape and about the size of small marbles, of marcasite coated by pyrite. Small granular masses of pyrrhotite also occur in the graphitic schists in the albite porphyrites. Bands of graphitic schist up to 50 feet in width occur in the Golden Mile but some are only from a mere film to a few inches in width though of considerable length as compared with their width.

A sedimentary origin has been assigned to these rocks by some of the earlier observers, but from their common occurrence at Kalgoorlie and other centres in igneous rocks of various types at a very considerable distance from any known sediments, and their common association at Kalgoorlie with albite porphyrite dykes, there is little doubt that they represent highly sheared and sheeted zones in which graphite and, in places, cryptocrystalline quartz were subsequently deposited. The manner in which the graphite was deposited is still in doubt. It undoubtedly arose from an igneous magma, most probably that from which the porphyrites were derived, and probably in the form of a hydrocarbon, but whether in solution or as a gaseous emanation has not yet been determined, nor whether it and the associated silica were deposited at the same time.

The age of the graphite relative to bleaching and ore deposition has likewise not been determined, but I am inclined to regard it as older than either. The introduction of gold and tellurium was probably a short and special phase towards the end of the period of vein-alteration, and it is probable that the formation of tellurides was restricted to a particular portion of the period of ore deposition, as although much of the gold is associated with pyrite some of the richest telluride ore occurs in portions of the lode where relatively little pyrite is present. Moreover, the fact that although in places the rich ore consists of highly siliceous lode matter, in others it is apparently no more siliceous than the enclosing rock, and also that in some of the most siliceous lode matter the gold content is exceeding low, suggests that the gold and much of the silica were deposited independently, although small quartz veins were undoubtedly formed during the deposition of gold and tellurides.

Ore deposition was followed by a recurrence of pressure during which further faulting took place at two periods, the first in which pressure from an east-northeasterly direction predominated, resulting in the formation of one main and possibly several minor faults dipping in that direction at about 45 degrees. The main fault is exposed at the 1,200-feet level of the Ivanhoe mine.

During the second period pressure from a south-westerly direction predominated and found relief in the formation of a much greater number of faults dipping southwest at angles ranging mostly between 30° and 50°. These faults appear to be confined to the western portion of the belt, namely, to the Ivanhoe, Horseshoe, and Great Boulder mines, where they have affected the lodes to a considerable extent.

Mention should also be made of a series of faults, striking eastnortheast, which affect the Golden Zone lode at the North End. These appear to be of purely local occurrence and to be due to a thrust movement arising at a shallow depth, as the faults appear to die out at a depth of 500 feet, although the horizontal displacement at the surface may be as much as 120 feet. Beyond the fact that they are later than gold deposition, the relative age of these faults is unknown.

Probably one of the last earth movements of importance was that which resulted in the formation of a number of shear zones and planes striking roughly parallel to the lodes but with a steeper, almost vertical dip, some of the planes having a slight but distinct easterly dip. This shearing caused a reopening of the lodes in places and is of some importance as affecting the stoping of the ore bodies. The post-gold shear zones of the Hannans Reward-Mt. Charlotte leases at the North End probably belong to this series.

The probable sequence of events in the geological history of the Kalgoorlie area is shown in the following table:—

TABLE SHOWING PROBABLE SEQUENCE OF EVENTS IN THE GEOLOGICAL HISTORY OF KALGOORLIE.

Introduction of rocks and mineralising solution.	*Earth movements.*
Extrusion of basic lavas (Older Greenstones)	
Intrusion of lavas by Younger Greenstone dykes	
	Pressure converting most of greenstones into epidiorites and imposing a schistose structure in places
Intrusion of greenstones by large dyke of hornblende porphyrite and smaller dykes of albite porphyrite	
	Relatively shallow pressure from southwest, causing overthrust faulting in places along margin of main Younger Greenstone dyke
	Deep-seated pressure from southsoutheast with shearing over fairly wide areas and formation of shear zones
Introduction of hydrocarbons with formation of graphitic schists along main shear zones	
Introduction of carbonating solutions containing sulphur and potash, extending over lengthy period and resulting in formation of calc-schists, greenstones and bleached greenstones followed by solutions containing gold, accompanied by sulphur and potash and later by tellurium	Recurrence of pressure with further shearing and formation of steep cross fissures at North End, followed by overthrust faulting from north affecting North End
	Less deep seated pressure accompanied by overthrust faulting, predominating at first from eastnortheast, followed by more intense pressure from southwest with formation of Boulder-Ivanhoe-Horseshoe series of faults
	Recurrence of deep-seated pressure probably mainly from south with formation of later shear zones and reopening of fissures along lodes

THE FAULTS.

The pre-gold faults.—Economically, the most important of the pre-gold faults affecting the eastern margin of the quartz dolerite dyke at its junction with the calc-schists, and the adjacent albite porphyrite dykes is the large fault which formed the hanging wall of the Brownhill-Oroya shoot. This shoot has not yet been examined in detail.

Another fault of this series has affected the calc-schist boundary and the albite porphrite dyke immediately west of the boundary, at the 1,800-feet level of the South Kalgurli mine, and is responsible for the flat dip of the East lode between the 1,800-feet and 1,920-feet levels. This fault consists of several planes forming a fault zone, instead of a single well-defined plane. Its dip varies considerably, but probably averages a little more than 40 degrees. It may be identical with the fault below which the calc-schist boundary dips sharply westward between the 1,944ft. and 2,095ft. levels of the Associated mine. Another less defined fault or series of fault planes, some distance west of the last, appears to have been responsible for bringing the east and west branches of the Australia lode together near the 1,700-feet level of the South Kalgurli mine, with the consequent formation of the rich shoot above that level. The Lake View East lode has been deflected along a similar fault still farther west, at the 1,800-feet level of the same mine. The dip of these faults is very variable and probably ranges from about 25 to 55 degrees.

The pre-gold faults have been responsible for the formation of ore shoots in different ways. In the first case, as shown by MacLaren, by overthrust faulting a relatively impermeable roof was opposed to the upward passage of the ore-bearing solutions, causing congestion and consequent deposition of gold and tellurides in mass. Of this the Brownhill-Oroya shoot is the most notable example.

The shoot formed at the junction of the two branches of the Australia lode above the 1,800-feet level of the South Kalgurli mine is an example of the second case. Here the solutions which travelled up the western branch of the lode shear were deflected along the fault planes to join those of the eastern branch, and gold and tellurides were deposited in mass in the sheared and shattered rock above the fault.

The adverse effect of the pre-gold faults from a mining point of view, *i.e.*, as viewed from the surface downwards, is that by overthrust faulting the economically less favourable calc-schist extends more sharply westward below the faults and the area of probable productive rock in a mine is thereby lessened at the lower levels.

The post-gold faults.—As stated, there are at least two series of these faults, of which the older is of much less importance, being represented, so far as is known, by only one important fault, namely, the easterly-dipping fault exposed at the 1,200-feet level of the Ivanhoe mine, and possibly by several minor faults. The second series is represented by a number of faults in the Ivanhoe, Golden Horseshoe, and Great Boulder mines. These faults usually strike between northwest and northnorthwest and dip southwest at flat angles, but both strike and dip are variable, neither being constant in the one fault. The extreme range in dip is probably from 20 to 55 degrees, the average being probably about 40 degrees. Although in the very early days of the field these faults were probably not thoroughly understood, at a comparatively early date excellent work was done in the attempt to map these faults both in plan and section. Many of the faults, however, have only been exposed in a few places, and some of those places where the faults had been met were inaccessible when their mapping was attempted and great difficulty was experienced in correlating them in plan and section.

Approximately fifteen of these faults are shown on the Main Shaft section of the Ivanhoe mine and more than twenty on that of the Golden Horseshoe.

The detailed examination of the 106-feet and 189-feet levels of the Ivanhoe mine has shown that the faults are by no means as simple as was at first supposed and indicates that some, at least, occur as systems consisting in places of two or more main faults, which may in turn consist in places of several planes joined by diagonal planes.

Owing to their complexity and the fact that the strike and dip are not constant great difficulty was experienced in tracing the faults from place to place. Moreover a fault which in one crosscut is well defined and consists of a single plane marked by several inches of crush clay (flucan), in the next may consist of a number of planes a few feet apart, which, owing to the general shearing the rocks have undergone, are not easily detected except where exposed by driving or stoping. The displacement of the lodes along the different faults varies considerably. Along most it appears to be small, but on the No. 1 slide (fault) in the Golden Horseshoe the displacement of the No. 3 lode along the fault plane, according to Mr. V. H. R. Murray, underground manager to the company, is nearly 90 feet. In the Ivanhoe mine the New lode has been thrust nearly 40 feet along the plane of No. 1 slide in Section 8, and in a rise from the face of the south drive on the New lode in Section 4 the displacement of the lode along the fault plane is 32½ feet. This last is a beautiful example of a clean-cut fault, particularly as the lode is narrow and well defined and is vertical where cut by the fault. The distance mentioned was measured along the plane between the vertical portions of the west wall of the lode above and below the fault, but the lode below the fault has been dragged along the plane for a distance of 9 feet 8 inches.

Where a strong fault consists of a single well-defined plane the displacement is usually clearly defined, but where it consists of a number of planes with movement along each the faulting may not be so clear, especially where the lode has been dragged along the planes, and the lode may only appear to be somewhat broken and to have an unusually flat dip.

The main faults occurring at the 106-feet and 189-feet levels of the Ivanhoe mine—as named on that mine—from west to east are: "A" slide, a branch of No. 1 slide (in the northern portion of the mine), No. 1 slide, No. 2 slide, and No. 3 slide. In addition, a small fault, not shown on the mine plans, throws the West lode three or four feet at the 106-feet level, at a point about 250 feet southwest of "A" slide.

The "A" slide-No. 1 slide groups of faults appear to be branches of one system, the so-called "Branch of No. 1 slide" lying between the two and apparently splitting, going south, in Section 5 at the 106-feet level and Section 6 at the 189-feet level, into two branches running towards "A" slide and No. 1 slide respectively. The more westerly branch is apparently joined by a branch of "A" slide running southeast towards No. 1 slide and continues to the south as a group of planes, roughly parallel to and from about 30 to 50 feet west of the main plane of No. 1 slide, but eventually joining it about coordinate 1,400 feet south. The main plane of No. 1 slide continues south in the Golden Horseshoe mine under the same name, passing a few feet west of the Main and No. 2 shafts at the 100-feet level, but an easterly branch of No. 1 slide, apparently diverging from the main fault in Section 12 of the Ivanhoe mine, continues south in the Horseshoe as No. 2 slide, which lies approximately 60 feet east of the main shaft and 110 feet east of No. 2 shaft at the 100-feet level.

The western branch of "A" slide has not been detected in the Horseshoe mine but may be represented at the 200-feet level by a diagonal plane noticed near the face of the main west crosscut. From the strike and shallow dip of this plane, however, it more likely represents the westernmost fault of the Ivanhoe mine and it is more probable that the western branch of "A" slide joins No. 1 slide north of the crosscut.

Both "A" slide and No. 1 slide are well defined in the main east crosscut at the 106-feet level of the Ivanhoe mine, where they are situated respectively about 80 feet and 240 feet east of the drive from the plat, No. 1 slide being immediately west of Wigg shaft. In this crosscut each consists of a main well-defined plane marked by more than a foot of crushed material, but though No. 1 slide is well defined in the

New lode drive east of Drysdale shaft, neither fault is so well defined south of the main east crosscut, and unfortunately portions of the workings at the 106-feet level that might have thrown further light on the positions and behaviour of these faults at several points were inaccessible.

"A" slide apparently displaces the Middle lode between 30 and 40 feet below the 106-feet level in Section 8.

No. 2 slide and No. 3 slide are probably branches of another system. At the 106-feet level of the Ivanhoe mine No. 2 slide can be definitely located only in the east crosscut off Drysdale shaft, about 80 feet west of the East lode, and for a short distance in the drive on that lode from about 110 feet south of the crosscut. A fault observed in east crosscut 1,400 feet south, on the Great Boulder boundary, is probably the southern continuation of this fault.

At the 189-feet level No. 2 slide has been cut in the east crosscut from Drysdale shaft at about 185 feet from the shaft, and also in the drive on the East lode from about 90 to 140 feet north of the main east crosscut. What appears to be its southerly continuation is situated about 15 feet west of the drive on the Boulder lode in the east crosscut in Section 14. This fault continues south in the Golden Horseshoe as No. 3 slide, which lies a short distance west of No. 4 lode in the northern portion of the mine at the 100-feet level.

The positions of the Ivanhoe No. 3 slide shown on the plans of the 106-feet and 189-feet levels do not agree. The position given on the northern portion of the plan of the 189-feet level is approximately correct, but at the 106-feet level the fault is probably entirely in the Great Boulder mine. In the main east crosscut at the 189-feet level it appears to lie a few feet east of No. 2 slide, which, however, could not be definitely identified, and it may join No. 2 slide to the south, but more probably diverges again to enter the Great Boulder mine. It is probably identical with the Horseshoe No. 4 slide, which is situated a few feet west of No. 4 lode north of the main east crosscut at the 200-feet level.

THE JASPERS AND GRAPHITIC SCHISTS.

As already indicated, the deep-seated pressure which extended over a long period found relief at different points in the various zones of weakness at different times, the shear lines forming the most accessible paths for mineralising solutions at one period not necessarily coinciding with those of another period. The formation of the graphitic schists, bleached zones, and lodes took place along such lines as offered the easiest paths at the particular period.

The best defined and longest line of jasper in the Kalgoorlie area occurs in the Younger Greenstones at the North End. The southern end of this line is a short distance south of the Bulong Road, whence it runs northnorthwest, gradually converging towards the eastern margin of the Younger Greenstone dyke, which it joins near the Broad Arrow Road immediately north of the old Sir John G.M.L. 4468E. It continues northward well beyond the limits of the area mapped. At depth this band is highly siliceous and though graphitic is less so than some to the south. Between the Bulong Road and Williamstown are several lenses of Jasper, passing into graphitic bands at depth, but these are relatively short and are very erratic in strike, ranging from northnorthwest to northeast.

The jaspers and graphitic schists of the Golden Mile are mostly comparatively short, but have a great range in width. With the exception of those occurring along some of the older fault planes, their association with albite porphyrite dykes, in particular the Great Boulder dyke, is more marked than at the North End. The most important zone of jaspers and graphitic schists in the Golden Mile is associated with the Great Boulder dyke, most of the lenses occurring within the dyke. Individual lenses range in width from a mere film to at least 50 feet, a lens apparently 50 feet wide having been cut in a borehole put in east from the main north drive at the 2,720-feet level of the Ivanhoe mine into the Great Boulder. The maximum length of the larger lenses has not been determined, but many of the thinner lenses are several hundred feet in length. The lenses of graphitic schists occurring within the albite poryphrite dyke are not confined to the margins of the dyke but are distributed throughout the dyke. In a bore depressed at an angle of 69 degrees, from the south drive on the Ivanhoe East lode in Section 14 of that mine, 13 different lenses of graphitic schist were cut within and on the margins of the dyke, ranging from a few inches to about nine feet (calculated width) in width.

The effect of the graphitic schists on gold deposition where they are associated with the lodes has not definitely been determined. They have been stated to cause impoverishment, but this may have been due to other causes. At the North End rich patches have occurred at their junctions with cross quartz veins, and a small rich shoot on the North Collier mine was associated with a graphitic seam.

THE POST-GOLD SHEAR ZONES.

The shear zones formed subsequently to ore deposition are usually noticeable as a number of planes a short distance apart, nearly vertical but as a rule with a slight easterly dip. Their average strike probably approaches very nearly that of the lodes, but in places they cross the lodes at a very acute angle, as in the south drive on the East lode at the 106-feet level of the Ivanhoe mine, in Section 13. At winze 1,185 feet south, in this drive, the east wall of the stope above the level is on one of these planes, which may have been mistaken for the wall of the lode. Being usually more marked than the planes of the lode shears and cutting them at acute angles, both vertically and horizontally, these planes are apt to interfere with stoping operations.

A feature ascribable to this later shearing is the narrow fissures or shear planes that in many places mark the middle of the lode channels. Usually after occupying a position near the middle of the lode for some distance they run to one or other of the walls, but in some cases they follow the middle of the lode for a considerable distance and have been found useful as a guide in driving where the lode is otherwise ill-defined.

THE LODES.

Distribution.—The lodes of the Golden Mile may be separated into two main groups, an eastern and a western. Of these the eastern group is distributed over a wider area. In the upper levels of the mines the two groups are separated by the Great Boulder albite porphyrite dyke.

The eastern group includes the lodes of the Kalgurli, South Kalgurli, Associated, Great Boulder Perseverance, and Lake View Consols mines; the western those of the Great Boulder, Ivanhoe, Golden Horseshoe, Chaffers and Hannans Star mines.

With the exception of the lower levels of the South Kalgurli mine, the detailed survey has so far been confined to the western group of mines.

In the South Kalgurli mine the principal lodes from east to west are the Australia lode, the Lake View lode, and the Perseverance lode. Of less importance are a lode about 85 feet east of the Australia lode at the 1,800-feet level; a lode in the Kalgurli mine about 180 feet east of the last and entirely in calc-schist at the lower levels; the Lake View East lode between the Australia and Lake View lodes; and the El Oro lode between the Lake View and Perseverance lodes.

Mention should also be made of several cross lodes striking roughly between west and westnorthwest. These include the Cross lode of the South Kalgurli mine and Tetley's lode and Tetley's No. 2 Cross lode of the Associated mine.

The principal lodes of the western group are the Boulder lode, including the Horseshoe No. 4 lode, and the Ivanhoe East lode (Horseshoe No. 3 lode). Of less importance are the Ivanhoe New lode, Ivanhoe Middle lode (Horseshoe No. 2 lode), Patterson lode, and the Ivanhoe West lode (Horseshoe No. 1 lode). These less important lodes are all situated west of the two principal lodes.

So far as examined, the lodes of the eastern group, certainly the eastern members of that group, appear to be more irregular and lenticular in habit than the two main lodes of the western group, and to have a lower gold content, though very rich shoots have occurred in them.

It is noticeable that whereas, as a general rule, the more important and longest lines of lode strike approximately northnorthwest, the less important lodes strike more nearly northwest or even, in the case of the cross lodes, westnorthwest, and converge towards and usually join the main lodes, going south. Exceptions to this are the Horseshoe No. 2 and No. 3 lodes, the former striking approximately northnorthwest, the latter bending in a southeasterly direction towards the No. 4 lode in the northern portion of the mine.

The eastern members of both groups of lodes are adversely affected at depth, but through different causes.

In the eastern area, the calc-schist, in which the lodes become less defined and generally much poorer, dips at a flatter angle than the lodes, the dip being further flattened where the margin is affected by the pre-gold flat faults, and the probable productive area of the mines is gradually lessened. Owing to the slightly more northwesterly strike of the calc-schist the southern portions of the mines are affected at a greater depth than the northern. Although at the surface the calc-schist boundary is less than half way across the Oroya North block and just outside the Australia East lease, the Kalgurli mine is entirely in calc-schist at the 1,800-feet level, and the Australia North lease of the Associated mine is similarly affected a little above the 2,095-feet level. The calc-schist enters the South Kalgurli mine, opposite the Main shaft, about the 1,700-feet level and enters the Main shaft at a depth of about 1,950 feet. The area of favourable rock in this mine is further lessened by the presence of a large albite porphyrite dyke on the hanging-wall of the calc-schist. As, however, no flat faults were detected east of the calc-schist boundary in the crosscut connecting with the Kalgurli mine at the 1,800-feet level, the calc-schist and albite porphyrite dyke may not affect the Australia lode in the South Kalgurli mine for a considerable depth below the present workings.

In the western group the adverse influence is the great albite porphyrite dyke of the Boulder mine. Possibly in part owing to the greater resistance of these rocks to shearing rendering the lode shears in them narrower and less defined, in part owing to the lack of iron-bearing minerals to act as precipitants, the lodes in the albite porphyrite dykes are generally unpayable.

The Boulder dyke is of very considerable though variable width. In Section 8 of the Ivanhoe mine it is 250 feet wide in some places, in others probably as much as 300 feet. It narrows, however, to the south and in Section 14 is only about 140 feet wide at a depth of 3,400 feet.

Although dipping at a steep angle, probably averaging about 75 degrees, though in places as high as 85 degrees, the Boulder dyke is flatter than the practically vertical Boulder lode and nearly vertical Ivanhoe East lode, which enter it at depth. As with the calc-schist in the eastern group of mines, the albite porphyrite dyke has a more northwesterly strike than the main lodes of the western group, and in consequence the northern portions of the lodes enter the dyke before the southern. In Section 8 of the Ivanhoe mine the dyke enters the mine at a depth of approximately 2,200 feet and meets the East lode at about 2,300 feet. This, however, is probably the tongue mentioned below. At the 3,620-feet level the dyke is apparently about 90 feet east of the Main shaft, but this level was under water when the mine was examined. Judging by its position in the bores put in from the 3,620-feet level the dyke meets the projected line of the Main shaft at 3,880 feet. The dip appears to be flattening at depth, although this may be only local.

The dyke has previously been regarded as simple in form but the detailed examination of the lower levels of the Ivanhoe mine shows that the dyke in the southern portion of the mine does not occupy the full width assigned to it on the mine plans, and that part of the supposed main body is a short tongue about 300 feet in length which runs south from the western side of the dyke and is separated from the main body by a wedge of bleached greenstone. The tongue appears to leave the main dyke about 670 feet south of the north boundary of the lease, at the 2,720-feet level, the line of junction pitching south. The East lode passes through the gap between the tongue and the main dyke at the 2,720, 2,870 and 3,020-feet levels, though the great part of the lode is in the porphyrite for about 200 feet south of the junction. From a point about 120 feet south of the main east crosscut at the 2,720-feet level, the East lode is entirely in quartz dolerite greenstone, bleached or partly bleached for some distance south of the junction.

Instead of continuing on its normal dip and passing through the albite porphyrite dyke at depth as had been hoped, the Ivanhoe East lode in the Main shaft section, as shown by the bores from the bottom levels, is still mainly within the hanging-wall half of the dyke at the greatest depth penetrated—approximately 4,080 feet—and is unpayable, though an occasional fairly high assay was recorded. It appears, moreover, to have split going down.

The probability is that the lode does eventually pass through the dyke, though at a much greater depth than its dip above the dyke indicated.

Owing to the inaccessibility of the lower levels I was unable to examine the few places in the north-east corner of the main lease where the dyke has been exposed in the Golden Horseshoe. It certainly does not cross the projected line of the Main shaft until at a much greater depth than in the Ivanhoe mine.

Mineral Composition and Structure.—The lodes vary widely in appearance, structure, and mineral composition, and the one lode may vary considerably from place to place. A lode may consist of highly siliceous and highly pyritic rock of a palish grey colour; of highly siliceous rock with but little pyrite; of highly sericitic and usually pyritic silvery-grey schist; of rock of the grey bleached type; of, in some parts of the subsidiary lodes, bleached greenstone of the white or reddish type; or of sheared and slightly schistose greenstone differing in no way from that of the more sheared portions of the country rock, but in places carrying veinlets of carbonate. Another variety of highly altered greenstone associated with the lodes is that to which Larcombe has applied the term "aphanite." The typical aphanite is a fine-grained, even-textured, usually more or less schistose rock of a grey colour mottled with paler yellowish areas. It consists mainly of carbonates and sericite with some quartz. Microscopically, its most characteristic feature is its lack of structure. In places it forms the rock enclosing the lodes, in places, where the lodes are poor, actually occupies the lode channel. It is much commoner in the western group than in the eastern.

As a rule the main lodes of both groups are composed of more highly altered rock than the less important lodes such as the Lake View East and El Oro lodes in the eastern group and the Ivanhoe Middle and West lodes in the western group.

Where the lodes are highly siliceous, indicating more complete alteration and replacement of the original rocks, the silica appears to have travelled along the previously existing shear planes from which it spread outwards until all the rock within the zone of most intense shearing was silicified, the silicification more or less obliterating the original shear planes. In places, as at the face of the south drive on the East lode at the 3,020-feet level of the Ivanhoe mine, the lode consists of a band of highly siliceous rock, of which a portion, seldom more than a few inches in width, may have a brecciated structure, enclosed by a varying width of less siliceous, highly schistose sericitic, carbonated, and more or less pyritic rock, with, in places, a few veinlets of quartz. Uusually, where the lodes are wide and highly altered, short veins of quartz, either at right angles or diagonal to the strike of the lode, traverse the lode from wall to wall and are useful as indicationg the width of the lode channel. The wider and more altered portions of the lodes are also marked in places by flat heads or "floors," which may be very numerous and only a few inches apart.

Although a payable gold content occurs in places where the lodes consist of highly altered siliceous rock, this is by no means an invariable rule and in many places the highly siliceous portions of the lodes are unpayable. As already mentioned, it would appear that silification and gold deposition were to a large extent independent of each other and a high degree of silification occurs in places where the lodes are in the generally unproductive albite porphyrite.

The richer ore appears to be usually associated with the highly schistose sericitic and pyritic type of lode. In places the greenish-coloured vanadium mica roscoelite is associated with rich ore.

In places in the eastern group, for example, the rich shoot in the Australia lode at the 1,600-feet level of the South Kalgurli mine, the rich ore appears to consist largely of rock of the grey bleached type containing a relatively small proportion of pyrite, but with irregular lenses and patches of tellurides and lesser quantities of free gold and occasional small veins of quartz and carbonate carrying thread-like veinlets of telluride and small irregular pieces of free gold.

Usually but little gold is present where the lode consists of little altered greenstone.

As is known to most miners, the pyrites associated with payable ore is finely granular and of a warm colour. Lode matter carrying coarse grains or crystals of pyrite is seldom, if ever, payable, nor does the whiter variety appear to be associated with a payable gold content.

Ore shoots.—The part played by the pre-gold faults in the formation of the Brownhill-Oroya shoot and the probability of a similar fault or faults being responsible for the rich shoot above the 1,700-feet level in the South Kalgurlie mine have already been mentioned. Although only a small proportion of the shoots of the Golden Mile have been investigated in detail, it would appear from the available evidence that structural features have been the governing factors in the formation of the shoots. In addition to the examples already mentioned shoots have occured at the junctions of cross lodes and main lodes; of subsidiary lodes and main lodes; and of two branches of the one lode. The formation of ore shoots at such junctions is most probably due to the concentration of greater quantites of the auriferous solutions in those places where a relatively wide area of highly sheared and shattered rock afforded an easy passage, and, in a few cases, a further concentration where relatively unsheared rock prevented the further passage of the solutions. The shear zones available for the passage of the gold-bearing solutions were doubtless irregular in their width and in the degree of shearing the rocks had undergone, and the occurrence of wider areas of sheared and shattered rock probably accounts for the formation of shoots of payable and even rich ore at those places where no junction exists.

11.—THE SOUTH KALGURLI GOLD MINE, BOULDER, EAST COOLGARDIE GOLDFIELD.

(F. R. Feldtmann, Field Geologist.)

INTRODUCTION.

Following a request from the manager of the South Kalgurlie Gold Mine, I was instructed to make an examination of this mine. The objects of the examination were:—

(a) To determine the downward continuation, if any, of the rich shoot worked above the 1,700-feet level.

(b) To determine so far as possible the positions of the rock boundaries, in particular those of the calc-schist and adjoining albite porphyrite dyke.

(c) To review generally the possibilities of the mine at depth with reference to the possible occurrence of other payable shoots.

As my examination only concerned the lower levels of the mine, the detailed survey was restricted to the 1,800-feet and 1,920-feet levels and parts of the 1,600-feet and 1,700-feet levels. Parts of the intervening stopes and several other levels were, however, briefly visited. As it was impossible to survey the stopes in detail, the lodes as shown in the accompanying sections are necessarily somewhat diagrammatic between the levels.

In connection with the examination, Nos. 18 and 19 levels of the Associated Gold Mine were also visited.

LOCATION.

The main lease of the South Kalgurli Consolidated Limited is G.M.L. 1208E, comprising 13 acres and situated east of the Kalgoorlie-Boulder Block road, immediately north of "The Block." It is bounded on the northwest by the Hainault mine, on the northeast by the Kalgurli, on the east by the Associated, on the southeast by the Great Boulder Perseverance, and on the southwest by the Enterprise, formerly the Great Boulder No. 1.

The mine is worked from two vertical shafts—the Main shaft, 1,970 feet in depth, and Morty shaft, nearly 1,100 feet in depth. The collar of Morty shaft is 31 feet below that of the Main shaft.

The mine coordinates are measured from the centre of the Main shaft, the assumed north being on a bearing of N.38°41'W.

GEOLOGY.

The rocks occurring in G.M.L. 1208E include Older Greenstones—most probably derivatives of basaltic dolerite—Younger Greenstones or derivatives of quartz dolerite, and albite porphyrite in the form of dykes intruding the greenstones.

The Older Greenstones.—The Older Greenstones consist of the highly carbonated fine-grained grey rock to which MacLaren has applied the term "calc-schist," and of a slightly darker less altered chloritic rock, intermediate between typical calc-schist and the chloritic rock, to which the term "fine-grained greenstone" was applied in Geological Survey Bulletin No. 69. The chloritic facies occurs in the main east crosscut at the 1,800-feet level where it forms the western margin of the Older Greenstones, immediately east of an albite porphyrite dyke. It passes insensibly into the more normal type. Both rocks may be roughly included in the term "calc-schist."

The calc-schist probably enters the lease from the Kalgurli mine at or a few feet below the 1,700-feet level. It appears to strike approximately parallel to the northeast boundary of the lease, but no definite data on this point are available. It is greatly to be regretted that no records, similar to those now kept, were kept of the changes of rock in a number of bores put out, in the earlier days of the mine, northeast from north drives 38 feet east, 16 feet west, and 123 feet west, at the 1,800-feet level, as these would have afforded valuable information on this point. In the main east crosscut at the 1,800-feet level the calc-schist boundary is 66 feet from the centre of the Main shaft. Here it dips southwest at about 50 degrees, owing to the presence of a fault, but must steepen a short distance below the level. Owing to an unfortunate set of circumstances I was unable to examine the shaft for more than a few feet below the 1,920-feet level, but according to Mr. Mundle, surveyor to the company, the calc-schist enters the shaft about 30 feet below that level. This would give a dip of about 68 degrees, which is probably about its normal dip where unaffected by faults.

The Younger Greenstones.—The Younger Greenstones include quartz dolerite amphibolite, quartz dolerite greenstone, bleached greenstone, and aphanite, as well as the lodes representing extreme forms of vein-alteration. Quartz dolerite amphibolite—the least altered quartz dolerite derivative found in the Kalgoorlie mining area—is uncommon on the Golden Mile, but an area about 160 feet in width was observed in the main west crosscut at the 1,800-feet level, between the Lake View East lode and the albite porphyrite dyke which forms the footwall of the Lake View lode. It represents an area that has escaped the effects of the wide-spread chloritisation and carbonation that accompanied or preceded gold-deposition and by which the quartz dolerite greenstone was formed.

Quartz dolerite greenstone forms the bulk of the country rock of the mine. It is either dark greenish in colour or speckled dark green and white and may be either massive or schistose.

The bleached rocks mark a further degree of alteration in which the chlorite and leucoxene of the greenstones have been wholly or partly replaced by either magnetite or pyrite. In places the replacement is only partial, giving a whitish rock with faint green specks. This may be termed "semi-bleached greenstone," of which typical examples occur in the main west crosscut at the 1,800-feet level.

The typical bleached greenstones are white, pale-grey, or pale reddish or brownish rocks with specks of pyrite or magnetite. In this mine the pyritic variety predominates.

Close examination is sometimes needed to distinguish these rocks in the field from the albite porphyrite, particularly when the latter is sheared and carbonated and sericitised.

Another variety of bleached quartz dolerite greenstone found on this mine, usually in close association with the ore bodies, is the grey bleached type, and probably much of the rock that has on the mine been termed "aphanite" belongs to this group. These are grey rocks, usually sheeted or slightly schistose and showing small black specks of magnetite in the hand specimen. They contain gold in places. Typical specimens were seen in the underhand stope below the main south drive at the 1,600-feet level, between coordinates 250 and 280 feet south.

The rocks termed "aphanite" by Larcombe represent more crushed and highly altered areas, usually in the immediate vicinity of the lodes. They are usually of a palish-grey colour, mottled with paler yellowish areas and are of even, fine-grained texture in the hand specimen. Microscopically their most important feature is their absence of structure. This type is not common on this mine, the only place where it was observed being the more southwesterly portion of crosscut 230 feet south at the 1,920-feet level.

The Albite Porphyrite Dykes.—These dykes are well known and need little description. Typically they consist of pale, almost white, rock, but some are pale yellowish or even strongly pinkish in colour. The unaltered rocks consist of a groundmass composed mainly of felspar with a little quartz, in which are small felspar phenocrysts, usually visible to the naked eye, but in many places these rocks are highly sheared and schistose and contain sericite and carbonate, together with some pyrite, in place of the original felspars. They are then difficult to distinguish from the bleached greenstones. The common occurrence in these dykes, however, of small angular flakes of a pale green mineral often serves to distinguish them from the bleached greenstones.

At least three of these dykes occur at the lower levels of the mine, one lying between the Perseverance and El Oro lodes at the 1,500-feet level; one, about 20 feet wide, forming a fairly constant footwall to the Lake View lode; and one, previously mentioned, from about 60 to 85 feet east of the East branch of the Australia lode, at the 1,800-feet level, and adjoining the hanging-wall of the calc-schist. This dyke is 21 feet wide in the main east crosscut at the 1,800-feet level, but probably reaches a width of 50 feet farther north. At the 1,920-feet level it is probably 80 feet in width near the Main shaft, but its eastern boundary has not been cut at this level.

THE FAULTS.

The faults occurring on the Kalgoorlie Field belong to at least two different series, namely, those formed prior to ore deposition and those formed subsequently to ore deposition. The faults of both series dip west or southwest at angles ranging from about 35 to 55 degrees, but usually between 40 and 45 degrees. One or two examples of a third, easterly-dipping, series are known. A number of the faults younger than the lodes occur on the western side of the "Belt," but none, so far as I know, have been definitely noted on the eastern side. On the other hand several faults have affected the calc-schist boundary prior to ore deposition and I have little doubt that a narrow zone of flat planes seen in the main east crosscut at the 1,800-feet level, immediately west of the calc-schist boundary, and also in north drive 38 feet east, at the same level, represents a fault of this series. The narrow width of the albite porphyrite dyke at this level and the flat dip of the calc-schist boundary are most probably due to overthrust faulting along these planes, as is also the position of the lode followed in north and south drives 38 feet east at the 1,800-feet level. This fault passes through the albite porphyrite dyke between the 1,800-feet and 1,920-feet levels, and at the 1,920-feet level is from about 13 to 21 feet west of the dyke and from about 77 feet to 85 feet west of the Main shaft. The effect of these faults is to bring the calc-schist boundary more sharply to the west below the fault.

Other flat planes, doubtless belonging to the pre-gold period of faulting, were seen in the main west crosscut at the 1,800-feet level, and, as shown in the main cross section, the Lake View East lode has followed a fault of this series at this level. Moreover, the greater distance apart of the two branches of the Australia lode in the southern portion of the mine at the 1,800-feet level, or, more correctly, the junction of the two branches above that level, appears to be due to the West branch having followed one or more planes of this series between the 1,800-feet and 1,700-feet levels. One of these planes can be seen in the stope on the West branch at the 1,700-feet level a short distance south of crosscut 94 feet south. Several flat planes seen in the main west crosscut at the 1,800-feet level, between coordinates 210 and 220 feet west, may be the downward continuation of this fault, which, farther north, may join the fault affecting the Lake View East lode.

THE LODES.

In general the lodes of this side of the "Belt" appear to be more irregular and lenticular in habit than those of the western side and are more difficult to follow over any distance. In places the lodes are highly siliceous, indicating more complete alteration and replacement of the original minerals. In other places the lode-rock is more or less bleached and sericitic and highly sheared. In yet others the rock, though usually highly sheared, appears to be less altered and is little different in the hand specimen from a somewhat crushed greenstone, though the microscope may reveal a considerable degree of alteration. It was noticed that as a rule in this mine the highly siliceous portions of the lodes seldom carry gold in payable quantities, also that some of the richest portions of the shoots, carrying stringers and patches of tellurides and, to a less extent, free gold, did not otherwise appear in the hand specimen to be greatly altered, and contained but a small amount of pyrite.

The most important lodes of the South Kalgurli mine, from east to west, are: the Australia lode, the Lake View East lode, the Lake View lode, the El Oro lode, and the Perseverance lode. In addition there are the Cross lode near coordinate 200 feet north, and a lode about 80 or 90 feet east of the Australia lode at the 1,800-feet level. For convenience this last lode is referred to in this report as the East lode, and must not be confused with the Australia lode which has sometimes been styled the East lode on the mine plans.

Various smaller or less defined lodes or lenses of lode matter occur which it is difficult to correlate from level to level. Several of these occur between the Australia and Lake View East lodes at the 1,800-feet and 1,920-feet levels.

The Perseverance Lode.—This lode has not been stoped below the 1,200-feet level. It probably passes out of the mine above the 1,500-feet level as it does not appear to have been cut in the long west crosscut at that level.

The El Oro Lode.—This lode likewise has not been stoped below the 1,200-feet level, except for a very short distance at the 1,500-feet level, where it has been driven on for nearly 500 feet. Here its gold content was exceedingly low. Judging by the amount of stoping, this lode is much lower in average value than the Perseverance lode and only a relatively small proportion has proved payable.

Above the 1,000-feet level the El Oro lode has a fairly marked westerly dip, but below that level it straightens up slightly.

The main west crosscut at the 1,800-feet level does not quite reach this lode, which, however, should be only a few feet west of the face.

The Lake View and Lake View East Lodes.—A considerable amount of stoping has been done on the Lake View and Lake View East lodes at the upper levels of the mine, but below the 1,000-feet level work has mainly been confined to the more easterly of the two lodes. But little stoping has, however, been done below the 1,350-feet level.

At the 1,700-feet level the Lake View East lode has been driven on for about 170 feet north of crosscut 94 feet south, and south of that crosscut it has been followed to the Perseverance boundary. It has been stoped for a short distance above the level, but the gold content was low.

At the 1,800-feet level, the Lake View lode was cut about 500 feet west of the Main shaft and was driven on south for a few feet, but the gold content was low. The lode has also been cut in borehole 249 feet south, put in west from the south drive on the Lake View East lode at this level. In this borehole the gold content was somewhat higher, two assays of 8½ dwts. being recorded.

The Lake View East lode has been driven on for a considerable distance north and south of the main west crosscut at the 1,800-feet level. At this level, and for a short distance above and below, it has followed a flat fault. In the north drive it consists only of a single flat seam. This drive leaves the lode about 120 feet north of the crosscut and bends to the northeast (or nearly true north), cutting near the face a strong body of highly siliceous lode material assaying up to 7 dwts.—probably the junction of two lodes cut in the main west crosscut at 160 feet and 240 feet west of the shaft. Further work on these lodes might reveal a payable ore body, though probably of small dimensions. No lodes corresponding to these two were seen at the 1,700-feet level.

The south drive on the Lake View East lode at the 1,800-feet level does not follow the lode very closely. It is mainly on the footwall portion. Near the Perseverance boundary the lode consists of a number of stringers of varying width but mostly of low grade. Assays of 10 dwts. were, however, recorded between 65 and 80 feet south of the main west crosscut.

In the main west crosscut at the 1,920-feet level, the lode consists of three comparatively narrow seams, between coordinates 346 feet west and 370 feet west.

The Australia Lode.—The Australia lode is, at the lower levels, the most important lode in the mine. It consists of two main branches—the East branch and the West branch—joining both to the north and south. Of these, the East branch, which has proved the more productive, is regarded as the main branch. It appears to correspond to the No. 3 lens of the Associated mine. Near the southern boundary of the South Kalgurli the lode appears at some of the levels to branch again, going south.

At the 1,600 and 1,700-feet levels the two main branches are in the shape of a bow, the West branch forming the body of the bow and the East branch, though usually the wider, the string. At the 1,800-feet level both branches curve outwards. The maximum width apart of the two branches at the lower levels of the mine ranges from about 45 feet at the 1,600-feet level to about 100 feet at the 1,800-feet level. The East branch is the more regular in strike and width. The West branch varies considerably in width and in the southern portion of the 1,600-feet level consists merely of a few shear planes in little altered country. At the 1,700-feet level it is much stronger, but consists of a number of lenses and stringers rather than one continuous body.

The northern junction of the two branches is apparently only a few feet north of the main west crosscut at the 1,600-feet level. A very small rich patch is stated to have occurred in the West branch a short distance above the level, immediately south of the main west crosscut. At the 1,700-feet level the junction is much farther, probably 130 feet, north. At the 1,800-feet level the junction is about 200 feet north of the main west crosscut. At the 1,920-feet level the position of the junction has not been determined, but may not be so far north as at the 1,800-feet level.

At the 1,700-feet level the West branch is the better defined north of the shaft and has been stoped up to about 20 feet above the floor of the level for some distance.

In general, neither branch has proved very productive north of the shaft, and at the 1,800-feet level both appear to be represented by mere seams from about 80 feet north of the main crosscut.

The southern junction of the East and West branches of the Australia lode is by far the more important, as along it one of the richest shoots of the mine has been formed. It varies considerably in pitch at the levels examined. At the 1,600-feet level it is 240 feet south of the Main shaft, along the strike of the East branch (235 feet by the mine co-ordinates). Here the West branch is represented merely by a shear plane along which subsequent movement has taken place.

At the 1.700-feet level the junction is nearly 270 feet south of the shaft. The West branch is fairly wide at and near this point.

At the 1,800-feet level the two branches are much farther apart in the southern portion of the mine, the West branch having a much flatter dip between the 1,700-feet and 1,800-feet levels. This appears to be due to the presence of one or more old fault planes with a flat westerly dip along which the ore-bearing solutions have been deflected, and at this level, if, as seems without doubt, the lode cut in the west bore-holes at 194 feet south and 331 feet south is the West branch of the Australia lode, the junction must be a considerable distance south of the southern boundary of the lease and there is no hope of finding a downward continuation of the rich shoot in the mine at this level.

At the 1,920-feet level little is yet known as to the relative positions of the two branches. It is possible that they are not so far apart as at the 1,800-feet level, but there appears to be no chance of their junctioning in the southern portion of the mine.

Another shoot of good ore occurred along the East branch from between about 20 and 60 feet south of the shaft, along the strike of the lode, to about 110 feet south of the shaft. It extended from a depth of about 1,400 feet to about 30 feet above the 1,700-feet level, where the lode became very narrow. Below the 1,700-feet level a much shorter body of good ore extended down to about 1,740 feet immediately north of winze 97 feet south. A leading stope has been taken off, to a height of 20 feet above the 1,800-feet level from about 100 feet to 140 feet south of the main west crosscut, in the hopes of getting the downward continuation of this body, but the gold content was disappointing.

The East Lode.—This lode has not been worked above the 1,800-feet level. At this level it has been followed for about 350 feet north and 260 feet south of the main east crosscut, where it is about 35 to 40 feet east of the east side of the shaft and on the hanging-wall of the albite porphyrite dyke. It branches immediately north of the crosscut, the East branch running more towards the eastern side of the dyke, the West branch, which has been followed in the more northerly workings, clinging fairly closely to the hanging-wall of the dyke, but straighter and mainly a few feet inside the dyke. In the drives north of the main crosscut the lode has largely followed the flat fault previously mentioned as affecting the albite porphyrite dyke and the western boundary of the calc-schist. The gold content of the lode north of the main crosscut was very low.

South of the main east crosscut the lode is lenticular in habit and difficult to follow. Assays up to 8dwts. were obtained from west crosscut 92 feet south, where the lode is fairly wide. At the southern end of south drive 38 feet east the lode is only represented by a shear zone in little altered greenstone. South of the main east crosscut the lode diverges from the dyke and the fault, which have not been cut south of the crosscut, and its dip is more normal.

Above the 1,800-feet level what appears to be the same lode was cut in borehole 12 feet north, at the 1,600-feet level, from about 113 feet to 118 feet east of the shaft. Here, according to the mine records, it is represented by a band of bleached greenstone assaying up to 4dwts. The albite porphyrite dyke was not cut in this bore, but is probably not far east.

Below the 1,800-feet level this lode was cut in the Main shaft at about 1,850 feet, on the hanging-wall of the dyke.

Without doubt the drives off the main west crosscut at the 1,920-feet level, at 67 feet west, are on this lode, which at this level hugs the hanging-wall of the dyke very closely. Near crosscut 198 feet south, however, the lode splits, the eastern branch entering the dyke, which bends more westerly south of this point, the western and narrower branch following the hanging-wall of the dyke. Throughout the drives at this level the gold content of the lode was very low, but one assay of 7dwts. was obtained from the eastern branch of the lode in east crosscut 198 feet south, and this branch was being followed south when I last visited this level.

CONCLUSIONS AND RECOMMENDATIONS.

The Calc-Schist.—The rock cut in the main east crosscut at the 1,800-feet level, at 66 feet from the Main shaft and immediately east of the albite porphyrite dyke, is undoubtedly the calc-schist, which, with few exceptions, has proved to be unfavourable to the occurrence of payable ore bodies. The crosscut as well as the incline winze from the Kalgurli boundary to the Kalgurli 1,850-feet level were closely examined, and proved to be entirely in calc-schist east of the point mentioned.

As stated, the calc-schist probably enters the mine a little below the 1,700-feet level. Owing to an overthrust fault, or series of faults, its dip is flat to a little below the 1,800-feet level, but must straighten up near the level as, according to the mine officials, it does not enter the Main shaft till about 30 feet below the 1,920-feet level.

The strike of the calc-schist boundary could not be determined with certainty. North of the main east crosscut at the 1,800-feet level it most probably adjoins the eastern boundary of the albite porphyrite dyke and is probably roughly parallel to the western boundary of the dyke, as shown on the plan of the 1,800-feet level. South of the main east crosscut, judging by its position in the Associated mine, it probably bends in a more easterly direction, diverging slightly from the dyke, and is probably not far from the easternmost corner of the lease.

As the albite porphyrite dyke hugs the western margin of the calc-schist so closely, and their effect on the lodes is generally the same, namely, impoverishment, they may be regarded together. Normally their strike and dip in this mine approach those of the lodes fairly closely, the dip being if anything a trifle flatter. Therefore, unless other faults occur below the 1,920-feet level they are not likely to affect the lodes for a considerable depth below the present workings. No traces of other faults were noticed east of the calc-schist boundary at the 1,800-feet level, but unless seen at their junction with a change of rock these faults, owing to the general shearing the rocks have undergone, are usually very difficult to detect.

The Australia Lode.—The main factor in the formation of the rich shoot in the Australia lode above the 1,700-feet level was a structural one, namely, the junction of the East and West branches. Other additional factors have been suggested, namely, the junction of the Associated No. 4 lens with the East branch at or close to the East and West branch junction, and also the presence of a "calcite floor" which influenced the distribution of the gold above and below it.

The Associated No. 4 lens, situated west of No. 3 lens which, as stated, apparently corresponds to the Australia Lode East branch, occurs in the same general channel of shearing, similarly to the West branch, of which, indeed, in spite of its difference in strike, it may broadly be regarded as the southerly continuation. It has not been regarded as of any great importance on the Associated mine. Its probable occurrence in the South Kalgurli mine and junction with the East branch is merely to be regarded as part of the same factor as the West branch junction.

Regarding the occurrence of "calcite floors" and their possible influence on gold distribution, these are thin veins of quartz and carbonate, nearly flat, but usually with a slight westerly or northwesterly dip, and must not be confused with the flat "floors" commonly occurring within the lodes. Their age relative to that of the lodes has not yet been definitely determined, but they are undoubtedly younger than the albite porphyrite dykes which they fault in places. If younger than the lodes they cannot have affected gold distribution, though they may have faulted the lodes slightly. If older, it is possible that they influenced the distribution of gold in their vicinity to a slight extent. One of these "floors" is stated to occur at the No. 16 (1,695 feet) level of the Associated mine, but does not seem to have had any marked immediate effect on the gold content of the lode.

A similar "floor" was seen at the No. 18 level (1,944 feet) of the same mine, where it was observed to fault an albite porphyrite dyke, apparently the same dyke as that occurring at the 1,800-feet and 1,920-feet levels of the South Kalgurli.

A "floor" of this type was observed in the South Kalgurlie mine in the stope between the 1,600-feet and 1,700-feet levels, below winze 328 feet south and about 28 feet below the 1,600-feet level. As good ore extended practically to the 1,700-feet level, the presence of this "floor" does no seem to have had any marked immediate effect on the gold distribution. It was noted, however, that the stope below the "floor" and north of the winze extended for some feet west of that above the "floor."

On the evidence at present available I am inclined to regard these "floors" as younger than the lodes and to have had no effect on gold distribution other than that of slight faulting of the lodes themselves. Further evidence is, however, necessary to determine this point.

The outstanding facts, therefore, are that the rich shoot of the Australia lode occurs at the southern junction of the East and West branches, and that with the diverging of these branches below the 1,700-feet level this shoot ceases to exist so far as the South Kalgurli mine is concerned, though it is possible that other bodies of payable ore may exist along either of the two branches. The junction of the two branches at and above the 1,700-feet level and their divergence below that level is, I have little doubt, due to the solutions which formed the West branch, having been deflected along a previously-existing fault line most probably consisting of several planes.

Regarding the position of the East branch at the 1,920-feet level, there is little doubt that the lode driven on at that level is the downward extension of that followed in drives 38 feet east at the 1,800-feet level, and termed the "East lode" in this report, and although it is possible that the East branch has junctioned with this lode a short distance above the 1,920-feet level, it is more likely that the lode matter cut in the main west crosscut from about 80 to 87 feet and from 103 to 118 feet, west of the shaft, represents the East branch of the Australia lode and also the seams at about 58 feet and 73 feet southwest of the south drive, in crosscut 230 feet south, the West branch being represented at this level by two branches at about 134 feet and 150 feet west of the shaft. As the East branch of the Australia lode appears to have normally a slightly steeper dip than the East lode, the two may eventually junction, though not for some considerable distance below the present workings. The two branches of the Australia lode might be further tested at the 1,920-feet level, preferably by two boreholes from the south drive. These could be put in from west crosscuts 113 feet south and 198 feet south on bearings of S.37°W. and S.30°W. respectively. Each might have to be put in for a distance of 120 feet or 130 feet before the West branch channel was completely penetrated.

The East Lode.—This lode, as stated, has not been worked above the 1,800-feet level, but what is apparently the same lode has been cut in east borehole 12 feet north at the 1,600-feet level. In this bore it is entirely in the quartz dolerite derivatives. Although the gold content of this lode has not so far proved to be payable—the highest assay recorded being 8¼dwts.—it might be tested by boring at the 1,700-feet level. A convenient place might be east crosscut 165 feet south off south drive 47 feet east. The lode should be about 60 feet east of the face of this crosscut. A bore put in east from the south drive off the plat at the 1,700-feet level, a few feet south of the ore bin, should cut this lode at about 90 feet.

Other Lodes.—The Lake View lode has been generally regarded as of low grade on this mine, and but little work has been done on it at the lower levels. The assays of 8dwts. recorded from west borehole 248 feet south, at the 1,800-feet level, suggest the possibility of the occurrence of a payable shoot, but the lode is so far west at the lower levels that, except by driving from the main west crosscut at the 1,800-feet level, much dead work would have to be done before the lode is cut. To reach this lode by continuing west crosscut 94 feet south at the 1,700-feet level would probably mean about 160 or more feet of crosscutting, with the probability of the lode proving unpayable when reached.

The Lake View East lode has, in general, given better returns though this lode also has mostly been of too low grade to be payable. Assays, however, from two places in the south drive on this lode at the 1,800-feet level, namely, between 65 and 80 feet and between 195 and 225 feet south of the main west crosscut, suggested the advisability of further testing the lode at these points by taking off a leading stope, and this work was being taken in hand when I last visited the mine. Although low assays were recorded from the hanging-wall portion of the lode in borehole 249 feet south, this portion might also be further tested.

Lodes or lenses of lode material were previously mentioned as occurring between the Australia Lode West branch and the Lake View East Lode at the 1,800-feet and 1,920-feet levels. Two of these were cut in the main west crosscut at the 1,800-feet level at about 160 feet and 240 feet west of the Main shaft. What is probably the junction of these two lodes was cut near the face of north drive 298 feet west, at the same level, between coordinates 185 feet and 207 feet north, and assays up to 7dwts. were recorded, suggesting the advisability of further testing these lodes, A convenient method would have been to continue west crosscut 150 feet north, off north drive 123 feet west, to cut these lodes and then drive north to cut north drive 298 feet west near the face. West crosscut 150 feet north is, however, now mullocked up.

In conclusion, there appears to be little hope of finding another shoot comparable to that worked on the Australia lode above the 1,700-feet level and the main hope of the mine, apart from the ore bodies developed above the workings examined, appears to lie in the discovery of ore bodies of lower but still payable grade along the main lines of lode.

PETROLOGICAL WORK.

(C. O. G. Larcombe, D.Sc.)

Two hundred and twenty-six (226) sections have been examined and described, made up as follows:—

Geological survey of Kalgoorlie ..	83
State boring operations	68
Wiluna	14
Various departments, etc.	61
	226

In addition to the above, about 150 sections have been made for Dr. Stillwell by my assistant. These were not examined by me but handed to Dr. Stillwell direct.

The most important matters dealt with during the year have been—

1. Petrological examinations of cores from the bores at Coolgardie.
2. Petrological examinations of cores from the bores at Sandstone.
3. Petrological examinations of cores from the bores at Ajana.
4. Examination of specimens collected by the field staff working on the geological survey of Kalgoorlie.
5. Petrology of Wiluna ores.
6. Petrological determinations for the department and for the general public.

1.—BORING AT COOLGARDIE.

Report on No. 1 Bore, Coolgardie.—This bore was put down in a westerly direction at an angle of 60 degrees (see Plates X. and XI.). It reached a depth of 623 feet along its direction of inclination. The vertical depth was 540 feet and the horizonal distance 311 feet. The bore passed through eight dykes and the assay value of the core taken from these dykes is indicated in the following table:—

No. of Dyke.	Depth in Feet.	Distance through.	Rock.	Assay Results.
	ft. in. ft. in.	ft. in.		
1	38 7—45 6	6 11	Dense brown felsite ...	Gold nil.
2	66 6—72 9	6 3	Do. do.	do.
3	180 0—183 0	3 0	Dense pale grey felsite ...	do.
4	391 0—411 0	20 0	Dense grey felsite	do.
5	415 6—422 0	6 6	Do. do.	do.
6	549 0—564 0	15 0	White aplite impregnated with pyrrhotite and traversed by small glassy veinlets of quartz containing pyrrhotite	549ft.—552ft.: Gold, 12dwt. 4grs. per ton. 552ft.—555ft.: Gold, 6dwt. 23grs. p r ton. 555ft.—558ft.: Gold, 4dwt. 3grs. per ton. 558ft.—561ft.: Gold, 2dwt. 17grs. per ton. 561ft.—564ft.: Gold, 3dwt. 4grs. per ton. Average (5 assays): Gold, 5dwt. 20grs. per ton.
7	570 0—577 0	7 0	Dark gray felsite with a little pyrrhotitic aplite	570ft.—573ft.: Gold, 0dwt. 21grs. per ton. 573ft.—575ft.: Gold, 0dwt. 10grs. per ton. 575ft.—577ft.: Gold, 2dwt. 9grs. per ton.
8	597 6—623 0	25 6	White aplite impregnated with pyrrhotite and traversed by small glassy veinlets of quartz containing pyrrhotite. A little felsite from 613ft. 6in. to 617ft.	597ft. 6in.—600ft. 2in.: Gold, 2dwt. 14grs. per ton. 600ft. 2in.—603ft.: Gold, 5dwt. 19grs. per ton. 603ft.—606ft.: Gold, 6dwt. 3grs. per ton. 606ft.—609ft.: Gold, 4dwt. 22grs. per ton. 609ft.—612ft.: Gold, 6dwt. 16grs. per ton. 612ft.—613ft. 6in.: Gold, 1dwt. 15grs. per ton. 613ft. 6in.—617ft.: Gold, 0dwt. 8grs. per ton. 617ft.—619ft.: Gold, 2dwt. 18grs. per ton. 619ft.—621ft.: Gold, 2dwt. 18grs. per ton. 621ft.—623ft.: Gold, 6dwt. 11grs. per ton. Average (10 assays): Gold, 4dwt. 0gr. per ton.
		90 2		

The above table indicates two significant features: (1) that two auriferous dykes were cut, viz., No. 6 between 549 and 564 feet, and No. 8 between 597ft. 6in. and 623ft.; (2) that the felsite rock is valueless, the values being confined to the pyrrhotitic aplite.

The average of five assays of core from No. 6 dyke was 5dwt. 20 grains of gold per ton over 15 feet. The average of 10 assays from the No. 8 dyke was 4dwt. of gold per ton over 25ft. 6in.

Nature and origin of the Lodestuff.—The rock (lodestuff) containing the values is a species of fine-grained granite known as aplite. It is a white rock of medium grain made up mainly of felspar and quartz, throughout which numerous irregular-shaped patches and grains of pyrrhotite—magnetic pyrites (Fe_nS_{n+1})—are scattered. In addition, this rock contains small glassy veinlets of quartz with pyrrhotite, and where these veinlets occur the values are generally highest.

Under the microscope the lodestuff (auriferous or gold-bearing pyrrhotitic aplite) is seen to consist of a medium-grained aggregate of quartz and felspar with irregular shaped ragged patches and grains of pyrrhotite scattered throughout the mass. Plates of slightly clouded orthoclase and finely striated plagioclase (near albite), showing both carlsbad and albite twinning are common. The quartz is shapeless, cracked, and sometimes in mosaic form. Irregular shaped patches of calcite may be seen. There is a noticeable amount of actinolitic hornblende in shreds, patches and nests. Flakes of bright brown biotite are intimately associated with the hornblende, and both these minerals appear to be of primary origin. Apatite rods occur. Glassy quartz veinlets traverse the aplite, and pyrrhotite forms a constituent of these veinlets.

Origin of the Aplite and its economic Significance.—The aplite is an acid rock of igneous origin. It occurs in the form of dykes. The mineralogical constitution of these dykes, viz., quartz, orthoclase, plagioclase, actinolite, biotite, apatite, calcite, pyrrhotite and occasionally gold, suggests that they are special differentiation products from some acidic (granitic) magma. The interesting feature is that the pyrrhotite—with which the gold is evidently associated—may be regarded as an accessory constituent of the aplite, *i.e.*, a part of the original magma.

The glassy quartz veinlets no doubt are contained in minute contraction fissures formed in the rock during its gradual cooling, and filled by the residual acid siliceous solutions containing pyrrhotite, and in places possibly gold.

Petrology:

(a) *The Greenstones.*—These, as shown by microscopic examination of the core rock, have been tremendously changed and altered, both physically and mineralogically, as the result of dynamic forces and chemical change. The phases of alteration are numerous, but for practical purposes the greenstones may be divided into (1) the reconstructed amphibolites, and (2) the hornblende-biotite-quartz schists.

(1) *The reconstructed amphibolite* is the common country, and this rock, together with its modifications, was the main formation from the surface to 518 feet. It is a dense green rock made up of a more or less confused aggregate of hornblende prisms and plates, often broken down into actinolitic fibres. In the less altered rock the plates lie in all azimuths. The hornblende plates may be seen undergoing distinct carbonation and chloritisation. Calcite is not infrequently segregated between the plates. Grains and mosaics of quartz, with specks of black oxide of iron and a little iron pyrites, make up the rest of the rock. At 497 feet the amphibolite is more schisted, chloritised and carbonated, while talc makes its appearance.

(2) *Hornblende-biotite-quartz schist.*—This rock occupies a powerful zone of schisting from 518 to 597 feet 6 inches. This zone contains the two large auriferous dykes, Nos. 6 and 8. In hand specimen the rock is beautifully banded, the alternating bands being made up of mosaics of quartz and calcite, hornblende and biotite, the latter bands being subordinate.

(b) *The Acidic Rocks.*—These are represented by dykes, some of which are auriferous and represent the so-called lodes. The dykes are of three types, viz.:—

1. Felsite;
2. Aplite containing pyrrhotite; and
3. Biotite aplite.

1. *Felsite.*—Of the eight dykes recorded five were felsite. It is a dense brownish to grey felsitic rock, consisting mainly of a cryptocrystalline aggregate of quartz and felspar, very often with numerous pale greenish actinolite needles scattered throughout it. The felsite is of no significance, because so far as this examination has gone the felsites do not contain any gold and must be neglected.

2. *Aplite containing pyrrhotite.*—This rock is of great importance because it is gold-bearing. Aplite is simply a fine-grained form of granite without dark constituents visible to the naked eye. The pyrrhotite, which possibly contains the gold—or in any case is associated with it—is a sulphide of iron that is attracted by the magnet. Pyrrhotite is brown, while iron pyrites is brass-yellow. The pyrrhotite-bearing aplite has already been described when discussing the nature and origin of the lodestuff. It is a medium-grained white to grey rock made up mainly of quartz and two kinds of felspar—orthoclase and plagioclase. Ragged grains and patches of pyrrhotite are scattered throughout this rock, in which it plays the part of an accessory constituent; that is to say, the pyrrhotite formed a part of the original magma from which the aplite crystallised. Glassy quartz veinlets, sometimes containing pyrrhotite, traverse the tplite, and wherever they occur values are likely to be good.

3. *The Biotite Aplite.*—A curious rock forms the hanging-wall of the No. 6 and No. 8 auriferous dykes, for a foot in the No. 6 dyke and 8ft. 6in. in the No. 8 dyke. At 548 feet it is an intensely altered rock with the appearance of a biotite granulite, consisting of a mass of scales and plates of brown biotite set in a fine-grained mosaic of quartz and possibly felspar with some calcite. At 596 feet the rock is somewhat

coarser in grain and is made up of calcite, biotite and hornblende in a quartz-felspar mosaic. At first it was thought that this rock may have been a metamorphic zone on the edge of the aplite dykes, but it has finally been interpreted as a differentiation product from the aplite and of increased basicity because: (a) it is not in both walls of the dyke; (b) it has the ground mass appearance in 548; (c) at 622 feet is decided dyke with biotite; (d) the ferromagnesian in the aplite is the same; and (e) its physical appearance suggests dyke rock.

Plate XI. is a cross section through the No. 1 bore, showing the position of the rock formations and auriferous dykes passed through.

REPORT OF No. 2 BORE, COOLGARDIE.

This bore was commenced 250 feet due north from No. 1 bore. The direction of boring was due west and the angle of depression 60 degrees. It was commenced on 24th March and completed on 15th November, 1927. It reached a depth of 1,052.25 feet, *i.e.*, a vertical depth of 911.27 feet and a horizonal distance of 526 feet.

The object of this bore was to test at depth the auriferous acid dykes that had been worked to about 300 feet in vertical depth in Tindal's mine. The bore passed through 22 dykes and the assay value of the core taken from these dykes is indicated in the following table:—

No. of Dyke.	Depth in feet.	Distance through.	Rock.	Assay results.
	ft. in. ft. in.	ft. in.		
1	173 0—177 0	4 0	Felsite	Gold, Nil.
2	467 9—482 0	14 3	Very fine grained to felsitic rock with specks of sulphide	do.
3	522 0—533 0	11 0	Pale aplite—medium to fine-grained and felsitic on foot wall. Impregnated with pyrrhotite and containing glassy quartz veinlets	522ft.—525ft. : Gold, trace. 525ft.—528ft. : Gold, nil. 528ft.—531ft. : Gold, 3grs. per ton. 531ft.—533ft. : Gold, nil.
4	537 6—547 9	10 3	White aplite strongly impregnated with coarse pyrrhotite and a little fine-grained pyrites. Sulphidic veinlets present.	537ft. 6in.—539ft. : Gold, 6oz. 9dwt. 13grs. per ton. 539ft.—541ft. : Gold, 0oz. 6dwt. 8grs. per ton. 541ft.—543ft. : Gold, 0oz. 0dwt. 5grs. per ton. 543ft.—545ft. : Gold, 0oz. 0dwt. 3grs. per ton. 545ft.—547ft. 9in. : Gold, 1oz. 16dwt. 1gr. per ton.
5	563 6—565 3	1 9	Dark felsite	Gold, nil.
6	570 0—571 0	1 0	Strongly felsitic dark dyke with specks of pyrrhotite and glassy quartz veins	Gold, nil.
7	575 0—576 9	1 9	Dark felsitic aplite with a little pyrrhotite	Gold, nil.
8	580 4—587 0	6 8	Pale aplite impregnated with pyrrhotite—some in coarse patches	580ft. 4in.—581ft. 10in. : Gold, 1dwt. 5 grs. per ton. 581ft. 10in.—583ft. : Gold, 5grs. per ton. 583ft.—584ft. : Gold, 3grs. per ton. 584ft.—585ft. : Gold, 3dwt. 4grs. per ton. 585ft.—586ft. : Gold, 10grs, per ton. 586ft.—587ft. : Gold, 10grs. per ton.
9	589 0—609 6	20 6	589ft.—595ft. : Dark aplite with numerous specks of sulphide 595ft.—600ft. : Centre of dyke. Pale fine-grained aplite with a considerable amount of fine-grained pyrrhotite and at 597ft. a distinct glassy quartz vein with pyrrhotite 606ft.—609ft. 6in. : Dark felsitic dyke with specks of sulphide	589ft.—591ft. : Gold, 3grs. per ton. 591ft.—593ft. : Gold, trace. 593ft.—596ft. 9in. : Gold, nil. 596ft. 9in.—597ft. 6in. : Gold, 7dwt. 20grs. per ton. 597ft. 6in.—606ft. 6in. : Gold, nil. 606ft. 6in.—608ft. 6in. : Gold, 5grs. per ton. 608ft. 6in.—609ft. 6in. : Gold, 1dwt. 15grs. per ton.
10	611 6—615 0	3 6	Dark felsite without any sulphide	Gold, nil.
11	657 0—658 0	1 0	Gray felsite	Gold, nil
12	664 0—670 0	6 0	Gray somewhat felsitic aplite with a little pyrrhotite	Gold, nil.
13	690 0—693 0	3 0	Dark felsite	Gold, nil.
14	694 0—695 0	1 0	Gray felsite	Gold, nil.
15	713 0—748 0	35 0	Mostly a fine-grained to felsitic dark gray aplite with specks of pyrrhotite. Rock dark from 739ft. to 748ft. and containing garnets. No sulphide from 740ft.—748ft.	713ft.—730ft. : Gold, nil. 730ft.—733ft. : Gold, 14grs. per ton. 733ft.—736ft. : Gold, 5grs. per ton. 736ft.—748ft. : Gold, nil.
16	751 3—758 0	6 9	Dark fine-grained garnetiferous dyke with no sulphides	751ft. 3in.—754ft. : Gold, nil. 754ft.—756ft. : Gold, traces. 756ft.—758ft. : Gold, 14grs. per ton.
17	760 0—764 0	4 0	Fine-grained gray aplite with no sulphides	Gold, nil.
18	766 0—771 0	5 0	Pale fine-grained aplite with a little pyrrhotite	Gold, nil.
19	793 0—799 0	6 0	Gray felsite with no sulphides	Gold, nil.
20	806 8—808 0	1 4	Dark felsite	Gold, nil.
21	810 0—818 6	8 6	Dark gray felsitic aplite with a little disseminated pyrrhotite	810ft.—813ft. : Gold, nil. 813ft.—816ft. : Gold, trace. 816ft.—818ft. 6in. : Gold, nil.

No. of Dyke.	Depth in feet.	Distance through.	Rock.	Assay results.
22	ft. in. ft. in. 824 0—886 0	ft. in. 62 0	From 824ft. to 856ft. nice looking aplite with disseminated pyrrhotite and occasional glassy quartz veins 856ft. to 886ft. dark mottled granodiorite	824ft.—830ft.: Gold, a trace. 830ft.—841ft.: Gold, nil. 841ft.—843ft.: Gold, 5dwt. 21grs. per ton. 843ft.—845ft.: Gold, 10grs. per ton. 845ft.—851ft.: Gold, nil. 851ft.—853ft.: Gold, a trace. 853ft.—855ft.: Gold, nil. 855ft.—858ft.: Gold, a trace. 858ft.—881ft.: Gold, nil. 881ft.—884ft.: Gold, a trace. 884ft.—886ft.: Gold, nil.

Nature and Origin of the Lodestuff.

Similar remarks apply to the lodestuff in both bores. The general description of the lodestuff given under No. 1 bore applies to No. 2 bore.

Out of the 22 dykes met with in the No. 2 bore only two, viz., Nos. 4 and 8 dykes, showed evidence of payable values. No. 9 dyke is only separated from No. 8 by two feet of actinolitic schist, so Nos. 8 and 9 may perhaps be best regarded as one dyke.

The No. 4 dyke is possibly the equivalent of No. 6 dyke in No. 1 bore, and Nos. 8 and 9 are possibly the equivalent of No. 8 in No. 1 bore.

The No. 4 *Dyke.*—This extended from 537ft. 6in. to 547ft. 9in., *i.e.,* 10ft. 3in. along the direction of the bore. Its vertical depth was from 466 to 475 feet and its horizontal distance from the starting point of the bore in a westerly direction would be 268 to 273.5 feet.

The values in this dyke, as shown in the above table, ranged from 3 grains to 6oz. 9dwts. 13 grs. per ton. An assay from 545 to 547ft. 9in. gave 1oz. 15dwts. 1gr. of gold to the ton. The gold is probably contained in the sulphide, but I am strongly inclined to believe that free gold was also present. Mr. B. H. Moore, M.E., showed that concentration of the sulphide greatly increased the value and he showed that free gold was present. Simple panning gave 2.1 grains of concentrate from 50 grammes of ore.

In hand specimens the ore from the No. 4 dyke is a white granitic-looking rock impregnated with sulphides of iron and containing small glassy quartz veinlets and veinlets of sulphide. It is a coarse-grained aplite approaching a fine-grained granite. The chief sulphide is pyrrhotite, but there is certainly some ordinary iron pyrites in this ore.

Under the microscope it consists of a mediumly coarse holocrystalline aggregate of quartz and felspar, the latter predominating and containing a lot of plagioclase. Calcite interstitially arranged is not uncommon and there are numerous rods of colourless apatite. Nests and fragments of greenish chloritised hornblende are scattered throughout the slide. Shapeless patches and grains of pyrrhotite impregnated the rock and a little crystallised iron pyrites may be seen. Quartz veinlets traverse the aplite.

The No. 8 dyke, from 580ft. 4in. to 587ft., all contained values, but the grade was very low, the highest assay being 3dwts. 4gr. of gold per ton. The rock from this dyke was, however, a pale pyrrhotitic aplite. Section 4961, from 582 feet, was a very felspathic variety rich in plagioclase and containing shapeless and ragged pieces of pyrrhotite disseminated throughout it. Some calcite was intergrown with the felspar, and scattered plates of chloritised hornblende were noted.

The No. 9 dyke, from 589ft. to 609ft. 6in., gave still poorer results than No. 8—as shown in the table. A small piece between 596ft. 9in. and 597ft. 6in., near the middle of the dyke, consisted of pale pyrrhotitic aplite with glassy quartz veinlets containing pyrrhotite, and assayed 7dwts. 20gr. of gold per ton. This result is no doubt due to special differentiation at this point. The next highest assay was 1dwt. 15gr. of gold per ton from 608ft. 6in. to 609ft. 6in. The remaining nine assays were negligible. The No. 9 dyke was a good example of textural and mineralogical changes, as follows:—

589ft.-596ft. 9in.: Dark felsitic non-sulphidic type.

596ft. 9in.-601ft. 6in.: Pale aplite with pyrrhotite.

601ft. 6in.-606ft. 6in.: Dark felsitic non-sulphidic form again.

606ft. 6in.-609ft. 6in.: Pale aplite with pyrrhotite.

If the Nos. 8 and 9 dykes in the No. 2 bore correspond to the No. 8 dyke in the No. 1 bore, it is clear that 250 feet south from the Nos. 8 and 9 dykes there is a considerable improvement in uniformity and grade of values—as shown by assay results of No. 8 dyke in No. 1 bore. It is quite evident that the felsitic types are valueless and the economic development of these dykes depends upon the relative proportions of pale or white aplite rich in pyrrhotite or quartz veinlets to dense dark non-sulphidic or felsitic types.

Petrology.

The rock formations are naturally similar to those met with in the No. 1 bore. But the increased depth of the No. 2 bore to 1,052ft. 3in. has revealed important features, viz., (1) a considerable increase in the width of the schisted zone into which the dykes had intruded; (2) the presence of another dyke (No. 22) to the westward of the two auriferous dykes; (3) the passing of the aplite by imperceptible gradations into a rock rich in the ferromagnesian minerals —hornblende and biotite, viz., granodiorite; (4) the fact that the schist zone is riddled with acid dykes, 22 having been encountered in 1,052 feet of boring.

The rock formations are as follow:—

1. *Greenstones*: Hornblende schists and reconstructed amphibolite, etc.

2. *Acid Rocks*: Felsite, aplite and granodiorite.

1. *The Greenstones.*—The whole zone into which the dykes have been intruded consists mainly of a reconstructed amphibolite and its modifications, viz., hornblende and actinolite schists with, in places where greater chemical and mineralogical changes have taken place, hornblende-biotite-quartz schists. A pretty uniform and consistent hornblende-actinolite schist and a confused aggregate of hornblende, actinolite and tremolite occurs from 615 to 750 feet. The rich No. 4 dyke is in actinolite schist.

2. *The Acidic Rocks.*—These are represented by dykes, some of which are auriferous and form the lodes. The dykes include—

(a) the felsites;
(b) the pyrrhotite-bearing aplites; and
(c) the granodiorite.

(a) *The felsites.*—These are valueless and call for little comment. Ten distinct felsite dykes were cut, but the felsite occurs also on the edge of the aplite dykes or even in them, the latter occasionally containing specks of pyrrhotite. They are cryptocrystalline aggregates of quartz and felspar, often with disseminated actinolitic rods, which account for their dark colour.

(b) *The pyrrhotite-bearing aplites,* which form the lodestuff, have been described under Bore 1. An important feature revealed by Bore 2 is that the pyrrhotitic aplites do not all contain gold.

(c) *The granodiorite* forms about half of No. 22 dyke on its footwall side. It is clearly a more basic differentiation product from the aplite dykes. It contains quite a lot of bright green hornblende and brown biotite.

Summary of Conclusions.

The results of the petrogrophic examination of core from the No. 1 and No. 2 bores have revealed facts of considerable interest regarding the geological occurrence, nature and origin of the ore deposits. Amongst the interesting conclusions that have been arrived at from these facts may be mentioned the following:—

1. The geological occurrence is in the form of a series of dykes intruding a powerfully altered and more or less schisted zone of reconstructed amphibolite.

2. The number of dykes met with was considerable, viz., 8 in No. 1 bore and 22 in No. 2 bore.

3. The dykes are made up of three kinds of rock, viz.: (a) felsite; (b) a dark dioritic type—granodiorite; and (c) a pale to white aplitic type impregnated with pyrrhotite.

4. The gold "values" are confined to the aplitic type, the felsitic and dioritic types being absolutely devoid of values.

5. Out of all the dykes encountered only four, two in each bore, gave evidence of promise so far as their gold contents were concerned. The dykes referred to are No. 6 and No. 8 in Bore 1, and 4 and 8 in Bore 2. For practical purposes No. 9 dyke in Bore 2 may be considered with No. 8, from which it is separated by only two feet of actinolite schist at the place where the bore passed through it.

6. The Nos. 6 and 8 dykes in Bore 1 are large low-grade formations made up of pale pyrrhotitic aplite with glassy quartz veinlets at intervals. These two dykes contain very consistent values over 40 feet where cut by the bore.

7. The No. 4 dyke in Bore 2 was 10ft. 3in. through where cut by the bore. Assays showed values ranging from 3 grains to over 6oz. of gold per ton. The Nos. 8 and 9 dykes were, on the whole, very low grade, but assays increased to 7dwts. 20gr. of gold per ton where patches of pyrrhotitic aplite occurred. The large proportion of felsite and non-sulphidic aplite were responsible for the poorness of dyke 9.

8. The following table would seem to indicate that No. 6 dyke, Bore 1, and No. 4 dyke, Bore 2, are one and the same; while No. 8 dyke, Bore 1, and Nos. 8 and 9 dykes considered together in Bore 2 are the same. The horizontal distances are quite in accordance with what is known of the line of strike on these dykes:—

—	Depth along inclination of bore.	Distance through.	Vertical depth.	Horizontal distance.
	ft. in. ft. in.	ft. in.	ft. in. ft. in.	ft. in. ft. in.
Bore 1—Dyke 6	549 0—564 0	15 0	476 0—488 0	248 6—282 0
Bore 2—Dyke 4	537 6—547 9	10 3	466 0—475 0	268 0—273 6
Bore 1—Dyke 8	597 6—623 0	25 6	518 0—539 6	298 0—311 5
Bore 2—Dykes 8 and 9 (as one) ...	580 4—609 6	29 2	502 0—528 0	290 0—304 7

9. The most important rock is the pyrrhotitic aplite, which forms the lodestuff and carried the gold.

10. The most important mineral is pyrrhotite, because it either carried the gold or is intimately associated with it. Pyrrhotite is an interesting form of magnetic sulphide of iron.

2.—BORING AT SANDSTONE.

1. In June, 1926, six sites were chosen at Sandstone, and boring was commenced on 13th October of that year. Three of these bores (Nos. 1, 2 and 3) were put down vertically to test at depth the Black Range reef, which has been followed in the workings of the Black Range mine. The other three bores

(Nos. 4, 5 and 6) are to be put down to test at depth the Sandstone reef. which has been followed in the workings of the Oroya Black Range mine. Five of these bores have now been completed, and the sixth bore is about to be commenced.

2. *Boring at the Black Range Mine.*—Boring at this mine was commenced on 13th October, 1926. Since this date three vertical bores have been completed, as follows:—

No. 1 Bore, depth 852 feet.
No. 2 Bore, depth 762ft. 2in.
No. 3 Bore, depth 774 feet.

In each of these three bores a powerful ore channel was met with, but the values disclosed were quite unpayable. The depths of these channels are as follow:—

No. 1 Bore: lode channel 611ft. 6in. to 640ft., *i.e.,* 28ft. 6in.
No. 2 Bore: lode channel 589ft. 6in. to 616ft. 6in., *i.e.,* 27ft.
No. 3 Bore: lode channel 567ft. to 585ft., *i.e.,* 18ft.

The highest values were from the No. 3 bore, where the quartz from 573ft. 11in. to 576ft. 2in. assayed 5dwts. 11gr. of gold per ton. The next highest assay was from 576ft. 2in. to 577ft. 3in. in the same bore, where the quartz assayed 3dwts. 1gr. of gold per ton.

It should be remarked that the channels revealed in these three bores were very powerfully schisted, and bore evidence of the action and crushing by tremendous earth forces. The enclosing quartz dolerite had been broken down to calcite-chlorite-leucoxene schist. The schist, however, contained practically no gold, the only gold of any note being recorded from the No. 3 bore, as already indicated.

Details of No. 1 *Bore*:

General.—This bore was put down vertically and reached a depth of 852 feet. Between 611ft. 6in. and 640ft. it passed through a well-defined channel, where powerful schisting had taken place and the country rock—quartz dolerite—had been broken down and mineralogically reconstructed into a calcite-leucoxene-chlorite schist. This channel is evidently the downward extension of the Black Range reef. The whole of the core from this schist channel was assayed, but the results were negative. Nine assays were made in three-feet sections. Of these, eight samples contained no gold at all, and one sample between 627 and 630 feet assayed three grains of gold to the ton.

There was only 3ft. 6in. of core from the surface to 60ft. This was divided into four samples and each was assayed separately, but no gold was found in them.

Geology.—The order of succession of rocks passed through was as follows:—

Depth. ft. in. ft. in.	Nature of Rock.
0 0—100 0	Rotten soft yellow and brownish ferruginous rock (zone of oxidation).
100 0—611 6	Fresh quartz dolerite with marked leucoxene.
611 6—640 0	Lode channel made of calcite-chlorite-leucoxene schist.
640 0—852 0	Fresh quartz dolerite with marked leucoxene.

Petrology.—The quartz dolerite is quite fresh. It is dense, somewhat mottled, and medium to fine in grain, showing white felspar and dark augite, with prominent white leucoxene on wetted surfaces. Occasionally glassy grains of quartz may be seen.

In section it is holocrystalline, and consists of pale brownish augite, altered felspar, quartz, leucoxene, and apatite. The felspar is ophitic, and micropegmatite is strongly developed.

Right up against the sheared channel at 640 feet the quartz dolerite is still massive, but it has been broken down into a quartz-calcite-chlorite rock. The quartz is all that is left of the original minerals, the felspar and augite being represented by calcite and chlorite.

Calcite-chlorite-leucoxene schist: This rock occurs between 611ft. 6in. and 640 feet, where the quartz dolerite has been so thoroughly schisted and affected by pressure and chemical changes as to produce a calcite-chlorite-leucoxene schist. The foliation planes are powerful; in fact the leucoxene has been drawn out into long streaks with their longer axes in one direction. Traces of the original quartz of the dolerite may be seen in the schist.

Details of No. 2 *Bore.*—The object of this bore was the same as No. 1, viz., to test at depth the Black Range reef. It reached a vertical depth of 774 feet. Like the No. 1 bore, it was throughout in quartz dolerite and its modifications. At 589ft. 6in. the lode channel was entered and continued to 616ft. 6in. The whole of the lodestuff was assayed, mostly in three-feet sections, and with disappointing results, as shown in the following table:—

From 589ft. 6in. to 600ft.	... No gold.
600ft. to 603ft. ...	... Gold, 5 grs. per ton.
603ft. to 612ft. 1in.	... No gold.
612ft. 1in. to 615ft. 6in. ...	... Gold, 14grs. per ton.
615ft. 6in. to 616ft. 6in. ...	... No gold.

The following is a brief description of the rock formations passed through:—

Depth. ft. in. ft. in.	Nature of Rock.
0 0— 97 0	Rotten rock from zone of oxidation.
97 0—589 6	Mottled quartz dolerite with leucoxene.
589 6—616 6	Lode channel consisting of schisted and highly altered quartz dolerite with quartz from 604ft. to 606ft. 6in.
616 6—774 0	Quartz dolerite.

Details of No. 3 *Bore.*—This bore, in conjunction with No. 2 and No. 3 bores, was put down vertically to test at depth the downward extension of the Black Range reef. It was stopped at 774 feet.

Values.—In the course of this bore four highly altered and crushed zones were met with. Their depth and values are as follow:—

Shear Zone.	Depth. ft. in. ft. in.		Assay result.
No. 1 ...	207 10—211 6	...	Gold, nil.
2 ...	497 9—501 3	...	Gold, nil.
3 ...	537 0—537 10	...	Gold, nil.
4 ...	567 0—585 0	...	
	567 0—569 0	...	Gold, nil.
	569 0—570 7	...	Gold, 10grs. per ton.
	570 7—573 11	...	Gold, nil.
	573 11—576 2	...	Gold, 5dwt. 11grs. per ton
	576 2—577 3	...	Gold, 3dwt. 1gr. per ton.
	577 3—585 0	...	Gold, nil.

The No. 4 shear zone is evidently the main channel. It consists of slightly pyritic carbonated and broken up quartz dolerite, but not so noticeably schisted as the rock from the main channels in the Nos. 1 and 2 bores.

The gold seems to have been confined to the siliceous (quartz) portion of the channel from 573ft. 11in. to 577ft. 3in., but here the values were less than 6dwt. of gold to the ton.

The zone of oxidation ended at 86 feet. Apart from the four schisted and altered channels referred to above, the whole of this bore was in mottled quartz dolerite similar to that met with in the Nos. 1 and 2 bores. At depth there is a tendency for the quartz dolerite to pass over in to epidiorite, *e.g.,* S. 4867 and S. 4868, from 600ft. and 633ft. 2in., respectively.

3. *Boring at Oroya Black Range Mine.*—Three vertical bores—Nos. 4, 5 and 6—are to be put down at this mine to test at depth the Sandstone reef. The Nos. 4 and 5 bores have been completed, and the No. 6 bore was commenced towards the end of December, 1927.

The No. 4 bore was stopped at 700ft. 4in. and the No. 5 bore at 753ft. 2in. Although in both bores well-defined shear zones were met with the gold content was negligible, as will be noted under the detailed description of each bore.

Details of No. 4 Bore.—The object of this bore was to test the downward extension of the Sandstone reef which had been worked in the Oroya Black Range mine. It was carried down vertically to a depth of 700ft. 4in.

Two rock formations were passed through, viz.: (1) a dense aphanitic pale greenish rock which formed the general country rock, and (2) a dense black dolerite dyke.

The country rock is a dense pale greenish fibrous zoisite amphibolite. R. 1/4423, S. 4911 from 700ft. 4in. consists largely of fibrous hornblende distributed amongst relict and possibly albitised felspathic material with some clear zoisite. Small shapeless individuals of quartz are scattered throughout this mass, together with grains of what appear to be remnants of leucoxene. This rock evidently forms a key to the origin of the fibrous amphibolites which were possibly basic rocks of basaltic to doleritic texture containing quartz. The country rock of the Nos. 4 and 5 bores is so considerably different lithologically from that met with in the Nos. 1, 2, and 3 bores, that it may be of a different age—possibly belonging to the older greenstones.

The details are as follow:—

Depth. ft. in. ft. in.	Nature of rock formation.
0 0—115 0	Creamy-coloured oxidised rock.
115 0—295 0	Dense fibrous amphibolite.
295 0—296 0	White quartz.
296 0—308 0	Dense fibrous amphibolite.
At 308ft.	An inch shear zone.
308 0—350 0	Dense fibrous amphibolite.
350 0—352 0	Channel 1, brecciated amphibolite.
352 0—359 0	Dense fibrous amphibolite.
359 0—361 0	Channel 2, brecciated amphibolite.
361 0—484 6	Dense fibrous amphibolite.
484 6—496 5	Fresh ophitic dolerite.
496 5—505 5	Dense fibrous amphibolite.
505 5—508 5	Channel 3, quartz with some iron pyrites and mispickel.
508 5—573 0	Dense fibrous amphibolite.
573 0—580 0	Channel 4, mainly quartz.
580 0—700 4	Dense fibrous amphibolite.

Sheared, brecciated and other channels.—This bore proved that considerable disturbance had taken place at different depths. Schisting and brecciation were distinct and open spaces filled with quartz were noted. All the rock from these disturbed zones was assayed. The following are brief descriptions of the structural and other changes met with:—

Channel 1, 350ft.-352ft.: Crushed rock with a cement of zoisite, epidote, and calcite, all recrystallised.

Channel 2, 395ft.-361ft.: Breccia of country rock, epidotised and cemented by carbonates.

Channel 3, 505ft. 5in.-508ft. 5in.: Quartz with some iron pyrites and mispickel in lath-shaped crystals. Only 1 foot of core obtained over these 3 feet.

Channel 4, 573ft-577ft.: Mainly white quartz. Only 1ft. 7in. of core received.

Channel 5, 577ft.-580ft.: Mainly quartz, somewhat cellular and iron-stained. Only 16 inches of core received.

From these remarks it would appear as if the main reef extended between depths of 573 and 580 feet.

Assays.—Any rock material showing distinct structural or mineralogical changes, or any evidence whatever of the presence of values, was assayed. The details are as follow:—

	Depth. ft. in. ft. in.	Result.
Channel 1 ...	350 0—352 0 ...	Gold, nil.
2 ...	359 0—361 0 ...	Gold, nil.
3 ...	505 5—508 5 ...	Gold, 21grs. per ton.
4 ...	573 0—577 0 ...	Gold, nil.
5 ...	577 0—580 0 ...	Gold, nil.

These assays show that the gold is in the quartz and not in the breccia.

Details of No. 5 Bore.—The object in putting this bore down was the same as for No. 4 bore, viz., to test the Sandstone reef at depth. It reached a total depth of 753ft. 2in.

This bore, like No. 4, passed through two similar rock formations, viz.: (1) a dense aphanitic pale green fibrous amphibolite, and (2) a black dolerite dyke.

The details of the rock material met with are as follow:—

Depth. ft. in. ft. in.	Nature of rock formation.
0 0—226 0	Decomposed oxidised greenstones.
226 0—450 0	Massive fibrous zoisite amphibolite.
450 0—455 0	No. 1 shear zone of calcite-chlorite schist.
455 0—508 0	Dense zoisite amphibolite.
508 0—514 0	No. 2 shear zone—similar to No. 1.
514 0—523 0	Dense zoisite amphibolite.
523 0—531 0	Dense black ophitic dolerite.
531 0—603 6	Dense zoisite amphibolite.
603 6—610 0	No. 3 shear zone with quartz.
610 0—753 2	Dense zoisite amphibolite.

Shear Zones.—This bore passed through three distinct shear or crush channels at the following depths:—

No. 1 shear channel, 450 to 455 feet.

No. 2 shear channel, 508 to 514 feet.

No. 3 shear channel, 603ft. 6in. to 610 feet.

The rock in these channels was crushed down in large part into a calcite-chlorite schist associated with some quartz. The auriferous solutions have evidently missed these channels.

Assays.—The assay samples were taken from the shear zones referred to, but the results were negative. The details are as follow:—

	Depth.	Assay results.
No. 1 shear zone ...	450ft to 455ft.	... Two assays: gold a trace.
No. 2 shear zone ...	508ft. to 514ft.	... Two nil; one a trace
No. 3 shear zone ...	603ft. 6in. to 610ft.	No gold.

No. 6 Bore.—This bore is also to test the Sandstone reef. At the present time it is down 273 feet, but the material has not yet been examined (5th January, 1928).

3.—BORING AT AJANA.

A deep bore was commenced at Ajana in October, the object being to test at a depth of about 700 feet the lead lodes in the Surprise mine. This bore was started on the western side of the lode at a depressed angle of 55 degrees and a horizontal bearing of 86 degrees.

Boring began in decomposed weathered granite, which continued to 22 feet, when hard granite came in. The granite extended to 415 feet, where a basic rock was encountered. The bore at the present time (25th January, 1928) is down 730 feet, and the material is under examination.

4.—GEOLOGICAL SURVEY OF KALGOORLIE.

Eighty-three rock sections were examined under the microscope, and it is fortunate that, notwithstanding their tremendous alteration, it was possible satisfactorily to determine nearly all of them.

5.—PETROLOGY OF WILUNA ORES.

Petrological investigations were carried out at intervals during the year on material from the Wiluna Company's mine, submitted by the State Mining Engineer and the Government Analyst.

The investigations for the State Mining Engineer were made with the specific object of determining the genesis and mutations of the ore. A lengthy report has already been presented by the writer (Annual Report, Department of Mines, 1925). It will therefore be sufficient to add the following extract from recent reports:—

"A remarkable feature is that there is no great evidence of schisting and shearing. The maceration, alteration, and reconstruction of the original rock are so great and thorough that your (State Mining Engineer's) conception of a shatter zone is very suggestive. The general microscopic evidence is in favour of mashing rather than shearing.

"It would appear that, concomitant with or slightly subsequent to the mashing process in the shattered zone, the rock mass was invaded by siliceous carbonated, alkaline, sulphidic, and auriferous solutions at high temperatures and pressures, with resultant metasomatism and reconstruction of the quartz dolerite greenstone into its present form of lode stuff. The granular sulphide of iron and prismatic forms of mispickel are without doubt of primary origin."

Amongst the material submitted by the State Mining Engineer was a black rock with which the writer was unacquainted at the time his original report was prepared. The rock in question came from a dyke which penetrates the west lode at the 200-feet level, north of the Central shaft. It is dense, black, and aphanitic, with a somewhat blocky tendency. In places it was peppered with minute specks of what proved microscopically to be leucoxene. Many small cleavage facets of felspar were scattered throughout the specimen.

Under the microscope it is seen to be made up of a mass of small and more or less clear plagioclase felspars lying in all azimuths. The ferro-magnesian constituents have disappeared; they have been replaced by patches of carbonates and pale green chlorite, both minerals being distributed interstitially between the felspars.

The slide is peppered with small grains and patches of leucoxenised ilmenite. The rock may be termed a carbonated chloritised dolerite.

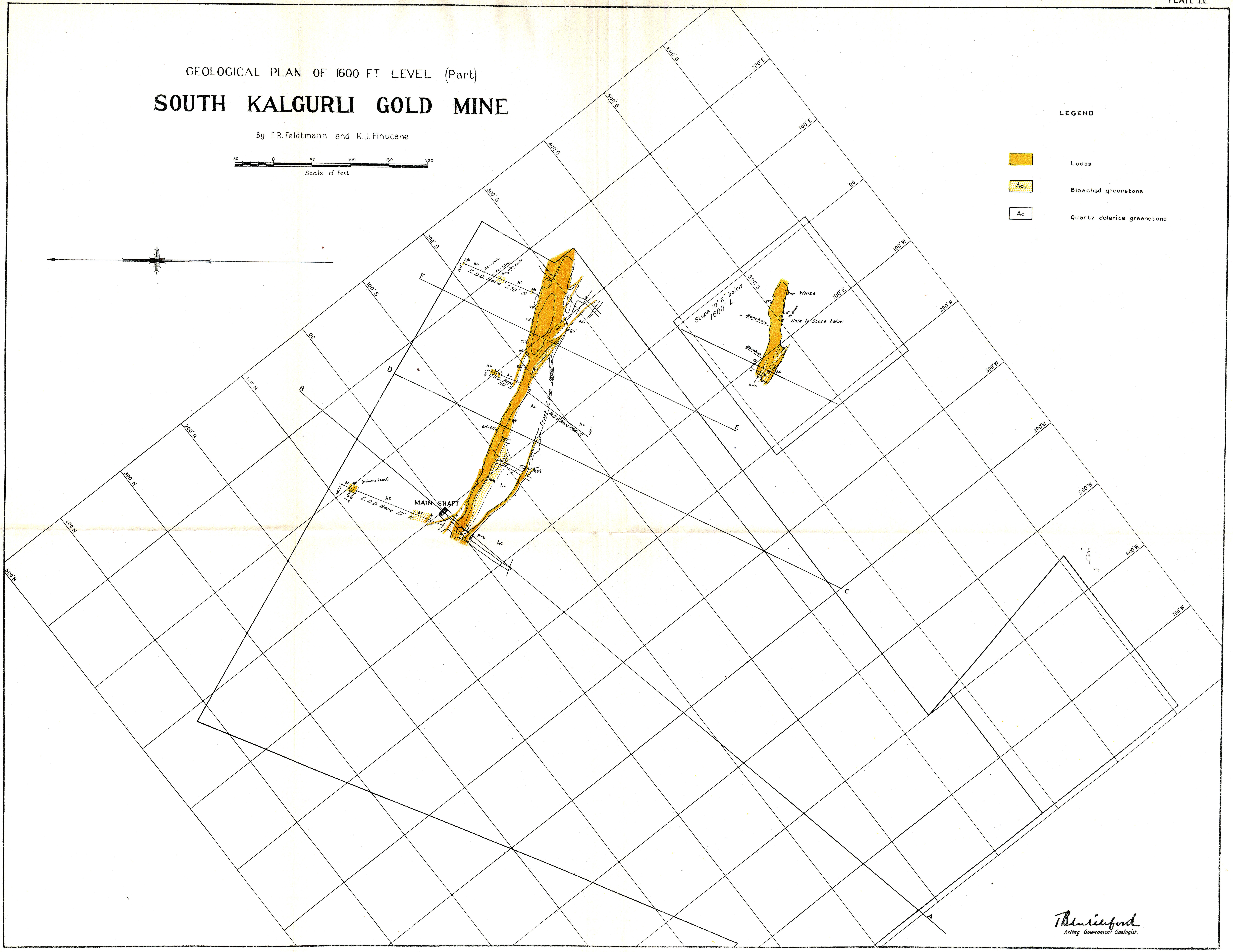
6.—PETROLOGICAL DETERMINATIONS FOR THE DEPARTMENT AND FOR THE PUBLIC GENERALLY.

This forms part of the routine work, but there was nothing of very special nature to report from the material examined.

The Government Analyst submitted a number of rocks, amongst which the most interesting were those from the Tabba Tabba Tinfield, where remarkable garnetiferous zoisite-uralite schists were apparently derived from epidiorites along lines of shearing and crushing.

Other samples examined came from the York district, Mullewa, Lake Grace area, Beverley, Glenelg Hills, Geraldton, and other places.

INDEX.


GEOLOGICAL PLAN OF 1600 FT LEVEL (Part)
SOUTH KALGURLI GOLD MINE
By F.R. Feldtmann and K.J. Finucane
50 0 50 100 150 200
Scale of Feet
LEGEND
Lodes
Bleached greenstone
Quartz dolerite greenstone
Acb
Ac
MAIN SHAFT
E.D.D. Bore 270' S
E.D.D. Bore 18' S
E.D.D. Bore 12' N
W.D.D. Bore 78' S
Ac (mineralised)
Stope 10' 6" below 1600' L.
Winze
Borehole
Hole to Stope below
600' S
500' S
400' S
300' S
200' S
100' S
00
100' N
200' N
300' N
400' N
500' N
200' E
100' E
100' W
200' W
300' W
400' W
500' W
600' W
700' W
A
B
C
D
E
F
Acting Government Geologist.

GEOLOGICAL PLAN OF 1700 FT LEVEL (Part)

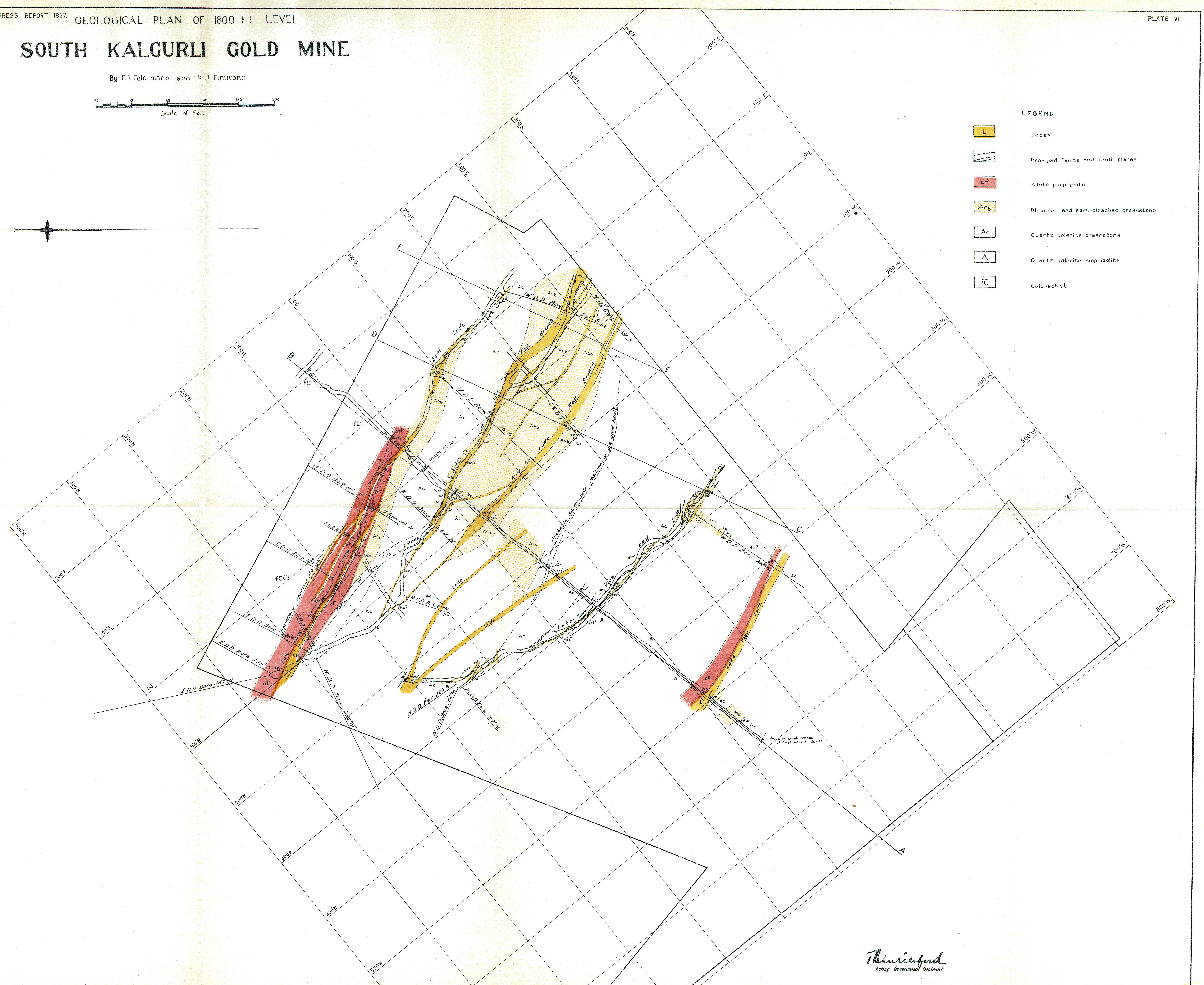
SOUTH KALGURLI GOLD MINE

By F.R. Feldtmann and K.J. Finucane

GEOLOGICAL PLAN OF 1800 FT LEVEL

SOUTH KALGURLI GOLD MINE

By F. R. Feldtmann and K. J. Finucane



T. Blatchford
Acting Government Geologist.

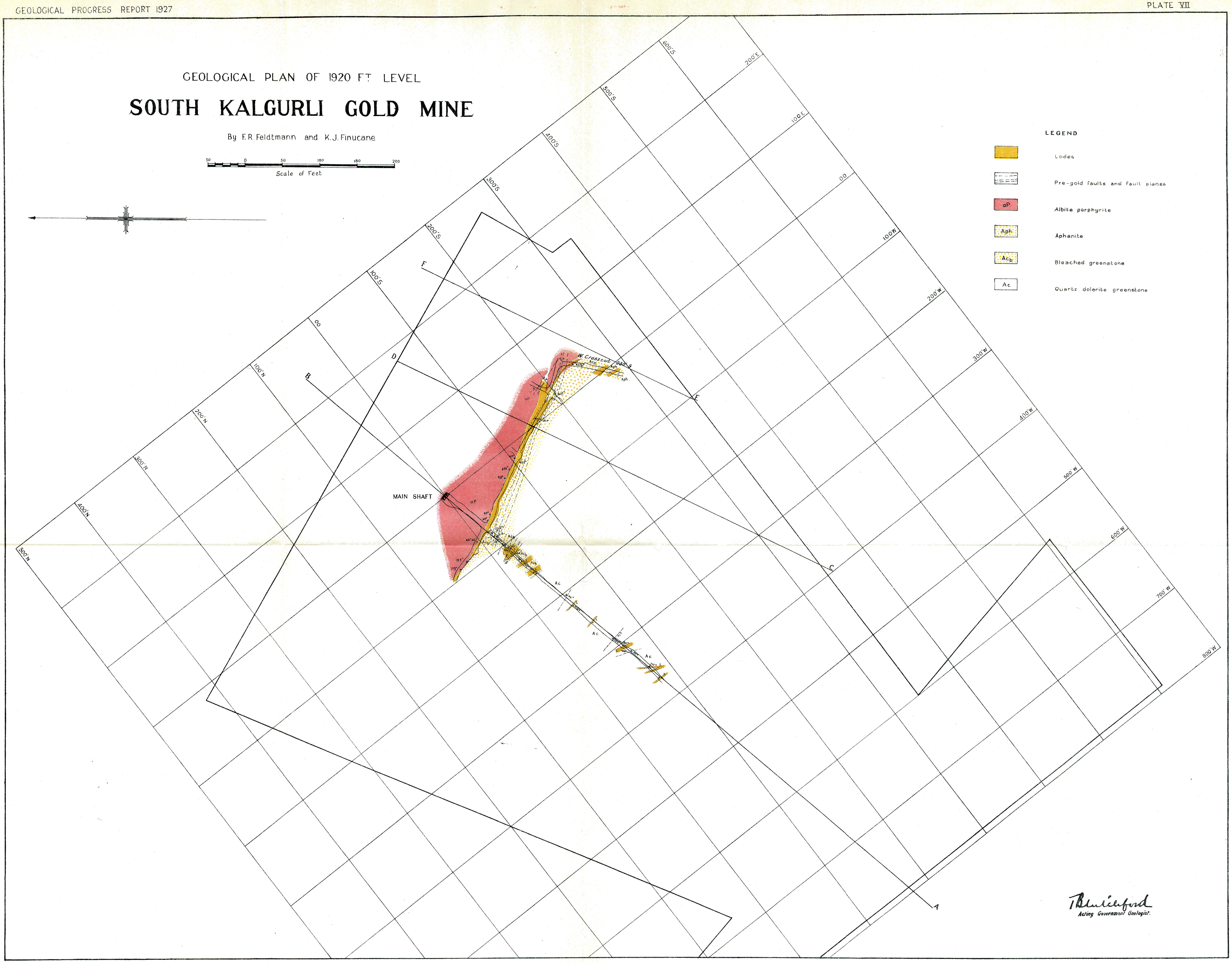
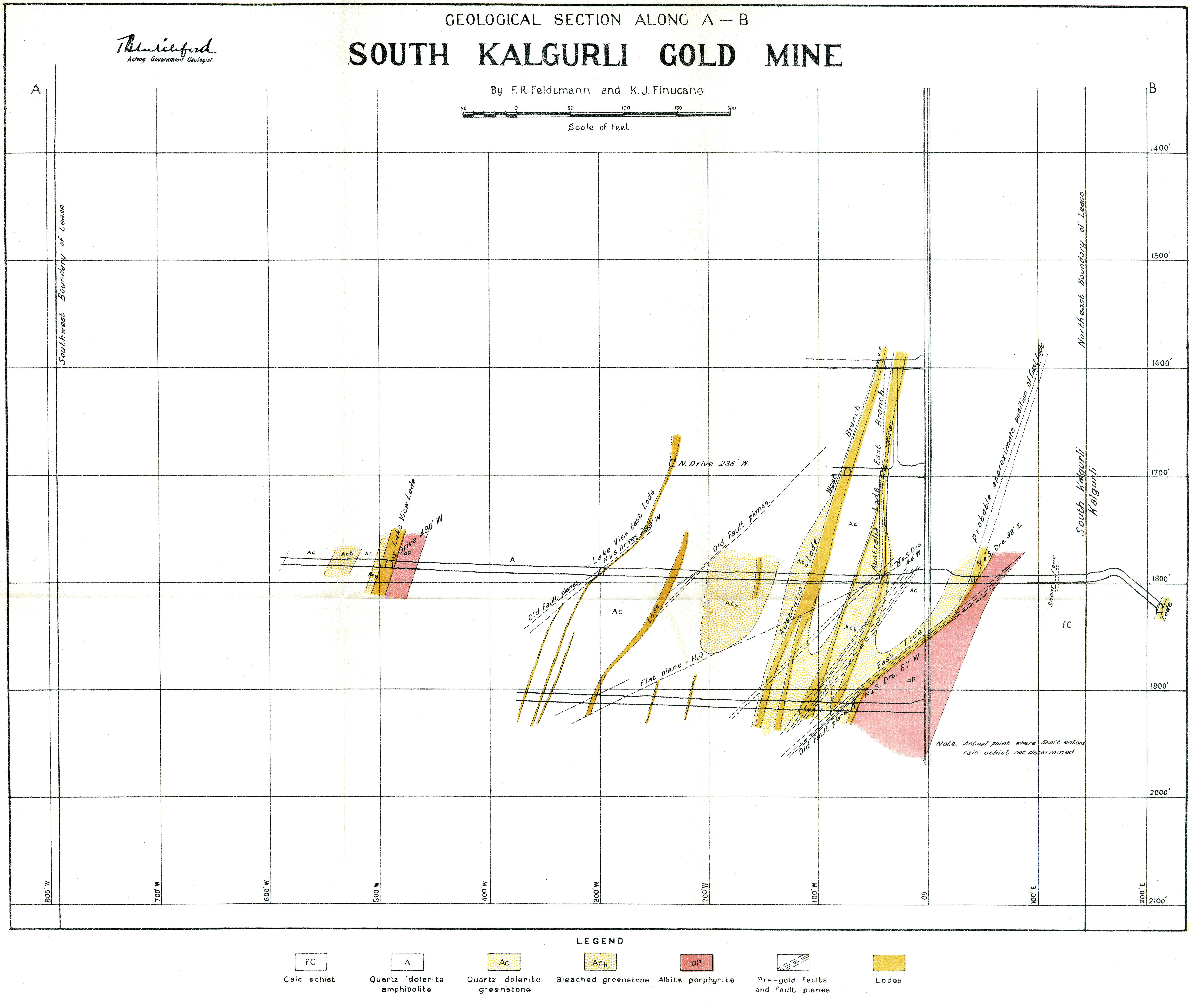

GEOLOGICAL PLAN OF 1920 FT. LEVEL
SOUTH KALGURLI GOLD MINE
By F.R. Feldtmann and K.J. Finucane
50 0 50 100 150 200
Scale of Feet
LEGEND
Lodes
Pre-gold faults and fault planes
aP Albite porphyrite
Aph Aphanite
Acb Bleached greenstone
Ac Quartz dolerite greenstone
MAIN SHAFT
W. Crosscut
600'S
500'S
400'S
300'S
200'S
100'S
00
100'N
200'N
300'N
400'N
500'N
200'E
100'E
00
100'W
200'W
300'W
400'W
500'W
600'W
700'W
800'W
A
B
C
D
E
F
T. Blatchford
Acting Government Geologist.

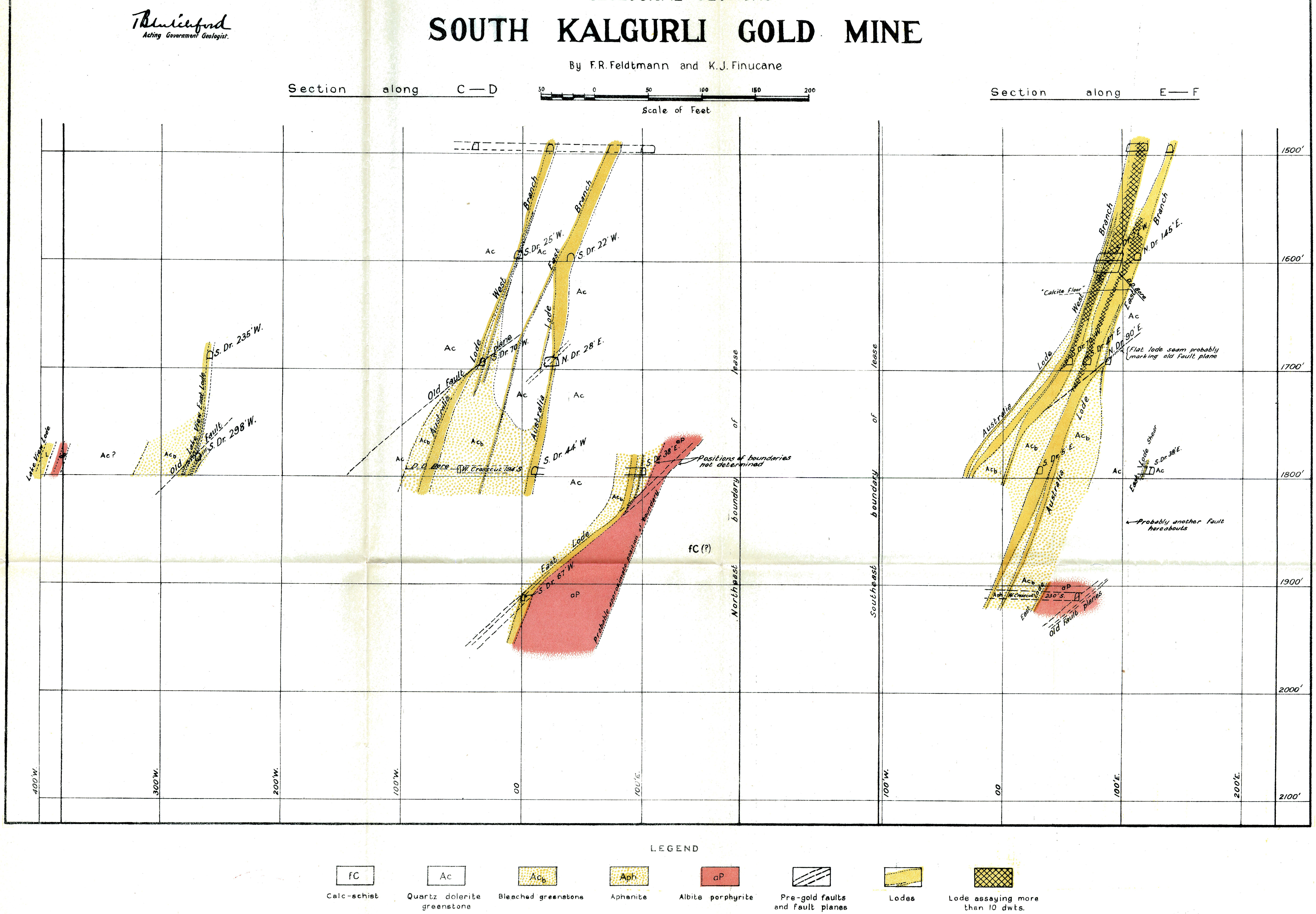
PLATE VIII


GEOLOGICAL SECTION ALONG A — B
SOUTH KALGURLI GOLD MINE
Acting Government Geologist.
By F. R. Feldtmann and K. J. Finucane
Scale of Feet
Southwest Boundary of Lease
Northeast Boundary of Lease
South Kalgurli
Kalgurli
Lake View Lode
S. Drive 490' W
Lake View East Lode
N & S. Drives 295' W
N. Drive 235' W
Old Fault planes
Flat plane - H₂O
West Branch
East Branch
Australia Lode
N & S. Drs 44' W
Probable approximate position of East Lode
N & S. Drs 38' E
East Lode
N & S. Drs. 67' W
Shear Zone
Note. Actual point where Shaft enters calc-schist not determined
1400'
1500'
1600'
1700'
1800'
1900'
2000'
2100'
800' W
700' W
600' W
500' W
400' W
300' W
200' W
100' W
00
100' E
200' E
LEGEND
Calc schist
Quartz dolerite amphibolite
Quartz dolerite greenstone
Bleached greenstone
Albite porphyrite
Pre-gold faults and fault planes
Lodes

GEOLOGICAL SECTIONS

SOUTH KALGURLI GOLD MINE

By F.R. Feldtmann and K.J. Finucane



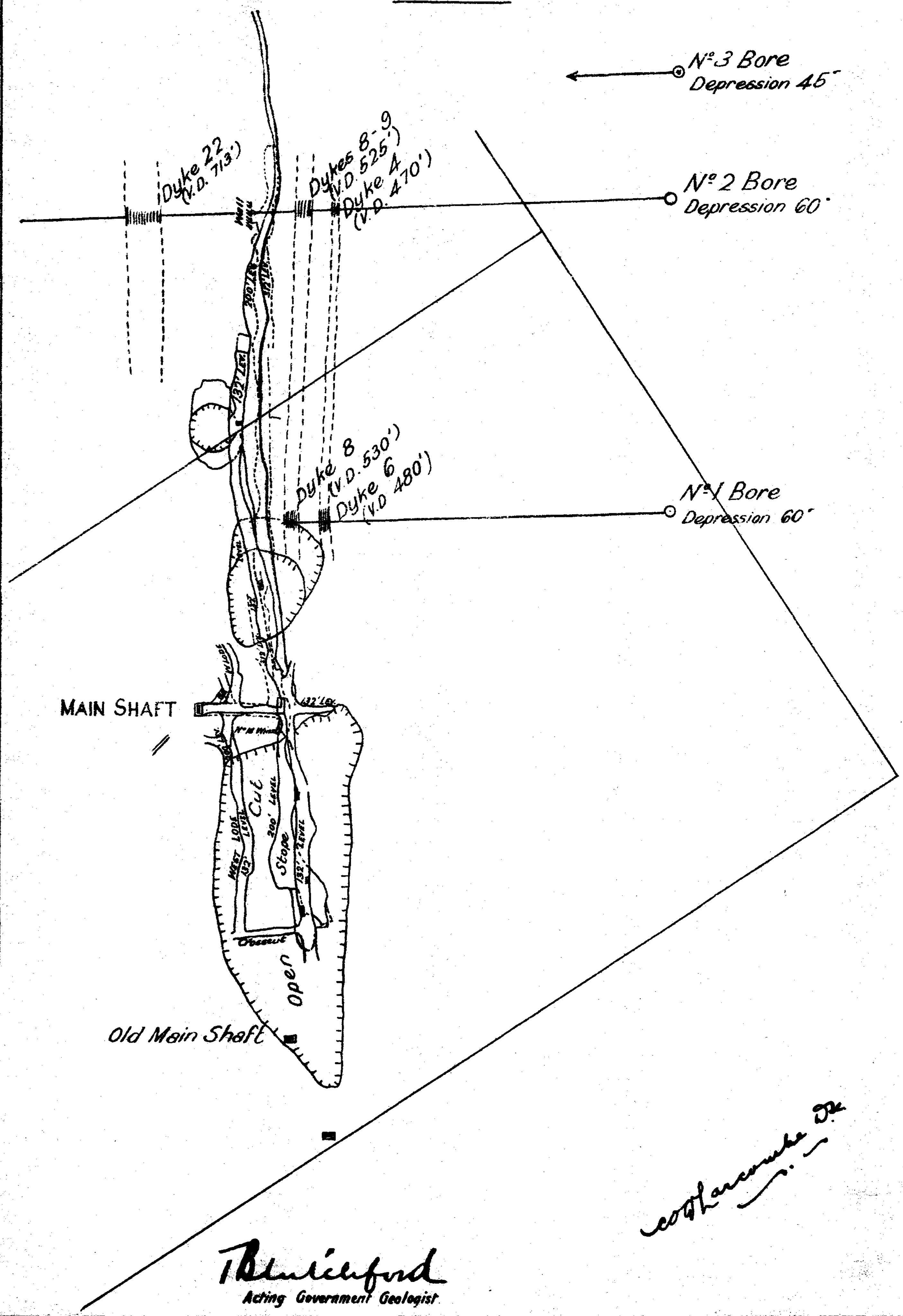
— Plan Shewing Bore Sites —

— TINDAL'S G. M. —

— COOLGARDIE G. F. —

100 0 100

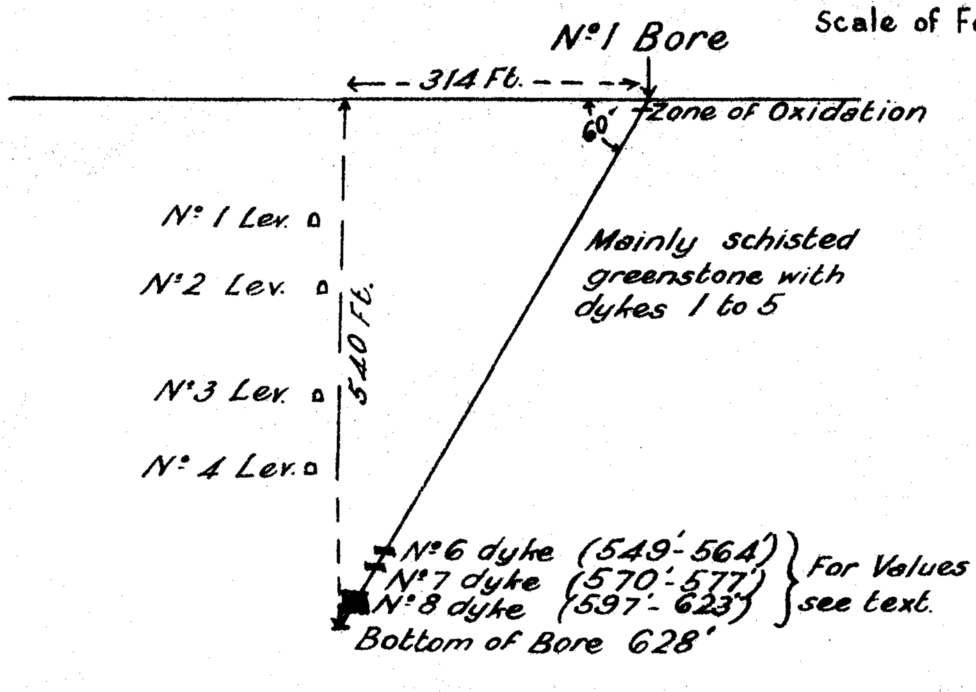
— Scale of Feet —



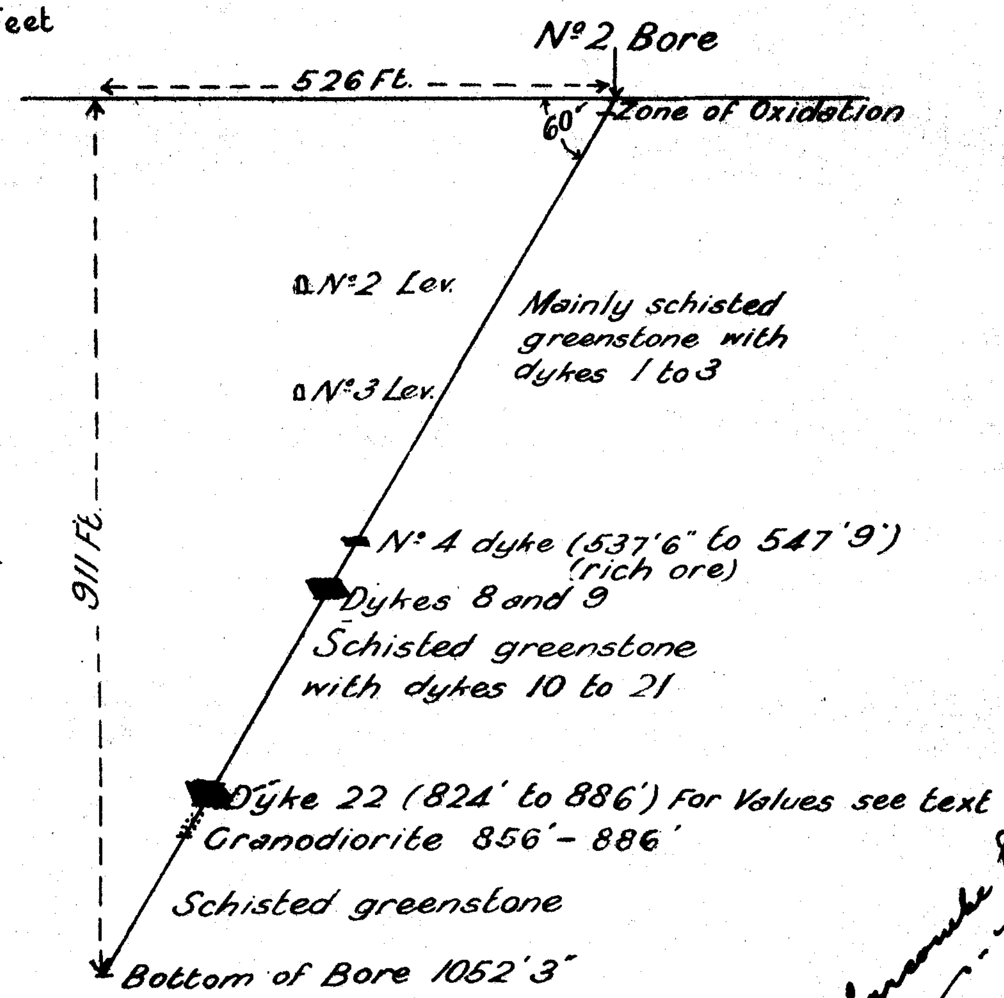
T. Blatchford
Acting Government Geologist

Geological Section Through Nos. 1 and 2 Bores
TINDAL'S GOLD MINE COOLGARDIE
Shewing positions of gold-bearing dykes.

200 0 200
Scale of Feet



— FIGURE 1 —



— FIGURE 2 —

T. Blatchford
Acting Government Geologist.

C. O. Kanoenke Del.

INDEX—continued.

DIVISION V.

SCHOOL OF MINES OF WESTERN AUSTRALIA.

School of Mines,
Kalgoorlie, January 20th, 1928.

The Under Secretary for Mines.

I beg to forward for the information of the Hon. the Minister my Report for the year 1927.

The continued depression in the Mining Industry and the shutting down of the Oroya Links had an influence on the School by reducing, to a small extent, the number of individuals in attendance. Those now taking classwork are younger, on the average, than the students of previous years. While there is little in the present outlook to induce youths to take up a systematic course of training, which, in their opinion, does not offer them much prospect of immediate profitable employment, there is need for the School to maintain efficient courses of instruction in its various departments, so that those who do attend may be suitably trained ready to take up responsible positions whenever a revival occurs in mining. Throughout Australia to-day the number of men being trained or ready to take up important positions in mining is much smaller than formerly. It may also be said that mining is in a transition stage, and that future mining and metallurgical work will call for officers with better technical training than in the past. A technical officer should have a sound knowledge of mining, metallurgy or engineering (mechanical or electrical), gained by the study of allied subjects and by experience. In any sudden demand for such officers, the schools which have kept up an efficient staff will have the best chance of supplying the requirements of the industry.

At the end of 1926, Mr. F. F. Allsop, B.Sc., Assistant in Chemistry, was transferred to the Analyst's Department in Perth, and at the beginning of 1927, Mr. C. Cecil, Assistant in Physics, was transferred to the Technical School. Both of these officers had rendered good service. It was found possible to carry on the work of the School during 1927 without filling either of these vacancies. By the resignation of the Research Metallurgist, Mr. A. S. Winter, at the beginning of the year, to take up the duties of Principal of the Zeehan School of Mines, the Kalgoorlie School lost a keen and capable officer. Through delay in the appointment of a successor and by the early retirement of the officer appointed in September, the amount of work conducted in the Experimental Plant was less than would have been accomplished had a Research Metallurgist been employed for the whole year, but the Lecturer in Metallurgy, Mr. Moore, with the assistance of his cadet, carried out a number of valuable investigations. In addition to the hours of duty made available by rearrangement of his classwork, Mr. Moore devoted a large amount of his own time to carrying out the tests in the plant and he deserves credit for the results obtained.

The classwork in Mathematics, and in Gas Engine and Indicator work proceeded along the lines of previous years, and good work was accomplished by the Lecturers and their students. No class was held in Engine Driving.

Satisfactory classes were conducted in first and second year Fitting and Turning. A number of lectures were delivered throughout the year, and a large amount of practical work was accomplished including various repairs in the Experimental Plant. Students greatly appreciated the visits with their instructor to the Printing Office and to the plants on the mines.

The Engineering and Drawing classes maintained a good average enrolment. Students were regular in attendance and made satisfactory progress with their studies. Steps are being taken to secure new models for use in connection with these classes, but there is need of a testing machine to facilitate the work of the more advanced students.

Fair classes were conducted in Preparatory and first year Physics and in Electrical Engineering. Three theses in second year Electrical Engineering were handed in by students completing their Associateship Courses. The Lecturer advocates the installation of a Diesel oil engine in order that students and others in the district may obtain instruction in the use of a prime mover which, he considers, will play an important part in the future development of mining.

Although the classes in Mining and Surveying were not large the attendance was satisfactory and students worked steadily. In the past these classes have helped many students to secure lucrative positions. One student entered for the University Annual Examinations in Surveying, and was successful.

The attendance at the classes in Geology, Mineralogy, and Petrology was above the average of recent years, and good work was accomplished, more particularly by the senior students. The geological excursions were confined to the Kalgoorlie district. Traverses and surveys were made along the line extending from the Eclipse to the Croesus Proprietary. The north end of the field was examined in detail, and a new geological section was made from near the Kalgoorlie racecourse for some miles across the north end to Parkeston. The Lecturer in Geology spent a considerable amount of time in research and underground work, the results of which he hopes will be of benefit to the Industry. At the suggestion of the State Mining Engineer, the Lecturers in Geology and in Physics have been enquiring into the tests to locate ore bodies, which are being conducted locally by geophysical methods.

The junior classes in Chemistry were well attended but, due probably to the uncertainty existing, under the present conditions of the industry, as to the chances of securing employment in positions which require technical knowledge, the senior classes had a poor enrolment. The Lecturer in Chemistry carried out the following investigations in the Experimental Plant:—

Beneficiation of ferruginous sands from the Great Victoria Gold Mine.

Flotation of ore from the Golden Horseshoe.
Concentration of hematitic ilmenite.
Concentration of silver-lead ore from Durack's lode.
Investigation of the Murdoch Copper Leaching Process.
Flotation of sulphide ore from Wiluna Gold Mines Limited, (3 investigations.)
Treatment of Riverina Proprietary ore.
Bromocyanidation of Kalgoorlie ores.

The last-named is not yet complete. Other investigations which are pending are, the method of treatment of ore from lode material cut in the Coolgardie bores, the treatment of ferruginous bauxite, and further tests on the concentration of hematitic ilmenite and on bromocyanidation.

This experimental research calls for continuous study of the current literature of concentration, flotation and other metallurgical processes, and necessitates a large amount of chemical and assay work. During the year the following estimations were made in connection with research in the Plant:—

Gold	989
Silver	164
Copper	222
Lead	146
Iron	455
Titanium	80
Other determinations	487
	2543

Reports on the investigations conducted during 1927 have been sent forward for publication as Bulletin No. 3 of the School of Mines. Previous reports and bulletins have received considerable notice outside Australia, and many requests for copies have been received. This indicates that the Department's effort to assist the industry, by affording facilities for the investigation of treatment problems, is appreciated.

Two candidates competed for the Junior and one for the Entrance Scholarship. There were no entries for the Senior Scholarship. A Junior Scholarship was awarded but the candidate for the Entrance Scholarship did not gain sufficient marks to qualify.

The following secured Diplomas for the Associateship Courses, and Certificates for Short Courses completed during the year:—

J. H. Terrell—Associateship in Mining.

C. R. Ehlers—Associateship in Mechanical and Electrical Engineering.

E. N. Johns—Associateship in Mechanical and Electrical Engineering.

C. C. Meredyth—Associateship in Mechanical and Electrical Engineering.

J. E. Manners—Associateship in Mining: Mine Surveyor's Certificate, and Geologist's Certificate.

Thanks are due to the following gentlemen for valuable donations made to the School in 1927:—

1. The General Manager,
   Messrs. Bewick, Moreing and Co.
   A number of pieces of experimental apparatus formerly used in the firm's assay office. The bottle agitator for cyanide testing will be fitted up in the School experimental plant and used in place of the present Abbe Pebble Mill.
2. Mr. R. Hamilton:
   44 volumes of "The Transactions of the American Institute of Mining and Metallurgical Engineers."
3. Mr. William Walker:
   82 copies of Bulletins and Reports of the Geological Survey Department of W.A., and 32 other technical publications.
4. The General Manager,
   Perseverance Gold Mine Limited:
   2 melting pots.
5. The Secretary, Government Hospital, Kalgoorlie.
   4 used X-Ray tubes.

Dr. Stilwell has been accommodated with a room at the School in which to carry on the work incidental to the survey he is making of the district.

Dr. Larcombe, besides carrying out his duties as Lecturer in Geology, throughout the year performed the duties of Acting Petrologist of the Geological Survey Department.

During my absence on leave for 3 months during the first half of 1927, Mr. T. Butement and Mr. B. H. Moore carried on the administrative work of the School in a satisfactory manner.

By furnishing reports as to assay values, and by indicating means of utilising and disposing of base metal ores, every effort has been made to give prospectors information likely to be of assistance to them. During 1927, 238 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	177
Assays for Silver	13
Assays for Copper	6
Assays for Lead	3
Sundry Assays	8
Mineral determinations ..	31
	238

The visit of the Hon, the Minister, S. W. Munsie Esqr., on the occasion of the Annual Dinner arranged by the Students' Association, and his comments on the work of the School, were greatly appreciated by the students and the staff.

For the benefit of youths who intend to take up farming pursuits, a tentative syllabus for a course in Agricultural Chemistry has been drawn up, and if sufficient inducement offers, classwork will be commenced during the coming year. The proposed course, which includes elementary chemistry, instruction in the use of tools, repair work, the elements of blacksmithing and internal combustion engines, will give to young men, who are turning their attention to farming, a valuable training in scientific principles and aid them in becoming successful farmers.

The statistics dealing with the enrolment of students and the examination results are forwarded herewith.

F. B. ALLEN,
Director, School of Mines.

SCHOOL OF MINES OF WESTERN AUSTRALIA.

EXAMINERS.

The following Examiners conducted the Examinations in November, 1927:—

Subject.	Examiners.
Preparatory Mathematics ...	F. B. Allen, M.A., B.Sc.; R. Davis, B.Sc., and E. Illidge, B.Sc.
Preparatory Chemistry	B. H. Moore, B.E., F.S.A.S.M.
Preparatory Physics and Electricity	D. McDougall, A.I.E.E.
Preparatory Geology	C. O. G. Larcombe, D.Sc., F.S.T.C., F.G.S.
Preparatory Mechanical Drawing	C. C. Meredyth, A.W.A.S.M.
Mathematics I.	E. H. Illidge, B.Sc., and R. Davis, B.Sc.
Mechanics—Theoretical	R. Davis, B.Sc., and E. H. Illidge, B.Sc.
Physics I.	R. Davis, B.Sc., and D. McDougall, A.I.E.E.
Chemistry I.	B. H. Moore, B.E., F.S.A.S.M., and R. R. Baxter, B.Sc.
Engineering Chemistry, I. and II.	L. W. Phillips, B.Sc., and B. H. Moore, B.E., F.S.A.S.M.
Assaying ... ... Assaying II. ... ... Metallurgy I. and II. ...	B. H. Moore, B.E., F.S.A.S.M., and G. S. Compton, B.Sc.
Petrology ... ... Mineralogy ... ... Geology	C. O. G. Larcombe, D.Sc., F.S.T.C., F.G.S., and G. S. Compton, B.Sc.
Mining Geology	C. O. G. Larcombe, D.Sc., F.S.T.C., F.G.S.
Practical Mathematics	E. H. Illidge, B.Sc.
Mechanical Drawing, I. and II. ...	J. H. Tate.
Applied Mechanics ... Building Construction ...	B. H. Moore, B.E., F.S.A.S.M., and J. H. Tate.
Mechanical Engineering I. and II. Machine Design	J. H. Tate and T. Butement, A.O.U.S.M.
Surveying I. and II. ... Mining I. and II.	T. Butement, A.O.U.S.M.
Electrical Engineering I. and II.	D. McDougall, A.I.E.E.
Fitting and Turning I. and II. ...	C. D. Slee.
Gas Engine ... ... Indicator	A. R. E. Bosustow.

JUNIOR SCHOLARSHIP.

Subject.	Examiners.
Physical Geography	C. O. G. Larcombe, D.Sc., F.S.T.C., F.G.S.
Mathematics ... ... English	F. B. Allen, M.A., B.Sc.

ATTENDANCES, 1927.

Subjects.	Effective Enrolment.		
	1st Term.	2nd Term.	3rd Term.
Elementary Mathematics	13	12	12
Preparatory Mathematics	33	24	22
Preparatory Chemistry	31	28	27
Preparatory Physics	22	15	14
Preparatory Mechanical Drawing ...	39	32	27
Preparatory Geology	8	9	7
Mathematics—First Course	15	14	12
Theoretical Mechanics	6	7	7
Physics—First Course	7	7	6
Chemistry—First Course	6	6	3
Engineering Chemistry—Second Course...	1	1	1
Assaying—First Course	...	2	2
Assaying—Second Course	1	1	1
Geology—First Course	4	4	4
Mining and Economic Geology	3	3	3
Mineralogy	2	2	2

ATTENDANCES—*continued.*

Subject.	Effective Enrolment.		
	1st Term.	2nd Term.	3rd Term.
Petrology	3	3	3
Mining—First Course	1	2	2
Mining—Second Course (Mine Sampling)	4	...	...
Mining—Second Course (Ore Dressing) ...	3	2	2
Mining—Second Course (Accounts and Administration)	...	2	2
Surveying—First Course	5	5	5
Surveying—Second Course	2	3	3
Mechanical Drawing—First Course ...	16	15	15
Mechanical Drawing—Second Course ...	9	8	8
Applied Mechanics	7	5	5
Mechanical Engineering—First Course ...	11	10	10
Mechanical Engineering—Second Course	2	2	2
Building Construction	1	1	1
Electrical Engineering—First Course ...	5	4	4
Electrical Engineering—Second Course	2	2	2
Fitting and Turning—First Course ...	28	20	17
Fitting and Turning—Second Course ...	8	6	6
Machine Design	2	2	2
Practical Mathematics	3	3	3
Gas Engine and Indicator	13	9	8
Total Enrolments	316	271	250
Individual Students	117	101	91

—	1926.			1927.		
	1st Term.	2nd Term.	3rd Term.	1st Term.	2nd Term.	3rd Term.
Total Enrolments	365	274	247	316	271	250
Individual Students	140	108	98	117	101	91

EXAMINATION RESULTS.

The following table shows the passes obtained by students of the Western Australian School of Mines, Kalgoorlie, at the Annual Examinations held in November, 1927, including the Supplementary Examinations held in February, 1927:—

Subject.	Class of Pass.		
	Credit.	Pass.	Totals.
Elementary Mathematics	...	6	6
Preparatory Mathematics	...	1	1
Preparatory Mathematics (Arithmetic) ...	1	5	6
Preparatory Mathematics (Algebra) ...	...	3	3
Preparatory Mathematics (Geometry) ...	...	2	2
Preparatory Chemistry	...	8	8
Preparatory Physics	...	5	5
Preparatory Drawing	4	15	19
Preparatory Geology	...	1	1
Mathematics—First Course	...	...	...
Mathematics—First Course (Algebra) ...	...	...	...
Mathematics—First Course (Geometry)	...	...	...
Mathematics—First Course (Trigonometry)	...	...	...
Theoretical Mechanics	1	4	5
Physics	...	5	5
Chemistry—First Course	...	1	1
Engineering Chemistry—Second Course	...	1	1
Assaying—First Course	1	1	2
Geology	...	3	3

EXAMINATION RESULTS—*continued.*

Subject.	Class of Pass.		
	Credit.	Pass.	Totals.
Mineralogy ...	...	1	1
Petrology ...	...	2	2
Mining Geology—Surveyors' Course ...	...	1	1
Mining and Economic Geology ...	...	2	2
Mining—First Course ...	...	2	2
Mining—Second Course (Ore Dressing) ...	...	2	2
Mining—Second Course (Mine Sampling)	...	2	2
Mining—Second Course (Mine Accounts and Administration)	...	2	2
Surveying—First Course ...	3	2	5
Surveying—Second Course ...	1	2	3
Mechanical Drawing—First Course ...	6	7	13
Mechanical Drawing—Second Course ...	5	3	8
Applied Mechanics ...	2	2	4
Mechanical Engineering—First Course ...	2	8	10
Mechanical Engineering—First Course (Gas Engine)	3	2	5
Mechanical Engineering—First Course (Indicator)	...	5	5
Building Construction ...	...	1	1
Electrical Engineering—First Course ...	2	2	4
Electrical Engineering—Second Course	1	4	5
Fitting and Turning—First Course ...	...	10	10
Fitting and Turning—Second Course ...	3	3	6
Mechanical Engineering—Second Course	2	...	2
Machine Design ...	4	...	4
Practical Mathematics ...	1	...	1
Totals ...	42	130	172

ASSAYER'S 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.
Woolf, M.	K.S.M.	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.
Carrigg, C. G.	K.S.M.	November, 1922.
Greer, J. H.	K.S.M.	November, 1922.
Mundle, E. B.	K.S.M.	November, 1922.
Esdaile, A. N.	K.S.M.	November, 1923.
Paterson, A. V.	K.S.M.	November, 1923.
Simons, H. H. J.	P.T.S.	November, 1924.
Brown, C. W.	K.S.M.	November, 1926.
Lynch, T.	K.S.M.	November, 1926.

INDUSTRIAL CHEMIST'S CERTIFICATES.

The following have gained Certificates:—

Cecil, C.	K.S.M.	November, 1921.
Chapman, F.	P.T.S.	November, 1922.
Carrigg, C. G.	K.S.M.	November, 1922.
Esdaile, A. N.	K.S.M.	November, 1922.
Paterson, A. V.	K.S.M.	November, 1924.

MINE SURVEYOR'S 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. R. W.	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.
Agnew, R. J.	K.S.M.	November, 1922.
Crutchett, E. G.	K.S.M.	November, 1922.
Davies, I.	K.S.M.	November, 1922.
Eddy, J. T.	K.S.M.	November, 1922.
Rosenberg, J. M.	K.S.M.	November, 1923.
Gibbons, L. P. J.	K.S.M.	November, 1924.
Terrell, J. H.	K.S.M.	November, 1924.
Manners, J. E.	K.S.M.	November, 1926.
Golding, H. D.	K.S.M.	November, 1927.
Jensen, H.	K.S.M.	November, 1927.

DRAUGHTSMAN'S CERTIFICATES.

The following have gained Certificates:—

Galt, W.	K.S.M.	November, 1915.
Butement, J. C.	K.S.M.	November, 1915.
Edmondson, F. C.	K.S.M.	November, 1915.
Lang, J. H.	K.S.M.	November, 1915.
Davies, W.	K.S.M.	November, 1917.
Weselman, C.	K.S.M.	November, 1917.
Thompson, E. P.	K.S.M.	November, 1920.
Gill, L. J.	K.S.M.	November, 1921.
Macbeth, R. A.	K.S.M.	November, 1921.
Rosenberg, J. M.	K.S.M.	November, 1921.
Spalding, J.	K.S.M.	November, 1922.
Taylor, H.	K.S.M.	November, 1922.
Sinclair, R. J.	K.S.M.	November, 1925.
Thrupp, T. W.	K.S.M.	November, 1926.
Ehlers, C. R.	K.S.M.	November, 1927.
Johns, E. N.	K.S.M.	November, 1927.
Meredyth, C. C.	K.S.M.	November, 1927.

ELECTRICIAN'S CERTIFICATES.

The following have gained Certificates:—

Galt, W.	K.S.M.	November, 1915.
Butement, J. C.	K.S.M.	November, 1915.
Edmondson, C. F.	K.S.M.	November, 1915.
Lang, J. H.	K.S.M.	November, 1915.
Davies, W.	K.S.M.	November, 1917.
Weselman, C.	K.S.M.	November, 1917.
Thompson, E. P.	K.S.M.	November, 1920.
Gill, L. J.	K.S.M.	November, 1921.
Macbeth, R. A.	K.S.M.	November, 1921.
Rosenberg, J. M.	K.S.M.	November, 1921.
Spalding, J.	K.S.M.	November, 1923.
Taylor, Harry	K.S.M.	November, 1923.
Meredyth, C. C.	K.S.M.	November, 1925.
Sinclair, R. J.	K.S.M.	November, 1925.
Thrupp, T. W.	K.S.M.	November, 1926.
Johns, E. N.	K.S.M.	November, 1927.
Ehlers, C. R.	K.S.M.	November, 1927.

GEOLOGIST'S CERTIFICATES.

Gabel, J.	K.S.M.	November, 1911.
Leevers, J. C.	K.S.M.	November, 1916.
Mundle, E. B.	K.S.M.	November, 1920.
Agnew, R. J.	K.S.M.	November, 1923.
Terrell, J. H.	K.S.M.	November, 1927.
Manners, J. E.	K.S.M.	November, 1927.

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, 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.
Getty, A. (K.S.M.), Diploma in Metallurgy, November, 1916.
LeMesurier, C. R. (K.S.M.), Diploma in Metallurgy, November, 1916.
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.
Macbeth, 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.
Rowledge, H. P. (P. and K.), Diploma in Metallurgy, November, 1922.
Taylor, Harry (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1923.
Spalding, J. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1924.
Sinclair, R. J. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1925.
Cecil, Clyde (K.S.M.), Diploma in Metallurgy, November, 1926.
Thrupp, Thos. W. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1926.
Ehlers, C. R. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1927.
Johns, E. N. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1927.
Meredyth, C. C. (K.S.M.), Diploma in Mechanical and Electrical Engineering, November, 1927.
Manners, J. E. (K.S.M.), Diploma in Mining, November, 1927.
Terrell, J. H. (K.S.M.), Diploma in Mining, November, 1927.

ENGINE-DRIVER'S CERTIFICATES.

The following Students of the School of Mines have passed the examinations held by the Chief Inspector of Machinery during 1927 for various Engine-driver's Certificates:—

Name.	Certificate.
Baker, C. E.	Third Class Competency.
Craib, W.	do. do.
Beames, H. M.	Winding Competency.
Coombs, G. F.	Boiler Attendant's Competency.
Ferguson, S. M. J.	do. do. do.
Willoughby, A. E.	do. do. do.
Sinclair, R. J.	Internal Combustion Competency.
Wadeisha, J.	Second Class Competency.
Willoughby, A. E.	Third Class Competency.

SCHOLARSHIP EXAMINATIONS, 1927.

JUNIOR SCHOLARSHIP.

Candidate.	District.
Smith, Allan	Kalgoorlie.
Godenzi, W.	Kalgoorlie.

Allan Smith gains the Junior Scholarship.

ENTRANCE SCHOLARSHIP.

Candidate.	District.
Pinkus, C. A.	Kalgoorlie.

Scholarship not awarded.

THE CRITCHLEY PARKER PRIZES.

The following have been recommended for the prizes offered by Critchley Parker, Esq., Melbourne:—

R. L. Nevile—The Industrial Australian and Mining Standard.
A. R. Glendinning—Mining Standard Publication.

MECHANICS' INSTITUTE (KALGOORLIE) FREE MEMBERSHIP PRIZES.

The following have been recommended:—

Crocos, A. J.; Pinkus, C. A.; Stubbs, F. H.; and Taggart, J. H.

INSTITUTE OF MINE SURVEYORS OF W.A. INC. PRIZES. (Books).

For these the following have been recommended:—

Metallurgical side, T. Lynch; Mining side, H. Jensen; Engineering side, A. J. Crocos.

YEAR'S FEE SCHOLARSHIPS.

Subject.	Holder.
Preparatory Mechanical Drawing ...	Stevens, D. A.
Theoretical Mechanics	Warman, C. H.
Assaying I.	Illidge, E. E.
Mine Sampling	Finucane, K. J.
Surveying I.	Arnatt, R. F.
Surveying II.	Finucane, K. J.
Mechanical Drawing I.	McNeill, J. B.
Mechanical Drawing II.	Parker, P. J.
Applied Mechanics	Manners, J. E.
Mechanical Engineering I.	Parker, P. J.
Mechanical Engineering II.	Baker, S.
Machine Design	Glendenning, E. R.
Gas Engine	Taggart, J. H. C.
Engineering I.	Warman, C. H.
Fitting and Turning II.	Warman, C. H.
Practical Mathematics	Warman, C. H.

LIST OF TEXT BOOKS FOR 1928.

ELEMENTARY AND PREPARATORY MATHEMATICS.

Arithmetic	Pendlebury
Algebra, Part I.	Baker & Bourne
School Geometry, Parts 1 to 6... ...	Hall & Stevens
Elementary Mensuration	F. H. Stevens

PREPARATORY PHYSICS.

Manual of Mechanics and Heat ...	Gregory & Hadley
Class Book of Physics, Parts 6, 7, 8 ...	Gregory & Hadley

PREPARATORY CHEMISTRY.

Elementary Study of Chemistry ...	McPherson & Henderson
Chemical Calculations	Whitely

PREPARATORY GEOLOGY.

Outlines of Physiography	Herbertson
Geology for beginners	Watts

PREPARATORY MECHANICAL DRAWING.

Machine Drawing, Book I. ...	Jones
Practical Plane and Solid Geometry ...	Morris & Husband

MATHEMATICS—FIRST COURSE.

Elementary Algebra	Baker & Bourne
New Trigonometry for Schools ...	Borchardt & Perrot
School Geometry, Parts 1 to 6 ...	Hall & Stevens
Chambers' Mathematical Tables ...	

THEORETICAL MECHANICS.

The Elements of Statics	Loney
The Elements of Dynamics	Loney
The Elements of Hydrostatics ...	Loney

PRACTICAL MATHEMATICS.

No prescribed Text Book.

CHEMISTRY—FIRST COURSE.

Elementary Study of Chemistry ...	McPherson & Henderson
Chemical Calculations	Whitely

ENGINEERING CHEMISTRY—FIRST COURSE.

No prescribed Text Book.

ENGINEERING CHEMISTRY—SECOND COURSE.

No prescribed Text Book.

ASSAYING—FIRST COURSE.

Manual of Fine Assaying	Fulton, C. H.

ASSAYING—SECOND COURSE.

Technical Methods of Ore Analysis ...	Low, A. H.

METALLURGY—FIRST COURSE.

Stamp Milling and Cyaniding ...	Thompson
Text Book of Ore Dressing	Richards

METALLURGY—SECOND COURSE.

No prescribed Text Book.

GEOLOGY.

An introduction to Geology	Scott

MINERALOGY.

Elements of Mineralogy, Crystallography	Moses & Parsons
Blow-Pipe Analysis	

PETROLOGY.

Minerals in Rock Sections	Laquer
Petrology for Students	Harker

MINING AND ECONOMIC GEOLOGY.

A Text Book of Mining Geology ...	Park

SCHOOL OF MINES OF WESTERN AUSTRALIA.

KALGOORLIE.

ANNUAL EXAMINATIONS, 1927.

(T) Denotes Terminal Pass only.

PREPARATORY CHEMISTRY.

Pass—
Terrell, Walter
Pinkus, Clifford A.
McGowan, Frederick J
McNeil, James B.
Taggart, Joseph H. C.
Scott, John S.
Stubbs, Frank H. R.
Smith, John W.

PREPARATORY MECHANICAL DRAWING.

Credit—
Stevens, David A.
Pinkus, Clifford A.
McMahon, Edward J. (T.)
Terrell, Walter

Pass—
Graham, Kenneth J.
Rinaldi, Gerard J.
Stubbs, Frank H.
Crisp, Charles J.
Reynolds, William C.
Main, Eric W.
Marshall, Melville (T)
Ditchburn, Raymond (T)
Grafton, Arthur L.
Blackmore, Stanley J.
Black, Charles H. ⎫
Wilson, Thomas H. ⎪
Leahy, John ⎬ Equal.
Green, Daniel J. ⎪
Oldfield, Robert H. ⎭

PREPARATORY PHYSICS.

Pass—
Terrell, Walter
Pinkus, Clifford A.
Stubbs, Frank H. R.
Graham, Kenneth J.
Wilson, Thomas H.

PREPARATORY GEOLOGY.

Pass—
Stubbs, Frank H. R.

PREPARATORY MATHEMATICS.
(All Sections).

Pass—
McMahon, Edward J. (T)

PREPARATORY MATHEMATICS.
Arithmetic Section.

Credit—
Browne, George T.

Pass—
Rinaldi, Gerard J. (T)
McMahon, Edward J. (T)
Evans, Basil P.
Horton, Charles W.
Graham, Kenneth J.

Algebra Section.

Pass—
McMahon, Edward J.
Lehman, Kenneth (T)
Browne, George T.

Geometry Section.

Pass—
McMahon, Edward J. (T)
Horton, Charles W.

ELEMENTARY MATHEMATICS.

Pass—
Taggart, Joseph H. C.
Grafton, Arthur A. L.
Marshall, Melville (T)
Reynolds, William C. (T)
Wilson, Thomas H.

THEORETICAL MECHANICS.

Credit—
Warman, Charles H.

Pass—
Crocos, August J.
Newman, Henry B.

PHYSICS.
FIRST COURSE.

Pass—
Shaw, Edward R.
Gardner, Denis
Oakley, Philip R. ⎫
Colgan, Richard R. ⎭ Equal

CHEMISTRY.
FIRST COURSE.

Pass—
Butler, James W.

ENGINEERING CHEMISTRY.
SECOND COURSE.

Pass—
Lynch, Thomas

ASSAYING.
FIRST COURSE.

Credit—
Illidge, Ernest H.

Pass—
Arnatt, Robert F.

GEOLOGY.
FIRST COURSE.

Pass—
Jensen, Harold
Arnatt, Robert F.
Bell, William R.

MINERALOGY.

Pass—
Golding, Hollis D.

PETROLOGY.

Pass—
Golding, Hollis D.
Lynch, Thomas

MINING AND ECONOMIC GEOLOGY.

Pass—
Weatherall, Martin V.
Jensen, Harold

MINING GEOLOGY.
SURVEYOR'S COURSE.

Pass—
Golding, Hollis D.

ANNUAL EXAMINATIONS—*continued.*

(T) Denotes Terminal Pass only.

MINING.
FIRST COURSE.

Pass—
Arnatt, Robert F.
Bell, William R.

MINING.
SECOND COURSE.
(Mine Sampling.)

Credit—
Finucane, Kevin J.
Jensen, Harold

ORE DRESSING.

Pass—
Golding, Hollis D.
Jensen, Harold

MINE ACCOUNTS AND ADMINISTRATION.

Pass—
Jensen, Harold
Golding, Hollis D.

SURVEYING.
FIRST COURSE.

Credit—
Arnatt, Robert F.
Warman, Charles H. } Equal.
Weatherall, Martin V. }

Pass—
Glendenning, Angus R. } Equal.
Bell, William R. }

SURVEYING.
SECOND COURSE.
(Provisional pending plan.)

Credit—
Finucane, Kevin J.

Pass—
Nevile, Roy L.

SURVEYING.
SECOND COURSE.

Pass—
Jensen, Harold
(Written examination 1926, Plan now accepted).

MECHANICAL DRAWING.
FIRST COURSE.

Credit—
McNeill, James B.
Allan, Archibald T.
Browne, George T.
Schellenberger, Otto
Horton, Charles W.
Smith, John W.

Pass—
Bingley, Horace F.
Julian, Jack H.
Koetsveld, William A.
Hudson, James R.
Bingley, William L.
Mathews, Frank R.
Barber, Harry M.

MECHANICAL DRAWING.
SECOND CORUSE.

Credit—
Parker, Peter J.
Wynne, Walter E.
Shaw, Edward R.
Oakley, Philip R.
Warman, Charles H.

Pass—
McGowan, Frederick J.
Crocos, August J.
Manners, Joseph E.

APPLIED MECHANICS.

Credit—
Manners, Joseph E.
Nevile, Roy L.

Pass—
Sargent, Richd. A. S. } Equal.
Parker, Pete J. }

MECHANICAL ENGINEERING.
FIRST COURSE.

Credit—
Parker, Peter J.
Warman, Charles H.

Pass—
Newman, Henry B.
Beames, Hurtle M.
McGowan, Frederick J.
Crocos, August J.
Matthews, Clifford W.
Manners, Joseph E.
Lehman, Kenneth
Nicholson, Arthur W.

MECHANICAL ENGINEERING.
SECOND COURSE.

Credit—
Baker, Stanley
Neville, Roy L.

MECHANICAL ENGINEERING.
FIRST COURSE.
(Gas Engine.)

Credit—
Taggart, Joseph H.
Nevile, Roy L.
Glendenning, Angus R.

Pass—
Illig, Herbert M.
Nicholson, Arthur W.

INDICATOR.

Pass—
Glendenning, Angus R. } Equal
Nevile, Roy L. }
Taggart, Joseph H. } Equal
Nicholson, Arthur W. }
Illig, Herbert M.

MACHINE DESIGN.

Credit—
Glendenning, Angus R.
Nevile, Roy L.

BUILDING CONSTRUCTION.

Pass—
Nevile, Roy L.

ELECTRICAL ENGINEERING.
FIRST COURSE.

Credit—
Warman, Charles H.
Manners, Joseph E.

Pass—
Crocos, August J.
Sargent, Richard A. S.

ELECTRICAL ENGINEERING.
SECOND COURSE.
(Provisional pending thesis.)

Pass—
Glendenning, Angus R.
Nevile, Roy L.

ELECTRICAL ENGINEERING.
SECOND COURSE.

Credit—
Johns, Edward N.

Pass—
Lloyd, Robert F.
Ehlers, Charles R.
(Written examinations completed. Theses now accepted.)

FITTING AND TURNING.
FIRST COURSE.

Pass—
Richard, Gilbert
Main, Edward W.
Graham, Kenneth J.
Pinkus, Clifford A.
Stubbs, Frank H. R.
Browne, George T. (T)
Julian, Jack H.
Crisp, Charles J.
Groves, Albert
Hogan, George S. (T)

FITTING AND TURNING.
SECOND COURSE.

Credit—
Warman, Charles H.
McGowan, Frederick J.
Crocos, August J.

Pass—
Barber, Harry M.
Irving, George F.
Horton, Charles W.

MACHINE DESIGN.

Credit—
Newman, Henry B.
Meredyth, Cyril C.
(Written examination completed. Theses now accepted.)

PRACTICAL MATHEMATICS.

Credit—
Warman, Charles H.

SUPPLEMENTARY EXAMINATIONS.
(Held in February, 1927.)

ELEMENTARY MATHEMATICS.

Pass—
Black, Charles H.

MATHEMATICS.
FIRST COURSE.
(Algebra Section.)

Pass—
Golding, Hollis D.

PHYSICS.
FIRST COURSE.

Pass—
Crocos, August J.

THEORETICAL MECHANICS.

Pass—
Johns, Edward N.
Manners, Joseph E.

REPORT on Investigation into the Beneficiation of Ferruginous Sands from the Great Victoria Gold Mine.

The material submitted by Hon. H. Seddon, M.L.C., for investigation consisted of cyanided ferruginous sand residues from the treatment of the ore from the Great Victoria Gold Mine, Burbidge.

The purpose of this investigation was to determine whether by any method of concentration this material could be made to possess a marketable value on account of its iron and gold content, or could be converted into a product of sufficiently high grade in iron to be suitable for blast furnace smelting. In the investigation three main determinations have been considered advisable, viz.—

1. The possibility of concentrating the iron value in a rich concentrate of smaller weight.
2. A determination of the course followed by the gold, *i.e.*, whether it tended to concentrate in one or other of the products of the concentration, or distribute itself uniformly between the products.
3. The possibility of concentrating the alumina in one or other of the products so as to produce a suitably high-grade bauxite for aluminium production purposes.

The following analysis shows the composition of the sands as received:—

	Per cent.	
H_2O, CO_2, etc. (loss on ignition	2·8	
Fe	46·0	(equivalent to 65·7 per cent. Fe_2O_3.
SiO_2	24·5	
Al_2O_3	4·2	
CaO	trace	
MgO	1·4	
Au	0·4	dwt. per ton (2,240 lbs.)

As the material is already comparatively high grade so far as concerns the iron content, and is very low in both gold and alumina, it was decided that the best method of attacking the problem consisted in investigating methods whereby a definite system of concentration of the iron could be adopted, and the procedure to be adopted to give the best results in this direction, and then determining the course followed by the gold and the alumina during this process of concentration.

Preliminary experiments, both on the sands as received and after regrinding, carried out at the end of 1926, showed conclusively that neither gravity nor magnetic concentration could be depended on to bring about any marked improvement in the grade of the ore. Since magnetic concentration appeared to be out of the question because of the very low difference in the magnetic properties of the iron minerals and the other constituents in the raw sands as received, it was decided to convert the ferric oxide to magnetic oxide, Fe_3O_4, by reduction with charcoal. This reduction was easily carried out by heating the sands, without or with further grinding, with a slight excess (3 per cent.) of powdered charcoal to a temperature between 500° and 600° C.

$$3Fe_2O_3 + C = 2Fe_3O_4 + CO.$$

The product was found to be strongly magnetic and readily amenable to magnetic concentration. The result of a preliminary test on reduced material is shown in the preliminary report of 3rd December, 1926, by Mr. Winter and myself, and shows that there is a possibility of producing a high-grade concentrate in this way.

In furtherance of this investigation more detailed experimental testing has now been carried out on this material, converted as above described, both in its original comparatively coarse state, and after much finer grinding. As a result of these tests, it has become possible to formulate definite conditions of operation of the magnetic concentrator, which will enable a high recovery of iron to be made in the form of a high-grade concentrate from the sands without secondary crushing. A summary of these results will be found on pages 6, 7, 8.

In carrying out the tests to determine the most suitable operating conditions, variations have been made in the principal factors affecting the magnetic concentration, viz., fineness of grinding of ore, rate of feed, current used to produce the magnetic field, height of magnets from travelling belt, and re-treatment of the products, with combinations of variations of the above conditions.

It has been found that satisfactory concentration of the iron content could be obtained under several different sets of conditions, but that the best results, both as regards the percentage recovery and the grade of the concentrate, were obtained from the treatment of the product obtained by the reduction of the coarse sands as received, and that uniform and consistently high recoveries and high-grade concentrates could be obtained under a comparatively simple set of operating conditions, details of which are set out on page 6.

In carrying out each test made to determine the effect of variation of conditions, the appearance of the products was used as a guide in deciding whether re-treatment of any or all of the products under the same or slightly altered conditions was necessary to produce clean concentrates and tails. Therefore, in some cases several re-treatments of all the products were necessary.

In the most suitable conditions for concentration as finally determined, two methods of treatment present themselves as being capable of yielding similar results, although in practice the simpler method would receive the preference. These methods are as follows:—

1. Production of a high-grade concentrate without paying special attention to the production of low-grade tails and either a high or low-grade middle product, followed by a re-treatment of the combined tails and middlings from the first concentration under slightly different conditions as regards the setting of the magnets. This method produces a low-grade tail and a high-grade first and second concentrate together with a middling of only slightly lower grade than the first and second concentrates, which is therefore included in the final concentrates.

2. Production of high-grade concentrate and middle product together with low-grade tails by a single treatment with the first magnet set as far as possible from the feed belt and the second magnet set very close to the belt. This is the simpler procedure, and as the results are similar to those obtained by the first method, this mode of treatment is to be preferred.

The results of comparative tests under similar conditions on reduced sands after re-grinding show that no advantage is gained by further comminution of the material, and therefore no expense need be incurred for fine grinding. In fact, it appears possible to obtain better results on the coarse material than on the re-ground sands.

The results of Tests 17 to 23 show that it is apparently possible, by the method above described, to produce a concentrate of very high grade, up to nearly 67 per cent. iron, and at the same time to obtain a recovery in these concentrates of over 90 per cent. of the total iron, the weight of concentrate varying up to 84 per cent. of the original sands This result must be considered highly satisfactory as the material is originally of comparatively high grade in iron, and a concentration of this metal into a high-grade product without serious loss of iron in the tails becomes increasingly difficult as the percentage of iron in the original ore increases. A total loss of 10 per cent., or less, of the iron content cannot be considered excessive, although by further treatment this loss might be appreciably reduced, but at the same time the cost of such treatment would probably exceed the value of the iron recovered.

Until the method of procedure adopted in Tests 19 to 23 was arrived at, the different conditions of operation were varied by setting the magnets at different distances from the travelling belt and by varying the current used for producing the magnetic field.

The procedure finally adopted as being the most simple and as giving the best results is as follows: In the first treatment No. 1 magnet is set as far as possible from the belt, while No. 2 is set slightly lower. The concentrate from this treatment is set aside as a finished product, while the middlings and tails are re-treated together after lowering both magnets an equal amount. The concentrate and middle product from this second treatment are very high grade and constitute, with the first concentrate, the final concentrate of high grade, while the residue from the re-treatment is of sufficiently low grade to be discarded. In both the first treatment and the re-treatment the current used to produce the magnetic field is 1 ampere at 220 volts, so that the power for this purpose is comparatively small.

GRADING ANALYSIS OF ORIGINAL SANDS, ASSAY VALUE—46·0 per cent., Fe.

I.M.M. Screen.	Weight, per cent.	Fe per cent.	Distribution, per cent.
+ 40	17·5	37·0	14·5
+ 60	30·9	44·8	31·0
+ 80	25·6	47·0	26·9
+ 100	4·1	47·2	4·3
+ 150	14·6	47·6	15·6
— 150	7·2	47·0	7·6

MAGNETIC CONCENTRATION TESTS.

Test No.	Tails.			Middlings.			Concentrate.		
	Weight per cent.	Iron, per cent.	Per cent. of total iron.	Weight, per cent.	Iron, per cent.	Per cent. of total iron.	Weight, per cent.	Iron, per cent.	Per cent. of total iron.
Reduced Sands—Assay Value, 53·76 per cent. Fe.									
1	28·13	25·0	13·88	25·78	56·8	28·90	46·09	62·9	57·22
2	5·26	8·4	0·83	25·19	56·8	26·85	69·55	55·4	72·31
Reduced Sands Re-ground—Assay Value, 53·76 per cent. Fe.									
3	17·56	27·6	9·10	21·41	57·8	23·25	67·64	59·0	61·03
4	19·41	28·1	10·11	16·99	59·6	18·77	63·59	60·3	71·10

Reduced Re-ground Sands—Assay Value, 53·3 per cent. Fe.

GRADING ANALYSIS.

I.M.M. Screen.	Weight, per cent.	Fe, per cent.	Distribution, per cent.
+ 40	0·9	54·94	0·91
+ 60	2·4	52·52	2·33
+ 80	15·3	50·70	14·36
+ 100	7·2	55·76	7·43
+ 150	31·3	55·96	32·43
— 150	42·9	53·54	42·52

Test No.	Tails weight per cent.	Tails iron, per cent.	Tails per cent. of total iron	Middlings weight, per cent.	Middlings iron, per cent.	Middlings per cent. of total iron	Concentrate weight, per cent.	Concentrate iron, per cent.	Concentrate per cent. of total iron
5	37·56	40·6	28·76	2·34	55·0	2·43	60·09	60·7	68·80
6	41·09	41·6	31·99	5·48	58·8	6·03	53·42	62·0	61·98
7	8·33	15·2	2·37	42·91	50·8	40·83	48·75	62·2	56·73

RE-GROUND SANDS REDUCED—ASSAY VALUE, 53·3 PER CENT. FE.

Test No.	Product.	First Treatment.			Re-treatment of Middlings.				Total Weight, per cent.	Iron, per cent., Average Value.	Recovery, per cent. of total Fe.
		Wt., per cent.	Fe, per cent.	Per cent. of total Fe.	Weight, per cent. Of Middlings.	Weight, per cent. Of Orig. Ore.	Fe, per cent.	Per cent. of total Fe.			
8	Tails ...	12·1	28·2	6·35	40·5	16·5	46·0	7·6	28·6	38·46	20·4
	Middlings ...	40·7	52·2	39·47	...	...	...	...	...	...	...
	Concentrate ...	47·2	61·8	54·18	59·5	24·2	57·2	13·8	71·4	60·24	79·6
9	Tails	5·7	14·2	1·5	21·1	10·4	30·2	10·5	16·1	7·44	7·0
	Middlings ...	49·2	50·6	47·2	51·3	25·2	53·4	25·5	25·2	45·40	23·1
	Concentrate ...	44·4	61·6	51·3	27·6	13·6	59·8	12·7	58·0	61·23	69·9
10	Tails	7·3	15·8	2·2	6·6	3·9	20·0	1·5	11·2	17·20	3·7
	Middlings ...	59·7	54·7	61·9	21·0	12·6	47·8	11·4	12·6	47·80	11·4
	Concentrate ...	33·0	57·4	35·9	72·4	43·2	59·8	49·0	76·2	58·70	84·9
11	Tails	4·5	14·4	1·2	18·28	7·6	23·6	3·4	12·1	20·2	4·6
	Middlings ...	41·7	42·6	36·9	51·6	21·5	50·6	20·5	21·5	50·6	20·5
	Concentrate ...	53·8	61·0	61·9	30·1	12·6	54·6	12·9	66·4	59·8	74·9
12	Tails	9·6	15·6	2·9	8·5	3·5	32·6	2·2	13·1	20·1	5·0
	Middlings ...	39·2	50·9	38·1	51·0	21·1	50·6	20·2	21·1	50·6	20·2
	Concentrate ...	51·0	60·6	59·0	40·5	14·6	56·4	15·7	65·6	59·7	74·8
13	Tails	6·8	13·1	1·7	10·2	4·1	23·0	1·7	10·9	16·2	3·3
	Middlings ...	40·2	48·9	37·1	60·1	24·2	50·5	22·6	24·2	50·5	22·6
	Concentrate ...	53·0	62·4	61·2	29·7	11·9	57·8	12·7	64·9	61·6	74·1
14	Tails	8·5	18·4	2·9	11·3	5·8	27·1	2·9	14·3	21·9	5·8
	Middlings ...	51·2	52·4	49·8	46·1	23·6	53·1	23·3	23·6	53·1	23·2
	Concentrate ...	40·3	63·2	47·3	42·6	21·8	58·4	23·6	62·2	61·4	70·9
	REDUCED SANDS RE-GROUND TO—100 MESH I.M.M.—ASSAY VALUE, 58·73 PER CENT. Fe.										
15	Tails	5·2	26·7	2·6	23·2	11·2	33·3	6·8	16·4	31·2	9·4
	Middlings ...	48·3	49·3	43·7	38·0	18·4	49·3	16·7	18·4	49·3	16·7
	Concentrate ...	46·5	62·6	53·4	38·7	18·7	59·6	20·5	65·2	61·7	73·9
16	Tails	29·5	36·9	18·4	11·4	2·9	43·8	2·2	32·4	37·5	20·6
	Middlings ...	25·9	58·3	34·1	38·2	9·9	57·0	18·2	9·9	57·0	18·2
	Concentrate ...	44·6	62·8	47·4	50·4	13·0	62·6	13·7	57·6	62·7	61·1

RE-GROUND SANDS REDUCED—ASSAY VALUE, 54·34 PER CENT, FE.

Grading Analysis.

I.M.M. Screen.	Weight, per cent.	Iron, per cent.	Distribution, per cent.
+ 40	0·75	58·17	0·81
+ 60	2·70	54·13	2·69
+ 80	12·60	52·92	12·29
+ 100	4·90	54·13	4·69
+ 150	26·05	54·94	26·40
— 150	53·10	54·33	53·10

Test No.	Product.	Wt., per cent.	Fe, per cent.	Per cent. of total Fe.	Weight, per cent. Of Middlings.	Weight, per cent. Of Orig. Ore.	Fe, per cent.	Per cent. of total Fe.	Total Weight, per cent.	Iron, per cent., Average Value.	Recovery, per cent. of total Fe.
17	Tails	6·9	21·8	2·8	16·1	6·7	29·1	3·6	13·6	25·2	6·4
	Middlings ...	41·5	49·8	38·4	16·1	6·7	34·3	4·3	6·7	34·3	4·3
	Concentrate ...	51·5	61·4	58·8	67·7	28·1	58·4	30·5	79·6	60·3	89·3
18	Tails	0·8	12·9	0·2	10·8	6·2	25·4	2·9	7·0	24·0	3·1
	Middlings ...	56·6	49·2	51·4	19·0	10·7	29·9	5·9	10·7	29·9	5·9
	Concentrate ...	42·5	61·6	48·3	70·1	39·7	58·2	42·6	82·2	59·9	90·9
19	Tails ... }	...	...	...	8·6	4·5	23·2	1·9	4·5	23·2	1·9*
	Middlings }	56·5	48·6	50·7	29·9	20·3	40·7	15·2	20·3	40·7	15·2*
	Concentrate ...	43·5	61·4	49·3	61·0	31·7	57·2	33·4	75·2	59·6	82·7*
	Tails	...	...	...	10·2	2·1	19·4	0·7	6·6	21·9	2·6
	Middlings ...	...	...	...	41·9	8·5	31·3	4·9	8·5	31·3	4·9
	Concentrate ...	...	...	...	47·9	9·7	53·7	9·6	84·9	58·9	92·3
20	Tails	...	...	...	32·0	27·8	18·8	9·9	27·8	18·8	9·9
	Middlings ...	86·9	50·7	51·6	32·2	28·0	63·2	3·2	28·0	63·2	33·7
	Concentrate ...	13·1	66·9	16·6	35·8	31·1	66·7	39·5	48·2	66·7	56·2

* Retreatment of middlings and tails.

REDUCED SANDS—ASSAY VALUE, 54·74 PER CENT. FE.

Grading Analysis.

I.M.M. Screen.	Weight, per cent.	Iron, per cent.	Distribution, per cent.
+ 40	16·4	43·4	12·9
+ 60	28·3	52·7	27·1
+ 80	25·6	58·2	27·1
+ 100	5·5	60·2	6·0
+ 150	15·7	60·0	17·1
— 150	8·5	63·4	9·8

Test No.	Product.	First Treatment.			Retreatment of Middlings.				Total Weight, per cent.	Iron, per cent., Average Value.	Recovery, per cent. of total Fe.
		Wt., per cent.	Fe., per cent.	Per cent. of total. Fe.	Weight, per cent. Of Middlings.	Weight, per cent. Of Orig. Ore.	Fe, per cent.	Per cent. of total Fe.			
21	Tails	39·3	37·6	27·6	5·9	2·7	21·0	1·1	42·0	36·5	28·7
	Middlings ...	45·3	63·3	53·6	28·9	13·1	64·8	15·9	13·1	64·8	15·9
	Concentrate ...	15·4	65·4	18·8	65·2	29·5	66·5	36·6	44·9	66·1	55·4
22	Tails ... }	...	...	...	27·4	22·6	16·3	6·8	22·6	16·3	6·8
	Middlings }	82·5	51·0	78·5	40·1	33·1	62·2	38·4	33·1	62·2	38·4
	Concentrate ...	17·5	66·0	21·5	32·5	26·8	66·5	33·2	44·3	66·3	54·7
23	Tails ... }	...	...	...	33·0	28·7	25·9	13·9	28·7	25·9	13·9
	Middlings }	87·2	51·6	84·2	45·8	33·9	62·6	39·6	33·9	62·6	39·6
	Concentrate ...	12·8	66·3	15·8	28·1	24·5	66·9	30·6	37·3	66·7	46·4
24	Tails	25·9	19·4	9·6	...	...	...	...	25·9	19·4	9·6
	Middlings ...	62·5	64·0	76·0	...	...	...	...	62·5	64·0	76·0
	Concentrate ...	11·6	65·4	14·4	...	...	...	...	11·6	65·4	14·4
25	Tails	26·4	23·2	11·4	...	...	...	...	26·4	23·2	11·4
	Middlings ...	62·0	64·4	74·3	...	...	...	...	62·0	64·4	74·3
	Concentrate ...	11·6	66·4	14·3	...	...	...	...	11·6	66·4	14·3
26	Tails	25·8	26·5	12·6	...	...	...	...	25·8	26·5	12·6
	Middlings ...	22·9	60·6	25·6	...	...	...	...	22·9	60·6	25·6
	Concentrate ...	51·3	65·4	61·8	...	...	...	...	51·3	65·4	61·8
27	Tails	26·6	25·2	12·5	...	...	...	...	26·6	25·2	12·5
	Middlings ...	22·0	60·6	24·9	...	...	...	...	22·0	60·6	24·9
	Concentrate ...	51·4	65·2	62·6	...	...	...	...	51·4	65·2	62·6
28	Tails	28·5	23·4	12·8	...	...	...	...	28·5	23·4	12·8
	Middlings ...	60·5	63·0	73·4	...	...	...	...	60·5	63·0	73·4
	Concentrate ...	11·0	65·0	13·8	...	...	...	...	11·0	65·0	13·8
29	Tails	4·7	19·4	1·7	...	...	...	...	4·7	19·4	1·7
	Middlings ...	68·2	54·6	68·1	...	...	...	...	68·2	54·6	68·1
	Concentrate ...	27·1	60·8	30·2	...	...	...	...	27·1	60·8	30·2

Remarks on Tests.

Tests 1, 2.—The first concentrate and middlings were re-concentrated. The final middlings were not of sufficiently high grade to be included in the concentrate, and therefore the recovery of iron was low.

Tests 3, 4, 5, 6, 7.—These tests were carried out on re-ground reduced sands, and the recovery was low for the same reasons as in Tests 1 and 2.

Tests 8-14.—These tests involved re-treatment of middlings from the first concentration for the purpose of producing low-grade tails and final middlings, and final high-grade concentrate. The recovery in the concentrates was satisfactory but the loss in the middlings was too high, and the grade of the same not sufficiently low to warrant them being discarded.

Tests 15, 16.—Similar tests on reduced re-ground sands passing 100-mesh I.M.M. screen to ascertain if fine grinding improved the recovery.

Tests 17-19.—The grade of the middlings and tails was very much reduced and the recovery in the concentrate increased, but the continued re-treatment of the products necessary to obtain this result involved too many operations for this method to be practicable.

Test 20.—This involves one re-treatment of combined tails and middlings. The concentrates and final middlings are of sufficiently high grade to constitute a finished product and the total recovery is high.

Test 21.—This test was carried out to show the necessity of re-treating the tails as well as the middlings from the first concentration, as the total recovery fell off, although the grade of the final concentrates and middlings was very high.

Test 22.—This is a duplicate of Test 20, which gave similar results.

Test 23.—This is a duplicate of Tests 20 and 21, except that the current used for production of the magnetic field was 0.9 ampere instead of 1 ampere. The grade of the concentrate was satisfactory, but the recovery was lower than in Tests 21 and 22.

Tests 24, 25, 28.—These were carried out to ascertain the possibility of securing similar results to those of Tests 20 and 21 with one concentration only; in this case, No. 1 magnet was set as far from the travelling belt as possible, while No. 2 magnet was set at the same distance as in the re-treatment in

Tests 20, 21. The results are practically equal to those in Tests 20 and 21; operating conditions are greatly simplified and less plant is necessary.

Tests 26, 27.—These were carried out on the same lines as Tests 24, 25, 28, but with No. 1 magnet lowered to the same level as No. 2 magnet, both being at the same level as No. 2 magnet in Tests 24, 25, 28, The results show much the same total recovery, but the grade of the total concentrate is slightly less than in Tests 24, 25, 28. This is only a variation of operating conditions and would not simplify the method of treatment as compared with that of Tests 24, 25, 28.

Test 29.—This was carried out on reduced reground sands used in Tests 17-20 under the same conditions as in Tests 24, 25, 28. This test confirms the conclusion previously arrived at that fine grinding is unnecessary and, in fact, leads to low recoveries and low-grade concentrates.

In view of the high recovery in the form of a high-grade concentrate obtained in the tests in which the combined middlings and tails from the first concentration were re-treated with the magnets lowered, it was considered that the same result might be achieved in one operation by setting No. 1 magnet low, as in the re-treatment of the combined middlings and tails from the first treatment. If this could be done successfully, the treatment would be simplified, since only one machine and one treatment would be necessary. A preliminary test, No. 24, on the reduced sands on these lines, gave a total recovery in the middlings and concentrate of 90.4 per cent., while the average value of this combined concentrate was 64.2 per cent. Fe. This result was so encouraging that further tests were carried out to duplicate this result, if possible, and to ascertain whether variation in the position of the magnets would give improved results. Tests 25 and 28 confirmed the result of Test 24, but Tests 26 and 27, in which the first magnet was lowered, gave similar recoveries but lower grade concentrate. To determine whether this method of treatment would be suitable for finely ground material, Test 29 was carried out under similar conditions to those of Tests 24, 25 and 28, but, as had been found previously, fine grinding tended to give unsatisfactory results. Hencee fine grinding of this material is a disadvantage.

The results of this investigation into the magnetic concentration of the iron values in the sands have enabled the following conclusions to be arrived at, viz.:—

1. Magnetic or gravity concentration of the raw sands is impracticable.
2. Magnetic concentration is simple after the Fe_2O_3 in the sands has been reduced to Fe_3O_4 by heating in a non-oxidising atmosphere to 500°-600° C. with 3 per cent. of powdered charcoal.
3. Finer grinding of the sands is a decided disadvantage, as better results from every point of view can be obtained by treatment of the coarse sands.
4. One treatment only is necessary to secure a recovery in the concentrate of 90 per cent. of the total iron in the ore in a high-grade concentrate assaying 65 per cent., and over, of iron.
5. For best results with single treatment the first magnet must be set high and the second low, so that the first magnet shall extract the most magnetic portion, while the second magnet completes the concentration.
6. Provided No. 2 magnet is kept low, the position of No. 1 magnet may be varied without seriously affecting the precentage recovery of iron, but the grade of the concentrate diminshes if No. 1 magnet is lowered.
7. The current necessary to produce a magnetic field of sufficient intensity to bring about the desired separation is 1 ampere at 220 volts.
8. The highest recovery of iron, together with production of a high-grade concentrate, is obtained by setting the machine so that the first concentrate contains the most magnetic material, followed by re-treatment of the combined middlings and tails with both magnets lowered so as to produce as clean a tail as possible. These conditions necessitate a duplication of plant, and it is doubtful whether the slightly increased recovery by this method over the single treatment method would compensate for the increased cost for provision and operation of the second concentrator.

Gold Distribution.

In order to determine the course followed by the gold during the magnetic concentration, two samples, of 500 grams each (Tests 30, 31) of reduced coarse sands, were concentrated on the magnetic concentrator under the conditions of single treatment found suitable for concentration of the iron (Test 24). The results of these concentrations, so far as the iron content of the sands is concerned, were similar to those of the smaller tests and are shown along with the calculated distribution of the gold in the accompanying tabulation. This result shows that a certain amount of concentration of the gold takes place in the magnetic concentrates, which contain 88.2 and 89.9 per cent. respectively, of the gold in the original sands. The original sands are, however, of such low grade that the grade of the concentrate is not much higher than that of the original sands.

If some of the original ore, before treatment, could be obtained, it would be interesting to test it in the same way to ascertain whether a magnetic concentrate could be produced, of reasonably high grade. In the tests made on the sands, the gold content of the magnetic concentrates is only 25 to 50 per cent. greater than that of the original sands, and it is probable that a similar concentration would take place in the case of the raw ore, so that the ratio of concentration would be very low.

Alumina Distribution.

In order to obtain some information as to the course followed during magnetic concentration by the alumina, the products of Test 24 were assayed for alumina, the results and the distribution of the alumina being shown in the accompanying tabulation. Those results show that a certain amount of enrichment has taken place in the concentrate and middlings which contain 80 per cent. of the total alumina, but the original sands are so low in alumina that production of a high-grade alumina concentrate is not possible, although the test shows that in this particular ore the alumina, for the most part, follows the iron during the concentration. Whether this would be so in the case of ferruginous bauxites requires investigation in view of the possibility of utilising some of the Western Australian impure bauxites for the production of aluminium.

GOLD AND ALUMINA DISTRIBUTION.

Test No.	Product.	Weight, per cent.	Iron, per per cent.	Gold, dwt. per ton.	Alumina, per cent.	Distribution, per cent.		
						Iron.	Gold.	Alumina.
30 ...	Tails	25·0	23·8	0·2	...	11·1	11·8	...
	Middlings ... ... Concentrate	75·0	63·8	0·5	...	88·9	88·2	...
31 ...	Tails	25·2	27·2	0·2	...	12·9	10·1	...
	Middlings ... ... Concentrate	74·8	61·6	0·6	...	87·1	89·9	...
24 ...	Tails	25·9	19·4	...	4·7	9·6	...	19·9
	Middlings	62·5	64·0	...	6·8	76·0	...	69·6
	Concentrate	11·6	65·4	...	5·5	14·4	...	10·4

B. H. MOORE,
Lecturer in Metallurgy.

School of Mines, Kalgoorlie,
18th March, 1927.

Flotation Tests on Golden Horseshoe Estates Ore.

Four samples of dry-crushed, graded ore were supplied by Mr. J. W. Sutherland, General Manager, Golden Horseshoe Estates, with the request that experiments be made to determine whether a satisfactory recovery of the gold values could be obtained from ore more coarsely crushed than is usually considered advisable for flotation concentration.

These samples had all been crushed and graded in the dry state, which has commonly been found to render the flotation of the pyrite and its associated gold values much more difficult and less complete than when wet grinding is practised.

Therefore it was expected that high percentage recoveries of the gold would not be obtained by flotation, and that difficulty would be experienced in securing the necessary conditions for effective oiling of the pulp before flotation, particularly as Mr. Sutherland desired that no further crushing of the samples should be carried out. This expectation was realised during the flotation, although comparatively high recoveries were obtained in the concentrates, even under these most unfavourable conditions. The results of these tests point to the possibility that after comparatively coarse wet grinding in contact with the necessary flotation reagents a high percentage recovery of the gold may be obtained by flotation. The results also indicate the advisability of determining the limiting coarseness of crushing under correct conditions for flotation concentration, consistent with an economic recovery of the gold values, in order to ascertain the point at which the cost of the additional fine grinding will exceed the value of the additional gold recovered by so doing.

The samples received were marked as follows: No. 1,—20 mesh: No. 2,—100 mesh; No. 3,—100 +150 mesh; No. 4, — 150 mesh. The quantity of No. 3 sample was too small for testing purposes, and therefore no work was done on this grade.

The flotation conditions adopted were as follows:—

Ore	600 gram.
Salt water (2% soln.)	3,000 c.c.
Potassium Xanthate ...	0·05 gram. = 0·187lb. per ton.
Euco-tar (1 : 6) ...	0·24 gram = 0·9 lb. per ton.
Kerosene	0·3 gram = 1·05 lb. per ton.

The ore and reagents were agitated with a small quantity of salt water in the pebble jars for 1¼ hours without grinding, and after addition of the further quantity of salt water, flotation was carried out in the Ruth machine. During the progress of each float it was evident, from the escape in the froth of globules of oil and tar, that oiling had been inefficient. In addition, the weight of the concentrates obtained shows that the floats were contaminated with a large proportion of gangue, a result always obtained under these conditions.

The following are the detailed results of the tests:—

TEST 1.—20-mesh sample.

——	Weight.	Au, dwt. per ton.	Distribution of gold, per cent.
Feed	100·0	28·4	100·0
Concentrate ...	18·7	91·0	60·0
Residue	81·3	13·7	39·2

TEST 2. —100-mesh sample.

—	Weight.	Au, dwt. per ton.	Distribution of gold, per cent.
Feed	100·0	33·6	100·0
Concentrate ...	25·8	111·0	85·3
Residue	74·2	5·4	9·7

TEST 3. —150-mesh sample.

—	Weight.	Au, dwt. per ton.	Distribution of gold, per cent.
Feed	100·0	31·8	100·0
Concentrate ...	28·4	99·0	88·4
Residue	71·6	4·8	10·8

The high percentage weight of float and the low grade of the concentrates, compared with the grade of the feed, are due to the conditions of crushing and oiling. The low percentage weight float obtained in Test 1 is due to the impossibility of floating the coarser portion of the pyrite.

It is advisable, if further testing in this direction is desired, that the different grades on which flotation is to be carried out should be produced by wet grinding and that the necessary oiling should be performed during the grinding operation. This can readily be done in the Metallurgical Laboratory at the School of Mines, and it is desirable that it should be so done in order that flotation of the different grades may be carried out as soon as possible after the grinding and oiling operations.

B. H. MOORE,
Lecturer in Metallurgy.
Metallurgical Laboratory,
School of Mines, Kalgoorlie,
8th April, 1927.

Concentration of Hematitic Ilmenite.

During 1926 a sample of hematitic ilmenite from the Darling Ranges was submitted by the State Mining Engineer for magnetic concentration. A brief report by Mr. Winter and myself, dated 13th May, 1926, indicated that it was not possible to concentrate the titanic oxide either in the magnetics or the non-magnetics, by magnetic concentration, the grade of both products being practically the same as that of the feed.

The possibility of concentrating the titanic oxide into a high-grade commercial product has again been under consideration, and an investigation has now been carried out with that object in view.

The sample of ilmenite submitted showed on analysis—

Chemical Analysis :

TiO_2	24·19	per cent.
Fe	50·4	„

Mineral Analysis :

TiO_2	24·19	per cent.
FeO	21·77	„
Fe_2O_3	47·81	„

By reason of the high percentage of oxides of iron in the ore it was thought that if the oxides of iron could, by reduction, be converted to magnetic oxide of iron, Fe_3O_4, or to sponge iron, magnetic concentration of the reduced material would possibly enable concentration of the titanic oxide to be made, either in the magnetics or the non-magnetics. As it was considered possible that the titanic oxide would, after reduction of the oxides of iron, concentrate in the magnetic portion because of its close association mineralogically with the oxide of iron, it was decided to reduce the oxides of iron, as far as possible, to sponge iron, since by so doing a subsequent chemical leaching process could be used to remove the metallic iron and so produce a high-grade titanic oxide product, while at the same time the iron extracted from the ore might be recovered by electrolysis of the resulting solution.

Reduction to sponge iron was found to be comparatively easy. The finely crushed ore was mixed with 34 per cent. of fine charcoal and the mixture heated in covered crucibles for seven hours at 900° to 1000° C. The product was found to contain—

TiO_2	24·6	per cent.
Fe, metallic ...	50·43	„
Fe, total	55·2	„
C	11·1	„

This product was then subjected to magnetic concentration under varying conditions as regards both the position of the rotating magnets relative to the feed belt of the concentrator and also the current used to produce the magnetic field. Although it was found that a high percentage of the titanic oxide was obtained in the form of a rich iron concentrate, the grade of this concentrate was not sufficiently high for commercial purposes, the highest grade concentrate obtained containing 33.2 per cent. TiO_2 and giving a recovery in the concentrate of 97.7 per cent. of the total TiO_2. In order to produce a marketable product from this magnetic concentrate further treatment, either by magnetic concentration or by some chemical process would be necessary, thus increasing the cost of production of a high-grade product. Further testing along these lines was therefore not proceeded with as it was considered that a straight-out leaching process having for its object the removal of the metallic iron from the metallised ore in one operation would be likely to yield better results at a much lower cost. The results of magnetic concentration of the metallised product are shown in Table "A."

TABLE A.—MAGNETIC CONCENTRATION OF METALLISED ORE.

Test No.	Sponge.			Magnetics.		Non-Magnetics.			Distribution.				Loss in Concentration.			Operating Conditions.
									TiO_2.		Fe. Metal.					
	Fe, metal. %	TiO_2, %	Wt. %	Fe, metal. %	TiO_2. %	Wt. %	Fe, metal. %	TiO_2. %	Magnetics.	Non-magnetics.	Magnetics.	Non-magnetics.	Wt. %	TiO_2. %	Fe, metal. %	
1	50·43	24·6	72·4	53·75	33·2	6·3	8·65	8·8	97·7	2·2	77·1	1·08	21·3	0·1	21·82	Current, 1 ampere ; No. 1 magnet high, No. 2 magnet low.
2	50·43	24·6	74·0	58·8	29·8	10·8	27·5	12·0	89·6	5·3	86·3	5·89	15·2	5·1	7·78	Current, 1 ampere ; both magnets at upper limit.
3	50·43	24·6	78·5	60·3	28·9	9·9	18·5	16·6	92·2	6·7	93·9	3·6	11·6	1·1	2·5	Current, 0·85 ampere ; both magnets at upper limit.
4	50·43	24·6	70·4	57·8	30·97	12·2	25·6	19·9	88·6	9·9	80·7	6·19	17·4	1·5	13·1	Current, 1·3 ampere ; slow feed ; both magnets at upper limit.

Considerable loss of weight by dusting took place during the magnetic concentration, partly in the form of fine ore, and partly in the form of fine charcoal.

Leaching of these magnetic concentrates for removal of the metallic iron should theoretically yield a product containing over 60 per cent. TiO_2, whereas direct leaching of the metallised ore would theoretically yield a product containing 48 per cent. TiO_2, and it therefore becomes a question as to whether the increase in grade by the introduction of magnetic concentration warrants the use of that process as an intermediate step.

Leaching tests with ferric chloride solution have been carried out on the magnetic concentrates from Tests 1 and 3 to ascertain whether the final product so obtained would approximate in TiO_2 content to that theoretically possible. The results of these tests are shown in Table "B."

TABLE B.—LEACHING OF MAGNETIC CONCENTRATES.

Conct. from Test No.	Magnetic Concentrates.			Ferric Chloride Solution.			Solution after Leaching.		Time of Leaching, hours.	Leaching Temperature, °C.			Leached Ore.			Leached Ore ignited.		Metallic Fe dissolved.	
	TiO_2. %	Fe, metal, %	Wt., gram.	Vol., c.c.	Fe·· gram. per litre.	Fe·· gram. per litre.	Fe··· gram. per litre.	Fe·· gram. per litre.		Initial.	Exothermic rise.	Maximum.	Wt., gram.	TiO_2. %	Fe, metal. %	Wt., gram.	TiO_2. %	Wt., gram.	Wt. %
1	33·2	53·75	10·0	150	80·0	*Nil*	20·2	90·0	2	22·5	20·0	52·0	5·71	48·5	4·37	5·25	52·7	4·53	84·3
3	28·9	60·3	10·0	160	80·0	*Nil*	22·6	87·8	2	22·5	19·5	51·0	5·64	52·5	4·58	5·16	57·3	4·86	80·6

Since the magnetic concentration tests did not produce a material of sufficiently high grade, direct leaching of the metallised product with ferric chloride solution has been applied. The reaction between ferric chloride and sponge iron is as follows:—

$$2FeCl_3 + Fe = 3FeCl_2 + 54{,}300 \text{ calories.}$$

Therefore 2 parts, by weight, of ferric iron are required to dissolve 1 part, by weight, of metallic iron, and the reaction is also strongly exothermic. Since the metallised ore contains 50.4 per cent. metallic iron, the ferric iron required for solution of the iron is 1.008 gram per gram of ore.

The results of these leaching tests (Table "C") show that the sponge iron readily dissolves in ferric chloride solution and that the grade of the residue in TiO_2 is conseqeuntly correspondingly increased. This residue still contains the excess carbon left after the reduction, which is readily removed by ignition, thus still further increasing the grade of the final residue. The results also show that the heat of the chemical reaction is sufficient to complete the solution of the iron and that no external heat need be applied.

TABLE C.—LEACHING OF METALLISED HEMATITIC ILMENITE WITH FERRIC CHLORIDE SOLUTION.

Test No.	Raw Ore.		Metallised Ore.			$FeCl_3$ Solution.			Filtrate.		Time of Leaching, hours.	Leaching Temperature °C.			Leached Ore.			Leached Ore ignited.		Metallic Fe dissolved.	
	TiO_2. %	Fe, total. %	TiO_2, %	Fe, metal. %	Wt., gram.	Vol. c.c.	Fe··· gram. per litre.	Fe·· gram. per litre.	Fe··· gram. per litre.	Fe·· gram. per litre.		Initial.	Exothermic rise.	Maximum.	Wt., gram.	TiO_2 %	Fe, metal. %	Wt., gram.	TiO_2. %	Wt., gram.	Per cent.
1	24·19	50·4	24·6	50·4	10·0	104	79·8	*Nil*	0·84	120·96	2	22·5	27·5	50·0	6·304	44·95	3·26	4·98	56·9	3·88	76·9
2	24·19	50·4	24·6	50·4	10·0	200	79·8	*Nil*	37·56	66·04	2	23·5	14·5	60·0	5·653	46·20	2·14	4·47	58·5	4·76	94·4
3	24·19	50·4	24·6	50·4	10·0	150	79·8	*Nil*	24·0	89·8	2	22·5	20·0	64·0	5·752	41·75	0·30	4·49	57·4	5·10	100·0
4	24·19	50·4	24·6	50·4	10·0	150	80·0	*Nil*	22·08	86·12	1	25·0	19·0	44·0	5·768	49·47	1·32	4·76	60·0	4·23	83·9

Reduction of the oxides of iron to sponge iron, followed by leaching of the product with ferric chloride solution, has given the best results, and, as this method involves no preliminary concentration, it is to be preferred to direct magnetic concentration or to leaching after magnetic concentration of the metallised ore. Ignition of the leached ore, for the purpose of removing the excess carbon, still further increases the grade of the final product. The quantity of carbon used for reduction appears to have been excessive, as a high percentage remains in the metallised product, the removal of which is necessary before final treatment of the leached ore for the recovery of pure titanic oxide. Complete reduction of the oxides of iron to sponge iron could probably be effected by the use of less carbon, although an excess over the theoretical amount is necessary in order to prevent oxidation of the sponge iron. The necessary carbon can be calculated from the percentage composition of the ore, and the quantity required in excess of this amount could probably be determined experimentally.

The American market price for ilmenite, 52 per cent. TiO_2 (practically pure ilmenite), during 1926 was 1.5 cents per pound. The final product from the above metallisation and leaching process is, however, of higher grade owing to decomposition of some of the ilmenite during the reduction to sponge iron, and therefore should command a ready market. The production of commercial titanic oxide for the manufacture of titanium pigments involves conversion of the iron and titanium oxides to sulphates by heating with sulphuric acid, leaching out of the sulphates of iron and titanium, reduction of the ferric salts and precipitation of titanic oxide by boiling the reduced solution. The last traces of sulphuric acid are removed by the addition of barium carbonate so that the final precipitate contains barium sulphate, while the last traces of iron are rendered innocuous by the addition of calcium phosphate after the barium carbonate for the purpose of forming colourless phosphate of iron (0.02 per cent. iron is sufficient to discolour the product). The washed and neutralised titanic oxide is then calcined and ground to such fineness that 99.95 per cent. will pass a screen of 5,000 meshes per square centimetre. Titanium white (titanic oxide paint), the name given to the above product, is said to possess the following advantages over zinc white and white lead: greater covering power; non-poisonous; chemically inert and therefore not discoloured by gases such as hydrogen sulphide; no saponifying action on linseed oil.

In conclusion, it has been shown that the titanic oxide in this ore can be concentrated in a high-grade product of considerable commercial value, for which there is an increasing demand, and as a concentrate of the grade produced in the leaching tests shown in Table "C" has a value of approximately £7 per ton, a further and more detailed investigation into the possibility of utilising this ore is desirable if the ore deposit is of sufficient magnitude to warrant its exploitation.

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines, Kalgoorlie,
12th April, 1927.

Preliminary Report on the Murdoch Copper Leaching Process.

In order to test this process, as suggested by the State Mining Engineer in his letter of 19th March, some experimental work has been carried out, and is being continued, to determine the applicability of the process to the treatment of Whim Creek oxidised ore.

The process, which is protected under Australian Patent 16878/24, claims to recover the copper from oxidised copper ores by leaching with a solution of calcium chloride, sodium chloride and sulphurous acid, by which means the copper is converted to cuprous chloride which dissolves in the sodium chloride solution and is precipitated therefrom as cuprous oxide by the addition of milk of lime. The reactions of dissolution and precipitation are, respectively—

$$2CuO + CaCl_2 + SO_2 = CaSO_4 + Cu_2Cl_2$$
$$Cu_2Cl_2 + CaO = CaCl_2 + Cu_2O$$

the calcium chloride necessary for the dissolution being thus regenerated by the precipitation reaction.

The inventor claims that for oxidised ores crushing to one-sixth to one-twelfth inch is usually sufficient, that leaching is carried out by percolation, and that the leaching solution should contain as nearly as possible the exact amounts of calcium chloride and sulphur dioxide necessary to dissolve the copper and sufficient sodium chloride to keep the cuprous chloride in solution.

A statement of probable cost of treatment is given, but, unfortunately, no data appear on the subject of the results obtained by the application of the process, either experimentally or on the larger commercial scale.

In order to test the solvent action of the solution, qualitative experiments were first carried out on C.P. copper oxide, CuO, and on malachite and chrysocolla, as the behaviour of these compounds in contact with the solution would serve as a guide to the action of the solution on the minerals commonly occurring in oxidised copper ores. These three compounds were readily attacked by the solvent at ordinary temperature, and complete solution of the copper took place after a comparatively short time in each case. These compounds were, however, all in a fine state of division and the results therefore indicated that this solvent would readily dissolve the copper from oxidised copper minerals, provided the ore were sufficiently finely ground to enable the solvent to come into contact with all particles of the copper minerals.

In consequence of the qualitative results, quantitative testing was commenced on a sample of Whim Creek oxidised ore. This ore, which assayed 5.05 per cent. copper and 12.51 per cent. iron, contained the greater portion of its copper content in the form of malachite and azurite, together with some chrysocolla and also quartz and malachite in such intimate association as to be practically a solid solution of the two minerals. The presence of this mixture of quartz and malachite in considerable quantity in this ore indicates the necessity of finer crushing than is recommended by the inventor of the process if a high recovery of the copper is to be obtained. This mixture is probably, in part, responsible for the low percentage extraction obtained in short periods of time, and the considerably increased extraction obtained by prolonging the time of leaching or by fine grinding of the ore in contact with the solution.

The sample of Whim Creek ore used for testing was crushed to pass an 8-mesh I.M.M. screeen. The grading analysis of the minus 8-mesh ore is set out hereunder.

GRADING ANALYSIS.

I.M.M. Screen.	Weight, per cent.	Cu, per cent.	Per cent. of Total Copper.
— 8, + 16	28·90	5·05	30·31
— 16, + 20	9·32	4·66	9·01
— 20, + 40	21·70	4·60	20·73
— 40, + 60	8·42	5·05	8·83
— 60, + 80	7·12	5·11	7·55
— 80, + 100	1·18	5·05	1·23
— 100	23·36	4·60	22·32

This analysis shows a remarkable uniformity of copper content of the different grades, although a very large proportion of the total copper is contained in the coarser grades.

In making up the leaching solutions, the sulphur dioxide and calcium chloride contents have been calculated from the equation given for the dissolution of the copper, but this makes no allowance for the action of sulphurous acid on ferric and other oxides likely to occur in the ore. In one test, after a six-hour period of leaching, the iron content of the ore was reduced from 12.51 per cent. to 11.88 per cent., this reduction being equivalent to the consumption in this way of 0.72 grams of sulphur dioxide per hundred grams of ore, or practically 30 per cent. of the amount of sulphur dioxide calculated as necessary for the dissolution of the copper. This action will probably increase with the time of leaching and the fineness of grinding of the ore, and therefore it is impossible to calculate with any degree of accuracy the exact amount of sulphur dioxide required for leaching a given quantity of ore, while the dissolved iron will, in addition, be precipitated by milk of lime as ferrous hydroxide along with cuprous oxide in the precipitation process, increasing the bulk of the precipitate and lowering its degree of purity. Similar action will, no doubt, take place in the case of other metallic oxides which, however, do not usually occur in such relatively large quantities as does ferric oxide. This action must therefore be allowed for in calculating the make-up of the leaching solution, and as it is impossible to estimate the extent of the solvent action of the solution on these oxides, it is difficult to make the necessary allowance so that sufficient sulphur dioxide shall be present to dissolve all the copper. Experimental leaching under similar conditions to those adopted on the large scale may, however, possibly give an approximate indication as to the amount of sulphur dioxide that will be probably consumed in doing this useless work.

In carrying out the tests, the conditions as laid down by the inventor have been adhered to as closely as possible, *i.e.*, the quantities of sulphur dioxide and calcium chloride have been those necessary to react with the whole of the copper in the ore, while the sodium chloride has varied from 3.6 per cent. to 16.9 per cent. In the treatment of minus 8-mesh ore the time of treatment has varied from 6 to 71.25 hours, the highest extractions being obtained from 30 to 48 hour periods. The highest extraction obtained on this minus 8-mesh ore has been 62.1 per cent., this result being secured after 33, 36 and 48 hour periods of leaching, no improvement being shown by increasing the time above 33 hours. These results point to the conclusion that on this sample the maximum extraction possible under the conditions set out is 62 per cent., possibly owing to the fact that a considerable proportion of the copper is present in the form of the solid solution of quartz and malachite previously mentioned and that this mixture in a coarse state does not readily give up the copper to the leaching solution. That this is probably the case is shown by the results of Tests 13-16, in which the coarse ore was ground in the pebble mill in the leaching solution for one hour and the leaching periods varied from one to four hours. These tests gave slightly higher recoveries in very short periods of time, indicating that finer grinding than to minus 8-mesh is likely to give higher extractions in much shorter periods than when treating the coarse ore. The pebble mill product all passed 150-mesh I.M.M. screen. The results of these four tests also show that nothing is apparently gained by increasing the time of treatment beyond one hour, the period during which the grinding of the ore took place in the solvent in the pebble mill.

It is possible that on account of the solvent action of the solution on ferric oxide and other metallic oxides besides copper oxide the calculated amount of sulphur dioxide used is insufficient (as shown previously) to attack all the oxidised copper minerals, and this deficiency in the amount of sulphur dioxide used may probably account for the comparatively low extraction. This point will be followed up in subsequent tests by increasing the amounts of sulphur dioxide and calcium chloride to determine whether a higher extraction can be obtained by making an allowance for the sulphur dioxide used up in this way.

The testing so far carried out on this ore has not been of sufficient extent to give the process a fair trial on this particular ore, although it is evident that finer grinding than that recommended is necessary in this case.

No attention has yet been paid to the precipitation of the copper from the solution, as the first consideration is the determination of the suitability of the dissolution process to the treatment of this ore. Further testing will be carried out to ascertain the best leaching conditions, after which an investigation of the precipitation process will be made.

The results of all tests are shown in the following tabulation :—

LEACHING OF WHIM CREEK OXIDISED ORE—ASSAY VALUE : Cu, 5·05 per cent. ; Fe, 12·51 per cent.

Test No.	Ore, Wt., gram.	Solution.				Time of Leaching, hour.	Residue Cu. %	Extraction. %	Remarks.
		Vol. c.c.	$CaCl_2$, gram.	NaCl, gram.	So_2, gram.				
1	100	435	3·78	21·6	1·46	6	4·77	5·5	Percolation Test.
2	100	435	3·78	21·6	1·46	21·33	4·20	16·8	do. do.
3	100	600	3·78	21·6	2·30	71·25	4·20	16·8	do. do.
4	100	675	12·60	114·0	0·90	18·0	4·49	11·12	do. do.
5	100	675	4·41	67·2	2·56	18·0	3·65	27·7	do. do.
6	100	675	4·41	67·2	2·56	24·0	4·26	15·6	do. do.
7	50	400	2·52	40·0	1·54	27·0	3·08	37·9	do. do.
8	100	530	5·04	70·8	2·56	30·0	2·02	60·0	do. do.
9	100	530	5·04	70·8	2·56	33·0	1·91	62·1	do. do.
10	100	530	5·04	70·8	2·56	36·0	1·91	62·1	do. do.
11	100	530	5·04	70·8	2·56	24·0	2·75	45·5	do. do.
12	100	530	5·04	70·8	2·56	48·0	1·91	62·1	do. do.
13	200	660	10·0	70·0	5·12	1·0	1·79	64·5	Ground in pebble mill for one hour in solution.
14	200	512	10·0	70·0	5·12	2·0	1·85	63·3	Ground in pebble mill for one hour in solution ; contact, one hour.
15	200	512	10·0	70·0	5·12	3·0	1·85	63·3	Ground in pebble mill for one hour in solution ; contact, two hours.
16	200	512	10·0	70·0	5·12	4·0	1·85	63·3	Ground in pebble mill for one hour in solution ; contact, three hours.
17	100	256	5·0	35·0	2·56	48·0	3·37	33·2	Percolation Test.
18	100	256	5·0	35·0	2·56	48·0	3·42	32·2	do. do.
19	100	256	5·0	35·0	2·56	40·0	2·97	41·2	do. do.
20	100	256	5·0	35·0	2·56	38·0	2·97	41·2	do. do.

Tests 11, 19, and 20 were carried out under similar conditions, except as regards time of leaching, the solution being run slowly and continuously through the ore charge. This method of leaching apparently does not give results comparable to those obtained in Tests 8, 9, 10 and 12, in which the solution conditions were similar, but in which the whole of the solution was kept in contact with the ore for the whole period of leaching. Apparently, therefore, the only method by which leaching of the coarse ore is likely to yield satisfactory results is that adopted in Tests 8, 9, 10 and 12, viz., contact of the ore charge with sufficient of the solvent liquor containing the requisite quantities of solvents to more than cover the charge. This method of treatment, with increased quantities of calcium chloride and sulphur dioxide will be adopted in subsequent tests on the minus 8-mesh ore in the endeavour to determine the maximum extraction possible.

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines of W.A.,
Kalgoorlie, 11th May, 1927.

Supplementary Report on Murdoch Copper Leaching Process.

As indicated in my Report of 11th May, 1927, on this process, the method of leaching which promised to give satisfactory results on Whim Creek oxidised ore crushed to pass an 8-mesh I.M.M. screen necessitated contact of the solution with the ore for considerable periods. In order to determine whether high percentage extractions could be obtained by long contact of the ore with the solvent liquor, a series of tests has been carried out in which the ore was kept in contact, in closed glass containers for different periods of time, with solvent liquors of different concentrations of sulphur dioxide, calcium chloride and sodium chloride. In Tests 21 to 25 the ore was kept in contact with solutions of varying concentrations of sulphur dioxide and sodium chloride for a period of eighteen days, at the end of which time each charge was filtered, thoroughly washed and assayed. In all cases the filtrate still contained free sulphur dioxide. The results showed that the percentage extraction increased with increasing sulphur dioxide content of solution to a maximum of 90.69 per cent. in the period stated. According to the equation given by the inventor of the process for the solvent action of the solution, viz.,

$$2CuO + CaCl_2 + SO_2 = CaSO_4 + Cu_2Cl_2,$$

the quantities of sulphur dioxide and calcium chloride theoretically required for leaching purposes on this ore are: sulphur dioxide 2.54 parts and calcium chloride 2.2 parts per 100 parts of ore. In order to ensure that these conditions should be fulfilled, and that there should be a slight excess of these reagents, rather more than these proportions of sulphur dioxide and calcium chloride were used in the subsequent series of tests (Tests 26 to 31), in which the solution conditions were kept constant and leaching was carried out for increasing periods of time. The percentage of sodium chloride in the leaching solution was kept high to obviate the possibility of any cuprous chloride being precipitated in the ore after its formation by the action of the sulphur dioxide and calcium chloride on the copper minerals. These tests, which were concluded at intervals of five days to ascertain the minimum leaching time in which the maximum extraction could be obtained, show that beyond a 15-day leaching period the rate of increase in the percentage recovery is very small and the results are the same at 25 and 30 days. It appears, therefore, that on this ore, crushed to the fineness stated in my previous report, the maximum extraction possible with solvent liquor of concentration slightly higher than the theoretical is 91.68 per cent., obtained after 25 days' contact, but that for practical purposes the economic maximum is 90 per cent., obtained after 15 days' leaching.

Finer grinding of the ore would, no doubt, result in increased extraction, as shown in Tests 13-16 in my report of 11th May, but it is doubtful whether the extra cost of the fine grinding operation would be compensated for by the slightly increased extraction. In addition, if the ore were ground in solution, precipitation of copper from the solution would take place by the action of the iron of the grinding machines on the dissolved copper salt, with consequent loss of copper and increased wear of the machines.

Hence minus 8-mesh ore is capable of yielding at least 90 per cent. extraction by contact leaching with solutions of the requisite concentration of sulphur dioxide, calcium chloride, and sodium chloride after fifteen days, but the concentration of the leaching solution must be maintained at or above that theoretically necessary to dissolve all the copper in the ore. This would necessitate very careful chemical control of the concentration of the leaching solution.

The following tabulation shows the conditions and the results of these series of leaching tests:—

CONTACT LEACHING TESTS.

Test No.	Ore.		Solution.				Time of leaching, days.	Residue, Cu per cent.	Extraction, per cent.
	Wt., gram.	Cu, per cent.	Volume c.c.	SO_2, wt., gram.	$CaCl_2$ per cent.	NaCl per cent.			
21	50	5·05	212·5	1·275	1·18	8·23	18	2·2	60·0
22	50	5·05	265·5	1·594	1·18	13·18	18	0·85	83·16
23	50	5·05	318·5	1·912	1·18	11·00	18	0·69	86·33
24	50	5.05	372.0	2.231	1.18	9.40	18	1.01	80.00
25	50	5.05	425.0	2.550	1.18	8.23	18	0.47	90.69
26	50	5.05	210.0	1.600	2.38	16.66	5	1.31	74.06
27	50	5.05	210.0	1.600	2.38	16.66	10	0.67	86.73
28	50	5.05	210.0	1.600	2.38	16.66	15	0.49	90.29
29	50	5.05	210.0	1.600	2.38	16.66	20	0.45	91.09
30	50	5.05	210.0	1.600	2.38	16.66	25	0.42	91.68
31	50	5.05	210.0	1.600	2.38	16.66	30	0.42	91.68

For the purpose of testing the precipitation of the copper with milk of lime the filtrates from a number of leaching tests were combined. Precipitation was found to be rapid and complete, but the precipitate did not settle rapidly. The precipitate which filtered rapidly was light yellow in colour and rapidly turned blue after filtration owing to rapid carbonation taking place by the action of atmospheric carbon dioxide. In no case did the filtrate show a trace of copper in solution. The precipitate, however, was of low grade owing to contained CaO and $CaCO_3$ from the milk of lime. The low grade of the precipitate, 23.26 per cent copper, is largely due to the method of precipitation adopted in these experiments, viz., addition of milk of lime to the pregnant copper solution until no further precipitate is produced, by which method excess of the precipitant is used. In practice the method that suggests itself as the most suitable would be to add to a charge of pregnant solution the theoretical quantity of milk of lime required for precipitation of the whole of the copper and to keep the mixture agitated until the liquor no longer showed a trace of copper in solution. This would result in a high-grade precipitate and minimise the consumption of lime, although the precipitate would always contain precipitated ferric hydroxide on account of the solvent action of the leaching solution on the oxide of iron in the ore. Careful control of the sulphur dioxide content of the leaching solution would prevent excessive dissolution of oxide of iron, as sulphurous acid solution will attack oxides and carbonates of copper in preference to oxide of iron.

This investigation has shown that on comparatively coarsely crushed oxidised ore the leaching solution used is capable of extracting a high percentage of the copper, but that the solvent liquor must be kept in contact with the ore for at least fifteen days. It is necessary that at least the theoretical quantities of calcium chloride and sulphur dioxide must be present in the leaching solution and that sufficient sodium chloride must also be present to keep in solution the cuprous chloride formed by the action of the solution on the oxidised copper minerals. In practice, when the regenerated calcium chloride solution containing calcium sulphate is used repeatedly there will be a tendency for the concentration of this salt in the solution to increase until the saturation point is reached, when any excess above this quantity will either be precipitated in the ore or will be kept in solution by sulphur dioxide, which latter case would necessitate a higher percentage of sulphur dioxide in the leaching solution than that theoretically necessary for the dissolution of the copper minerals.

One advantage of the process is the regeneration of calcium chloride by the precipitation reaction so that after the solution has once been brought up to the requisite concentration there should be no necessity to add further quantities of this salt except as may be necessary to compensate for losses by leakage and inclusion in the residues and precipitate. This regeneration of calcium chloride takes place at the expense of the lime used for precipitation, which therefore fulfils a dual purpose.

The principal items of expense in the process as regards the chemicals used will be the cost of lime and of sulphur dioxide, the latter being practically half the copper present in the ore, so that if the sulphur dioxide is produced from sulphur the quantity of the latter necessary will be at least 25 per cent. of the quantity of copper present in the ore. This expense would be considerable if the sulphur dioxide were produced in this way, but if sulphide ores were being roasted and the calcines treated by the process the roaster gases could be used for charging the leaching solution with sulphur dioxide.

Precipitation by means of lime is rapid and complete and the precipitate filters readily. In order to secure complete precipitation, only the theoretical amount of lime is necessary and any excess of calcium hydroxide in the solution would consume sulphur dioxide in the re-activation of the solution, while excess of lime in suspension during the precipitation reaction would reduce the grade of the precipitate. The grade of the precipitate will depend entirely on the careful adjustment of the quantity of milk of lime used, and, on account of the small solubility of calcium oxide or hydroxide, sufficient time must be allowed for precipitation to take place by the action of calcium hydroxide in solution which will take place progressively, as calcium oxide continuously dissolves owing to the consumption of that already in solution by the reaction of precipitation.

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines, Kalgoorlie,
25th July, 1927.

Preliminary Report on the Flotation of Sulphide Ore from the West Lode, Wiluna Gold Mines, Limited.

Ore Sample.

A sample of ore from the West Lode, Wiluna Gold Mines, Limited, was received from the State Mining Engineer on 12th May. This sample consisted of the rejected portion of a number of assay samples, roughly crushed at the mine. The State Mining Engineer in his letter of advice regarding this sample requested that testing should be carried out on this sample of ore at the School of Mines to ascertain, if possible, the reasons for the difficulty in securing a satisfactory recovery of the gold-bearing minerals by flotation, and to determine means by which this difficulty could be overcome. Figures supplied to the State Mining Engineer by the Mine Metallurgist indicated that the ore contains about 2 per cent. of arsenopyrite and 5.7 per cent. of pyrite. Mine water of specific gravity 1.14 and containing 18.45 per cent. of solids was being used in the flotation plant on the mine.

Grinding of Ore.

For testing by flotation in the Metallurgical Laboratory of the School of Mines the ore was first crushed dry to pass a 16-mesh I.M.M. screen, and the final grinding for the flotation was carried out wet in the pebble mills for different periods of time for the purpose of determining the degree of comminution necessary. The grading analyses of the various products are as follows:—

GRADING ANALYSES.

—16 mesh Product (Dry Crushed).		1.5 hours' grinding with light pebble load (normal load). Tests 4–9.		2 hours' grinding with light pebble load (normal load). Tests 10–32.		2 hours' grinding with heavy pebble load (normal load x 2). Tests 39–43.		3 hours' grinding with heavy pebble load (normal load x 2). Tests 33–38.	
I.M.M. Screen.	Per cent.	I.M.M. Screen.	Per cent.	I.M.M. Screen.	Per cent.	I.M.M. Screen.	Per cent.	I.M.M. Screen.	Per cent.
+20	31.6	...	...	...	...	...	...	...	...
—20+40	29.0	...	...	...	...	...	...	...	...
—40+60	9.1	...	...	...	...	...	...	...	...
—60+80	5.8	...	...	...	...	...	...	...	...
—80+100	0.8	— 80 +100	7.55	—80 +100	0.46	—80 +100	0.00	—80 +100	0.00
—100	23.7	—100 +150	15.00	—100 +150	9.75	—100 +150	7.70	—100 +150	1.10
...	...	—150	77.45	—150	89.79	—150	92.30	—150	98.90

These results indicate that this ore is harder and tougher than the general run of auriferous sulphide ores previously tested, for which one hour's grinding in the pebble mills under normal conditions was usually sufficient to yield a product showing over 95 per cent. — 150 mesh.

The results of the flotation tests indicated that, other conditions being equal, no advantage, so far as recovery of gold is concerned, was gained by grinding to a greater degree of fineness than 90 per cent. — 150 mesh.

Use of Salt Water.

As mine water was not available for use during testing, solutions of sodium chloride (salt) of varying concentration up to 20 per cent. NaCl were used, as well as fresh water. These tests showed that the results when using salt water were invariably better than when using fresh water, not only as regards the percentage recovery of gold but also as regards the rapidity of flotation of the sulphide minerals, and that increasing concentrations of NaCl in the flotation pulp up to 20 per cent. caused no difficulties. Hence it is extremely improbable that the density of the mine water is a contributory cause of the unsatisfactory recovery unless the mine water contains some dissolved solids which inhibit flotation of the sulphides. An analysis of the mine water is not available, so that an opinion cannot be expressed regarding the effect of the dissolved solids other than NaCl. The density of the mine water should assist flotation of the sulphides, an effect which was made use of in some of the early flotation processes.

In all the tests in which fresh water was used the flotation of the sulphide minerals was very slow and the froth was dirty, whereas in salt water flotation was more rapid, the froth was of better character, and the concentrates were cleaner.

Pulp Consistency.

In a previous series of tests on ore from the East Lode carried out by Mr. Winter in 1925 the consistency of the flotation pulp was 5 parts of water to one part of solids, by weight. In the present series of tests the consistency has been varied from a 6 to 1 ratio to a 3 to 1 ratio, and it has been found that although an increase in the density of the pulp did not appear to have a favourable effect on the percentage recovery by flotation, yet at the same time it improved the character of the froth produced. No definite conclusions can be arrived at regarding the effect of variation of pulp density on the percentage recovery or on the percentage weight of float produced, or on the grade of the concentrates.

Even with the use of salt water the percentage weight of concentrates produced has been inordinately high, partly on account of the presence in the ore of considerable quantities of carbonates and partly on account of the slow rate of flotation of the sulphides, which necessitated a long flotation period in the endeavour to produce a low-grade residue.

Reagents.

The principal reagents used during flotation, besides NaCl, have been potassium xanthate, thiocarbanilide, sodium sulphide, and sulphuric acid. Potassium xanthate and thiocarbanilide both act as conditioning agents and tend to render partially oxidised sulphide particles amenable to flotation by producing on their surfaces a film to which the oil will adhere. It was found that without the use of potassium xanthate flotation was extremely slow, and that it was impossible to produce a well-loaded froth. When potassium xanthate was not used the residues were high grade and the concentrates of very low grade.

The best results when potassium xanthate was used were obtained when this reagent was added during the grinding in the pebble mill, although after the first concentrate had been taken off it was possible to produce subsequent crops of concentrate by continued additions of xanthate in the flotation cell. The flotation of the sulphides was always slow when xanthate was not added until the actual flotation, and more rapid when it was added during the grinding operation.

Thiocarbanilide behaved similarly to xanthate, but it was not used sufficiently to enable a comparison to be made with xanthate.

Sodium sulphide was used for the purpose of re-sulphidising any sulphides which had become filmed with oxide, but it was found that in a neutral pulp its action was slight and that the pulp required to be made acid before any great improvement was effected. This necessitated the use of so much acid to decompose the carbonates in the ore that the use of sodium sulphide in an acid pulp is out of the question. Time of contact is also an important factor in the action of sodium sulphide as well as xanthate and thiocarbanilide.

The behaviour of the pulp with and without the use of these sulphidising agents points very strongly to the conclusion that a considerable proportion of the sulphides in this sample of ore has been partially oxidised and that it is this condition which inhibits flotation of the auriferous sulphides. Hence it is evident, if this conclusion be correct, that some means must be adopted to re-condition the ore and so render the sulphides amenable to flotation. Sodium sulphide appears to offer possibilities in this direction, especially if the use of sulphuric acid can be avoided, and the result of Test 43 in which ferrous sulphate was added indicates that this reagent may assist in the flotation when used in conjunction with sodium sulphide.

Ferric chloride was used in one test as a possible means of removing the oxide film from the partially oxidised minerals, but its effect was not very marked.

Oils.

The following oils and combinations thereof were used, viz., eucalyptus oil, kerosene, coal tar, creosote oil, and fumol. The last named appeared to improve the condition of the froth and a comparatively low grade residue was obtained when it was used with creosote oil, but as it is probably not procurable in quantity in Australia its use was discontinued. The eucalyptus-tar mixture did not appear to be satisfactory, as residues were high and there seemed to be a tendency for this mixture to produce a concentrate containing a large percentage of gangue. Creosote oil (Australian Gas Light Co.'s Middle Oil) was apparently a satisfactory collector, as by its use comparatively good recoveries were obtained, although, as in the case of coal tar, the percentage weight of concentrate was high. Eucalyptus and kerosene gave more satisfactory floats than eucalyptus alone.

Other conditions than variation of oils required so much modification that it is impossible to form a definite conclusion as to the most suitable oil or combination of oils. In all probability any of the combinations of oils used would give satisfactory results if the ore were in a suitable condition for flotation.

Percentage Weight of Concentrate.

This was in all cases high owing to the slow rate of flotation, which necessitated removal of froth over a long period, so that considerable quantities of gangue were removed with the concentrates. With the speeding up of flotation by suitable methods of re-conditioning the ore, no doubt this difficulty will disappear.

Conclusion.

Apart from the determination of the cause of the unsatisfactory recovery obtainable by flotation of this ore, two main objects have been held in view in carrying out these preliminary tests: (a) production of a low-grade residue, and (b) production of a clean, high-grade concentrate. Neither of these objects has so far been attained although the results of the preliminary tests have opened up avenues for investigation, by following which, means may be devised to overcome the difficulties which present themselves in the case of this ore sample. These preliminary tests and the inconclusiveness of the results serve to show the necessity for the conduct of a large number of small-scale experiments to examine, qualitatively at first, the behaviour of the ore under as many variations of conditions as may be possible. This necessitates the provision of apparatus for carrying out tests on small charges of, say, 50 gram, to ascertain the behaviour of ores under various modifications of conditions before applying the results of such tests to the treatment of larger quantities of 500 gram and upwards, for the latter of which the present flotation machines are designed. Such experiments when carried out in the present flotation machines rapidly deplete the available supply of ore before definite conclusions have been reached.

The following conclusions have been arrived at as a result of this series of tests:—

1. The use of salt water is essential.
2. Salt water containing up to 20 per cent. NaCl introduces no difficulties in flotation.
3. The sample of ore supplied has been subjected to partial oxidation which prevents complete flotation of the auriferous sulphides.
4. The use of conditioning agents, such as potassium xanthate, is necessary in order to re-sulphidise the partially oxidised minerals.
5. Re-conditioning of the ore involves the use of larger quantities than usual of potassium xanthate and the time of contact between the ore and the sulphidising agent must be prolonged. Hence it is advantageous to add the xanthate or other conditioning agent to the pulp during the fine grinding process.

6. A comparatively thick flotation pulp (3 parts water : 1 part solids) is likely to give better results than a thin one.
7. Fine grinding is essential but no advantage is apparently gained by grinding finer than 92 per cent. minus 150 mesh.
8. Eucalyptus oil and kerosene are suitable for flotation, although creosote oil is also satisfactory.
9. The high percentage weight of concentrate produced throughout this series of tests is due to the presence in the ore of large quantities of calcium carbonate which, as is well known, shows a very marked tendency to float with the sulphides.
10. The high percentage of carbonates in the ore prohibits the use of an acid pulp in conjunction with sodium sulphide, since excessive amounts of acid are necessary to decompose the carbonates before the sulphidising action of sodium sulphide can take place on this ore as sodium sulphide does not appreciably sulphidise the minerals in neutral or alkaline solution.
11. Except where an acid pulp was used, the concentrates contained a high percentage of carbonates.

Further testing of this ore is desirable in order that the information gained in this series of tests may be utilised in evolving a method of overcoming the difficulties of flotation due to the mineralogical nature and the condition of this ore. It is therefore advisable that a larger sample of similar ore should be obtained.

A detailed statement of the results of the series of tests is given in the attached tabulation.

B. H. MOORE,
Lecturer in Metallurgy.

School of Mines, Kalgoorlie,
23rd June, 1927.

FLOTATION TESTS ON SULPHIDE ORE FROM WEST LODE, WILUNA GOLD MINES LIMITED.

Test No.	Ore.		Pulp consistency, water : solids ratio.	Oil.			Reagents.			Concentrate.			Residue Au, dwt. per ton (2,000 lb.).	Extraction, per cent.	Remarks.
	Wt., gram.	Au, dwt. per ton (2,000lb.).		Description.	Wt., gram.	Wt., lb. / ton (2,000 lb.).	Description,	Wt., gram.	Wt., lb. per ton (2,000 lb.).	Wt., gram.	Wt., per cent.	Au, dwt. per ton (2,000 lb.).			
1	600	10·0	5 : 1	Euco ... Kero. ...	0·32 0·25	1·07 0·83	NaCl ... Pot. Xanth.	5% 0·05	soln. 0·166	... 126·0	... 21·0	... 30·0	... 3·2	... 68·0	
2	600	10·0	5 : 1	Euco-tar ... Kero. ...	0·32 0·25	1·07 0·83	NaCl ... Pot. Xanth.	5% 0·05	soln. 0·166	... 113·0	... 18·8	... 33·0	... 3·1	... 69·1	
3	500	10·0	6 : 1	Euco-tar ...	0·32	1·07	NaCl ... Pot. Xanth.	5% 0·05	soln. 0·2	69·0 60·0	25·8 ...	29·5 18·5	5·2 ...	43·5 ...	
4	600	10·12	5 : 1	Euco. ... Kero. ...	0·32 0·25	1·07 0·83	Pot. Xanth.	0·05 ...	0·166 ...	... 118·9	... 19·8	... 21·0	... 3·9	... 61·5	
5	600	10·12	5 : 1	Euco. ... Kero. ...	0·32 0·30	1·07 1·00	NaCl ... Pot. Xanth.	2% 0·05	soln. 0·166	... 110·5	... 18·4	... 32·0	... 3·2	... 67·4	
6	600	10·12	5 : 1	Euco. ... Kero. ...	0·32 0·30	1·07 1·00	NaCl ... Pot. Xanth.	5% 0·05	soln. 0·166	... 108·5	... 18·1	... 34·0	... 3·5	... 65·4	
7	600	10·12	5 : 1	Euco. ... Kero. ...	0·32 0·30	1·07 1·00	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	... 124·2	... 20·7	... 26·0	... 2·9	... 71·3	
8	600	10·12	5 : 1	Euco. ... Kero. ...	0·32 0·30	1·07 1·00	NaCl ... Pot. Kanth.	15% 0·05	soln. 0·166	... 125·0	... 20·8	... 30·0	... 3·6	... 64·4	
9	600	10·12	5 : 1	Euco. ... Kero. ...	0·32 0·30	1·07 1·00	NaCl ... Pot. Xanth.	18% 0·05	soln. 0·166	... 118·4	... 19·7	... 26·5	... 3·7	... 63·6	
10	600	10·12	5 : 1	Euco. ...	0·38	1·27	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	29·5 115·0	4·9 19·2	16·0 29·0	... 3·4	... 66·4	Xanthate added in cell after removal of first float. Flotn. very slow.
11	600	10·12	5 : 1	Euco. ...	0·38	1·27	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	... 96·5	... 16·1	... 40·0	... 2·8	... 72·3	Xanthate added to pebble mill. Slow float.
12	600	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	67·0 52·7	11·2 8·8	36·0 20·0	... 3·5	... 65·4	As for Test 10.
13	600	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	... 98·8	... 16·5	... 38·0	... 2·9	... 71·3	Rapid, dark, heavy froth. Xanthate added to mill.
14	600	10·12	5 : 1	Euco-tar (1 : 6)	0·38	1·27	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	23·0 74·3	3·8 12·4	31·6 29·6	... 2·8	... 72·3	As for Test 10.
15	600	10·12	5 : 1	Euco-tar ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	27·0 79·2	4·5 13·2	32·0 25·0	... 3·9	... 61·5	As for Test 10.
16	600	10·12	5 : 1	Euco-tar ...	0·38	1·27	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	... 116·5	... 19·4	... 32·0	... 3·0	... 70·3	Good, dark, rapid float.
17	600	10·12	5 : 1	Euco-tar ... Kero. ...	0·47 0·2	1·59 0·67	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	54·5 89·2	9·1 14·9	28·8 21·4	... 3·7	... 63·6	Xanthate added in cell; slow float before addition of xanthate.
18	900	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	5% 0·05	soln. 0·166	... 102·0	... 17·0	... 37·0	... 2·85	... 72·6	
[illegible]	600	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	15% 0·05	soln. 0·166	... 121·2	... 20·2	... 32·0	... 2·8	... 72·3	Good, fast float.
20	600	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	20% 0·05	soln. 0·166	... 116·3	... 19·4	... 30·0	... 3·1	... 69·4	Good, fast float
21	500	10·12	6 : 1	Euco-tar ... Kero. ...	0·38 0·125	1·52 0·50	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·2	... 78·7	... 13·1	... 33·0	... 3·5	... 65·4	Good, fast float.

FLOTATION TESTS ON SULPHIDE ORE FROM WEST LODE, WILUNA GOLD MINES LIMITED.

Test No.	Ore. Wt., gram.	Ore. Au, dwt. per ton (2,000lb.).	Pulp consistency, water : solids ratio.	Oil. Description.	Oil. Wt., gram.	Oil. Wt., lb. / ton (2,000 lb.).	Reagents. Description.	Reagents. Wt., gram.	Reagents. Wt., lb. per ton (2,000 lb.).	Concentrate. Wt., gram.	Concentrate. Wt., per cent.	Concentrate. Au, dwt. per ton (2,000 lb.).	Residue Au, dwt. per ton (2,000 lb.).	Extraction, per per cent.	Remarks.
22	600	10·12	5 : 1	Euco. ...	0·38	1·27	Pot. Xanth.	0·05	0·166	143·5	23·9	30·0	3·1	69·4	
23	600	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	Pot. Xanth.	0·05	0·166	134·5	22·4	30·4	3·1	69·4	
24	600	10·12	5 : 1	Euco-tar ... Euco. ... Kero ...	0·19 0·38 0·125	0·63 1·27 0·42	Pot. Xanth.	0·05	0·166	... ... 140·8	... ... 23·5	... ... 27·2	... ... 3·35	... ... 66·9	Tests 22–27 carried out in fresh water. Slow steady flotation, but dirty froth. Depth of loaded froth very shallow
25	600	10·12	5 : 1	Euco. ...	0·38	1·27	... ...	...	...	118·7	19·8	24·8	4·6	54·5	
26	600	10·12	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	... ...	... ...	... ...	... 86·2	... 14·4	... 23·6	... 5·5	... 45·6	
27	600	10·12	5 : 1	Euco-tar ... Euco. ... Kero. ...	0·19 0·38 0·125	0·63 1·27 0·42	... ...	... ...	... ...	... ... 137·2	... ... 22·9	... ... 24·8	... ... 4·6	... ... 54·5	
28	600	9·2	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·33	... 153·5	... 25·6	... 26·0	... 2·0	... 78·2	
29	600	9·2	5 : 1	Euco. ... Kero. ...	0·57 0·25	1·90 0·84	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·33	163·0	... 27·2	... 26·0	... 2·2	... 76·1	
30	600	9·2	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth. Thiocarb-) anilide	10% 0·1 0·05	soln. 0·33 0·166	... ... 161·5	... ... 26·9	... ... 27·5	... ... 2·1	... ... 77·2	Good float.
31	750	9·2	4 : 1	Euco. ... Kero. ...	0·48 0·15	1·28 0·40	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·13	... 198·0	... 26·4	... 29·0	... 2·5	... 72·8	Good, fairly fast float
32	1,000	9·2	3 : 1	Creosote oil Fumol ...	0·50 0·15	1·00 0·30	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·2	191·5 80·0	19·1 8·0	31·5 12·8	... 2·25	... 75·5	Good, firm froth ; concentrate B taken off after adding xanthate.
33	600	9·2	5 : 1	Euco. ... Kero ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·33	161·0	26·8	26·0	2·55	72·3	
34	750	9·2	4 : 1	Euco. ... Kero. ...	0·38 0·125	1·01 0·33	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·27	... 170·0	... 22·7	... 32·0	... 2·55	... 72·3	
35	1,000	9·2	3 : 1	Euco. ... Kero. ...	0·38 0·125	0·76 0·25	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·2	... 213·8	... 21·4	... 32·0	... 2·5	... 72·8	
36	600	9·2	5 : 1	Creosote oil Kero. ...	0·375 0·125	1·25 0·42	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·33	121·5	20·2	31·0	2·4	73·9	
37	750	9·2	4 : 1	Creosote oil Kero. ...	0·375 0·125	1·0 0·33	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·27	... 186·2	... 24·8	... 36·0	... 2·6	... 71·7	
38	1,000	9·2	3 : 1	Creosote oil Kero. ...	0·375 0·125	0·75 0·25	NaCl ... Pot. Xanth.	10% 0·1	soln. 0·2	239·2	23·9	23·5	2·7	70·6	
39	600	9·2	5 : 1	Euco. ... Kero.	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth. Na_2S ... H_2SO_4 ...	10% 0·05 1·5 till	soln. 0·166 5·0 acid	... ... 114·4	... ... 19·1	... ... 36·0	... ... 2·3	... ... 75·0	
40	600	9·2	5 : 1	Euco. ... Kero. ...	0·38 0·125	1·27 0·42	NaCl ... Pot. Xanth.	10% 0·05	soln. 0·166	... 101·2	... 16·9	... 38·0	... 2·5	... 72·8	Added Na_2S and H_2SO_4 till flotation of pyrite ceased.
41	600	9·2	5 : 1	Euco. ... Kero.	0·38 0·125 ...	1·27 0·42 ...	NaCl ... Pot. Xanth. $FeCl_3$ ...	10% 0·05 2·0	soln. 0·166 6·6	... ... 129·1	... ... 21·5	... ... 28·0	... ... 2·7	... ... 70·6	Similar to Test 40.
42	600	9·2	5 : 1	Euco. ... Kero.	0·38 0·125 ...	1·27 0·42 ...	NaCl ... Pot. Xanth. $FeSO_4.7H_2O$	10% 0·05 2·0	soln. 0·166 6·66	... ... 103·6	... ... 17·3	... ... 36·8	... ... 3·0	... ... 67·4	Added Na_2S after grinding ; twenty minutes contact.
43	750	9·2	4 : 1	Euco. ... Kero.	0·38 0·125	1·01 0·33	NaCl ... Pot. Xanth. $FeSO_4.7H_2O$ Na_2S ...	10% 0·05 2·0 2·0	soln. 0·13 5·33 5·33	... ... 121·8	... ... 20·3	... ... 38·0	... ... 2·35	... ... 74·4	Na_2S and $FeSO_4.7H_2O$ added during grinding.

School of Mines, Kalgoorlie
23rd June, 1927.

B. H. MOORE,
Lecturer in Metallurgy.

Supplementary Report on the Flotation of Sulphide Ore from the West Lode, Wiluna Gold Mines, Limited, Wiluna.

At the request of the State Mining Engineer, the General Manager of Wiluna Gold Mines, Ltd., Mr. H. E. Vail, supplied a second sample of ore from the West Lode for experimental investigation. This sample of ore had been crushed at the mine to approximately half-inch size and contained a considerable proportion of fines. For the purpose of this investigation samples of ore have been cut out from this parcel and crushed dry to pass an 8-mesh I.M.M. screen and the final grinding for flotation purposes has been carried out wet in the pebble mills, the grinding period being three hours in each case, as it had been found in the preliminary investigation that for flotation it was essential that the feed to the flotation machine should be at least 90 per cent. minus 150-mesh I.M.M. screen. This fine grinding is rendered imperative on account of the extreme fineness of the sulphide minerals in the ore, since successful flotation can not be achieved unless the sulphides are completely separated from the enclosing gangue. In Tests 1-6 the pebble mill product was 82 per cent. minus 150-mesh, while in the remainder of the tests the whole of the ore passed 150-mesh.

Use of Salt Water.

There was received with the ore a small quantity of Wiluna salt water, some of which has been used in the testing without any difficulty being experienced in obtaining results similar to those obtained with a 5 per cent. solution of sodium chloride. Re-use of the salt water filtered from the residues and concentrates produced in these tests introduced no difficulties in treatment, so that it can safely be concluded that if other flotation conditions are correct the use of this salt water, dense though it be, will introduce no detrimental factors in the flotation of this ore. The density of the Wiluna salt water is 1.12 and its mineral content is as follows:—

	Grains per gallon.	Per cent.
Calcium sulphate, $CaSO_4$ ...	1,412·7	2·02
Magnesium sulphate, $MgSO_4$	1,162·3	1·66
Magnesium chloride, $MgCl_2$	28·3	0·04
Sodium chloride, NaCl ...	10,011·4	14·30
Total solids ...	12,614·7	18·02

Acid reaction, P_H — 3·0.

In the previous investigation (*vide* the Report of 23rd June, 1927) it was shown that better results were obtained by using salt water than when fresh water was used, even when the water used for flotation contained up to 20 per cent. NaCl. Hence, in the present investigation the use of salt water has been adhered to.

Flotation Oils.

Since, in previous investigations, eucalyptus oil, creosote oil and kerosene have been found to be suitable and efficient oiling and collecting agents for the auriferous sulphides, these oils have been used in varying proportions in the present series of tests. Coal tar has not been used on account of the unsatisfactory nature of the results obtained in the previous series of tests. Creosote oil, Australian Gaslight Co.'s Middle Oil, Sp. Gr. 0.96, has been found to give excellent results when used in conjunction with eucalyptus oil and kerosene, lower grade residues being produced when this mixture of oils was used than when eucalyptus oil and kerosene alone were used.

Conditioning Agents.

The use of potassium xanthate has been found to improve the nature of the floats, dirty floats and high-grade residues being produced when this reagent was absent and other flotation conditions were kept constant. When used, this reagent has been added to the pebble mill charge.

In the previous investigation on ore from this lode, which the results of tests showed to be partially oxidised, the use of sodium sulphide was found to be necessary to film the partially oxidised sulphides and render them amenable to flotation. In the present series of tests the use of this reagent has been found necessary, and therefore in the majority of tests this reagent has been used. The time of contact of this reagent with the ore is an important factor, and to determine the result of variation of time of contact a series of tests has been carried out in which all other conditions have been kept constant while the time of contact has been varied. In all tests where sodium sulphide has been used this reagent has been added to the pebble mill charge so that it might be enabled to act on the sulphides as soon as they were separated from the gangue. In this way residues have been reduced to 1 dwt. and less per ton.

Pulp Consistency.

The consistency of the flotation feed has been varied from 1 part solids to 5 parts water up to 1 part solids to 3 parts water, and the results indicate that the high-density pulp introduces no difficulties, although, as is natural in a thick pulp, there is a tendency for the percentage of concentrate to be increased by inclusion of gangue in the float. This is not necessarily a disadvantage, since the primary concentrate can always be re-cleaned to a high-grade concentrate at small cost, as is invariably the practice in base metal flotation practice. The use of a thick pulp also increases considerably the capacity of the flotation plant. Two concentrates have been produced in nearly all tests, the second representing a middle product which in practice would be returned for re-treatment to the flotation machines along with the feed. In all tests in which the residues have been of low grade, the grade of the second concentrate or middle product has been either less or but little greater than that of the original feed. In practice this middle product would be returned to the flotation machine for re-treatment, while the first concentrate is of such high grade and constitutes so small a percentage of the feed that its re-treatment would be unnecessary.

Time of Flotation.

The time of flotation has been kept constant throughout, six minutes being allowed for removal of the first concentrate and a subsequent eight minutes for the second concentrate. The oils and reagents necessary for flotation have been added to the pebble mill charge, as this procedure has invariably been found to yield best results. In some cases additional quantities of oil have been added to the flotation machine after removal of the first concentrate, but, apparently, no advantage is gained by so doing, and in the later tests this practice has been discontinued.

Duration of Treatment with Sodium Sulphide.

Apparently at least eight hours' contact of the flotation feed with sodium sulphide is necessary before flotation, shorter periods of contact resulting in the production of high-grade residues; while still better results are obtained by increasing the time of contact. This appears to be due to the fact that the sulphides in this ore are comparatively slow floating and that long contact with sodium sulphide very greatly increases the flotation speed, so that low-grade residues can be produced in a reasonably short flotation period. Maintenance of the pulverised ore in contact with sodium sulphide will introduce no difficulties in practice, this result being obtainable by similar methods to those at present in use in the agitation of slime with cyanide solution.

Conclusions.

As a result of this and the previous investigation the following conclusions have been arrived at and definite conditions can be laid down for successful flotation of the auriferous sulphides in this ore, viz.:—

1. The ore must be finely ground, preferably to pass 150-mesh I.M.M. screen.

2. The use of salt water is beneficial, and no difficulty is experienced when using sodium chloride solutions up to 20 per cent. concentration, or when using and re-using mine water which contains 14.3 per cent. sodium chloride.

3. In order to obtain a high percentage extraction and low-grade residues, the use of sodium sulphide in quantities up to 4 pounds per ton of ore is essential, and best results are obtained by adding this reagent during the grinding operation and allowing the ore to remain in contact with the sulphide for eight to sixteen hours subsequent to the grinding operation.

4. The use of potassium xanthate results in the production of a cleaner concentrate than when it is absent, and tends to make flotation of the sulphides more rapid.

5. As oiling and collecting agents, eucalyptus oil, creosote oil, and kerosene constitute an excellent combination, but coal tar in conjunction with eucalyptus oil and kerosene causes flotation of a considerable proportion of gangue, with the consequent production of a low-grade concentrate constituting too high a percentage of the ore for the process to be an economical success.

6. A thick pulp, 1 part solids to 3 parts water, gives better results under the conditions set out than a thinner pulp.

7. In order to produce a high-grade concentrate it is necessary to collect the first and more rapidly floating concentrate separately from the slower floating and lower grade portion of the sulphides, the latter of which will be returned to the head of the flotation machine for retreatment.

The following tabulation shows the results of tests carried out on this ore:—

ALL ASSAY VALUES ARE STATED IN DWT. PER TON OF 2,000 LB.

Test No.	Ore.		Feed, solid : water ratio.	Oil.			Reagents.			Conct.		Middling.		Residue Au, dwt. per ton.	Distribution of gold, per cent.			Remarks.
	Wt., gram.	Au, dwt. per ton.		Description.	Wt., gram.	Wt., lb. per ton.	Description.	Wt., gram.	Wt., lb. per ton.	Wt., per cent.	Au, dwt. per ton.	Wt., per cent.	Au, dwt. per ton.		Conct.	Midd.	Tails.	
1	600	8·5	1 : 5	Euco ... Creosote oil	0·24 0·288	0·8 0·96	NaCl ... Pot. Xanth.	5 % 0·1	Soln. 0·33	10·65	67·9	5·53	13·4	1·7	76·96	7·89	15·15	Added Euco-tar (1 : 6) 0·4 lb/ton; Na_2S, 6·7 lb./ton for middling flotn.
2	600	8·5	1 : 5	Euco. ... Creosote oil ...	0·24 0·288 ...	0·8 0·96 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	12·85	55·4	3·53	12·5	1·25	82·19	5·13	12·68	Middling taken off as in Test 1.
3	600	8·5	1 : 5	Euco. ... Creosote oil	0·24 0·288 ...	0·8 0·96 ...	NaCl. ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	10·48	62·0	4·83	19·0	1·95	71·62	10·12	18·26	No oil or reagents added after taking off concentrate.
4	600	8·5	1 : 5	Euco. ... Creosote oil	0·24 0·288 ...	0·8 0·96 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	10·12	64·0	3·60	17·0	2·00	73·47	6·94	19·59	Added euco-tar (1 : 6), 0·4 lb./ton at commencement of flotn.
5	600	8·5	1 : 5	Euco-tar Kero. ...	0·48 0·2	1·6 0·66	NaCl ... Pot. Xanth.	5 % 0·1	Soln. 0·33	6·57	74·0	4·88	23·0	2·10	61·83	14·50	23·67	Dirty float, No oil or reagents added during flotn.
6	600	8·5	1 : 5	Euco-tar Kero.	0·48 0·2 ...	1·6 0·66 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	8·53	65·0	3·40	17·0	2·2	68·79	7·17	24·04	As for Test 5.
7	600	8·5	1 : 5	Euco. ... Creosote oil	0·24 0·288 ...	0·8 0·96 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	8·12	72·0	6·80	20·5	1·6	68·48	15·94	15·58	After taking off conct. added euco-tar, 0·4 lb./ton for middling.
8	600	8·5	1 : 5	Euco. ... Creosote oil	0·24 0·288 ...	0·8 0·96 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	8·13	66·0	4·83	26·0	1·75	62·79	14·69	22·52	As for Test 7.
9	600	8·5	1 : 5	Euco. ...	0·36	1·2	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 6·66	9·23	60·0	4·88	21·0	1·5	70·53	13·05	16·42	As for Test 7.
10	600	8·5	1 : 5	Euco. ... Kero.	0·30 0·2 ...	1·0 0·66 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·33 0·66	9·38	62·5	3·62	20·0	1·5	74·30	9·17	16·53	As for Test 7.
11	750	8·5	1 : 4	Euco. ... Creosote oil	0·24 0·288	0·64 0·77	NaCl ... Na_2S ...	5 % 2·0	Soln. 5·33	12·27	51·0	9·15	12·5	1·0	76·44	13·97	9·59	As for Test 7.
12	750	8·5	1 : 4	Euco. ... Creosote oil	0·24 0·288 ...	0·64 0·77 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	9·02	70·0	5·32	26·0	1·45	70·65	15·46	13·88	Added euco— 0·08 lb. ton; creosote oil, 0·096 lb./ton for middling flotn.
13	750	8·5	1 : 4	Euco. ... Creosote oil	0·24 0·288 ...	0·64 0·77 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	9·61	64·0	5·40	10·0	1·2	79·65	7·04	13·31	As for Test 12.
14	750	8·5	1 : 4	Euco. ... Creosote oil	0·24 0·288 ...	0·64 0·77 ...	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	9·85	64·0	3·91	10·0	1·3	78·59	7·56	13·85	As for Test 12.
15	750	8·5	1 : 4	Euco. ... Creosote oil Kero. ...	0·24 0·288 0·125	0·64 0·77 0·33	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	10·17	69·0	5·65	9·0	0·9	84·71	6·14	9·15	As for Test 12.
16	750	8·5	1 : 4	Euco. ... Creosote oil Kero. ...	0·24 0·288 0·20	0·64 0·77 0·53	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	8·08	79·5	8·69	16·0	1·0	74·28	16·08	9·64	No addition of oil or reagents during flotn.
17	750	8·5	1 : 4	Euco. ... Creosote oil Kero. ...	0·24 0·288 0·20	0·64 0·77 0·53	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	9·50	63·0	8·12	13·0	0·9	76·92	13·56	9·52	As for Test 16.
18	750	8·5	1 : 4	... ... Creosote oil Kero. ...	... 0·31 0·20	... 0·83 0·53	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·27 5·33	9·28	72·0	5·65	9·0	1·0	83·23	6·17	10·60	As for Test 16.
19	750	8·5	1 : 4	Euco. ... Creosote oil	0·24 0·288 ...	0·64 0·77 ...	Wiluna salt water Pot. Xanth. Na_2S ...	... 0·1 2·0	... 0·27 5·33	9·43	69·0	7·49	14·0	1·3	75·34	12·15	12·51	As for Test 16.
20	750	8·5	1 : 4	Euco. ... Creosote oil Kero. ...	0·24 0·288 0·125	0·64 0·77 0·33	Wiluna salt water Pot. Xanth. Na_2S ...	... 0·1 2·0	... 0·27 5·33	7·67	65·0	9·92	20·0	1·3	61·96	24·67	13·37	As for Test 19.

ALL ASSAY VALUES ARE STATED IN DWT. PER TON OF 2,000 LB.

Test No.	Ore. Wt., gram.	Ore. Au, dwt. per ton.	Feed, solid : water ratio.	Oil. Description.	Oil. Wt., gram.	Oil. Wt., lb. per ton.	Reagents. Description.	Reagents. Wt., gram.	Reagents. Wt., lb. per ton.	Conct. Wt., per cent.	Conct. Au, dwt per ton.	Middling. Wt., per cent.	Middling. Au, dwt. per ton.	Residue Au, dwt. per ton.	Distribution of gold, per cent. Conct.	Distribution of gold, per cent. Midd.	Distribution of gold, per cent. Tails.	Remarks.
21	750	8·5	1 : 4	Euco. ... Creosote oil Kero. ...	0·24 0·288 0·125	0·64 0·77 0·33	Wiluna salt water Pot. Xanth. Na_2S ...	... 0·1 2·0	... 0·27 5·33	9·09	78·0	8·03	9·0	1·0	82·05	8·36	9·59	Wiluna salt water from previous tests used. Eight hours' contact with Na_2S.
22	750	8·5	1 : 4	Euco. ... Creosote oil Kero. ...	0·24 0·288 0·125	0·64 0·77 0·33	Wiluna salt water Pot. Xanth. Na_2S ...	... 0·1 2·0	... 0·27 5·33	10·93	57·0	10·20	12·0	1·0	75·58	14·84	9·58	Wiluna salt water from previous tests used. Twenty four hours' contact with Na_2S.
23	1,000	8·5	1 : 3	Euco. ... Creosote oil Kero. ...	0·36 0·432 0·20	0·72 0·86 0·40	Wiluna salt water Pot. Xanth. Na_2S ...	... 0·1 2·0	... 0·2 4·0	20·62	38·0	...	...	1·0	90·78	...	9·22	One concentrate only. Wiluna salt water from previous tests used. Eight hours' contact with Na_2S.
24	1,000	8·5	1 : 3	Euco. ... Creosote oil	0·48 0·576 ...	0·96 1·15 ...	Wiluna salt water Pot. Xanth. Na_2S ...	... 0·1 2·0	... 0·2 4·0	10·76	58·0	7·20	6·5	0·9	83·80	6·28	9·82	Wiluna salt water from previous tests used. Eight hours' contact with Na_2S.
25	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	7·27	85·0	4·55	26·0	1·4	71·88	13·76	14·36	Four hours' contact with Na_2S.
26	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	9·00	73·0	6·37	18·0	1·15	74·45	13·81	11·74	Six hours' contact with Na_2S.
27	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Na_2S	5 % 2·0 ...	Soln. 4·0 ...	4·70	70·0	5·32	27·0	4·05	39·30	17·16	43·54	Four hours' contact with Na_2S but without pot. xanthate.
28	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Na_2S	5 % 2·0 ...	Soln. 4·0 ...	7·26	67·0	3·30	17·5	3·5	56·75	6·73	36·53	Six hours' contact with Na_2S but without pot. xanthate.
29	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 0·4	11·02	70·0	6·53	11·5	1·1	82·66	7·61	9·73	Sixteen hours' contact with Na_2S.
30	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	12·67	54·0	6·43	9·5	1·4	79·81	7·12	13·07	Twelve hours' contact with Na_2S.
31	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	10·53	71·0	9·63	7·5	1·15	82·01	7·92	10·07	Forty-eight hours' contact with Na_2S.
32	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 1·0	Soln. 0·2 2·0	12·01	59·0	8·04	8·5	1·25	80·81	7·68	11·51	Forty-eight hours' contact with Na_2S.
33	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	9·97	70·0	9·07	7·0	0·6	86·16	7·84	6·00	Twelve hours' contact with Na_2S.
34	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5% 0·1 2·0	Soln. 0·2 4·0	7·73	90·0	9·10	10·0	0·5	83·99	10·98	5·03	Sixteen hours' contact with Na_2S.
35	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	8·94	80·0	9·63	6·0	0·7	86·17	6·96	6·87	Twenty hours' contact with Na_2S.
36	1,000	8·6	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·432 0·25	0·96 0·86 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	6·56	96·0	8·58	7·0	0·6	85·02	8·10	6·88	Eight hours' contact with Na_2S; less creosote oil.
37	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl	5 %	Soln.	7·25	63·2	5·72	10·4	4·5	50·34	6·53	43·13	No Na_2S or Pot. xanthate.
38	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl	5 %	Soln.	7·65	52·0	5·92	12·0	3·9	49·36	8·81	41·83	Duplicate of Test 37.
39	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth.	5 % 0·1 ...	Soln. 0·2 ...	9·80	69·6	7·01	10·4	1·2	79·79	8·52	11·69	No Na_2S.
40	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·756 0·25	0·96 0·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	10·49	62·4	9·94	12·0	1·0	76·70	13·97	9·33	Duplicate of Test 33.
41	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	11·14	53·6	10·17	12·8	1·0	74·08	16·15	9·77	Duplicate of Test 33.
42	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	13·65	56·8	7·75	10·0	0·9	83·95	8·39	7·66	Duplicate of Test 33.
43	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	11·35	51·2	11·72	16·8	0·9	68·67	23·26	8·07	Duplicate of Test 34.
44	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	12·20	61·6	8·30	8·8	0·85	84·24	8·18	7·58	Duplicate of Test 34.
45	1,000	8·4	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	13·04	55·2	8·82	8·0	0·75	84·78	8·31	6·91	Duplicate of Test 34.

In all tests where sodium sulphide has been used, and the time of contact is not stated, that period has been the grinding period, viz., three hours. Tests 37, 38 show clearly the effect of not using potassium xanthate and sodium sulphide. Tests 40-45 confirm the results of Tests 33, 34 and show the possibility of reducing the residues below 1 dwt. per ton with a consequent recovery of over 90 per cent. of the gold.

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines, Kalgoorlie,
27th August, 1927.

Report on the Flotation of Sulphide Ore from the East Lode, Wiluna Gold Mines, Limited, Wiluna.

Ore Sample.

At the same time as the sample of ore from the West Lode, previously reported upon, a sample of ore from the East Lode was also received through the courtesy of the General Manager of Wiluna Gold Mines, Limited, Mr. H. E. Vail. This sample, weighing 2 cwt., was found to have been crushed to approximately half-inch size and to contain a considerable proportion of fines, much of which appeared to be oxidised ore. Examination of the ore sample disclosed the presence of considerable quantities of completely oxidised and semi-oxidised ore, the relative proportions of which it was impossible to determine. A sample of this oxidised and semi-oxidised ore was collected and found to assay the same as the general sample, viz., 5.6 dwts. Au per ton (2,000 lb.). On account of the partially oxidised character of the ore it was considered that the ore was not entirely suitable for testing for flotation, but, nevertheless, tests have been carried out to determine whether a satisfactory recovery of the gold could be obtained by flotation. The presence of oxidised ore is confirmed by the estimation of total and sulphate sulphur which was carried out on the first bag of ore tested and gave the following result:—

Total Sulphur 2.185 per cent., representing Sulphur as Sulphide 2.058 per cent.
Sulphur as Sulphate 0.127 per cent., representing (SO_4) 0.381 per cent.

In consequence of the semi-oxidised condition of a considerable proportion of the ore it has not been found possible to obtain similar results to those obtained on ore from the West Lode, even with the use of re-conditioning agents such as potassium xanthate and sodium sulphide. In addition, the sample was of low grade—5.6 dwts. Au per ton—and therefore in order to obtain a high percentage recovery of the gold in the form of a flotation concentrate, it is necessary that the flotation residues should be of lower grade than 0.5 dwt. Au per ton. This has so far not been found possible, although it has been found possible by flotation alone to produce residues assaying 1 dwt. Au per ton and by cyanidation of the flotation residues to produce final residues of as low grade as 0.1 dwt. Au per ton.

Although the average grade of ore from the mine is approximately 10 dwts. Au per ton (2,000 lb.), this sample from the East Lode is only of slightly more than half that grade, and therefore was either taken from a low-grade portion of the lode or contains nearly 50 per cent. of non-auriferous gangue.

On account, therefore, of the low grade of this sample of ore, and the presence of a considerable proportion of oxidised ore, results obtained by flotation cannot be considered to be indicative of the probable results from the flotation treatment of true sulphide ore of the grade of average run-of-mine ore. Results on such an ore, unsuitable as it is for flotation treatment, do, however, indicate that very much better results should be obtained on ore which has not been partially oxidised.

The results of a series of cyanidation tests on flotation residues shown in tabular form under "Cyanidation of Flotation Residues" tend to support the conclusion that in all probability as much as 80 per cent. of the gold not recoverable by flotation is present in the oxidised portion of the ore and is therefore not possible of recovery by flotation concentration. Direct cyanidation tests on the ore also support this view.

Since Wiluna ore contains a small percentage of arsenical pyrites and a portion of the gold is associated with this mineral, which is considered by flotation authorities to be the most difficult of all sulphides to float,* it is necessary, if low-grade residues are to be produced, that means must be adopted to secure the flotation of this mineral.

Flotation Conditions.

In a previous investigation on ore from the West Lode flotation conditions were determined which enabled residues of lower grade than 1 dwt. Au per ton to be produced. These conditions have therefore been used as a basis for the investigation of the ore from the East Lode, but on account of the different nature of the ore under investigation these conditions have had to be modified somewhat, as a result of which the production of residues of 1 dwt. Au per ton has been found comparatively easy. As it will be necessary to treat in the same plant ores from the different lodes of the mine it is necessary, if flotation treatment is to be adopted, to determine conditions which will give equally good results on the different classes of ore.

Salt Water.

Previous investigations have shown that in order to produce an economical percentage of concentrate of high grade the use of salt water is essential, no difficulty being encountered with solutions containing from 5 to 20 per cent. sodium chloride, or with mine water containing over 14 per cent. sodium chloride. The effect of using fresh water when other conditions are suitable is shown in Test 40, where a low-grade concentrate, high-grade middle product and a low recovery were obtained, in addition to which the froth contained much slimed gangue material and was not of similar character to that produced when salt water was used. Hence, except to show the effect of fresh water, all tests have been carried out in salt water.

Pulp Consistency.

In previous tests it has been found that a pulp ratio of one part solids to three parts water gave better results than a pulp containing a smaller proportion of solids, in spite of the fact that in a thick pulp there is always a tendency for gangue particles to be included in the froth to a greater extent than in a thin pulp. Other conditions being equal, a thin flotation feed apparently tends to the production of relatively high-grade residues—*vide* Tests 23, 24. The use of a thick pulp has the added advantage that the capacity of the flotation machine is thereby increased.

* Selective Flotation as Applied to Canadian Ores, by C. S. Parsons—Memorandum Series No. 11, Mines Branch, Department of Mines, Canada.

Oils.

The same combination of oils has been used as in previous tests, viz., eucalyptus oil (crude), creosote oil (Australian Gaslight Co.'s Middle Oil, Sp. Gr. 0.96) and kerosene, and in the main the proportions previously found satisfactory have been adhered to, no benefit having been derived from an increase in the proportion of creosote oil. In all cases where salt water has been used this combination of oils and collecting agents has been found to produce a compact and well-loaded froth. In all cases the whole of the oils has been added to the pebble mill charge, since this procedure has always been found to yield the most satisfactory results.

Conditioning Agents.

On account of its proved beneficial effect on the flotation of partially oxidised ore from the West Lode, sodium sulphide has been largely used as a re-sulphidiser of partially or superficially oxidised sulphide minerals. It has been found, however (Test 9), that sodium sulphide alone brings about but slightly better results than when no sulphide is used (Test 7), other conditioning agents being absent.

Potassium xanthate, however, has been found essential and its effect is very marked. (*Cf.* Tests 7, 8, 9.) In a recent paper presented at the Salt Lake City Meeting of the American Institute of Mining and Metallurgical Engineers, in August, 1927, the author, in attempting to explain the action of alkali xanthates, suggests the possibility that insoluble xanthates of the heavy metals are formed by reaction of the xanthate ion with the base metal atom at the surface of the mineral, and that explains why, after treatment with xanthate, pyrite is the most floatable of all the sulphide minerals.*

In the present series of tests it has been found that when xanthate is used for this purpose no sodium sulphide need be used, and that apparently the maximum proportion of xanthate necessary is 0.6 pound per ton of ore. (Tests 28, 29, 30.) If Gaudin's theory, quoted above, as to the action of xanthate is correct, it would appear that this effect would be enhanced by increasing the time of contact of the pulverised ore with the xanthate. Therefore the conclusion is reached that it is advisable to add the xanthate to the mill circuit as early as possible and that consequently the xanthate should be added to the tube mills along with the oils so that the action may go on between the xanthate and the fresh surfaces of the sulphide minerals as soon as the latter are produced. A comparison of the results of Tests 37 and 38, in the latter of which xanthate was added to the flotation machine, the two tests being identical in all other respects, shows that there is a marked increase in the percentage of the gold recovered by flotation and a diminution of the grade of the middle product when the xanthate is added to the pebble mill.

Ferrous sulphate has been used in some cases to clean the surface of the sulphides before flotation (Tests 25, 27), and so render more rapid the adherence of the oil film, but, except when sodium sulphide was used in conjunction with the ferrous sulphate practically no benefit has been derived from its use. In the case where sodium sulphide was used with ferrous sulphate, probably the floatability of the pyrite was increased by deposition on its surface of a thin film of precipitated ferrous sulphide produced by the action of the sodium sulphide on the ferrous sulphate.

* Flotation Mechanism, by A. M. Gaudin, Director of Research, University of Utah.

On account of its solvent action on arsenious oxide, a film of which may be formed by oxidation on the surface of the arsenical pyrites, a small quantity of tartaric acid has been used in Tests 37, 38, 39, 41, 42, 43 for the purpose of removing such possible film which would inhibit flotation, and this has resulted in the production of residues of 1 dwt. per ton with a recovery of over 75 per cent. of the gold in the form of a concentrate, leaving approximately 15 per cent. of the gold in the residues. Cream of tartar and argol gave much less satisfactory results. Sodium sulphide, when used in conjunction with tartaric acid and potassium xanthate has no appreciable effect on the results.

From the foregoing the following conclusions are reached, viz.:—

(a) The use of sodium sulphide on this partially oxidised ore is not necessary.

(b) The use of potassium xanthate is essential, and by its use residues of 1 dwt. per ton can be obtained, with a recovery of approximately 75 per cent. of the gold in the finished concentrate in one operation, a further 10 per cent. being contained in the middle product which is re-treated.

(c) Increasing the proportion of potassium xanthate used slightly improves the result, apparently the most efficient proportion being 0.6 lb. per ton.

(d) On account of its solvent action on arsenious oxide which, owing to partial oxidation, may film the arseno-pyrite, tartaric acid used in conjunction with xanthate appears to yield a low grade residue with a high percentage recovery in the concentrate.

(e) In order to secure the best results from the use of xanthate, it is advisable to add the reagent to the grinding mill so as to secure the longest possible contact between the xanthate and the mineral surfaces.

Fineness of Grinding.

On account of the fineness of the sulphide minerals in the ore, fine grinding is necessary and, as is usual for flotation, the final fine grinding, if not the whole of the grinding, must be carried out wet, partly on account of the oxidation of the sulphide minerals that will take place owing to the heat generated during a dry-grinding operation and partly on account of the tendency during dry-crushing for the sulphide and gangue particles to be ground into one another. Grading analyses of the flotation feed are as follows:—

TESTS 1–13.

I.M.M. Screen	Per cent.
+ 100	1·2
+ 150	17·8
— 150	81·0

TESTS 14–18.

I.M.M. Screen.	Per cent.
+ 100	0·0
+ 150	10·9
— 150	89·1

TESTS 19–49.

I.M.M. Screen.	Per cent.
+ 100	0·0
+ 150	1·2
— 150	98·8

For all tests the ore has been crushed dry to pass a 16-mesh I.M.M. screen, the final crushing being carried out wet in the pebble mill.

Time of Flotation.

In the previous investigations on ore from the West Lode the duration of flotation which gave best results was found to be six minutes for the removal of the concentrate, with a further eight minutes for removal of the middle product for re-treatment. These periods have been adhered to in the present investigation with good results, although in some tests with the higher proportions of xanthate it has been evident that a shorter flotation period would probably have yielded equally good results. Even with this comparatively long flotation period the percentages of concentrate and middling have not been high. This period of the duration of flotation is an important factor in the economical flotation of ores since in practice it must be controlled by regulation of the rate of flow of the pulp through the flotation cells and this, in turn, determines the tonnage capacity of the machine on a particular ore. Hence the flotation period must be as short as possible consistent with the production of low grade residues. Test 46 shows the effect of reduction of time of flotation from 14 to 10 minutes, although further confirmation of the effect of this reduction is necessary before a definite conclusion as to the minimum time of flotation can be arrived at, and some modification of other flotation factors may possibly permit of a reduction in the time required to produce a low grade residue.

The following tabulation shows the detailed results of all the flotation tests carried out on this sample:—

FLOTATION TESTS ON SULPHIDE ORE FROM EAST LODE, WILUNA GOLD MINES, LTD.

Sample No. 1, Assay Value—5·6 dwt. Au. per ton (2,000 lbs.)

Test No.	Ore, Wt., Gram.	Feed, Solid : Water Ratio.	Oil.			Reagents.			Conct.		Middlings.		Residue, Au, dwt./ton.	Distribution of gold, per cent.			Remarks.
			Description.	Wt., gram.	Wt., lb./ton.	Description.	Wt., gram.	Wt., lb./ton.	Wt., per cent.	Au, dwt./ton.	Wt., per cent.	Au, dwt./ton.		Conct.	Midd.	Tails.	
1	1,000	1 : 3	Euco ... Creosote oil Kero ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Zanth.	5 % 0·1 ...	Soln. 0·2 ...	10·13	38·2	7·17	7·6	1·3	70·49	9·92	19·59	
2	1,000	1 : 3	Euco ... Creosote oil Kero ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	9·18	42·6	6·20	9·2	1·15	71·69	10·46	17·85	Three hours' contact with Na_2S.
3	1,000	1 : 3	Euco ... Creosote oil Kero ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	10·26	45·6	6·48	11·0	1·3	72·27	11·01	16·72	Sixteen hours' contact with Na_2S.
4	1,000	1 : 3	Euco ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	Na Cl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	10·88	40·6	5·89	14·0	1·6	67·19	12·54	20·27	Eighteen hours' contact with Na_2S
5	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	6·95	54·8	7·83	16·4	1·5	60·73	18·88	20·39	Twenty-six hours' contact with Na_2S.
6	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 2·0	Soln. 0·2 4·0	9·00	44·2	5·02	12·0	1·6	66·79	10·11	23·10	Twenty-eight hours' contact with Na_2S.
7	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl	5 %	Soln.	5·57	35·0	5·97	30·4	2·8	31·23	29·07	39·70	Determination of effect of non-use of pot. xanth. and Na_2S.
8	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth.	5 % 0·1 ...	Soln. 0·2 ...	6·77	54·2	6·52	9·8	1·55	64·91	11·30	23·79	Determination of effect of pot. xanth. alone.
9	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Na_2S	5 % 1·0 ...	Soln. 2·0 ...	6·42	36·0	4·63	23·2	2·9	38·74	18·00	43·26	Determination of effect of Na_2S alone.
10	1,000	1 ; 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 1·0	Soln. 0·2 2·0	7·37	51·0	5·20	16·4	1·75	61·20	13·88	24·92	Twenty-four hours' contact with Na_2S.
11	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·1 1·0	Soln. 0·2 2·0	7·55	60·0	4·60	10·0	1·55	71·33	7·24	21·43	Twenty-four hours' contact with Na_2S.
12	1,000	1 : 3	Euco ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	Wiluna salt Pot. Xanth. Na_2S ...	water 0·1 1·0	... 0·2 2·0	7·15	51·0	6·55	14·0	1·55	61·79	15·54	22·67	Twenty-four hours' contact with Na_2S.
13	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 2·0	Soln. 0·4 4·0	6·87	58·0	6·45	10·8	1·3	68·60	11·98	19·42	Twenty-one hours' contact with Na_2S.
14	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 2·0	Soln. 0·4 4·0	10·02	40·0	6·35	9·0	1·7	66·97	9·55	23·48	Twenty-one hours' contact with Na_2S.
15	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 2·0	Soln. 0·4 4·0	8·05	52·0	5·33	6·8	1·35	73·21	6·34	20·45	Twenty-one hours' contact with Na_2S.
16	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 3·0	Soln. 0·4 6·0	9·61	45·0	8·70	6·4	1·45	71·29	9·18	19·53	Twenty-four hours' contact with Na_2S.
17	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 4·0	Soln. 0·4 8·0	10·16	40·0	6·95	5·6	1·6	70·31	6·73	22·96	Twenty-four hours' contact with Na_2S.
18	1,000	1 : 3	Euco ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 5·0	Soln. 0·4 10·0	11·31	34·0	8·69	6·0	1·4	70·08	9·50	20·42	Twenty-four hours' contact with Na_2S.
19	1,000	1 : 3	Euco ... Creosote oil Kero. ...	0·48 0·72 0·25	0·96 1·44 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·25 2·0	Soln. 0·50 4·0	6·85	68·5	6·92	11·2	1·5	69·40	11·46	19·14	Twenty-two hours' contact with Na_2S.
20	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·90 0·25	0·96 1·80 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·25 2·0	Soln. 0·50 4·0	7·63	62·0	6·02	11·2	1·5	70·60	10·06	19·34	Twenty-two hours' contact with Na_2S.
21	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 1·08 0·25	0·96 2·16 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·25 2·0	Soln. 0·50 4·0	8·66	54·5	5·70	8·0	1·3	75·04	7·25	17·71	Twenty-two hours' contact with Na_2S.
22	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 2·0	Soln. 0·4 4·0	7·42	53·0	6·36	10·4	1·55	66·31	11·15	22·54	Twenty-four hours' contact with Na_2S.

FLOTATION TESTS ON SULPHIDE ORE FROM EAST LODE, WILUNA GOLD MINES, LTD.—*continued.*

Sample No. 1, Assay Value—5·6 dwt. Au. per ton (2,000 lbs.)

Test No.	Ore, Wt., Gram.	Feed, Solid : Water Ratio.	Oil. Description.	Oil. Wt., gram.	Oil. Wt., lb./ton.	Reagents. Description.	Reagents. Wt., gram.	Reagents. Wt., lb./ton.	Conct. Wt., per cent.	Conct. Au, dwt./ton.	Middlings. Wt., per cent.	Middlings. Au, dwt./ton.	Residue, Au, dwt./ton.	Distribution of gold, per cent. Conct.	Distribution of gold, per cent. Midd.	Distribution of gold, per cent. Tails.	Remarks.
23	600	1 : 5	Euco. ... Creosote oil Kero ...	0·288 0·345 0·15	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·12 1·2	Soln. 0·4 4·0	7·82	49·0	5·78	10·6	1·3	68·72	11·01	20·27	As for Test 22.
24	750	1 : 4	Euco. ... Creosote oil Kero. ...	0·36 0·432 0·187	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·15 1·5	Soln. 0·4 4·0	7·32	54·0	6·53	9·6	1·45	67·81	10·76	21·43	As for Test 22.
25	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. $FeSO_4$ $7H_2O$	5 % 0·1 2·0	Soln. 0·2 4·0	7·47	44·0	6·40	8·8	1·2	64·99	14·62	20·39	
26	1,000	1 : 3	Euco. ... Creosote oil Kero.	0·48 0·576 0·25 ...	0·96 1·15 0·50 ...	NaCl ... Pot. Xanth. $FeSO_4$ $7H_2O$ Na_2S ...	5 % 0·1 2·0 2·0	Soln. 0·2 4·0 4·0	8·45	41·0	4·56	10·4	1·5	66·08	9·04	24·88	Twenty-four hours' contact with Na_2S and $FeSO_4$. $7H_2O$.
27	1,000	1 : 3	Euco. ... Creoso-e oil Kero.	0·48 0·576 0·25 ...	0·96 1·15 0·50 ...	NaCl ... Pot. Xanth. $FeSO_4$ $7H_2O$ Na_2S ...	5 % 0·1 3·0 2·0	Soln. 0·2 6·0 4·0	9·07	44·5	6·87	9·8	1·3	69·56	11·60	18·84	Twenty-four hours' contact with Na_2S and $FeSO_4$. $7H_2O$.
28	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth.	5 % 0·2 ...	Soln. 0·4 ...	7·09	52·0	5·87	14·8	1·1	66·87	15·76	17·37	Determination of effect of increasing quantities of pot. xanthate.

Sample No. 2—Assay Value—5·33 dwt. Au per ton (2,000 lb.)

Test No.	Ore, Wt., Gram.	Feed, Solid : Water Ratio.	Oil. Description.	Oil. Wt., gram.	Oil. Wt., lb./ton.	Reagents. Description.	Reagents. Wt., gram.	Reagents. Wt., lb./ton.	Conct. Wt., per cent.	Conct. Au, dwt./ton.	Middlings. Wt., per cent.	Middlings. Au, dwt./ton.	Residue, Au, dwt./ton.	Distribution of gold, per cent. Conct.	Distribution of gold, per cent. Midd.	Distribution of gold, per cent. Tails.	Remarks.
29	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth.	5 % 0·3 ...	Soln. 0·6 ...	8·37	51·5	4·93	9·4	1·1	75·25	8·09	16·66	
30	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·59	NaCl ... Pot. Xanth.	5 % 0·4 ...	Soln. 0·8 ...	7·88	52·5	5·43	7·8	1·1	75·02	7·68	17·30	
31	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·2 1·0	Soln. 0·4 2·0	10·40	41·0	7·28	5·6	1·1	76·45	7·31	16·24	Determination of effect of increasing quantities of pot. xanthate with constant quantity of Na_2S. Twenty-four hours' contact with Na_2S.
32	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot.Xanth. Na_2S ...	5 % 0·3 1·0	Soln. 0·6 2·0	9·84	41·0	6·57	8·8	1·2	71·85	10·29	17·86	
33	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·4 1·0	Soln. 0·8 2·0	9·50	45·0	6·94	7·6	1·2	73·64	9·08	17·28	
34	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot .Xanth. Na_2S ...	5 % 0·2 2·0	Soln. 0·4 4·0	11·04	36·0	7·61	7·2	1·0	74·48	10·27	15·25	As for Tests 31, 32, 33, with twice the quantity of Na_2S.
35	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Na_2S ...	5 % 0·3 2·0	Sol.n 0·6 4·0	9·94	42·0	6·61	9·0	1·0	74·49	10·61	14·90	
36	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth Na_2S ...	5 % 0·4 2·0	Soln. 0·8 4·0	11·29	37·0	6·53	9·2	1·0	74·59	10·72	14·69	
37	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Ac. Tartaric	5 % 0·2 0·1	Soln. 0·4 0·2	5·85	44·5	6·93	19·2	1·9	46·56	23·79	29·65	Xanthate added during flotation.
38	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Ac. Tartaric	5 % 0·2 0·1	Soln. 0·4 0·2	8·60	46·5	5·58	7·6	1·0	75·72	8·03	16·25	Tartaric acid and xanth. added to pebble mill.
39	1.000	1 : 3	Euco. ... Creosote oil Kero.	0·48 0·576 0·25 ...	0·96 1·15 0·50 ...	NaCl ... Pot. Xanth. Ac. Tartaric Na_2S ...	5 % 0·2 0·1 2·0	Soln. 0·4 0·2 4·0	11·29	35·0	6·42	7·0	1·0	75·64	8·60	15·76	All reagents added to pebble mill. 24 hours' contact with Na_2S.
40	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	Pot. Xanth. Na_2S	0·3 1·0 ...	0·6 2·0 ...	11·52	31·0	7·48	10·8	1·2	66·74	15·09	18·17	Fresh water used. Twenty-four hours' contact with Na_2S.
41	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Ac. Tartaric	5 % 0·2 0·1	Soln. 0·4 0·2	12·27	33·0	6·29	8·0	1·0	75·45	9·37	15·18	Duplicate of 38.
42	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·720 0·25	0·96 1·44 0·50	NaCl ... Pot. Xanth. Ac. Tartaric	5 % 0·2 0·1	Soln. 0·4 0·2	7·63	53·0	8·20	8·2	1·0	72·76	12·09	15·15	Increased quantity of creosote oil.
43	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·864 0·25	0·96 1·74 0·50	NaCl ... Pot. Xanth. Ac. Tartaric	5 % 0·2 0·1	Soln. 0·4 0·2	9·77	42·0	7·14	7·6	1·2	72·71	9·61	17·68	Increased quantity o creosote oil.
44	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Pot. Bitart	5 % 0·2 0·1	Soln. 0·4 0·2	8·51	50·0	6·55	6·8	1·4	72·25	7·56	20·19	Effect of potassium bitartrate instead of tartaric acid.
45	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth Argol ...	5 % 0·2 0·2	Soln. 0·4 0·4	7·87	49·0	8·48	9·0	1·1	69·59	11·97	18·44	Effect of argol instead of tartaric acid.
46	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·51	NaCl ... Pot. Xanth.	5 % 0·3 ...	Soln. 0·6 ...	7·88	48·0	6·14	13·2	1·65	62·92	13·48	23·60	Five minutes' flotation each for conct. and middling.
47	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Argol ...	5 % 0·2 0·5	Soln. 0·4 1·0	10·49	34·0	7·72	9·2	1·6	63·85	12·71	23·44	Similar to Test 45 but with increased quantity of argol.
48	1.000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Argol ...	5 % 0·3 0·2	Soln. 0·6 0·4	10·23	39·0	6·45	9·8	1·4	68·92	10·92	20·16	Similar to Test 45 but with increased quantity of pot. xanth.
49	1,000	1 : 3	Euco. ... Creosote oil Kero. ...	0·48 0·576 0·25	0·96 1·15 0·50	NaCl ... Pot. Xanth. Argol ...	5 % 0·3 0·5	Soln. 0·6 1·0	8·77	45·0	7·63	13·2	1·4	64·44	16·44	19·12	Quantities of argol and pot. xanth., both increased.

Cyanidation of Flotation Residues.

Since the lowest grade residues produce by flotation of this ore have been 1.0 dwt. per ton, it was suspected that a large proportion of this non-floatable gold was contained in the oxidised ore known to be present in the sample, and, therefore, in order to ascertain whether these residues could be still further reduced by cyanidation, a series of tests, tabulated below, has been carried out on some of these flotation residues. These tests on residues of varying grades, show that the flotation residues from the treatment of this ore are capable of being readily and economically cyanided with a reduction in grade to 0.1—0.2 dwt. gold per ton.

CYANIDATION TESTS ON FLOTATION RESIDUES.

Flotation Test Residue, Test No.	Residue.		Cyanide Solution.		CaO, lb./ton.	Solution after leaching KCN per cent.	KCN Consumption lb./ton.	Cyanidation Residue, Au, dwt./ton.	Extraction per cent.
	Wt., gram.	Au, dwt./ton.	Volume, c.c.	KCN, per cent.					
15	224	1·35	500	0·107	...	0·068	1·74	0·2	85·2
16	224	1·45	500	0·107	...	0·068	1·74	0·2	86·2
17	224	1·60	500	0·107	...	0·065	1·875	0·2	87·5
15	224	1·35	500	0·110	1·0	0·087	1·027	0·1	92·6
16	224	1·45	500	0·110	1·0	0·080	1·34	0·1	93·1
17	224	1·60	500	0·110	1·0	0·088	0·98	0·1	93·7
29	224	1·10	500	0·106	1·0	0·087	0·85	0·1	90·9
32	224	1·20	500	0·106	1·0	0·082	1·07	0·1	91·66
35	224	1·00	500	0·106	1·0	0·080	1·16	0·1	90·0
39	224	1·00	500	0·106	1·0	0·083	1·03	0·1	90·0

All tests were agitated in pebble mill jars for twenty-four hours.

Therefore it is apparent that when treating by flotation a mixture of suphide and oxidised ores, the subsequent economical treatment of comparatively high grade flotation residues presents no difficulties, provided that flotation itself is successful in concentrating the whole of the auriferous sulphides. It is also evident, in the case of this sample of ore, that the flotation conditions described in the detailed statement of tests are such as to enable practically the whole of the auriferous sulphides to be floated, and that the comparatively high grade of the residues is due to the presence of non-floatable gold contained in the oxidised ore, particularly in view of the fact, described later, that direct cyanidation or bromocyanidation of the raw ore is incapable of extracting more than a comparatively small percentage of the total gold. Hence it is reasonable to conclude, on account of the ease of its extraction by cyanidation, that the major portion of the gold in the flotation residues is present in such a form as to be incapable of recovery by flotation.

Treatment of Concentrates.

Two distinct methods of treatment are available for recovery of the gold values from the flotation concentrates, viz.:—

(1) Direct cyanidation, either with or without the addition of bromocyanogen.

(2) Roasting of the concentrates and cyanidation of the resulting oxidised product.

Tests carried out by Mr. A. S. Winter and myself during 1926 on the cyanidation of flotation concentrates produced from Wiluna ore indicated that the maximum extraction obtainable by bromocyanidation was somewhat less than 40 per cent. Therefore recourse must be had to roasting and cyanidation of the concentrates.

Since the use of salt water is essential to successful flotation of this ore, and since the presence of salt in the concentrates leads to heavy volatilisation loss of gold during roasting of the concentrates, especially in the presence of arsenopyrite, the concentrates must be thoroughly washed with fresh water before roasting. Since the concentrates settle readily, this may be carried out by decantation or the concentreates may be filtered, preferably in some form of pressure filter, and well washed with fresh water in the filter.

In order to determine possible losses of gold by volatilisation during roasting, tests have been carried out on the roasting of concentrates (a) without removal of the salt contained in the filtered concentrate, and (b) after complete removal of the salt by washing with fresh water. The results of these tests are shown in the following table:—

LOSS OF GOLD BY VOLATILISATION DURING ROASTING OF CONCENTRATES.

——	In the absence of salt.	In the presence of salt.
Assay value of raw conct., dwt. per ton (2,000 lb.)	41·0	41·0
Weight of raw conct., gram. ...	50	50
Weight of roasted conct., gram.	43·9	43·85
Loss of weight, gram. ...	6·1	6·15
Loss of weight, per cent. ...	12·2	12·3
Assay value of roasted conct., dwt. per ton	43·0	38·0
Gold lost by volatilisation, per cent.	7·91	18·71
Maximum temperature during roasting	600° C.	600° C.

To determine the recovery of gold obtainable by cyanidation of the roasted concentrates, a composite sample has been made up from a number of concentrates produced in the laboratory, which had been thoroughly washed to remove salt and filtered and dried. This composite sample assayed 47.5 dwt. gold per ton and contained 17.49 per cent. sulphur and 4.44 per cent. arsenic. Roasting was carried out in a muffle furnace at a maximum temperature of 600° C. with the following result:—

——	Raw Concentrate.	Roasted Concentrate.
Assay, value, dwt. au per ton	47·5	50·8
Sulphur as sulphide, per cent.	17·49	0·44
Sulphur as sulphate, per cent.	...	1·87
Arsenic, per cent. ...	4·44	2·35
Arsenic as arsenate, per cent.	...	0·91

Cyanidation tests were then carried out under the conditions and with the results tabulated below :—

CYANIDATION TESTS ON ROASTED CONCENTRATES.

Assay value of roasted concentrates—50·8 dwt. Au per ton.

Test No.	Conct. Wt., gram.	KCN. Soln.		CaO, lb./ton.	Soln. after treatment.		KCN Consumption, lb./ton.	Residue, Au, dwt. /ton.	Extraction per cent.
		Vol. c.c.	KCN, per cent.		KCN, per cent.	Prot. Alk. CaO, %			
1	200	500	0·5	1·0	0·1775	*nil*	16·125	3·8	92·5
2	200	500	0·5	1·25	0·22	*nil*	14·0	2·7	94·7
3	200	500	0·5	1·5	0·2325	*nil*	13·375	3·25	93·6

Although the grade of these residues may appear to be high, it must be borne in mind that the concentrates will constitute about 12 per cent., or less, of the ore, while the remaining 88 per cent.—the flotation residues—may be considered to assay about 1 dwt. per ton, so that the grade of the total residues will not greatly exceed 1 dwt. per ton.

Direct Cyanidation of Raw Ore.

In order to determine whether satisfactory extractions of the gold values could be made by direct cyanidation of the ore without roasting, a sample of ore was ground in the pebble mill so that 96.5 per cent. passed 150-mesh I.M.M. screen, and after filtering and drying, a series of tests was carried out under the conditions and with the results set out below, These tests show that direct cyanidation, with or without the addition or bromocyanogen, is incapable of yielding a satisfactory extraction. A similar result was obtained in 1926 in a series of tests on the direct cyanidation of flotation concentrates produced from the ores of the Wiluna and Kalgoorlie mines, when it was found that, although high percentage recoveries could be obtained by bromocyanidation of Kalgoorlie concentrates, not more than 40 per cent. extraction could be obtained from Wiluna concentrates by similar means. (*Vide* Report on Treatment of Flotation Concentrates by A. S. Winter and B. H. Moore, 19th October, 1926.)

DIRECT CYANIDATION TESTS ON RAW ORE.

Pebble Mill Product—96·5 per cent. minus 150 mesh I.M.M.—Assay Value, 5·2 dwts. per ton.

Test No.	Ore, Wt., gram.	KCN Solution.		CaO, lb./ton.	BrCN, lb./ton.	Agitation.		Solution after treatment, KCN, per cent.	Consumption KCN, lb./ton.	Residue, Au, dwt./ton.	Extraction, per cent.	Remarks.
		Volume c.c.	KCN, per cent.			Method.	Time, hours.					
1	224	500	0·5	5	...	Air	16	0·435	2·9	3·85	25·96	
2	224	500	0·5	5	1	Air	16	0·3175	8·15	3·6	30·77	BrCN added after 14 hours' agitation.
3	224	500	0·5	5	...	Air	20	0·315	8·26	3·4	34·61	
4	224	500	0·5	10	1	Air	20	0·2975	9·04	3·55	31·73	BrCN added after 18 hours' agitation ; 5lb. CaO per ton one hour later.
5	224	500	0·5	5	...	Air	24	0·25	11·16	3·1	40·38	
6	224	500	0·5	10	1	Air	24	0·2925	9·26	3·7	28·84	BrCN added after 22 hours' agitation ; 5lb. CaO per ton one hour later.
7	224	500	0·5	5	...	Bottle	24	0·455	2·0	3·6	30·77	
8	224	500	0·5	10	1	Bottle	24	0·4475	2·34	3·6	30·77	As in Test 6.
9	224	500	0·5	5	1	Bottle	24	0·3585	7·075	3·2	38·46	Ore first agitated two hours with lime water, then cyanided. BrCN added after 21·5 hours' agitation, then 5lb. CaO per ton.
10	224	500	0·5	10	1	Bottle	24	0·408	4·6	3·2	38·46	

Summary.

As a result of this investigation and the two investigations on ore from the West Lode, the following conclusions have been arrived at:—

(1) The use of salt water is essential for the production of a clean concentrate, which constitutes a small percentage of the original ore. The concentration of sodium chloride in the water used for making up the mill and flotation pulp may vary from 5 to 20 per cent. without harmful effect, while the salt water from the mine, containing 18 per cent. of dissolved solids of which sodium chloride accounts for 14 per cent., introduces no difficulties in flotation.

(2 A pulp consistency of one part solids to three parts water is the most suitable for flotation, which is advantageous from the point of view of the capacity of the flotation plant.

(3) A suitable combination of oils for oiling and collecting consists of crude eucalyptus oil, creosote oil, and kerosene which are used in the proportion of 0.96, 1.15, and 0.5 lb. per ton, respectively. As in the case of Kalgoorlie sulphide ores, it is more satisfactory to add the oils to the ore pulp during the grinding operation than to the flotation machine.

(4) For accelerating the flotation of the pyrite and arsenopyrite, potassium xanthate is the most suitable conditioning agent, although on the sample of ore from the West Lode, sodium sulphide has also been necessary, while on the partially oxidised and low grade ore from the East Lode the use of sodium sulphide offers no advantages. On East Lode ore potassium xanthate alone yields satisfactory results, and its use is essential for both ores. Addition of xanthate to the pebble mill gives better results than when this reagent is added to the flotation cell.

(5) For flotation this ore should be ground to pass 150-mesh I.M.M. screen.

(6) The sulphides in this ore are comparatively slow floating, especially when neither xanthate nor sodium sulphide is used as an accelerator and this necessitates a longer time of flotation than is usually required for the sulphide ores of Western Australia, which involves slow passage of the pulp through the flotation cells and a consequent reduction in capacity. Further investigation of the time of flotation is necessary to determine whether modifications of some of the flotation conditions or the use of other reagents may result in a reduction of the time of flotation necessary.

(7) The treatment of mixed sulphide and oxidised ore presents no difficulty inasmuch as conditions can be laid down by the use of which practically complete flotation of the sulphide minerals may be attained. while the flotation residues, if the grade warrants, may be treated economically by cyanidation, from which treatment the final residues may be discarded at a very low grade. For this treatment counter current decantation seems to possess advantages over other methods.

(8) The subsequent treatment of the concentrates produced by flotation is complicated by the presence of arsenopyrite, since, apparently, quite appreciable loss of gold by volatilisation takes place during the roasting of these concentrates, irrespective of whether the concentrates are freed from salt or not, although in the latter case the volatilisation loss is more marked. The roasting of this concentrate calls for extensive investigation for the purpose of determining the roasting conditions necessary to prevent, or at least to minimise, this loss.

(9) Cyanidation of the roasted flotation concentrates can be successfully carried out with a high percentage recovery.

(10) Direct cyanidation or bromocyanidation of the raw ore is out of the question on account of the low percentage extraction obtainable, and for the same reason similar treatment of the flotation concentrates is unsatisfactory. (*Vide* Report on Treatment of Flotation Concentrates by A. S. Winter and B. H. Moore, 19th October, 1926.)

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines of W.A.,
Kalgoorlie 19th October, 1927.

Report on an Investigation into the Treatment of Silver-Lead Ore from Durack' Lode, Kimberley Goldfield, North-West Australia.

Under instructions from the State Mining Engineer an investigation has been made of the possibility of concentrating a sample of silver-lead ore from Mr. Durack's newly found lode in the Kimberley Goldfield, forwarded for that purpose by Mr. A. E. Fordham of Fremantle.

The ore consists essentially of copper-stained quartz containing crystals of galena, PbS, and cerussite, $PbCO_3$ and anglesite, $PbSO_4$. The whole parcel of 3½ cwt. was carefully sampled and a representative sample, on analysis, gave the following result:—

Lead	12·08 per cent.
Copper	3·61 „
Silver	56·527 ozs. per ton (2,240lbs.)
Gold	2·6 dwts. per ton (2,240lbs.)
Insoluble	68·36 per cent.
Sulphur, Total ...	1·07 „
Sulphur as Sulphate	0·35 „

By calculation, this gives the following mineral analysis:—

Galena, PbS	5·38 per cent.
Anglesite, $PbSO_4$	3·31 „
Cerussite, $PbCO_3$	6·66 „
Copper Carbonate, $CuCO_3$ ...	7·01 „

In grinding the ore for gravity and flotation concentration it was found to yield a slime of a colloidal nature which filtered extremely slowly even under an air pressure of 100 pounds per square inch. This was particularly noticeable in the fine grinding necessary for flotation concentration.

In investigating the concentration of this ore four distinct objects had to be considered, viz.:—

(1) Production of a lead concentrate containing a minimum of copper.
(2) Production of a copper product containing a minimum of lead.
(3) Determination whether the silver and/or gold are associated with the lead or copper minerals, or both, and the consequent production of a lead concentrate or copper product of high tenor in silver and gold.
(4) Production of residues of low tenor in lead, copper, silver and gold.

The specific gravities of the valuable minerals in the ore are as follows:—Galena, 7.5; Cerussite, 6.5; Anglesite, 6.3; Malachite, 4.0; Azurite, 3.8. Hence, theoretically, it should be possible to separate the lead minerals from the copper minerals by gravity methods of concentration. Practically, however, it was not found possible to obtain separately high grade lead and copper concentrates on the Wilfley table with low grade table residues, on account of the readiness with which the oxidised lead minerals and the copper minerals slimed during the grinding operation and the difficulty of concentrating this slime on the table and its consequent entry into the table residues. To determine the nature of the sand and slime in the Wilfley feed a classification test was carried out on the ore after grinding in the pebble mill under the same conditions as obtained when grinding for Wilfley table concentration, with the following result:—

Ore Assay.				Product.	Assay Value.				Distribution of Values.				Weight of Product, per cent.
Pb, %	Cu, %	Ag, oz./ton.	Au, dwt./ton.		Pb, %	Cu, %	Ag, oz./ton.	Au, dwt./ton.	Pb, %	Cu, %	Ag, %	Au, %	
12·20	3·57	54·57	2·4	Sand ...	10·88	2·96	53·56	3·2	46·50	41·00	49·47	67·09	50·41
				Slime ...	12·72	4·19	55·60	1·6	53·50	59·00	50·53	32·91	49·59

Grading analyses of the sand and slime products are as follows:—

SAND.

I.M.M. Screen.	Per cent.
+ 60 ...	9·60
+ 80 ...	19·65
+ 100 ...	8·20
+ 120 ...	19·00
+ 150 ...	13·45
— 150 ...	30·10

SLIME.

I.M.M. Screen.	Per cent
+ 100 ...	1·95
+ 120 ...	3·75
+ 150 ...	6·75
— 150 ...	87·55

This test shows that the lead, silver and copper values are very evenly distributed between the two products, but that the greater proportion of the gold is present in the sand product. It appears, therefore, that the gold is probably contained in the quartz and is not in intimate association with either the lead or the copper minerals.

It is possible to secure by table concentration a high grade lead concentrate containing some copper and a high grade copper concentrate containing some lead, but the residues still contain relatively high percentages and a considerable proportion of the total lead and copper.

Direct flotation of the galena is capable of yielding a high-grade lead-silver concentrate, but the residues contain the oxidised lead minerals and the copper minerals, all of which become amenable to flotation after treatment with sulphidising agents such as alkaline sulphides, so that their selective flotation is almost impossible.

Both gravity and flotation concentration have been tested under varying conditions with comparatively unsatisfactory results as regards percentage recoveries of the lead and copper in separate concentrates, although these methods have been capable of yielding concentrates of high tenor in lead, silver, and gold.

On account of the apparent impossibility of producing a lead concentrate of low tenor in copper, it appeared that probably the simplest method of attacking the problem would consist in—

(a) removal of the copper minerals by leaching with suitable solvents, followed by

(b) concentration by gravity or flotation methods or a combination of both, of the lead, silver and gold in the leached ore.

This method of treatment is suggested by the necessity of producing lead concentrates containing a minimum of copper, and as the copper minerals are soluble without difficulty in the solvents commonly used for leaching copper ores, such a method should yield for subsequent concentration of the lead minerals a product containing very little copper, and hence practically no contamination of the lead concentrates by copper would take place. For the removal of copper in the minimum of time five per cent. sulphuric acid has been used as the solvent, although many other solvents might in practice be used. By leaching with acid of this concentration it was found possible to remove rapidly 90 per cent., and over, of the copper. Since the residue, after leaching, contains both galena and oxidised lead minerals, three methods of treatment of the leached ore offer themselves for the concentration of the lead minerals, viz.—

(a) Concentration of as much as possible of the lead minerals by gravity concentration, followed by sulphidisation of the oxidised lead minerals in the table residue and their subsequent flotation. (*Vide* Test 12.)

(b) Concentration of galena by flotation, followed by sulphidisation of the oxidised lead minerals in the flotation residue and their subsequent flotation. (*Vide* Test 19.)

(c) Sulphidisation of the oxidised lead minerals and subsequent flotation of both the oxidised minerals and the galena in a bulk concentrate. (*Vide* Tests 14, 15, 16.)

In America where several mills are successfully floating oxidised lead minerals after sulphidisation, it is the general practice to remove the galena by a preliminary flotation or gravity concentration and then to sulphidise the oxidised lead minerals and to recover these filmed minerals in the form of a flotation concentrate. In a paper recently presented before the American Institute of Mining and Metallurgical Engineers by A. W. Hahn, General Manager of the Eureka Metallurgical Co. of Salt Lake City, it is shown that if an ore contains both sulphide and oxidised minerals the sulphides should be removed either by tabling or a primary flotation before attempting to sulphidise and float the oxidised minerals, and that where this method of treatment is adopted, recoveries of lead are higher than when a straight flotation is made use of to produce a bulk concentrate, although the recoveries of silver and gold are the same in the two cases. Test 13 shows that by Wilfley table concentration of the leached ore and subsequent flotation of the table residues after sulphidisation high percentage recoveries of silver and gold are obtained in the form of a high grade concentrate, and that nearly 90 per cent. of the lead can be recovered in a concentrate assaying about 33 per cent. lead.

When an attempt is made, as in Tests 14, 15, 16 to recover the lead, silver and gold values in one flotation operation after sulphidising the ore, the residues are still of sufficiently high grade to warrant their subsequent treatment. Test 19 shows that by flotation of the galena from the leached ore it is possible to produce a small quantity of concentrate of high grade in lead, silver and gold, and that by subsequent sulphidisation and flotation of the residues from the first flotation a total recovery of approximately 90 per cent. of these metals is possible. For sulphidising purposes the crushed ore requires to be kept in contact with sodium sulphide for definite periods, 24 hours apparently being sufficient for the sulphidising of this ore.

In order to determine whether the silver remaining in the residues after leaching, Wilfley concentration, and flotation could be extracted, cyanidation tests have been carried out on the residue from Test 13, assaying 8.31 oz. silver per ton. In these tests leaching has been performed by contact and mechanical agitation for 48 hours with solution assaying 0.117 per cent. KCN and 0.02 per cent. CaO, in one case, and 0.0585 per cent. KCN and 0.01 per cent. CaO, in the other case, the ratio of solution to ore being 2.5 to 1. "Aero" Brand cyanide was used in both tests, the results of which are as follows:—

	Test 1.	Test 2.
Cyanide solution, per cent., KCN ...	0·117	0·0585
Cyanide solution, per cent., CaO ...	0·02	0·01
Head assay, oz. Ag. per ton ...	8·31	8·31
Residue assay, oz. Ag. per ton ...	8·31	8·31
Extraction, per cent.	*Nil*	*Nil*
Cyanide solution after treatment, per cent. KCN	0·063	0·003
Cyanide consumption, lbs. KCN per ton	3·0	3·1

It appears, therefore, that the silver is associated with the lead minerals and is not amenable to cyanidation.

The results of this investigation show that the most satisfactory method of treatment of this ore consists in—

(1) Grinding to 50 per cent. minus 150-mesh.

(2) Leaching with a suitable solvent, such as dilute sulphuric acid, to remove copper.

(3) Precipitation of copper from the solution by means of metallic iron.

(4) Wilfley table concentration or flotation of the washed residues from the leaching process.

(5) Treatment of the Wilfley or flotation residues with sodium sulphide for 24 hours to sulphidise the oxidised lead minerals.

(6) Regrinding of these residues after treatment with sodium sulphide, with addition of the necessary flotation agents.

(7) Flotation of the sulphidised lead minerals.

In the case of operations 5 and 6 the order may be reversed, but regrinding should take place in contact with sodium sulphide, and at least 24 hours' contact of the pulp with sodium sulphide should be allowed. At the same time it is preferable that regrinding should take place in contact with the flotation agents to secure the maximum effect of the oils.

The results of the tests are set out in the accompanying tabulated summary—

SUMMARY OF TESTS ON SILVER-LEAD ORE FROM DURACK'S LODE, KIMBERLEY GOLDFIELD, N.W. AUSTRALIA.

Test No.	Ore Assay. Pb, per cent.	Ore Assay. Cu, per cent.	Ore Assay. Ag, oz./ton.	Ore Assay. Au, dwt./ton.	Product.	Weight per cent.	Assay Value. Pb, per cent.	Assay Value. Cu, per cent.	Assay Value. Ag, oz./ton.	Assay Value. Au, dwt./ton.	Distribution of Values. Pb, per cent.	Distribution of Values. Cu, per cent.	Distribution of Values. Ag, per cent.	Distribution of Values. Au, per cent.	Method of Treatment.
1	12·08	3·61	56·527	2·6	Flotn. Conct. A	15·00	26·11	3·85	189·04	10·8	35·27	19·31	54·38	61·93	Flotation in 1 : 3 pulp with Euco, 0·57 lb./ton, creosote oil, 1·4 lb/ton, Na_2S, 4·5 lb/ton for Conct. A. Conct. B taken off after addition of Na_2S, 4·5 lb./ton.
					Flotn. Conct. B	14·10	21·55	5·77	53·70	4·8	27·37	28·18	14·52	25·87	
					Residue ...	70·90	5·85	2·14	22·87	0·45	37·36	52·51	31·10	12·20	
2	12·08	3·61	56·527	2·6	Flotn. Conct. A	11·20	28·18	5·72	217·14	14·4	27·61	21·50	53·09	69·69	Flotation in 1 : 3 pulp with Euco, 0·57 lb/ton, creosote oil, 1·43 lb/ton for Conct. A. Conct. B taken off after addition of Na_2S, 9 lb./ton.
					Flotn. Conct. B	15·95	26·21	8·13	18·36	1·2	36·57	43·52	6·39	8·31	
					Residue ...	72·85	5·62	1·43	25·48	0·7	35·82	34·98	40·52	22·00	
3	12·08	3·61	56·527	2·6	Wilfley Conct.	51·50	19·63	3·74	89·22	3·6	78·72	67·53	72·56	72·55	Wilfley concentration followed by regrinding of Wilfley residues and flotation in 1 : 6 pulp with Euco, 1·12 lb/ton, creosote oil, 2·04 lb/ton, pot. xanthate, 0·21 lb./ton of residues.
					Flotn. Residue	35·13	2·45	1·03	25·09	0·55	6·71	12·73	13·93	7·58	
					Flotn. Conct. ...	13·37	14·00	4·22	64·00	3·8	14·57	19·77	13·51	19·87	
4	12·08	3·61	56·527	2·6	Wilfley Conct.	32·84	22·41	4·58	107·30	8·4	61·87	47·34	62·14	66·47	Wilfley concentration followed by regrinding of Wilfley residues and flotation in 1 : 5 pulp with Euco, 1 lb./ton, creosote oil, 1·67 lb./ton, pot. xanthate, 0·33 lb./ton, Na_2S, 6·6 lb./ton of residues.
					Flotn. Conct. ...	19·11	17·82	4·78	86·80	6·4	28·63	28·75	29·25	29·47	
					Flotn. Residue	48·05	2·35	1·58	10·15	0·35	9·50	33·91	8·61	4·06	
5	12·08	3·61	56·527	2·6	Wilfley Conct.	24·92	24·24	5·10	121·88	7·2	49·94	43·94	51·87	47·42	Wilfley concentration followed by regrinding of Wilfley residues and flotation in 1 : 4 pulp with Euco, 0·96 lb./ton, creosote oil, 1·5 lb./ton, pot. xanthate, 0·3 lb./ton, Na_2S, 9 lb./ton.
					Flotn. Conct. ...	24·80	19·48	3·74	87·50	7·2	39·94	32·06	38·32	47·19	
					Flotn. Residue	50·28	2·43	1·38	11·04	0·4	10·12	24·00	9·81	5·39	
6	12·08	3·61	56·527	2·6	Wilfley Conct. A.	25·63	32·63	6·55	144·26	6·8	63·16	44·70	62·48	65·77	Wilfley concentration (Wilfley Conct. A) with re-concentration of residue (Wilfley Conct. B), followed by re-grinding of residues and flotation with Euco, 0·84 lb./ton, creosote oil, 1·63 lb./ton, Na_2S, 13 lb./ton, pot. xanthate, 0·33 lb./ton of residue.
					Wilfley Conct. B	5·89	13·36	7·28	86·70	1·0	5·94	11·41	8·62	2·22	
					Flotn. Conct. ...	16·92	16·37	5·93	70·04	4·4	20·92	26·71	20·02	28·10	
					Flotn. Residue	51·56	2·56	1·25	10·18	0·2	9·98	17·18	8·88	3·91	
7	12·08	3·61	56·527	2·6	Wilfley Residue	64·89	5·88	2·24	23·63	2·4	29·00	39·72	46·96	60·76	Concentration on Wilfley. Concentrate re-ground with Euco. 0·45 lb./ton, creosote oil, 0·7 lb./ton of concentrate and floated in 1 : 2 pulp containing 2 per cent. sodium carbonate.
					Flotn. Conct. ...	3·14	64·23	7·70	550·95	32·0	15·34	6·61	53·04	39·24	
					Flotn. Residue	31·97	22·90	6·14	*Nil*	*Nil*	55·66	53·67	0·00	0·00	
8	12·08	3·61	56·527	2·6	Conct. A ...	2·83	66·30	2·70	126·60	24·0	10·89	2·05	6·69	18·59	Concentrated on Wilfley for bulk concentrate. Concentrate re-concentrated on Wilfley — conct. = Conct. A; residue = Conct. B. Residues from the two concentrations combined.
					Conct. B ...	25·66	42·37	7·54	121·74	6·0	63·23	52·21	58·45	42·20	
					Residue ...	71·51	6·22	2·37	26·05	2·0	25·88	45·74	34·86	39·21	
9	13·57	3·95	59·64	3·2	Conct. A ...	3·35	55·74	9·26	444·95	27·0	15·98	8·07	26·02	32·37	Concentrated on Wilfley. Concentrate re-ground with Na_2CO_3, 8 lb./ton and floated with "aero-float" (phosphocresylic acid), 0·12 lb./ton. Concentrate = Conct. A, residue = Conct. B. Wilfley residue re-ground with Na_2CO_3, 3·4 lb./ton; Na_2S, 5·6 lb./ton; Euco, 0·3 lb./ton, and floated with aero-float, 0·16 lb./ton for Conct. C.
					Conct. B ...	24·77	21·45	7·07	94·70	4·4	45·42	45·54	40·89	38·95	
					Conct. C ...	12·66	20·05	4·97	84·34	4·0	21·69	16·35	18·61	18·09	
					Residue ...	59·22	3·34	1·95	14·03	0·5	16·91	30·04	14·48	10·59	
10	13·57	3·95	59·64	3·2	Flotn. Conct. ...	12·45	33·57	7·07	183·25	12·0	28·30	20·52	38·38	40·79	Ore ground in pebble mill with Na_2CO_3, 4·5 lb./ton and floated with aero-float, 0·24 lb./ton. Residue concentrated on Wilfley.
					Wilfley Conct.	28·40	25·74	6·86	94·30	6·8	49·50	45·42	45·05	52·73	
					Wilfley Residue	59·15	5·54	2·47	16·64	0·4	22·20	34·06	16·57	6·48	
11	13·57	3·95	59·64	3·2	Wilfley Conct.	25·9	31·28	1·88	137·32	3·2	62·94	1·23	61·25	53·76	Ore ground and leached with 5 per cent. H_2SO_4 for 72 hours. Residue washed and concentrated on Wilfley after re-grinding.
					Wilfley Residue	64·8	7·36	0·42	34·69	1·1	37·06	0·69	38·75	46·24	
					Solution ...	9·3	...	...	...	...	...	98·08	...	...	
12	13·57	3·95	59·64	3·2	Wilfley Conct.	19·38	32·01	2·34	144·14	10·2	59·30	1·15	55·95	74·74	Ore ground and leached with 5 per cent. H_2SO_4 for 48 hours. Residue washed and concentrated on Wilfley. Wilfley residue agitated 1 hour with Na_2S, 5 lb./ton; pot. xanthate, 0·3 lb./ton; Euco, 0·7 lb./ton; creosote oil, 0·8 lb./ton. Added aero-float, 0·28 lb./ton during flotation.
					Flotn. Conct. A	4·54	34·29	2·81	267·26	6·0	14·88	0·32	24·30	10·30	
					Flotn. Conct. B	4·57	8·18	0·52	50·71	1·8	3·57	0·06	4·64	3·11	
					Flotn. Residue	44·75	5·20	0·26	16·86	0·7	22·25	0·29	15·11	11·85	
					Solution ...	26·76	...	...	...	...	...	98·18	...	...	
13	13·57	3·95	59·64	2·4	Wilfley Conct.	20·11	33·36	0·48	154·45	7·3	53·16	2·44	51·74	66·81	Ore ground in pebble mill; leached with 5 per cent. H_2SO_4; residue concentrated on Wilfley. Residue treated with Na_2S, 12 lb./ton for 24 hours, then ground 1 hour with Na_2CO_3, 5 lb./ton; pot. xanth., 0·13 lb./ton Eucho, 0·6 lb./ton and floated.
					Flotn. Conct. ...	12·87	33·98	0·96	186·36	5·2	34·66	3·12	39·95	30·46	
					Flotn. Residue	60·01	2·56	0·08	8·31	0·1	12·18	1·21	8·31	2·73	
					Solution ...	7·01	...	...	...	...	...	93·23	...	...	
14	13·57	3·95	59·64	2·4	Flotn. Conct. ...	14·83	48·88	1·87	287·52	11·2	54·48	7·02	69·14	88·96	Treatment similar to Test 13 with exception of Wilfley concentration.
					Flotn. Residue	77·25	7·84	0·24	24·635	0·3	45·52	4·69	30·86	11·04	
					Solution ...	7·92	...	...	...	...	...	88·29	...	...	
15	13·57	3·95	59·64	2·4	Flotn. Conct. ...	16·85	40·04	1·87	248·6	10·2	50·37	7·97	71·79	92·49	As for Test 14 with addition of creosote oil, 0·32 lb./ton during regrinding in pebble mill.
					Flotn. Residue	78·00	8·52	0·24	21·1	0·2	49·63	4·74	28·21	7·51	
					Solution ...	5·15	...	...	...	...	...	87·29	...	...	
16	13·57	3·95	59·64	2·4	Flotn. Conct. ...	14·32	46·45	1·71	287·76	12·8	49·74	6·20	69·59	92·42	As for Test 14 with addition of creosote oil, 0·64 lb./ton during regrinding in pebble mill.
					Flotn. Residue	79·25	8·48	0·16	22·72	0·2	50·26	3·21	30·41	7·58	
					Solution ...	6·43	...	...	...	...	...	90·59	...	...	

SUMMARY OF TESTS ON SILVER-LEAD ORE FROM DURACK'S LODE, KIMBERLEY GOLDFIELD, N.W. AUSTRALIA.

Test No.	Ore Assay.				Product.	Weight per cent.	Assay Value.				Distribution of Values.				Method of Treatment.
	Pb, per cent.	Cu, per cent.	Ag, oz./ton.	Au, dwt./ton.			Pb, per cent.	Cu, per cent.	Ag, oz./ton.	Au, dwt./ton.	Pb, per cent.	Cu, per cent.	Ag, per cent.	Au, per cent.	
17	13·57	3·95	59·64	2·4	Galena Conct....	5·12	54·75	6·14	528·75	23·5	24·94	7·96	54·18	65·46	Ore ground in pebble mill; leached 24 hours with 5 per cent. H_2SO_4. Residue reground half hour with Na_2CO_3, 4 lb./ton; pot. xanth., 0·1 lb./ton; Euco, 0·36 lb./ton, and floated to separate galena. Residue agitated 24 hours with Na_2S, 10 lb./ton and floated to recover oxidised lead minerals.
					Second Conct....	8·81	33·18	1·25	85·61	5·5	26·01	2·78	15·09	26·36	
					Residue ...	75·20	7·33	1·04	20·42	0·2	49·05	19·80	30·73	8·18	
					Solution ...	10·87	...	...	...	...	...	69·46	...	...	
18	11·50	3·64	59·21	1·6	Flotn. Conct. A	17·12	37·49	2·81	198·83	6·6	55·84	13·21	63·74	75·47	As for Tests 14, 15, 16, but concentrate B removed after addition of aero-float, 0·072 lb./ton.
					Flotn. Conct. B	20·33	14·82	1·25	61·39	1·8	26·27	6·98	23·37	24·53	
					Flotn. Residue	56·00	3·67	0·20	12·28	tr.	17·89	3·08	12·89	...	
					Solution ...	6·55	...	...	...	...	...	76·73	...	...	
19	11·50	3·64	59·21	1·6	Galena Conct....	6·04	57·95	5·41	473·88	22·4	29·66	8·97	54·94	84·56	As for Test 17.
					Second Conct....	38·31	18·25	1·25	50·96	0·5	59·26	13·16	37·47	11·97	
					Flotn. Residue	45·85	2·85	0·21	8·61	0·1	11·08	2·64	7·59	3·49	
					Solution ...	9·8	...	...	...	...	...	75·23	...	...	

A suggested flow-sheet for the treatment of this ore along the lines described above is attached.

Kalgoorlie, 2nd September, 1927.

B. H. MOORE,
Lecturer in Metallurgy.
Metallurgical Laboratory,
School of Mines of W.A.,

Report on an Investigation into the Treatment of Ore from the Riverina Proprietary Gold Mine.

At the request of Mr. Alfred Forbes of the Riverina Proprietary Gold Mine, and with the approval of the State Mining Engineer, tests have been carried out to ascertain the most suitable and economical method of treatment of that company's ore. The proposed treatment plant involves crushing by stamp battery and grinding in pans, followed by cyanidation, and information was desired on the following points:—

(1) The fineness to which crushing and grinding must be carried to secure an economical extraction.

(2) Whether amalgamation is necessary before cyanidation.

(3) Whether it will be necessary to cyanide sand and slime separately.

(4) Whether concentration of the sulphide minerals is necessary.

A partial analysis of a sample of this ore for the purpose of determining the sulphide minerals in the ore gave the following result:—

Total Sulphur ...	1·91 per cent.
Arsenic	0·156 „
Lead	0·166 „
Gold	11·6 dwt. per ton (2,240lbs.)

By calculation from these results the proportions of sulphides in the ore are as follows:—

Pyrite, FeS_2 ...	3·41 per cent.
Arsenopyrite, FeAsS	0·34 „
Galena, PbS ...	0·19 „
	3·94 „

In order to obtain some preliminary information regarding the fineness of grinding necessary and the possibility of making a suitable and economically satisfactory recovery of the gold by amalgamation and cyanidation, a sample from the first parcel of ore received from the mine, assaying 13.2 dwt. gold per ton (2,240 lbs.), was crushed through breaker, rolls and pulveriser, yielding a product the grading analysis of which was as follows:—

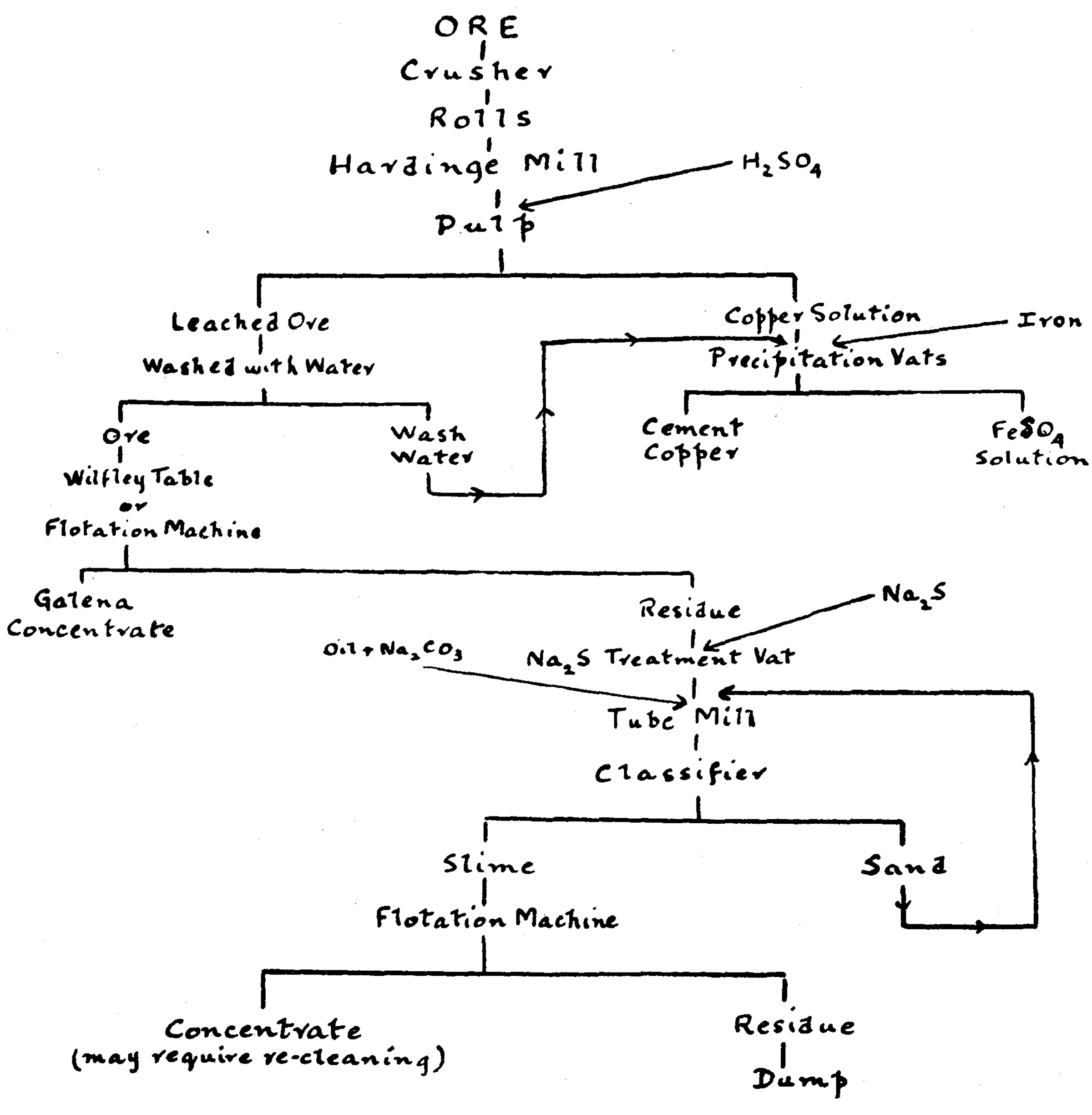
I.M.M. Screen.	Per cent.
+ 8	0·65
+ 16	11·80
+ 20	7·60
+ 40	26·40
+ 60	10·00
+ 100	10·50
— 100	33·05

To determine the extraction obtainable by amalgamation during the grinding of the ore to different sizes, 1,000 gram charges were ground in pebble mills with 1,000c.c. of water, 1 gram of mercury, and a small strip of amalgamated silverfoil for periods of half, one, and one and a half hours, the mercury and amalgam being afterwards recovered by panning off in an amalgamated copper pan. These periods of grinding gave products of the degrees of fineness shown in the following grading analyses:—

I.M.M. Screen.	Test 1. (½-hour grinding.)	Test 2. (1-hour grinding.)	Test 3. (1½-hour grinding.)
	per cent.	per cent.	per cent.
+ 40	2·9	0·1	0·0
+ 60	12·1	1·9	0·1
+ 80	18·9	10·5	1·3
+ 100	2·7	4·6	1·1
+ 150	21·8	32·6	25·7
— 150	41·6	50·3	71·8

SUGGESTED FLOW SHEET

Silver-Lead Ore, Durack's Lode



The results of these amalgamation tests are as follows:—

	Test 1.	Test 2.	Test 3.
Head sample, assay value, dwt. Au per ton	15·2	13·2	13·2
Residue, assay value, dwt, Au per ton	4·0	4·8	4·8
Extraction by amalgamation, per cent	69·69	63·63	63·63

These tests show, therefore, that so far as concerns the effect of fineness of grinding on amalgamation, nothing is gained by grinding finer than that shown in the grading analysis of Test 1. Hence, comparatively coarse grinding is capable of yielding very satisfactory results by amalgamation alone.

In order to determine the extraction possible by cyanidation of the ore after amalgamation, agitation tests were carried out on each of the residues from these tests. Two series of agitation tests were carried out on these products in which agitation was continued for 24 and 36 hours, respectively, to determine whether any benefit was obtainable by prolonging the period of agitation. Agitation was performed in pebble mill jars with the following results:—

"A" SERIES.

(Twenty-four hours' Agitation.)

—	Residue from Amalgamation. Test 1.	Residue from Amalgamation. Test 2.	Residue from Amalgamation. Test 3.
Original head value, dwt. per ton	13·2	13·2	13·2
Residue from amalgamation test, dwt. per ton	4·0	4·8	4·8
Extraction by amalgamation, per cent.	69·69	63·63	63·63
Amalgamation residue, weight, gram.	224	224	224
Cyanide solution { Volume, c.c.	500	500	500
Cyanide solution { KCN, per cent.	0·2	0·2	0·2
CaO added. lb. per ton	10	10	10
Solution after test { KCN, per cent.	0·176	0·176	0·1675
Solution after test { Protective alkali, CaO .per cent. ...	0·042	0·0345	0·0345
Consumption of KCN, lb. per ton	1·2	1·2	1·625
Cyanidation residue, dwt. per ton	1·8	0·9	0·7
Extraction by cyanidation, per cent.	55·0	81·25	85·41

"B" SERIES.

(Thirty-six hours' Agitation.)

—	Residue from Amalgamation. Test 1.	Residue from Amalgamation. Test 2.	Residue from Amalgamation. Test 3.
Original head value, dwt. per ton	13·2	13·2	13·2
Residue from amalgamation test, dwt. per ton	4·0	4·8	4·8
Extraction by amalgamation, per cent.	69·69	63·63	63·63
Amalgamation residue, weight, gram.	224	224	224
Cyanide solution { Volume, c.c.	500	500	500
Cyanide solution { KCN, per cent.	0·2	0·2	0·2
CaO added, lb. per ton	10	10	10
Solution after test { KCN, per cent.	0·1675	0·1625	0·1600
Solution after test { Protective alkali, CaO per cent. ...	0·03	0·039	0·0345
Consumption of KCN, lb. per ton	1·625	1·875	2·0
Cyanidation residue, dwt. per ton	1·7	0·7	0·5

The results obtained by combined amalgamation and cyanidation on this sample of ore are therefore as follows:—

PERCENTAGE EXTRACTIONS OF TOTAL GOLD.

"A" SERIES.

(Twenty-four hours' Agitation.)

—	Test 1.	Test 2.	Test 3.
Extraction by amalgamation	69·69	63·63	63·63
Extraction by cyanidation	16·67	29·55	31·36
Total extraction	86·36	93·18	94·69

"B" SERIES.

(Thirty-six hours' Agitation.)

—	Test 1.	Test 2.	Test 3.
Extraction by amalgamation	69·69	63·63	63·63
Extraction by cyanidation	17·43	31·06	32·58
Total extraction	87·12	94·69	96·21

These tests lead to the following conclusions:—

(1) Fine grinding of the ore is not necessary to obtain a high percentage extraction of the gold by amalgamation and cyanidation.

(2) Although slightly higher percentage extraction is obtained on a 97.5 per cent. minus 100-mesh product than on a 82.9 per cent. minus 100-mesh product, the increased recovery so obtained does not compensate for the extra cost of grinding to the finer size.

(3) Agitation for 36 hours in cyanide solution does not materially increase the extraction over that obtainable in 24 hours.

(4) Amalgamation during grinding yields a high percentage recovery.

(5) Consumption of cyanide during cyanidation is not excessive provided sufficient lime is added to neutralise the effect of the cyanicides in the ore.

In order to obtain confirmation of these results and also to secure information as to the results obtainable by treatment with cyanide solution by percolation, a second sample of ore, assaying 11.6 dwt. gold per ton (2,240lbs.) was crushed dry, the grading analysis of the product being as follows:—

I.M.M. Screen.	Per cent.
+ 16	1·2
+ 20	2·0
+ 40	26·7
+ 60	14·1
+ 100	14·8
— 100	41·2

A bulk sample of this product was then amalgamated by grinding wet with mercury in the pebble mill for one hour with the addition of lime equivalent to 4.7 pounds per ton of ore, for the purpose of destroying cyanicides and of neutralising the acidity of the ore before cyanidation. The product, after separation of mercury and amalgam, was filtered and allowed to dry so that a representative sample might be obtained for assay and treatment purposes. The assay value of the residue after amalgamation was 6.2 dwt. gold per ton, which represents an extraction, by amalgamation, of 46.55 per cent. of the total gold. The consumption of lime during the grinding operation was equivalent to 4.4 pounds per ton of ore, while the grading analysis of the product was as follows:—

I.M.M. Screen.	Per cent.
+ 40	0·0
+ 60	0·5
+ 80	6·8
+ 100	3·2
+ 150	33·0
— 150	56·5

This product is considerably finer than that produced by one hour's grinding in the previous tests.

Agitation and percolation tests have been carried out on this product to determine the extractions obtainable by both methods and to ascertain the time necessary to secure the maximum economical extraction by percolation. Two series of percolation tests, the duration of treatment increasing from 24 hours 144 hours, have been carried out on this residue, the conditions and the results of which are set out in the following table.

PERCOLATION TESTS.

Original head value, 11·6 dwt. Au. per ton (2,240 lbs.)
Residue from amalgamation, 6·2 dwt. Au per ton.
Extraction by amalgamation, 46·55 per cent.

Series I.

Test No.	1.	2.	3.	4.	5.	6.
Ore, weight, gram	224	224	224	224	224	224
Cyanide solution { Volume, c.c.	500	500	500	500	500	500
Cyanide solution { KCN, per cent.	0·206	0·206	0·206	0·206	0·206	0·206
Time of leaching, hours	24	48	72	96	120	144
CaO added, lb. per ton	10	10	10	10	10	10
Solution after test { KCN, per cent.	0·125	0·136	0·146	0·117	0·082	0·076
Solution after test { CaO, per cent.	0·032	0·053	0·027	0·017	0·030	0·030
Consumption of KCN, lb. per ton	4·05	3·52	3·02	4·45	6·20	6·50
Residue, dwt. Au per ton	3·6	3·2	3·0	2·6	2·6	2·5
Extraction, per cent.	41·93	48·39	51·61	58·06	58·06	59·68
Percentage Extractions by Amalgamation and Cyanidation						
Extraction by amalgamation	46·55	46·55	46·55	46·55	46·55	46·55
Extraction by cyanidation	22·41	25·86	27·58	31·04	31·04	31·90
Total extraction	68·96	72·41	74·13	77·59	77·59	78·45

Series. II

Test No.	7.	8	9.	10.	11.	12.
Ore, weight, gram	224	224	224	224	224	224
Cyanide solution { Volume, c.c.	500	500	510	*500	500	500
Cyanide solution { KCN, per cent.	0·203	0·203	0·203	0·203	0·203	0·203
CaO added, lb. per ton	10	10	10	10	10	10
Time of leaching, hours	48	48	120	120	144	144
Solution after test { KCN, per cent.	0·163	0·177	0·073	0·070	0·076	0·070
Solution after test { CaO, per cent.	0·0276	0·0288	0·0305	0·032	0·0342	0·0357
Consumption of KCN, lb. per ton	2·0	1·3	6·5	6·65	6·35	6·65
Residue, dwt. Au per ton	1·45	1·56	2·1	1·7	2·1	2·05
Extraction, per cent.	76·61	74·84	66·13	72·58	66·13	66·93
Percentage Extractions by Amalgamation and Cyanidation.						
Extraction by amalgamation	46·55	46·55	46·55	46·55	46·55	46·55
Extraction by cyanidation	40·95	40·00	35·34	38·79	35·34	35·78
Total extraction	**87·50**	**86·55**	**81·89**	**85·34**	**81·89**	**82·33**

For the purpose of comparison of the results obtainable by percolation and agitation, respectively, on this amalgamation residue four 24-hour agitation tests have been carried out under similar conditions as regards concentration of cyanide solution and lime addition with the results shown below.

Agitation was performed in the pebble mill jars.

AGITATION TESTS.

Original head value, 11·6 dwt. Au per ton (2,240 lb.).
Residue from amalgamation, 6·2 dwt. Au per ton.
Extraction by amalgamation, 46·55 per cent.

Test No.	1.	2.	3.	4.
Ore, eight, gram.	224	224	224	224
Cyanide solution: Volume, c.c.	500	500	500	500
Cyanide solution: KCN, per cent.	0·2	0·2	0·2	0·2
CaO added, lb. per ton	10	10	10	10
Time of agitation	24	24	24	24
Solution after test: KCN, per cent.	0·179	0·180	0·177	0·177
Solution after test: CaO, per cent.	0·097	0·110	0·094	0·086
Consumption of KCN, lb. per ton	1·05	1·00	1·15	1·15
Residue, dwt. Au per ton	1·4	1·2	1·45	1·2
Extraction, per cent.	77·42	80·64	76·61	80·64
Percentage Extractions by Amalgamation and Cyanidation.				
Extraction by amalgamation	46·55	46·55	46·55	46·55
Extraction by cyanidation	41·38	43·10	40·95	43·10
Total extraction	87·93	89·65	87·50	89·65

Comparison of the results of percolation and agitation tests on both samples of this ore, after amalgamation, shows that—

(1) Higher percentage extractions are obtainable by agitation than by percolation;

(2) twenty-four hours' agitation yields a higher extraction than a six-day percolation period;

(3) the consumption of cyanide is very much less by agitation than by percolation treatment.

Therefore, from every aspect, agitation treatment of the amalgamated ore possesses distinct advantages over percolation treatment, and combined amalgamation and cyanidation can be safely said to be capable of extracting 90 per cent., and over, of the total gold at a small cost for less of cyanide, although the quantity of lime necessary to protect the cyanide from decomposition by the constituents of the ore is high. In neither case does the ore after grinding contain sufficient coarse product to introduce difficulties into the treatment by agitation.

Since amalgamation and cyanidation are capable of yielding an economical extraction of 90 per cent., or more, of the gold in this ore, it follows that the introduction of concentration into the treatment scheme is unnecessary, especially as the ore contains approximately only 4 per cent. of sulphide minerals. Concentration, either by gravity or flotation methods, would possibly simplify the treatment process if the residues from the concentration could be produced of sufficiently low grade to be discarded without further treatment, and if the concentrates produced could be treated directly by cyanidation or by amalgamation and cyanidation combined, without roasting and with the production of a low grade residue from the treatment of the concentrates. If this were possible the plant required for cyanidation of the concentrates would be much smaller than that required for amalgamation and cyanidation of the whole of the ore. For this ore flotation concentration would be preferable to gravity methods on account of the small percentage of sulphides in the ore.

In order to ascertain the results obtainable by flotation concentration of this ore, tests have been carried out under the conditions and with the results set out below.

Ore of assay value 11.6 dwt. Au per ton was ground in the pebble mill in salt water to pass 150-mesh I.M.M. screen, with the addition of potassium xanthate 0.2 lb. per ton, eucalyptus oil 0.48 lb. per ton, creosote oil 0.86 lb. per ton, and kerosene 0.25 lb. per ton. Flottion was performed in a Ruth machine in a 5 per cent. salt solution and the concentrate was removed during a period of six minutes, the greater portion of the concentrate being obtained during the first three minutes. The following figures are the average results of a number of tests—

Concentrate: Weight, per cent.	9·05
Concentrate: Assay value, dwt. Au per ton ...	107·5
Residue, dwt. Au per ton	1·0
Distribution of values, Au per cent: Concentrate	91·45
Distribution of values, Au per cent: Residue ...	8·55

Therefore flotation is capable of producing a high-grade concentrate and a low grade residue, the latter of which can be discarded so that only the concentrate, approximately 9 per cent. of the ore would require subsequent treatment.

To determine the extraction that could be obtained by direct cyanidation of the flotation concentrate, a composite sample for cyanidation has been made by combining the concentrates from a number of tests, this composite sample assaying 101.75 dwt. per ton. The main details of the cyanide tests carried out on this sample are as follows:—

	Test 1.	Test 2,
Cyanide solution, KCN per cent. ...	0.160	0.160
Time of agitation, hours	24	48
Cyanide consumption, lb. KCN per ton	4.36	5.75
Residue, dwt. Au per ton ...	10.0	6.0
Extraction per cent.	90.17	94.10

No doubt agitation with cyanide for longer periods would have resulted in a still further reduction of the grade of the residues.

These tests show extractions of 82.46 per cent. and 86.05 per cent., respectively, of the gold in the original ore, while the values of the total residues (flotation and cyanide) are 1.8145 dwt. and 1.4525 dwt., respectively. Comparing these results with those obtained by amalgamation and direct cyanidation of the ore, it is apparent that concentration of this ore can not compete, either as regards extraction or cost of treatment, with the direct treatment without concentration.

Summarising the results of this investigation, the following are the more important points which have been determined and which will assist in deciding upon the method of treatment to be adopted:—

(1) This ore is readily amenable to treatment by amalgamation and cyanidation.

(2) Fine grinding is not necessary for securing a high percentage extraction. Grinding to 90 per cent. minus 100-mesh is sufficient to enable a high recovery to be made by amalgamation and cyanidation, although a satisfactory recovery can be made by amalgamation of much coarser material.

(3) Agitation of the amalgamated product with cyanide solution for 24 hours is sufficient to produce residues assaying 1 dwt. per ton, and less.

(4) Treatment by percolation gives similar results to those obtained by agitation, but the rate of dissolution of the gold is very much slower, at least six days' treatment being necessary to obtain a satisfactory extraction.

(5) In agitation treatment the consumption of cyanide is comparatively low, provided sufficient lime is present during the treatment to neutralise both free and latent acidity of the ore and to prevent the action of other cyanicides. In the treatment by percolation, which is much slower, the consumption of cyanide is much increased, and, for this reason alone, it is probable that agitation treatment will yield a more economical extraction than treatment by percolation, even though it may be necessary to resort to finer grinding for this purpose. The extra cost of the finer grinding would be more than offset by the lower consumption of cyanide and the more rapid dissolution of the gold.

(6) The consumption of lime varies up to approximately eight pounds per ton of ore.

(7) Since the ore contains approximately 4 per cent. of sulphides and a high percentage extraction is possible by amalgamation and direct cyanidation, concentration of the sulphides is unnecessary.

(8) In the grinding of this ore to the fineness necessary for successful amalgamation and cyanidation, the proportion of slime produced is so small as not to interfere with the treatment of the product by percolation, and therefore separate treatment of sand and slime is not necessary.

Conclusion.

Treatment of this ore by amalgamation and cyanidation without concentration, which yields a high percentage extraction at a small cost for cyanide and lime, is recommended as the most suitable method of treatment. Amalgamation would best be carried out during the grinding operation, and, while only comparatively coarse crushing is necessary to obtain a satisfactory extraction, it may be necessary to grind somewhat finer than is actually necessary for cyanidation purposes, in order that no difficulties may be introduced into the agitation treatment through the presence of coarse sand.

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines of W.A.,
Kalgoorlie, 18th November, 1927.

Preliminary Report on the Bromocyanidation of Kalgoorlie Ores.

One of the most serious items of cost in the treatment of Kalgoorlie ores as at present carried out in the dry crushing all-roasting plants now in operation is the cost of roasting the whole of the ore, although the proportion of sulphide minerals requiring roasting prior to cyanidation is comparatively small. To minimise or to eliminate entirely the cost of this portion of the treatment two modifications of present-day treatment practice are available, viz.—

1. Concentration of the sulphide minerals by flotation subsequent to amalgamation of the ore to eliminate the coarse and free gold followed by (a) roasting and cyanidation of the flotation concentrate, or (b) direct cyanidation or bromocyanidation of the flotation concentrate;
2. Bromocyanidation of the raw ore after amalgamation, with complete elimination of the roasting process.

In the laboratory and on the larger scale in the pilot plant of Oroya Links Ltd., it has been demonstrated that flotation concentration can be successfully applied to these ores, a low-grade flotation residue and a concentrate being produced, the economical roasting and cyanidation of the latter of which presents no difficulties, while laboratory tests on the direct bromocyanidation of flotation concentrates indicated the possibility of this method of treatment of the concentrates being successfully applied. Bromocyanidation tests on flotation concentrates carried out in the Metallurgical Laboratory of the School of Mines during 1926 showed that a high percentage extraction of the gold was possible in this way although the residues from the treatment of these concentrates were of comparatively high grade.

Bromocyanidation of the raw ore was successfully applied in the so-called Diehl process in several of the wet treatment plants which are not now operating, but this method of treatment has gradually been discarded and the all-roasting method has been retained. Not only does this method of treatment eliminate the roasting operating, but it also enables the whole of the milling of the ore to be carried out wet, thus giving improved hygienic conditions in the mills, and calls for a very much simplified treatment plant and flow sheet. Laboratory experiments on the bromocyanidation of these ores and on the similar treatment of flue dust on a large scale have been conducted for some time past by Mr. C. E. Blackett, formerly of the Golden Horseshoe Estates but now of the Boulder Perseverance, Limited. These tests showed that high percentage extractions could be obtained by carefully controlled bromocyanidation, both on finely ground raw ore and on tonnage parcels of flue dust which is notoriously difficult to treat by the ordinary methods of cyanidation.

The results of these tests having been communicated to the State Mining Engineer by Mr. J. W. Sutherland of the Golden Horseshoe Estates, instructions were issued to me to endeavour to confirm and to check the results on raw ore obtained by Mr. Blackett. The treatment conditions employed by Mr. Blackett have been followed in the present investigation with varying success until it was possible to obtain some information regarding the important factors influencing the treatment by this method. The tests carried out have shown that there are certain treatment conditions which require careful chemical control and the variation of which has an important influence on the results of the tests.

While, in the past, the time of treatment necessary by this method has been usually 16 to 24 hours, Mr. Blackett claims to have obtained extractions of over 90 per cent, of the gold in three hours' treatment, divided into a two-hour period of agitation with cyanide solution and a one-hour period of agitation after addition of bromocyanogen. If the treatment time can be reduced to this short period it will mean that a comparatively small treatment plant will have a large tonnage capacity and therefore the treatment plant will be greatly simplified. The treatment conditions suggested by Mr. Blackett and adopted in his tests have been as follows:—

1. Grinding to minus 150-mesh;
2. Amalgamation to remove coarse gold which would not be dissolved during cyanidation;
3. Two hours' agitation with cyanide solution of concentration 0.15 per cent. KCN in a 1:1 pulp;
4. Addition of 1 lb. of lime per ton of ore to the agitation pulp;
5. One hour's agitation after addition of 1 lb. of bromocyanogen per ton of ore;
6. Addition of 2 lb. of lime per ton of ore to the pulp at the completion of the treatment to neutralise the acidity of the solution and to regenerate metallic cyanides in the solution.

After agitation with the bromocyanogen the solution must be acid, *i.e.*, must show no protective alkalinity, and sufficient lime must then be added to produce a very low protective alkalinity in the solution.

In order to confirm, if possible, the results stated to have been obtained by Mr. Blackett a large number of tests have up to the present been carried out on ores of varying grade and under the stated conditions. These tests indicated that modification of the stated conditions was in some cases necessary and therefore the conditions set out above have been varied, one at a time, to ascertain the best conditions in the treatment of any particular ore and the effect of the variation of treatment conditions on the extraction obtained.

In all the tests carried out, details of which are set out later, the ore has been ground in pebble mills with water until over 99 per cent. would pass a 200-mesh screen, and the agitation charge has been 200 gram of ore, 200 c.c. of cyanide solution, and 0.1 gram CaO (1 lb. per ton of ore). Agitation has been performed in pebble mill jars, without pebbles, and the residues from each test, after well washing with water under air pressure, have been dried and assayed, while the solution after filtration from the residues has been assayed for free cyanide, protective alkalinity and bromocyanogen. Amalgamation prior to cyanidation has in some cases been adopted and has shown that up to approximately 20 per cent. of the gold can be recovered in this way. All assay values are stated as per ton of 2,000 lb.

The results of preliminary tests are shown in the following tabulation:—

Test No.	Soln. KCN, per cent.	CaO added.		Time of Agitation.		BrCN added, lbs. per ton.	Solution after treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction per cent.	Remarks.
		During treatment, lb/ton.	After treatment, lb./ton.	With KCN, hours.	With BrCN, hours.		KCN, per cent.	CaO, per cent.	BrCN, per cent.				
					GREAT BOULDER PROPRIETARY ORE—ASSAY VALUE, 15·2 dwts. Au per ton.								
1	0·15	1·0	0·5	2	1	1·0	0·123	0·132	...	0·54	4·8	68·4	
2	0·15	1·0	0·5	2	1	1·0	0·133	0·111	...	0·34	1·2	92·1	
3	0·15	1·0	0·5	2	1	1·0	0·093	0·182	...	1·14	4·3	71·7	Ore amalgamated before cyanidation. Extraction is total extraction.
4	0·203	1·0	0·0	2	1	1·0	0·100	0·0048	0·019	2·06	2·50	83·55	To determine the effect of grinding in strong solution.
					BOULDER PERSEVERANCE ORE—ASSAY VALUE, 7·0 dwts. Au per ton.								
5	0·15	0·0	0·5	2	1	1·0	0·073	0·020	...	1·54	0·55	92·14	
6	0·15	0·0	0·5	2	1	1·0	0·084	0·020	...	1·32	0·50	92·84	
7	0·15	0·5	0·5	2	1	1·0	0·095	0·0036	0·054	1·10	0·70	90·00	
8	0·15	0·5	0·5	2	1	1·0	0·083	0·0048	0·040	1·34	0·60	91·43	
					BOULDER PERSEVERANCE ORE—ASSAY VALUE, 7·4 dwts. Au per ton.								
9	0·15	0·5	0·5	2	1	1·0	0·112	0·0012	0·0097	0·76	0·40	94·59	
10	0·15	0·5	0·5	2	1	1·0	0·111	0·0036	0·0097	0·78	0·30	95·94	
11	0·15	0·5	1·0	2	1	1·0	0·110	0·0072	0·0014	0·80	0·40	94·59	
12	0·15	0·5	1·0	2	1	1·0	0·100	0·0060	0·0010	1·00	0·35	95·27	

These tests indicate that grinding to at least minus 150-mesh is essential, that a minimum of lime should be added during the agitation with cyanide solution in order that the solution after completion of the treatment with bromocyanogen may be acid, and that in order to obtain a correct value for the cyanide solution after treatment slightly more lime should be added than is necessary to neutralise this acidity. The tests on Boulder Perseverance ore also show that it is possible to obtain a high percentage extraction from this low-grade ore at the expense of a reasonably small consumption of cyanide.

In the following series of tests on South Kalgurli ore assaying 10.8 dwt. gold per ton, which was ground in the pebble mill to pass a 200-mesh screen, the treatment conditions were kept constant and were as follows:—

Cyanide solution	0.15 per cent. KCN
CaO added during treatment	1 lb. per ton or ore
CaO added after treatment ...	2 lbs. per ton of ore
Time of agitation with KCN	2 hours
Time of agitation with BrCN	1 hour.

The results of these tests are as follows:—

SOUTH KALGURLI ORE—ASSAY VALUE, 10·8 dwts. Gold per ton.

Test No.	Solution after Treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent.
	KCN, per cent	CaO per cent.	BrCN, per cent.			
13	0·1355	0·0408	0·0013	0·29	3·3	69·44
14	0·1350	0·0228	0·0013	0·30	1·7	84·26
15	0·1335	0·0216	0·0013	0·33	1·75	83·79
16	0·1340	0·0204	0·0013	0·32	1·5	86·11
17	0·1310	0·0180	0·0013	0·38	1·3	87·96
18	0·1280	0·0108	0·0013	0·44	1·2	88·88
19	0·1390	0·0144	*Nil*	0·22	1·65	84·72
20	0·1310	0·0144	Trace	0·38	1·0	90·74
21	0·1360	0·0192	Trace	0·28	1·3	87·96
22	0·1300	0·0072	*Nil*	0·40	1·3	87·96
23	0·1300	0·0108	Trace	0·40	1·3	87·96
24	0·1310	0·0192	Trace	0·38	1·1	89·81
25	0·1300	0·0156	*Nil*	0·40	1·05	90·28
26	0·1310	0·0132	Trace	0·38	1·5	86·11
27	0·1360	0·0192	Trace	0·28	2·0	81·48
28	0·1320	0·0228	Trace	0·36	1·0	90·74
29	0·1320	0·0180	Trace	0·36	1·1	89·81
30	0·1330	0·0180	*Nil*	0·34	1·3	87·96

In this series the ore, of fair average grade, was not amalgamated before cyanidation and it was considered that possibly this might account for the erratic nature of the residue values and extractions, many of which were so nearly satisfactory as to encourage the belief that with further investigation definite conditions might be determined which would enable extractions well over 90 per cent. to be obtained.

In order to determine the effect of amalgamation or non-amalgamation on the results obtained by cyanidation a sample of the same ore from the South Kalgurli mine, assaying 10.8 dwt. gold per ton, was amalgamated during grinding in the pebble mills, the amalgam was removed by panning off the product in an amalgamated copper pan and the final amalgamation residue dried. This residue assayed 8,0 dwt. gold per ton, showing that 25.92 per cent. of the gold in the original sample had been extracted by amalgamation.

In the series of tests on this ore, tests 31 to 36 were carried out under constant conditions similar to those obtaining in tests 13 to 30, tests 37 and 38 under the same conditions except the time of agitation with bromocyanogen which was increased to two hours, while test 39 was given four hours' agitation with cyanide alone to furnish a comparison between the results obtainable with and without bromocyanogen.

In the case of this sample of ore, amalgamation before cyanidation is apparently unnecessary as no improvement in extraction is obtained by the introduction of the preliminary amalgamation. At the same time the introduction of amalgamation would be necessary in the treatment scheme to remove, before cyanidation, any gold not capable of being dissolved by the cyanide solution. The results of this series of tests are as follow :—

SOUTH KALGURLI ORE.

Assay Value, 10·8 dwts. Au per ton; Amalgamation Residue, 8·0 dwts. Au per ton.

Test No.	Solution after Treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent. (on amalgamated ore).	Extraction on Original Ore, per cent.		
	KCN, per cent.	CaO, per cent.	BrCN, per cent.				By amalgamation.	By cyanidation.	Total.
31 ...	0·121	0·0037	0·0014	0·58	1·55	80·62	25·92	59·73	85·65
32 ...	0·136	0·0045	0·0014	0·28	1·3	83·75	25·92	62·04	87·96
33 ...	0·140	0·0045	0·0014	0·20	1·1	86·25	25·92	63·71	89·63
34 ...	0·138	0·0084	0·0014	0·24	1·35	83·12	25·92	61·58	87·50
35 ...	0·136	0·0082	0·0014	0·28	1·25	84·37	25·92	62·51	88·43
36 ...	0·140	0·0052	0·0014	0·20	1·2	85·00	25·92	62·97	88·89
37 ...	0·143	0·0082	0·0013	0·14	1·05	86·87	25·92	64·35	90·27
38 ...	0·135	0·0052	0·0013	0·30	1·25	84·37	25·92	62·50	88·42
39 ...	0·147	0·0067	...	0·06	5·15	35·62	25·92	26·39	52·31

As the results of these tests are similar to those obtained in the previous series on the same ore, it is evident that the presence of coarse free gold is not the factor preventing a high percentage extraction from being obtained, and therefore other treatment factors must be varied to ascertain their effects on the cyanidation.

A new sample of South Kalgurli ore was prepared for treatment by grinding in pebble mills, without amalgamation, to pass a 200-mesh screen, filtering and drying. This pebble mill product assayed 12.13 dwt. gold per ton. A number of series of tests was carried out on this product in which the time of agitation with KCN and BrCN and the concentration of cyanide solution were varied, for the purpose of ascertaining whether the time of treatment previously used was too short and the effect of increasing the concentration of the cyanide solution. All other treatment conditions were kept constant and the same as in previous tests, viz.—

Agitation charge	200 gram. ore, 200 c.c. KCN solution, 1lb. CaO per ton of ore
Bromocyanogen addition ...	1 lb. per ton of ore.
CaO addition after treatment	2 lbs. per ton of ore.

Series I.

This series was carried out under the conditions originally laid down by Mr. Blackett to obtain results which would form a basis for comparison with the series of tests to be carried out under conditions suggested by the results of previous tests. The results are remarkably consistent, and show that under the stated conditions 85 to 86 per cent. is the maximum extraction to be expected from this sample of ore.

SERIES I.

Test No.	Soln. KCN, per cent.	Time of Agitation		Solution after Treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction per cent.
		With KCN, hours.	With BrCN, hours.	KCN, per cent.	CaO, per cent.	BrCN, per cent.			
40 ...	0·16	2	1	0·143	0·0067	Trace	0·34	1·7	85·98
41 ...	0·16	2	1	0·155	0·0171	Trace	0·10	1·75	85 57
42 ...	0·16	2	1	0·151	0·0134	Trace	0·18	1·8	85·16
43 ...	0·16	2	1	0 1495	0·0148	Trace	0·21	1·8	85·16
SERIES II. Variation of Time of Agitation.									
44 ...	0·16	2·5	1·5	0·153	0·0171	0·0027	0·14	1·1	90·93
45 ...	0·16	2·5	1·5	0·148	0·0089	0·0027	0·24	1·35	88·87
46 ...	0·16	2·5	1·5	0·145	0·0117	0·0027	0·30	1·0	91 75
SERIES III. Variation of Time of Agitation.									
47 ...	0·16	3	1	0·146	0·0104	0·0033	0·28	1·5	87·63
48 ...	0·16	3	1	0·148	0·0164	0·0033	0·24	1·95	83·51
49 ...	0·16	3	1	0·142	0·0097	0·0033	0·36	2·1	82·64

Series II. and III., in which time of agitation with KCN and BrCN was varied, indicate that apparently no benefit is derived from an increase in the time of agitation with KCN alone but that an increase in the time of agitation after the addition of BrCN increases the extraction by from 3.5 to 5 per cent. Therefore other treatment conditions remaining constant, an increase in the time of agitation after addition of BrCN improves the extraction, although, from theoretical considerations, nothing will be gained by prolonging this period beyond that at which the whole of the BrCN has been destroyed. Consequently it becomes necessary to determine the period of agitation with BrCN which will yield the best results.

In the next two series of tests, the effect of increases in the concentration of the cyanide solution was determined, all other treatment conditions being maintained constant as originally suggested by Mr. Blackett.

SERIES IV.

Increased Concentration of Cyanide Solution.

Test No.	Soln., KCN, per cent.	Time of Agitation.		Solution after treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent.
		With KCN, hours.	With BrCN, hours.	KCN, per cent.	CaO, per cent.	BrCN, per cent.			
50 ...	0·203	2	1	0·194	0·0112	0·0091	0·18	1·7	85·98
51 ...	0·203	2	1	0·190	0·0164	0·0121	0·26	1·9	84·34
52 ...	0·203	2	1	0·184	0·0141	0·0162	0·38	1·4	88·46

SERIES V.

Increased Concentration of Cyanide Solution.

53 ...	0·25	2	1	0·231	0·0156	0·0121	0·38	2·55	78·98
54 ...	0·25	2	1	0·234	0·0149	0·0148	0·32	2·2	81·86
55 ...	0·25	2	1	0·231	0·0116	0·0202	0·38	2·1	82·68

These two series appear to lead to the conclusion that increasing the concentration of the cyanide solution increases the grade of the residues, or decreases the extraction, although the average extraction is slightly higher in Series IV. than in Series I. Therefore, apparently, cyanide solutions of greater concentration than 0.16 per cent. KCN are disadvantageous and it may be possible that even weaker cyanide solutions may be equally as effective as 0.16 per cent. solution.

It is not advisable, if such can be avoided, to increase the quantity of bromocyanogen used above 1 lb. per ton or ore on account of the cost of this reagent and therefore it is necessary to determine the effect of increased time of agitation with KCN or BrCN, or both, and of cyanide solutions of less concentration than 0.16 per cent. KCN.

The consumption of cyanide during the treatment is in nearly all cases very low and apparently none of the treatment conditions which has been varied up to the present seriously affects this item.

In order to determine the effect of further increases in the time of treatment of this ore, both with KCN and BrCN, the following series of tests has been carried out on the same sample of ore, assaying 12.13 dwt. gold per ton, in which the time of agitation was increased to three hours with cyanide solution, followed by two hours' agitation after addition of 1 lb. BrCN per ton of ore. Other conditions of treatment have been similar to the conditions obtaining in previous tests, the cyanide solution assaying 0.148 per cent. KCN.

SERIES VI.

South Kalgurli Ore—Assay Value, 12·13 dwts. Gold per ton.

Test No.	Soln., KCN, per cent.	Time of Agitation.		Solution after treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent.
		With KCN, hours.	With BrCN, hours.	KCN, per cent.	CaO, per cent.	BrCN, per cent.			
56 ...	0·148	3	2	0·125	0·0059	0·0189	0·46	1·4	88·46
57 ...	0·148	3	2	0·121	0·0052	0·0202	0·54	1·0	91·75
58 ...	0·148	3	2	0·1215	0·0052	0·0175	0·53	1·0	91·75

These tests indicate that it may be possible to obtain higher percentage extractions by increasing the time of agitation with both KCN and BrCN, although Series II. and III. indicated that the time of agitation after addition of BrCN was more important than the time of agitation with KCN, two hours' treatment with KCN being apparently as effective as three hours' agitation. It appears also that this increase in the agitation times also results in increased consumption of cyanide, although this is still comparatively small.

The supply of this sample of ore having been exhausted, a new sample of South Kalgurli ore was ground as before, but was found to assay only 5.9 dwt. gold per ton. On this sample a number of series of tests have been carried out with weaker cyanide solution, 0.1 per cent. KCN, and different times of agitation.

SERIES VII.

SOUTH KALGURLI ORE—Assay Value, 5·9 dwts. Gold per ton.

Test No.	Soln., KCN, per cent.	Time of Agitation.		Solution after treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent.
		With KCN, hours.	With BrCN, hours.	KCN, per cent.	CaO, per cent.	BrCN, per cent.			
59 ...	0·106	2	2	0·087	0·0134	0·0040	0·38	1·3	77·97
60 ...	0·106	2	2	0·084	0·0178	0·0027	0·44	0·8	86·44
61 ...	0·106	2	2	0·083	0·0158	0·0040	0·46	1·1	81·36
SERIES VIII.									
62 ...	0·106	3	2	0·100	0·0149	0·0040	0·12	0·8	86·44
63 ...	0·106	3	2	0·102	0·0171	0·0067	0·08	0·7	88·13
64 ...	0·106	3	2	0·100	0·0208	0·0054	0·12	0·6	89·83
SERIES IX.									
65 ...	0·104	4	2	0·095	0·0119	0·0189	0·18	1·4	76·27
66 ...	0·104	4	2	0·0955	0·0126	0·0204	0·17	2·0	66·10
67 ...	0·104	4	2	0·092	0·0082	0·0216	0·24	0·7	83·13
SERIES X.									
68 ...	0·105	2	1	0·1045	0·0253	0·0067	0·01	1·0	83·05
69 ...	0·105	2	1	0·105	0·0253	0·0052	0·00	1·0	83·05
70 ...	0·105	2	1	0·105	0·0297	0·0091	0·00	1·1	81·36

These series show that the maximum agitation periods necessary for this ore under these conditions are three hours with cyanide solution and two hours after addition of bromocyanogen, and that increasing the time of agitation with cyanide solution beyond three hours lowers the extraction.

Although the consumption of cyanide is always low in a properly conducted test it was not to be expected that it would become practically nil in Series X. This low cyanide consumption can, however, be explained by taking into account the cyanide content of the added bromocyanogen which should, by reason of its process of production, always contain a certain amount of free cyanide. In these tests the bromocyanogen solution used contained 2.39 per cent. BrCN and therefore 4.2 c.c. of this solution contained 0.1 gram BrCN (equivalent to 1 lb. per ton on a 200-gram charge). After neutralising 4.2 c.c. of this stock solution with lime water and titrating with standard silver nitrate solution it was found to contain 0.022 gram KCN as free cyanide. Addition of this quantity of free cyanide to the 200 c.c. of cyanide solution used in each test increases its free cyanide content by 0.011 per cent., so that the actual free cyanide available in these tests was $0.105 + 0.011 = 0.116$ per cent. The consumption of cyanide has been calculated only on the basis of the cyanide solution without taking into account the KCN introduced in the bromocyanogen solution, and therefore the actual consumption of cyanide should be 0.22 lb. per ton more than that calculated from the concentration of the cyanide solution alone. Therefore, in this series of tests in which the consumption of cyanide is apparently nil it is actually 0.23, 0.22, and 0.22 lb. per ton in the three tests. That this is a feasible explanation of this apparently peculiar fact is confirmed by the results of the determination of free cyanide in the filtered solution from the treatment of the ore in some tests before addition of the lime necessary for neutralisation, when an increase in the free cyanide content of the solution of approximately 0.01 per cent. was found to take place after neutralisation. This explanation will account for the very low cyanide consumption in many of the tests. At the same time, in practice it is customary to base the consumption of cyanide on the difference between the free cyanide content of the solution before and after treatment, so that on this basis the consumption would be as stated in the results of the tests.

On account of the unsatisfactory nature of the results of the tests of Series IX. these tests were repeated on the same ore and under the same conditions, with the trifling exception that the strength of the cyanide solution was 0.1 per cent. KCN instead of 0.104 per cent.

SERIES XI.

SOUTH KALGURLI ORE—Assay Value, 5·9 dwts. Gold per ton.

Test No.	Soln., KCN, per cent.	Time of Agitation.		Solution after treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent.
		With KCN, hours.	With BrCN, hours.	KCN, per cent.	CaO, per cent.	BrCN, per cent.			
71 ...	0·1	4	2	0·0985	0·0186	0·0121	0·03	1·0	83·05
72 ...	0·1	4	2	0·100	0·0172	0·0121	0·00	1·2	79·66
73 ...	0·1	4	2	0·099	0·0268	0·0121	0·02	1·3	77·97

Previous tests in which 1 lb. BrCN per ton of ore was used have, on account of the presence of BrCN in the solution after completion of the test, led to the conclusion that it might be possible to reduce the bromocyanogen addition to 0.75 lb. per ton of ore without harmful effect. Consequently, four series of tests were carried out with the diminished quantity of bromocyanogen, but, in every case, the residues have been of high grade, although it is possible that the weaker cyanide solution may have also contributed to this result.

On account of the low grade of the sample of ore used in the last five series of tests it was considered advisable to discontinue treatment of this sample for the time being, and consequently a new sample of Boulder Perseverance ore was prepared in the usual way for treatment. This sample assayed 11.2 dwt. gold per ton. Previous tests having shown the advisability of agitation with bromocyanogen for at least two hours, four series of tests have been carried out on this ore in which three and four-hour periods of agitation with KCN have been adopted, while 1 lb. and 0.75 lb. additions of bromocyanogen per ton of ore have been made. In all these tests all other treatment conditions have remained constant.

SERIES XII.

1 lb. BrCN per ton of Ore.

Test. No.	Soln., KCN, per cent.	Time of Agitation.		Solution after treatment.			Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction. per cent.
		With KCN, hours.	With BrCN, hours.	KCN, per cent.	CaO. per cent.	BrCN, per cent.			
74 ...	0·1	3	2	0·094	0·0141	0·0162	0·12	3·7	66·96
75 ...	0·1	3	2	0·094	0·0097	0·0189	0·12	3·8	66·07
76 ...	0·1	3	2	0·095	0·0089	0·0256	0·10	3·0	73·21
SERIES XIII. 1 lb. BrCN per ton of Ore.									
77 ...	0·1	4	2	0·095	0·0171	0·0108	0·10	3·1	72·32
78 ...	0·1	4	2	0·095	0·0104	0·0108	0·10	3·0	73·21
79 ...	0·1	4	2	0·094	0·0149	0·0175	0·12	2·8	75·00
SERIES XIV. 0·75 lb. BrCN per ton of Ore.									
80 ...	0·1	3	2	0·091	0·0231	0·0168	0·18	4·2	62·50
81 ...	0·1	3	2	0·0895	0·0164	0·0168	0·21	4·15	62·95
82 ...	0·1	3	2	0·090	0·0112	0·0168	0·20	4·2	62·50
SERIES XV. 0·75 lb. BrCN per ton of Ore.									
83 ...	0·1	4	2	0·095	0·0149	0·0114	0·10	3·2	71·43
84 ...	0·1	4	2	0·095	0·0149	0·0141	0·10	3·4	69·64
85 ...	0·1	4	2	0·095	0·0245	0·0131	0·10	7·7	40·18

These series showed that a reduction in the quantity of bromocyanogen used resulted in lower extraction which was slightly improved by increasing the time of agitation with KCN from three to four hours.

The unsatisfactory nature of the results of the tests of the last four series led to their repetition under exactly similar conditions on a new sample of Boulder Perseverance ore, amalgamated during grinding, as it was considered possible that this ore contained some gold too coarse for ready dissolution. This sample of ore assayed 14.27 dwt. gold per ton before, and 11.47 dwt. gold per ton after amalgamation, representing an extraction by amalgamation of 19.62 per cent. of the gold.

SERIES XVI.

1 lb. BrCN per ton of Ore.

Test No.	Soln. KCN, per cent.	Time of Agitation. With KCN, hours.	Time of Agitation. With BrCN, hours.	Solution after Treatment. KCN, per cent.	Solution after Treatment. CaO, per cent.	Solution after Treatment. BrCN, per cent.	Consumption of KCN, lb. per ton.	Residue, dwt. Au per ton.	Extraction, per cent. on amalgd. ore.	Extraction on original ore, per cent. By amalgn.	Extraction on original ore, per cent. By cyanidn.	Extraction on original ore, per cent. Total.
86 ...	0·1	3	2	0·091	0·0193	0·0108	0·18	3·35	70·79	19·62	56·90	76·52
87 ...	0·1	3	2	0·094	0·0215	0·0094	0·12	3·95	65·56	19·62	52·70	72·32
88 ...	0·1	3	2	0·090	0·0215	0·0094	0·20	3·75	67·30	19·62	54·10	73·72

SERIES XVII.

1 lb. BrCN per ton of Ore.

89 ...	0·1	4	2	0·087	0·0164	0·0135	0·26	3·8	66·87	19·62	53·75	73·37
90 ...	0·1	4	2	0·086	0·0141	0·0189	0·28	4·3	62·51	19·62	50·25	69·87
91 ...	0·1	4	2	0·088	0·0171	0·0121	0·24	3·95	65·56	19·62	52·70	72·32

SERIES XVIII.

0·75 lb. BrCN per ton of Ore.

92 ...	0·1	3	2	0·088	0·0134	0·0054	0·24	5·0	56·41	19·62	45·34	64·96
93 ...	0·1	3	2	0·084	0·0268	0·0040	0·32	5·05	55·97	19·62	44·99	64·61
94 ...	0·1	3	2	0·085	0·0178	0·0040	0·30	5·1	55·53	19·62	44·64	64·26

SERIES XIX.

0·75 lb. BrCN per ton of Ore.

95 ...	0·1	4	2	0·088	0·0171	0·0081	0·24	5·1	55·53	19·62	44·64	64·25
96 ...	0·1	4	2	0·084	0·0216	0·0040	0·32	5·2	54·66	19·62	43·94	63·56
97 ...	0·1	4	2	0·087	0·0171	0·0080	0·26	5·7	50·30	19·62	40·43	60·06

These duplicate series lead to the conclusions that—

1. Amalgamation is not necessary for treatment of this ore;
2. A 0.1 per cent. cyanide solution is much less efficient than a 0.15 per cent. solution, the latter of which appears to give the best results of all the solutions used in the whole series of tests;
3. The minimum effective quantity of bromocyanogen is 1 lb. per ton of ore;
4. Apparently the best times of agitation are three hours with cyanide solution and two hours after addition of bromocyanogen;
5. Consumption of cyanide is always low.

A further and more detailed investigation of this method of treatment is urgently required as the process, if it can be successfully applied, will not only simplify the method of treatment and the plant necessary for that purpose, but will also materially reduce the cost of treatment of the ore. The present investigation has been purely of a preliminary nature for the purpose of determining the treatment factors which require investigation, but sufficient has been done to yield some information regarding the effect of the variation of certain factors and to form a basis for future and more searching investigations. This investigation has shown the possibility of obtaining by this method of treatment residues of 1 dwt. gold per ton, and less, from ores of varying grades, but it is necessary that ores of all grades from all the mines of the field should be investigated for the purpose of endeavouring to lay down some definite lines of treatment which may be applicable to all the ores of the field. The cost of treatment by this method has not yet been investigated, but it may be pointed out that the cost of cyanide will be comparatively small on account of the generally low consumption of that reagent, while the cost of bromocyanogen will be approximately two shillings and sixpence per ton of ore. The most important features of the method are the rapidity with which an extraction of 90 per cent., and more, of the gold can be obtained and the very low consumption of cyanide during the treatment.

B. H. MOORE,
Lecturer in Metallurgy.

Metallurgical Laboratory,
School of Mines of W.A.,
Kalgoorlie, 28th November, 1927.

DIVISION VI.

OPERATIONS UNDER "THE INSPECTION OF MACHINERY ACT, 1921."

Report of the Chief Inspector of Machinery and Chairman of the Board of Examiners for Engine-drivers for the Year 1927.

Office of the Chief Inspector of Machinery,
Department of Mines,
Perth, 13th February, 1928.

The Under Secretary for Mines.

Sir,

I have the honour to submit, for the information of the Hon. Minister for Mines, my Report on the operations of the "Inspection of Machinery Act, 1921," for the year ended 31st December, 1927:—

(1) Inspection of boilers.

(2) Explosions and interesting defects.

(3) Inspection of machinery.

(4) Accidents to persons caused by boilers and machinery.

(5) Board of Examiners for Engine-drivers.

(6) General.

DIVISION I.

Inspection of Boilers.

Return showing operations in the proclaimed districts (boilers only) during the years ended 31st December, 1926 and 1927.

—	Total. 1926.	Total. 1927.
Total number of useful boilers registered	3,341	3,422
New boilers registered during year	116	156
Boilers re-instated	1	1
Conversions	3	12
Inspections for year—Thorough	1,536	1,569
Working	98	60
Boilers condemned—Temporarily	109	39
Permanently	24	56
Boilers sent to other States	10	8
Transferred to other departments	1	1
Transferred from other departments	1	1
Number of notices for repairs issued	302	334
Number of Certificates issued, including those issued under Section 30	1,519	1,557

There were 156 new registrations during the year, compared with 116 the previous year. Thirty-five were imported from the United Kingdom, 21 from the United States of America, 35 from the Eastern States, 16 from unknown sources, and 49 were manufactured in this State. Local manufactures included 1 vertical multitubular portable, 1 digester, 1 steriliser, 4 steam-jacketed vessels, 10 vulcanisers, and 32 air receivers.

The number of useful boilers on the Register at the end of the year was 3,422, an increase of 81 during 12 months. One boiler was transferred from another department, 1 was reinstated, 9 were transferred beyond the jurisdiction of the Act, 12 were converted into containers, etc., and 56 were permanently condemned.

The number of thorough and working inspections was 1,569 and 60 respectively, a total of 1,629, showing an increase of 33 thorough and a decrease of 38 working inspections.

1,390 inspections were made in districts worked from Head Office, representing 85.3 per cent. of the total number made in all districts. 239 inspections were made in Goldfields districts worked from Kalgoorlie, being 14.7 per cent. of total inspections. A rearrangement of a few Goldfields districts was made during the year, and is outlined in Division VI. of this report.

The following table shows the number of boilers temporarily and permanently condemned, as a percentage of inspections made each year:—

Year.	Temporarily.	Permanently.
	%	%
1899	2·64	1·420
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	4·32	1·358
1922	5·22	·940
1923	3·76	1·213
1924	5·44	1·418
1925	5·25	·685
1926	6·67	1·468
1927	2·33	3·43

Fifty-six boilers were permanently condemned as steam generators, not being worth the cost of repairs necessary for their reinstatement. During 1926 there were 24 boilers permanently condemned.

There were less temporary condemnations for repairs than has been usual in past years, but it is necessary to point out that there has been an alteration in the method adopted, and certain repair notices do not now necessarily temporarily condemn boilers. 334 notices for repairs were issued and 39 boilers were temporarily condemned, compared with 302 and 101 during 1926.

During the year extensive and costly repairs were made, particularly to locomotive and to locomotive type boilers.

DIVISION II.

Explosions and Interesting Defects.

There was no explosion during the year, and only two interesting defects were recorded.

A boiler of the watertube type in operation on the Goldfields developed small areas of corrosion inside the steam and water drum over the inlet slots of the anti-priming pipe. The corrosion was apparently caused as a result of the vortex created when the slots furthest from the stop-valve became clogged. Similar corrosion has not been reported previously, and a baffle-plate was fitted over slots in the internal steam-pipe to protect the shell.

Several heads cracked off hollow space-stays in the water-leg of a watertube boiler. This occurrence was unexpected and unusual, for the boiler is in good condition generally. The damaged stays were stated by the makers to have been made from hydraulic tubing, but have the appearance of being welded and not solid drawn.

While the interior of a Cornish boiler at a coal mine was being coated with an anti-corrosion compound, two men engaged doing the work were overcome with fumes given off by the compound and were rendered unconscious. It was with difficulty that they were rescued and resuscitated.

DIVISION III.

Inspection of Machinery.

Return showing classification of power-driven machinery in use or likely to be used again in proclaimed districts during the years ended 31st December, 1926 and 1927.

Classification.	Totals.	
	1926.	1927.
Number of groups driven by—		
Steam engines	1,061	1,060
Oil engines	1,036	1,116
Gas engines	222	216
Compressed air engines ...	36	32
Electric motors	3,967	4,309
Hydraulic pressure	10	3
	6,332	6,736

The total number of groups registered at the close of the year was 6,736, an increase of 404 groups. Those electrically-driven showed an increase of 342, steam-driven a decrease of 1, gas-driven a decrease of 6, oil-driven an increase of 80, compressed air-driven a decrease of 4, and hydraulically-driven, a decrease of 7.

The number of machinery registrations in the Goldfields districts continued to decline but was more than balanced by the increase in other districts, and the net result indicates prosperity in the State.

The number of notices issued in the interests of safety of various classes of machinery was 246, compared with 208 similar notices issued during 1926. Owners have complied promptly with instructions relative to safeguarding machinery, and have shown a desire to assist in making our efforts to prevent accidents successful.

Despite the vigilance of Inspectors of Machinery and the co-operation of owners, operatives continue to take risks that are unwarranted, particularly with cutting tools of various types. Such risks inevitably lead to accidents sooner or later, particularly to fingers, and most of the accidents recorded were of such a nature.

RETURN SHOWING OPERATIONS IN THE PROCLAIMED DISTRICTS (MACHINERY ONLY) DURING THE YEARS ENDED 31st DECEMBER, 1926 AND 1927.

—	Totals.	
	1926.	1927.
Total registrations, useful machinery	6,332	6,736
Total inspections made	4,825	5,371
Certificates (bearing fees) issued ...	4,419	3,013
Certificates (steam without fees) issued	406	356
Notices issued (machinery dangerous)	208	246
Number of extension certificates issued under Section 42 of Act ...	...	...

The number of inspections made was 5,371, an increase of 546, and the number of certificates issued was 3,387. Reference is made in Division VI. of this report to the number of certificates issued.

Ninety-two electrically-driven passenger lifts were in use in the State at 31st December, a decrease of 2; 95 goods lifts were in operation, a decrease of 6. The reductions have been due to building construction in the Metropolitan Area, where several old lifts have been dismantled and are being replaced by modern types. Several additional lifts will also be erected during next year.

There was no accident to machinery of a sufficiently interesting nature to require mention in this report.

DIVISION IV.

Accidents to Persons caused by Machinery and Boilers.

Class of Machinery.	Number of persons injured.
Metal-working :	
Press	1
Crimping machine ...	1
Lathe	1
Pneumatic hammer ...	1
Wood-working :	
Shaper	2
Buzzer	4
Circular saw	2
Printing :	
Stapling machine ...	1
Rope-making :	
Winding machine ...	1
Saw-milling :	
Circular saw	2 [1]
Crushed by log carriage	1 [1]

Accidents to Persons caused by Machinery and Boilers—continued.

Class of Machinery.	Number of Persons injured.
Gearing :	
Pump	1
Flock machine ...	1
Belting :	
Drive belt	1
Shafting :	
Ore conveyor ...	2
Counter shaft ...	1 [1]
Goods lift	1
Paper-bag and Box-making :	
Slotting machine ...	1
Turning-out machine	1
Bag machine ...	1
Envelope machine ...	1
Bending machine ...	1
Boilers :	
Scalding	2
Steam jet	1
General :	
Emery wheel ...	3
Leather-cutting press	1
Friction winch ...	1
Cask-washing machine	1
	38

Numbers within brackets denote fatal accidents.

Thirty-eight accidents to persons were reported during the year: 28 in districts controlled from Head Office, mostly in the Metropolitan Area, and 10 in Goldfields districts. Of the total, 10 were minor accidents which did not incapacitate the injured persons for more than 48 hours, 25 were serious, and 3 were fatal. Most of the 25 serious accidents caused injuries to fingers or hands, and only 7 resulted in broken limbs or other serious injury. During 1926 there were 43 accidents, 3 of which proved fatal.

The first fatal accident occurred on 14th August. An employee at a mine was assisting to tighten a pump belt, and when the work was completed, he stood back on a platform to allow the mill foreman to place the belt in position for starting Suddenly his unbuttoned woollen jacket became entangled round a revolving shaft, and while being whirled round, his head and body came into contact with a beam and platform, causing injuries which proved fatal.

On the 23rd August a cleaner employed at a sawmill was working in the space between the saw bench and the skids. A log had been cut through and deposited on the skids and the carriage was set in motion towards the log yard. The cleaner reached over the rail to pick up a rake, evidently not noticing the approaching carriage, which crushed him against the bench. He had his ribs fractured, complications arose and he died a few days later.

On 4th October a benchman employed at a sawmill was truck by a piece of timber and died from his injuries three hours later. In this instance two benches were in line with a wooden partition between them. The saws were revolving towards each other, an unusual lay-out. A piece of timber about 15 feet long, 5in. x 3in., was hurled from one saw with great force on to the partition. So great was the force of the impact that it knocked a 9in. x 2in. plank off the partition, which struck the benchman working at the other saw on the head and shoulders. The construction of a stronger partition has made impossible a similar accident in the future.

In each of these three fatal accidents, the jury returned a verdict of accidental death, no blame being attachable to anyone. The inspectors of this department never cease warning persons working about machinery of the danger of loose clothing, and still unfortunately there are some who disregard such warnings.

There were three accidents caused through steam. Two of them were of a minor nature and do not require comment. The third happened as a result of using a steam jet to cleanse containers for neatsfoot oil. A drum made of thin metal was placed in an inverted vertical position, so that a steam jet entered the bunghole. The heat melted the more or less congealed oil remnants in the drum, but instead of the melted oil trickling out of the drum, the space between the jet and the edges of the bung became sealed and sufficient pressure was raised in the drum to blow its bottom out. At that moment the works manager happened to be nearby and received facial bruises and cuts from the flying metal. This method of cleaning containers has been in use for years and no accident had occurred previously. It is surmised a piece of cotton waste or other material found its way into the drum, and, when heat was applied, fell on to the opening round the jet and sealed the drum. A reducing valve has been installed to make the cleaning operation quite safe in future.

It is pleasing to note that the number of accidents caused through wood-working machinery in factories had decreased, only eight being reported. In all cases efficient guards had been provided. In one case the operator had removed the guard to "facilitate" a special job, and consequently lost portions of three fingers. No prosecution was instituted, as the owner of the machinery was blameless and the operative had received sufficient punishment. Other cases were due to unfortunate happenings, mostly to misjudgment in feeding small pieces of timber to cutting machines.

Once again I find it necessary to point out that skilled workmen are not infrequently the worst offenders against precautionary measures. Especially does this refer to the removal of guards, as well as to unwarranted risks taken in other directions. These men become so used to the machinery they are working with that they forget the danger which is ever present, and it is only after an accident happens that they remember warnings.

There were no cases of gassing at gas-power plants, and there was no injury caused by metal belt fasteners, which were a source of danger in past years.

DIVISION V.

Board of Examiners for Engine-drivers.

During the year the Board was occupied nine days in travelling from centre to centre in connection with examinations held in the country; 11 days were devoted to country examinations, and 22 days were occupied in Perth dealing with applications and conducting examinations.

At Perth four examinations were held, two were held at Kalgoorlie, two at Bunbury and two at Leonora. Examinations advertised for Southern Cross, Mt. Magnet, Geraldton and Albany lapsed on account of insufficient applications being received.

During the year 200 applications were received and 174 certificates were granted by the Board. Last year 245 applications were received and 199 certificates were granted.

RETURN SHOWING TOTAL NUMBER OF ENGINE-DRIVERS' AND BOILER ATTENDANTS' CERTIFICATES GRANTED DURING THE YEARS 1926 and 1927.

Class of Certificate.	No. granted. 1926.	1927.
Winding Competency, including certificates issued under Regulation 40 and Section 60 of Act	3	4
First-class Competency, including certificates issued under Regulations 40 and 45 and Sections 60 and 63 of Act	7	9
Second-class Competency, including certificates issued under Regulation 40 and Section 60 of Act	17	13
Third-class Competency, including certificates issued under Regulation 45 and Sections 60 and 63 of Act	33	32
Locomotive Competency	11	12
Traction Competency	3	3
Internal Combustion Competency	17	16
Crane and Hoist Competency ...	9	10
Boiler Attendant Competency ...	83	61
Interim	1	1
Copies	6	7
Transfers	9	6
Totals	199	174

It has been gratifying to notice the marked improvement in knowledge shown at examinations by those candidates who have followed the advice of the Board relative to the course of study they should pursue.

A minor case of overwinding occurred as a result of a peculiar happening. A skip of ore was approaching the kick-up into a bin on a brace at a mine, when a sack which had been stuffed into a ventilator above the engine-driver dropped on to his head, and momentarily obscured his vision. The damage done was slight, and investigations showed that no action was necessary except to warn the drivers and management that the ventilator must be kept free from obstructions.

A cage operated by a single-compartment winder at a mine shaft hit the bearers at 1,500ft. level, causing slight damage to them, the cage bottom, and 25ft. of the rope, which was kinked. The accident, which was of a minor nature, was caused by a confusion in the nomenclature of the levels resulting in a misunderstanding between braceman and engine-driver. Neither man was actually blameworthy, and precautionary measures have been instituted to prevent a similar mishap.

DIVISION VI.

General.

During the year the Australian Commonwealth Engineering and Standards Association appointed sectional committees to formulate regulations for the manufacture, inspection and control of (a) Steam boilers and underfired pressure vessels and (b) Cranes and hoists. The object of the movement is to devise regulations that will be applicable and acceptable to all the States in the Commonwealth, thereby establishing standards of manufacture, inspection and control which will overcome the unnecessary differences now existing between the States. The sectional committees are composed of representatives of the principal interests throughout the Commonwealth, including Government departments controlling inspection of machinery. The committees mentioned have commenced their comprehensive tasks, and it can be confidently anticipated that in due course their recommendations will prove beneficial to the many interests concerned.

Conditions and circumstances relative to our operations in the several districts proclaimed in the Act are continually altering. Such alterations demand modifications in our procedure from time to time, and the past has been no exception in that regard. At the beginning of January the Kalgoorlie Office was left in charge of one inspector. The number of boiler and machinery registrations has steadily declined in the Goldfields districts for some years, and the other Kalgoorlie Office inspector was transferred to Perth to assist in handling the ever increasing volume of work in districts worked from Head Office. On account of those portions of the East Murchison and Murchison Districts west of Lawlers and Wiluna having only 47 boiler registrations left therein, it was decided to work them from Head Office once a year instead of twice a year from Kalgoorlie. An inspector from Head Office, commencing in September, worked up the Midland country to Geraldton and Northampton, then eastward to Mullewa and Mt. Magnet, through the Murchison, across to Carnarvon, and back to Mullewa, thence to Perth via Wongan Hills, etc. It was a long trip of 5,000 miles and in future will be done in two stages, but was found to be quite satisfactory. This alteration accounted for only 239 inspections of boilers in Goldfields districts worked from Kalgoorlie, as compared with 287 during 1926. It also increased the inspections made from Head Office.

Alterations were made relative to the issue of certificates for machinery. As a result of a ruling by the Solicitor General, several groups of machinery are now included, when necessary, on one certificate, instead of issuing a certificate for each group. During the year 5,371 groups were inspected and 3,387 certificates were issued. At some factories or plants there are 70 or 80 groups of machinery and hitherto each group required an office file; now there is but one file for each factory or plant. During the year the number of machinery files has been reduced by approximately 2,000, and a similar saving has been made in number of certificates issued. In addition, "Application for fees" leaves have been bound in certificate books and are filled in, by means of carbon sheets, when certificates are written by inspectors, thus obviating a great amount of typing. The results of these and other alterations have been beneficial to all concerned.

The total number of boiler and machinery registrations at the close of the year was 10,158, an increase of 485 registrations. Once again the increase in the South-Western division more than compensated for the decline in Goldfields divisions.

Repairs to boilers during the year have been exceptionally extensive, and some owners have spent large sums of money in that direction, several old locomotive and locomotive type boilers having been practically rebuilt. In this work autogenous welding has played an important part, and its value for repair work has now been established in this State.

Revenue.

The total revenue from all sources during the year was £5,451 17s. 1d., a decrease of £85 3s. 7d., when compared with the revenue for 1926, as follows:—

Source.	1926.			1927.		
	£	s.	d.	£	s.	d.
Fees for boiler inspections	2,838	9	6	2,538	15	0
Fees for machinery inspections	2,215	19	0	2,542	0	3
Engine-drivers' fees ...	269	10	6	226	1	0
Special inspections and expenses	213	1	8	145	0	10
Totals	5,537	0	8	5,451	17	1

Expenditure.

The total expenditure for the year was £5,829 5s. 8d., a decrease of £713 1s. 4d. compared with the expenditure for 1926:—

Source.	1926.			1927.		
	£	s.	d.	£	s.	d.
Salaries	5,286	12	5	4,713	10	2
Travelling allowances and fares	686	10	11	544	15	6
Motor cars costs	258	8	8	238	4	1
Hire of conveyances ...	82	4	6	44	4	6
Sundries	131	8	1	215	10	6
Engine-drivers	97	2	5	73	0	11
Totals	6,542	7	0	5,829	5	8

The total loss was £377 8s. 7d., compared with a loss of £1,005 6s. 4d. during 1926.

Mileage.

The distance travelled by inspectors during the year was 39,097 miles; 8,209 miles by rail, 29,630 miles by road, 1,200 miles by air and 58 miles by water. The number of miles travelled showed a decrease of 4,313 when compared with the mileage travelled during 1926. The average distance travelled per inspection during 1927 was 5.58 miles, compared with 6.72 miles during 1926.

Staff.

On the 1st July, Mr. E. P. Lee, Inspector of Machinery, retired after 28 years' service, and the vacant position was filled by Mr. W. J. Jordan on 24th October. When the vacancy occurred, it became necessary to call for applications for an inspector of machinery. The Hon. Minister appointed a Board of Examiners, under Clause 3 of the "Regulations relating to the examination and qualifications of applicants for the position of inspector of machinery," to deal with the matter in accordance with the provisions of the Act and Regulations. The Board, consisting of Messrs. A. T. Bowden, B.Sc (Mech. Eng.), Lecturer in Charge of Mechanical Engineering at the University of Western Australia, B. Prynn Jones, Senior Inspector of Machinery, and myself as Chairman, reviewed the applications and conducted an examination, on the 1st September, of those eligible to sit for it. The Board, as a result of the examination, recommended Mr. Jordan, who was appointed to the position. Appended to this report are the papers set for the examination.

There was no change in the personnel of the Clerical staff.

I desire to thank all members of the staff for a particularly successful year's work.

In conclusion, I wish to extend my sincere thanks to officers attached to the Crown Law, Police, and Postal Departments for great assistance rendered by them during the year in connection with the administration of the Act.

I have, etc.,

A. M. HOWE,

Acting Chief Inspector of Machinery and
Acting Chairman of the Board of Examiners.

APPENDIX.

EXAMINATION OF CANDIDATES FOR THE POSITION OF INSPECTOR OF MACHINERY.

Morning Paper—10 a.m. to 1 p.m. 1st September, 1927.

Only four (4) questions to be answered, No. 2 being compulsory.
All questions carry equal marks.
Workings must be shown.

1. (a) Enumerate the events, in correct order, which happen during a complete cycle of a modern gas-engine.

(b) Enumerate various portions of plant necessary for making producer gas for use in engines.

(c) Describe the precautions necessary when repairing starting and operating gas-power plants.

(d) Sketch an indicator diagram you would expect to obtain from a modern gas-engine.

(e) Describe briefly how heavy fuel oil is utilised in internal combustion engines.

2. A direct acting steam-driven pump has a steam cylinder 22 inches diameter, a stroke of 3 feet 4 inches and makes 210 strokes per minute. It is supplied with steam at a pressure of 144lbs. per sq. inch from a boiler burning 2,950.86 lbs. of coal per hour. The pump delivers 360,000 gallons of water per hour against a head of 350 feet. Assuming the mean effective pressure in the steam cylinder to be five-eighths of the boiler pressure, calculate the following:—

(a) I.H.P. of engine.
(b) Pump horse-power.
(c) Coal burned (lbs.) per I.H.P. per hour.
(d) Coal burned (lbs.) per million gallons of water delivered.
(e) Mechanical efficiency of engine and pump.

3. State what parts you would examine and what data you would require to compute the safe working load of—

(a) Travelling jib crane.
(b) Winding engine.
(c) Passenger lift.

4. (a) What should be the dimension of a jarrah beam, to carry a load of two tons at any point of a span of 20 feet, allowing a factor of safety of 5.

(b) Calculate the deflection of this beam with the load at its centre point.

Deflection formula may be taken as:—

$$\text{Deflection} = \frac{L^3 \times W}{4 \times 1{,}500{,}000 \times b \times d^3}$$

Take L, b, d in inches and W in lbs. weight of beam may be neglected.

Note.—Take the ultimate tensile strength as 5,000lbs. per sq. inch.

5. (a) Explain fully the means you would adopt to increase the power of a compound non-condensing engine, without making any important structural alterations.

(b) State the advantages derived from the use of surface condensers in conjunction with steam engines.

(c) What information does an indicator diagram convey to an engineer?

6. (a) A 20 h.p. gas engine drives a direct current generator whose efficiency may be taken as 90 per cent. Current is generated at 220 volts. How many 100 c.p. half-watt lamps could be connected (1) in series, (2) in parallel with the supply?

(b) Make a neat sketch of the lay-out of the switchboard.

(c) What would you consider a reasonable overall efficiency for a plant of this nature?

EXAMINATION OF CANDIDATES FOR THE POSITION OF INSPECTOR OF MACHINERY.

Afternoon Paper—2 p.m. to 5 p.m., 1st September, 1927.

Only four (4) questions to be answered, No. 2 being compulsory.
All questions carry equal marks.
Workings must be shown.

1. Give freehand sketches showing the correct setting for any two of the following types of boilers:—

(a) Lancashire.
(b) Water-tube.
(c) Underfired multitubular.
(d) Locomotive.

Show by arrows the course of draught of each.

State the advantages and disadvantages of each type.

2. (a) Compute the working pressure of the Cornish boiler shown on attached sketch, allowing a factor of safety of 5 for the shell and 4 for the tube. Material, mild steel throughout. Computations must be given. The formulæ attached may be used.

(b) Criticise the design of this boiler and suggest alterations which would improve it, assuming shell and plates to be of sufficient thickness.

3. (a) Where and why does deterioration usually take place, under working conditions, in Vertical, Locomotive type, and Water-tube boilers?

(b) Mention the chief impurities found in boiler feed water. Describe briefly their effects on boilers, and one approved method for the treatment of water before use in boilers.

4. (a) Illustrate by means of sketches the best arrangement of water pipes, branch and main steam pipes and valves that you would adopt for a nest of four Cornish boilers each 6ft. diameter, 24ft. long, equipped with any well-known Economiser. Give brief reasons for method suggested.

(b) What is superheated steam? What advantages and disadvantages are expected from its use? Describe and give a sketch of a superheater usually attached to a water-tube boiler.

5. (a) Criticise fully the longitudinal seam shown on attached small sketch.

(b) Discuss the use of electric and oxy-acetylene welding for boiler repairs.

(c) Compare riveted and welded joints for general use in boilers.

EXAMINATION OF CANDIDATES FOR THE POSITION OF INSPECTOR OF MACHINERY.

Data and Formulae for Boiler Calculations.

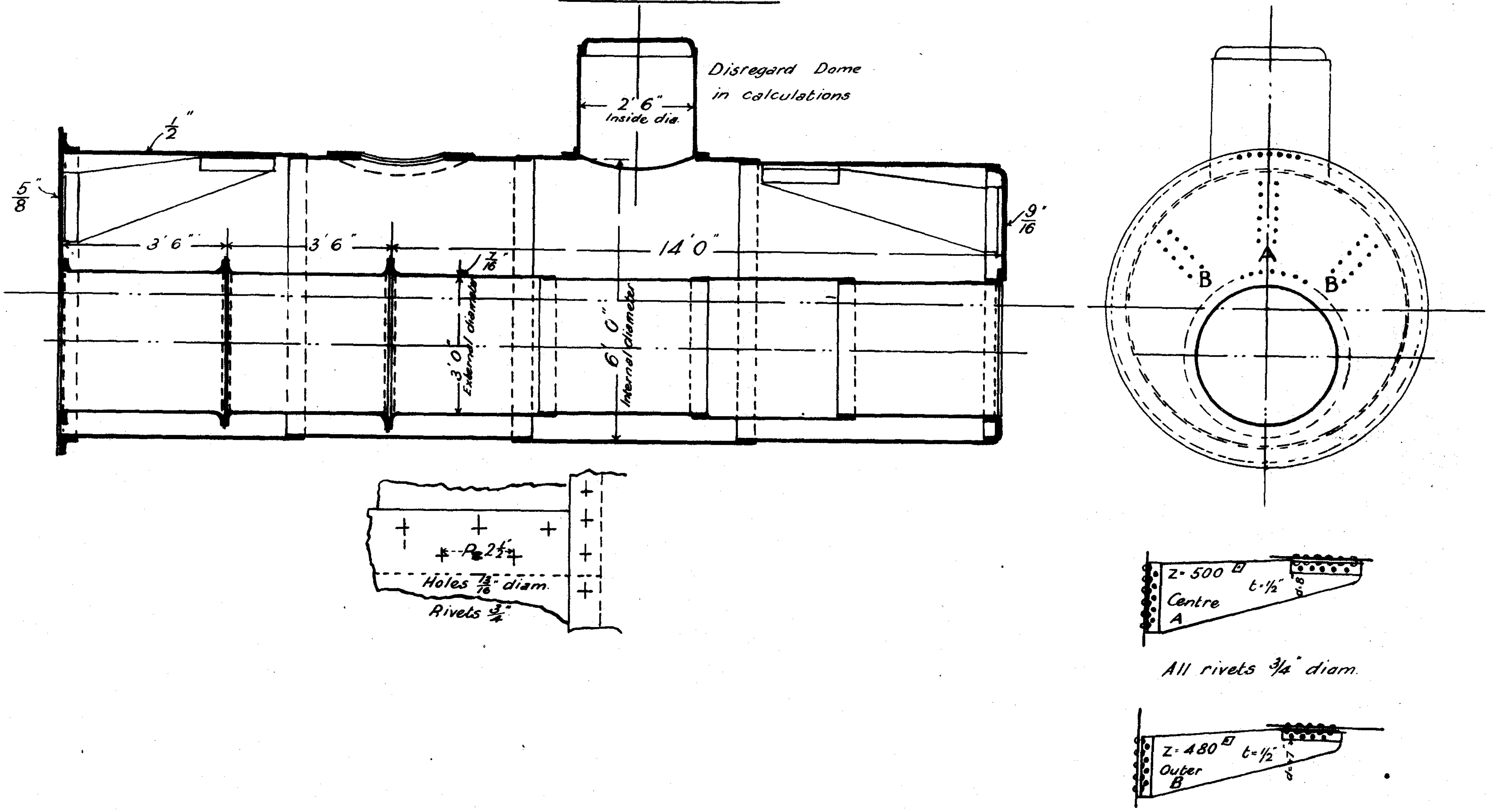
Afternoon Paper—2 p.m. to 5 p.m., 1st September, 1927.

1. Bursting pressure of shell $= \frac{T\,S\,x\,t}{R} \times$ least percentage of joints.

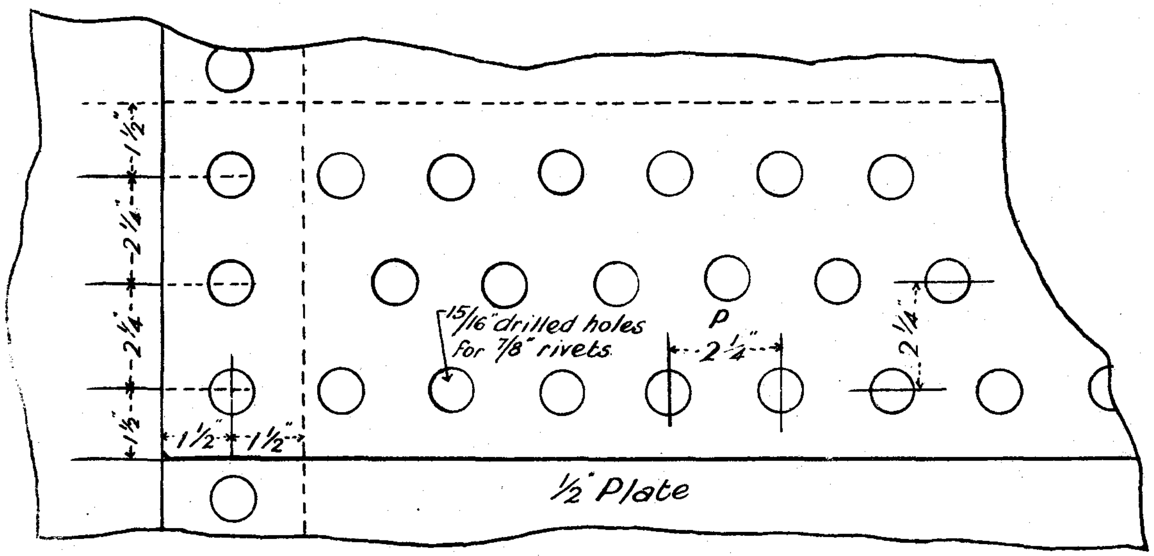
$Rt = \frac{100\,(P - d)}{(P)}$ = Resistance of plates to tearing between the rivets of pitch "P" expressed as a percentage of the resistance of the solid plate.

$Rs = \frac{100\,(n \times a \times fs)}{p \times t \times ft}$ = Resistance of rivet to shearing, expressed as a percentage of the solid plate to tearing.

QUESTION No. 2



— QUESTION Nº 5 —



— *LONGITUDINAL SEAM TREBLE RIVETED LAP JOINT* —

— *CIRCUMFERENTIAL SEAM SINGLE RIVETED LAP JOINT* —

Where T. S = tensile strength in lbs. per square inch (take as 28 tons).

R = radius of boiler in inches.

t = thickness of plate in inches.

P = pitch of rivets in inches.

a = area of rivets in square inches before riveting.

d = diameter of holes in inches (usually ft.+1/16in.)

d ft. = diameter of rivets in inches before riveting.

n = No. of rivets in one pitch "P."

ft. = resistance to tearing in tons (say 28 tons).

fs. = resistance to shearing in tons (say 23 tons).

2. Collapsing pressure of tube $= \dfrac{C \times t^2}{D \times \sqrt{\ }}$

When C = a constant (say 660).

t = thickness in thirty-seconds of an inch.

D = external diameter of tube in inches.

L = length of greatest unsupported length of tube in inches.

3. *Gusset Stays* (calculate front end stays only).

(a) Strength of gusset plates:—

when d = depth of gusset plates in inches (as shown on blue print).

t = thickness of gusset plates in inches (as shown on blue print).

Z = area of front end plate supported by each stay, in square inches. Take Z for "A" and "B" respectively as 500 and 480 square inches.

then working pressure $= \dfrac{10{,}000 \times d \times t}{Z}$

(b) Strength of gusset connection to shell:—

When n = Total number of rivets connecting the two angles of any stay to shell.

r = area of one rivet *before* riveting.

f = shearing stress in lbs. per square inch on rivets (take f = 8,000).

Z = area of front end supported by stay in square inches as above.

then working pressure $= \dfrac{f \times r \times n}{Z}$

(c) Strength of gusset connections to end:—

n = total number of rivets connecting the two angles of any stay to end.

r = area of one rivet in square inches before riveting.

T = tensile stress in lbs. per square inch to load, assumed to be uniformly distributed (take T = 6,000 lbs.)

Z = area supported as above.

then working pressure $= \dfrac{T \times r \times n}{Z}$

DIVISION VII.

ANNUAL REPORT OF THE CHEMICAL BRANCH, MINES DEPARTMENT, FOR THE YEAR 1927.

The Under Secretary for Mines, Perth.

I have the honour to submit, for the information of the Hon. the Minister, my Report on the work of this Branch during the year 1927.

Staff.

During the year Mr. W. W. Saw, B.Sc., A.A.C.I., resigned from the staff, and his place was filled by the appointment of Mr. C. R. Le Mesurier, A.W.A.S.M., A.A.C.I.

It was hoped during the year to engage a Research Chemist to investigate certain problems connected with the Metropolitan Water Supply, but scarcity of funds prevented this for the time being.

In March the 3rd Class Chemists presented to the Appeal Board a group appeal against their existing classification of £324-£408 per annum. The Board's decision was that the classification should be £336-£408 as from 1st July, 1926. The Senior Chemists, who also appealed, were raised from £360-£456 to £432-£480, and the Supervising Chemists also obtained small increases.

Materials Examined.

From the detailed statements of the Supervising Chemists hereunder, it is apparent that in all 3,975 samples were submitted for examination. These were distributed amongst the three sections of the Laboratory as follows:—

Foods, Drugs and Toxicology	832
Mineralogy, Mineral Technology and Geochemistry	1,867
Agriculture, Water and Sewerage	1,276
	3,975

This represents an increase of 594 over the previous year.

Mineral samples still preponderate over the others. There has, however, been a notable increase in agricultural samples, largely traceable to the increased technical staff of the Agricultural Department and to the activities in regard to agricultural problems of the Commonwealth Institute of Scientific and Industrial Research. Foods and drugs also showed a pronounced increase.

The most numerous class of samples is that of gold ores and residues, of which 1,240 were received. Other numerically important samples were foods (168 samples), toxicological (113), explosives (169), wheats (260), brans and pollards (155), and waters (599).

Foods and Drugs.

Two meetings of the local Food Standards Advisory Committee were held during the year, one attended by myself, and the other, in my absence, by Mr. Stacy.

In May an interstate conference was held at Melbourne to discuss uniform standards for foods and drugs. This was attended by Mr. C. E. Stacy as my deputy, and in his detailed report will be found an account of the most important decisions arrived at. In 1922 a similar conference drew up a uniform set of regulations, but as only a minority of the States, including Western Australia, translated them into law, the conference was more or less futile.

The 1927 conference has suggested many and drastic alterations in the regulations at present in force in this State. Most of them appear to be fully justified and it is hoped there will be a unanimous proclamation of these regulations throughout Australia on a set date, and subsequent rigid enforcement of them. Only in this way can many reprehensible practices in the food and drug trades be held in check.

During 1927 there was great activity in the inspection of milk supplies, probably as the outcome of public argument regarding the relative values of natural and pasteurised milk. In addition to the large number of samples dealt with by the Local Health Boards' Laboratory, this Branch analysed 93 samples, of which only 60 complied with the regulations.

In view of the suggestion that the present regulation governing lemon juice sets too high a standard for citric acid content, viz., 6 per cent., the juice from lemons collected at a number of commercial and private orchards is being examined. Owing to the big range in acidity indicated by the results at present obtained, the investigation is being continued with a view to determine if possible the influence of time of year, length of storage, degree of irrigation, etc., on this factor.

Twelve samples of drugs were examined and only seven complied with the provisions of the regulations in regard to composition.

Metropolitan Water Supply.

Regular meetings of the Advisory Committee were held each month, and attended in almost every instance by myself. In my absence Mr. A. J. Hoare acted as my deputy.

The principal matters dealt with were the prevention of the supplies from bacterial contamination, their sterilization to make assurance doubly sure, and their treatment to avoid corrosion of the mains and consequent ferruginous discoloration of the tap-water.

Bacteriological tests indicate the continued efficacy of the treatment of the Hills water at the pipe heads with liquid chlorine in such proportions that tests made along the main at a distance equal to half an hour's travel of the water still indicated a trace of free chlorine.

Treatment of the water to avoid corrosion is a much more difficult matter owing to the exceptional composition of most of our Darling Range stream waters. Comparative figures for several of the principal city supplies were obtained during the year. They show:—

	Total salts per million.	Dissolved oxygen per million.	Dissolved CO_2 per million.	pH.
Sydney ...	78	5·1	3·1	?
Melbourne ...	32 to 60	?	?	?
Adelaide ...	281 to 360	?	?	?
Brisbane ...	86 to 347	?	?	7·2 to 8·4
Hobart ...	80	?	?	?
Newcastle ...	42 to 64	?	?	?
Perth (Hills)...	154 to 494	9·0	6 to 21	6·3 to 6·9

A recently published article by J. R. Bayliss, on "Treatment of water to prevent corrosion," summarises the facts in the following words:—"No treatment of water will prevent corrosion of iron where a fresh metal is exposed. . . All evidence indicates that iron pipe, whether galvanised, painted with coal tar pitch, or cement lined, is (indefinitely—E.S.S.) durable only when the water is saturated with calcium carbonate or is more alkaline."

Efforts have been made to minimise the corrosion in Perth by rendering the water more alkaline and more nearly saturated with lime, and by coating new pipes with cement, and inducing chemical films to form on the surface of those already laid. With this object in view experiments are now being made with sodium silicate, a substance which has proved to be extraordinarily effective in one or two instances in England.

Alcoholic Beverages.

The usual annual batch of agents' standard samples of spirits were not collected for analysis this year. These are required for comparison in suspected cases of false trade description, an offence which has markedly decreased in recent years in the Metropolitan area owing to the activity of the Chief Inspector of Liquors.

In a case where a licensee was charged with selling whisky greatly under standard strength a defence was set up that the cause was a differential evaporation of alcohol through an ill-fitting stopper. In view of this an experiment lasting over twelve months was carried out in the Laboratory to determine the difference in strength of two halves of one sample of the brand of whisky concerned, one half being in a securely stoppered bottle, the other in a bottle with a small hole perforated in the stopper. It proved that an appreciable and finally similar loss amounting to 0.8 degrees occurred in both during the periodical decantation in and out of the bottle into the hydrometer cylinder. The additional loss suffered by the imperfectly stoppered bottle was only 0.8 degrees. Such natural causes therefore plainly failed to explain the reduction from the normal 25 under proof to 32.5 under proof detected in the case upon which the prosecution was founded, and in which a fine of £20 was inflicted.

All the ales and stouts on the local market have again been examined for alcoholic content and the presence of saccharin, salicylic acid, and other preservatives. They were all found to conform with the regulation under the Health Act.

Sanitation of Factories.

The inspection of motor car workshops, begun in the previous year, was continued with a view to determining the danger to health of pollution of the air with volatile oils, etc., from paints and varnishes in use. Several of the paints themselves were analysed to determine the nature of their volatile constituents. As a result no further facts emerged likely to modify the statements made in last year's report.

Several samples of air from the Government Power House and Railway Workshops and from three business houses in the city were examined for oxygen, carbon monoxide, and dioxide. The oxygen in all cases was found to be normal, whilst the maximum carbon monoxide found was 0.005 per cent., and carbon dioxide 0.13 per cent. These latter figures are far below the usually accepted toxic proportons. In every case therefore the air was certified as unpolluted.

Explosives.

Of the 169 samples submitted by the Chief Inspector of Explosives, 105 were fireworks and 64 detonators. The fireworks were submitted to qualitative analysis with a view to detecting the dangerous association of sulphur with potassium chlorate. This mixture was detected in 16 cases, the chlorate reaching to a maximum of 45 per cent. of the total charge. Complete analyses were made of a number of the detonators, but in the majority of cases information was only sought as to the hygroscopicity of the charge and the actual content of water.

Cereals.

These are not included under Foods as the examinations made include not only milling and analytical tests of wheat and flour, but also investigations of brans and pollards from the point of view of their utilisation as stock and poultry feed.

Oven 200 wheats, mainly of the 1927-8 season, were examined for moisture content as received at railway sidings and as shipped at various ports. This was undertaken to check the apparently anomalous water content of some shipments on arrival in England. As the apparent water content varies somewhat according to the details of the method used, the following procedure was suggested and adopted for use both here and in England:—Fifty berries split apart along the crease and weighed in stoppered weighing tube. Uncovered and dried for one hour in air oven at 130° C. Stoppered, cooled for 20 minutes in desiccator, and weighed again. The figures thus obtained lay mostly between 8 and 11 per cent., but the extremes were 6.43 and 14.67 per cent. The figures varied somewhat with the variety of wheat, but were mostly dependent on the temperature and humidity of the atmosphere at the time of loading.

As a result of analytical work done in 1926, following complaints from dairymen and poultry-breeders, a regulation was gazetted on the 1st January, fixing standards for bran and pollard under the Fertilisers and Feeding Stuffs Act. To check this regulation a number of analyses were made during the year of by-products from commercial mills and from the departmental experimental milk. The figures obtained, which are quoted by Mr. Hoare (page 14), agree closely with the standards fixed, except in certain commercial materials which were obviously improperly prepared.

As in previous years, the competitive wheat samples submitted to the Royal Agricultural Society were judged in the Government Laboratory, Mr. R. G.

Lapsley, Senior Chemist in the Agricultural section, acting as one of the three judges. The championship was awarded to a sample of Comeback grown at Kellerberrin.

Farmers' Water Supplies.

As usual a large number of water samples from trial drills and new wells have been submitted to determine their suitability for stock-watering and other purposes. Most of them come from the Wheat Belt, where there is practically no surface water and supplies must be drawn from shallow depths, where the salinity of the water is extremely variable and often excessive.

The standards for stock waters published in my last Annual Report are standing the test of time and have been confirmed on several occasions. A committee of the National Research Council of Australia is now investigating the actual effect upon different classes of stock of pure solutions of single commonly occurring salts. The results are awaited with the greatest interest.

Fertilisers.

It is satisfactory to note that of 67 samples of fertilisers analysed under the Fertilisers and Feeding Stuffs Act only two were below the standard of the guaranteed composition. In many cases the nitrogen and phosphoric oxide content of nitrogenous manures were considerably in excess of the guarantee. In the case of superphosphates, the manufacture of which is capable of very close control, the analyses were usually very close to the guarantee.

A question arose during the year regarding the degree of fineness which should be demanded in the case of basic slag (Thomas phosphate) which is imported into the State only in small quantities. A regulation under the Fertilisers and Feeding Stuffs Act requires that not less than 80 per cent. shall pass a 100-mesh sieve and not less than 95 per cent. shall pass a 60-mesh sieve. One small parcel imported showed only 76 and 91 per cent. respectively. As however, standard sieves are not mentioned in the regulation, and a solubility test of this parcel showed 14.7 per cent. P_2O_5 soluble in 2 per cent. citric acid, it was advised that the parcel be allowed to be sold. It is understood that in the factories 80-mesh commercial sieves are used for screening. Provided these sieves are kept in a reasonable state of repair there should be no doubt that 95 per cent. of the finished article will pass a 60-mesh sieve, whilst in almost every instance it has been found that over 80 per cent. will pass a commercial 100-mesh sieve.

Fungicides.

In July a regulation was gazetted under "The Plant Diseases Act, 1914," as follows:—

> "Every application for registration" (of a fungicide or insecticide). "shall be accompanied by a certificate of analysis from the Government Analyst or any other analyst registered or appointed under any law of the State of Western Australia."

This will prevent the registration of valueless mixtures for the destruction of plant parasites. The fees chargeable under this regulation are 15s. for each constituent determined, with a maximum of £3 for any one sample.

In connection with the now extensive use of "copper carbonate" for preventing bunt in wheat, the results of analyses of local commercial supplies is of interest. Originally the compound used was the basic carbonate, $CuCO_3.Cu(OH)_2$. Whilst most bunticides are still purchasable as "copper carbonate," the actual copper compound supplied is not always the original one but in many cases a basic sulphate or oxychloride, or a mixture of basic sulphate and carbonate.

The following figures have been obtained from samples purchased from different vendors in Perth:—

BUNTICIDES.

	Copper Cu.	CO_2.	Sol. SO_3	Insol. SO_3.	Cl.	Compound present.
Theory.	57·4	19·9	...	...	...	Basic Carbonate.
A	50·04	17·64	2·54	·49	...	Basic carbonate, some bluestone.
B	51·08	11·4	·98	6·41	...	Mixed basic carbonate and sulphate.
C	53·48	6·64	·82	12·11	...	do. do.
D	49·88	2·00	·72	17·03	...	Mainly basic sulphate.
E	49·76	0·56	1·61	19·92	...	Basic sulphate.
F	46·48	0·88	3·83	·43	17·09	Oxychloride, some bluestone.
G	54·36	?	?	?	15·08	do. do.

There is good reason, however, to believe that both the basic sulphate and oxychloride are as effective as bunticides as the basic carbonate, tests of all three having been made at the State Experiment Farm, Merredin.

Mineral Assays.

By far the most numerous assays are those made for gold, numbering in all 1,240 for the year. About one-half of these are made for the State Batteries, chiefly check and umpire assays of tailings. The balance is divided between the State Mining Engineer, in connection with mine sampling, and prospectors.

Some rich silver lead ores were received from the East Kimberley, Gascoyne, and Lower Murchison Districts, but in every case it appeared that the quantity of such ore in sight was small. The Kimberley ores ran as high as 72 ounces of silver per ton, scales of metallic silver being seen in some samples, but in others the silver minerals were obscured by the other minerals present.

Manganese ores are evidently being sought for, 46 samples being submitted for partial analysis. With the completion of the railway from Meekatharra to Horseshoe, there is a prospect of shipments of ore at an early date from the large deposits at the latter place.

Quite a number of tantalum ores were submitted for assay as a result of renewed purchase and export from this State for the manufacture principally of malleable tantalum vessels for the chemical trade. The tantalum minerals submitted or collected by officers of the Laboratory for examination included manganotantalite, mangano-columbite, tapiolite, tantalofergusonite, and tanteuxenite. Further reference to these will be made later. The minimum grade of ore at present saleable appears to be 63 per cent. Ta_2O_5.

Amongst the rarer minerals for which inquiry has been made, and which may ultimately be exportable at a profit, are beryllium ores (chiefly beryl) and lithium ores (chiefly lepidolite, spodumene, and amblygonite). Of these beryl and lepidolite appear to occur in the State in commercial quantities, as well as lithiophilite, another possible source of lithium.

Caesium has this year for the first time been in commercial demand, and a preliminary search has been made for it. The most promising source of it so far discovered is the lepidolite found in the tin-bearing pegmatite of the Tabba Tin Mine (N.W. Div.).

Inspections of Mineral Deposits.

In furtherance of my work as Government Mineralogist it is necessary that from time to time I should inspect typical mineral deposits in the field.

In the spring a month was spent on a tour of inspection of the various tin and tantalum deposits in the Pilbara Goldfields, including the world-famous Wodgina centre. A report covering my observations in this area will be found forming an appendix to this Report.

In January I visited the molybdenite deposit at Spencer's Brook. Although a little work was done during war time on this deposit, no ore was ever sold, nor does there seem any likelihood of it in the future.

In February I spent a few days in the Chittering-Mogumber area where kyanite, now in use as a super-refractory, is found in several places. The mineral is mostly in coarse crystals scattered through narrow bands of mica schist, some of which may ultimately pay to concentrate.

Important Mineral Records.

Several important mineral records were made during the year, some of which are dealt with in detail by Mr. Bowley in Section II. hereunder, and others in my appended report on the North-West tin and tantalum fields.

Helvite and Beryl, Mt. Francisco, N.W. Division.—Helvite, a very curious and rare sulpho-silicate of beryllium, manganese and iron, was collected (for the first time in Australia) by a prospector at Mt. Francisco, and subsequently identified by Mr Bowley. A detailed examination of the specimens is being made. As the mineral was in fair sized lumps it may be ultimately utilisable as a source of beryllium for aeroplane parts, for which the chief source at present is beryl. This latter mineral, not previously known at Mt. Francisco, was found by me to be present there in large quantities.

Ruby, Burbanks, Central Division.—This red transparent variety of corundum was detected in minute crystals in a fuchsite schist outcropping about two miles west of the townsite. So far no fragments large enough to be cut as a gem have been discovered. Associated with the ruby are brown andalusite, and blue kyanite.

Hydrothorite, Wodgina, N.W. Division.—This new mineral was found in a collection from the Tantalite Mine (M.L. 86) at Wodgina, and has been described in detail in a paper presented to the Royal Society of W.A. It is a hydrous silicate of thorium, carrying 58 per cent. of thoria, 3 per cent of uranium oxide, and 0.11 grains of radium per ton. If it should be discovered in commercial quantities it would be a valuable source of thorium for incandescent mantles.

Xenotime, Holleaton, S.W. Division.—In concentrating a biotite schist to determine if it were gold-bearing, a prospector recovered a heavy yellow concentrate which proved on examination in the Laboratory to be xenotime (phosphate of yttrium). A number of samples examined thereafter yielded from traces up to 1.85 per cent. of xenotime, the concentrate averaging 60 per cent. of rare earths with 0.2 to 1.0 per cent. of uranium oxide and 0.008 to 0.038 grains of radium per ton. It does not seem possible to produce commercially a saleable concentrate from this rock, but other richer uranium-radium ores may exist in the district.

Lithiophilite, Wodgina, N.W. Division.—This mineral is one of the ores of lithium, but so far does not seem to have ever been produced in commercial quantities. I discovered at Wodgina that it was somewhat abundant on two mining leases there, masses from a few pounds up to 10cwt. in weight being visible in the outcrops of pegmatite veins. The low price so far offered per unit for lithium ores prevents any attempt at export from such a remote locality. This mineral was first detected in Australia at Mt. Francisco, 25 miles from Wodgina.

Caesium-bearing Lepidolite, Tabba, N.W. Division. —A research into the distribution of caesium in the State, the details of which are being carried out by Mr. Chapman, has revealed the fact that quite appreciable quantities of this metal are present in a lepidolite collected by me from the lode of the Tabba Tin Mine. This is of importance as this year, for the first time, a commercial demand has arisen for caesium, which will apparently be very difficult to satisfy.

Pilolite, Wadara Hills, East Division.—A snow-white "mineral cork" found in digging a well on the east side of the No. 1 Rabbit-proof Fence, near the Wadara Hills, agrees with Doelter's alpha-pilolite. It has been described in detail to the Royal Society of Western Australia.

Daubreeite, Montague, Central Division.—The discovery of this oxychloride of bismuth in auriferous quartz is described by Mr. Bowley below.

Cassiterite and Tantalite, Cummins Range, Kimberley Division.—A mixture of these two minerals, in coarse fragments, has been found in alluvium in this locality. Two samples were submitted and each had about three parts of cassiterite to one of tantalite, the latter assaying 77 per cent. tantalic oxide and 6 per cent. niobic oxide. This is the first time that tantalite has been found in the Kimberley Division.

Council of Scientific and Industrial Research.

During the year I was reappointed a member of the W.A. State Committee of this body for a term of three years. A number of meetings have been held and good progress has been made in initiating research into problems affecting the industries of the State. So far these have been almost entirely confined to those relating to agriculture, but as time goes on doubtless the same assistance will be given to other industries. Already the Council's activities have thrown a large amount of analytical work on this Branch, and it appears that the staff will shortly need to be augmented to cope with it.

EDWARD S. SIMPSON, D.Sc., B.E., A.A.C.I.,
Government Mineralogist and Analyst.

SECTION. I—TOXICOLOGY, FOOD AND DRUGS SECTION.

By C. E. Stacy, A.A.C.I.

During the past year 832 samples in all have been received from the following sources:—

Health Department ...	180	State Hotels ...	9
Police Department ...	106	Government Stores ...	40
Liquor Inspection Branch ...	59	Crown Law Department ...	9
Agricultural Department ...	99	Lands Department ...	1
Department of Works and Labour ...	9	Kellerberrin Roads Board ...	1
Explosives Branch ...	170	Children's Hospital ...	2
State Saw Mills ...	12	Royal Society for the Prevention of Cruelty to Animals ...	1
Inspector of Factories ...	18	Chemical Branch ...	7
Geological Survey ...	1	Public Pay ...	51
State Mining Engineer ...	14	Public Free ...	27
Perth Public Hospital ...	8		
Wyndham Meatworks ...	3		
Water Supply Department ...	5		832

Samples were classified as follows:—

Foods ...	168	Wool ...	8
Drugs ...	28	Paints ...	8
Toxicological ...	113	Turpentine ...	6
Beers and Stouts ...	28	Fruit ...	29
Wines ...	14	Air ...	9
Hop Beer and Ginger Beer ...	11	Iron ...	2
Spirits ...	14	Dye ...	2
Cider ...	1	Explosives ...	169
Petroleum (natural) ...	25	Powder ...	2
Oils ...	51	Motor Spirit ...	5
Hydrometers ...	11	Dust ...	2
Thermometers ...	11	Limestones and Lime ...	9
Cattle Dips ...	38	Molasses ...	2
Disinfectants ...	2	Powellising ...	9
Tars ...	2	Miscellaneous ...	41
Tallow and Grease ...	10		
Coal ...	2		832

The number of samples is 230 in excess of those examined last year. The increase is accounted for by an increased number of foods, 169 as against 147, which is gratifying; a fresh record in the number of toxicological samples, which reached the large figure of 113 as against last year's record of 85; and 169 explosives as against 76.

Twelve samples of drugs were handed in by the Health Inspectors during the year, as against none for the previous year. Five of these failed to comply with the regulations.

Several prosecutions were made in respect to defective samples of milk.

As remarked above, the large number of 113 toxicological samples was received, many in an advanced stage of decomposition and causing great discomfort to the staff. The building of the proposed new hygienic second storey room was deferred by the Government through lack of funds. It is to be hoped that funds for this necessary piece of work will be provided for in the next financial year.

A table similar to that given last year is shown here, giving the number and kinds of food and drugs supplied and their comparison with those of the previous year:—

Material.	No. of samples.	No. complying with regulations *re*—		No. of samples.	No. complying with regulations *re*—	
		Labelling.	Composition.		Labelling.	Composition.
		1926.			1927.	
Milks ...	23	23	14	93	93	60
Condensed Milk ...	10	10	6	2	2	2
Smoked Fish ...	21	21	10	14	14	10
Non-excisable fermented drinks ...	8	8	1	10	10	1
Beers and Stouts ...	No	samples.	...	28	28	28
Drugs ...	No	samples.	...	12	11	7

Interstate Food and Drug Conference.

A conference of food and drug analysts, trade representatives and medical men was held in Melbourne during May by the arrangement of the Federal Health Council. Dr. E. S. Simpson was unable to attend and it was my privilege to act as his deputy. The conference sat for ten days and made an earnest and, I believe, successful attempt to achieve practical uniformity among the States with regard to food and drug regulations without interfering with what may be regarded as purely domestic legislation. The 1922 conference was taken as the basis of negotiations.

Among many other important alterations to the existing regulations which were suggested may be mentioned:—

1. A new clause disallowing the word "Imitation" unless specifically allowed by the regulations.

2. A new clause regarding "Trade name," disallowing in regard to a mixture the representation by the name of any single constituent only, or misrepresentation of composition, or false indication of origin, character, or place of manufacture.

3. A new clause to disallow the word "Pure" unless covered by the regulations and containing no foreign substance.

4. A regulation to restrict preservative substances to sulphur dioxide and benzoic acid or benzoates in all foods with the exception of butter, in which the amount of boron compounds permitted was reduced from 5/10ths to 3/10ths of 1 per cent. for export and interstate trade till 1st of July, 1928, when such preservative is disallowed except for Australian use. Glycerine is not to be included as a preservative, but placed in the same category as salt, saltpetre, sugars, acetic acid, alcohol, herbs or spices, essential oils and hop extract.

5. In margarine colouring matter and preservatives are to be prohibited, but an admixture of butter not exceeding 10 per cent. to be allowed.

6. The list of "permitted" colours, this word being used in lieu of "harmless," was lengthened, but "Bismark brown" was deleted as being dangerous. It was decided that the Rowe number given in the Society of Dyers and Colourists' Colour Index must be disclosed. In the case of more than one colouring all must be disclosed.

7. Flour must not be bleached for local sale, and a general resolution to discourage the practice all over Australia simultaneously was carried.

8. Infants' Foods.—A very long discussion took place in regard to this subject, which was eventually handed to a sub-committee whose recommendations were accepted, the main addition being that the food when prepared as directed should render at least 400 calories per day for every child up to one month old.

9. It was decided that the standard for olive oil at present in force would not exclude other oils carefully sophisticated, and the regulation was broadened by the words "It shall not contain any other oil."

10. I am glad to say that the conference adopted a Reichert Meissl and a Polenske figure for butter, which I have so long advocated.

11. The word "approved" vehicle, instead of "harmless," was used for essences, and "imitation" substituted for "terpeneless" essences of lemon.

12. The regulation for tonic wines was deleted and a medicated wine regulation introduced, which should prevent the sale of fraudulent articles.

13. A resolution was carried introducing a regulation with regard to the bottling of all imported spirits in bond. I pointed out at the time that this would not prevent the practice of refilling with bulk spirit and that only legislation similar to that carried out under the W.A. Licensing Act would be effective.

14. Two important regulations were agreed to by the conference regarding proprietary medicines. The first was that the principal ingredients for which therapeutical properties were claimed should be disclosed on the label, and if for internal use the quantity per dose stated. The second was that the vendor of these articles should be prevented from advertising in any paper, other than a medical journal or *bona fide* trade journal or price-list, that the medicine in question is a cure or remedy for diseases such as cancer, tuberculosis, Bright's disease, etc., as enumerated. It does not prevent, however, such vendor advertising it as a relief for these diseases.

This is an object for which the Pure Foods Advisory Committee in Western Australia has been working for years, and I think it is a matter for congratulation that a clause which has worked successfully in Queensland since 1920 has been unanimously adopted by the 1927 conference.

15. It was resolved that all preparations made from nuts in which the word "butter" occurred should be called "pastes" such as "Peanut paste" in lieu of "Peanut butter."

An attempt to broaden the definition of the word "wine" was negatived. It was, however, pointed out that all States except Western Australia allowed wine cocktails and Vermouth to be retailed under an Australian wine license. This seems rather unfair to holders of these licenses in this State.

I am sorry I was unable to persuade the conference to fix a standard for "soundness," *i.e.*, volatile acidity, in wines. Some of the samples submitted of recent years have been nothing short of disgraceful in this respect. An investigation of Western Australian wines in regard to this and other standards is still in progress, carried over from last year.

Fruit Juices.

An inquiry into the acidity of natural lemon-juice is being carried out, as there seems to be a possibility that our present standard may be too high.

Milks.

It is a debatable point whether our present standard for fat, *i.e.*, 3.2 per cent., is sufficiently high. The standard for fat in normal milk throughout the Commonwealth is 3.5. Most of the cases of watered milk for which prosecutions are instituted in this State, whilst showing a deficiency in solids not fat, have a fat content above 3.2 per cent. I think it would be a good move on the part of our Advisory Committee to move for a standard for milk fat of 3.5, equal to our standard for normal milk.

Human Milks.

Twenty-five samples of human milk were received and analysed during the year. When these come from Infant Welfare clinics or from more or less indigent people they are analysed free of charge. This entails a considerable amount of work, as a complete analysis has to be made. Such a function of this Laboratory, however, constitutes a valuable aid to the health of the community.

Spirits.

The number of spirits analysed is low this year, viz., 14. This is accounted for by the fact that standards for the year have not been made, and that the inspection by the officers of the Chief Inspector of licensed premises is keen. I hope, however, that another year will not be allowed to run without new standards being prepared.

Toxicology.

The poison most used was again lysol, hydrocyanic acid in some form or other coming second. The curious psychological fact that the use of poisons runs in cycles was again demonstrated, lysol being used in the earlier months of the year, whilst most of the later cases were strychnine. An interesting case during the year was poisoning by carbon monoxide, this substance being found by spectroscopic and other tests in the blood from the liver and kidneys and also in a sample of *post mortem* blood.

Whilst on this subject it is of interest to note that a resolution of the conference under the auspices of the Federal Health Council, referred to previously, was carried to the effect that the administration of the Poisons Act should be carried out by the Departments of Public Health.

C. E. STACY, A.A.C.I.,
Assistant Government Analyst and Toxicologist.

SECTION II.—MINERALOGY, MINERAL TECHNOLOGY AND GEOCHEMISTRY.

By H. Bowley, A.A.C.I.

The work of the section during the year has been carried out along usual lines, 1,867 samples having been received, showing a decrease of 106 on those examined during the previous year, the gold ores numbering 1,240 against 1,435 for the preceding period. This would show an increase of 89 samples for other examinations.

The following list shows the source of the samples dealt with:—

Department of Mines:—	
Minister for Mines	7
Mines	42
Central Mining Board	13
State Mining Engineer	288
State Batteries	596
Geological Survey	213
Departmental	61
State Implement Works	1
State Brick Works	2
Museum	2
Department of Works and Labour	2
Customs	1
Public Pay	47
Prospectors	592
	1,867

Classified as:—

Abrasives	5	Lithium Ore	6
Aluminium ore ...	8	Manganese ore ...	46
Alunite	14	Metallurgical product	4
Asbestos	3	Mica	18
Barytes	4	Molybdenite	2
Beryllium ore ...	8	Miscellaneous minerals	80
Bismuth ore	6	Phosphate rock ...	5
Chromium ore ...	2	Pigment	2
Clay	14	Platinum ore ...	2
Coal	12	Rare earth ore ...	22
Cobalt ore	5	Rocks	28
Copper ore	12	Salt	2
Felspar	14	Silver ore	31
Garnet...	7	Sulphur ore	3
Glass Sand	4	Tantalum ore ...	27
Gold ore	1,240	Tin ore	43
Graphite	7	Titanium ore ...	18
Gypsum	9	Tungsten ore ...	5
Iron ore	65	Vanadium ore ...	6
Lead ore	39	Zinc ore	3
Limestone	11	Unclassified	25
			1,867

Staff.

The section was without the services of a chemist for two months, owing to the resignation of Mr. W. W. Saw, B.Sc., A.A.C.I., who left the service to join the staff of the Vacuum Oil Co. as a technical officer.

Mr. Saw proved himself to be a very zealous and efficient officer during his association with the section for $5\frac{1}{2}$ years and his loss has been severely felt, he having devoted a large amount of time and thought during the past two years to the chemistry of tantalum and niobium, the determination of which is of a difficult and intricate nature calling for considerable skill, experience and ability. It is to be regretted that it was found impossible to retain his services as the information gained by him in this and other specialised work has, to a large extent, been lost to the department.

Mr. C. R. Le Mesurier, A.W.A.S.M., A.A.C.I., was appointed on 17th October to fill the vacancy created by Mr. Saw's resignation.

During the year Mr. F. E. Chapman, of the Food and Drug Section, who has specialised in spectroscopy, was loaned to the section to work in collaboration with Mr. D. G. Murray on the detection and determination of caesium, rubidium, and thallium in a number of local minerals with gratifying results. It is hoped to continue this research as opportunity offers.

Messrs. Kildahl and Armstrong visited Wiluna with the State Mining Engineer to facilitate the assaying of the samples taken in connection with the report on the request of the Wiluna Gold Mines, Limited, for railway connection with Wiluna.

Although the staff of the section now consists of six professional officers and one Laboratory assistant, little opportunity was afforded for other than routine work, with the result that a considerable amount of necessary investigational work has had to remain in abeyance, a condition of affairs very much to be regretted when, owing to the decline of the mining industry, a more energetic research into the properties and utilisation of this State's large potential resources is called for.

Exhibitions.

Two very interesting exhibits were prepared by the staff of the section for display at the Chemical Society's Annual Conversazione, both of which were illustrative of the economic importance of local minerals.

One demonstrating the possibility of making glass from local raw materials indicated that, with the exception of suitable boron minerals, there occur within a reasonable distance of the metropolis all the materials used in the manufacture of various types of glasses. The exhibit, which was of a comprehensive nature, included various grades of glass sands, materials used in the manufacture of fluxes and intermediates, also glasses produced from a number of metropolitan sands, the latter ranging from melts, made from the high grade Lake Gnangara sand, showing high brilliancy and lustre, to a colourless glass prepared from the well known yellow sand of Perth, demonstrating the practicability of producing a colourless glass from that material without the use of decolorisers.

The other exhibit dealt with the mineralogy of quartz and beryl, showing the various types of each mineral and their great similarity in physical properties and the close resemblance in microscopic appearance.

Clays.

Fourteen samples of clay were examined along the usual lines during the year, two of which were useful types for the manufacturing of fine pottery, whilst several others were suitable for use in the manufacture of sanitary ware.

In connection with the investigations of the physical properties of clays the experiments have been somewhat limited in regard to refractory clays owing to the need for a suitable furnace for temperatures over 1,350° Centigrade, the maximum temperature obtainable with the furnace at our disposal. Knowing that highly refractory clays do occur in the State and that there is a considerable demand for highclass refractory bricks, etc., also the fact that it is left almost solely to this branch to examine local raw materials to determine their suitability for ceramic purposes, it is essential that the necessary apparatus be obtained in order that a valuation be placed on the various types suitable for high temperature work.

A fine-grained micaceous clay from Kanowna, almost devoid of plasticity, which may be used as a flux in white or light coloured ware of various kinds, and a coarse refractory clay, containing 49.55 per cent. of grit consisting of quartz, microcline felspar and sericite mica, from Harvey, suitable for use as a substitute for "Cornish Stone," are of special interest.

The following figures were obtained on examination:—

Locality	Kanowna	Harvey
Lab. No.	2,609	1,453
Mechanical Analysis :	%	%
Clay substance	88·25	49·55
Grit under 90-mesh	11·61	14·86
Grit under 60-mesh ...	·07	3·95
Grit under 30-mesh	·07	12·26
Grit over 30-mesh	Trace	19·38
	100·00	100·00
Sodium Chloride	0·54	Nil
Plasticity, Ashley figure ...	4	56
	%	%
Air shrinkage from wet plastic...	1·9	5·7
Burning Test :—	Kanowna	Harvey
Linear shrinkage from air dry :—	%	%
1050° C.	·18	·18
1150° C.	5·57	·83
1250° C.	16·49	2·67
1350° C.	16·17	2·69
Porosity (water absorbed)—		
1050° C.	Disintegrates in water	20·73
1150° C.	21·06	20·93
1250° C.	·76	16·11
1350° C.	Nil	14·70
Colour—		
1050° C. ...	Pure white	Good white
1150° C. ...	Good white	Creamy white
1250° C. ...	Greyish white	Greyish white
1350° C. ...	Creamy white	Greyish white
Incipient vitrification	1200° C.	1250° C.

Tantalum.

The success attained recently in the development of a market for tantalum articles, and the fact that the Western Australian ore is much preferred, have stimulated the production of tantalum ores in the Pilbara district. These facts, coupled with Dr. Simpson's inspection of the north-west tantalum fields, have called for an increase of assays for that metal, 27 samples having been dealt with during the year from this district.

Tantalite was recorded from three new localities during the year. Two samples of tin-bearing ore submitted by some prospectors from the northern end of Cummins Range, in the Kimberley district, contained 74.2 per cent. and 72.4 per cent. of cassiterite associated with 25.8 per cent. and 20.36 per cent. of tantalite respectively; the tantalite contained 77.32 per cent. of tantalic oxide and 5.74 per cent. of niobic oxide.

A pegmatite from 12 miles S.S.E. of Norseman, consisting of quartz, albite, microcline and biotite, associated with a little garnet, contained a small amount of tantalite; another pegmatite consisting of quartz, lepidolite, muscovite and albite from Logan's Find, on concentrating yielded a little tantalite. Both these localities should be further prospected to determine if there are payable quantities of tantalite present in the pegmatites of the district.

Xenotime.

An examination of a biotite quartz rock from Holleaton revealed the presence of slightly under one per cent of a heavy yellow mineral occurring as microscopic octahedra which proved to be the radio-active mineral xenotime, a phosphate of yttrium metals carrying uranium and minute quantities of radium, associated with some zircon. Several samples submitted subsequently from the same locality were examined, two only carrying over one per cent. of fine concentrate with a specific gravity over 3.16, viz., 1.85 per cent. and 1.45 per cent.

One series of samples averaging 1.007 per cent. of concentrates gave the following figures:—

Analysis of pure concentrate :—

	per cent.
Rare earths, mainly yttrium earths, Y_2O_3, etc.	58·47
Uranium oxide, UO_3	0·20
	grs. per ton
Radium	0·0076
equal to—	
On average original ore :—	per cent.
Rare earths, mainly yttrium earths, Y_2O_3, etc.	0·585
Uranium, UO_3	0·002
Radium	0·000076 grs. per ton

Whilst another series gave—

	Fine concentrate. (a)	(b)	On original ore. (a)	(b)
Rare earths, mainly yttrium earths, per cent. ...	61·14	60·14	0·523	0·374
Uranium, UO_3, per cent. ...	0·99	0·91	0·008	0·006
Radium, grains per ton ...	0·038	0·035	0·00032	0·00022

Alunite.

A sample of white rock, from 25 chains south of the Reward Lake at Campion, contained 54.4 per cent. of alunite. This sample is of special interest as it is the first rock material containing alunite received from this locality and may possibly have some direct bearing on the occurrence of alunite in the lakes to the north.

Manganese Ores.

A number of manganese ores from various localities were examined with the results shown hereunder:—

Polianite.—Sixteen miles south-east of Mt. Palgrave. This ore consisted of an intimate mixture of polianite and psilomelane, with a little quartz and limonite. A partial analysis gave—

MnO_2, 89·74% ; MnO, 3·16% ; Fe_2O_3, 1·68% ; SiO_2, 2·25%. Metallic manganese, 59·16%.

Romanèchite.—Christmas Creek. This mineral occurs in a ferruginous manganese ore, from the above locality, consisting of a mixture of psilomelane, romanèchite and limonite, with a little kaolin.

Other manganese ores examined gave the following results on examination:—

			%	%	%
Psilomelane,	Christmas Creek,	Mn.	57·51	41·84	
„	Hamersley River	„	29·67		
„	Hamersley Estuary	„	53·54		
„	Between Gascoyne and No. 31 Rivers	„	46·68	25·55	31·01
„	830-Mile Post, Rabbit-Proof Fence	„	25·27		
„	Gutha	„	23·40	15·62	16·50
			39·88	32·25	30·55

A series of samples from Coppermine Creek, near the Fitzgerald River, assayed—

No.	3	4	5	6	284	285	286	287	288	289
	%	%	%	%	%	%	%	%	%	%
MnO_2	61·24	72·04	74·42	79·44	80·96	46·15	67·78	34·46	62·68	67·71
MnO	3·95	·35	3·64	4·09	4·61	3·10	5·90	3·20	5·27	4·83
Fe_2O_3	11·96	4·34	·46	·29	2·17	8·56	3·26	14·71	5·91	6·48
SiO_2	5·92	11·45	9·91	9·66	6·09	17·59	13·41	24·98	11·97	7·55
Equal to—										
Mn	41·76	45·80	49·85	53·37	54·71	31·56	47·40	24·26	43·69	46·53
Fe	8·37	3·04	·32	·20	1·52	6·20	2·35	10·30	4·14	4·53

Miscellaneous Mineral Notes.

Felspar.—A bulk sample of microcline felspar, with intergrowths of albite and a little muscovite mica and kaolin, from Mullalyup, suited for the manufacture of porcelains, glazes and enamels, gave on analysis the following figures:—

K_2O, 12·44% ; Na_2O, 2·48% ; Fe_2O_3, 0·74%.
Equal to—
Microcline, 73·40% ; Albite, 20·97%.

Daubréeite (bismuth oxychloride).—An auriferous quartz ore from Montague, consisting mainly of quartz with some limonite, contained a small amount of heavy creamy-white granules of daubréreite; this is the first recorded occurrence of this mineral in the State.

Tetradymite (bismuth telluride).—Specimens of a rich gold ore, containing an appreciable amount of a lead grey mineral occuring as soft, flexible laminae up to 3/16ths inch in diameter, which proved to be tetradymite, were received from Rothsay.

Native Bismuth and Pucherite (bismuth vanadate).—Samples of ore from the Valda May Mine, Holleaton, consisting in one case mainly of quartz and in the other of quartz and felspar, contained both native bismuth and pucherite.

Chromite (iron chromite).—A vanning test of a weathered serpentine from nine miles south-east of Bullfinch gave 0.37 per cent. of a heavy black concentrate, which proved to be chromite.

Cobaltite (cobalt sulpharsenide).—A greenstone schist from Hamersley River, consisting of chlorite, biotite, cobaltite, pyrite, quartz and graphite, assayed—

Co, 10·07% ; Ni, 0·90% ; As, 14·98% ; S, 8·19%.

Hemimorphite and Descloizite. Braeside.—A zinc lead ore, from seven miles east of Braeside Homestead, was found to consist of hemimorphite, descloizite, anglesite, vanadinite, quartz, pyromorphite and psilomelane.

A partial analysis gave—

Lead, 26·20% ; Zinc, 20·75% ; Vanadic oxide, 9·20% ; Gold, Nil ; Silver, 3 dwts. 2 grs. per ton.

Vanadinite.—A concentrate obtained by dollying quartz gold ore from P.A. 1547, Holleaton, proved to consist of vanadinite associated with cerussite, scheelite, gold and zircon.

Spessartite, Hamersley River and Coppermine Creek.—A sample of manganese ore from Hamersley River contained an appreciable quantity of small crystals of spessartite associated with psilomelane, limonite and quartz. Spessartite has also been recognised in a sample from Coppermine Creek consisting of psilomelane, magnetite, pyrolusite, quartz and spessartite.

Galena (Argentiferous).—A number of samples of galena carrying appreciable quantities of silver were dealt with from various localities during the year. The following are the most important:—

	Lead. %	Silver per ton. oz.	dwt.	gr.
Panton	45·62	72	14	11
Chamberlain River district ...	32·36	47	11	15
West of Warrawagine ...	80·77	11	10	18
Lyndon Station	72·69	51	8	9
12 miles East of Yalgoo ...	25·12	31	17	21

A complex ore from Grosmont, consisting of quartz and common opal with galena, sphalerite, anglesite, cerussite, malachite, azurite, chalcopyrite and smithsonite, assayed:—

Pb 23·75%; Zn 5·17%; Cu 1·51%; Au 2dwt. 7grs. per ton. Ag. 20oz. 17dwt. per ton.
Another sample from the same locality contained:—
Pb 13·50%; Zn 3·01%; Cu 0·81%; Au 8dwt. 12gr. per ton. Ag 14oz. per ton.

Rutile (titanium dioxide).—A specimen of black mineral from Manjimup district, which the prospector declares occurs in considerable quantities, proved to be rutile with a little ilmenite, assaying 84.15 per cent. of titanium dioxide.

Helvite (silicate and sulphide of beryllium, iron and manganese).—This interesting beryllium mineral, not previously recorded in Australia, has been received from the old Congo Lease, Mt. Francisco. The mineral is in large angular masses up to two inches in diameter and is coated with hydrated oxides of iron and manganese. It has a specific gravity of 3.314 and is fairly brittle, breaking with an uneven fracture showing in places a distinct octahedral cleavage. The freshly-broken mineral is brown in colour with a resinous lustre, is isotropic, and is decomposed with hydrochloric acid with the evolution of sulphuretted hydrogen. A detailed examination of the mineral is in hand.

H. BOWLEY, A.A.C.I.

SECTION III.—AGRICULTURE, WATER AND SEWERAGE.

(BY A. J. HOARE, A.A.C.I.)

The volume of work in this section is increasing; 1,276 samples were entered for examination during the year, being an increase of 468, or 58 per cent., on the previous year's figures. It was not possible to finish all of the work by the end of the year as one of the staff was away on long service leave.

The following list shows the sources of the samples dealt with:—

Agricultural Department	344
Metropolitan Water Supply and Sewerage...	481
Department of Works and Labour	29
Lands Department	2
Health Department	12
Mines Department	1
Geological Survey	1
Forestry Department	7
Group Settlement Board	2
Wyndham Meatworks	2
Co-operative Wheat Pool	196
Royal Agricultural Society	24
Training College, Claremont	1
Commonwealth Meteorological Bureau ...	17
Chemical Branch	25
Public Pay	113
Public Free	19
	1,276

Classified as:—

Soils	53
Fertilisers	67
Wheats	260
Flours	7
Brans and pollards	155
Fodders	15
Fungicides and insecticides	26
Limes and limestones	19
Gypsum	7
Waters	599
Sewage	63
Miscellaneous	5
	1,276

Soils.

The number of samples received this year shows a decrease of 66 over last year. With the exception of 24 samples taken from the North Bencubbin-Lake Brown district, some of which showed a high percentage of salt, there is nothing of interest to report.

Fertilisers.

There was a decrease of 47 samples received this year. Normally the number of fertiliser samples taken will increase each year, as the cultivation of the land increases more and more. Of the samples received, only two came below the guaranteed analysis.

Fungicides and Insecticides.

Amongst the samples received, 10 were in the powder form for dusting trees and vines by means of a dusting gun or bellows. These were manufactured in the Eastern States, and before they could be placed on the market in this State chemical analyses were necessary for registration purposes. The figures found did not agree with the figures printed on the packets and so far the products have not been registered in this State. The balance of the samples were so-called basic copper carbonates, used in the dry pickling of wheat.

Fodders.

Several interesting samples were received during the year one being Kangaroo paw (*Anigozauthus*) rhizomes to ascertain their feeding value for stock. The figures found are as follow:—

Anigozanthus Rhizomes.

Lab. No. 21.	Air dry sample. %	Original sample. %
Moisture	8·05	71·25
Ash	10·10	3·16
Crude protein (albumenoids) ...	7·17	2·24
Crude fibre...	24·86	7·77
Non-nitrogenous extract (carbohydrates, etc.)	48·72	15·24
Sulphuric ether extract	1·10	·34
Unit food value (Guthrie's basis)	59·41	18·57

(Analyst: R. G. Lapsley).

These rhizomes have evidently a low fodder value most nearly comparable to that of some green grasses.

Two products from cotton seed were received, one a cotton seed meal, plus molasses, put up in lumps about the size of a walnut and sold as cotton seed nuts, the other sample being the ordinary cotton seed meal.

The following table shows the analyses of these samples:—

Cotton Seed Fodders.

Lab. Nos.	1374 C.S. nuts. %	1375 C.S. meal. %
Moisture	10·38	9·69
Ash	6·19	5·39
Crude protein (albumenoids) ...	32·94	33·56
Crude fibre...	13·91	15·80
*Non-nitrogenous extract (carbohydrates, etc.)	30·88	29·47
Sulphuric ether extract	5·70	6·09
*Total reducing sugars (reported as invert sugar)	·92	...
Sucrose	6·57	...
Unit food value (Guthrie's basis)	76·65	76·73

* Included in nitrogen free extract figure.

(Analyst: J. Pericles.)

Although the feeding value of these meals is high, it is to be remembered that, according to text books, cotton seed meal contains a toxic substance which renders it unsafe to give to pigs or to young or pregnant animals.

Gypsums, Limes and Limestones.

With the exception of the poor quality of the ground lime supplied for the lime treatment of the metropolitan water supplies, there is nothing of any importance to report under this heading.

Waters.

There is a further increase of 177 samples over the previous year, a fair number of these being for stock and irrigation purposes. In some cases these are too saline and unfit for stock or irrigation, the extreme limits for cyclic salts being taken in the Department as 450 grains per gallon for horses, 700 grains for cattle, and 900 grains for sheep. For irrigation, 150 grains per gallon of dissolved salts has usually been looked upon as the extreme limit, except in a climate where the rainfall is very high and the ground exceptionally well drained.

Work is still being carried out for the Advisory Committee on metropolitan water supplies, such as hygienic and complete mineral analyses, the hydrogen ion concentration by the calorimetric method of the waters from reservoirs, pipe-head dams and service mains. The hygienic analyses are made every quarter and about every month complete chemical analysis of one of the supplies is made. An extra chemist to take over this work would prove of great assistance to this section.

In connection with complaints received by the Metropolitan Water Supply Department as to the colour and turbidity of the water coming from the service taps, dissolved oxygen and free carbon dioxide tests were made frequently of water from the service mains and pipe-head dams. The dissolved oxygen from the service mains ranged from nil to about 9.5 parts per million, and the free carbon dioxide from 2 to 16 parts per million. No relationship could be found between the colour and turbidity which ranged from clear to very cloudy and the dissolved oxygen or carbon dioxide tests.

Lab. Nos.	3513. Greenmount Reservoir.	3514. Lower Bickley Reservoir.	3515. Wungong pipe-head dam.	3516. Canning pipe-head dam.	3517. Tap, W. S. yards Kelmscott.	3518. Tap, Kenwick Station.
			Parts per million.			
Dissolved oxygen	6·67	10·10	9·40	8·58	8·95	8·05
Free carbon dioxide	11·00	23·00	9·00	7·00	6·00	7·00
Reaction (pH)	7·2	7·1	6·9	6·9	7·1	6·9

(Analysts, B. L. Southern and F. F. Allsop).

The water from the Mundaring reservoir, Kalgoorlie reticulation, and country town supplies are frequently analysed for the Department of Works and Labour.

The Commonwealth rain-water survey for salinity was discontinued early this year; this survey was carried on for about two years.

Several private samples were received. These were taken from wells, artesian bores and gold mines; but there was nothing of outstanding interest in any of them to warrant any special comments.

Sewage.

Of the 63 sewage samples received this year, 12 are from private installations. These effluents did not show any great degree of purity. The balance were taken from the Perth, Fremantle, and Subiaco treatment works at intervals of three months.

Cereals.

Flour.—Only seven samples of flour were received for testing as to strength, etc.

Bran and Pollard.—A tentative regulation fixing a standard for the moisture, fibre, and ash content was gazetted on the 1st January, 1927, the standards being:—

	Moisture. %	Fibre. %	Ash. %
Bran, not more than ...	10·5	8·5	3·5
Pollard, not more than ...	11·0	4·5	2·0

Some interesting figures were obtained from the analyses of 24 brans and pollards, by-products from the experimental mill at the Government Laboratory, on the Royal Agricultural Show Wheats, 1927. These were from 10 varieties of wheat; the average figures have been taken and are as follows:—

	Moisture. %	Fibre.* %	Ash.* %
Bran—			
Minimum	9·20	5·01	3·18
Maximum	11·46	9·45	5·36
Average	10·26	7·55	4·00
Standard †	10·50	8·50	3·50
Pollard—			
Minimum	8·95	2·30	1·55
Maximum	10·55	5·03	2·59
Average	9·71	3·76	2·09
Standard †	11·00	4·50	2·00

* Calculated to standard moisture basis.

† Maximum permitted under regulation.

These figures are all very close to the standards fixed.

Of the commercial samples of mill offal received, some were up to the standard, but others were above, and contained screenings, etc. The following table gives the average figures for 47 bran samples and 48 pollard samples taken during the year by the Agricultural Department inspectors from the mills and stores:—

	Moisture. %	Fibre.* %	Ash.* %
Bran—			
Minimum	7·88	6·89	2·99
Maximum	11·76	10·27	4·97
Average	9·67	9·07	4·22
Standard †	10·50	8·50	3·50
Pollard—			
Minimum	8·15	2·51	1·72
Maximum	12·45	7·14	6·74
Average	9·51	4·93	2·59
Standard †	11·00	4·50	2·00

* Calculated to standard moisture basis.
† Maximum permitted under regulation.

It will be seen that the averages for the commercial samples are about 0.5 per cent. above the standard in regard to fibre and ash. A sample of bran, of whose quality complaint was made, gave the following figures:—

	Moisture.	Fibre.*	Ash.*
Lab. No. ...	%	%	%
1750	12·04	14·08	4·62
Standard	10·50	8·50	3·50

* Calculated to standard moisture basis.

This was an extremely bad sample, the bulk consisting of matters foreign to bran, the main foreign bodies being wheat dust, wheat scourings, chopped pales, backbone and broken grain.

Wheat.—An investigation is being carried on as to the increase or decrease of moisture in wheat during transit to Great Britain. About 200 samples were received up to the end of 1927. The percentage of moisture in the wheat before loading ranged from 8.0 to 13.0 Definite figures from the unloading port are not yet to hand. This work is being continued this year on the new season's wheat, and it is hoped that some definite information will be gained by the end of the year.

The Agricultural Department submitted 13 samples from the Merredin Experimental Farm stud plots, which were for general milling test.

Royal Agricultural Society Show Exhibits.—The entries totalled 24, eight less than last year. As in previous years a preliminary examination took place first on the general appearance and bushel weight. None was rejected and they were all milled in the experimental mill attached to this section. The prizes were awarded according to points given for the milling characteristics, percentage absorption of water, protein, colour, and calculated pounds of bread that would be produced from one ton of the wheat.

The champion prize this year was awarded to a sample of Comeback, a very fine specimen of the variety from Kellerberrin, which was closely followed by a Comeback sample from Three Springs.

The milling investigations were carried out by Mr. R. G. Lapsley, B.Sc. (Agr.), A.A.C.I., who also acted as judge in conjunction with Mr. G. L. Sutton, Director of Agriculture, and Mr. E. W. Wilson, miller to the Peerless Roller Flour Milling Co.

A list of the prize-winners and tabulated results are appended.

A. J. HOARE, A.A.C.I.,
Supervising Chemist,
Agriculture, Water Supply and Sewerage.

WHEATS FOR MILLING FOR THE ROYAL AGRICULTURAL SHOW, 1927.

Lab. No.	Zone.	Class.	Variety.	No.	Grain. Moisture.	Grain. Protein.	Grain. Bushel weight.	Products. Flour.	Products. Bran.	Products. Pollard.	Products. Yield marks.	Flour Analysis. Moisture.	Flour Analysis. Protein.	Flour Analysis. Protein marks.	Flour Analysis. Strength % absorption.	Flour Analysis. Marks.	Flour Analysis. Colour marks.	Total marks.	Pounds of bread per ton of wheat.	Prizes.
					%	%		%	%	%		%	%							
1915		1	Comeback ...	8	12·0	12·8	66	73·0	19·1	7·9	35·5	12·0	11·5	4·25	62·5	37·5	5·0	82·25	2,362	Champion.
1908		2	Nabawa ...	1	12·7	9·9	63½	69·3	21·4	9·3	26·25	11·7	10·0	3·75	52·0	27·0	4·5	61·5	2,097	
1912			do. ...	5	11·7	9·9	63	68·8	22·0	9·2	25·0	11·8	9·0	3·5	50·5	25·5	5·0	59·5	2,063	
1913			do. ...	6	13·5	9·4	63½	70·2	20·9	8·9	28·5	11·6	8·6	3·5	51·0	26·0	4·0	62·0	2,111	2nd Prize
1928			do. ...	21	13·7	10·0	61⅝	70·1	20·7	9·2	28·25	11·4	8·2	3·25	51·75	26·5	4·25	62·25	2,115	1st Prize
1909		3	Gluyas ...	2	13·1	11·0	63⅛	70·0	20·8	9·2	28·0	11·1	10·3	3·7	49·3	24·25	4·5	60·5	2,081	2nd.
1910	1		do. ...	3	12·8	11·6	61¾	69·6	21·3	9·1	27·0	11·6	11·0	4·0	49·5	24·5	4·5	60·0	2,072	
1917			do. ...	10	12·2	9·7	63¾	70·0	21·0	9·0	28·0	11·6	9·0	3·5	50·5	25·5	4·5	61·5	2,098	1st.
1911		4	Merredin ...	4	11·3	9·9	64½	70·6	21·1	8·3	29·5	11·1	9·1	3·5	52·0	27·0	5·0	65·0	2,136	1st.
1914			do. ...	7	13·4	9·4	66	68·4	22·6	9·0	24·0	11·8	8·5	3·25	52·2	27·25	5·0	59·5	2,073	Mixed with another variety.
1927			do. ...	20	13·9	10·8	63⅝	71·0	20·1	8·9	30·5									
												11·1	9·9	3·75	50·5	25·5	4·5	64·25	2,127	2nd.
1915		5	Comeback ...	8	12·0	12·8	66	73·0	19·1	7·9	35·5									
1916			Carrabin ...	9	12·5	10·5	66	71·1	19·9	9·0	30·75	12·0	11·5	4·25	62·5	37·5	5·0	82·25	2,362	1st and Champion.
1926			Onas ...	19	11·8	9·2	62½	70·5	20·5	9·0	29·25	12·0	10·0	3·75	61·0	36·0	4·5	75·0	2,279	2nd.
												12·0	8·5	3·5	51·5	26·5	4·5	63·75	2,127	
1919		6	Nabawa ...	12	12·9	10·8	63⅝	71·9	19·6	8·5	32·75									
1923			do. ...	16	12·8	7·7	64½	70·7	20·7	8·6	29·75	11·9	9·1	3·5	52·4	27·5	4·5	68·25	2,182	2nd.
1925			do. ...	18	13·5	8·1	62¾	70·9	20·5	8·6	30·25	11·4	6·6	3·0	50·8	25·5	4·5	62·75	2,123	
1929			do. ...	22	13·2	12·0	62½	72·4	19·9	7·7	34·0	11·1	7·2	3·0	52·8	28·0	4·5	65·75	2,157	
1924			do. ...	17	12·0	8·9	63¾	70·4	20·5	9·1	29·0	10·9	11·1	4·0	53·4	28·5	4·5	71·0	2,212	1st.
												11·4	8·2	3·25	52·9	28·0	4·0	64·25	2,143	
1920	2	7	Gresley ...	13	12·9	9·4	65½	70·0	21·6	8·4	28·0									
												11·3	8·5	3·5	50·2	25·25	4·5	61·25	2,093	1st.
...		8	Gluyas ...		No	entry.														
1918		9	Florence ...	11	11·1	10·6	66¾	71·4	19·9	8·7	31·5	11·7	10·0	3·75	60·75	35·75	4·0	75·0	2,284	
1921			Firbank ...	14	13·4	9·2	65¾	70·0	21·1	8·9	28·0	11·4	8·5	3·5	52·4	27·5	5·0	64·0	2,125	
1922			Comeback ...	15	11·3	11·2	65½	71·7	19·7	8·6	32·25	11·6	10·6	4·0	61·3	36·25	4·5	77·0	2,302	2nd.
1930			do. ...	23	12·1	11·7	65½	73·0	18·9	8·1	35·5	11·3	10·6	4·0	60·0	35·0	4·5	79·0	2,326	1st.
1931			Carrabin ...	24	12·7	10·6	65	71·8	19·3	8·9	32·5	10·8	9·9	3·75	60·1	35·25	5·0	76·5	2,289	
...	3	...	Classes	10, 11	and 12	— No	entries.													

Figures for protein, absorption and bread yield are on standard moisture basis.

Government Chemical Laboratory, Wellington Street, Perth,
30th September, 1927.

Judges—GEO. L. SUTTON,
R. G. LAPSLEY.
E. M. WILSON.

APPENDIX TO ANNUAL REPORT OF THE CHEMICAL BRANCH.

Report on the Pilbara Tin and Tantalum Deposits.

(By EDWARD S. SIMPSON.)

During August a visit of inspection was paid to most of the tin- and tantalum-bearing districts in the Pilbara Goldfield with the object of collecting information as to what minerals were being mined at the present time. what was the quality and composition of the concentrates produced, and finally what other minerals of growing or potential value had been neglected or overlooked.

The general impression gained was that owing to the ruling high price of tin and growing demand for tantalum, great interest was being taken in the search for new deposits of those metals, and in re-examining those previously known. Whilst, however, a large number of mining leases and claims were being pegged, with three exceptions, viz., at Mud Springs, Tabba and Wodgina, there were no active mining operations going on yet. On all the older fields a few aborigines and elderly white men (often pensioners) have for many years been eking out a living by fossicking, and their position, when the tin-bearing areas are leased to new peggers, will have to be considered.

The following are brief notes on the various centres visited:—

Moolyella.

At Mud Springs, south of the earlier worked tin areas, Messrs. Ellis and Maher had a number of men at work raising alluvium, which was being put through a crusher and concentrator. This area had previously been pot-holed, but only a small proportion of the whole wash had been worked. There were approximately three feet of wash, consisting of a mixture of ferruginous clay and gravelly quartz and felspar (microcline) This lay beneath an overburden varying from three to six feet, which was being removed by tractor and scoop.

A tin concentrate which I collected (purposely incompletely dressed) contained 90.1 per cent. of cassiterite, with 1.5 per cent. of manganocolumbite, 8.3 per cent. of spessartite (manganese garnet), and traces of zircon, magnetite, monazite, and epidote. With care it could be dressed up to 70 per cent. metallic tin. About two-thirds of the ore was finer than 10-mesh.

There were a few camps at Prospectors' Gully, where two or three white fossickers were said to be at work.

In Moolyella Gully about 30 aborigines were fossicking in pot-holes six to eight feet deep, with two to three feet of payable wash, consisting of coarse microcline-quartz gravel, cemented with sand and tough green clay. My impression was that there was no large extent of alluvial ground in this gully, but if the tin continues down to Brockman's Creek, the latter would provide a very large mass of alluvium. Most of the preliminary concentrates from Moolyella Gully carry a fair amount of manganese garnet (spessarite) with a gravity of 4.2, as well as some monazite (sp. gr. 5.3) and manganocolumbite (sp. gr. 5.7). These require a little skill in removing from the tin to bring the latter up to a good marketable grade. Monazite is the mineral from which the thoria for incandescent mantles is obtained. Some Moolyella monazite analysed many years ago carried 5.02 per cent. of thoria.

At Tadgebanna, south of Moolyella Gully, 20 aborigines were said to be at work fossicking.

The Moolyella field is situated in granite country traversed by thousands of pegmatite veins, only very few of which appear to carry visible tin ore. Some, however, have yielded very rich specimens. They have already been described by A. Gibb Maitland and A. Montgomery.

Water supply is a difficulty on this field except during the short rainy season, and if ever the alluvium is to be worked on a large scale, an abundant and permanent supply will have to be located.

Tabba Tabba.

This tin and tantalum field lies on Pastoral Lease 2841, about eight miles S.S.W. of the 35-mile post on the Marble Bar railway. It appears to be of very small extent, the proved metalliferous area being less than two miles square. It is situated on the south-western end of a low epidiorite ridge, with granite near at hand on the west and south, and the greenstone continuing to the east and north.

The chief tin workings are on M.L. 313 (Tabba Tabba Tin Mine), owned by the Consolidated Mines Selection Coy. On this lease are two prominent outcrops of albite-pegmatite, one running N. 20° W. for the greater part of the length of the 24-acre lease, junctioning at the southern end with a similar vein running in a curve approximately eastwards to the boundary, about 10 chains. Both veins are tin-bearing throughout and are from three to five feet thick, with steep to nearly vertical dip. They were being opened up systematically at many points, and the easterly vein in particular promised to be of good workable grade almost throughout its length. From a 35ft. shaft near its west end very rich ore was being raised and stacked, individual lumps containing from five to 25 per cent. of tin oxide. Tin was visible in each of the other openings along this vein, with high grade ore again near the eastern boundary. Tin was also seen in each of the openings made into the northerly vein, which, however, appears less rich than the easterly vein.

Both veins should crush easily, being composed largely of coarsely crystallised soda felspar (albite), with subordinate amounts of quartz, microcline, muscovite, lepidolite and spessartite (manganese garnet). The lepidolite was caesium-bearing. No tantalite was observed in either lode, but a little may be present as it is not easily distinguished from black tin, and I have arranged to be supplied with some concentrates to test this point.

Two leases are being worked for tantalite at Tabba.

On Thelemann's M.L. 317, which lies immediately north-east of the Tabba Tin Mine, there are at least two parallel pegmatite veins which have shed abundant gravelly tantalite on to the gentle slopes. It is only this detrital ore which was being recovered by dry concentration by hand ("sieving"). The soil is nowhere more than a foot or two thick, but tantalite can be obtained over almost every square yard of the lease.

A number of samples of tantalum concentrates from this lease (M.L. 317) submitted to me in the past two years have given results for tantalite oxide varying from 36 to 72 per cent., associated in almost every instance with cassiterite ranging from 4 to 16 per cent. The clean tantalum mineral was in some cases found to be manganocolumbite, in other cases manganotantalite, often a mixture of the two.

A sample of partial concentrates collected by the writer was found to have the following mineral composition:—

	per cent.
Tantalum ore	70
Cassiterite	16
Spessartite garnet	10
Quartz, mica and felspar	4
	100

The "tantalum ore" in this concentrate was partly manganocolumbite, carrying 41 per cent. of tantalic oxide and 42 per cent. niobic oxide, and partly manganotantalite, carrying 70 per cent. tantalic oxide and 14 per cent. niobic oxide. The latter is readily saleable, but the former could only be used in small quantities to "water down" rich ore which is above the market standard of 63 per cent. Ta_2O_5.

Tantalum concentrate with as much as 10 per cent. of cassiterite are not at present marketable, but it should be possible to separate them by electromagnets.

On Young & Moulden's M.L. 312 there is a prominent pegmatite vein up to 40ft. wide in places, bearing N.W. Soft detritus alongside this vein was being partially concentrated for tantalite by "sieving," and the concentrates, running about 10 per cent. tantalite, were being carted to Wodgina (58 miles) for final dressing.

Streaks of fine tantalite were visible in albite in a small hole near by, but it was not yet evident whether the whole pegmatite vein, or any large part of it, would be worth crushing and concentrating. The minerals noted in the vein were albite, quartz, microcline, lepidolite, muscovite, and very rarely beryl.

There are three good wells close to the leases at Tabba and abundant water is available from them at 40 feet for machine crushing and concentration, but not for any large scale sluicing.

Strelley.

Time did not permit of my seeing the old and new tantalite prospects on Strelley station, north of the railway, between the 30 and 35-mile posts. From this place samples of high grade manganotantalite (tantalate of manganese) and tapiolite (tantalate of iron) have been received for assay. They are associated in some cases with cassiterite.

Wodgina.

After being long deserted, mining for tantalite, and active prospecting for both this mineral and tin was again proceeding at Wodgina.

The main pegmatite vein on the old *Tantalite mine* was being thoroughly opened up by Messrs. Young and Moulden along almost the whole length of M.Ls. 86 and 87. With a small plant, consisting of crusher, jigs and table, high grade tantalite was being recovered from the soil on the slope below the outcrop, and to some extent from the lode. The concentrates, I understand, were being produced at the rate of between 20 and 30 tons per annum, and were readily saleable at about £250 per ton. They consist of almost clean manganotantalite with very little spessartite (manganese garnet) and occasional pebbles of scheelite. They appear to be free from cassiterite.

The main vein runs north and south throughout the length of M.Ls. 86 and 87 and a little beyond them in both directions. It consists mainly of coarsely crystallised albite, with irregularly distributed bunches of quartz, microcline and lepidolite, and frequent small crystals of spessartite garnet. Other rarer constituents will be referred to later. Its width varies considerably. At the north end, where a second vein crosses it at an angle of about 45°, there is a large mass of pegmatite which has been opened up by adits and shafts to a depth of about 30ft. and has yielded much tantalite as well as other minerals. Near the middle of M.L. 87 there was a 20ft. shaft with crosscut disclosing four or five feet of coarse albite, then 20ft. of a barren "granite" horse, then another four or five feet of coarse albite thickly studded with tantalite in lumps from one to five lbs. in weight. Detrital tantalite could be picked up in the surface soil from one end of the leases to the other, and this in spite of the fact that over 70 tons of tantalite were obtained from the surface of them when they were previously worked many years ago.

The mineral from this vein, which is often well crystallised, is remarkably uniform in grade and averages:—

	per cent.
Tantalic oxide	68
Niobic oxide	15
Manganese oxide	13
Iron oxide	2

Buyers, I understand, are disinclined to take concentrates under 63 per cent. tantalic oxide.

The felspars in the vein are of excellent quality for potters' use, but they are too far from the nearest factory to repay the cost of transport.

Associated with the tantalite in this vein, mainly at its northern end, are a number of rarer minerals which would have an economic value if obtainable in commercial tonnages.

Four different radium minerals, viz., mackintoshite, thorogummite, pilbarite and hydrothorite, have been obtained. These minerals carry radium in quantities of one to 10 centigrammes per ton, in addition to 34 to 57 per cent. of thoria (used in incandescent gas mantles), and three to 37 per cent. of uranium oxide (used in the glass and other industries). Unfortunately my inspection goes to show that they occur only in quite small amounts, very irregularly distributed in the lode, and on present showing have no economic importance.

Associated with the radium minerals at the north end are large masses of lithiophilite, a phosphate of manganese and lithium, carrying eight to nine per cent. of lithia, for the production of which it would be saleable. Masses from one lb. to 200 or 300lbs. in weight were seen in the workings and on the dumps, and if the lode at this point were worked on a large scale the mineral might well be hand-picked and set aside for sale when a sufficient tonnage had accumulated.

With it are some small veins and larger masses of apatite (fluophosphate of calcium), not in sufficient quantity, however, to be of value.

A little further south a dump carried many large masses of a white mineral which has been presumed to be quartz, but which proved on analysis to be beryl. A grey beryl from another part of the lode carried 12.08 per cent of beryllium oxide. A demand is slowly arising for this mineral for the manufacture of electrical porcelain and light alloys. It should be worth stacking during mining operations.

The very large mass of lepidolite on a cross vein at the north end, with other smaller masses scattered along the main vein, will probably one day be saleable for its lithia content.

About 60 chains west of M.L. 86 is Lewis' P.A. 608, of 18 acres, which is traversed by many pegmatite veins, conspicuous in the enclosing dark green Warrawoona greenstones. The most important vein runs north for nearly one-quarter of a mile. It is mainly composed of albite, quartz, chalcedony and microcline, with subsidiary muscovite and lepidolite.

At the northern end fine-grained tantalite is freely visible in the vein but has not yet been worked.

In the laboratory it was found that each small particle of this tantalite was traversed by numerous microscopic films of quartz and albite, so that in order to obtain a commercial concentrate it was necessary to grind the primary concentrate through a 60-mesh sieve and then reconcentrate. The product thus obtained assayed 67.8 per cent. of tantalic oxide, with 11.4 per cent. of niobic oxide. This is of marketable grade.

At several places on the P.A. lithiophilite is plentiful in boulders up to 21 inches cube (about 10 cwt.). On the surface this has weathered greatly, and lost much of its valuable lithia, but the centres of the largest blocks are unweathered, and doubtless at a shallow depth the whole mass of the mineral will be fresh and normally rich in lithia, *i.e.,* about eight to nine per cent Li_2O. Some apatite is associated with it.

About a mile further west are some old, long abandoned, shallow workings on a pegmatite vein, said to have yielded about 7cwt. of tantalite. Detrital ore collected by myself proved to be manganocolumbite with only 43 to 47 per cent, tantalic oxide. A hundred yards to the east, boulders of fine scaly lepidolite are scattered about the surface. Some of these masses of lepidolite enclose pieces of blue apatite. The wide distribution of lithium minerals throughout this district is remarkable.

The Mt. Cassiterite Tin Mine, M.L. 84, has not been worked for many years. A large amount of not very systematic mining has been done in the past and coarse cassiterite is still visible in some of the workings. It is usually not in the pegmatite, but in the adjacent chlorite-biotite schist. In view of the high price of tin there is a prospect of this mine being reopened.

On one dump of the mine spodumene (silicate of lithium and aluminium) was somewhat common. This mineral usually carries five to eight per cent. of lithia, and is sometimes used as a source of this compound. The clean Wodgina mineral assayed 6.70 per cent, of lithia. It has not previously been recorded from the North-West.

This old tin mine, the Tantalite mine, and the present township of Wodgina lie in an amphitheatre in the heart of the Wodgina greenstone massif. Except for a few inches of surface soil and a narrow shallow stream bed the locality is devoid of workable alluvial ground.

Altogether 74 minerals have been recorded as occurring within a radius of 20 miles of Mt. Tinstone, viz.:—

Bismuth, gold, molybdenite, galena, chalcocite, blende, pyrrhotite, chalcopyrite, pyrite, quartz, chalcedony and jasper, corundum, haematite, ilmenite, spinel, magnetite, rutile, cassiterite, limonite, psilomelane, calcite, cerussite, smithsonite, bismutosphaerite, malachite, microcline, albite, oligoclase, labradorite, hypersthene, spodumene, hornblende, beryl, helvite, spessartite, olivine, vesuvianite, topaz, gadolinite, metagadolinite, epidote hemimorphite, schorl and indicolite, muscovite, lepidolite, biotite, prochlorite, talc, kaolin, chrysocolla, nontronite, mackintoshite, thorogummite, pilbarite,* hydrothorite,* microlite, columbite, manganocolumbite, tantalite, manganotantalite, calciotantalite,* tapiolite, ixiolite, tanteuxenite,* monazite, lithiophilite, purpurite, apatite, autunite, anglesite, ferberite, scheelite, ferritungstite, ferrimolybdite.

Of these, the four marked * are species first described as new from this district, whilst several of the others have not yet been recognised elsewhere in Australia. Tanteuxenite is the tantalate and titanate of yttrium, corresponding to euxenite which is the niobate and titanate of yttrium.

Mt. Francisco.

Sixteen miles due S.S.W. of Wodgina, but 33 miles by the only passable road for motors, is Francisco Well, which is the present centre for prospecting the greenstones and granite country surrounding it. Two tin leases (M.Ls. 299 and 309), pegged here by S. C. Theobald, I did not have time to see.

About four miles east of the well is Hooley's columbite lode. It is a felspar vein bearing east in granite, the principal gangue being albite, with quartz, microcline, and in places muscovite and lepidolite. Beryl was observed to be not uncommon in it in crystals ranging from a few ounces to 50lbs. in weight. Manganocolumbite is abundant in the soil near the outcrop as well as in the vein. Several tons of pebbly ore ($\frac{1}{4}$ to 3 inches) could easily be collected on the surface, but unfortunately there is no demand as yet for an ore so low in tantalum, though inquiries are beginning to be received. Assays of clean concentrates show:—

	Tantalic oxide per cent.	Niobic oxide Per cent.
Minimum	13·7	65·9
Maximum	51·9	31·3

No cassiterite was observed on this lease.

In flat granite country, five miles south of Francisco Well, G. J. Hooley has discovered detrital tin ore in considerable quantities. The ore is in the gravelly and clayey soil along the barely discernible outcrops of two east and west pegmatite veins. Good prospects (1 to 3ozs. from 10lbs.) were obtained at intervals along several chains of each outcrop. The concentrates consist mainly of cassiterite with a little limonite, monazite, and tanteuxenite (tantalate and titanate of yttrium). There should be no difficulty in concentrating this ore to a high grade.

Between this tin find and Mt. Francisco there are some potholes on a basic dyke which are the source of specimens of ceylonite submitted to the Department some months ago, and from which others were collected by myself. This mineral (an aluminate of magnesium and iron) is highly refractory and can be used as a lining for steel furnaces, etc. Its comparatively low value (£4 to £5 per ton) would prohibit its being worked profitably in such a remote place.

Abydos.

About 10 miles south-west of the homestead on Abydos station some work has been done on a tin find, which I was unable to visit. The owner, Mr. Leeds, however, showed me several hundredweight of very clean concentrates from it, which assay 71 per cent metallic tin, the only impurity being about five per cent. of monazite.

I was shown two large specimens of gadolinite (silicate of yttrium and beryllium), said to have come from this tin find. This mineral is in small demand at about £200 per ton. Of similar value is the mineral tanteuxenite*, of which I have also received specimens from the same locality. Detrital manganocolumbite, assaying five to 18 per cent. tantalic oxide, has been collected in the vicinity.

Five miles north of the homestead, in the midst of level granite country traversed by pegmatite, violet coloured corundum has been discovered. I found the mineral in situ in a narrow bar, eight to 10 feet wide, of gneissic chlorite-biotite rock, with broken crystals, one to three inches in length, in fair number on the surface of the ground beside it. In half an hour I collected 5lbs. of corundum along about five chains of outcrop. Very little more was visible, but since my visit W. Lockyer has sunk on the bar, and reports that he has collected about 2cwt. of clean mineral. Corundum is worth £15 to £20 a ton as an abrasive, and although this particular deposit does not seem capable of yielding any commercial tonnage, it is of importance as indicating the presence, previously unsuspected, of the mineral in this district and the possibility of larger supplies being located.

Woodstock.

Amidst the rough granite ridges on the west side of the Yule River about 12 miles south of Woodstock homestead, allanite (silicate of cerium, aluminium and lime) and tanteuxenite (tantalate and titanate of yttrium) have been found in pegmatite veins. I was unable to visit the spot where the former was found, but the prospector informs me there was only very little visible. As its market price is only about £30 per ton, the find has no economic importance. I was shown the hole from which a few pounds of tanteuxenite were extracted, but there was not a single remaining piece to be seen, either there or in the immediate vicinity. This mineral is quoted at about £200 a ton, but it is quite evident that no commercial supply has yet been disclosed at Woodstock.

Cooglegong.

There is a large area of tin-bearing country stretching south from Pilga homestead and west from the Black Ridge which runs N.N.E. past Hillside homestead. This is undulating granite country traversed by many small pegmatite veins and larger greenstone dykes. Cassiterite can be detected in many very small (1 to 3-inch) pegmatite veins, and in a few instances in somewhat larger ones. On Stutz's P.A., about one mile south-east of Spear Hill, three apparently parallel tin-bearing pegmatites in gneissic epidiorite have been opened up in shallow holes. The veins are composed of albite, quartz and microcline and are not more than a foot thick, and the tin is nowhere very rich in them. About two tons of vein stuff have been broken out, which would probably average about one per cent. of black tin.

The shallow depression running north-west from this point towards Spear Hill has been extensively pot-holed by tin miners and is still being worked on a small scale. The holes are eight to 15 feet deep with about six inches of payable gravel at the bottom. The concentrates contain, besides cassiterite, a fair percentage of coarse gravelly monazite, now removed by redressing the primary concentrates. An analysis made of it some years ago showed the presence of 4.5 per cent. of thoria and from 55 to 65 per cent. of ceria. As this mineral has in recent years been worth £5 to £6 per unit of thoria, it may be worth saving if ever the alluvium is worked on a large scale. In 1923 the price had fallen temporarily to £3 5s. 6d. a unit; later quotations are not available.

Mr. Mandelstamm had cut a trench up to six feet deep and three chains long across the Two-mile Creek, and black tin appears in the bottom of this trench wherever tested. Just south of the creek, on M.C. 25, he had broken into a flat pegmatite vein lying just beneath the surface of the ground over an area of an acre or more. This vein did not appear to be more than a foot thick and was nowhere very rich. It is the usual albite-quartz-microcline-garnet combination so common in the North-West.

It was impossible in the time at my disposal to see more of the tin deposits in this extensive field, or to investigate the occurrence of fergusonite (tantalate of yttrium) at Trig. Hill. There have been inquiries for small tonnages of this mineral at prices ranging from £70 to £225 per ton.

Gadolinite (silicate of yttrium and beryllium) is also in small demand at about £150 to £200 per ton. Three tons of it were obtained some years ago at Cooglegong, and I visited the spot where it was said to have been obtained. This is in a pegmatite vein about four miles east of the Cooglegong Hotel and half a mile west of the Black Ridge. None of the mineral was seen in the vein, but immediately below it, in a dry creek bed a black gravel was observed mixed with quartz and felspar. A sample of this brought to Perth was found to consist of—

	per cent
Cassiterite	30
Gadolinite	30
Magnetite	25
Fergusonite	10
Monazite, garnet and limonite ...	5
	100

* The supposed tanteuxenite has since been shown to be tantaliferous polycrase.

This is a mile or more east of any old workings for tin, thus extending the area of known tin-bearing country.

Two miles to the west is another vein from which a few hundred pounds of gadolinite was obtained some years ago. A few more pounds of the mineral were observed alongside the outcrop, but it is evident that the mineral is not plentiful. A few small specimens were noted in a third parallel vein about 200 yards further west.

The analysis of Cooglegong gadolinite made many years ago by B. F. Davis, and published in Geological Survey Bulletin 40, is not reliable. The true composition of this mineral is as follows:—

SiO_2.	BeO.	FeO.	MnO.	MgO.	CaO.	Al_2O_3.	Fe_2O_3.
24·22	10·09	11·36	·44	*Nil*	·24	·95	·88
Ce_2O_3.	La_2O_3.	Y_2O_3.	H_2O.	ThO_2.	TiO_2.	PbO.	Total.
1·31	3·50	45·78	·94	·57	·02	·15	100·46

So far as present knowledge goes it would appear that the tin lodes at Cooglegong are all small, flat-lying, and poor in tin. The alluvial deposits on the other hand, though nowhere more than 15 feet deep, are spread over a very large extent of country, and have nowhere been worked on a face but only pot-holed along the richest gutters. They should be well worth working on a larger and more complete scale. The country is very dry for the greater part of the year, and it will not be easy to provide an adequate water supply for this purpose.

The positions of this and the "Old Shaw" (Eleys) Tinfield, shown on the Lands Department Map 98/300, required amendment.

Eleys.

On the opposite, that is the south-east, side of the Black Ridge and some eight or 10 miles south of Cooglegong, is the Eleys Tinfield, which has provided work for a few fossickers ever since 1900. It appears to be similar in structure to, but smaller in extent than the Cooglegong field. Like the latter, however, it has never been worked on an extensive systematic scale, but only pot-holed along the most obvious gutters.

The only portion of the field which was being worked at the time of my visit was the upper end of Eleys Creek, in the area pegged out as M.Cs. 15 and 16. At a depth of three or four feet a rich gutter was being worked for tin, the ore being mostly between 1/32in. and 1/8in. in diameter. Some bagged ore shown me was very clean, but to get it in this condition the primary dry-blown concentrate had been reconcentrated with water to remove a fair percentage of heavy foreign minerals. A parcel of these rejects was found to consist of—

	per cent.
Monazite	69·4
Tanteuxenite	26·7
Garnet...	1·0
Iron compounds	·8
Quartz and felspar	2·0
Cassiterite	·1
	100·0

The monazite is in fragments from 1/8th to 1 inch in diameter and would be saleable if produced in bulk as the result of large scale operations.

I did not see any tin lodes on this field, nor did I hear of any, but doubtless many of the small pegmatites in the granite are tin-bearing, as they are at Cooglegong. Very little evidence could be obtained as to the extent and value of the alluvial deposits. They are nowhere apparently more than 10 or 15 feet thick, and although only certain gutters have been worked in the past, there is an area of about three square miles of made ground which might pay to work on a large scale. An adequate water supply for working will again be a difficulty.

Conclusions.

During my hurried inspection of the tin and tantalum fields of the North-West I was deeply impressed with the great extent of country which carries deposits of those metals. Furthermore, the previously known area is rapidly being increased by new discoveries. The main factors leading to this increased prospecting and mining for these metals are (1) the present abnormally high price of tin, (2) the discovery in 1921 of a method for producing malleable tantalum suitable for chemical ware, and the consequent increase in price and demand for tantalite.

At Moolyella and Tabba Tabba rich lodes of tin ore are known, but elsewhere the workable deposits are mainly alluvial. These latter have nowhere been more than pot-holed, and although of no great thickness, in comparison with those of Malaya and the Dutch Indies, they are still of wide extent and should pay in many places to work systematically on a broad face and on a large scale. The chief difficulty to be overcome in alluvial mining is the lack of large volumes of water for breaking up and concentrating the dirt except during two months of the year. This may yet be overcome by conservation in dams or by means of a large scale dry concentrator, one make of which is already on the market. The comparatively small quantity of water needed for lode mining can readily be supplied from wells all the year round.

One high-grade tantalum lode is already being worked at Wodgina and another is also known at Strelley. The former is producing the main part of the supply for the whole world at present. Alluvial deposits of high-grade ore are known at Tabba Tabba and Strelley. Should it be found possible as time goes on to utilise, in place of pure tantalum, alloys of tantalum and its twin brother niobium, or the latter metal alone, several other known deposits in the North-West which are now lying idle could be worked at a profit.

A word of warning needs to be issued against the indiscriminate blending of tantalum ores from various parts of the North-West. The Wodgina ore from the lode on M.Ls. 86 and 87 has established a high reputation mainly because of its extreme purity, being practically free from tin and titanium. Alluvial ores from other places in the North-West are often contaminated to a notable extent with black tin and with titanium-bearing minerals such as tanteuxenite, and an admixture of them with the Wodgina mineral may lead to a condemnation of the latter, or a marked reduction in the price paid for it.

Finally, I should like to suggest the necessity for further geological work being done in the North-West. The tin and tantalum deposits are intimately related to the junction lines of the granite with the older greenstones, lines which are only approximately laid down on the small scale (10 miles to the inch) Pilbara map of A. Gibb Maitland. These junction lines need to be surveyed in detail and mapped on a scale of 300 chains to the inch, when they would be of the greatest value in developing the tinfields.

DIVISION VIII.

REPORT OF THE CHIEF INSPECTOR OF EXPLOSIVES FOR THE YEAR 1927.

The Under Secretary for Mines.

I have the honour to submit for the information of the Hon. the Minister for Mines, in compliance with Section 45 of "The Explosives Act, 1895," a report on the working of the Department during the year 1927.

The following table shows the quantity of Explosives imported into the State during the year:—

TABLE I.

Importations of Explosives into Western Australia during 1927.

	Quantity. lbs.
Gelignite	663,000
Gelatine Dynamite	428,000
Blasting Gelatine	85,000
Permitted Explosives	40,000
Blasting Powder	131,250
Pellet Powder	90,000
Fuse (Coils)	247,680
Detonators (number)	2,260,000

Particulars are given in Table No. 2 with regard to the quantities of the different classes of Explosives imported during the past five years.

TABLE II.

Comparison of Explosives imported into Western Australia during the past five years.

——	1923.	1924.	1925.	1926.	1927.
	lbs.	lbs.	lbs.	lbs.	lbs.
Gelignite	997,000	1,439,000	893,650	586,000	663,000
Gelatine Dynamite	165,000	282,000	234,500	380,000	428,000
Blasting Gelatine	30,000	91,250	84,350	103,000	85,000
Permitted Explosives	2,500	50,000	7,500	35,000	40,000
Powder, Blasting	180,000	148,750	730,000	92,500	221,250
Powder, Sporting	...	...	...	...	...
Fuse (Coils)	368,640	365,400	335,880	204,000	247,280
Detonators (number)	1,150,000	3,000,000	2,756,000	2,360,000	2,260,000

The importations were confined to four shipments, which arrived from Great Britain at regular intervals of about three months.

The manufacturers and importers are endeavouring to arrange for deliveries of the Gelatinous Nitro-Glycerine Explosives so as to, as far as possible, avoid the accumulation of stocks in the Magazines in this State, with the view to minimising the risks of faulty detonation, owing to fall in velocity of detonation, which takes place on prolonged storage in this climate.

All the Explosives on arrival are submitted to examination and tested, and with the exception of one consignment of 50 per cent. Gelignite, were found to be satisfactory and passed the official tests. This consignment was kept under close observation and frequently tested. After being stored at Fremantle for a few weeks it was found to give satisfactory tests, and was accordingly allowed to be passed into consumption. No complaints were received by the Department from the users of this Explosive.

One consignment of Blasting Powder was slightly damaged by water during very rough weather while stored on the lighters during transit from the steamer in Gage Roads. A close examination was made of the affected cases, and as a result it was found necessary to condemn 400 lbs., which was taken possession of and destroyed.

I have again set out in the following table figures showing the consumption of Explosives of the Nitro-Compound class in the different industries where Explosives are used.

TABLE III.

Distribution and Consumption of Explosives during 1927.

——	lbs.	Percentage of Total.
Gold Mining	740,750	62.29
Agricultural and Land Clearing ...	286,300	24.00
Government Departments, including Railways, Public Works and Water Supplies	72,550	6.1
Quarrying	55,650	4.6
Lead Mining	2,300	.19
Copper Mining	...	...
Coal Mining	29,150	2.45
Tin Mining	2,550	.21

For comparative purposes the figures are given for the years 1926 and 1927 in Table IV.

TABLE IV.

Distribution and Consumption of Explosives.

—	1926. lbs.	1926. Percentage of Total.	1927. lbs.	1927. Percentage of Total.
Gold Mining ...	800,100	61.9	740,750	62.29
Agricultural and Land Clearing ...	369,400	28.5	286,300	24.00
Government Departments, including Railways, Public Works, and Water Supplies ...	24,000	1.8	72,550	6.10
Quarrying ...	51,150	4.9	55,650	4.60
Lead Mining ...	17,250	1.3	2,300	.19
Copper Mining ...	...	...	...	...
Coal Mining ...	29,100	2.2	29,150	2.45
Tin Mining ...	1,500	.11	2,550	.21

The following licenses have been issued during the year for the storage and sale of Explosives.

TABLE V.

Licenses issued during 1927.

For Magazines on Government Reserves ...	43
For Magazines used by Government Departments ...	22
For Magazines erected on Private Property ...	53
Store Licenses for the Sale of Explosives—	
Mode A ...	98
Mode B ...	3
For Sale of Fireworks only ...	254
License for the preparation and use of Explosives of Class IV. Chlorate Mixture ...	1
Licenses for the Importation of Explosives into the State of Western Australia ...	2

Inspections have been made of magazines and other licensed premises throughout the State. The following places have been visited:—Perth and Fremantle (including all the metropolitan area), Northam, Merredin, Southern Cross, Westonia, Bullfinch, Coolgardie, Kalgoorlie, Norseman, Broad Arrow, Menzies, Kookynie, Laverton, Meekatharra, Cue, Magnet, Sandstone, Yalgoo, Geraldton, Mullewa, Three Springs, Carnamah, Moora, Northampton, Harvey, Bunbury, Busselton, Margaret River, Donnybrook, Greenbushes, Bridgetown, Manjimup, York, Beverley, Narrogin, Wagin, Katanning, Albany, and Denmark. One hundred and sixty-one inspections were made, as a result of which it was found necessary to take proceedings against two persons for breaches of the Act, particulars of which are as follow:—

Place.	Offence.	Penalty.
Parkerville ...	Storing Explosives on unlicensed premises	Fined £5 and costs 3s.
Fremantle ...	do. do.	Fined £1 16s. 0d. and costs £2 7s. 6d.

The following Explosives found in licensed premises were unfit for consumption, and were destroyed:—

TABLE VI.

Destruction of Explosives during 1927.

Date, 1927.	Place.	Kind and Quantity.	Remarks.
February 10th ...	Fremantle ...	2,000 No. 8 Detonators (Electric)	Owing to deterioration.
Do. ...	do. ...	40lbs. Gelignite ...	Owing to chemical deterioration.
Do. ...	do. ...	50lbs. Gelignite ...	do. do.
February 24th...	Denmark ...	5lbs. Gelignite ...	do. do.
March 1st ...	Gnowangerup ...	5lbs. Gelignite ...	do. do.
March 5th ...	Ravensthorpe ...	150lbs. Gelignite ...	do. do.
March 10th ...	Darkan ...	10lbs. Gelignite ...	do. do.
May 5th ...	Fremantle ...	5lbs. Gelignite ...	Owing to absorption of moisture.
June 10th ...	Leonora ...	15lbs. Gelignite ...	Owing to chemical deterioration.
July 9th ...	Fremantle ...	177lbs. Powder ...	Damaged by water.
July 15th ...	do. ...	225lbs. Powder ...	do. do.
November 19th ...	Moora ...	15lbs. Viking Powder ...	Owing to absorption of moisture

The number of tests shown in Table VII. were made with a view to ascertaining whether the Explosives imported into and stored in the State comply with the requirements of the Act.

TABLE VII.

Heat tests ...	594
Complete Analysis ...	169
Fuse tests ...	140
Velocity of detonation ...	38
A.D.C. tests ...	24
Miscellaneous tests ...	192

A thorough investigation was also made in connection with complaints received from some of the miners in Kalgoorlie that detonators being supplied to the mines were failing to completely explode, and so causing misfires of charges. As a result of this investigation certain recommendations were made to the State Mining Engineer with a view to minimising the risk of detonators becoming faulty in their action, and so causing misfires.

Application was received for the authorisation of one new Explosive only, which after investigation was added to the list of Explosives to be imported, manufactured, or stored in this State.

There were no new reserves for Explosives declared during the year, therefore the number remains the same as last year, *i.e.*, 59, with a total area of 3,294 acres.

The total revenue received by the Department during the year was £1,367.

I again desire to acknowledge the courtesy of the Commissioner of Police and his Officers for the assistance they have rendered the Department.

T. N. KIRTON,
Chief Inspector of Explosives.

By Authority: FRED. WM. SIMPSON, Government Printer, Perth.

WESTERN AUSTRALIA.

DEPARTMENT OF MINES.

MINING STATISTICS,

1927.

v 1392/28.

MINING STATISTICS TO 31st DECEMBER, 1927.

TABLE OF CONTENTS.

TABLE OF CONTENTS—*continued.*

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 1927, AND THE ESTIMATED VALUE THEREOF, TOGETHER WITH A COMPARISON FOR PREVIOUS YEARS, AND THE TOTAL PRODUCTION TO DATE.

	Description of Mineral.	1927.		1926.		1925.		1924.		Previously to 1924.		Total to date.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
			£		£		£		£		£		£
1.	Antimony ... ... (Exported) statute tons	...	...	4½	85	...	...	...	...	89	1,743	93	1,828
2.	Arsenical Ore ... ... (Exported) do.	*	819	*	347	*	1,045	*	777	*	10,036	...	13,024
3.	Asbestos ... ... (Reported) do.	11	304	105	2,728	51	1,641	74	2,206	784	35,696	1,025	42,575
4.	Bismuth ... ... (Exported) do.	...	...	...	...	...	...	...	...	11	844	11	844
5.	Coal ... ... (Reported) do.	501,505	407,967	474,819	394,400	437,461	363,203	421,864	363,255	6,399,653	3,831,878	8,235,302	5,360,703
6.	Copper { Ore ... ... (Exported) do.	2	101	...	...	1,201	18,200	2,795	40,676	76,128	928,143	80,126	987,120
	Copper { Ingot and Matte (Exported) do.	...	...	1	84	...	...	...	...	13,414	817,979	13,415	818,063
7.	Emeralds ... ... (Reported) carats	200	421	...	...	...	...	...	...	...	...	200	421
8.	Gadolinite ... ... (Reported) statute tons	...	...	...	...	...	...	...	...	1	112	1	112
9.	Gold ... (Exported and Minted) fine ounces	408,353	1,734,571	437,343	1,857,716	441,252	1,874,320	485,035	2,060,298	35,344,880	150,135,505	37,116,862	157,662,410
10.	Graphite ... ... (Exported) statute tons	...	...	...	...	...	...	...	...	*	696	...	696
11.	Gypsum ... ... (Reported) do.	6,675	9,818	3,918	5,618	3,060	4,118	4,237	5,278	728	638	18,617	25,470
12.	Ironstone ... ... (Reported) do.	...	...	...	...	...	...	...	...	57,830	36,695	57,830	36,695
13.	Lead (Ore and Concentrates) (Exported) do.	...	...	...	...	...	...	...	...	44,032	508,748	44,032	508,748
14.	Lead and Silver Lead (Ore and Concentrates) (Exported) do.	1,413	24,592	4,162	76,741	4,664	103,300	4,854	83,095	11,402	194,637	26,495	482,365
15.	Lead (Pig) ... ... (Exported) do.	...	...	...	...	...	...	...	...	23,052	628,956	23,052	628,956
16.	Limestone ... ... (Reported) do.	...	...	...	...	...	...	...	...	93,706	18,290	93,706	18,290
17.	Magnesite ... ... (Exported) do.	...	...	...	...	...	...	...	...	806	1,526	806	1,526
18.	Manganese ... ... (Exported) do.	30	303	82	503	...	...	20	160	40	352	172	1,318
19.	Mica ... ... (Exported) do.	4	536	4	† 8,328	...	...	...	...	*	1,357	...	10,221
20.	Molybdenite ... ... (Exported) do.	...	...	...	...	...	...	...	...	78	865	78	865
21.	Pyritic Ore ... ... (Reported) do.	...	...	...	...	...	...	...	...	74,048	45,496	74,048	45,496
22.	Silver ... ... (Exported) fine ounces	49,895	5,829	68,413	8,863	81,226	11,661	89,146	13,409	4,233,248	586,275	4,521,928	626,037
23.	Tantalite ... ... (Exported) statute tons	17	3,746	24	5,751	5	1,010	...	...	*	18,780	...	29,287
24.	Tin Ore ... ... (Exported) do.	77	13,316	67	10,450	108	15,392	87	12,008	15,565	1,510,066	15,904	1,561,232
25.	Tungsten Ore { Scheelite ... (Exported) do.	...	...	...	...	...	...	...	...	21	2,507	21	2,507
	Tungsten Ore { Wolfram ... (Exported) do.	...	...	...	...	...	...	...	...	15	1,441	15	1,441
26.	Zinc ... ... (Exported) do.	...	...	...	...	...	...	...	...	184	5,437	184	5,437
	Unenumerated ... ... (Exported)	...	114	8	250	...	...	...	...	...	7,091	...	7,455
	TOTAL VALUES	...	2,202,437	...	2,371,864	...	2,393,890	...	2,581,162	...	159,331,789	...	168,881,142

* Weight not stated. † The value stated for Mica is that declared by the exporter at the time of shipment, but later information indicates that it is overstated.

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 £5·825 per fine oz. for the year 1920, £5·314 for the year 1921, £4·693 for the year 1922, £4·4244 for the year 1923, and £4·65107 for the year 1924. The amounts of £974,504, £590,428, £239,487, £89,158, and £195,629, should therefore be added to make up the actual total value of such gold.

TABLE I.

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 1927.

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	...	...	...	...	3	38	...	...	...	...	...	...	...	...
Antimony (Metal and Ore) do.	...	...	63	5,040	...	...	...	...	...	...	...	...	...	...
Arsenical Ore ... do.	*	819	151	1,679	70	350	...	...	...	...	...	...	...	...
Asbestos ... ... do.	11	304	...	...	...	...	...	...	...	...	...	...	...	...
Bismuth (Metal and Ore) do.	...	...	¾	204	...	...	...	...	...	...	...	...	...	...
Coal ... ... do.	501,505	407,967	11,126,114	9,782,002	1,099,040	987,465	2,139,727	982,533	112,056	99,802	...	...	2,366,994	2,366,994
Copper (Ingot and Matte) do.	...	...	376	12,655	3,741	218,842	...	...	5,811	362,988	201	12,452	...	...
Copper Ore ... ... do.	2	101	...	...	...	...	...	...	...	...	...	...	...	...
Gold ... ... Fine ounces	408,353	1,734,571	18,032	76,595	37,979	161,321	38,538	163,699	4,861	20,646	418	1,776	118,830	504,756
Gypsum ... ... Statute tons	6,675	9,818	...	...	...	...	20,835	11,388	...	...	93,850	82,119	...	...
Iron ... ... do.	...	...	118,951	654,230	...	...	...	...	...	...	722,425	830,789	3,383	17,761
Iron Oxide ... ... do.	...	...	5,011	3,116	...	...	...	...	...	...	...	...	...	...
Ironstone ... ... do.	...	...	...	...	506	506	...	...	...	...	...	...	...	...
Lead and Silver Lead do.	1,413	24,592	290,259	3,487,446	913	22,289	6	132	5,583	135,403	5	123	...	...
Limestone ... ... do.	...	...	119,094	44,660	84,961	42,876	...	...	169,522	167,373	121,272	45,477	...	...
Magnesite ... ... do.	...	...	10,017	16,141	...	...	72	237	...	...	330	825	...	...
Manganese Ore ... do.	30	303	1,202	4,285	241	362	...	...	...	...	...	...	...	...
Molybdenite ... ... do.	...	...	...	...	1	205	...	...	...	...	...	...	...	...
Mica ... ... do.	4	536	...	...	1	50	...	...	...	...	...	...	...	...
Platinum ... ... Fine ounces	...	...	226	3,200	...	...	...	...	...	...	...	...	33	231
Precious Stones	...	421	...	13,580	...	2,602	...	...	...	...	...	9,157	...	...
Tungsten Ores } Scheelite Statute tons	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tungsten Ores } Wolfram do.	...	...	...	...	...	...	...	...	149	9,886	...	...	4	289
Silver ... ... Fine ounces	49,895	5,829	5,341	534	84,118	9,813	1,470	172	741,782	87,024	179	20	387,590	45,410
Tantalite ... Statute tons	17	3,746	...	...	...	...	...	...	...	...	...	...	...	...
Tin (Ore and Ingot) ... do.	77	13,316	1,030	287,539	1,111	193,774	62	11,454	1,106	317,593	...	...	...	...
Zinc (Spelter and Conc.) do.	...	...	277,425	996,877	...	...	...	...	6,326	181,242	...	...	...	...
Other	...	114	...	3,107,629	...	5,498	...	7,728	...	239,070	...	205,784	...	580,436
Total Value ...	...	2,202,437	...	18,497,412	...	1,645,991	...	1,177,343	...	1,621,027	...	1,188,522	...	3,515,877

* Weight not stated.

PART I.—GOLD.

TABLE II.

TOTAL YEARLY PRODUCTION OF GOLD, IN FINE OUNCES, AS REPORTED TO THE MINES DEPARTMENT, TO 31ST DECEMBER, 1927.

GOLDFIELD.	DISTRICT.	1927.		1926.		1925.		1924.		1923.		1922.	
		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	... ...	...	193·89	...	64·61	...	29·43	...	12·77	...	30·55	...	5·01
Pilbara	Marble Bar ...	1,601·40		1,950·46		2,404·98	2,502·10	1,858·12	2,134·38	2,388·05	2,543·62	2,779·45	3,100·16
Do.	Nullagine ...	421·43	2,022·83	425·78	2,376·24	97·12		276·26		155·57		320·71	
West Pilbara ...	... ...	...	52·84	...	29·19	...	34·95	...	76·45	...	64·22	...	94·33
Ashburton	... ...	...	15·41	...	10·26	...	10·63	...	3·18	...	9·24	...	13·57
Gascoyne	... ...	...	78·63	...	85·21	...	3·37	...	2·46	...	...	...	1·52
Peak Hill	... ...	...	1,689·22	...	2,139·60	...	1,635·65	...	2,113·13	...	1,699·82	...	2,159·89
East Murchison ...	Lawlers	193·76		450·74		1,254·51		2,453·98		4,302·94		4,650·83	
Do.	Wiluna	4,266·87	6,025·33	3,141·63	5,335·56	2,137·66	5,398·50	1,083·97	4,896·94	3,697·11	11,016·41	5,385·30	13,050·62
Do.	Black Range ...	1,564·70		1,743·19		2,006·33		1,358·99		3,016·36		3,014·49	
Murchison	Cue	2,936·60		4,180·73		2,338·71		1,912·68		4,155·09		4,840·68	
Do.	Meekatharra ...	19,017·04	27,886·30	23,465·84	33,486·74	22,369·37	29,439·22	19,225·14	24,425·20	20,355·91	27,037·53	26,953·23	36,304·33
Do.	Day Dawn ...	1,473·59		1,505·33		638·68		775·94		850·79		1,114·58	
Do.	Mt. Magnet ...	4,459·07		4,334·84		4,092·46		2,511·44		1,675·74		3,395·84	
Yalgoo	... ...	...	2,394·40	...	6,382·18	...	2,828·36	...	5,611·23	...	7,713·45	...	18,132·49
Mt. Margaret ...	Mt. Morgans ...	3,718·89		4,984·07		4,804·69		5,552·43		5,556·38		7,768·38	
Do.	Mt. Malcolm ...	31,563·34	36,698·45	36,826·35	43,628·15	35,445·39	41,849·88	35,839·35	43,704·83	20,301·14	26,876·42	16,811·82	27,649·19
Do.	Mt. Margaret ...	1,416·22		1,817·73		1,599·80		2,313·05		1,018·90		3,068·99	
North Coolgardie ...	Menzies	1,436·20		2,139·74		4,211·90		8,252·74		11,278·60		11,650·21	
Do.	Ularring ...	451·00		110·99		...	4,549·66	210·98	9,509·19	219·18	12,212·93	1,401·44	13,624·14
Do.	Niagara	14·91	2,054·58	39·08	2,471·94	188·83		197·30		269·14		197·17	
Do.	Yerilla	152·47		182·13		148·93		848·17		446·01		375·32	
Broad Arrow ...	... ...	...	7,569·81	...	1,460·49	...	8,242·38	...	2,660·61	...	2,740·98	...	3,628·56
N.E. Coolgardie ...	Kanowna ...	2,243·94		5,976·20		5,747·31	5,897·75	4,525·97	4,690·51	4,592·90	4,714·51	3,882·13	4,545·10
Do.	Kurnalpi ...	242·81	2,486·75	222·57	6,198·77	150·44		164·54		121·61		662·97	
East Coolgardie ...	East Coolgardie...	298,858·80		303,933·40		304,891·85	305,769·11	335,480·59	336,098·63	369,859·84	370,669·86	375,757·25	376,388·69
Do.	Bulong	397·09	299,255·89	103·57	304,036·97	877·26		618·04		810·02		631·44	
Coolgardie	Coolgardie ...	4,278·72		3,507·44		7,459·75	10,308·44	7,100·35	10,242·79	9,929·81	13,076·81	9,662·68	16,170·54
Do.	Kunanalling ...	1,507·26	5,785·98	2,490·22	5,997·66	2,848·69		3,142·44		3,147·00		6,507·86	
Yilgarn	... ...	...	9,226·77	...	11,792·22	...	13,296·97	...	8,451·00	...	8,375·97	...	12,793·95
Dundas	... ...	...	2,739·06	...	2,681·68	...	2,601·30	...	3,429·14	...	6,357·85	...	8,043·99
Phillips River ...	... ...	...	283·98	...	19·33	...	27·20	...	145·44	...	374·58	...	688·75
* Donnybrook ...	... ...	...	...	...	...	...	...	...	...	...	...	...	...
State generally	... ...	...	10·20	...	133·39	...	108·33	...	...	...	157·74	...	144·45
TOTAL	Fine Ounces ...	...	406,470·32	...	428,330·19	...	434,533·23	...	458,207·88	...	495,672·49	...	536,539·28
TOTAL	Sterling Value	£1,726,576		£1,819,431		£1,845,780		£1,946,343		£2,105,483		£2,279,074	

* Abolished 4th March, 1908.

TABLE II.—*Total Yearly Production of Gold, in Fine Ounces, etc.*—continued.

Goldfield.	District.	1921. District.	1921. Goldfield.	1920. District.	1920. Goldfield.	1919. District.	1919. Goldfield.	1918. District.	1918. Goldfield.	Previous to 1918. District.	Previous to 1918. Goldfield.	Total to December 31st, 1927. District.	Total to December 31st, 1927. Goldfield.
		ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.
Kimberley	... ...	...	49·35	...	...	...	150·73	...	15·08	...	17,854·54	...	18,405·96
Pilbara	Marble Bar ...	2,556·95		3,164·15	4,052·49	2,960·51	3,421·39	2,991·73	3,748·40	119,775·86		144,431·66	
Do.	Nullagine ...	69·62	2,626·57	888·34		460·88		756·67		77,744·34	197,520·20	81,616·72	226,048·38
West Pilbara ...	... ...	...	67·10	...	133·91	...	95·26	...	120·37	...	27,466·46	...	28,235·08
Ashburton	... ...	...	22·31	...	...	...	...	...	...	...	8,883·24	...	8,967·84
Gascoyne	... ...	...	7·46	...	...	...	...	...	...	...	676·54	...	855·19
Peak Hill	... ...	...	1,078·53	...	1,655·71	...	2,255·38	...	1,089·31	...	250,637·89	...	268,154·13
East Murchison ...	Lawlers	3,008·81		2,693·15		4,951·82		4,115·55		898,308·11		926,384·20	
Do.	Wiluna	4,092·30	18,762·26	5,478·99	19,600·25	7,035·72	27,413·89	7,909·60	29,210·72	74,996·34	1,693,828·68	119,225·49	1,834,539·16
Do.	Black Range ...	11,661·15		11,428·11		15,426·35		17,185·57		720,524·23		788,929·47	
Murchison	Cue	7,186·83		9,642·63		9,020·49		10,183·75		347,636·49		404,034·68	
Do.	Meekatharra ...	30,046·77		28,163·45	46,604·07	35,436·80	50,569·85	44,119·86	63,285·43	808,378·87		1,077,532·28	
Do.	Day Dawn ...	726·80	41,256·53	4,671·54		2,383·58		4,176·83		1,297,962·45	2,842,982·80	1,316,280·11	3,223,278·00
Do.	Mt. Magnet ...	3,296·13		4,126·45		3,728·98		4,804·99		389,004·99		425,430·93	
Yalgoo	... ...	...	3,579·20	...	2,965·43	...	4,788·38	...	4,397·89	...	112,389·21	...	171,182·22
Mt. Margaret ...	Mt. Morgans ...	7,612·89		5,560·87		5,302·34		5,294·03		498,676·78		554,831·75	
Do.	Mt. Malcolm ...	8,364·49	20,803·51	42,800·83	77,335·84	49,506·74	88,151·93	46,368·64	85,346·97	1,507,312·22	2,735,295·33	1,831,140·31	3,227,340·50
Do.	Mt. Margaret ...	4,826·13		28,974·14		33,342·85		33,684·30		729,306·33		841,368·44	
North Coolgardie ...	Menzies	8,034·25		11,468·50		20,859·22		30,345·06		926,136·67		1,035,813·09	
Do.	Ularring	1,605·06		57·53	12,024·18	931·66	23,019·41	4,791·82	36,829·91	282,230·97		292,010·63	
Do.	Niagara	345·17	10,640·08	223·26		746·51		1,203·81		499,719·22	1,905,801·05	503,144·40	2,032,737·07
Do.	Yerilla	655·60		274·89		482·02		489·22		197,714·19		201,768·95	
Broad Arrow ...	... ...	...	8,875·01	...	7,445·23	...	11,728·57	...	4,125·88	...	463,729·09	...	522,206·61
N.E. Coolgardie ...	Kanowna ...	3,378·29		1,248·14	1,738·80	5,250·96	5,472·08	3,439·60	3,700·25	681,317·43		721,602·87	
Do.	Kurnalpi ...	769·69	4,147·98	490·66		221·12		260·65		28,750·11	710,067·54	32,057·17	753,660·04
East Coolgardie ...	East Coolgardie	378,344·62		401,417·01	401,495·91	396,995·28	397,054·89	524,729·46	524,823·36	16,414,272·43		20,104,540·53	
Do.	Bulong	85·30	378,429·92	78·90		59·61		93·90		161,052·60	16,575,325·03	164,807·73	20,269,348·26
Coolgardie	Coolgardie ...	4,629·54		3,482·79	5,986·43	4,222·21	5,814·30	5,334·36	7,962·75	962,697·56		1,022,305·21	
Do.	Kunanalling ...	4,918·20	9,547·74	2,503·64		1,592·09		2,628·39		205,299·28	1,167,996·84	236,585·07	1,258,890·28
Yilgarn	... ...	...	19,241·50	...	37,636·51	...	54,002·74	...	70,765·88	...	836,211·19	...	1,081,794·70
Dundas	... ...	...	5,455·77	...	6,541·18	...	12,529·61	...	15,949·44	...	578,873·66	...	645,202·68
Phillips River ...	... ...	...	865·75	...	1,422·76	...	1,700·12	...	4,478·49	...	79,463·38	...	89,469·78
*Donnybrook ...	... ...	...	...	...	...	...	...	...	...	...	841·76	...	841·76
State generally	... ...	...	99·85	...	20·67	...	46·41	...	195·43	...	7,465·27	...	8,381·74
TOTAL	Fine Ounces ...	...	525,556·42	...	626,659·37	...	688,214·94	...	856,045·56	...	30,213,809·70	...	35,669,539·38
TOTAL	Sterling Value ...	£2,232,422		£2,661,880		£2,923,351		£3,636,250		£128,337,982		£151,514,578	

* 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 1927.

Goldfield.	District.	Date of Proclamation of Goldfield.				Area in Square Miles.		Leases in force, 31-12-1927.		Particulars of Plant.					Average Number of Men engaged in Gold Mining.		
										Milling.		Cyaniding.			Men employed.		
		Proclamation gazetted.	To take effect from.	Latest Amendment of Boundaries gazetted.	To take effect from.	Goldfield.	District.	No.	Area in Acres.	Stamps.	Other Mills.	Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	Above Ground.	Under Ground.	Diggers.
Kimberley	... ...	20-5-86	20-5-86	31-10-02	1-11-02	33,833	...	2	48	...	...	...	...	...	...	...	4
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	10	98	45	4	10	...	...	10	26	4
	Nullagine ...						6,887	5	90	18	...	7	...	...	4	2	1
West Pilbara	... ...	20-9-95	1-11-95	1-3-07	1-3-07	10,843	...	2	30	...	...	...	...	...	...	...	2
Ashburton	... ...	11-12-90	11-12-90	18-10-01	14-10-01	14,230	...	...	...	...	...	...	...	...	...	...	2
Gascoyne	... ...	25-6-97	15-4-97	...	...	5,313	...	...	...	...	...	...	...	...	...	...	2
Peak Hill	... ...	19-3-97	1-4-97	13-11-14	1-12-14	23,650	...	8	49	10	...	9	...	...	15	16	5
East Murchison ...	Lawlers ...	28-6-95	28-6-95	2-2-20	2-2-20	26,058	6,691	4	73	25	2	18	...	...	18	5	6
	Wiluna ...						10,496	54	1,109	33	1	...	9	2	138	98	...
	Black Range						8,871	4	62	25	...	8	...	...	24	28	1
Murchison	Cue	24-9-91	24-9-91	28-11-13	1-1-14	25,474	8,593	15	234	30	1	29	2	...	62	21	...
	Meekatharra						12,250	20	293	70	10	8	...	...	54	124	5
	Day Dawn ...						896	6	64	3	...	6	...	...	18	9	...
	Mt. Magnet ...						3,735	12	123	20	3	16	...	...	42	38	2
Yalgoo	... ...	8-2-95	23-1-95	30-7-15	9-8-15	23,230	...	11	146	30	5	17	...	...	49	48	1
Mt. Margaret	Mt. Morgans	12-3-97	1-4-97	2-2-20	2-2-20	59,918	14,007	7	116	25	6	15	6	1	37	24	...
	Mt. Malcolm						6,018	24	529	65	6	6	4	1	122	225	...
	Mt. Margaret						39,893	7	134	30	6	16	1	...	32	9	...
North Coolgardie ...	Menzies ...	28-6-95	28-6-95	7-9-17	17-9-17	13,746	6,805	9	94	25	3	...	...	...	26	13	1
	Ularring ...						3,093	3	60	20	1	...	...	...	8	1	...
	Niagara ...						688	...	...	10	...	...	...	...	5	2	...
	Yerilla ...						3,160	2	27	20	1	5	...	...	8	5	1
Broad Arrow	... ...	17-11-96	20-11-96	8-6-06	1-7-06	1,038	...	11	185	35	17	9	7	2	64	56	5
North-East Coolgardie ...	Kanowna ...	20-3-96	15-4-96	27-3-08	1-4-08	20,604	1,094	9	116	50	2	2	...	...	27	25	3
	Kurnalpi ...						19,510	...	...	5	1	2	...	...	9	8	1
East Coolgardie ...	East Coolgardie	21-9-94	1-10-94	27-3-08	1-4-08	1,800	810	86	1,276	255	193	56	127	62	855	1,073	21
	Bulong ...						990	3	57	5	...	3	...	...	24	15	2
Coolgardie	Coolgardie ...	6-4-94	6-4-94	1-3-07	1-3-07	11,702	9,384	16	283	45	5	19	...	...	85	73	14
	Kunanalling						2,318	4	45	25	3	8	...	...	23	19	...
Yilgarn	... ...	1-10-88	1-10-88	28-1-16	1-2-16	17,700	...	40	745	70	4	14	4	1	80	64	...
Dundas	... ...	31-8-93	31-8-93	1-3-07	1-3-07	11,430	...	8	104	25	1	17	...	...	39	37	...
Phillips River	... ...	21-9-00	14-9-00	28-1-16	1-2-16	5,078	...	4	63	30	...	3	1	...	17	7	...
State generally ...	... ...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	1	...
	Total	...	...	...	...	436,948	...	386	6,253	1,049	275	303	161	69	1,901	2,072	83

TABLE III.—*Return showing for the respective Goldfields and Districts, etc.*—continued.

Goldfield.	District.	1927 Gold and Silver Yield—Districts.						1927 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 ...	...	...	...	...	...	...	...	193·89	...	...	...	193·89	...
Pilbara	Marble Bar ...	11·33	...	926·50	1,590·07	1,601·40	...						
Do.	Nullagine ...	...	50·51	148·00	370·92	421·43	...	11·33	50·51	1,074·50	1,960·99	2,022·83	...
West Pilbara ...	...	...	...	...	...	...	...	49·36	...	20·00	3·48	52·84	...
Ashburton ...	...	...	...	...	...	...	...	15·41	...	...	...	15·41	...
Gascoyne	...	...	...	...	...	...	...	78·63	...	...	...	78·63	...
Peak Hill ...	...	...	...	...	...	...	...	111·32	40·61	2,320·00	1,537·29	1,689·22	...
East Murchison ...	Lawlers ...	...	1·34	76·05	192·42	193·76	...						
Do.	Wiluna ...	...	43·47	3,410·75	4,223·40	4,266·87	...	...	44·81	5,553·05	5,980·52	6,025·33	...
Do.	Black Range ...	...	...	2,066·25	1,564·70	1,564·70	...						
Murchison ...	Cue	10·95	46·81	3,560·05	2,878·84	2,936·60	...						
Do.	Meekatharra ...	22·46	7·81	38,385·00	18,986·77	19,017·04	...						
Do.	Day Dawn ...	22·58	...	1,799·50	1,451·01	1,473·59	...	58·27	68·92	48,645·80	27,759·11	27,886·30	...
Do.	Mt. Magnet ...	2·28	14·30	4,901·25	4,442·49	4,459·07	...						
Yalgoo	...	...	...	...	...	...	...	23·00	5·87	2,721·75	2,365·53	2,394·40	...
Mt. Margaret ...	Mt. Morgans ...	10·79	9·83	10,607·80	3,698·25	3,718·89	...						
Do.	Mt. Malcolm ...	4·07	53·62	95,909·75	31,505·65	31,563·34	2,604·79	20·54	92·78	106,981·05	36,585·13	36,698·45	2,604·79
Do.	Mt. Margaret...	5·68	29·31	463·50	1,381·23	1,416·22	...						
North Coolgardie...	Menzies ...	5·68	24·58	726·60	1,405·94	1,436·20	...						
Do.	Ularring ...	...	...	...	451·00	451·00	...						
Do.	Niagara ...	...	...	...	14·91	14·91	...	5·68	24·58	1,081·60	2,024·32	2,054·58	...
Do.	Yerilla ...	...	...	355·00	152·47	152·47	...						
Broad Arrow ...	...	...	...	...	...	...	...	72·65	268·92	14,369·83	7,228·24	7,569·81	...
N.E. Coolgardie ...	Kanowna ...	34·00	80·39	2,953·05	2,129·55	2,243·94	...						
Do.	Kurnalpi ...	70·38	...	350·00	172·43	242·81	...	104·38	80·39	3,303·05	2,301·98	2,486·75	...
East Coolgardie ...	East Coolgardie	359·56	380·05	473,820·12	298,119·19	298,858·80	28,624·84						
Do.	Bulong ...	16·75	78·92	332·60	301·42	397·09	...	376·31	458·97	474,152·72	298,420·61	299,255·89	28,624·84
Coolgardie ...	Coolgardie ...	81·12	35·63	3,484·51	4,161·97	4,278·72	...						
Do.	Kunanalling ...	4·52	19·85	1,384·80	1,482·89	1,507·26	...	85·64	55·48	4,869·31	5,644·86	5,785·98	...
Yilgarn	...	...	...	...	...	...	...	2·89	16·97	26,921·35	9,206·91	9,226·77	...
Dundas	...	...	...	...	...	...	...	·35	...	3,664·05	2,738·71	2,739·06	...
Phillips River ...	...	...	...	...	...	...	...	4·91	1·49	273·00	277·58	283·98	...
State generally		...	...	...	...	...	...	...	10·20	...	...	10·20	...
Total for 1927 ...		...	...	...	...	...	...	1,214·56	1,220·50	695,951·06	404,035·26	406,470·32	31,229·63

TABLE III.—*Return showing for the respective Goldfields and Districts, etc.*—continued.

Goldfield.	District.	Total Gold and Silver Yield—Districts. Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Total Gold.	* Silver.	Total Gold and Silver Yield—Goldfields. 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	...	...	...	...	...	...	...	4,278·71	...	17,597·50	14,127·25	18,405·96	...
Pilbara	Marble Bar ...	12,537·79	3,727·97	85,210·03	128,165·90	144,431·66	613·91						
Do.	Nullagine ...	6,793·60	534·57	42,303·24	74,288·55	81,616·72	28·67	19,331·39	4,262·54	127,513·27	202,454·45	226,048·38	642·58
West Pilbara ...	...	...	...	...	...	...	...	5,847·72	275·00	19,322·71	22,112·36	28,235·08	1,331·07
Ashburton	...	...	...	...	...	...	...	8,652·20	315·64	...	...	8,967·84	7,787·69
Gascoyne	...	...	...	...	...	...	...	495·48	21·88	356·70	337·83	855·19	...
Peak Hill	...	...	...	...	...	...	...	2,401·07	4,244·64	527,511·01	261,508·42	268,154·13	2,287·63
East Murchison ...	Lawlers ...	5,614·49	7,252·42	2,040,097·91	913,517·29	926,384·20	25,997·48						
Do.	Wiluna ...	99·46	272·30	222,805·00	118,853·73	119,225·49	237·00	7,226·57	23,951·72	3,461,328·05	1,803,360·87	1,834,539·16	42,735·05
Do.	Black Range ...	1,512·62	16,427·00	1,198,425·14	770,989·85	788,929·47	16,500·57						
Murchison	Cue	1,313·80	5,840·03	490,176·72	396,880·85	404,034·68	513·68						
Do.	Meekatharra ...	11,844·32	13,472·76	1,600,946·24	1,052,215·20	1,077,532·28	5,028·90						
Do.	Day Dawn ...	2,471·16	9,903·37	1,975,046·83	1,303,905·58	1,316,280·11	169,210·44	17,520·01	45,247·03	4,626,099·42	3,160,510·96	3,223,278·00	175,927·20
Do.	Mt. Magnet ...	1,890·73	16,030·87	559,929·63	407,509·33	425,430·93	1,174·18						
Yalgoo	...	...	...	...	...	...	...	1,612·49	1,878·55	235,655·80	167,691·18	171,182·22	1,022·61
Mt. Margaret ...	Mt. Morgans ...	1,815·91	3,814·70	1,030,057·00	549,201·14	554,831·75	5,775·05						
Do.	Mt. Malcolm ...	2,801·14	7,635·49	3,629,421·86	1,820,703·68	1,831,140·31	93,770·84	8,072·72	19,539·95	6,289,984·06	3,199,727·83	3,227,340·50	156,393·76
Do.	Mt. Margaret...	3,455·67	8,089·76	1,630,505·20	829.823·01	841,368·44	56,847·87						
North Coolgardie ...	Menzies ...	1,148·95	4,003·41	1,239,190·18	1,130,660·73	1,035,813·09	19,224·48						
Do.	Ularring ...	22·17	1,162·61	298,568·88	290,825·85	292,010·63	5,973·05						
Do.	Niagara ...	1,525·78	1,618·39	899,327·36	500,000·23	503,144·40	5,603·42	3,944·11	14,356·78	2,656,650·71	2,014,436·18	2,032,737·07	30,863·99
Do.	Yerilla ...	1,247·21	7,572·37	219,564·29	192,949·37	201,768·95	63·04						
Broad Arrow ...	...	...	...	...	...	...	...	19,590·12	16,167·80	879,695·31	486,448·69	522,206·61	2,184·96
N.E. Coolgardie ...	Kanowna ...	104,604·34	11,651·31	970,982·70	605,347·22	721,602·87	2,522·12						
Do.	Kurnalpi ...	12,179·19	6,135·65	6,572·41	13,742·33	32,057·17	11·22	116,783·53	17,786·96	977,555·11	619,089·55	753,660·04	2,533·34
East Coolgardie ...	East Coolgardie	28,376·13	34,994·09	31,942,969·96	20,041,170·31	20,104,540·53	2,144,323·50						
Do.	Bulong ...	26,770·45	15,240·85	156,025·03	122,796·43	164,807·73	12·92	55,146·58	50,234·94	32,098,994·99	20,163,966·74	20,269,348·26	2,144,336·42
Coolgardie	Coolgardie ...	9,613·74	11,314·17	1,589,919·15	1,001,377·30	1,022,305·21	891·44						
Do.	Kunanalling ...	1,050·81	6,547·53	289,991·09	228,986·73	236,585·07	48·67	10,664·55	17,861·70	1,879,910·24	1,230,364·03	1,258,890·28	940·11
Yilgarn	...	...	...	...	...	...	...	95·69	1,513·97	2,361,312·11	1,080,185·04	1,081,794·70	32,288·71
Dundas	...	...	...	...	...	...	...	2,053·35	14,043·67	915,705·86	629,105·66	645,202·68	36,392·90
Phillips River ...	...	...	...	...	...	...	...	483·77	783·42	92,729·20	88,202·59	89,469·78	15,688·17
Donnybrook † ...	...	...	...	...	...	...	...	23·24	...	1,653·30	818·52	841·76	...
State generally ...	...	...	...	...	...	...	...	154·45	362·00	27·00	7,865·29	8,381·74	30,876·54
Total to 31st December, 1927 ...		...	...	...	...	...	...	**284,377·75**	**232,848·19**	**57,169,602·35**	**35,152,313·44**	**35,669,539·38**	**2,684,232·73**

* 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 1927, AND THE TOTAL PRODUCTION TO DATE.

Kimberley Goldfield.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927.					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. Dockerell	...	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	...
	From Goldfields generally :—											
	Reported by Banks and Gold Dealers		193·89	...	...	...	...	4,278·71	...	...	...	...
		Total	**193·89**	...	...	...	...	**4,278·71**	...	**17,597·50**	**14,127·25**	...

Pilbara Goldfield.

MARBLE BAR DISTRICT.

Bamboo Creek	850	Federation	...	...	23.50	101.49	...	...	...	76.50	383.13	...
Do. ...	819	Forrest Abbey	...	...	...	...	...	...	...	178.00	188.83	...
Do. ...	707	Kitchener	...	...	253.00	360.38	...	...	...	4,212.00	8,312.20	...
Do. ...	740	(Mount Prophecy)	...	...	...	...	...	...	1.11	1,040.50	1,898.07	...
Do. ...	740, 794 ...	Mount Prophecy Leases ...	...	...	197.50	181.03	...	...	...	2,045.00	3,004.35	...
Do. ...	794	(Perseverance)	...	...	...	...	...	...	...	290.50	584.21	...
Do. ...	817	Prince Charlie	...	...	91.00	330.90	...	...	...	399.25	1,279.99	...
Do. ...	...	Voided leases	...	...	...	...	...	...	508.66	15,328.60	23,515.49	...
Do. ...	...	Sundry claims	...	...	46.50	24.68	...	...	307.83	1,249.85	1,534.16	...

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	...	...	...	...	...	...	...	10.25	58.01	...
Lallah Rookh	...	Voided leases	...	...	...	...	...	...	4.78	3,283.50	4,170.81	**574.01**
Do.	...	Sundry claims	...	...	...	...	...	...	...	6,992.00	6,892.82	...
Marble Bar ...	844	Anglo French	...	...	114.00	183.01	...	...	...	348.50	453.77	...
Do. ...	854	Coongan Star	...	...	10.50	35.25	...	...	...	10.50	35.25	...
Do. ...	852	Great Oversight	...	...	17.50	12.69	...	...	...	30.50	61.35	...
Do. ...	(805)	Homeward Bound East ...	...	...	...	...	...	...	...	760.50	951.68	...
Do. ...	845	Outward Bound	...	...	126.00	168.81	...	...	...	821.00	922.69	...
Do. ...	851	Viking	...	...	...	...	...	...	...	34.50	45.52	...
Do. ...	...	Voided leases	...	...	...	...	...	...	181.87	21,601.95	27,400.38	...
Do. ...	...	Sundry claims	...	...	47.00	31.34	...	38.68	149.23	5,304.14	5,911.12	...
North Pole ...	...	Voided leases	...	...	...	...	...	...	...	474.00	340.75	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	50.50	69.56	...
North Shaw ...	...	Voided leases	...	...	...	...	...	7.53	...	762.45	861.28	...
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	...	...	...	...	...	...	73.90	1,438.50	1,739.44	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	171.69	639.25	797.44	...
Warrawoona...	...	Voided leases	...	...	...	...	...	...	16.99	10,072.80	18,136.84	...
Do.	...	Sundry claims	...	...	...	...	...	44.30	403.70	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	...	Voided leases	...	...	...	...	...	...	42.86	757.79	1,113.33	...
Do.	...	Sundry claims	...	...	...	...	...	.93	39.41	355.86	592.18	...
Yandicoogina	...	Voided leases	...	...	...	...	...	...	140·76	2,733.20	5,824.23	...
Do.	...	Sundry claims	...	...	...	...	...	...	238.35	103.75	120.34	...
	From District generally:—											
	Sundry Parcels treated at:											
		State Battery, Bamboo Creek	...	...	...	160.49	...	...	...	...	3,372.85	**39.90**
		State Battery, Marble Bar	...	...	...	...	...	...	...	...	621.64	...
		Various Works	...	...	...	...	...	...	...	237.95	1,204.91	...
	Reported by Banks and Gold Dealers		11.33	...	...	...	...	12,238.49	340.88	...	...	...
		Total	**11.33**	...	926.50	1,590.07	...	12,537.79	3,727.97	85,210.03	128,165.90	**613.91**

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 1927 Alluvial.	Total for 1927 Dollied and Specimens.	Total for 1927 Ore treated.	Total for 1927 Gold therefrom.	Total for 1927 Silver.	Total Production Alluvial.	Total Production Dollied and Specimens.	Total Production Ore treated.	Total Production Gold therefrom.	Total Production 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	219L	Shamrock	...	...	...	...	...	...	...	89.00	109.15	11.77
Do.	...	Voided leases	...	...	...	...	...	...	8.19	4,482.00	8,854.88	...
Do.	...	Sundry claims	...	...	...	...	...	...	3.77	461.50	751.47	16.90
Elsie ...	...	Voided leases	...	...	...	...	...	...	...	408.25	1,323.85	...
Do.	...	Sundry claims	...	...	...	...	...	...	...	24.00	27.48	...
Jimble Bar ...	225L [41H] ...	Coobina	...	50.51	2.00	33.01	...	...	50.51	2.00	33.01	...
McPhee's Creek	...	Voided leases	...	...	...	...	...	...	...	113.00	137.92	...
Middle Creek	...	Voided leases	...	...	...	...	...	...	...	6,848.90	8,603.45	...
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	...	...	...	...	...	165.69	210.96	3,984.75	9,336.03	...
20-Mile Sandy	...	Voided leases	...	...	...	...	...	...	3.20	5,093.70	7,786.99	...
Do.	...	Sundry claims	...	...	146.00	204.47	...	33.10	20.55	3,495.65	4,271.29	...
	From District generally:—											
	Sundry Parcels treated at:											
	Doherty's Works		...	...	...	85.61	...	...	...	...	1,262.93	...
	Fremantle Trading Co., Ltd. Works		...	...	...	...	...	...	...	...	8.29	...
	State Battery, 20-Mile Sandy		...	...	...	47.83	...	...	...	62.00	1,815.43	...
	Various Works		...	...	...	...	...	...	...	50.50	2,641.67	...
	Reported by Banks and Gold Dealers		...	...	...	...	...	6,593.74	35.54	...	...	...
		Total	...	50.51	148.00	370.92	...	6,793.60	534.57	42,303.24	74,288.55	28.67

West Pilbara Goldfield.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927 Alluvial.	Total for 1927 Dollied and Specimens.	Total for 1927 Ore treated.	Total for 1927 Gold therefrom.	Total for 1927 Silver.	Total Production Alluvial.	Total Production Dollied and Specimens.	Total Production Ore treated.	Total Production Gold therefrom.	Total Production Silver.
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 ...	...	Voided leases	...	...	...	...	...	...	48.12	267.00	413.59	...
Do. ...	...	Sundry claims	...	...	...	...	...	1.11	86.24	163.00	249.86	...
Roebourne ...	M.L. 183, M.L. 167	Roebourne Copper Mines, Ltd. ...	...	...	...	...	...	...	...	...	21.12	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	113.36	577.87	350.74
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 ...	171	Yank Lennan	...	...	20.00	3.48	...	...	...	20.00	3.48	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	2,436.15	3,079.81	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	64.00	62.90	...
Whim Creek	...	Voided leases	...	...	...	...	...	...	...	...	...	883.80
	From Goldfield generally :— Reported by Banks and Gold Dealers		49.36	...	...	...	...	5,637.03	92.82	...	7.16	...
		Total	**49.36**	...	**20.00**	**3.48**	...	**5,847.72**	**275.00**	**19,322.71**	**22,112.36**	**1,381.07**

Ashburton Goldfield.

Mt. Mortimer	...	Sundry claims	...	...	...	...	...	364.63	315.64	...	...	74.47
Uaroo ...	...	Voided leases	...	...	...	...	...	...	...	...	...	7,713.22
	From Goldfield generally :— Reported by Bank and Gold Dealers		15.41	...	...	...	...	8,287.57	...	...	...	...
		Total	**15.41**	...	...	...	...	**8,652.20**	**315.64**	...	...	**7,787·69**

Gascoyne Goldfield.

Bangemall ...	...	Voided leases	...	...	...	...	...	...	6.22	350.70	313.82	...
Do. ...	...	Sundry claims	...	...	...	...	...	85.21	15.66	6.00	24.01	...
	From Goldfield generally :— Reported by Banks and Gold Dealers		78.63	...	...	...	...	410.27	...	...	...	...
		Total	**78.63**	...	...	...	...	**495.48**	**21.88**	**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 1927. Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Total Production. 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 ...	...	Voided leases	...	...	...	...	...	60.86	30.91	4,725.25	2,019.78	...
Do. ...	...	Sundry claims	...	...	...	...	...	235.35	23.51	1,093.75	506.79	...
Horseshoe ...	...	Voided leases	...	...	...	...	...	...	1,962.66	728.38	1,973.46	2.00
Do. ...	...	Sundry claims	...	...	...	...	...	15.70	648.12	16.05	45.14	...
Mt. Fraser ...	...	Voided leases	...	...	...	...	...	...	...	389.50	320.96	...
Do. ...	...	Sundry claims	88.28	40.61	15.00	25.93	...	88.28	40.61	160.25	146.84	...
Peak Hill ...	459P	Atlantic	...	...	291.00	83.85	...	...	...	936.50	829.09	...
Do. ...	448P	Evening Star	...	...	426.00	132.24	...	...	17.97	2,542.50	3,917.07	...
Do. ...	491P	Independent	...	...	163.50	92.47	...	...	...	355.25	396.59	...
Do. ...	5P, 306P ...	No. 1 North leases	...	...	834.25	245.36	...	...	610.10	5,681.00	3,970.25	.04
Do. ...	492P	North Star	...	...	371.00	51.20	...	...	...	963.50	170.05	...
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 Goldfield, Ltd.)	...	...	...	...	...	...	191.46	462,057.01	223,273.59	2,285.59
Do. ...	496P	Wembley	...	...	143.25	55.30	...	...	...	313.50	144.19	...
Do. ...	(497)	Wowser	...	...	...	...	...	...	...	86.25	8.73	...
Do. ...	...	Voided leases	...	...	...	...	...	...	543.06	21,981.87	7,545.60	...
Do. ...	...	Sundry claims	23.04	...	71.00	29.85	...	53.11	251.84	20,442.50	5,803.37	...
Ravelstone ...	...	Voided leases	...	...	...	...	...	...	101.64	4,219.85	3,117.68	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	553.60	283.17	...
Wilgeena ...	...	Voided leases	...	...	...	...	...	...	28.54	128.50	146.79	...
Wilthorpe ...	...	Voided leases	...	...	...	...	...	...	...	47.00	20.93	...
Yowerina ...	(495P)	Baumgarten's Reward	...	...	...	...	...	...	...	19.50	36.46	...
Do. ...	...	Sundry claims	...	...	5.00	21.94	...	...	...	24.50	105.59	...

From Goldfield generally :—												
Sundry Parcels treated at :												
Purcell's Works			...	...	...	422.00	...	...	...	...	3,295.70	...
State Battery, Egerton			...	...	...	...	...	...	...	...	294.87	...
State Battery, Peak Hill			...	...	...	377.15	...	...	3.05	15.00	2,815.76	...
Various Works			...	...	...	...	...	...	...	30.00	319.97	...
Reported by Banks and Gold Dealers			...	...	...	...	...	1,947.77	345.17	...	...	...
Total			**111.32**	**40.61**	**2,320.00**	**1,537.29**	...	**2,401.07**	**4,244.64**	**527,511.01**	**261,508.42**	**2,287.68**

East Murchison Goldfield.

LAWLERS DISTRICT.

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	...	...	...	...	...	...	...	3,555.00	2,819.91	...
Do. ...	382	(Yellow Aster : Yellow Aster G.M. Co. N.L.)			...	...	...	...	...	10,359.75	5,425.26	...
Do. ...	...	Voided leases	...	...	...	...	...	...	141.57	23,350.50	11,377.02	...
Do. ...	...	Sundry claims	...	...	42.00	8.77	...	...	478.40	1,569.75	893.00	...
Lake Darlot ...	...	Voided leases	...	...	...	...	...	...	4,448.42	65,385.30	48,740.44	...
Do. ...	...	Sundry claims	...	...	...	...	...	1.16	474.45	3,972.64	3,387.61	2.60
Lawlers ...	(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. ...	(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 1927. Alluvial.					Total Production. Alluvial				
			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 oz.
Lawlers ...	(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. ...	(1234)	Vivien Gem	...	...	...	...	...	...	...	547.00	59.78	...
Do. ...	58, (62), (918), (1178)	Waroonga G.M. Co., Ltd.	...	...	...	...	...	...	3.27	55,416.00	13,455.56	...
Do. ...	(62), (562), (563)	(Waroonga South leases)	...	...	...	...	...	...	...	42,150.00	14,329.48	...
Do. ...	58	(Woronga: London and Western Australian Exploration Co., Ltd.)	...	...	...	...	...	...	...	2,438.50	2,755.45	...
Do. ...	...	Voided leases	...	...	...	...	...	...	687.39	311,849.22	161,852.88	2,533.25
Do. ...	...	Sundry claims	...	...	...	...	...	14.81	261.04	11,551.98	7,115.54	268.34
New England	...	Voided leases	...	...	...	...	...	...	57.54	899.00	720.25	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	4.32	554.50	465.23	...
Sir Samuel	(1230)	Canberra	...	...	...	...	...	...	...	19.00	14.80	...
Do. ...	1225 ...	Combine	...	...	...	...	...	...	...	13.00	7.74	...
Do. ...	1235	Dolly Pot	...	...	4.05	67.65	...	...	...	4.05	67.65	...
Do. ...	(1228)	Vanguard	...	...	...	2.47	...	...	...	249.00	154.97	...
Do. ...	(1232)	Westralia	...	...	...	...	...	...	...	286.00	152.02	...
Do. ...	...	Voided leases	...	...	...	...	...	...	13.49	266,065.50	138,811.99	10,225.58
Do. ...	...	Sundry claims	...	1.34	20.00	19.69	...	...	22.71	4,350.00	2,995.88	...
Wiluna ...	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. ...	870, (10J) ...	(Moonlight)	...	...	...	...	...	...	...	1,856.00	787.66	...
Do. ...	917, [12J] ...	(Squib)	...	...	...	...	...	...	...	276·50	67.00	...
Do. ...	...	Voided leases	...	...	...	...	...	...	537.27	104,086.75	62,811.02	124.00
Do. ...	...	Sundry claims	...	...	...	...	...	5.30	...	2,841.15	1,516.76	...
		From District generally :—										
		Sundry Parcels treated at:										
		Great Eastern Battery	...	...	...	...	...	...	...	...	6,201.33	151.37
		Lawlers Public Battery (Retreatment Works) ...	...	...	...	...	...	...	...	...	1,439.37	...
		Queen Works	...	...	...	25.86	...	...	...	...	1,300.97	39.36
		State Battery, Lake Darlot	...	...	...	...	...	...	...	315.00	1,097.09	...
		State Battery, Sir Samuel	...	...	10.00	67.98	...	...	...	33.50	1,845.47	...
		State Battery, Wiluna	...	...	...	...	...	...	...	390.00	2,047.17	20.00
		Western Machinery Co., Ltd., Works	...	...	...	...	...	...	...	80.00	37.25	...
		Various Works	...	...	...	...	...	...	...	1,619.50	14,563.26	744.33
		Reported by Banks and Gold Dealers	...	...	...	...	...	5,593.22	67.15	...	5.74	...
		Total	...	**1.34**	**76.05**	**192.42**	...	**5,614.49**	**7,252.42**	**2,040,097.91**	**913,517.29**	**25,997.48**

WILUNA DISTRICT.

Collavilla ...	...	Voided leases	...	...	...	...	...	...	...	1,518.00	496.28	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	30.00	21.47	...
Corboy's Find	350J	Corboy's Reward	...	...	382.00	162.79	...	...	...	707.00	386.80	...
Do. ...	359J	Corboy's Reward North	...	...	148.00	59.08	...	...	...	1,079.00	578.57	...
Do. ...	(367J)	Laughing Jack	...	...	...	...	...	...	...	103.00	31.76	...
Do. ...	(340J)	Wandilla	...	...	20.00	4.15	...	...	...	45.00	26.26	...
Do. ...	355J	(Waratah)	...	...	...	...	...	...	...	42.50	31.27	...
Do. ...	355J, 357J ...	Waratah leases	...	...	234.00	91.02	...	...	...	234.00	91.02	...
Do. ...	357J	(Waratah South)	...	...	...	...	...	...	...	190.50	126.30	...
Do. ...	...	Sundry claims	...	...	521.00	276.61	...	...	...	767.00	345.74	...
Gum Creek ...	...	Voided leases	...	...	...	...	...	...	...	1,334.50	579.16	...
Mt. Keith ...	...	Voided leases	...	...	...	...	...	...	8.29	8,279.50	6,882.05	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	78.26	1,595.25	976.93	...
New England	(353J)	Toscana	...	...	198.00	90.30	...	...	1.25	722.00	1,137.47	5.00
Do. ...	...	Voided leases	...	...	...	...	...	...	...	952.00	309.11	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	137.00	122.49	...
Wiluna ...	91J, [940] ...	(Adelaide)	...	...	...	...	...	...	...	401.00	33.29	...
Do. ...	352J	Black Adder	...	...	151.25	193.55	...	...	...	593.75	791.19	...
Do. ...	231J	Brilliant	...	...	278.00	79.31	...	...	...	1,326.00	424.03	...
Do. ...	373J	Brilliant North	...	...	392.00	717.31	...	...	...	511.75	1,088.16	...
Do. ...	405J	Capelli's Reward	...	...	44.75	14.29	...	...	...	44.75	14.29	...
Do. ...	369J	Cromarty Hope	...	...	365.00	143.34	...	...	...	618.50	317.49	...
Do. ...	391J	Gloaming	...	...	141.50	54.79	...	...	...	141.50	54.79	...
Do. ...	(397J)	Gordon	...	...	7.00	10.25	...	...	...	7.00	10.25	...
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

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 1927. Alluvial.					Total Production. Alluvial.				
			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 ...	119J	(Happy Jack)	...	...	...	...	...	...	...	743.00	236.41	...
Do. ...	(371J)	Little Bulletin	...	...	...	...	...	...	...	30.75	18.32	...
Do. ...	10J, [870] ...	(Moonlight)	...	...	...	...	...	...	...	5,181.00	1,078.40	...
Do. ...	10J, [870], 37J, 91J, 109J, (123J)	Moonlight leases	...	...	25.75	24.79	...	...	...	28,767.00	11,991.14	...
Do. ...	377J	Mother of Gwalia	...	...	...	...	...	...	...	15.75	27.10	...
Do. ...	333J	Neb	...	...	...	...	...	...	...	754.75	257.16	...
Do. ...	275J	W.A.	...	...	...	...	...	...	...	173.25	136.10	...
Do. ...	6J, [542], 7J, [548], (8J), ([550]), (11J), (13J), (14J), (15J), (17J), (21J), (161J), (163J), (193J), 194J, (256J), (257J)	(Western Machinery Co., Ltd.) ...	...	...	...	...	...	...	...	69,555.50	33,178.75	...
Do. ...	12J, [917], (23J), ([946]), (28J), ([954]), (30J), ([959]), (33J), ([967]), (36J), ([975]), (43J), ([1018]), (76J), ([1090]), (113J) 119J, (124J), (137J), 266J	(Wiluna Gold Mines, Ltd.)	...	...	...	...	...	...	...	31,150.75	14,659.20	...
Do. ...	6J, [542], 7J, [548], 12J, [917], 119J, 194J, 262J, 263J, 264J, 266J, 271J, 272J, 276J, 277J, 278J, 280J, 281J, 282J, 283J, 287J, 389J	Wiluna Gold Mines, Ltd.	...	...	...	435.18	...	...	...	...	435.18	...
Do. ...	...	Voided leases	...	...	...	...	...	...	27.92	23,940.00	10,974.91	...
Do. ...	...	Sundry claims	...	43.47	502.50	264.81	...	89.68	153.66	11,136.25	5,560.51	.33
	From District generally :—											
	Sundry Parcels treated at:											
	State Battery, Mt. Keith		...	...	...	...	...	...	...	...	781.64	12.68
	State Battery, Wiluna		...	...	...	1,601.83	...	...	...	202.00	13,862.32	198.70
	Reported by Banks and Gold Dealers		...	...	...	...	...	9.78	2.92	...	...	...
	Total		...	43.47	3,410.75	4,223.40	...	99.46	272.30	222,805.00	118,853.73	237.00

BLACK RANGE DISTRICT.

Barrambie ...	...	Voided leases ...	...	...	...	...	...	...	...	455.50	1,862.24	...
Do. ...	...	Sundry claims	...	...	...	...	...	3.53	133.52	158.05	494.37	...
Bellchambers	...	Sundry claims	...	...	...	...	...	...	...	159.00	59.81	...
Birrigrin ...	...	Voided leases ...	...	...	...	...	...	...	820.68	12,018.16	15,040.45	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	34.52	744.50	678.89	...
Curran's Find	...	Voided leases ...	...	...	...	...	...	18.24	222.89	7,038.50	3,001.02	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	29.38	1,188.50	430.37	...
Erroll's ...	...	Voided leases ...	...	...	...	...	...	14.17	132.04	72.00	426.68	...
Do. ...	...	Sundry claims	...	...	...	...	...	6.53	399.11	228.00	327.90	...
Hancock's ...	949B	Comedy King ...	...	...	65.25	96.93	...	...	...	158.25	237.69	...
Do. ...	...	Voided leases ...	...	...	...	...	...	...	6,523.59	31,359.75	32,496.84	55.72
Do. ...	...	Sundry claims	...	...	58.50	12.77	...	4.21	119.02	2,867.00	1,443.42	...
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 ...	...	...	286.00	310.55	...	...	...	852.00	942.59	...
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	...	...	57.00	131.09	...	...	45.67	876.50	672.88	...
Nungarra ...	...	Voided leases ...	...	...	...	...	...	25.94	932.34	9,000.75	4,813.99	...
Do. ...	...	Sundry claims	...	...	...	...	...	46.67	1,455.98	3,601.90	2,212.33	...
Sandstone ...	(946B)	Nous Verrons ...	...	...	...	...	...	...	...	185.50	155.51	...
Do. ...	(95U)	Oroya East ...	...	...	207.00	173.47	...	...	60.87	207.00	173.47	...
Do. ...	947B	Waratah ...	...	...	290.00	235.63	...	...	...	316.55	279.77	...
Do. ...	...	Voided leases ...	...	...	...	...	...	4.75	3,550.59	688,541.42	442,459.33	11,754.22
Do. ...	...	Sundry claims	...	...	258.50	228.48	...	33.72	1,358.39	5,629.15	3,483.30	...
Youanmi ...	...	Voided leases ...	...	...	...	...	...	.36	126.92	358,978.78	176,882.54	4,608.55
Do. ...	...	Sundry claims	...	...	804.00	197.15	...	1.07	2.31	4,234.75	1,031.63	...
	From District generally:—											
	Sundry Parcels treated at:											
	State Battery, Sandstone ...		...	...	...	...	...	...	...	222.00	16,425.21	59.53
	State Battery, Youanmi ...		...	...	40.00	178.63	...	...	...	40.00	4,324.09	...
	Various Works ...		...	...	...	...	...	...	...	37.00	5,664.78	...
	Reported by Banks and Gold Dealers		...	...	...	...	...	1,353.43	11.43	...	...	...
		Total ...	...	...	**2,066.25**	**1,564.70**	...	**1,512.62**	**16,427.00**	**1,198,425.14**	**770,989.85**	**16,500.57**

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

Murchison Goldfield.

CUE DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Dollied and Specimens.	Ore treated.	Gold therefrom.	Silver.	Total Production. 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
Barrambie ...	...	Voided leases	...	...	...	...	...	...	22.49	16,903.92	14,338.52	125.60
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	70.50	35.81	...
Cuddingwarra	(1860)	Big Bell	...	...	...	...	...	...	...	64,448.36	10,965.90	85.29
Do. ...	2050	Little Bell	...	4.49	149.50	26.47	...	...	4.49	149.50	26.47	...
Do. ...	...	Voided leases	...	...	...	...	...	10.59	124.53	35,855.75	43,796.59	15.42
Do. ...	...	Sundry claims	4.47	...	95.25	75.00	...	6.90	91.39	998.98	1,378.52	...
Cue	2053	Carnation	...	...	28.25	3.93	...	...	...	28.25	3.93	...
Do. ...	(2049)	Gem of Cue Extended	...	...	...	...	...	...	...	71.75	100.59	...
Do. ...	...	Voided leases	...	...	...	...	...	41.26	544.21	280,993.62	215,678.11	66.63
Do. ...	...	Sundry claims	2.10	11.43	379.05	222.07	...	73.47	624.43	18,791.04	11,462.31	...
Eelya ...	...	Voided leases	...	...	...	...	...	...	8.78	971.00	1,778.94	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	101.86	595.15	630.47	...
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	1,017.00	1,130.39	...
Reedy's Find	1977	Emu	...	...	...	...	...	...	...	555.50	280.88	...
Do. ...	1981	(Emu North)	...	...	...	...	...	...	...	529.00	282.46	...
Do. ...	1981	Emu North: Moraroa G.M.Co., N.L.	...	...	1,636.00	1,028.41	...	...	...	9,175.00	4,287.62	5.00
Do. ...	...	Voided leases	...	...	...	...	...	...	214.65	1,346.75	6,107.35	...
Do. ...	...	Sundry claims	...	...	...	...	...	169.59	89.74	505.50	672.27	
Tuckabianna...	2048	Buttercup	...	...	445.50	105.65	...	...	...	728.25	167.44	...
Do. ...	...	Voided leases	...	...	...	...	...	...	162.70	3,020.00	4,302.51	...
Do. ...	...	Sundry claims	...	26.76	405.75	239.32	...	24.06	128.90	1,282.00	844.71	...
Tuckanarra ...	2056	Hermit	...	...	28.00	46.80	...	...	...	28.00	46.80	...
Do. ...	...	Voided leases	...	...	...	...	...	14.65	3,061.77	18,000.40	20,708.29	172.77
Do. ...	...	Sundry claims	...	4.13	380.00	239.94	...	99.95	622.49	4,393.73	7,927.83	...

From District generally :—										
Sundry Parcels treated at :										
Cue No. 1 Works	...	...	...	...	...	...	...	1,870.50	6,684.54	...
State Battery, Cue	...	...	12.75	753.95	...	...	...	12.75	3,266.42	...
State Battery, Tuckanarra	...	...	...	137.30	...	...	...	518.50	4,091.53	...
Triplicate Works	...	...	...	...	...	...	...	...	3,546.56	...
Various Works	...	...	...	...	...	...	...	5,055.02	18,568.66	...
Reported by Banks and Gold Dealers	4.38	...	...	...	...	870.26	7.54	...	...	...
Total	**10.95**	**46.81**	**3,560.05**	**2,878.84**	...	**1,313.80**	**5,840.03**	**490,176.72**	**396,880.85**	**513.68**

MEEKATHARRA DISTRICT.

Abbott's ...	...	Voided leases	...	...	...	...	...	...	26.45	35,210.60	37,124.40	...
Do. ...	...	Sundry claims	...	...	50·25	39·34			·49	118·85	138·42	
Belele ...	...	Sundry claims	...	...	75.50	45.07	...	...	...	75.50	45.07	...
Burnakura ...	...	Voided leases	...	...	...	...	...	...	3,239.43	38,480.95	30,579.03	26.90
Do. ...	...	Sundry claims	...	...	...	...	...	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	...	...	...	...	...	...	41.63	435.60	487.80	...
Gabanintha ...	1521N	Mountain View	...	...	...	13.43	...	...	...	...	13.43	...
Do. ...	...	Voided leases	...	...	...	...	...	...	16.93	21,918.00	13,447.58	815.57
Do. ...	...	Sundry claims	...	...	8.00	24.96	...	13.05	74.38	1,080.50	797.29	...
Garden Gully	...	Voided leases	...	...	...	...	...	26.36	74.91	29,854.06	21,435.37	1,102.59
Do. ...	...	Sundry claims	...	...	53.00	42.36	...	...	5.38	483.10	514.62	...
Gum Creek ...	...	Voided leases	...	...	...	...	...	25.27	88.12	3,639.08	3,359.56	...
Do. ...	...	Sundry claims	...	...	43.50	20.31	...	...	...	381.50	298.67	...
Holden's Find	1291N	Waterloo	...	...	50.00	18.98	...	...	...	14,306.00	4,968.07	...
Do. ...	...	Voided leases	...	...	...	...	...	...	18.00	1,487.00	1,154.88	...
Do. ...	...	Sundry claims	...	...	...	...		164.95	44.63	230.25	195.97	...
Jillawarra ...	...	Voided leases	...	...	...	...	...	...	1,134.68	1,499.55	2,801.53	...
Do. ...	...	Sundry claims	...	...	...	...	...	169.94	142.95	23.50	53.81	...
Meeka Pools...	...	Voided leases	...	...	...	...	...	...	...	111.58	82.27	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	2.84	211.72	184.83	...
Meekatharra...	1534N	Empire	...	...	17.50	32.20	...	...	...	17.50	32.20	...
Do. ...	(1501N)	Empire	...	...	14.50	55.37	...	...	39.89	395.25	968.65	...
Do. ...	477N	(Fenian)	...	...	...	...	...	...	...	8,831.75	18,289.22	...
Do. ...	477N, 814N ...	Fenian leases	...	...	...	...	...	...	...	313,485.94	254,989.70	...
Do. ...	1466N	Haveluck	...	...	61.50	128.49	...	...	...	689.50	1,115.04	...
Do. ...	(1528N)	Haveluck North	...	...	10.00	4.81	...	...	...	68.75	72.89	...
Do. ...	475N	(Ingliston Consols Extended) ...	...	...	...	...	...	...	...	1,536.25	4,248.25	.30
Do. ...	475N, 515N, 729N, 822N	Ingliston Consols Extended leases	...	...	35,759.00	17,003.36	...	...	...	486,449.22	252,648.93	...
Do. ...	(1531N)	Ingliston G.M. Co., N.L.	...	...	...	16.07	...	...	...	222.75	348.10	...
Do. ...	1538N	Ingliston G.M. Co., N.L.	...	...	9.25	19.46	...	...	...	9.25	19.46	...
Do. ...	533N	Marmont	...	...	...	...	...	...	...	55,126.10	39,906.03	...

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

MURCHISON GOLDFIELD—*continued.*

MEEKATHARRA DISTRICT—continued.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs
Meekatharra	580N	(Marmont Extended)	...	...	...	...	...	...	...	43.00	38.03	...
Do. ...	580N	Marmont Extended	...	...	183.25	197.47	...	...	...	183.25	197.47	...
Do. ...	580N, (888N) ...	(Marmont Extended leases) ...	...	...	...	...	...	...	...	152.00	129.61	...
Do. ...	1537N	New Gwalia	...	...	52.75	85.85	...	...	...	52.75	85.85	...
Do. ...	1529N	Prohibition G.M. Co., N.L.	...	...	1,000.00	157.79	...	...	...	1,000.00	157.79	...
Do. ...	1532N	Prohibition South	...	...	137.25	16.97	...	...	...	137.25	16.97	...
Do. ...	1530N	United	...	...	301.75	380.56	...	...	...	526.00	670.71	...
Do. ...	...	Voided leases	...	...	...	...	...	3.88	598.42	353,397.89	193,175.58	2,454.74
Do. ...	...	Sundry claims	...	...	267.50	101.11	...	187.56	216.61	8,254.95	4,138.49	...
Mistletoe ...	1502N	Munarra	...	6.84	...	...	...	...	1,000.24	309.00	268.66	...
Do. ...	...	Voided leases	...	...	...	...	...	4.15	...	...	...	...
Do. ...	...	Sundry claims	...	...	...	...	...	113.64	63.65	...	...	...
Mt. Maitland	...	Sundry claims	...	...	...	...	...	...	...	41.25	96.25	...
Munara Gully	...	Voided leases	...	...	...	...	...	...	...	13,167.75	6,489.65	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	11.62	90.50	66.31	...
Nannine ...	(166N)	Nannine	...	...	...	...	...	...	218.15	267.00	772.96	...
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	...	·97	...	...	...	74.53	419.02	2,482.45	1,991.28	...
Quinn's ...	...	Voided leases	...	...	...	...	...	7.30	1,186.50	18,931.16	8,886.79	90.70
Do. ...	...	Sundry claims	...	...	...	...	...	15.07	1,172.91	1,671.50	1,458.18	...
Ruby Well ...	...	Voided leases	...	...	...	...	...	...	...	7,443.00	3,988.36	...
Do. ...	...	Sundry claims	...	...	...	...	...	998.30	389.32	261.00	341.66	...
Stake Well ...	...	Voided leases	...	...	...	...	...	...	200.12	21,362.00	9,566.18	...
Do. ...	...	Sundry claims	1.32	...	...	...	...	1.32	31.79	286.50	301.26	...
Star of the East	...	Voided leases	...	...	...	...	...	...	...	27,244.00	20,305.40	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	127.62	94.97	...
Yalonginda ...	1533N	Heroic	...	...	150.50	73.41	...	...	...	150.50	73.41	...
Do. ...	...	Voided leases	...	...	...	...	...	...	1,591.82	25,776.02	13,256.35	8.68
Do. ...	...	Sundry claims	...	...	140.00	22.32	...	13.82	536.58	2,374.17	1,940.69	...

		From District generally :—										
		Sundry Parcels treated at :										
		Ruby Well Battery	...	...	...	...	...	...	...	...	699.32	...
		State Battery, Meekatharra	...	...	...	487.08	...	...	...	14.00	12,387.41	19.00
		State Battery, Quinn's	...	...	...	...	...	...	...	...	618.79	...
		Tumbulgum Sand Syndicate Works	...	...	...	...	...	...	...	...	205.95	...
		Various Works	...	...	...	...	...	...	...	172.75	4,475.42	342.17
		Reported by Banks and Gold Dealers	21.14	...	...	...	...	9,949.63	13.79	...	...	...
		Total	**22.46**	**7.81**	**38,385.00**	**18,986.77**	...	**11,844.32**	**18,472.76**	**1,600,946.24**	**1,052,215.20**	**5,028.90**

DAY DAWN DISTRICT.

Day Dawn ...	1D, 170D, 210D ...	Great Fingall leases	...	...	213.25	145.31	...	...	...	330.25	413.59	...
Do. ...	1D	(Great Fingall No. 1)	...	...	...	...	...	...	...	...	5.93	
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.) ...	...	...	...	...	...	...	18.19	1,865,708.45	1,185,412.46	169,210.20
Do. ...	1D	(London, Australian, and General Exploration Co., Ltd.)	...	...	...	...	...	...	...	32.00	10.24	...
Do. ...	569D	South Fingall	...	...	1,295.25	866.57	...	...	...	2,431.00	1,408.52	...
Do. ...	...	Voided leases	...	...	...	...	...	160.64	545.37	46,027.38	31,319.37	.24
Do. ...	...	Sundry claims	...	...	188.25	36.83	...	33.99	304.36	4,693.91	2,865.52	...
Jasper Hill ...	...	Voided leases	...	...	...	...	...	4.90	1,210.23	16,080.75	9,369.47	...
Do. ...	...	Sundry claims	...	...	44.25	8.94	...	...	401.27	402.75	477.38	...
Lake Austin (Island)	536D	Eureka	...	...	...	...	...	...	1,271.01	57.25	892.61	...
Do. ...	...	Voided leases	...	...	...	...	...	601.92	1,591.39	29,954.12	45,477.99	...
Do. ...	...	Sundry claims	22.58	...	23.75	17.55	...	59.07	567.57	953.39	586.03	...
Mainland ...	571D	Mainland Consols	...	...	15.25	370.09	...	...	590.51	39.25	667.74	...
Do. ...	...	Voided leases	...	...	...	...	...	.41	2,706.26	7,272.13	23,129.51	...
Do. ...	...	Sundry claims	...	...	19.50	5.72	...	3.24	677.12	123.45	170.58	...
		From District generally :—										
		Sundry Parcels treated at :										
		Neptune Works	...	...	...	...	...	...	...	...	160.57	...
		Various Works	...	...	...	...	...	...	16.61	940.75	1,537.30	...
		Reported by Banks and Gold Dealers	...	...	...	...	...	1,606.99	3.48	...	.77	...
		Total	**22.58**	...	**1,799.50**	**1,451.01**	...	**2,471.16**	**9,903.37**	**1,975,046.83**	**1,303,905.58**	**169,210.44**

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

MURCHISON GOLDFIELD—*continued.*

MOUNT MAGNET DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Lennonville ...	964M	(Empress)	...	...	...	...	...	...	...	1,649.00	7,361.81	...
Do. ...	964M	Empress	...	...	...	...	...	...	...	75.00	454.53	...
Do. ...	964M, (1078M), (1079M), (1115M), (1116M), (1117M)	(Empress leases)	...	...	...	...	...	...	...	4,813.00	3,171.33	...
Do. ...	...	Voided leases	...	...	...	...	...	...	3,196.79	134,931.23	113,240.12	458.82
Do. ...	...	Sundry claims	2.28	...	102.25	33.86	...	19.14	98.01	2,982.17	2,450.08	...
Mt. Magnet ...	1221M	Broken Bond	...	...	71·50	118.20	...	...	...	212.25	541.18	...
Do. ...	1228M	Christmas Gift	...	...	38.00	268.45	...	...	...	38.00	268.45	...
Do. ...	1215M	Hill 60	...	...	3,830.00	2,073·54	...	...	...	6,482.00	3,047.46	...
Do. ...	(1156M)	Leap Year	...	...	...	29.06	...	...	...	1,633.75	1,312.48	...
Do. ...	1201M	Neptune	...	6.70	47.25	92.81	...	...	6.70	360.00	544.68	...
Do. ...	1075M	New Havelock	...	...	...	...	...	...	15.77	2,105.00	1,005.29	...
Do. ...	(1225M)	Poverty Pot	...	...	19.75	15.01	...	...	...	39.75	375.26	...
Do. ...	1216M	Revenue	...	...	...	16.52	...	...	...	44.75	647.83	...
Do. ...	(1220M)	Rubicon	...	...	34.00	22.23	...	...	...	97.00	56.15	...
Do. ...	1224M	Saturn	...	...	113.50	53.23	...	...	41.00	275.50	219.54	...
Do. ...	...	Voided leases	...	...	...	...	...	27.83	8,409.19	368,505.11	209,207.39	714.36
Do. ...	...	Sundry claims	...	7.60	521.50	417.25	...	1.82	1,261.81	24,121.25	16,212.84	...
Mt. Magnet, East	... ...	Voided leases	...	...	...	...	...	63.29	764.53	5,522.28	2,811.75	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	37.22	214.50	144.10	...
Moyagee ...	1217M	Moyagee	...	...	70.00	59.76	...	...	...	197.90	639.50	...
Do. ...	...	Voided leases	...	...	...	...	...	...	5.08	4,571.45	6,696.48	...
Do. ...	...	Sundry claims	...	...	...	...	...	2.83	111.10	661.73	762.65	...
Paynesville ...	1196M	Elsie	...	...	48.50	367.26	...	...	1,434.45	48.75	469.21	...
Do. ...	...	Voided leases	...	...	...	...	...	...	178.89	39.02	69.52	...
Do. ...	...	Sundry claims	...	...	5.00	20.71	...	...	469.98	140.67	881.62	...
Youanmi ...	...	Sundry claims	...	...	...	...	...	...	...	33.00	44.58	...

From District generally :—												
Sundry Parcels treated at :												
		Fremantle Trading Co., Ltd., Works	...	...	...	...	...	...	...	...	143.80	...
		Long Reef Cyanide Works	...	...	...	7.11	...	...	...	...	260.76	...
		Morning Star Battery	...	...	...	...	...	...	...	...	874.80	...
		State Battery, Boogardie	...	...	...	847.49	...	...	...	92.51	17,765.42	...
		Various Works	...	...	...	...	...	...	...	43.06	15,828.72	1.00
Reported by Banks and Gold Dealers			...	...	...	...	...	1,775.82	.35	...	...	...
		Total	**2.28**	**14.30**	**4,901.25**	**4,442.49**	...	**1,890.73**	**16,030.87**	**559,929.63**	**407,509.33**	**1,174.18**

Yalgoo Goldfield.

Adavale ...	...	Sundry claims	...	...	...	...	...	...	...	10.00	12.56	...
Bilberatha ...	...	Voided leases	...	...	...	...	...	...	...	554.00	200.07	...
Do. ...	...	Sundry claims	...	...	19.75	34.43	...	...	2.90	44.00	135.11	...
Carlaminda ...	...	Voided leases	...	...	...	...	...	...	...	947.32	524.72	3.30
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	114.00	71.96	...
Field's Find...	986	Baldwin	...	...	80.00	56.42	...	...	...	80.00	56.42	...
Do. ...	907, 909 ...	Brown's Reward leases ...	...	...	362.00	350.53	...	...	...	4,421.25	3,757.90	...
Do. ...	985	Churchill	...	...	70.00	38.45	...	...	...	70.00	38.45	...
Do. ...	902	Field's Find Extended ...	...	...	...	...	...	...	10.38	31.50	31.35	...
Do. ...	984	Mt. Guthrie	...	...	130.50	16.88	...	...	...	201.50	40.10	...
Do. ...	...	Voided leases	...	...	...	...	...	...	209.34	36,207.05	26,833.68	...
Do. ...	...	Sundry claims	...	...	109.75	63.59	...	5.77	163.59	1,053.75	852.28	...
Goodingnow	(878)	Carnation	...	...	34.00	57.47	...	...	...	3,017.00	4,824.94	...
Do. ...	980	Lake View	...	...	405.00	617.26	...	...	...	573.00	839.90	...
Do. ...	974	Princess Mary	...	...	...	...	...	...	...	38.00	36.01	...
Do. ...	...	Voided leases	...	...	...	...	...	146.70	272.73	25,679.56	29,300.26	...
Do. ...	...	Sundry claims	...	...	...	...	...	148.00	80.76	3,309.00	1,845.53	...
Gullewa ...	...	Voided leases	...	...	...	...	...	...	.78	23,074.50	15,137.98	...
Do. ...	...	Sundry claims	...	5.87	8.00	5·87	...	...	21·07	711.75	588.21	...
Kirkalucka ...	...	Sundry claims	...	...	...	...	...	...	...	8.80	4.01	...
Messenger's Patch	880, 897 ...	Brilliant G.M. Co., N.L.	...	...	774.00	366.68	...	...	...	8,392.00	4,407.04	333.18
Do. ...	880	(Gnows Nest)	...	...	...	...	...	...	...	10,938.00	9,827.20	158.06
Do. ...	880, 897 ...	(Gnows Nest G.Ms., Ltd.)	...	...	...	...	...	...	...	6,175.00	6,709.40	363.97
Do. ...	...	Voided leases	...	...	...	...	...	...	321.80	591.76	383.10	...
Do. ...	...	Sundry claims	...	...	15.00	12.93	...	463.12	324.29	453.55	293.78	...
Mt. Farmer ...	...	Voided leases	...	...	...	...	...	...	...	64.00	40.19	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	5.00	6.22	...
Mt. Gibson ...	...	Voided leases	...	...	...	...	...	...	6.44	434.50	803.57	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	76.00	40.84	...
Ninghan ...	...	Voided leases	...	...	...	...	...	...	...	10.00	1.41	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	5.00	17.89	...

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 1927. Alluvial. Fine ozs.	Total for 1927. Dollied and Specimens. Fine ozs.	Total for 1927. Ore treated. Tons (2,240lbs.)	Total for 1927. Gold therefrom. Fine ozs.	Total for 1927. Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Total Production. Dollied and Specimens. Fine ozs.	Total Production. Ore treated. Tons (2,240lbs.)	Total Production. Gold therefrom. Fine ozs.	Total Production. Silver. Fine ozs.
Noongal ...	953	Revival	...	...	215.00	80.91	...	...	...	1,360.00	754.21	...
Do. ...	...	Voided leases	...	...	...	...	...	...	15.86	3,086.95	1,847.66	...
Do. ...	...	Sundry claims	23.00	...	87.00	65.32	...	34.55	64.97	710.75	445.85	...
Nyounda ...	...	Voided leases	...	...	...	...	...	...	217.63	416.00	183.91	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	4.28	44.00	33.24	...
Pinyalling ...	...	Voided leases	...	...	...	...	...	...	1.36	2,281.60	902.03	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	2.59	160.50	132.57	...
Rothsay ...	...	Voided leases	...	...	...	...	...	...	...	9,360.25	3,560.38	...
Do. ...	...	Sundry claims	...	...	254.50	89.18	...	...	...	1,798.75	851.92	...
Wadgingarra...	...	Voided leases	...	...	...	...	...	...	...	541.61	600.91	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	71.50	38.21	...
Warda Warra	(982)	Western Queen	...	...	16.00	3.38	...	...	...	36.00	9.82	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	15.50	14.88	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	127.00	96.70	...
Warriedar ...	...	Voided leases	...	...	...	...	...	...	...	12,122.00	4,313.13	7.30
Do. ...	...	Sundry claims	...	...	141.25	24.77	...	...	2.84	2,031.10	734.69	...
Yalgoo ...	...	Voided leases	...	...	...	...	...	...	3.23	6,314.50	9,965.18	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	19.89	856.50	518.75	...
Yuin ...	(976)	Royal Standard	...	...	...	97.85	...	...	...	...	177.55	...
Do. ...	...	Voided leases	...	...	...	...	...	...	127.12	66,048.50	27,188.08	130.13
Do. ...	...	Sundry claims	...	...	...	...	...	...	4.70	279.50	59.20	...
	From Goldfield generally :—											
	Sundry Parcels treated at :											
		Brown's Reward Battery	...	...	...	72.60	...	...	...	...	72.60	...
		State Battery, Goodingnow (Payne's Find) ...	...	...	...	11.12	...	...	...	38.50	1,957.40	...
		State Battery, Warriedar	...	...	...	299.89	...	...	...	...	3,774.45	...
		Various Works	...	...	...	...	...	9.42	...	664.00	1,795.78	26.67
	Reported by Banks and Gold Dealers		...	...	...	...	...	804.93	...	...	...	...
		Total	23.00	5.87	2,721.75	2,365.53	...	1,612.49	1,878.55	235,655.80	167,691.18	1,022.61

Mount Margaret Goldfield.

MOUNT MORGANS DISTRICT.

Australia United	...	Voided leases	...	...	...	...	...	...	1,911.63	15,913.69	23,305.76	1.76
Do. ...	...	Sundry Claims	...	...	...	...	...	...	580.98	799.25	2,072.62	...
Eucalyptus ...	...	Sundry claims	...	...	...	...	...	...	...	88.50	107.04	...
Federation Well	...	Voided leases	...	...	...	...	...	...	...	1,248.50	1,782.71	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	108.07	64.68	...
Korong	...	Voided Leases	...	...	...	...	...	17.95	72.23	2,722.00	3,473.45	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	34.97	279.28	232.89	...
Linden ...	346F [1024R] ...	Great Carbine	...	...	...	...	...	...	...	136.50	41.07	...
Do. ...	341F, [903R], 343F, [985R]	Torquay leases	...	...	...	...	...	...	...	6 223.53	3,806.97	.68
Do. ...	...	Voided leases	...	...	...	...	...	...	...	26,124.75	12,939.25	...
Do. ...	...	Sundry claims	4.29	4.95	94.75	45.58	...	4.29	4.95	1,254.00	955.97	...
Mt. Margaret	...	Voided leases	...	...	...	...	...	.37	...	6,412.89	4,290.53	12.55
Do. ...	...	Sundry claims	...	4.90	...	...	...	16.61	66.95	366.10	289.21	...
Mt. Morgans...	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. ...	...	...	10,395.00	3,520.99	...	...	...	197,193.82	54,883.69	...
Do. ...	...	Voided leases	...	...	...	...	...	...	76.56	38,923.75	22,769.63	77.86
Do. ...	...	Sundry claims	3.81	...	...	...	...	12.48	22.66	1,392.29	1,704.22	...
Murrin Murrin	...	Voided leases	...	...	...	...	...	10.43	222.93	128,706.22	101,163.09	29.60
Do. ...	...	Sundry claims	2.69	...	20.50	31.66	...	2.69	245.90	1,615.55	1,686.52	...
Redcastle ...	...	Voided leases	...	...	...	...	...	4.49	436.54	2,509.95	2,169.63	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	103.58	139.00	163.01	...
Yundamindera	...	Voided leases	...	...	...	...	...	...	...	2,553.50	2,093.61	...
Do. ...	...	Sundry claims	...	...	97.55	100.02	...	...	2.35	885.15	591.72	...
	From District generally :—											
	Sundry Parcels treated at:											
	Battlesville Battery		...	...	...	...	...	...	...	126.00	370.00	15.94
	Hainault Sulphide Plant, Kalgoorlie		...	...	...	...	...	...	...	127.21	83.91	...
	Mt. Morven Cyanide Works		...	...	...	...	...	...	...	...	129.48	...
	State Battery, Linden		...	...	...	...	...	...	...	10.00	1,981.34	...
	Westralia Mt. Morgans Works		...	...	...	...	...	...	...	...	153.10	...
	Various Works		...	...	...	...	...	...	...	788.50	3,010.07	84.03
	Reported by Banks and Gold Dealers		...	...	...	...	...	1,746.60	32.47	...	...	...
		Total	10.79	9.85	10,607.80	3,698.25	...	1,815.91	3,814.70	1,030,057.00	549,201.14	5,775.05

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued

MT. MARGARET GOLDFIELD—*continued.*

MOUNT MALCOLM DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927.					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.
Cardinia ...	...	Voided leases	...	...	...	...	...	13.87	1,591.66	1,631.74	3,613.33	...
Do. ...	...	Sundry claims	...	...	...	...	...	3.40	24.70	60.00	89.52	...
Diorite King...	...	Voided leases	...	...	...	...	...	...	845.23	34,659.03	31,744.34	24.05
Do. ...	...	Sundry claims	2.15	...	...	1.15	...	11.21	148.62	2,664.80	3,190.15	...
Dodger's Well	...	Voided leases	...	...	...	...	...	...	57.90	1,299.30	1,927.94	...
Do. ...	...	Sundry claims	...	...	...	...	...	.95	3.37	798.75	665.13	...
Lake Darlot...	...	Voided leases	...	...	...	...	...	...	...	1,048.11	450.52	...
Do. ...	...	Sundry claims	...	52.73	...	...	...	63.04	58.25	599.20	146.05	...
Leonora ...	198c	(Eastern)	...	...	...	...	...	...	...	302.00	321.72	...
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.	...	...	95,854.00	31,407.08	2,604.79	...	...	3,064,210.67	1,424,000.65	92,046.85
Do. ...	198c, 1082c ...	(Sons of Gwalia South G.M. Co., N.L.)	...	...	...	...	...	...	...	631.00	903.61	...
Do. ...	198c, 1082c, (1257c), (1258c), 1259c, (1284c), (1285c), (1300c), (1301c)	(Sons of Gwalia South G.Ms., Ltd.) ...	...	...	...	...	...	...	...	98,239.00	51,593.99	8.66

Do. ...	198c, 1082c, 1259c	(Sons of Gwalia South G.Ms., Ltd)	...	...	...	...	...	...	...	9,909.00	3,169.89	...
Do. ...	...	Voided leases	...	...	...	...	...	...	1,852.57	162,734.95	87,867.40	10.71
Do. ...	...	Sundry claims	...	.89	55.75	97.42	...	30.31	330.67	10,750.80	9,497.18	...
Malcolm ...	...	Voided leases	...	...	...	...	...	...	47.07	62,301.78	47,425.54	...
Do. ...	...	Sundry claims	...	...	...	...	...	5.75	26·50	3,073.65	2,121.73	...
Mertondale ...	...	Voided leases	...	...	...	...	...	...	...	88,663.00	60,840.00	1,497.58
Do. ...	...	Sundry claims	.37	...	...	...	...	1.82	63·04	1,092.46	1,538.97	...
Mt. Clifford ...	1329c	Victory No. 1	...	...	...	...	...	...	249.29	2,475.46	7,854.66	...
Do. ...	...	Voided leases	...	...	...	...	...	...	1,364.45	3,381.50	7,339.23	...
Do. ...	...	Sundry claims	1·55	...	...	...	...	49.26	273.83	1,042.75	1,641.91	...
Pig Well ...	1547c	Starlight	...	...	...	...	...	...	...	12.00	3.45	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	13,575.32	14,673.13	63.68
Do. ...	...	Sundry claims	...	...	...	...	...	...	34.61	2,738.40	1,160.33	...
Randwick ...	...	Voided leases	...	...	...	...	...	...	239.49	8,065.15	8,671.57	...
Do. ...	...	Sundry claims	...	...	...	...	...	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	...	...	...	...	...	36.84	16.52	1,397.80	939.58	...
Wilson's Creek	...	Voided leases	...	...	...	...	...	...	...	333.50	168.27	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	4.24	5.00	19.04	...
Wilson's Patch	...	Voided leases	...	...	...	...	...	...	99.38	27,395.10	12,638.18	1.05
Do. ...	...	Sundry claims	...	...	...	...	...	4.68	13.73	814.00	1,086.36	...
	From District generally :—											
	Sundry Parcels treated at:											
	Fremantle Trading Co., Ltd., Works ...	...	...	...	...	...	...	...	...	...	1.42	...
	State Battery, Leonora	...	...	...	...	...	...	...	...	103.00	11,334.80	98.14
	Various Works	...	...	...	...	...	...	...	...	371.50	7,149.72	20.12
	Reported by Banks and Gold Dealers ...	...	...	...	...	...	...	2,483.14	131.00	...	...	...
		Total	**4.07**	**53.62**	**95,909.75**	**31,505.65**	**2,604.79**	**2,801.14**	**7,635.49**	**3,629,421.86**	**1,820,703.68**	**93,770.84**

MOUNT MARGARET DISTRICT.

Burtville ...	2138T	Nil Desperandum	...	...	30·25	144.07	...	...	...	595.87	1,841.49	...
Do. ...	...	Voided leases	...	...	...	...	...	2.29	413.80	66,801.18	103,935.19	275.27
Do. ...	...	Sundry claims	...	...	...	...	...	...	133.54	3,261.90	2,942.79	...
Duketon ...	...	Voided leases	...	...	...	...	...	3.54	3,213.21	31,485.42	22,318.21	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	65.43	238.50	370.38	...
Eagle's Nest	...	Voided leases	...	...	...	...	...	...	145.34	331.00	1,215.78	...
Do. ...	...	Sundry claims	...	...	...	...	...	11.45	428.41	147.50	133.96	...
Erlistoun ...	2113T	Baneygo North	...	29.31	83.00	30.91	...	...	29.31	670.00	213.46	...
Do. ...	2141T, 2145T ...	King of Creation leases ...	...	...	199.00	80.55	...	...	...	1,054.00	481.74	...
Do. ...	...	Voided leases	...	...	...	...	...	...	11.66	27,012.07	18,461.35	...
Do. ...	...	Sundry claims	...	...	8.00	11.86	...	1,179.43	116.81	2,197.24	1,976.72	...

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

MT. MARGARET GOLDFIELD—*continued.*

MOUNT MARGARET DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927.					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.
Euro ...	...	Voided leases	...	...	...	...	...	...	65.14	91,556.25	37,582.89	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	46.52	259.50	370.57	...
Laverton ...	715T, 806T, (1206T), (1207T), (1483T), (1523T), (1524T), (1525T,) (1542T), (1544T), (1548T)	(Kalgoorlie and Boulder Firewood Co., (Ltd.)	...	...	...	...	...	...	...	71,802.00	25,003.11	3,364.01
Do. ...	715T, 806T, (1206T), (1207T), (1483T), (1523T), (1524T), (1525T), (1542T), (1544T), (1548T)	(Lancefield G.M. Co., Ltd.)	...	...	...	...	...	...	...	102,179.78	39,402.81	...
Do. ...	715, 806T, (1206T), (1207T), (1483T), (1523T), (1524T), (1525T), (1542T), (1544T), (1548T)	(Lancefield G.M. Co., Ltd.)	...	...	...	...	...	...	...	153,829.00	58,842.47	5,824.39
Do. ...	715T, 806T, (1206T), (1207T), (1483T), (1523T), (1524T), (1525T), (1542T), (1544T), (1548T)	(Lancefield G.M. Co., Ltd.)	...	...	...	...	...	...	...	260,749.00	103,535.54	21,612.29
Do. ...	715T, 806T, (1206T), (1523T), (1524T), (1525T), (1542T), (2050T), (2051T)	Lancefield G.Ms., Ltd.	...	...	...	1,015.15	...	...	...	352,730.05	132,147.38	21,081.58
Do. ...	2200T	Pinnacles	2.63	...	104.00	17.83	...	2.63	...	122.00	23.76	...
Do. ...	...	Voided leases	...	...	...	...	...	17.66	2,024.11	457,265.74	260,867.84	4,674.69
Do. ...	...	Sundry claims	...	...	...	28.17	...	209.18	1,396.48	5,196.45	5,012.39	...
Mt. Barnicoat	...	Voided leases	...	...	...	...	...	...	...	652.00	359.12	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	23.00	23.37	...
Mt. Shenton	...	Voided leases	...	...	...	...	...	...	...	15.00	26.65	...
Do. ...	...	Sundry claims	...	...	39.25	52.69	...	...	...	39.25	52.69	...
Quartz Hill ...	...	Voided leases	...	...	...	...	...	...	...	10.00	3.86	...
Red Hill ...	...	Sundry claims	...	...	...	...	...	...	...	27.00	13.76	...

	From District generally:—											
	Sundry Parcels treated at:											
	Brown Hill Consols Works, Kalgoorlie	...	...	...	...	...	...	...	...	...	13.70	...
	Mulga Queen Works	...	...	...	...	...	...	...	...	6.00	181.20	...
	State Battery, Laverton	...	...	...	...	...	...	...	...	97.50	2,865.39	15.64
	Various Works	...	...	...	...	...	...	...	...	151.00	9,603.44	...
	Reported by Banks and Gold Dealers	...	3.05	...	...	...	...	2,029.49	...	...	...	...
	Total		**5.68**	**29.31**	**463.50**	**1,381.23**	...	**3,455.67**	**8,089.76**	**1,630,505.20**	**829,823.01**	**56,847.87**

North Coolgardie Goldfield.

MENZIES DISTRICT.

Comet Vale	5217z	(Gladsome)	...	...	...	...	...	...	...	10,879.50	8,678.16	95.29
Do.	5217z, (5333z), (3180z), 5476z	Gladsome leases	...	...	...	...	...	...	...	64,875.00	50,329.09	1,410.36
Do.	(5410z)	Lake View	...	...	...	...	...	...	10.04	1,135.65	295.85	...
Do.	...	Voided leases	...	...	...	...	...	...	409.70	147,111.07	119,022.33	3,839.28
Do.	...	Sundry claims	...	...	8.60	3.77	...	...	34.99	927.54	635.80	...
Goongarrie	...	Voided leases	...	...	...	...	...	.94	1,027.51	27,198.29	17,428.84	...
Do.	...	Sundry claims	2.74	22.20	13.00	12.60	...	41.55	791.95	1,383.27	1,696.07	...
Menzies	5505z	Golden Age	...	...	119.00	606.86	...	...	...	119.00	606.86	...
Do.	5423z	Lady Shenton	...	...	25.00	7.20	...	...	...	5,314.58	4,214.23	...
Do.	(5504z)	Scandinavia	...	...	15.00	5.15	...	...	...	55.00	33.12	...
Do.	5484	Warrior	...	...	177.00	72.68	...	...	...	1,160.00	539.65	...
Do.	...	Voided leases	...	...	...	...	...	45.42	1,070.55	889,328.47	696,785.41	11,341.73
Do.	...	Sundry claims	1.09	...	178.00	133.74	...	45.57	372.98	20,606.39	15,531.33	776.49
Mt. Ida	(5503z)	Adventure	...	...	...	...	...	...	1.19	...	...	...
Do.	(5500z), (5501z), (5502z)	Elsie May leases	...	...	...	...	...	...	...	5.00	1.85	...
Do.	5506z	D. D.	...	...	77.00	29.14	...	...	...	77.00	29.14	...
Do.	5480z, 5481z	Unexpected leases	...	...	...	101.00	...	...	...	765.00	503.57	...
Do.	5481z	(Unexpected South)	...	...	...	...	...	...	...	36.00	29.45	...
Do.	...	Voided leases	...	...	...	...	...	...	77.07	57,882.37	68,229.23	106.63
Do.	...	Sundry claims	...	2.38	114.00	106.99	...	43.79	11.95	5,697.00	3,303.78	...
	From District generally:—											
	Sundry Parcels treated at:											
	Balkis Battery		...	...	...	...	...	...	...	65.75	4,648.28	...
	Boddington's Cyanide Works		...	...	...	...	...	...	...	...	1,069.35	...
	Crusoe Wedderburn Cyanide Works		...	...	...	...	...	...	...	...	1,497.89	...
	Fremantle Trading Co., Ltd., Works		...	...	...	...	...	...	...	...	212.98	...
	Gidney's Cyanide Works		...	...	...	...	...	...	...	...	906.97	585.27
	Lady Harriet Battery		...	...	...	326.81	...	...	...	279.50	5,029.02	30.00
	Menzies Mining & Exploration Corporation, Ltd., Works		...	...	...	...	...	...	...	639.50	732.04	...
	State Battery, Mt. Ida		...	...	...	...	...	...	...	1,842.25	5,028.57	...
	Various Works		...	...	...	...	...	...	...	1,807.05	23,641.87	1,039.43
	Reported by Banks and Gold Dealers		1.85	...	...	...	...	971.68	195.48	...	...	...
	Total		**5.68**	**24.58**	**726.60**	**1,405.94**	...	**1,148.95**	**4,003.41**	**1,239,190.18**	**1,030,660.73**	**19,224.48**

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

NORTH COOLGARDIE GOLDFIELD—*continued.*

ULARRING DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs
Davyhurst ...	...	Voided leases	...	...	...	...	...	2.93	138.99	155,644.73	123,063.43	5 403.14
Do. ...	...	Sundry claims	...	...	...	...	...	...	30.12	5,999.15	3,219.41	...
Diemel's Find	...	Sundry claims	...	...	...	...	...	...	7.37	102.50	119.13	...
Mulline ...	...	Voided leases	...	...	...	...	...	...	274.09	98,230.72	98,844.73	530.75
Do. ...	...	Sundry claims	...	...	...	...	...	...	53.82	7,122.60	5,061.70	.69
Mulwarrie ...	...	Voided leases	...	...	...	...	...	...	56.84	18,440.68	25,625.54	38.47
Do. ...	...	Sundry claims	...	...	...	...	...	...	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	...
	From District generally :—											
	Sundry Parcels treated at:											
	Hannan's Central Battery, Kalgoorlie ...	...	...	...	...	...	...	...	...	18.40	4.66	...
	State Battery, Mulline	...	...	...	...	451.00	...	...	...	538.50	13,761.97	...
	State Battery, Mulwarrie	...	...	...	...	...	...	...	...	613.18	4,821.30	...
	Various Works	...	...	...	...	...	...	...	15.82	186.75	654.37	...
	Reported by Banks and Gold Dealers ...	...	...	...	...	...	...	19.24	.77	...	...	...
		Total	...	...	...	**451.00**	...	**22.17**	**1,162.61**	**298,568.88**	**290,825.85**	**5,973.05**

NIAGARA DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
Desdemona ...	...	Voided leases	...	...	...	...	...	...	5.73	9,585.25	7,471.39	12.04
Do ...	...	Sundry claims	...	...	...	...	...	...	8.99	1,331.70	634.19	...
Kookynie ...	(780G)	Cosmo	...	...	...	12.91	...	...	3.27	66.99	230.69	...
Do. ...	...	Voided leases	...	...	...	...	...	...	264.29	735,330.94	389,169.30	5,375.97
Do. ...	...	Sundry claims	...	...	...	2.00	...	39.08	93.85	4,931.85	4,440.09	...
Niagara ...	...	Voided leases	...	...	...	...	...	...	104.54	84,472.50	51,887.97	...
Do. ...	...	Sundry claims	...	...	...	...	...	23.29	70.23	9,880.41	6,084.35	...
Tempa ...	...	Voided leases	...	...	...	...	...	...	35.94	49,285.87	22,246.08	174.24
Do. ...	...	Sundry claims	...	...	...	...	...	28.21	244.17	3,221.35	1,912.63	...

		From District generally :—										
		Sundry Parcels treated at :										
		Grafter Battery	...	...	...	...	...	...	...	98.00	448.91	...
		Hainault Sulphide Plant, Kalgoorlie	...	...	...	...	...	...	...	...	9.03	...
		Lubra Queen G.M. Co., N.L., Works	...	...	...	...	...	...	...	...	153.47	...
		State Battery, Niagara	...	...	...	...	...	...	...	671.50	8,955.70	...
		Various Works	...	...	...	...	...	...	...	451.00	6,356.43	41.17
		Reported by Banks and Gold Dealers	...	...	...	...	...	1,435.20	787.38	...	...	...
		Total	...	...	...	**14.91**	...	**1,525.78**	**1,618.39**	**899,327.36**	**500,000.23**	**5,603.42**

YERILLA DISTRICT.

Edjudina ...	1078R	Ace of Hearts	...	...	51.50	39.34	...	...	...	84.00	56.82	...
Do. ...	(1062R)	Martin	...	...	...	...	...	...	...	121.25	98.66	...
Do. ...	1011R	Neta	...	...	...	...	...	...	...	156.75	102.56	...
Do. ...	(1010R), 1011R ...	(Neta leases)	...	...	...	...	...	...	...	407.00	340.01	...
Do. ...	(1077R)	New Glengarry	...	...	...	...	...	...	...	62.75	21.26	...
Do. ...	...	Voided leases	...	...	...	...	...	...	18.44	32,203.20	41,731.77	37.79
Do. ...	...	Sundry claims	...	...	186.50	89.85	...	...	21.26	4,055.33	3,305.49	...
Eucalyptus ...	...	Voided leases	...	...	...	...	...	...	2,864.77	1,351.35	3,020.68	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	367.50	362.50	381.82	...
Linden ...	1024R, [346F] ...	Great Carbine	...	...	...	...	...	...	...	67.75	20.30	...
Do. ...	903R, [341F], 985R, [343F]	Torquay leases	...	...	...	...	...	...	...	325.68	107.45	...
Do. ...	903R, [341F], (904R), 985R, [343F], (992R)	(Westralia United Goldfields, Ltd.) ...	...	...	...	...	...	...	...	1,995.00	1,452.42	...
Do. ...	...	Voided leases	...	...	...	...	...	7.53	553.16	17,179.60	22,098.74	...
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 ...	...	Voided leases	...	...	...	...	...	6.30	87.08	37,835.25	19,760.20	2.00
Do. ...	...	Sundry claims	...	...	117.00	23.28	...	.87	5.31	6,571.35	3,321.74	...
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	40.50	65.53	...
Yundamindera	...	Voided leases	...	...	...	...	...	...	80.47	69,067.85	46,004.87	5.82
Do. ...	...	Sundry claims	...	...	...	...	...	...	85.22	3,151.25	2,740.75	...

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

NORTH COOLGARDIE GOLDFIELD—*continued.*

YERILLA DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
	From District generally :—											
	Sundry Parcels treated at :											
	Battles Ville Battery		...	...	...	...	...	...	...	...	621.83	...
	Fremantle Trading Co., Ltd., Works		...	...	...	...	...	...	...	...	4.92	...
	Neta Battery		...	...	...	...	...	...	...	...	327.37	...
	State Battery, Linden		...	...	...	...	...	...	...	72.00	4,030.90	...
	State Battery, Yarri		...	...	...	...	...	...	...	251.50	5,016.74	3.50
	State Battery, Yerilla		...	...	...	...	...	2.17	...	72.00	1,257.22	...
	Various Works		...	...	...	...	...	...	...	786.35	5,277.20	...
	Reported by Banks and Gold Dealers		...	...	...	...	...	1,011.56	154.74	...	...	...
	Total		...	...	**355.00**	**152.47**	...	**1,247.21**	**7,572.37**	**219,564.29**	**192,949.37**	**63.04**

Broad Arrow Goldfield.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
Bardoc ...	1833w	Zoroastrian	...	...	...	...	...	...	23.25	22.45	106.77	...
Do. ...	...	Voided leases	...	...	...	...	...	...	1,863.68	73,236.55	51,823.64	203.60
Do. ...	...	Sundry claims	...	...	69.53	62.54	...	53.82	578.02	3,607.11	3,134.28	...
Black Flag ...	...	Voided leases	...	...	...	...	...	27.81	373.99	40,332.13	24,451.48	...
Do. ...	...	Sundry claims	...	...	...	...	...	710.99	180.49	2,181.08	2,063.02	...
Broad Arrow...	1771w	North Duke	...	...	...	...	...	...	1,533.79	153.30	592.36	...
Do. ...	1933w	Oversight Tara United ...	...	73.21	42.50	141.98	...	...	457.99	187.79	448.52	...
Do. ...	...	Voided leases	...	...	...	...	...	54.85	6,915.18	119,584,24	102,266.10	18.85
Do. ...	...	Sundry claims	...	51.29	...	...	...	987.53	1,340.52	9,430.20	7,098.75	...
Canegrass ...	...	Voided leases	...	...	...	...	...	...	...	89.10	133.13	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	218.84	39.00	268.29	...
Carnage ...	...	Voided leases	...	...	...	...	...	...	...	138.00	251.97	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	81.00	57.26	...
Paddington ...	...	Voided leases	...	...	...	...	...	5,557.72	257.75	175,109.58	82,198.30	18.96
Do. ...	...	Sundry claims	...	...	53.30	13.92	...	1,714.16	2.13	10,544.48	6,705.03	...
Siberia ...	1336w, 1399w ...	Associated Northern Blocks (W.A.), Ltd.	...	...	12,474.00	6,145.53	...	...	...	20,401–61	12,561.69	...
Do. ...	1399w, (1424w), (1429w), (1442w), (1655w)	(Associated Northern Blocks (W.A.), Ltd.)	...	...	...	...	...	...	...	247,585.84	91,053.70	1,664.70

Siberia ...	(1935w) ...	Exchequer	...	...	...	...	...	...	...	120.50	202.61	...
Do. ...	1371w	Gimlet South	...	...	...	16.32	...	...	...	72,401.22	12,207.36	...
Do. ...	1399w	(Gimlet South Extended) ...	...	...	...	...	...	...	...	525.00	835.44	...
Do. ...	1399w, (1424w), (1429w), (1442w)	(Gimlet South Extended leases)	...	...	...	...	...	...	...	215.00	39.98	...
Do. ...	1289w	Lady Evelyn	...	2.16	...	...	...	...	2.16	902.00	1,577.19	...
Do. ...	1289w, (1308w) ...	(Lady Evelyn leases)	...	...	...	...	...	...	25.26	5,376.25	5,267.70	...
Do. ...	1906w	Orinda	...	...	561.25	223.37	...	...	...	2,456.25	1,851.67	...
Do. ...	(1940w)	Orinda King	...	...	23.25	18.01	...	...	...	23.25	18.01	...
Do. ...	1914w	Renown	...	65.77	21.00	167.07	...	...	595.62	146.00	437.94	...
Do. ...	1375w	(Siberia Consols)	...	...	...	...	...	...	41.58	1,013.50	3,136.03	...
Do. ...	1375w	Siberia Consols	...	...	50.00	51.45	...	...	46.30	709.75	1,393.84	...
Do. ...	1375w, (1610w), (1720w)	(Siberia Consols G.M. Co., N.L.) ...	...	...	...	...	...	...	39.23	352.50	598.52	...
Do. ...	1336w	(Slippery Gimblet)	...	...	...	...	...	...	...	26,110.50	8,217.79	...
Do. ...	1336w, (1338w), (1419w)	(Slippery Gimblet leases: Associated Northern Blocks (W.A.), Ltd.)	...	...	...	...	...	...	...	6,897.00	2,528.10	...
Do. ...	(1937w)	Wentworth Extended	...	...	35.00	7.58	...	...	...	35.00	7.58	...
Do. ...	1936w	Wentworth	...	...	978.00	349.26	...	...	...	1,533.50	632.00	...
Do. ...	...	Voided leases	...	...	...	...	...	...	789.17	25,701.92	14,753.92	...
Do. ...	...	Sundry claims	...	76.35	62.00	20.42	...	238.08	858.92	14,417.79	9,545.18	...
Smithfield ...	...	Voided leases	...	...	...	...	...	...	...	1,027.00	200.90	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	23.79	82.00	185.24	...
	From District generally:—											
	Sundry Parcels treated at:											
		Brown Hill Consols Works, Kalgoorlie ...	...	...	...	...	...	...	...	38.99	15.32	...
		Fremantle Trading Co., Ltd., Works	...	...	...	...	...	...	...	...	80.10	...
		Hannans Central Works, Kalgoorlie	...	...	...	...	...	...	...	8.70	15.47	...
		Hainault Sulphide Plant, Kalgoorlie	...	.14	...	...	...	...	.14	...	9.57	...
		Pole Works	...	...	...	...	...	...	...	...	356.07	...
		Regan's Carnage Battery	...	...	...	...	...	...	...	27.00	598.81	...
		State Battery, Ora Banda	...	...	...	8.39	...	...	...	72.05	2,573.56	...
		State Battery, Siberia	...	...	...	...	...	...	...	40.00	1,102.96	...
		Zoroastrian Works	...	...	...	...	...	...	...	116.50	1,082.23	...
		Various Works	...	...	...	...	...	2,271.17	...	16,622.68	31,760.91	278.85
	Reported by Banks and Gold Dealers		72.65	...	...	2.40	...	7,973.99	...	...	2.40	...
		Total	**72.65**	**268.92**	**14,369.83**	**7,228.24**	...	**19,590.12**	**16,167.80**	**879,695.31**	**486,448.69**	**2,184.96**

North-East Coolgardie Goldfield.

KANOWNA DISTRICT.

Black Swan	...	Voided leases	...	...	...	...	...	...	...	160.00	141.76	...
Gambier ...	...	Voided leases	...	...	...	...	...	...	38.73	12,729.00	6,638.30	.07
Do. ...	...	Sundry claims	...	...	...	...	...	24.70	245.94	858.75	750.42	...
Gindalbie ...	...	Voided leases	...	...	...	...	...	...	19.94	43,613.28	39,438.75	38.31
Do. ...	...	Sundry claims	...	...	...	...	...	...	674.82	1,061.77	1,240.06	...
Gordon ...	1469x	Sirdar	...	51.27	639.55	441.44	...	...	51.27	639.55	441.44	...
Do. ...	(1467x)	Sirdar	...	11.15	625.50	638.58	...	...	205.33	1,195.00	1,639.09	...
Do. ...	...	Voided leases	...	...	...	...	...	...	282.64	46,428.23	13,630.96	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	99.41	666.50	583.94	...
Kanowna ...	1461x	Golden Eagle: North White Feather G.Ms., Ltd.	...	...	...	...	...	...	15.56	66.00	75.01	...
Do. ...	1389x	Golden Valley	...	...	25.00	112.45	...	...	...	6,842.13	5,332.16	...

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 1927.					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 ...	(1465x)	Golden Valley Main Reef ...	...	...	180.00	206.33	...	...	...	1,330.00	1,414.70	...
Do. ...	1464x	Golden Valley West	...	...	240.00	91.78	...	...	...	845.00	389.88	...
Do. ...	(1019x)	(Kanowna)	...	...	...	...	...	5.84	691.94	9,588.50	14,544.42	...
Do. ...	(1299x)	(Kanowna Consol)	...	...	...	...	...	...	...	713.50	129.30	...
Do. ...	(1299x)	(Kanowna Consol)	...	...	...	...	...	...	...	339.00	207.36	...
Do. ...	(1299x), (1300x)	(Kanowna Consol leases) ...	...	...	...	...	...	...	6.76	312.00	261.31	...
Do. ...	(1299x), (1379x),	(Kanowna Consol leases) ...	...	...	...	...	...	...	...	4,584.00	2,096.11	...
Do. ...	1468x	Kanowna Main Lode	...	...	150.00	40.49	...	...	...	150.00	40.49	...
Do. ...	1466x	Kanowna Red Hill G.M. Co., N.L.	...	...	770.00	370.03	...	...	...	3,076.00	1,339.05	...
Do. ...	12x, 13x, (14x), (15x), (18x), (19x), (72x), (855x), (974x), (1035x), (1103x), (1263x), (1278x), (1438x)	North White Feather G.Ms., Ltd. ...	...	...	...	...	...	...	...	56,060.27	25,299.82	...
Do. ...	(1299x), (1379x), (1432x)	Orion Gold Mines, Ltd.	...	...	...	...	...	...	...	510.00	192.68	...
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	...	...	...	...	...	8.47	3,701.82	448,813.59	235,815.94	806.56
Do. ...	...	Sundry claims	...	17.97	173.00	136.91	...	88.95	1,871.33	14,975.27	8,007.37	1.50
Mulgarrie ...	...	Voided leases	...	...	...	...	...	...	1,216.63	6,902.26	4,197.98	...
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	...
	From District generally:—											
	Sundry Parcels treated at:											
	Lady Pratt Works		...	...	...	...	...	...	...	31.00	281.01	...
	Old Cement Works (Martin's Battery) ...		...	...	150.00	90.59	...	...	...	11,043.78	15,651.73	...
	Various Works		...	...	...	...	...	330.42	867.52	147,843.26	132,539.98	...
	Reported by Banks and Gold Dealers		34.00	...	...	.95	...	104,145.96	.86	...	85.64	...
		Total	**34.00**	**80.39**	**2,935.05**	**2,129.55**	...	**104,604.34**	**11,651.31**	**970,982.70**	**605,347.22**	**2,522.12**

KURNALPI DISTRICT.

Jubilee ...	...	Voided leases	...	...	...	...	...	...	145.13	1,821.25	1,408.51	...
Do ...	...	Sundry claims	...	...	...	...	...	25.57	...	46.00	28.91	...
Kurnalpi ...	...	Voided leases	...	...	...	...	...	371.18	3,100.64	2,925.01	2,778.07	**6.27**
Do. ...	...	Sundry claims	16.19	...	350.00	172.43	...	296.82	203.63	1,454.50	760.37	...
Mulgabbie ...	...	Voided leases	...	...	...	...	...	...	1,138.12	84.65	7,429.71	**4.95**
Do. ...	...	Sundry claims	...	...	...	...	...	6.50	1,528.51	139.50	955.10	...
		From District generally:— Sundry Parcels treated at:										
		Success Battery	...	...	...	...	...	...	...	45.00	188.51	...
		Various Works	...	...	...	...	...	...	...	56.50	193.15	...
		Reported by Banks and Gold Dealers	54.19	...	...	...	...	11,479.12	19.62	...	...	...
		Total	**70.38**	...	**350.00**	**172.43**	...	**12,179·19**	**6,135.65**	**6,572.41**	**13,742.33**	**11.22**

East Coolgardie Goldfield.

EAST COOLGARDIE DISTRICT.

Binduli ...	...	Voided leases	...	...	...	...	...	...	...	334.10	224.30	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	566.51	528.43	...
Boorara ...	(5386E)	Elsie May	...	...	...	...	...	...	77.51	9.12	106.77	...
Do. ...	...	Voided leases	...	...	...	...	...	...	381.56	306,642.45	171,638.36	**408.36**
Do. ...	...	Sundry claims	...	...	.25	.97	...	.49	53.46	865.76	934.12	...
Boulder ...	392E	(Acrobat: Paringa Consolidated Mines, Ltd.)	...	...	...	...	...	...	...	10.25	37.15	...
Do. ...	392E	(Acrobat: Paringa Mines (1909), Ltd.)	...	...	...	...	...	...	...	17,035.57	7,856.69	...
Do. ...	38E, 71E, 72E, (101E)	(Associated G.Ms. of W.A., Ltd.) ...	...	...	...	...	...	...	8.49	2.204,190.28	1,159,144.86	**35,284.05**
Do. ...	38E, 71E, 72E ...	Associated G.Ms. of W.A. (New), Ltd.	...	...	56,990.79	24,935.39	1,226.00	...	...	114,660.34	48,585.01	**2,243.52**
Do. ...	49E, (4211E) ...	Associated Northern Blocks (W.A.), Ltd.	...	...	509.71	842.38	...	...	538.31	426,273.83	513,902.07	**4,844.50**
Do. ...	24E	Blue Gap	...	...	76.81	39.53	...	...	...	216.61	127.51	...
Do. ...	(682E), 902E, 923E, 986E, (1064E), 1124E, 1196E, 4075E	(Boulder Deep Levels, Ltd.) ...	...	...	...	...	...	...	...	3,043.00	1,778.10	**26.71**
Do. ...	902E, 923E, 986E, 1124E, 1196E, 4075E	(Boulder Deep Levels (1907), Ltd.) ...	...	...	...	...	...	...	...	787.50	210.30	...
Do. ...	66E	Boulder Perseverance, Ltd. ...	...	...	60,996.64	42,449.44	9,212.44	...	...	217,901.50	176,743.14	**37,496.26**
Do. ...	281E	(Brookman Bros.: Boulder G.M. Co., Ltd.)	...	...	...	...	...	...	...	8,655.00	8,417.00	...
Do. ...	24E, (888E), (949E)	(Central and West Boulder G.Ms., Ltd.)	...	...	...	...	...	...	...	70,895.31	36,261.65	...
Do. ...	352E	(Chaffers G.M. Co., Ltd.)	...	...	...	...	...	...	...	4,256.00	1,299.03	**161.50**
Do. ...	352E, 873E, 4334E	(Chaffers G.M. Co., Ltd.)	...	...	...	...	...	...	...	111,111.00	44,796.77	...
Do. ...	352E, 873E, 4334E	(Chaffers Gold Mining Co. (1913), Ltd.)	...	...	...	...	...	...	...	13,350.00	3,334.91	**129.57**
Do. ...	1621E	(Croesus Proprietary G.M. Co.) ...	...	...	...	...	...	...	...	79.00	45.87	...
Do. ...	5345E	Enterprise	...	...	1,530.82	1,005.84	...	...	...	4,207.67	2,276.60	...
Do. ...	351E, 1001E, 1002E, 1085E, 1113E, 1219E, 1326E, 1397E	Golden Horseshoe Estates Co., Ltd.	...	...	1,817.96	4,397.38	275.85	...	...	4,810,689.96	2,952,924.99	**700,279.22**

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 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs
Boulder ...	2325E, 2326E ...	(Golden Link Consolidated G.Ms., Ltd.)	...	...	...	...	...	...	...	1,525.00	733.48	...
Do. ...	(750E), 1621E ...	(Golden Links, Ltd.)	...	...	...	...	...	...	...	87,115.02	43,504.60	19.06
Do. ...	5419E	Good Hope	...	...	61.60	59.96	...	...	...	61.60	59.96	...
Do. ...	873E	(Great Boulder Main Reefs, Ltd.) ...	...	...	...	...	...	...	...	143,292.39	119,541.14	761.98
Do. ...	66E	(Great Boulder Perseverance G.M., Ltd.)	...	...	...	...	...	...	...	3,306,942.88	1,841,159.00	203,821.43
Do. ...	16E, 51E, 61E, 102E, 280E, 1109E, (4361E)	Great Boulder Proprietary G.Ms., Ltd.	...	...	88,469.58	73,683.50	10,587.00	...	...	3,984,625.59	3,367,015.33	388,147.10
Do. ...	902E, 1124E ...	(Great Boulder South G.M., Co., Ltd.)	...	...	...	...	...	...	...	437.00	122.11	...
Do. ...	3643E	(Hainault G.M., Ltd.)	...	...	...	...	...	...	...	517,345.70	184,570.02	113.30
Do. ...	1004E	(Hannan's North Croesus G.M. Co., Ltd.)	...	...	...	...	...	...	...	50.00	13.21	...
Do. ...	15E, 60E, 902E, 923E, 986E, 1116E, 1124E, 1196E, 4075E	(Hannan's Star Consolidated, Ltd.) ...	...	...	...	...	...	...	...	360.00	175.59	...
Do. ...	15E, 60E, 1116E...	(Hannans Star G.M. Co., Ltd.) ...	...	...	...	...	...	...	...	85,652.75	40,438.85	2,142.59
Do. ...	15E, 60E, 1116E...	(Hannans Star, Ltd.)	...	...	...	...	...	...	...	13,470.50	4,716.66	191.22
Do. ...	4317E	Idaho	...	246.82	28.00	64.62	...	...	1,243.96	354.67	635.01	6.20
Do. ...	4317E, (4318E), (4442E)	(Idaho leases)	...	...	...	...	...	...	4,847.57	128,727.26	63,546.75	...
Do. ...	(946E), (4370E), (4531E)	(Ironsides North leases) ...	...	...	...	...	...	...	...	71,677.81	128,290.00	...
Do. ...	(946E)	Ironsides North	...	...	...	...	...	...	...	4.95	345.99	...
Do. ...	(946E)	(Ironsides North G.M. Co., N.L.) ...	...	...	...	...	...	...	...	1,348.00	807.48	...
Do. ...	31E, 1357E, 1413E, 1507E, 4399E, 4445E, 4476E	(Ivanhoe Gold Corporation, Ltd.) ...	...	...	...	...	...	...	...	4,296,179.00	2,571,681.86	447,123.80
Do. ...	1507E, (2899E), (3712E), (3713E)	(Ivanhoe Junction G.M. Co., N.L. ...	...	...	...	...	...	...	...	1,764.00	121.43	...
Do. ...	1004E	[1](Kalgoorlie Golden Eagle) ...	...	...	...	...	...	...	...	4,891.50	1,289.65	...
Do. ...	1004E	(Kalgurli Golden Eagle: Golden Links, Ltd.)	...	...	...	...	...	...	...	193.00	31.63	...
Do. ...	22E, 34E ...	(Kalgurli G.Ms., Ltd.)	...	...	...	...	...	...	...	1,683,548.41	1,072,090.59	188.24
Do. ...	15E, 25E, 31E, 32E, 60E, 352E, 873E, 902E, 923E, 986E, 1116E, 1124E, 1196E, 1357E, 1413E, 1507E, 2325E, 2326E, 4075E, 4334E, 4399E, 4445E, 4476E, 4493E, 4503E, 4508E	Lake View & Star, Ltd.	...	...	145,355.00	85,012.50	7,323.55	...	...	419,489.37	224,931.47	39,139.86

Do.	...	15E, 25E, 32E, 60E, 352E, 873E, 902E, 923E, 986E, 1116E, 1124E, 1196E, 2325E, 2326E, 4075E, 4334E, (4432E), (4433E), (4434E), 4493E	(Lake View & Star, Ltd.)	...	...	...	...	...	...	...	1,764,864.70	630,551.50	56,537.86
Do.	...	25E, 32E, 2325E, 2326E	(Lake View Consols, Ltd.)	...	...	...	...	...	...	...	1,179,303.55	1,016,875.27	38,491.89
Do.	...	5159E	Lake View South	...	...	124.01	50.77	...	...	...	1,643.83	1,033.87	...
Do.	...	281E, 287E, 444E,	(North Kalgurli Co., Ltd.)	...	...	...	...	...	43.99	...	104,116.49	60,229.47	7,202.47
Do.	...	281E, 287E, 444E	North Kalgurli (1912), Ltd.	...	...	14.77	10.11	...	...	...	36,325.36	19,348.87	...
Do.	...	5232E	(Old Bank of England)	...	...	...	...	...	...	...	1,082.68	972.85	...
Do.	...	5232E	Old Bank of England: Boulder Perseverance, Ltd.	...	...	39.31	11.06	...	...	...	39.31	11.06	...
Do.	...	(73E), 410E, (448E), (532E), (578E), (698E), 944E, (1395E), (3031E), (4180E)	(Oroya Brown Hill Co. Ltd.) ...	...	...	...	...	...	...	...	1,075,862.55	1,163,881.77	61,682.30
Do.	...	(6E), 22E, 34E, (73E), (131E), (245E), (269E), (301E), 410E, (448E), (532)E, (578E), (698E), (739E,) (743E), (750E), (794E), 944E, (969E), 1004E, (1395E), 1621E, (3031E), (4180E), 5405E, 5406E, 5407E, 5408E, 5409E, 5410E, 5413E	Oroya Links, Ltd.	...	...	19,258.49	8,955.13	...	...	...	1,017,456.92	447,023.92	28,532.96
Do.	...	392E	Paringa Mining & Exploration Co., Ltd.	...	...	18.44	17.71	...	...	...	193.31	64.50	...
Do.	...	(4E), 392E ...	(Paringa Mines (1909), Ltd.) ...	...	...	...	...	...	...	...	26,890.74	12,599.54	...
Do.	...	1208E, 3612E, 3643E	South Kalgurli Consolidated, Ltd. ...	...	...	90,571.04	47,624.68	...	...	...	1,215,317.33	509,061.22	15,071.52
Do.	...	1208E, 3612E ...	(South Kalgurli G.Ms., Ltd.) ...	...	...	...	...	...	...	...	826,909.00	347,222.75	17,609.67
Do.	...	(4537E)	Union Jack	...	...	9 37	6.11	...	...	...	6,750.79	3,229.15	...
Do.	...	...	Voided leases	...	...	...	...	...	109.90	5,888.84	408,536.29	273,782.46	[illegible].63
Do.	...	...	Sundry claims	...	...	185.79	110.76	...	24.58	5.80	2,948.47	1,636.75	...
Feysville	...	Block 48 ...	Hampton Gold Mining Areas, Ltd:—	...	...	...	...	...	...	15.36	278.73	443.28	...
			P.P.L. 40: Learhinan, D. ...	...	...	...	...	...	...	...	8.00	9.68	...
			P.P.L. 306, Excelsior	...	...	...	...	...	...	...	17.00	2.79	...
			P.P.Ls. 63, 84, 86, Golden Hope G.Ms., N.L.	...	...	...	35.29	...	...	...	16,585.30	8,477.65	69.60
			P.P.L. 1, White Hope, Hopeful Syndicate, Ltd.	...	...	3,210.00	1,240.55	...	...	...	29,850.03	11,718.57	...
			Sundry claims	...	...	...	...	...	...	...	20·53	22.06	...
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	...

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 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Feysville ...	Block 45 ...	Hampton Properties, Ltd. :— P.P.L. 252, Mount Martin ...	...	...	...	...	...	...	...	9,563.00	4,675.67	...
Do ...	Block 45 ...	Hampton Properties, Ltd	...	...	...	...	...	...	52·75	69.75	80.52	...
Do. ...	Block 50 ...	(Hampton Properties, Ltd.)	...	...	...	...	...	...	7.26	6,348.00	3,956.22	...
Do. ...	Block 50 ...	Hampton Properties, Ltd. :—	...	...	...	...	...	...	106.23	943.27	699.50	...
		P.P.L. 17, McFarlane	...	...	...	...	...	...	...	67.40	33.40	...
		P.P.L. 12, Celebration Junction ...	...	...	176.11	178.71	...	...	...	310.11	275.92	...
		P.P.Ls. 9, 274, Hampton Celebration (W.A.), Ltd.	...	...	...	...	...	...	...	22,117.75	9,461.47	...
		P.P.L. 222, Hampton Jubilee ...	...	...	15.78	7.43	...	...	...	382.06	278.75	...
		P.P.L. 74, Lavis. H.	...	...	7.00	1.68	...	...	...	7.00	1.68	...
		P.P.L. 23, Mutooroo Copper Corporation, N.L.	...	...	10.78	7·17	...	...	...	1,436.88	2,256.19	...
		P.P.L. 10, Pernatty Central Copper Mining Co., N.L.	...	...	9.00	12.89	...	...	...	918.29	843.72	...
		P.P.L. 29, Permatty East ...	...	...	...	...	...	...	...	11.27	3.43	...
Do. ...	...	Voided leases	...	...	...	...	...	...	110.74	561.30	394.24	...
Do. ...	...	Sundry claims	...	72.16	24.21	61.04	...	...	92.23	444.30	395.88	...
Kalgoorlie ...	5418E	Charlis	...	...	9.00	15.80	...	...	...	9.00	15.80	...
Do. ...	(5394E)	Dorothy	...	...	...	...	...	...	...	27.87	9.93	...
Do. ...	(5411E)	Elsie Marma	...	...	...	...	...	...	...	62.47	28.16	...
Do. ...	5350E, 5351E ...	Great Boulder Proprietary G.Ms., Ltd.	...	...	...	...	...	...	...	8,980.56	6,365.89	...
Do. ...	(4546E), 4547E, 4548E	Hannan's Hill leases	...	...	506.00	333.32	...	...	...	1,367.00	1,069.17	...
Do. ...	(4546E), 4547E, 4548E, (4551E)	(Hannan's Reward, Ltd.)	...	...	...	...	...	...	5.72	33,378.00	9 005.69	...
Do. ...	5417E	Hidden Secret	...	6.89	239.00	172.02	...	...	6.89	239.00	172.02	...
Do. ...	5416E	Miss Australia	...	...	402.00	287.45	...	...	...	402.00	287.45	...
Do. ...	4632E	North End	...	...	55.69	15.63	...	...	...	388.68	89.36	...
Do. ...	5415E	Return	...	...	27.00	15.27	...	...	...	27.00	15.27	...
No. ...	5368E	Rose of Diorite	...	...	1,623.00	1,594.12	...	...	1.73	4,191.00	3,940.16	...
Do. ...	5389E	Sons of Gwalia, Kalgoorlie ...	...	...	50.09	48.49	...	...	...	175.99	93.82	...
Do ...	...	Voided leases	...	...	...	...	...	242.48	9,478.81	942,765.66	384,402.28	44,017.12
Do. ...	...	Sundry claims	...	42.61	786.23	818.15	...	207.69	505.31	46,428.36	19,564.98	...
Wombola ...	(5391E)	Caledonian	...	4.40	64.14	138.70	...	...	4.40	234.22	449.50	...
Do. ...	(5414E)	Eclipsall	...	...	140.70	299.61	...	...	...	231.70	345.23	...
Do. ...	4766E	Great Hope	...	...	204.00	2,445.97	...	...	146.61	3,178.53	14,711.96	...
Do. ...	...	Voided leases	...	...	...	...	...	...	1,867.91	9,452.33	12,752.39	...
Do. ...	...	Sundry claims	...	...	116.00	168.57	...	...	4.15	1,714.71	2,440.28	...

From District generally :—										
Sundry claims	21.57	5.57	48.01	160.36	...	10,930.03	441.28	5,4 0.46	2,279.54	...
Sundry Parcels treated at :—										
Adeline Works	...	...	...	...	...	42.64	35.12	127.90	20,900.12	...
Associated Northern Works	...	...	...	...	...	...	...	...	287.41	...
Bonnie Lass Works	...	...	...	...	...	...	...	55.00	1,297.73	...
Brown Hill Consols Works	...	...	...	...	...	...	...	780.38	45,161.54	...
Dunstan and Cummings Works	...	...	...	...	...	...	...	...	9,244.56	1,644.00
Fraser's Works	...	...	...	59.00	...	...	...	...	82.94	...
Fremantle Trading Co., Ltd., Works	...	...	...	...	...	...	...	...	12,860.37	8,028.22
Great Boulder Perseverance Battery	...	...	...	...	...	...	...	...	7.18	...
Hainault Sulphide Plant	...	...	...	119.43	...	...	...	35.66	5,658.62	870.95
Hannans Central Lakeside Works	...	...	...	...	...	...	...	58.06	4,788.43	...
Hannans Central Works	...	...	...	...	...	...	...	193.80	65,360.26	67.17
Hannans Reward Battery	...	...	...	461.52	...	...	...	...	2,172.47	...
Kalgurli G.M., Ltd., Works	...	...	...	...	...	...	...	7.44	658.04	...
Lone Hand Works	...	...	38.00	143.18	...	...	14.43	507.00	6,189.24	...
North Kalgurli Battery	...	...	...	...	...	...	...	...	810.22	...
Oroya Links Battery	...	...	...	...	...	...	...	32.34	453.58	...
Various Works	...	...	...	...	...	341.72	15.15	38,756.72	75,984.27	1,968.67
Reported by Banks and Gold Dealers	337.99	1.60	...	...	...	11,866.99	9,014.92	2.39	52.06	...
Total	**359.56**	**380.05**	**478,820.12**	**298,119.19**	**28,624.84**	**28,376.13**	**34,994.09**	**31,942,969.96**	**20,041,170.31**	**2,144,323.50**

BULONG DISTRICT.

Balagundi ...	...	Voided leases	...	...	...	...	...	...	2,408.98	1,110.68	1,473.73	12.92
Do. ...	...	Sundry claims	...	75.39	...	...	...	...	200.75	294.76	231.91	...
Bulong ...	1266Y	Peacehaven	...	...	11.10	91.17	...	...	...	12.10	107.96	...
Do. ...	1191Y	Sweet Nell	...	...	10.00	65.83	...	...	...	400.84	980.20	...
Do. ...	...	Voided leases	...	...	...	...	...	107.54	8,433.70	99,635.96	82,526.49	...
Do. ...	...	Sundry claims	...	3.53	...	...	...	1,648.60	1,113.38	6,999.31	15,040.67	...
Hogan's Find	...	Voided leases	...	...	...	...	...	...	908.82	309.50	276.51	...
Majestic ...	Block 41 ...	Hampton Gold Mining Areas, Ltd.:— P.P.L. 275, Long Looked For ...	...	...	...	...	...	19.45	...	235.34	218.57	...
Do. ...	Block 41 ...	(Hampton Properties, Ltd.)	...	...	...	...	...	...	...	41.00	22.66	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	1,007.70	333.30	...
Do, ...	...	Sundry claims	...	...	...	...	...	42.88	43.20	101.90	46.25	...
Mt. Monger ...	...	Voided leases	...	...	...	...	...	...	1,862.57	1,128.35	979.59	...
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	1,697.60	891.34	...
Do. ...	...	Sundry claims	...	...	9.00	20.52	...	112.69	47.56	311.50	530.82	...
Trans Find ...	1198Y	Transville	...	...	302.50	123.90	...	...	...	957.42	831.03	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	4.50	31.63	...

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

EAST COOLGARDIE GOLDFIELD—*continued.*

BULONG DISTRICT—*continued.*

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial. Fine ozs.	Total for 1927. Dollied and Specimens. Fine ozs.	Total for 1927. Ore treated. Tons (2,240lbs.)	Total for 1927. Gold therefrom. Fine ozs.	Total for 1927. Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Total Production. Dollied and Specimens. Fine ozs.	Total Production. Ore treated. Tons (2,240lbs.)	Total Production. Gold therefrom. Fine ozs.	Total Production. Silver. Fine ozs.
Woodline ...	...	Voided leases	...	...	...	...	...	...	...	792.75	610.57	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	39.33	61.57	...
	From District generally :—											
		Sundry claims	...	...	...	...	...	5.64	41.85	744.55	254.99	...
		Sundry Parcels treated at :										
		Various Works	...	...	...	...	...	...	...	6,102.15	5,848.25	...
		Reported by Banks and Gold Dealers	16.75	...	...	...	...	24,595.54	52.39	...	...	...
		Total	**16.75**	**78.92**	**332.60**	**301.42**	...	**26,770.45**	**15,240.85**	**156,025.03**	**122,796.43**	**12.92**

Coolgardie Goldfield.

COOLGARDIE DISTRICT.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial. Fine ozs.	Total for 1927. Dollied and Specimens. Fine ozs.	Total for 1927. Ore treated. Tons (2,240lbs.)	Total for 1927. Gold therefrom. Fine ozs.	Total for 1927. Silver. Fine ozs.	Total Production. Alluvial. Fine ozs.	Total Production. Dollied and Specimens. Fine ozs.	Total Production. Ore treated. Tons (2,240lbs.)	Total Production. Gold therefrom. Fine ozs.	Total Production. Silver. Fine ozs.
Bonnievale ...	4600	Melva Maie	...	...	44.00	26.62	...	...	...	580.00	1,522.44	...
Do. ...	...	Voided leases	...	...	...	...	...	...	25.00	350,852.84	188,088.12	...
Do. ...	...	Sundry claims	...	16.42	39.00	116.16	...	...	122.62	2,327.33	2,879.94	...
Bulla Bulling	...	Voided leases	...	...	...	...	...	...	...	776.81	668.19	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	12.82	375.56	263.64	...
Burbanks ...	...	Voided leases	...	...	...	...	...	13.36	342.96	408,391.36	301,719.13	521.06
Do. ...	...	Sundry claims	...	16.48	154.00	195.30	...	43.37	158.43	5,555.90	4,662.72	...
Cave Rocks	...	Voided leases	...	...	...	...	...	...	...	132.00	28.04	...
Coolgardie ...	4567	Griffiths Gold Mine	...	...	...	...	...	...	4.16	17,782.50	2,043.31	...
Do. ...	Block 59 ...	Hampton Gold Mining Areas, Ltd.:—	...	...	...	...	...	...	...	9.00	1.57	...
		P.P.L. 308, Golden Bell	...	...	46.50	84.38	...	...	...	46.50	84.38	...
		P.P.L. 119, Golden Eagle ...	...	...	66.50	123.08	...	...	...	482.09	953.23	...
Do. ...	Block 49 ...	Hampton Plains Estates, Ltd. :— ...	...	...	...	...	...	...	10.94	150.00	157.31	...
		P.P.L. 384, Paul, A. W.	...	...	...	...	...	...	...	39.25	20.95	...
		P.P.L. 395, Paul, A. W.	...	...	18.00	21.54	...	...	...	18.00	21.54	...
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. ...	...	Voided leases	...	...	...	...	...	1,299.02	4,494.64	543,683.98	320,522.17	.96
Do. ...	...	Sundry claims	.42	2.73	749.25	578.98	...	136.60	2,085.25	39,596.81	16,357.47	...
Eundynie ...	...	Voided leases	...	...	...	...	...	...	...	29,812.50	14,966.76	1.75
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	117.00	31. 1	...
Gibraltar ...	4586	Carlton	...	...	69.00	28.92	...	...	15.28	1,445.00	1,175.47	...
Do. ...	5200	Perseverance	...	...	70.75	54.53	...	...	...	216.62	214.38	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	29,343.25	14,916.26	...
Do. ...	...	Sundry claims	...	...	155.00	128.74	...	...	48.55	791.45	567.36	...
Gnarlbine ...	...	Voided leases	...	...	...	...	...	...	10.94	1,899.75	1,049.90	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	1.31	228.10	170.61	...
Higginsville ...	...	Voided leases	...	...	...	...	...	...	287.26	32,578.00	14,938.44	134.79
Do. ...	...	Sundry claims	...	...	...	...	...	...	16.52	772.90	516.90	...
Londonderry	...	Voided leases	...	...	...	...	...	...	46.25	27,102.85	18,537.59	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	6.00	1,801.17	1,616.22	...
Mungari ...	...	Voided leases	...	...	...	...	...	...	17.71	735.00	331.78	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	107.82	346.51	204.90	...
Paris ...	...	Voided leases	...	...	...	...	...	...	4.30	...	...	...
Red Hill ...	...	Voided leases	...	...	...	...	...	...	1,541.48	40,797.40	31,070.65	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	34.62	160.42	287.90	...
Ryan's Find	...	Voided leases	...	...	...	...	...	...	...	54.16	151.69	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	.44	87.69	226.64	...
St. Ives ...	4905	Brennan's Idough	9.53	...	265.00	109.73	...	9.53	38.03	2,697.50	1,795.25	...
Do. ...	5195	Clifton	...	...	386.75	198.67	...	...	...	1,319.65	574.37	...
Do. ...	4732	Ives Lake View Reward Junction	...	...	100.00	957.31	...	...	...	3,443.75	2,091.70	...
Do. ...	4720, 4721, 4722	Ives Reward G.Ms., N.L. ...	...	...	1,025.00	416.34	...	...	...	12,549.41	3,777.21	...
Do. ...	4720, 4721, 4722	Lake View Reward leases ...	...	...	...	...	...	...	...	883.25	544.64	...
Do. ...	5210	Rose Doreen	...	...	...	...	...	...	...	88.75	47.60	...
Do. ...	...	Voided leases	...	...	...	...	...	45.10	2.75	1,205.75	1,463.86	...
Do. ...	...	Sundry claims	13.32	...	32.75	34.01	...	186.97	...	994.56	383.30	...
Widgiemooltha	5207	Elgin	...	...	54.00	60.47	...	...	...	242.50	344.61	...
Do. ...	...	Voided leases	...	...	...	...	...	9.42	867.11	9,960.35	7,413.68	.17
Do. ...	...	Sundry claims	...	...	148.51	59.21	...	33.84	105.40	4,780.11	2.759.38	...
	From District generally :—											
	Sundry Parcels treated at:											
	Burbanks Main Lode Works		...	...	...	...	...	2.77	...	557.50	1,261.60	114.17
	Fremantle Trading Co., Ltd., Works		...	...	...	...	...	...	...	...	20.08	...
	Highgate Battery		...	...	...	...	...	...	...	100.00	336.90	...
	Imperial Battery		...	...	...	1.33	...	...	...	26.00	11.92	...
	Lady Robinson Cyanide Works		...	...	...	...	...	...	...	70.00	348.28	...
	State Battery Coolgardie		...	...	...	493.52	...	...	...	691.01	13,326.56	9.65
	State Battery St. Ives		...	...	60.50	473.13	...	...	...	60.50	982.52	...
	Various Works		...	...	...	...	...	4.98	...	3,083.61	15,618.12	108.89
	Reported by Banks and Gold Dealers		57.85	...	...	...	...	7,828.78	543.04	...	...	...
	Total		81.12	35.63	3,484.51	4,161.97	...	9,613.74	11,314.17	1,589,919.15	1,001,377.30	891.44

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 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. 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	...	...	...	...	...	10.94	75.48	5,142.25	4,825.96	1.38
Do. ...	...	Sundry claims	...	...	...	...	...	...	18.57	1,149.75	424.74	...
Carbine ...	33s	(Carbine)	...	...	...	...	...	...	10.85	2,401.00	1,164.53	...
Do. ...	33s	Carbine	...	...	580.00	419.57	...	...	...	580.00	419.57	...
Do. ...	33s, (710s), (711s), (807s), (863s), (890s)	(Carbine leases)	...	...	500.00	510.14	...	...	677.13	49,590.86	38,697.72	...
Do. ...	...	Voided leases	...	...	...	...	...	...	...	3,347.00	3,233.60	...
Do. ...	...	Sundry claims	...	...	8.00	16.36	...	123.94	...	93.00	175.29	...
Carnage ...	...	Voided leases	...	...	...	...	...	176.04	659.31	2,402.00	2,170.67	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	61.00	27.50	...
Cashman's (Siberia)	716s, [1289w] ...	Lady Evelyn	...	...	...	...	...	...	...	241.75	479.81	...
Do. ...	...	Voided leases	...	...	...	...	...	67.51	793.44	7,187.90	6,395.33	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	6.16	116.00	67.61	...
Chadwin ...	...	Voided leases	...	...	...	...	...	...	...	1,111.75	2,062.12	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	8.87	507.00	449.22	...
Dunnsville ...	...	Voided leases	...	...	...	...	...	...	181.12	17,407.10	7,982.23	...
Do ...	...	Sundry claims	...	...	...	73.81	...	.43	121.27	313.19	394.85	...
Jourdie Hills	...	Voided leases	...	...	...	...	...	...	18.00	28,009.74	19,401.09	28.45
Do. ...	...	Sundry claims	...	...	...	...	...	1.86	27.85	760.50	422.33	...
Kandana ...	...	Voided leases	...	...	...	...	...	...	...	465.00	68.12	...
Kintore ...	...	Voided leases	...	...	...	...	...	6.66	143.66	44,174.14	31,882.70	...
Do. ...	...	Sundry claims	...	19.85	17.50	36.25	...	100.30	20.63	1,259.20	1,199.39	...
Siberia ...	...	Voided leases	...	...	...	...	...	1.07	1,557.81	8,216.85	10,530.14	...
Do. ...	...	Sundry claims	...	...	...	...	...	30.91	...	223.00	349.86	...
25-Mile ...	696s	Blue Bell	...	...	...	...	...	...	...	85.00	24·19	...
Do. ...	696s	(Blue Bell)	...	...	...	...	...	...	8.05	697.00	429.47	...
Do. ...	696s, (727s) ...	(Blue Bell leases)	...	...	...	...	...	...	...	1,693.00	1,647.99	...
Do. ...	(892s)	Brittania	...	...	...	...	...	...	910.75	34.50	234.63	...
Do. ...	645s	Star of Fremantle	...	...	...	...	...	32.67	...	5,513.00	4,043.67	...
Do. ...	847s	Turn of the Tide	...	...	29.50	145.74	...	...	2.72	4,732.48	5,475.91	...

Do. ...	...	Voided leases	...	...	...	...	...	...	790.68	92,37[illegible].99	73,175.25	18.84
Do. ...	...	Sundry claims	...	...	249.80	221.22	...	201.05	514.08	8,347.83	6,238.08	...
	From District generally :—											
	Sundry Parcels treated at:											
	Blue Bell Battery		...	...	...	59.80	...	3.77	...	72.00	2,502.21	...
	Stanley Works		...	...	...	...	...	14.86	...	402.60	384.93	...
	Various Works		...	...	...	...	...	9.22	...	1,276.66	2,006.02	...
	Reported by Banks and Gold Dealers		4.52	...	...	...	...	269.58	1.10	...	... ...	...
	Total		**4.52**	**19.85**	**1,384.80**	**1,482.89**	...	**1,050.81**	**6,547.53**	**289,991.09**	**228,986.73**	**46.67**

Yilgarn Goldfield.

Blackbourne...	...	Voided leases	...	...	...	...	...	...	...	1,282·50	341·37	...
Bullfinch ...	3337	Easter Gift	...	14.42	158·00	82·76	...	...	14·42	158·00	82·76	...
Do. ...	3340	Hansfordhaven	...	...	305·60	167·54	...	...	...	305·60	167·54	...
Do. ...	...	Voided leases	...	...	...	...	...	...	3·57	480,486·66	178,685·23	27,833·41
Do. ...	...	Sundry claims	...	...	389·75	254·13	...	...	...	1,168·55	850·09	...
Corinthian ...	...	Voided leases	...	...	...	...	...	...	...	134,508·00	29,324·83	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	104·50	77·35	...
Ennuin ...	...	Voided leases	...	...	...	...	...	...	...	134·56	361·34	...
Do. ...	...	Sundry claims	...	...	14·50	31·93	...	...	...	131·50	104·05	...
Forrestonia ...	...	Voided leases	...	...	...	...	...	...	...	1,185·00	298·15	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	327·00	114·95	...
Golden Valley	2994	Radio	...	...	766·50	1,896·00	...	...	...	5,284·80	16,263·62	7·43
Do. ...	3248	Radio Deeps	...	...	85·00	48·59	...	...	...	610·00	1,138·61	...
Do. ...	(3323)	Valley Queen	...	...	...	...	...	...	...	19·00	11·97	...
Do. ...	3338	Valley Queen Extended ...	...	...	104·00	106·38	...	...	...	104·00	106·38	...
Do. ...	...	Voided leases	...	...	...	...	...	...	18·05	8,284·24	8,635·59	2·00
Do. ...	...	Sundry claims	...	...	88·50	123·23	...	...	2·75	2,407·22	2,301·59	...
Greenmount	3264	Transvaal	...	...	...	...	...	...	...	997·00	252·18	...
Do. ...	...	Voided leases	...	...	...	...	...	45·99	21·62	123,806·64	31,275·22	944·50
Do. ...	...	Sundry claims	...	...	...	...	...	...	4·12	875·00	334·48	...
Holleton ...	3334	Empress	...	...	23·00	19·35	...	...	...	23·00	19·35	...
Do. ...	3312	Glenelg Queen	...	...	198·75	411·85	...	...	...	211·00	495·54	...
Do. ...	3280	Hollow and Heaton's Reward...	...	...	...	...	...	...	9·33	21·50	127·55	...
Do. ...	...	Sundry claims	...	...	22·50	26·56	...	...	...	22·50	26·56	...
Hope's Hill ...	2544	Colleen Bawn	...	2.55	...	...	...	...	17·81	410·20	1,916·07	...
Do. ...	...	Voided leases	...	...	...	...	...	...	56·97	129,884·85	33,899·78	1·00
Do. ...	...	Sundry claims	...	...	14·00	11·18	...	...	25·38	1,677·00	546·08	...
Kennyville ...	...	Voided leases	...	...	...	...	...	...	18·76	32,377·13	15,222·68	·59
Do. ...	...	Sundry claims	...	...	20·00	16·11	...	...	5·06	2,068·50	912·84	...
Koolyanobbing	...	Voided leases	...	...	...	...	...	...	...	308·00	116·74	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	55·00	11·24	...

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 1927. Alluvial.	Total for 1927. Dollied and Specimens.	Total for 1927. Ore treated.	Total for 1927. Gold therefrom.	Total for 1927. Silver.	Total Production. Alluvial.	Total Production. Dollied and Specimens.	Total Production. Ore treated.	Total Production. Gold therefrom.	Total Production. Silver.
			Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.	Fine ozs.	Fine ozs.	Tons (2,240lbs.)	Fine ozs.	Fine ozs.
Marvel Loch...	719	(Great Victoria)	...	...	...	...	...	...	...	1,356·00	281·53	...
Do. ...	719, 944, 945, (1227), (1228), (1606)	Great Victoria G.Ms., N.L.	...	...	19,263·00	3,433·10	...	...	...	74,101·00	16,658·99	...
Do. ...	719, 944, 945, (1227), (1228), (1606)	(Great Victoria leases)	...	...	...	...	...	...	...	132,664·26	17,869·89	...
Do. ...	3277	Just in Time	...	...	1,183·00	338·39	...	...	...	5,680·00	1,296·91	...
Do. ...	852	May Queen	...	...	300·00	717·41	...	...	4·07	1,437·50	5,590·46	...
Do. ...	(3307)	Nevoria: Great Victoria G.Ms., N.L.	...	...	358·00	88·24	...	...	...	3,344·00	782·08	...
Do. ...	3281	(Resurrection)	...	...	50·00	4·55	...	...	...	61·00	59·14	...
Do. ...	3281	Resurrection: Great Victoria G.Ms., N.L.	...	...	2,194·00	415·41	...	...	...	2,194·00	415·41	...
Do. ...	...	Voided lease	...	...	...	...	...	...	104·39	257,155·00	97,016·26	771·03
Do. ...	...	Sundry claims	...	...	245·00	90·63	...	8·87	84·82	11,533·74	5,914·60	...
Mt. Jackson...	...	Voided leases	...	...	...	...	...	...	114·88	37,186·03	27,676·47	2,305·28
Do. ...	...	Sundry claims	1.29	...	7·75	46·14	...	5·71	30·46	1,697·00	1,177·74	·74
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	...	...	15·00	14·26	...	...	...	1,516·00	558·11	...
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.	...	...	400·00	309·05	...	...	...	5,222·00	2,964·41	...
Do. ...	(2951)	White Horseshoe	...	...	95·00	39·68	...	...	...	4,372·00	3,571·14	...
Do. ...	...	Voided leases	...	...	...	...	...	...	105·14	13,775·25	10,023·82	...
Do. ...	...	Sundry claims	...	...	9·00	4·33	...	...	...	2,264·25	1,544·36	...
Southern Cross	...	Voided leases	...	...	...	...	...	2·13	211·22	434,105·88	212,008·46	364·41
Do. ...	...	Sundry claims	...	...	57·50	31·91	...	5·50	595·45	4,356·23	1,448·66	...
Westons ...	3308	Consolidated	...	...	371·00	301·37	...	...	...	547·00	490·26	...
Do. ...	3310	Les Trois	...	...	82·00	43·07	...	...	...	304·00	256·77	...
Do. ...	3226	Royal Flush	...	...	38·00	32·49	...	...	...	880·00	649·42	...
Do. ...	...	Voided leases	...	...	...	...	...	...	4·06	421,897·99	299,018·68	21·78
Do. ...	...	Sundry claims	...	...	63·00	26·93	...	...	52·91	1,458·75	1,395·38	...

		From Goldfields generally :—										
		Sundry Parcels treated at :										
		Edna May Deeps Battery	...	...	...	...	...	...	...	...	117·37	...
		Glideaway Battery	...	...	...	...	...	...	...	...	250·87	...
		Great Victoria Cyanide Works	...	...	...	...	...	...	...	...	5,847·54	...
		Howlett's Battery	...	...	...	73·44	...	...	...	...	1,439·30	...
		Never Never Works	...	...	...	...	...	...	...	...	1,629·53	...
		Smith's Cyanide Works	...	...	...	...	...	...	...	...	26·16	...
		Spring Hill Works	...	...	...	...	...	...	...	...	854·27	...
		Sunbeam Battery	...	...	...	...	...	...	...	38·50	7,244·60	...
		Violet Works	...	...	...	...	...	...	...	...	998·34	...
		Various Works	...	...	...	...	...	...	...	118·28	26,087·03	36·54
		Reported by Banks and Gold Dealers	1·60	...	...	...	...	23·65	3·53	...	...	...
		Total	**2·89**	**16·97**	**26,921·35**	**9,206·91**	...	**95·69**	**1,513·97**	**2,361,312·11**	**1,080,135·04**	**82,288·71**

Dundas Goldfield.

Buldania ...	...	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 ...	1291	Mararoa No. 1	...	...	2,700·00	2,084·47	...	...	...	4,066·96	3,5 4·80	...
Do. ...	1290	Mararoa No. 2	...	...	...	...	...	...	...	436·50	285·39	...
Do. ...	1288	Mararoa No. 3	...	...	...	...	...	...	...	1,026·25	1,382·14	...
Do. ...	1315	New Mararoa	...	...	397·25	104·05	...	...	...	608·00	162·95	...
Do. ...	1317	O.K.	...	...	259·00	245·31	...	...	...	320·00	383·13	...
Do. ...	(1307)	Recoup North	...	...	...	...	...	...	...	278·00	240·33	...
Do. ...	990	Viking No. 1	...	...	79·05	157·18	...	...	42·44	888·30	2,067·44	...
Do. ...	990	(Viking No. 1)	...	...	...	...	...	...	...	1,274·00	3,095·95	...
Do. ...	990, (1060) ...	(Viking No. 1 leases)	...	...	...	...	...	...	...	775·50	1,176·13	16·89
Do. ...	990, (1016), (1060), (1117), (1181), (1194), (1235)	(Viking No. 1 leases)	...	...	...	...	...	...	...	48,452·00	44,457·70	242·83
Do. ...	...	Voided leases	...	...	...	...	...	4·23	10,415·94	821,239·77	526,006·58	34,600·73
Do. ...	...	Sundry claims	...	...	228·75	147·70	...	1,013·97	3,088·24	21,711·46	12,898·03	·59
Peninsula ...	...	Voi ed leases	...	...	...	...	...	...	17·61	7,807·14	4,833·88	...
		From Gold eld generally :—										
		Sundry P rcels treated at :										
		Rawlings & Bullen's Works	...	...	...	...	...	...	...	57·39	4,266·10	...
		State Battery, Norseman	...	...	...	...	...	...	...	405·14	14,143·21	885·41
		Various Works	...	...	...	...	...	...	54·52	425·75	6,562·86	646·45
		Reported by Banks and Gold Dealers	·35	...	...	...	...	1,035·15	...	...	1·04	...
		Total	**·35**	...	**3,664·05**	**2,738·71**	...	**2,053·35**	**14,043·67**	**915,705·86**	**629,105·66**	**36,392·90**

TABLE IV.—*Production of Gold and Silver from all sources, etc.*—continued.

Phillips River Goldfield.

Mining Centre.	Number of Lease.	Registered Name of Company or Lease.	Total for 1927. Alluvial.					Total Production. Alluvial.				
			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.
Hatter's Hill	...	Sundry claims	...	1·49	...	...	...	...	1·49	40·00	14·98	...
Kundip ...	(147), (179) ...	Fair Play leases	...	...	...	...	...	...	...	4,860·72	8,678·54	12·63
Do. ...	184	Gem	...	...	...	...	...	...	...	4,159·15	3,324·86	...
Do. ...	(151)	(Gem Consolidated)	...	...	...	...	...	...	...	777·50	616·30	...
Do. ...	(151), 156 ...	Gem Consolidated leases ...	...	...	...	...	...	...	...	6,315·76	5,690·35	8·00
Do. ...	M.L. 52, M.L. 94	Harbour View Gold & Copper Co., Ltd.	...	...	...	...	...	...	...	1,602·89	1,836·05	360·11
Do. ...	M.L. 52, M.L. 94	(Harbour View leases) ...	...	...	...	...	...	...	379·86	3,619·25	1,560·86	61·41
Do. ...	M.L. 52, M.L. 94	(Harbour View leases)	...	...	...	...	...	...	...	3,403·50	2,227·62	1·88
Do. ...	(98)	Hillsborough	...	...	...	...	...	...	...	3,295·51	6,018·84	118·03
Do. ...	M.L. 370 ...	North Harbour View ...	...	...	...	...	...	...	...	35·27	22·16	...
Do. ...	M.L. 52, M.L. 94	(Ravensthorpe G.M. Sydnicate, N.L.)	...	...	...	...	...	...	...	1,124·00	433·94	164·98
Do. ...	203	Two Boys	...	...	173·00	100·54	...	...	...	173·00	100·54	...
Do. ...	...	Voided leases	...	...	...	...	...	113·28	176·31	37,704·03	25,448·75	3,070·20
Do. ...	...	Sundry claims	1·41	...	100·00	59·15	...	84·05	71·58	1,056·88	655·48	15·45
Mt. Desmond	...	Voided leases	...	...	...	...	...	...	1·40	9·00	3,905·46	6,891·59
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	...	32·81	51·01
Mt. Purchas...	...	Voided leases	...	...	...	...	...	...	4·38	346·05	293·13	...
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	4·75	4·68	...
Ravensthorpe	...	Voided leases	...	...	...	...	...	...	141·80	21,933·76	25,149·50	4,384·07
Do. ...	...	Sundry claims	3·50	...	...	117·89	...	163·96	6·60	2,268·18	1,543·55	20·65
West River ...	...	Voided leases	...	...	...	...	...	...	...	...	10·34	31·06
Do. ...	...	Sundry claims	...	...	...	...	...	...	...	...	3·29	3·44
	From Goldfield generally:—											
	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		...	...	...	...	...	122·48	...	...	...	...
	Total		4·91	1·49	273·00	277·58	...	483·77	783·42	92,729·20	88,202·59	15,688·17

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.

[illegible]bel Bar ...	41H, [225L] ...	(Coobina)	...	...	...	...	...	...	57·42	...	...	·58
Do. ...	...	Voided leases	...	...	...	...	...	...	53·66	...	...	...
Do. ...	...	Sundry claims	...	10·20	...	...	...	...	10·20	...	...	...
Narra Tarra...	Loc. 833 ...	Narra Tarra: Fremantle Trading Co., Ltd.	...	...	...	...	...	...	...	...	91·51	20,718·76
	From State generally :—											
	Sundry Parcels treated at:											
	Fremantle Trading Co., Ltd., Works		...	...	...	...	...	...	...	...	3,300·16	9,675·43
	Hainault Sulphide Plant, Kalgoorlie		...	...	...	...	...	...	...	...	21·28	...
	State Smelter, Ravensthorpe		...	...	...	...	...	...	...	...	41·20	...
	Various Works		...	...	...	...	...	...	...	27·00	4,411·14	481·77
	Sundry Specimens		...	...	...	...	...	4·24	56·85	...	...	...
	Reported by Banks and Gold Dealers		...	...	...	...	...	150·21	183·87	...	...	...
		Total	...	**10·20**	...	...	...	**154·45**	**362·00**	**27·00**	**7,865·29**	**30,876·54**

TABLE V.

TOTAL OUTPUT OF GOLD BULLION ENTERED FOR EXPORT, AND RECEIVED AT THE PERTH BRANCH OF THE ROYAL MINT, FROM 1ST JANUARY, 1886, TO 31ST DECEMBER, 1927, SHOWING, IN FINE OUNCES, THE QUANTITY OBTAINED FROM THE RESPECTIVE GOLDFIELDS, AND THE TOTAL ANNUAL VALUE.

Year.	Kimberley.			Pilbara.			a West Pilbara.			Ashburton.		
	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.
	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.
Previous to 1927	22,422·06	7,015·99	29,438·05	147,302,43	153,867·88	301,170·31	4,351·11	26,514·53	30,865·64	4,104·96	2,178·33	6,283·29
1927 ...	...	193·89	193·89	...	2,881·52	2,881·52	...	81·91	81·91	...	15·41	15·41
Total ...	22,422·06	7,209·88	29,631·94	147,302·43	156,749·40	304,051·83	4,351·11	26,596·44	30,947·55	4,104·96	2,193·74	6,298·70

Year.	b Gascoyne.			c Peak Hill.			c East Murchison.			Murchison.		
	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total	Export.	Mint.	Total.
	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.
Previous to 1927	304·55	665·42	969·97	41,102·62	173,454·44	214,557·06	230,585·11	1,411,543·24	1,642,128·35	1,447,438·49	2,004,235·85	3,451,674·34
1927 ...	...	78·63	78·63	...	1,705·90	1,705·90	...	6,670·21	6,670·21	1,006·42	26,182·53	27,188·95
Total ...	304·55	744·05	1,048·60	41,102·62	175,160·34	216,262·96	230,585·11	1,418,213·45	1,648,798·56	1,448,444·91	2,030,418·38	3,478,863·29

Year.	d Yalgoo.			e Mt. Margaret.			f North Coolgardie.			g Broad Arrow.		
	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.
	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	ne ozs.	fine ozs.	fine ozs.	fine ozs.
Previous to 1927	11,478·21	92,586·41	104,064·62	607,310·81	2,662,409·93	3,269,720·74	261,964·27	1,714,099·02	1,976,063·29	121,540·42	210,729·84	332,270·26
1927 ...	...	2,642·75	2,642·75	...	37,487·96	37,487·96	...	1,950·78	1,950·78	79·74	5,346·55	5,426·29
Total ...	11,478·21	95,229·16	106,707·37	607,310·81	2,699,897·89	3,307,208·70	261,964·27	1,716,049·80	1,978,014·07	121,620·16	216,076·39	337,696·55

Year.	f North-East Coolgardie.			j East Coolgardie.			h Coolgardie.			Yilgarn.		
	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.
	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.
Previous to 1927	234,979·30	436,910·48	671,889·78	6,794,606·20	14,368,345·76	21,162,951·96	661,362·03	852,792·44	1,514,154·47	215,873·72	951,501·33	1,167,375·05
1927 ...	...	1,223·53	1,223·53	2,272·94	301,342·99	303,615·93	...	3,577·90	3,577·90	...	8,246·42	8,246·42
Total ...	234,979·30	438,134·01	673,113·31	6,796,879·14	14,669,688·75	21,466,567·89	661,362·03	856,370·34	1,517,732·37	215,873·72	959,747·75	1,175,621·47

Year.	i Dundas.			j Phillips River.			¶ Donnybrook.			State generally.		
	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.	Export.	Mint.	Total.
	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.	fine ozs.
Previous to 1927	113,896·47	600,567·62	714,464·09	39,035·37	42,498·08	81,533·45	282·21	557·53	839·74	17,918·52	18,176·91	36,095·43
1927 ...	...	4,993·75	4,993·75	...	269·41	269·41	...	...	...	...	101·37	101·37
Total ...	113,896·47	605,561·37	719,457·84	39,035·37	42,767·49	81,802·86	282·21	557·53	839·74	17,918·52	18,278·28	36,196·80

a Prior to 1st May, 1898, included with Pilbara. b Prior to March, 1899, included with Ashburton. c From 1st August, 1897.
d Prior to 1st April, 1897, included with Murchison. e From 1st August, 1897. f Prior to 1st May, 1896, included with Coolgardie.
g From 1st September, 1897. h Declared 5th April, 1894, to which date included with Yilgarn.
i Prior to 1893 included with Yilgarn. j Prior to 1902, included in State generally. ¶ Abolished 4th March, 1908.

Total Output of Gold Bullion entered for Export, and Received at the Perth Branch of the Royal Mint, etc.—

Year.	GRAND TOTAL.			
	Export.	Mint.	Total.	Value.
	fine ozs.	fine ozs.	fine ozs.	£ s. d.
1886	270·17	...	270·17	1,147 12 2¼
1887	4,359·37	...	4,359·37	18,517 8 6¼
1888	3,124·82	...	3,124·82	13,278 7 10¾
1889	13,859·52	...	13,859·52	58,871 9 11¼
1890	20,402·42	...	20,402·42	86,668 19 5
1891	27,116·14	...	27,116·14	115,182 0 10½
1892	53,271·65	...	53,271·65	226,283 11 8
1893	99,202·50	...	99,202·50	421,385 8 8½
1894	185,298·73	...	185,298·73	787,098 19 6
1895	207,110·20	...	207,110·20	879,748 4 2¼
1896	251,618·69	...	251,618·69	1,068,808 5 2
1897	603,846·44	...	603,846·44	2,564,976 12 9¼
1898	939,489·49	...	939,489·49	3,990,697 13 10
1899	1,283,360·25	187,244·41	1,470,604·66	6,246,731 10 7¾
1900	894,387·27	519,923·59	1,414,310·86	6,007,610 13 4½
1901	923,686·96	779,729·56	1,703,416·52	7,235,653 9 1
1902	707,039·75	1,163,997·60	1,871,037·35	7,947,661 9 7¾
1903	833,685·78	1,231,115·62	2,064,801·40	8,770,718 17 0¼
1904	810,616·04	1,172,614·03	1,983,230·07	8,424,225 17 8¾
1905	655,089·88	1,300,226·00	1,955,315·88	8,305,653 18 5½
1906	562,250·59	1,232,296·01	1,794,546·60	7,622,749 8 7
1907	431,803·14	1,265,750·45	1,697,553·59	7,210,749 6 2¾
1908	356,353·96	1,291,557·17	1,647,911·13	6,999,881 10 10½
1909	386,370·58	1,208,898·83	1,595,269·41	6,776,273 14 7¼
1910	233,970·34	1,236,661·68	1,470,632·02	6,246,847 15 0
1911	160,422·28	1,210,445·24	1,370,867·52	5,823,075 1 9¾
1912	83,577·12	1,199,080·87	1,282,657·99	5,448,384 16 5¾
1913	86,255·13	1,227,788·15	1,314,043·28	5,581,701 1 2¾
1914	51,454·65	1,181,522·17	1,232,976·82	5,237,352 12 6½
1915	17,340·47	1,192,771·23	1,210,111·70	5,140,227 15 5¼
1916	26,742·17	1,034,655·87	1,061,398·04	4,508,532 5 11
1917	9,022·49	961,294·67	970,317·16	4,121,645 6 2¼
1918	15,644·12	860,867·03	876,511·15	3,723,182 14 9
1919	6,445·89	727,619·90	734,065·79	3,118,118 5 6¼
1920	5,261·13	612,581·00	617,842·13	2,624,426 11 0
1921	7,170·74	546,559·92	553,730·66	2,352,098 6 8½
1922	5,320·16	532,926·12	538,246·28	2,286,324 17 5
1923	5,933·82	498,577·59	504,511·41	2,143,028 5 0½
1924	2,585·20	482,449·78	485,034·98	2,060,297 12 8½
1925	3,910·59	437,341·56	441,252·15	1,874,319 19 10¾
1926	3,188·22	434,154·98	437,343·20	1,857,715 16 7
1927	3,359·10	404,993·41	408,352·51	1,734,571 4 1½
Total	10,981,217·96	26,135,644·44	37,116,862·40	157,662,409 18 10¼

PART II.—MINERALS OTHER THAN GOLD.

TABLE VI.—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 1927, 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.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Previous to 1917* ...	362·87	4,982·17	5,345·04	460,540	244·53	9,465·12	9,709·65	754,309	607·40	14,452·16	15,059·56	1,215,224
1917	4·05	65·00	69·05	9,264	11·18	226·74	237·92	29,928	15·23	291·74	306·97	39,192
1918	5·70	93·80	99·50	20,984	50·52	245·28	295·80	57,653	56·22	339·08	395·30	78,637
1919	...	36·70	36·70	5,871	23·66	220·95	244·61	34,959	23·66	257·65	281·31	40,830
1920	...	41·50	41·50	7,616	10·25	179·84	190·09	31,249	10·25	221·34	231·59	38,865
1921	...	14·50	14·50	1,460	7·00	45·87	52·87	5,778	7·00	60·37	67·37	7,238
1922	...	25·35	25·35	2,446	·15	15·71	15·86	1,393	·15	41·06	41·21	3,839
1923	...	24·40	24·40	2,960	...	28·02	28·02	3,024	...	52·42	52·42	5,984
1924	...	28·55	28·55	4,048	·32	52·24	52·56	7,469	·32	80·79	81·11	11,517
1925	...	23·96	23·96	3,609	1·21	54·06	55·27	8,764	1·21	78·02	79·23	12,373
1926	...	35·42	35·42	5,446	...	61·41	61·41	10,126	...	96·83	96·83	15,572
1927	...	37·44	37·44	6,229	1·23	57·11	58·34	9,544	1·23	94·55	95·78	15,773
Total	372·62	5,408·79	5,781·41	530,473	350·05	10,652·35	11,002·40	954,196	722·67	16,066·01	16,788·68	1,485,044

* Includes 4·72 tons value £360 the produce of Cue District and ·15 tons value £15 the produce 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.	
	tons.	tons.	tons.	£	tons.	tons.	tons.	£	tons.	tons.	tons.	£
Previous to 1917 ...	2·25	83·80	86·05	11,682	...	3·19	3·19	1,804	2·25	86·99	89·24	13,486
1917	...	12·50	12·50	1,782	...	...	...	...	...	12·50	12·50	1,782
1918	...	...	...	...	...	...	...	...	...	...	...	...
1919	...	...	...	...	...	...	...	...	...	...	...	...
1920	...	...	...	...	...	...	..	...	...	..	...	...
1921	...	...	...	...	...	...	...	...	...	...	...	...
1922	...	...	...	...	...	...	...	...	...	...	...	...
1923	...	...	...	...	...	...	...	...	...	...	...	...
1924	...	...	...	...	...	...	...	...	...	...	...	...
1925	...	6·25	6·25	750	...	...	...	...	...	6·25	6·25	750
1926	...	19·45	19·45	2,357	...	...	...	...	...	19·45	19·45	2,357
1927	...	15·28	15·28	3,808	...	...	...	...	...	15·28	15·28	3,808
Total	2·25	137·28	139·53	20,379	...	3·19	3·19	1,804	2·25	140·47	142·72	22,183

Period.	Pyritic Ore.		Copper Ore.													
	Mt. Margaret G.F.		West Kimberley Goldfield		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.‖	Q'ntity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	
Previous to 1917 ...	48,506·57	17,846	109·52	1,709	32·87	386	5·00	120	75,822·37	631,901	347·36	6,341	601·21	18,295	81·12	1,527
1917 ...	3,575·46	1,752	...	...	...	...	...	...	783·61	13,406	3·71	67	287·84	9,683	75·00	1,523
1918 ...	2,251·81	1,629	...	...	...	...	...	...	1,844·19	28,961	...	...	76·28	2,480	82·44	1,314
1919 ...	4,135·93	4,919	...	...	...	...	...	...	1,030·78	15,807	...	...	14·39	353	...	...
1920 ...	6,019·98	7,276	...	...	...	...	9·00	360	1,700·50	32,059	...	...	35·39	1,401	...	...
1921 ...	6,116·66	7,871	...	...	...	...	...	...	1,055·00	18,955	...	...	...	...	...	...
1922 ...	3,441·15	4,203	...	...	...	...	...	...	164·00	2,481	...	...	...	...	...	...
1923 ...	...	...	...	...	...	...	...	...	221·00	3,500	...	...	...	...	...	...
1924 ...	...	...	...	...	...	...	...	...	79·00	1,012	...	...	...	...	...	...
1925 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1926 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1927 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	74,047·56	45,496	109·52	1,709	32·87	386	14·00	480	82,700·45	748,082	351·07	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.

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 1917	790·39	6,379	55·56	522	38·40	413	136·50	1,992	171·55	1,889	47,857·67	230,820	2·85	26
1917	82·92	2,164	...	...	...	...	...	...	...	...	...	...	...	...
1918	78·34	1,794	...	...	...	...	...	...	...	...	...	...	...	...
1919	16·81	377	...	...	...	...	...	...	...	...	...	...	...	...
1920	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1921	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1922	...	...	...	...	...	...	998·66	13,435	...	...	...	...	...	...
1923	...	...	...	...	...	...	9,626·29	59,143	...	...	...	...	...	...
1924	...	...	...	...	...	...	10,672·00	34,955	...	...	...	...	...	...
1925	...	...	...	...	...	...	2,469·72	8,952	...	...	...	...	...	...
1926	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1927	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	968·46	10,714	55·56	522	38·40	413	23,903·17	118,477	171·55	1,889	47,857·67	230,820	2·85	26

TABLE VI.—*Minerals other than Gold, etc.*—continued.

Period.	Copper Ore—continued. North Coolgardie Goldfield. Menzies District. Quantity.	Value.	East Coolgardie Goldfield. E. Coolgardie D. Quantity.	Value.	Phillips River Goldfield. Quantity.	Value.	State generally. Quantity.	Value.	Total. Quantity.	Value.	Gypsum. Yilgarn Goldfield. Quantity.	Value.	State generally. Quantity.	Value.	Total. Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Previous to 1917 ...	6·12	51	50·67	330	86,947·55	466,722	18·61	249	213,075·32	1,369,672	...	...	...	...	...	...
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	4,993	...	...	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	664·50	622
1922 ...	...	...	...	...	31·84	217	...	...	1,194·50	16,133	...	...	63·00	16	63·00	16
1923 ...	...	...	...	...	26·01	541	...	...	9,873·30	63,184	...	...	...	...	...	...
1924 ...	...	...	...	...	3·69	44	...	...	10,754·69	36,011	...	...	4,237·00	5,278	4,237·00	5,278
1925 ...	...	...	...	...	...	...	...	...	2,469·72	8,952	...	...	3,059·95	4,118	3,059·95	4,118
1926 ...	...	...	...	...	...	...	...	...	...	...	139·00	139	3,778·76	5,479	3,917·76	5,618
1927 ...	...	...	...	...	...	...	...	...	...	...	698·25	698	5,976·25	9,120	6,674·50	9,818
Total ...	6·12	51	50·67	330	95,693·95	587,695	18·61	249	253,228·59	1,744,827	837·25	837	17,779·46	24,633	18,616·71	25,470

Period.	Ironstone. W. Pilbara Gf. Quantity.	Value.	E. Coolgardie Gf. E. Coolgardie D. Quantity.	Value.	State generally. Quantity.	Value.	Total. Quantity.	Value.	Lead Ore. Northampton Mf. Quantity.	Value.	West Pilbara Gf. Quantity.	Value.	Total. Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Previous to 1917 ...	100·00	300	450·00	247	57,280·00	36,148	57,830	36,695	112,076·90	274,979	44·00	770	112,120·90	275,749
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
1922 ...	...	...	...	...	...	...	...	...	29,602·90	72,338	...	...	29,602·90	72,338
1923 ...	...	...	...	...	...	...	...	...	21,634·50	59,194	...	...	21,634·50	59,194
1924 ...	...	...	...	...	...	...	...	...	36,750·00	101,219	...	...	36,750·00	101,219
1925 ...	...	...	...	...	...	...	...	...	37,865·99	119,299	...	...	37,865·99	119,299
1926 ...	...	...	...	...	...	...	...	...	23,973·35	72,872	...	...	23,973·35	72,872
1927 ...	...	...	...	...	...	...	...	...	5,809·50	17,347	...	...	5,809·50	17,347
Total ...	100·00	300	450·00	247	57,280·00	36,148	57,830·00	36,695	407,027·32	1,265,476	106·57	1,529	407,133·89	1,267,005

Period.	Silver Lead Ore. Pilbara Goldfield. Marble Bar District. Quantity.	Value.	Ashburton Gfd. Quantity.	Value.	Total. Quantity.	Value.	Tungsten Ores. Wolfram. State generally. Quantity.	Value.	Scheelite. North Coolgardie Gf. Menzies District. Quantity.	Value.	Broad Arrow Goldfield. Quantity.	Value.	Coolgardie Gf. Coolgardie District. Quantity.	Value.	Dundas Goldfield. Quantity.	Value.	Total. Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Previous to 1917 ...	...	...	2,431·54	27,410	2,431·54	27,410	265·89	1,295	...	...	...	...	...	...	...	...	...	...
1917 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1918 ...	...	...	237·48	3,461	237·48	3,461	...	...	...	...	...	...	...	...	...	...	...	...
1919 ...	...	...	214·76	3,116	214·76	3,116	...	...	273·06	829	...	...	45·71	101	...	...	318·77	930
1920 ...	...	...	...	...	...	...	...	...	134·25	113	3·35	175	40·00	54	·41	10	178·01	352
1921 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1922 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1923 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1924 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1925 ...	51·00	1,268	30·00	630	81·00	1,898	...	...	...	...	...	...	...	...	...	...	...	...
1926 ...	90·50	1,305	...	...	90·50	1,305	...	...	...	...	...	...	...	...	...	...	...	...
1927 ...	36·00	792	60·00	1,179	96·00	1,971	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	177·50	3,365	2,973·78	35,796	3,151·28	39,161	265·89	1,295	407·31	942	3·35	175	85·71	155	·41	10	496·78	1,282

Period.	Coal. Collie Mf. Quantity.	Value.	Fireclay. Collie Mf. Quantity.	Value.	Gadolinite. Pilbara Gf. Marble Bar D. Quantity.	Value.	Asbestos. Pilbara Gf. Marble Bar D. Quantity.	Value.	Nullagine D. Quantity.	Value.	West Pilbara Goldfield. Q'nty.	Value.	Total. Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£
Previous to 1917	3,544,356·95	1,657,415	...	...	1·00	112	42·83	1,754	...	...	...	...	42·83	1,754
1917	326,550·07	191,822	...	...	...	...	...	...	...	...	...	...	...	...
1918	337,039·24	204,319	...	...	...	...	...	...	...	...	...	...	...	...
1919	401,713·18	270,355	...	...	...	...	...	...	53·00	1,443	...	...	53·00	1,443
1920	462,020·78	350,346	...	...	...	...	32·00	1,900	124·50	5,886	...	...	156·50	7,286
1921	468,816·65	407,117	677·80	646	...	...	32·60	1,360	202·75	12,221	...	...	235·35	13,581
1922	438,442·78	381,555	...	...	...	...	2·50	250	179·18	7,350	...	...	181·68	7,600
1923	420,713·98	368,949	...	...	...	...	3·00	150	111·00	3,865	·85	17	114·85	4,032
1924	421,863·86	363,255	...	...	...	...	...	...	73·58	2,206	...	...	73·58	2,206
1925	437,461·20	363,203	...	...	...	...	...	...	50·00	1,619	·74	22	50·74	1,641
1926	474,818·69	394,400	...	...	...	...	...	...	91·45	2,436	13·89	292	105·34	2,728
1927	501,504·95	407,967	...	...	...	...	...	...	10·80	304	...	...	10·80	304
Total ...	8,235,302·33	5,360,703	677·80	646	1·00	112	112·93	5,414	896·26	36,830	15·48	331	1,024·67	42,575

TABLE VI.—*Minerals other than Gold, etc.*—**continued.**

Period.	LIMESTONE.								DIAMONDS.		EMERALDS.		MAGNESITE.		ANTIMONY.		MANGANESE.	
	Murchison Gf. Cue District.		Yilgarn Goldfield.		State generally.		Total.		Pilbara Gf. Nullagine District.		Murchison Gf. Cue District.		E. Coolgardie Goldfield. Bulong District.		West Pilbara Goldfield.		Peak Hill Goldfield.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	tons.	£	tons.	£	tons.	£	tons.	£	carats.	£	carats.	£	tons.	£	tons.	£	tons.	£
Previous to 1917 ...	298·00	772	2,548·85	1,607	90,858·88	15,911	93,705·73	18,290	...	24	...	...	699·00	698	20·78	491	...	...
1917 ...	...	...	...	...	...	...	...	...	...	...	...	...	20·50	21	...	...	...	...
1918 ...	...	...	...	...	...	...	...	...	...	...	...	...	105·25	334	...	...	...	...
1919 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1920 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1921 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1922 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18·11	142
1923 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1924 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	58·63	294
1925 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1926 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1927 ...	...	...	...	...	...	...	...	...	...	...	200·00	421	...	...	...	...	...	...
Total ...	**298·00**	**772**	**2,548·85**	**1,607**	**90,858·88**	**15,911**	**93,705·73**	**18,290**	...	**24**	**200·00**	**421**	**824·75**	**1,053**	**20·78**	**491**	**76·74**	**436**

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 XXVI., page 66

TABLE VII.

QUANTITY AND VALUE OF BLACK TIN REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity. Lode.	1927. Quantity. Stream.	1927. Quantity. Total.	1927. Value.	Totals to Date. Quantity. Lode.	Totals to Date. Quantity. Stream.	Totals to Date. Quantity. Total.	Totals to Date. Value.
			tons.	tons.	tons.	£	tons.	tons.	tons.	£
		PILBARA GOLDFIELD.								
		MARBLE BAR DISTRICT.								
Cooglegong ...	...	Sundry claims	...	18·74	18·74	3,175	...	1,761·25	1,761·25	160,266
Mills Find ...	...	Sundry claims	...	...	...	...	...	·85	·85	69
Moolyella ...	...	Voided leases	...	...	...	...	...	330·53	330·53	21,340
Do. ...	...	Sundry claims	...	18·45	18·45	3,014	...	2,902·92	2,902·92	279,511
Old Shaw ...	...	Voided leases	...	...	...	...	...	6·75	6·75	424
Do. ...	...	Sundry claims	...	...	...	...	...	214·04	214·04	14,525
Tabba Tabba ...	...	Sundry claims	...	·25	·25	40	...	117·70	117·70	13,265
Wodgina ...	M.Ls. 86, 87, 95	H.M. and Anchorite leases ...	...	...	...	...	...	5·00	5·00	500
Do. ...	M.L. 84 ...	(Mount Cassiterite)	...	...	...	...	133·52	13·85	147·37	14,184
Do. ...	M.Ls. 84, (93), (148)	Mount Cassiterite leases ...	...	...	...	...	195·50	1·60	197·10	16,918
Do. ...	...	Voided leases	...	...	...	...	37·82	6·10	43·92	4,414
Do. ...	...	Sundry claims	...	...	...	...	5·78	48·20	53·98	5,062
		Totals	...	37·44	37·44	6,229	372·62	5,408·79	5,781·41	530,473
		MURCHISON GOLDFIELD.								
		CUE DISTRICT.								
Poona	...	Sundry claims	...	...	...	...	...	1·52	1·52	118
Cuddingwarra ...	...	Sundry claims	...	...	...	...	...	3·20	3·20	242
		Totals	...	...	...	...	...	4·72	4·72	360
		COOLGARDIE GOLDFIELD.								
		COOLGARDIE DISTRICT.								
Bulla Bulling ...	...	Sundry claims	...	...	...	...	...	·15	·15	15
		Totals	...	...	...	...	...	·15	·15	15
		GREENBUSHES MINERAL FIELD.								
Greenbushes ...	515	Kapanga	·90	·18	1·08	203	35·53	1·35	36·88	4,757
Do. ...	628	Lost and Found	·33	...	·33	50	·33	...	·33	50
Do. ...	505 (519) 614...	Scotia leases	...	7·50	7·50	1,124	...	98·01	98·01	11,706
Do. ...	Locs. 289, 290	Clarth and others	...	...	...	...	...	318·04	318·04	28,959
Do. ...	Loc. 290 ...	McKay & Struthers ...	...	...	...	...	...	5·39	5·39	762
Do. ...	...	Voided leases	...	...	...	...	243·09	3,471·20	3,714·29	368,249
Do. ...	...	Sundry claims	...	49·43	49·43	8,167	71·10	6,758·36	6,829·46	539,713
		Totals	1·23	57·11	58·34	9,544	350·05	10,652·35	11,002·40	954,196

TABLE VIII.

QUANTITY AND VALUE OF TANTALITE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity. Lode.	1927. Quantity. Stream.	1927. Quantity. Total.	1927. Value.	Total to Date. Quantity. Lode.	Total to Date. Quantity. Stream.	Total to Date. Quantity. Total.	Total to Date. Value.
			tons.	tons.	tons.	£	tons.	tons.	tons.	£
		PILBARA GOLDFIELD.								
		MARBLE BAR DISTRICT.								
Wodgina ...	M.Ls. 86, 87, 95	H.M. and Anchorite leases ...	...	15·28	15·28	3,808	2·25	83·78	86·03	14,015
Do. ...	M.L. 293 ...	May Be	...	...	...	...	...	2·00	2·00	240
Do. ...	...	Sundry claims	...	...	...	...	...	51·50	51·50	6,124
		Totals	...	15·28	15·28	3,808	2·25	137·28	139·53	20,379
		GREENBUSHES MINERAL FIELD.								
Greenbushes ...	(369)	Enterprise	...	...	...	...	...	3·19	3·19	1,804
		Totals	...	...	...	...	...	3·19	3·19	1,804

TABLE IX.

QUANTITY AND VALUE OF PYRITIC ORE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. †Value.	Total to Date. Quantity.	Total to Date. †Value.
			tons.	£	tons.	£
		MT. MARGARET GOLDFIELD.				
		Mt. Morgans District.				
Eulaminna ...	M.Ls. (4F), (5F), (11F), (12F)	West Australian Copper Co., Ltd.	...	...	61,687·98	38,818
Murrin Murrin...	M.L (18F) ...	Nangeroo: Nangaroo Mines, Ltd.	...	...	12,359·58	6,678
		Totals	...	...	**74,047·56**	**45,496**

† Represents the value of the sulphur only, the copper contents not having been treated.

TABLE X.

QUANTITY AND VALUE OF COPPER ORE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity. Ore.	1927. Quantity. Metallic Copper.	1927. Value.	Total to Date. Quantity. Ore.	Total to Date. Quantity. Metallic Copper.	Total to Date. Value.
			tons.	tons.	£	tons.	tons.	£
		WEST KIMBERLEY GOLDFIELD.						
~~Beryiton~~ ...	...	~~Voided leases~~	...	...	...	13·19	2·76	200
Yampi Sound ...	M.L. (1), [221H]	Yampi Sound Copper Mine	...	...	...	92·86	22·80	1,478
Do. ...	... ...	Sundry claims	...	...	...	3·47	·36	36
		Totals	...	...	...	**109·52**	**25·92**	**1,709**
		PILBARA GOLDFIELD.						
		Marble Bar District.						
Marble Bar ...	... ...	Voided Leases	...	...	...	11·00	1·64	90
Do. ...	... ...	Sundry claims	...	...	...	4·75	·48	25
North Pole ...	... ...	Voided leases	...	...	...	9·35	1·39	81
North Shaw ...	... ...	Voided leases	...	...	...	7·77	1·90	190
		Totals	...	...	...	**32·87**	**5·41**	**386**
		NULLAGINE DISTRICT.						
Lionel	... ...	Sundry claims	...	...	...	9·00	4·75	360
~~McPhee's Creek~~	M.L. (14L) ...	Tambina	...	...	...	5·00	2·22	120
		Totals	...	...	...	**14·00**	**6·97**	**480**
		WEST PILBARA GOLDFIELD.						
Croydon ...	... ...	Voided leases	...	...	...	604·00	108·65	7,333
Egina	... ...	Voided leases	...	...	...	542·00	104·15	6,643
Roebourne ...	M.L. 183 ...	(Carlow Castle: Roebourne Copper Mine, Ltd.)	...	...	...	69·00	7·80	780
Do. ...	M.L. 174 ...	Good Fortune	...	...	...	56·77	8·58	904
Do. ...	M.Ls. 174, (175)	(Good Fortune leases)	...	...	...	63·40	9·58	1,011
Do. ...	M.L. 184 ...	Good Luck	...	...	...	5·21	1·01	111
Do. ...	M.L. 167 ...	(Quod Est.)	...	...	...	22·43	3·49	256
Do. ...	M.Ls. 167, 183	Roebourne Copper Mines, Ltd.	...	...	...	122·45	18·50	1,855
Do. ...	M.Ls. 144, (192), (193)	Yannery and Whundo Copper Mining Co., Ltd.	...	...	...	404·50	87·14	8,116
Do. ...	M.L. 144 ...	Yannery Hill Copper Mine	...	...	...	469·25	113·81	9,961
Do. ...	...	Voided leases	...	...	...	2,729·28	515·83	44,459
Do. ...	...	Sundry claims	...	...	...	77·41	13·61	800
Whim Creek ...	M.L. 34 ...	(Balla Balla Copper Mines, Ltd.)	...	...	...	2,009·00	166·33	12,036
Do. ...	M.L. 34 ...	Mons. Cupri: Whim Well Copper Mines, Ltd.	...	...	...	282·50	33·75	2,979
Do. ...	Loc. 71 ...	Pilbarra Copper Fields, Ltd.	...	...	...	2,650·50	574·31	46,096
Do. ...	Loc. 71 ...	(Whim Well Copper Mines, Ltd.)	...	...	...	72,562·75	9,343·89	604,492
Do. ...	...	Voided leases	...	...	...	30·00	5·50	250
		Totals	...	...	...	**82,700·45**	**11,115·93**	**748,082**

TABLE X.—*Quantity and Value of COPPER ORE, etc.*—continued.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity. Ore.	1927. Quantity. Metallic Copper.	1927. Value.	Totals to Date. Quantity. Ore.	Totals to Date. Quantity. Metallic Copper.	Totals to Date. Value.
			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	227
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
Narra Tarra ...	Loc. 833 ...	Narra Tarra: Fremantle Trading Co., Ltd.	...	...	...	23,766·67	1,784·64	116,485
		Totals	...	...	...	23,903·17	1,820·69	118,477
		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. (66F) ...	Mt. Morven	...	...	...	11·53	2·40	163
Murrin Murrin...	(18F)	Nangeroo: Nangaroo 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 X.— *Quantity and Value of COPPER ORE, etc.*—continued.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927.			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. (16T) ...	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.Ls. 147, 179	Fair Play leases	...	...	...	130·09	131·30	11,975
Do. ...	G.M.L. 184 ...	Gem	...	...	...	90·98	22·58	2,404
Do. ...	G.M.Ls. 151, 156	Gem Consolidated leases	...	...	...	48·00	76·75	8,327
Do. ...	M.Ls. 52, 94 ...	Harbour View Gold and Copper Co., Ltd. ...	...	...	...	1,209·93	90·14	8,236
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	...	...	...	692·84	57·65	4,746
Do. ...	M.L. 370 ...	North Harbour View	...	...	...	15·72	·99	124
Do. ...	M.Ls. 52, 94 ...	(Ravensthorpe G.M. Syndicate, N.L.) ...	...	...	...	132·56	24·36	1,882
Do. ...	... ...	Voided leases	...	...	...	3,430·67	319·32	22,398
Do. ...	... ...	Sundry claims	...	...	...	111·12	17·40	1,372
Mt. Desmond ...	... ...	Voided leases	...	...	...	46,952·31	4,107·47	279,054
Do. ...	... ...	Sundry claims	...	...	...	140·25	25·17	1,901
Ravensthorpe ...	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 and 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)	...	...	...	281·56	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 and Copper Co., Ltd.)	...	...	...	14,432·25	714·90	40,313
Do. ...	... ...	Voided leases	...	...	...	7,880·86	986·55	63,429
Do. ...	... ...	Sundry claims	...	...	...	1,157·36	133·24	11,482
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	...	...	...	95,693·95	8,362·00	587,695
		STATE GENERALLY.						
...	... ...	Voided leases	...	...	...	5·11	1·54	56
...	... ...	Sundry claims	...	...	...	13·50	2·27	193
		Totals	...	...	...	18·61	3·81	249

TABLE XI.

QUANTITY AND VALUE OF IRONSTONE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. Value.	Totals to Date. Quantity.	Totals to Date. 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 XII.

QUANTITY AND VALUE OF LEAD ORE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Lead Ore.	1927. Metal therefrom.	1927. Value.	Totals to Date. Lead Ore.	Totals to Date. Metal therefrom.	Totals to Date. Value.
			tons.	tons.	£	tons.	tons.	£
		NORTHAMPTON MINERAL FIELD.						
Geraldine ...	Loc. 1 ...	Geraldine Mine	...	...	...	774·59	257·13	5,139
Do. ...	M.L. 200 ...	Grand Junction	97·50	29·00	500	227·50	39·19	795
Do. —	M.L. 24P.P. ...	(Springvale)	...	...	...	2,290·00	261·33	8,893
Do. ...	M.L. 24P.P. ...	Springvale: Tarcoola Blocks Mines, N.L.	3,215·00	324·26	8,577	3,350·00	357·46	9,640
Do. ...	M.Ls. 148, 150, 154, 158, 20P.P.	Surprise leases...	...	...	...	93,834·03	13,019·33	392,709
Do. ...	M.L. 158 ...	(Surprise South)	...	...	...	14·00	5·41	170
Do. ...	M.L. 153 ...	Three Sisters: Ajana Lead Mines, Ltd.	...	...	...	8,726·00	892·88	30,619
Do. ...	M.L. 153 ...	(Three Sisters)...	...	...	...	6·25	3·94	112
Do. ...	M.L. 197 ...	(Two Boys)	...	...	...	4,874·50	547·99	16,403
Do. ...	M.L. 197 ...	Two Boys: Two Boys Lead Mining Co., Ltd.	212·00	20·00	540	4,870·75	394·17	12,089
Do. ...	M.L. 202 ...	Welcome: Two Boys Lead Mining Co., Ltd.	874·00	86·00	2,404	1,263·00	115·21	3,274
Do. ...	M.L. 23P.P. ...	Wheal Ina	95·00	23·81	468	513·00	85·27	1,877
Do. ...	Loc. 7 ...	Thring & Green	547·00	160·00	2,840	3,168·38	979·25	23,893
Do. ...	...	Voided leases	...	...	...	145·49	87·61	1,357
Do. ...	...	Sundry claims	...	...	...	327·04	175·65	3,408
Narra Tarra ...	Loc. 833 ...	Jupp and others (Tributers) ...	734·00	108·60	1,978	734·00	108·60	1,978
Do. ...	Loc. 833 ...	Narra Tarra: Fremantle Trading Co., Ltd.	...	...	...	126,429·50	12,377·27	361,745
Do. ...	Locs. 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.L. 27P.P. ...	Lady Samson	...	...	...	45·00	7·25	132
Do. ...	Loc. 1146 ...	Wheal Ellen: Fremantle Trading Co., Ltd.	...	...	...	22,033·28	1,818·71	52,456
Do. ...	Loc. 436 ...	Wheal of Fortune Extended Syndicate	...	...	...	125·82	43·13	793
Do. ...	...	Voided leases	...	...	...	3,266·76	723·13	14,329
Do. ...	...	Sundry claims	35·00	7·00	40	257·12	139·14	2,719
Victoria... ...	...	Voided leases	...	...	...	19·00	12·54	212
		Totals	5,809·50	758·67	17,347	407,027·32	46,485·29	1,265,476
		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 XIII.

QUANTITY AND VALUE OF SILVER-LEAD ORE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. Value.	Totals to Date. Quantity.	Totals to Date. Value.
			tons.	£	tons.	£
		PILBARA GOLDFIELD.				
		MARBLE BAR DISTRICT.				
Braeside ...	M.L. 295 ...	Koongalin ...	22·00	540	46·00	1,140
Do. ...	M.L. 297 ...	Oakover ...	...	...	3·00	54
Do. ...	M.L. 288 ...	Ragged Hill ...	...	...	28·50	627
Do. ...	...	Sundry claims ...	14·00	252	98·50	1,509
Do. ...	...	Voided leases ...	...	...	1·50	35
		Totals ...	36·00	792	177·50	3,365
		ASHBURTON GOLDFIELD.				
Uaroo ...	M.L. 102 ...	Silver Star ...	60·00	1,179	90·00	1,809
Do. ...	...	Voided leases ...	...	...	2,880·95	33,947
Do. ...	...	Sundry claims ...	...	...	2·83	40
		Totals ...	60·00	1,179	2,973·78	35,796

TABLE XIV.

QUANTITY AND VALUE OF COAL REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. Value.	Totals to Date. Quantity.	Totals to Date. Value.
			tons.	£	tons.	£
		COLLIE MINERAL FIELD.				
Collie ...	197, etc. ...	Amalgamated Colleries of W.A., Ltd. (Cardiff Mine) ...	81,682·55	65,436	506,567·28	414,445
Do. ...	244, etc. ...	Amalgamated Collieries of W.A., Ltd. (Co-operative Mine) ...	147,067·90	118,864	907,417·71	759,148
Do. ...	85 etc. ...	Amalgamated Colleries of W.A., Ltd. (Proprietary Mine) ...	140,339·76	114,455	940,178·86	794,009
Do. ...	74, etc. ...	Amalgamated Colleries of W.A., Ltd. (Stockton Mine) ...	201·10	120	201·10	120
Do. ...	250, etc. ...	Amalgamated Colleries of W.A., Ltd. (Westralia Mine) ...	121,176·06	100,302	549,459·42	477,601
Do. ...	151, etc. ...	(Amalgamated Colleries of W.A., Ltd.) (Scottish Mine) ...	...	...	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 Colleries, Ltd.) ...	...	...	970,044·30	511,862
Do. ...	88 (part of) ...	(Collie Proprietary Coalfields of W.A., Ltd.) ...	...	...	477,781·55	242,918
Do. ...	85, etc. ...	(Collie Proprietary Coalfields of W.A., Ltd.) ...	...	...	580,392·15	289,246
Do. ...	314, etc. ...	(Griffin leases) ...	1,178·65	707	1,866·27	1,228
Do. ...	314, etc. ...	Griffin Coal Mining Co., Ltd. ...	287·18	172	287·18	172
Do. ...	260, etc. ...	Premier Coal Mining Co., Ltd. ...	9,571·75	7,911	468,086·03	347,155
Do. ...	151, etc. ...	(Scottish Collieries, Ltd.) ...	...	...	2,314·51	1;210
Do. ...	151, etc. ...	(Scottish Co-operative Colleries, Ltd.) ...	...	...	430,796·95	171,303
Do. ...	85, etc. ...	(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.) ...	...	...	507,384·11	307,913
Do. ...	250, etc. ...	(Westralia Black Diamond Colleries, Ltd.) ...	...	...	125,083·24	117,827
		Voided leases ...	...	...	25,569·85	12,930
		Totals ...	501,504·95	407,967	8,235,302·33	5,360,703

TABLE XV.

QUANTITY AND VALUE OF FIRECLAY REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. Value.	Totals to Date. Quantity.	Totals to Date. Value.
		COLLIE MINERAL FIELD.	tons.	£	tons.	£
Collie ...	87 ...	Amalgamated Collieries of W.A., Ltd. (Proprietary lease) ...	...	...	677·80	646
		Totals ...	...	...	677·80	646

TABLE XVI.

QUANTITY AND VALUE OF LIMESTONE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1927. Quantity.	1927. Value.	TOTALS TO DATE. Quantity.	TOTALS TO DATE. 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 XVII.

QUANTITY AND VALUE OF ASBESTOS REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1927. Quantity.	1927. Value.	TOTALS TO DATE. Quantity.	TOTALS TO DATE. Value.
			tons.	£	tons.	£
		PILBARA GOLDFIELD.				
		MARBLE BAR DISTRICT.				
Cooglegong ...	M.Ls. 274, 275	Chrysolite No. 1 leases	...	...	70·10	3,660
Soansville ...	...	Voided leases	...	...	42·83	1,754
		Totals	...	...	112·93	5,414
		NULLAGINE DISTRICT.				
Lionel	...	Voided leases	...	...	578·98	27,197
Do. ...	...	Sundry claims	10·80	304	317·28	9,633
		Totals	10·80	304	896·26	36,830
		WEST PILBARA GOLDFIELD				
Roebourne ...	... ...	Sundry claims	...	...	·85	17
Do. ...	M.L. 215 ...	Greenhill Reward	...	...	14·63	314
		Totals	...	...	15·48	331

TABLE XVIII.

QUANTITY AND VALUE OF GADOLINITE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1927. Quantity.	1927. Value.	TOTALS TO DATE. Quantity.	TOTALS TO DATE. Value.
			tons.	£	tons.	£
		PILBARA GOLDFIELD.				
		MARBLE BAR DISTRICT.				
Cooglegong ...	(M.L. 254) ...	Iverna	...	...	1·00	112
		Totals	...	...	1·00	112

TABLE XIX.

QUANTITY AND VALUE OF TUNGSTEN ORES REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

SCHEELITE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Ore.	1927. Contents Tungstic Trioxide.	1927. Value.	Totals to Date. Ore.	Totals to Date. Contents Tungstic Trioxide.	Totals to Date. 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.	1927. Ore.	1927. Metallic contents.	1927. Value.	Totals to Date. Ore.	Totals to Date. Metallic contents.	Totals to Date. Value.
			tons.	tons.	£	tons.	tons.	£
		MURCHISON GOLDFIELD.						
		CUE DISTRICT.						
Callie Spring ...	M.L. (11) ...	Socialist	...	...	...	194·00	6·11	877
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 XX.

QUANTITY AND VALUE OF MAGNESITE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. Value.	Totals to Date. Quantity.	Totals to Date. Value.
			tons.	£	tons.	£
		EAST COOLGARDIE GOLDFIELD.				
		BULONG DISTRICT.				
Bulong . .	... ...	Sundry claims	...	...	824·75	1,053
		Totals	...	...	824·75	1,053

TABLE XXI.

Quantity and Value of ANTIMONY reported to the Mines Department during 1927, and Totals to Date.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Ore.	1927. Metallic contents.	1927. Value.	Totals to Date. Ore.	Totals to Date. Metallic contents.	Totals to Date. 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 XXII.

Quantity and Value of GYPSUM reported to the Mines Department during 1927, and Totals to Date.

Locality.	Number of Lease, Claim, or Area.	Registered Name of Company or Lease.	1927. Quantity.	1927. Value.	Totals to Date. Quantity.	Totals to Date. Value.
			tons	£	tons.	£
		YILGARN GOLDFIELD.				
Lake Seabrook	... ...	Sundry claims	698·25	698	837·25	837
		Totals	**698·25**	**698**	**837·25**	**837**
		STATE GENERALLY.				
Baandee ...	...	Sundry claims	1,570·00	2,361	3,636·21	5,190
Dukin	...	Sundry claims	...	...	487·00	561
Hines Hill ...	...	Sundry claims	...	...	1,977·00	1,659
Koorda ...	M.L. 280H ...	White Cross	1,784·00	2,679	5,460·05	7,539
Woolundra ...	...	Sundry claims	2,622·25	4,080	6,229·20	9,684
		Totals	**5,976·25**	**9,120**	**17,779·46**	**24,633**

TABLE XXIII.

QUANTITY AND VALUE OF EMERALDS REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1927.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			carats (cut).	£	carats (cut).	£
		MURCHISON GOLDFIELDS. CUE DISTRICT.				
Poona	M.L. 79 ...	Star One: Star Mining Syndicate, Ltd.	200	421	200	421
		Totals	200	421	200	421

TABLE XXIV.

QUANTITY AND VALUE OF DIAMONDS REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

		PILBARA GOLDFIELD. NULLAGINE DISTRICT.				
Nullagine ...	M.R.C. (6L) ...	Morgans, A. E.	...	...	...	24
		Totals	...	...	...	24

TABLE XXV.

QUANTITY AND VALUE OF MANGANESE REPORTED TO THE MINES DEPARTMENT DURING 1927, AND TOTALS TO DATE.

LOCALITY.	NUMBER OF LEASE, CLAIM, OR AREA.	REGISTERED NAME OF COMPANY OR LEASE.	1927.		TOTALS TO DATE.	
			Quantity.	Value.	Quantity.	Value.
			tons.	£	tons.	£
		PEAK HILL GOLDFIELD.				
Horseshoe ...	...	Voided leases	...	...	18·11	142
Do. ...	...	Sundry claims	...	...	58·63	294
		Totals	...	...	76·74	436

TABLE

Return of Ore and Minerals other than Gold

Year.	Copper. Copper Ore. West Pilbara Gf. Quantity.	Value.	Northampton Mf. Quantity.	Value.	Phillips River Gf. Quantity.	Value.	State generally. Quantity.	Value.	Total. Quantity.	Value.	Copper Ingot, Matte, Etc. State generally. Quantity.	Value.	Total Value of Copper Exported.
	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	tons.	£	£
1850 ...	...	...	...	...	...	...	...	...	...	...	...	...	...
1 ...	...	...	...	...	...	...	...	...	...	...	...	...	...
2 ...	...	...	...	...	...	...	...	...	...	...	...	...	...
3 ...	...	...	[2]†	7	...	...	...	...	...	7	...	...	7
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
1922 ...	...	...	...	...	...	...	352	5,519	352	5,519	660	14,860	20,379
1923 ...	...	...	...	...	...	...	3,394	48,907	3,394	48,907	1,057	16,193	65,100
1924 ...	...	...	...	...	...	...	2,795	40,676	2,795	40,676	...	...	40,676
1925 ...	...	...	...	...	...	...	1,201	18,200	1,201	18,200	...	...	18,200
1926 ...	...	...	...	...	...	...	...	...	...	...	1	84	84
1927 ...	...	...	...	...	...	...	...	...	...	...	2	101	101
Total ...	...	...	...	...	...	...	...	...	80,124	987,019	13,417	818,164	1,805,183

[1]† *See* Woodward's Mining Handbook, Perth: By Authority, 1895; page 123.   [2]† Weight not stated.

XXVI.

ENTERED FOR EXPORT FROM 1850 TO 1927, INCLUSIVE.

Tin.											Year.
Black Tin (Dressed Tin ore).								Tin Ingot.		Total Value of Tin Exported.	
Pilbara Gf.		Greenbushes Mf.		[3]†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
...	...	5	300	...	...	5	300	...	...	300	9
...	...	68	5,400	...	...	68	5,400	...	...	5,400	1890
...	...	204	10,200	...	...	204	10,200	...	...	10,200	1
...	...	265	13,843	...	...	265	13,843	...	...	13,843	2
57	3,470	171	7,664	...	...	228	11,134	...	...	11,134	3
19	949	371	14,325	...	...	390	15,274	...	...	15,274	4
...	...	277	9,703	...	...	277	9,703	...	...	9,703	5
...	...	137	4,338	...	...	137	4,338	...	...	4,338	6
...	...	96	3,275	...	...	96	3,275	...	...	3,275	7
...	...	68	2,760	...	...	68	2,760	...	...	2,760	8
30	2,025	278	21,138	...	...	308	23,163	...	...	23,163	9
368	30,146	102	8,032	...	...	470	38,178	142	18,872	57,050	1900
439	34,600	68	4,895	...	...	507	39,495	97	12,607	52,102	1
248	19,698	31	2,870	...	...	279	22,568	141	16,830	39,398	2
267	20,988	25	1,868	...	...	292	22,856	235	29,277	52,133	3
64	4,932	24	1,389	379	20,797	467	27,118	129	16,155	43,273	4
188	16,853	119	8,177	666	51,748	973	76,778	[2]†	1	76,779	5
329	28,375	444	46,254	624	64,005	1,397	138,634	45	8,746	147,380	6
...	...	...	...	1,424	151,414	1,424	151,414	78	14,725	166,139	7
...	...	...	...	1,093	83,594	1,093	83,594	[2]†	1	83,595	8
...	...	...	...	698	62,989	698	62,989	...	...	62,989	9
...	...	...	...	500	45,129	500	45,129	...	...	45,129	1910
...	...	...	...	495	55,220	495	55,220	...	...	55,220	1
...	...	...	...	651	79,738	651	79,738	...	...	79,738	2
...	...	...	...	484	72,142	484	72,142	...	...	72,142	3
...	...	...	...	363	35,649	363	35,649	...	...	35,649	4
...	...	...	...	429	41,391	429	41,391	...	...	41,391	5
...	...	...	...	463	49,101	463	49,101	...	...	49,101	6
...	...	...	...	383	45,288	383	45,288	...	...	45,288	7
...	...	...	...	415	76,952	415	76,952	...	...	76,952	8
...	...	...	...	318	47,269	318	47,269	...	...	47,269	9
...	...	...	...	243	49,449	243	49,449	...	...	49,449	1920
...	...	...	...	67	6,485	67	6,485	...	...	6,485	1921
...	...	...	...	110	10,930	110	10,930	...	...	10,930	1922
...	...	...	...	131	15,095	131	15,095	...	...	15,095	1923
...	...	...	...	87	12,008	87	12,008	...	...	12,008	1924
...	...	...	...	108	15,392	108	15,392	...	...	15,392	1925
...	...	...	...	67	10,450	67	10,450	...	...	10,450	1926
...	...	...	...	77	13,316	77	13,316	...	...	13,316	1927
...	...	...	...	...	...	15,037	1,444,018	867	117,214	1,561,232	Total

[2]†Weight not stated. [3]†Probably the produce of Pilbara Goldfield and Greenbushes Mineral Field.

TABLE XXVI.—*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	...	...	[3]†	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	...	...	[3]†	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	...	...
1922	118,696	18,164	...	...	...	...	2,796	69,528	...	...
1923	109,005	16,036	...	...	3,172	43,416	20	609	...	...
1924	89,146	13,409	...	...	4,854	83,095	...	...	...	...
1925	81,226	11,661	...	...	4,664	103,300	...	...	...	...
1926	68,413	8,863	...	...	4,162	76,741	...	...	...	...
1927	49,895	5,829	...	...	1,413	24,592	...	...	...	...
Total ...	4,521,928	626,037	44,032	508.748	26,495	482,365	23,052	628,956	184	5,437

[3]† Weight not stated. [4]† Estimated. ‡ Ore and Concentrates.

entered for EXPORT from 1850 to 1927, inclusive—continued.

Tungsten Ore.				Arsenical Ore.		Tantalite.		Non-Metallic Minerals.				Year.
Wolfram.		Scheelite.						Graphite.		Magnesite.		
State generally.		State generally.		State generally.		State generally.		State generally.		State generally.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity	Value.	
tons.	£	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
...	...	...	...	...	...	...	...	...	...	...	...	1890
...	...	...	...	...	...	...	...	...	...	...	...	1
...	...	...	...	...	...	...	...	...	...	...	...	2
...	...	...	...	...	...	...	...	...	...	...	...	3
...	...	...	...	...	...	...	...	...	...	...	...	4
...	...	...	...	...	...	...	...	...	...	...	...	5
...	...	...	...	...	...	...	...	...	...	...	...	6
...	...	...	...	...	...	...	...	...	...	...	...	7
...	...	...	...	...	...	...	...	...	...	...	...	8
...	...	...	...	...	...	...	...	...	...	...	...	9
...	...	...	...	...	...	...	...	...	...	...	...	1900
...	...	...	...	...	...	...	...	...	...	...	...	1
...	...	...	...	...	...	...	...	1	6	...	...	2
...	...	...	...	...	...	...	...	...	...	...	...	3
...	...	...	...	...	...	...	...	...	...	...	...	4
...	...	...	...	...	...	18	5,729	...	...	...	...	5
...	...	...	...	...	...	...	...	...	...	...	...	6
...	...	4	140	...	...	...	...	...	...	...	...	7
...	...	...	...	...	...	2†	400	...	...	...	...	8
1	100	...	...	...	...	...	...	...	...	...	...	9
2	190	...	...	...	...	...	...	...	...	...	...	1910
9	826	...	...	...	...	...	...	...	...	...	...	1
...	...	...	...	...	...	...	...	...	...	...	...	2
1	86	...	...	...	...	...	...	...	...	...	...	3
½	40	...	...	...	...	...	...	7	40	...	...	4
¼	25	...	...	...	...	...	...	...	...	688	1,196	5
1	128	3	438	11	19	47	9,375	21	284	12	47	6
...	...	½	42	57	707	17	2,513	18	158	42	50	7
¼	31	5	720	679	2,564	...	...	5	75	62	225	8
½	15	6	772	...	...	¼	75	...	...	...	...	9
...	...	2½	395	1,765	4,260	...	...	13	130	...	...	1920
...	...	...	...	7	16	...	...	...	...	...	...	1921
...	...	...	...	1,075	1,784	...	...	2†	3	...	...	1922
...	...	...	...	**	686	4½	688	...	...	2	8	1923
...	...	...	...	**	777	...	...	...	...	...	...	1924
...	...	...	...	**	1,045	5	1,010	...	...	...	...	1925
...	...	...	...	**	347	24½	5,751	...	...	...	...	1926
...	...	...	...	**	819	17	3,746	...	...	...	...	1927
15	1,441	21	2,507	...	13,024	...	29,287	...	696	806	1,526	Total.

** Contained in Gold ore. 2† Weight not stated.

TABLE XXVI.—*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. State generally.		COAL. Collie River Mf.		MICA. 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	...	...	...	...	...	...	...	...	4,830	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	...	...	...	...	...	...	...	...	48,284	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 1927, inclusive—continued.

Year.	Non-Metallic Minerals—*continued.* Asbestos. State generally. Quantity.	Value.	Coal. Collie River Mf. Quantity.	Value.	Mica. State generally. Quantity.	Value.	Minerals not Elsewhere Included. Quantity.	Value.	Total Value of Minerals other than Gold exported to Date.	Year
	tons.	£	tons.	£	tons	£	tons	£	£	
Brought forward	...	...	...	...	...	...	...	...	508,968	
1890	...	...	...	...	...	...	...	...	7,671	1890
1	...	...	...	...	...	...	...	...	14,912	1
2	...	...	...	...	[2]†	25	...	...	22,714	2
3	...	...	...	...	[2]†	4	...	...	11,744	3
4	...	...	...	...	...	...	...	...	15,274	4
5	...	...	...	...	[2]†	3	...	...	22,658	5
6	...	...	...	...	...	...	...	...	4,438	6
7	...	...	...	...	[2]†	209	...	...	4,532	7
8	...	...	1	1	...	...	...	...	7,060	8
9	[2]†	1	798	772	[2]†	50	...	...	66,611	9
1900	...	...	355	350	[2]†	3	5	85	95,261	1900
1	...	...	971	969	...	...	...	4	171,453	1
2	...	...	12	12	...	...	[6]†2	41	61,551	2
3	[5]†	10	110	127	...	...	[7]† 22	230	109,468	3
4	...	...	11	7	...	...	7	81	97,132	4
5	...	...	108	87	...	...	62	127	192,251	5
6	...	...	86	65	...	...	10	1,035	222,621	6
7	...	...	26 *1,447	28 1,138	...	...	[8]†96	1,447	402,906	7
8	[2]†	1,242	13 *9,612	11 7,747	[2]†	10	42	2,750	176,827	8
9	...	...	353 *85,647	183 93,781	...	...	[9]† 263	735	282,650	9
1910	...	...	3 *48,876	2 38,400	...	...	½	100	200,106	1910
1	...	...	*40,063	29,344	...	...	[10]†14	407	197,439	1
2	...	...	6 *42,602	6 30,721	...	...	[11]†	8	212,509	2
3	...	...	*54,228	39,125	...	...	5	17	336,155	3
4	...	...	*54,416	38,244	4	323	[12]† 9	635	182,996	4
5	...	...	1,667 *26.167	1,513 19,288	[2]†	26	[13]†	115	218,495	5
6	...	...	2,447 *37,590	1,857 28,387	[2]†	10	[14]†	713	265,043	6
7	...	...	*31,951	29,359	...	...	[15]†	440	343,167	7
8	1	25	*23,238	24,424	...	...	[16]† 5	97	360,895	8
9	36	752	*69,708	76,924	1	514	[17]†	116	244,050	9
1920	31	2,525	*78,788	104,665	[18]†	120	[19]†	223	377,416	1920
1921	141	6,205	*116.993	188,686	...	...	[20]†	257	293,771	1921
1922	143	5,746	*71,164	115,835	2	60	[21]†	1,083	243,512	1922
1923	71	3,830	5,313 *43,729	7,969 73,256	...	...	[22]†	303	226,996	1923
1924	32	1,586	*36,829	60,292	...	...	[23]† 20	160	212,003	1924
1925	23	687	66 *37,208	198 58,650	...	...	...	...	210,143	1925
1926	63	1,823	*50,986	82,810	4	8,328	[24]†	838	196,035	1926
1927	11	908	*39,089	62,297	4	536	[25]†	418	112,562,	1927
Total	...	25,340	1,012,667	1,217,530	...	10,221	...	12,465	6.931,995	Total

* Bunker Coal. [2] †Weight not stated. [5] †4 cwts. [6] †Cobalt ore. [7] †Antimony ore. [12]†Bismuth. [16]†Molybdenite. [18]†7 cwts.

[8]†Includes—
Antimony ore, 25 tons = £630
N.E.I., 71 tons ... = 817
Total £1,447

[10]†Includes—
Iron ore, 9 tons ... = £7
Ores, N.E.I., 5 tons = 400
Total £407

[13]†Includes—
Bismuth, 1 ton ... = £37
Fireclay, 12 tons ... = 75
Manganese, 3 cwt. = 3
Total £115

[15]†Includes—
Antimony, 12 tons = £258
Bismuth, 9cwt. ... = 24
Molybdenite, 14 tons = 158
Total £440

[9]†Includes—
Other Concentrates, 29 tons = £108
N.E.I., 234 tons ... = 627
Total £735

[11]†Includes—
Manganese, 2 tons = £4
N.E.I. ... ... = 4
Total £8

[14]†Includes—
Antimony, 27 tons = £580
Bismuth, 4 cwt. ... = 133
Total £713

[17]†Includes—
Bismuth, 1 cwt. ... = £15
Corundum, 1 ton ... = 1
Molybdenite, 7 tons = 100
Total £116

[19]†Includes—
Antimony, 2½ tons = £45
Clay, 6 cwt. ... = 6
Gadolinite, 1 ton ... = 150
Iron Concentrates, 1 ton = 17
Molybdenite, 10 cwt. = 5
Total £223

[20]†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

[21]†Includes—
Barytes, 19 tons ... = £73
Felspar, 60 tons ... = 485
Gypsum, 2 tons 4
Molybdenite, 51 tons ... 505
Pottery clay, 1 ton ... 16
Total £1,083

[22]†Includes—
Clay, 34 tons ... = £94
Iron Ore, 2 tons ... = 9
Manganese, 22 tons ... 200
Total £303

[32]†Manganese.

[24]†Includes—
Antimony, 4½ tons ... £85
Felspar, 8½ tons 250
Manganese 82 tons ... 503
£838

[25]†Includes—
Gypsum 2 cwts ... = £1
Manganese, 30 tons ... 303
Pottery Clay 35 tons ... 114
Total £418

PART III.—ALL MINES.

TABLE XXVII.

MILLING AND CYANIDING PLANTS ERECTED IN THE RESPECTIVE GOLDFIELDS, DISTRICTS, AND MINERAL FIELDS ON THE 31ST DECEMBER, 1927, AND THE TOTAL VALUE OF MINING MACHINERY.

Mining Centre and Lease or Area.	Name of Mine, Company, or Works.	Milling. Batteries. Number of Heads of Stampers.	Other Mills. Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.	Flint Mills.	Grinding Pans.	Cyaniding. Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	Value of all Mining Machinery.
	PILBARA GOLDFIELD.													
	MARBLE BAR DISTRICT.													
Bamboo Creek. G.M.L. (795)	Bulletin	10	...	...	...	...	...	...	...	...	...	...	...	...
Λ	State Battery, Bamboo Creek	5	...	...	...	...	...	...	...	1	5	...	...	...
Lalla Rookh. R.C. 112	Lalla Rookh	10	...	...	...	...	...	...	...	...	5	...	...	...
Marble Bar. M.A. 37	Ironclad	10	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. (694)	Jo Jo	5	...	...	...	1	...	...	...	1	...	...	...	...
Λ	State Battery, Marble Bar	5	...	...	...	...	...	...	...	1	...	...	...	...
	Total	45	...	...	...	1	...	...	...	3	10	...	...	£12,550
	NULLAGINE DISTRICT.													
Eastern Creek. M.A. 11L	Doherty's Reward	10	...	...	...	...	...	...	...	...	4	...	...	...
G.M.L. 219L	Shamrock	3	...	...	...	...	...	...	...	...	3	...	...	...
20-Mile Sandy. Λ	State Battery, 20-Mile Sandy	5	...	...	...	...	...	...	...	...	...	...	...	...
	Total	18	...	...	...	...	...	...	...	...	7	...	...	£2,090
	PEAK HILL GOLDFIELD.													
Mount Egerton. Λ	State Battery, Mount Egerton	5	...	...	...	...	...	...	...	...	...	...	...	...
Peak Hill. T.A. 6P	Wind Power Cyanide Works	...	...	...	...	...	...	...	...	...	6	...	...	...
Λ	State Battery, Peak Hill	5	...	...	...	...	...	...	...	...	3	...	...	...
	Total	10	...	...	...	...	...	...	...	...	9	...	...	£3,068
	EAST MURCHISON GOLDFIELD.													
	LAWLERS DISTRICT.													
Kathleen Valley. G.M.L. 382	Yellow Aster	...	...	...	...	...	...	...	...	...	4	...	...	...
Lawlers. M.A. 32	Great Eastern	5	...	...	...	...	...	...	...	1	6	...	...	...
M.A. 11	Sands Retreatment Works	...	...	...	...	...	...	...	...	...	4	...	...	...
G.M.L. (1234)	Vivien Gem	5	...	...	...	...	...	...	...	...	...	...	...	...
58	Waroonga G.M. Co., Ltd.	10	...	...	...	...	...	1	...	...	...	...	...	...
Sir Samuel. Λ	State Battery, Sir Samuel	5	...	...	...	...	...	...	...	...	4	...	...	...
	Total	25	...	...	...	...	...	1	...	1	18	...	...	£9,487
	WILUNA DISTRICT.													
Corboy's Find. G.M.L. 404J	Toscana	3	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 359J	Corboy's Reward, North	5	...	...	...	...	...	...	...	...	...	...	...	...
Mt. Keith. Λ	State Battery, Mt. Keith	5	...	...	...	...	...	...	...	...	...	...	...	...
Wiluna. Λ	State Battery, Wiluna	10	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 12J	Wiluna Gold Mines, Ltd.	10	...	...	...	...	...	...	1	...	...	9	2	...
	Total	33	...	...	...	...	...	...	1	...	...	9	2	£69,517
	BLACK RANGE DISTRICT.													
Maninga Marley. G.M.L. 203B	Havilah	10	...	...	...	...	...	...	...	...	...	...	...	...
Sandstone. Λ	State Battery, Sandstone	10	...	...	...	...	...	...	...	...	6	...	...	...
Youanmi. Λ	State Battery, Youanmi	5	...	...	...	...	...	...	...	...	2	...	...	...
	Total	25	...	...	...	...	...	...	...	...	8	...	...	£7,873
	MURCHISON GOLDFIELD.													
	CUE DISTRICT.													
Cuddingwarra. G.M.L. 1860	Big Bell	10	...	...	...	...	...	...	1	...	12	2	...	...
Cue. Λ	State Battery, Cue	5	...	...	...	...	...	...	...	...	5	...	...	...
Reedy's Find. G.M.L. 1977	Mararoa G.M. Co., N.L.	5	...	...	...	...	...	...	...	...	9	...	...	...
Tuckanarra. Λ	State Battery, Tuckanarra	10	...	...	...	...	...	...	...	...	3	...	...	...
	Total	30	...	...	...	...	...	...	1	...	29	2	...	£14,796

TABLE XXVII.—*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.											
		Number of Heads of Stampers.	Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.	Flint Mills.	Grinding Pans.	Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	
	Meekatharra District.													
Holden's Find. G.M.L. 1291N	Waterloo	5	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 477N	Fenian...	15	...	...	...	...	...	...	...	4	...	...	...	...
G.M.L. 475N	Ingliston Consols Extended	15	...	...	...	...	...	...	...	3	...	...	...	...
G.M.L. 1531N	Ingliston G.M. Co., N.L.	10	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 533N	Marmont	10	...	...	...	...	...	...	...	...	...	...	...	...
↑	State Battery, Meekatharra	5	...	...	...	...	...	...	...	1	5	...	...	...
Nannine. G.M.L. 166N	Nannine	10	...	...	...	...	...	...	...	2	3	...	...	...
	Total	70	...	...	...	...	...	...	...	10	8	...	...	£33,070
	Day Dawn District.													
Lake Austin. G.M.L. 571D	Mainland Consols	3	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 569D	South Fingall	...	...	...	...	...	...	...	...	...	6	...	...	...
	Total	3	...	...	...	...	...	...	...	...	6	...	...	£1,900
	Mt. Magnet District.													
Lennonville. G.M.L. 964M	Empress	5	...	...	...	...	...	...	...	1	3	...	...	...
Mt. Magnet. G.M.L. 1215M	Hill 60	5	...	...	...	...	...	...	...	...	5	...	...	...
G.M.L. 1075M	New Havelock	5	...	...	...	...	...	...	...	1	3	...	...	...
↑	State Battery, Boogardie	5	...	...	...	...	...	...	...	1	5	...	...	...
	Total	20	...	...	...	...	...	...	...	3	16	...	...	£5,888
	YALGOO GOLDFIELD.													
Field's Find. M.A. 23	Brown's Reward	5	...	...	...	...	...	...	...	...	6	...	...	...
Goodingnow. ↑	State Battery, Payne's Find	5	...	...	...	...	...	...	...	1	3	...	...	...
Noongal. G.M.L. 953	Revival	5	...	...	...	...	...	...	...	...	2	...	...	...
Messenger's Patch. G.M.L. 880	Brilliant G.M. Co., N.L.	10	...	...	...	...	...	...	...	2	...	...	...	...
Yalgoo. P.A. 718	Moxon	...	1	...	...	...	...	...	...	...	...	...	...	...
Warriedar. ↑	State Battery, Warriedar	5	...	...	...	...	...	...	...	1	6	...	...	...
	Total	30	1	...	...	...	...	...	...	4	17	...	...	£17,028
	MT. MARGARET GOLDFIELD.													
	Mt. Morgans District.													
Linden. ↑	State Battery, Linden	10		...	...	...	...	...	...	1	6	...	...	...
G.M.L. 341F	Torquay	5	...	...	...	...	...	...	...	1	9	...	...	...
Mt. Morgans. G.M.L. 5F	Westralia Mt. Morgans Mines, N.L.	10	...	...	...	...	1	...	...	3	...	6	1	...
	Total	25	...	...	...	...	1	...	...	5	15	6	1	£17,102
	Mt. Malcolm District.													
Lake Darlot. ↑	State Battery, Lake Darlot	10	...	...	...	...	...	...	...	...	...	...	...	...
Leonora. G.M.L. 190C, etc.	Sons of Gwalia, Ltd.	30	...	...	...	...	...	...	4	...	...	4	1	...
↑	State Battery, Leonora	10	...	...	...	...	...	...	...	2	6	...	...	...
Mt. Clifford. G.M.L. 1329C	Victory No. 1	5	...	...	...	...	...	...	...	...	...	...	...	...
Pig Well. G.M.L. 1547C	Starlight	10	...	...	...	...	...	...	...	...	...	...	...	...
	Total	65	...	...	...	...	...	...	4	2	6	4	1	£275,995
	Mt. Margaret District.													
Erlistoun. G.M.L. 2113T	Baneygo, North	5	...	...	...	...	...	...	...	1	...	...	...	...
G.M.L. 2141T	King of Creation	5	...	...	...	...	...	...	...	...	...	...	...	...
Laverton. G.M.L. 715T	Lancefield Treatment Syndicate	...	...	...	...	...	...	...	...	...	8	...	...	...
G.M.L. (1807T)	Mary Mac G.M. Co., N.L.	10	...	...	...	...	...	...	...	4	3	1	...	...
↑	State Battery, Laverton	10	...	...	...	...	...	...	...	1	5	...	...	...
	Total	30	...	...	...	...	...	...	...	6	16	1	...	£5,678
	NORTH COOLGARDIE GOLDFIELD.													
	Menzies District.													
Comet Vale. G.M.L. 5217Z	Gladsome	10	...	...	...	...	...	...	...	2	5	...	...	...
Menzies. M.A. 65	Lady Harriet...	5	...	...	...	...	...	...	...	...	2	...	...	...
Mt. Ida ↑	State Battery, Mt. Ida	5	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 5481Z	Unexpected South	5	...	...	...	...	...	...	...	1	...	...	...	...
	Total	25	...	...	...	...	...	...	...	3	7	...	...	£13,458

TABLE XXVII.—*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.											
		Number of Heads of Stampers.	Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.	Flint Mills.	Grinding Pans.	Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	
	ULARRING DISTRICT.													
Mulline. M.A. 11U	No. 1 North Coolgardie Consols	10	...	...	...	...	...	...	...	1	...	...	...	...
↑	State Battery, Mulline	10	...	...	...	...	...	...	...	...	...	...	...	...
	Total	20	...	...	...	...	...	...	...	1	...	...	...	£1,505
	NIAGARA DISTRICT.													
Niagara. ↑	State Battery, Niagara	10	...	...	...	...	...	...	...	...	...	...	...	...
	Total	10	...	...	...	...	...	...	...	...	...	...	...	£1,840
	YERILLA DISTRICT.													
Edjudina. 1011R	Neta	10	...	...	...	...	...	...	...	1	...	...	...	...
Yarri. ↑	State Battery, Yarri	10	...	...	...	...	...	...	...	...	5	...	...	...
	Total	20	...	...	...	...	...	...	...	1	5	...	...	£3,595
	BROAD ARROW GOLDFIELD.													
Bardoc. G.M.L. 1833W	Zoroastrian	5	...	...	...	...	...	...	...	...	...	...	...	...
Siberia. G.M.L. 1836W	Associated Northern Blocks (W.A.), Ltd. ...	...	...	1	...	2	3	...	...	10	...	7	2	...
G.M.L. 1371W	Gimlet South...	10	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 1289W	Lady Evelyn	5	...	...	...	...	...	...	...	...	4	...	...	...
G.M.L. (1786W)	Pole	5	...	...	...	...	...	...	...	...	...	...	...	...
↑	State Battery, Ora Banda	5	...	...	...	...	...	...	...	1	5	...	...	...
↑	State Battery, Siberia	5	...	...	...	...	...	...	...	...	...	...	...	...
	Total	35	...	1	...	2	3	...	...	11	9	7	2	£62,158
	NORTH-EAST COOLGARDIE GOLDFIELD.													
	KANOWNA DISTRICT.													
Gordon. G.M.L. 1467X	Sirdar	...	...	...	...	1	...	...	...	1	2	...	...	...
Kanowna. G.M.L. 1389X	Golden Valley	5	...	...	...	...	...	...	...	...	...	...	...	...
M.A. 19X	Martin's Battery	15	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 12X	North White Feather G.Ms., Ltd. ...	20	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 1468X	Orion Mines, Ltd.	10	...	...	...	...	...	...	...	...	...	...	...	...
	Total	50	...	...	...	1	...	...	...	1	2	...	...	£6,950
	KURNALPI DISTRICT.													
Kurnalpi. M.A. 7K	Success Battery	5	...	...	...	...	...	...	...	...	2	...	...	...
Mulgabbie. M.A. 4K	Simmons Battery	...	1	...	...	...	...	...	...	...	...	...	...	...
	Total	5	1	...	...	...	...	...	...	...	2	...	...	£200
	EAST COOLGARDIE GOLDFIELD.													
	EAST COOLGARDIE DISTRICT.													
Boulder. G.M.L. 38E, etc.	Associated G.M.s. of W.A., Ltd.	...	...	7	...	...	...	1	...	20	...	6	7	...
G.M.L. 66E, etc.	Boulder Perseverance, Ltd.	...	...	8	...	...	...	4	2	17	...	24	13	...
G.M.L. 351E	Golden Horseshoe Estates Co.. Ltd. ...	100	...	1	...	...	3	6	15	5	20	22	14	...
M.A. 71E	Great Boulder No. 1, Ltd.	10	...	...	...	...	...	...	...	...	2	...	...	...
G.M.L. 16E, etc.	Great Boulder Proprietary G.Ms., Ltd. ...	...	1	6	...	...	2	4	...	20	...	22	7	...
G.M.L. 31E	Lake View and Star, Ltd.	10	...	9	...	...	...	...	3	2	...	26	7	...
G.M.L. 281E	North Kalgurli (1912), Ltd.	20	...	...	...	...	...	2	...	1	4	...	...	...
G.M.L. 410E	Oroya Links, Ltd.	50	...	11	...	...	1	...	3	18	...	7	3	...
G.M.L. 1208E	South Kalgurli Consolidated, Ltd.	...	...	4	...	...	...	...	1	6	...	6	6	...
T.A. 75E	Fraser's Treatment Works	...	...	...	...	...	...	...	...	...	8	...	...	...
Hampton Plains *Block* 48, P.P.L. 86	Golden Hope	10	...	...	...	...	...	...	...	2	...	2	1	...
Block 50, P.P.L 9	Hampton Celebration, W.A., Ltd.	10	...	...	...	...	...	1	1	...	...	6	2	...
Block 45	Hampton Properties, Ltd.	10	...	...	...	...	...	...	...	...	6	2	1	...
Block 48, P.P.L. 1	Hopeful Syndicate, Ltd.	10	...	...	...	...	...	1	...	1	...	2	...	...
Kalgoorlie. M.A. 7E	Hannan's Central Battery	20	...	...	...	...	...	...	...	...	8	...	...	...
G.M.L. 4547E	Hannan's Reward	5	...	...	...	...	...	...	...	1	5	2	1	...
Wombola. G.M.L. 4766E	Great Hope	...	...	...	...	1	...	1	...	1	3	...	...	...
	Total	255	1	46	...	1	6	20	25	94	56	127	62	£673,005

TABLE XXVII.—*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. Batteries. Number of Heads of Stampers.	Milling. Other Mills. Prospecting Mills.	Ball Mills.	Griffin Mills.	Huntington Mills.	Puddlers.	Other Crushers.	Flint Mills.	Grinding Pans.	Cyaniding. Leaching Vats.	Agitating Vats.	Vacuum Filters and Presses.	Value of all Mining Machinery.
	EAST COOLGARDIE GOLDFIELD.													
	BULONG DISTRICT.													
Bulong. G.M.L. 1191Y	Sweet Nell	5	...	...	...	...	...	...	...	...	3	...	...	...
	Total	**5**	...	...	...	...	...	...	...	...	**3**	...	...	**£1,000**
	COOLGARDIE GOLDFIELD.													
	COOLGARDIE DISTRICT.													
Coolgardie. G.M.L. 4567	Griffiths Gold Mine	10	...	...	...	...	...	...	...	...	6	...	...	...
↑	State Battery, Coolgardie	10	...	...	...	...	...	...	...	...	6	...	...	...
M.A. 82	Reform Battery	5	...	...	...	...	...	...	...	...	...	...	...	...
St. Ives. G.M.L. 4720	Ives Reward G.M.L., N.L.	10	...	...	...	...	...	...	...	3	...	...	...	...
G.M.L. 4732	Ives Reward Junction	...	...	...	...	1	...	...	...	...	...	...	...	...
↑	State Battery, St. Ives	5	...	...	...	...	...	...	...	1	5	...	...	...
Widgiemooltha. M.A. 280H	Imperial Battery	5	...	...	...	...	...	...	...	...	2	...	...	...
	Total	**45**	...	...	...	**1**	...	...	...	**4**	**19**	...	...	**£25,247**
	KUNANALLING DISTRICT.													
Carbine. G.M.L. 33S	Carbine	10	1	...	...	...	...	...	...	2	...	...	...	...
25-Mile. G.M.L. 696S	Blue Bell	5	...	...	...	...	...	...	...	...	6	...	...	...
G.M.L. 645S	Star of Fremantle	10	...	...	...	...	...	...	...	...	2	...	...	...
	Total	**25**	**1**	...	...	...	...	...	...	**2**	**8**	...	...	**£6,300**
	YILGARN GOLDFIELD.													
Golden Valley. G.M.L. 2994	Radio	5	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 3248	Radio Deeps	5	...	...	...	...	...	...	...	1	3	...	...	...
Greenmount. M.A. 25	Transvaal	10	...	...	...	...	...	...	...	...	...	...	...	...
Marvel Loch. G.M.L. 719	Great Victoria G.Ms., N.L.	10	...	...	...	...	...	...	...	1	...	4	1	...
M.A. 23	Howlett's Battery	5	...	...	...	...	...	...	...	...	4	...	...	...
G.M.L. 852	May Queen	5	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 3281	Resurrection	...	...	...	...	...	...	...	...	...	3	...	...	...
Parker's Range. G.M.L. 2801	Scot's Greys	5	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. 724	Spring Hill	10	...	...	...	...	...	...	...	1	4	...	...	...
Westonia. M.A. 27	Recovery Battery	5	...	...	...	...	...	...	...	1	...	...	...	...
G.M.L. 3308	Consolidated	10	...	...	...	...	...	...	...	...	...	...	...	...
	Total	**70**	...	...	...	...	...	...	...	**4**	**14**	**4**	**1**	**£21,475**
	DUNDAS GOLDFIELD.													
Norseman. G.M.L. 1291	Maroroa No. 1	10	...	...	...	...	...	...	...	...	7	...	...	...
M.A. 17	Rawlings & Bullen	10	...	...	...	...	...	...	...	...	4	...	...	...
↑	State Battery, Norseman	5	...	...	...	...	...	...	...	1	6	...	...	...
	Total	**25**	...	...	...	...	...	...	...	**1**	**17**	...	...	**£8,658**
	PHILLIPS RIVER GOLDFIELD.													
Kundip. G.M.L. (184)	Gem	5	...	...	...	...	...	...	...	...	...	...	...	...
G.M.L. (151)	Gem Consolidated	5	...	...	...	...	...	...	...	...	...	...	...	...
M.L. 52	Harbour View	10	...	...	...	...	...	...	...	...	...	...	...	...
T.A. 6	Two Boys	10	...	...	...	...	...	...	...	...	...	...	...	...
Ravensthorpe. P.A. 202	Cherighan	...	...	...	...	...	...	...	...	...	3	1	...	...
	Total	**30**	...	...	...	...	...	...	...	...	**3**	**1**	...	**£2,500**

TABLE XXVII.—*Milling and Cyaniding Plants erected in the respective Goldfields, Districts, etc.*—continued.

Goldfield	District	Milling: Batteries — Number of Heads of Stampers	Milling: Other Mills — Prospecting Mills	Ball Mills	Griffin Mills	Huntington Mills	Puddlers	Other Crushers	Flint Mills	Grinding Pans	Cyaniding: Leaching Vats	Agitating Vats	Vacuum Filters and Presses	Value of all Mining Machinery
	GOLD MINING.													
Pilbara	Marble Bar	45	...	...	...	1	...	...	...	8	10	...	...	12,550
	Nullagine	18	...	...	...	...	...	...	...	...	7	...	...	2,090
Peak Hill	... ...	10	...	...	...	...	...	...	...	...	9	...	...	3,068
East Murchison...	Lawlers	25	...	...	...	...	...	1	...	1	18	...	...	9,437
	Wiluna	33	...	...	...	...	...	1	...	...	...	9	2	69,517
	Black Range	25	...	...	...	...	...	...	...	...	8	...	...	7,873
Murchison ...	Cue	30	...	...	...	...	...	...	1	...	29	2	...	14,796
	Meekatharra	70	...	...	...	...	...	...	...	10	8	...	...	33,070
	Day Dawn	3	...	...	...	...	...	...	...	...	6	...	...	1,900
	Mt. Magnet	20	...	...	...	...	...	...	...	3	16	...	...	5,888
Yalgoo	... ...	30	1	...	...	...	...	...	...	4	17	...	...	17,023
Mt. Margaret ...	Mt. Morgans	25	...	...	...	...	1	...	...	5	15	6	1	17,102
	Mt. Malcolm	65	...	...	...	...	...	...	4	2	6	4	1	275,995
	Mt. Margaret	30	...	...	...	...	...	...	...	6	16	1	...	5,678
North Coolgardie	Menzies	25	...	...	...	...	...	...	...	3	...	...	...	13,458
	Ularring	20	...	...	...	...	...	...	...	1	...	...	...	1,505
	Niagara	10	...	...	...	...	...	...	...	...	...	...	...	1,840
	Yerilla	20	...	...	...	...	...	...	...	1	5	...	...	3,595
Broad Arrow	... ...	35	...	1	...	2	3	...	...	11	9	7	2	62,153
N.E. Coolgardie	Kanowna	50	...	...	...	1	...	...	...	1	2	...	...	6,950
	Kurnalpi	5	1	...	...	...	...	...	...	...	2	...	...	200
East Coolgardie	East Coolgardie	255	1	46	...	1	6	20	25	94	56	127	62	673,005
	Bulong	5	...	...	...	...	...	...	...	...	3	...	...	1,000
Coolgardie ...	Coolgardie	45	...	...	...	1	...	...	...	4	19	...	...	25,247
	Kunanalling	25	1	...	...	...	...	...	...	2	8	...	...	6,300
Yilgarn	... ...	70	...	...	...	...	...	...	...	4	14	4	1	21,475
Dundas	... ...	25	...	...	...	...	...	...	...	1	17	...	...	8,653
Phillips River	... ...	30	...	...	...	...	...	...	...	...	3	1	...	2,500
	Total Gold Mining Machinery ...	**1,049**	**4**	**47**	...	**6**	**10**	**22**	**30**	**156**	**303**	**161**	**69**	**£1,303,868**
	LEAD MINING.													
Northampton M.F. ...	... ...	...	...	...	...	...	...	9	...	...	...	...	...	£54,614
	Total, Lead Mining Machinery ...	...	...	...	...	...	...	**9**	...	...	...	...	...	**£54,614**
	TIN MINING.													
Pilbara	Marble Bar	...	...	...	...	...	1	2	...	...	...	...	...	2,791
Greenbushes Tinfield ...	... ...	...	...	...	...	...	1	3	...	...	...	...	...	13,287
	Total, Tin Mining Machinery ...	...	...	...	...	...	**2**	**5**	...	...	...	...	...	**£16,078**
	COPPER MINING.													
West Pilbara	... ...	...	...	...	...	...	...	5	2	1	...	...	...	54,000
Phillips River	... ...	...	...	5	...	...	...	10	2	...	...	3	1	7,900
	Total, Copper Mining Machinery	...	...	**5**	...	...	...	**15**	**4**	**1**	...	**3**	**1**	**£61,900**
	COAL MINING.													
Collie Coalfield	... ...	...	...	...	...	...	...	...	...	...	...	...	...	95,500
	Total, Coal Mining Machinery ...	...	...	...	...	...	...	...	...	...	...	...	...	**£95,500**
	ASBESTOS MINING.													
Pilbara	Nullagine	...	...	...	...	...	...	1	...	...	...	...	...	2,475
	Total, Asbestos Mining Machinery	...	...	...	...	...	...	**1**	...	...	...	...	...	**£2,475**
Total, Machinery other than Gold Mining		...	...	**5**	...	...	**2**	**30**	**4**	**1**	...	**3**	**1**	**£230,567**
Total, all Mining Machinery		**1,049**	**4**	**52**	...	**6**	**12**	**52**	**34**	**157**	**303**	**164**	**70**	**£1,534,435**

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.

Arrangements can be made for the insurance of gold sent by post. Particulars upon application to the Mint.

A circular can be obtained from the Deputy Master of the Mint giving all necessary information for intending depositors, Coining Regulations, etc., etc.

Forms for use in connection with gold sent to the Mint by post 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 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.

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.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Bullion or unmanufactured Gold, per 100 ozs. ...	3 9	4 6	5 3	6 9	8 3	9 9	11 3	12 9	15 0	17 3

1s. 6d. per 100ozs. for every additional 100 miles or part thereof.

Consignments of Gold Bullion in lots exceeding in the aggregate 30,000 ozs. despatched on any one day will be allowed a reduction of 33⅓ per cent. with a minimum charge as for 30,000 ozs. Consignors may combine to make up the required quantity, but each consignment must be charged for separately.

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:—

	Ozs.
Weight before melting	47.41
Standard gold	38.19

The calculation would be as follows:—

```
4741)3819.0(.805          .805 × £3 17s. 10½d. =
     3792.8               .805 × £3.894
     ------                      .805
      26200                      ------
      23705                      19470
      -----                     311520
       2495                     ------
       -----                  £3.134(670)
                                  20
                              ------
                              s. 2.680
                                  12
                              ------
                              d. 8.160 = £3 2s. 8d., value per ounce of gold as
                              ------         produced, at the mine.
```

By Authority: Fred. Wm. Simpson, Government Printer, Perth.